

Volume 1
Architectural & Structural

PROJECT

**New Employee Housing and New Garage
Black Lake and Stony Rapids, Saskatchewan**

PROJECT No.
S-03-2014A

SET No.

DATE
2018-09-14

Volume 2

Mechanical & Electrical

PROJECT

New Employee Housing and New Garage
Black Lake and Stony Rapids, Saskatchewan

PROJECT No. S-03-2014A	SET No.
DATE 2018-09-14	

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PART 1 General

1.1 RELATED SECTIONS

- .1 Appendix 00 31 21.01 – Existing Building Drawings
- .2 Appendix 00 31 21.02 – Site Remediation Report, Royal Canadian Mounted Police Detachment, Stony Rapids, Saskatchewan
- .3 Appendix 00 31 21.03 – Phase I Environmental Site Assessment for Royal Canadian Mounted Police, Stony Rapids Detachment, Stony Rapids, Saskatchewan
- .4 Appendix 00 31 21.04 – Public Works and Government Services Canada, Phase II Environmental Site Assessment, RCMP Stony Rapids Detachment Site, DFRP 14862, Stony Rapids, Saskatchewan
- .5 Appendix 00 31 21.05 – Supplemental Sampling Program, PRCMP Detachment, Stony Rapids, Saskatchewan
- .6 Section 01 74 21 – Construction Waste Management and Disposal
- .7 Appendix 01 74 21.01 – Generator Shop Drawing
- .8 Section 02 41 16 – Structure Demolition

1.2 EXISTING STONY RAPIDS POLICE BUILDING DRAWINGS

- .1 Refer to Appendix 00 31 21.01. Copies of drawings of the existing police building are included as follows for information and use:
 - .1 Title: “Stony Rapids Saskatchewan RCMP Complex, Project Number 86314, by Moore Taylor Architects, Prince Albert, SK and Selmec Engineering Ltd., Prince Albert, SK”. 22pages.
- .2 The drawings of the existing building attached were prepared primarily for the use of the Owner and may not be complete or show current conditions.
- .3 These drawings, by their nature, are provided for information to illustrate the type of construction and size and volume of the existing building but they cannot reveal all conditions that exist or can occur on the site.
- .4 If material resembling spray or trowel-applied asbestos or any other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately. Proceed only after receipt of written instructions has been received from Departmental Representative.
- .5 Direct all questions pertaining to the existing drawings to the Departmental Representative.

1.3 EXISTING STONY RAPIDS ENVIRONMENTAL INFORMATION

- .1 Refer to Appendix 00 31 21.02, Appendix 00 31 21.03, Appendix 00 31 21.04, and Appendix 00 31 21.05. Copies of existing environmental assessments are included as follows for information and use:
 - .1 Title: "Site Remediation Report Royal Canadian Mounted Police Detachment, Stony Rapids, Saskatchewan", submitted to Public Works and Government Services Canada, by AMEC Foster Wheeler Environment & Infrastructure, 4015 Millar Avenue, Saskatoon, SK. Project No. SX43441PRW, March 2017.
 - .2 Title: "Phase 1 Environmental Site Assessment for Royal Canadian Mounted Police, Stony Rapids Detachment, Stony Rapids, Saskatchewan", by Environmental Services, Public Works and Government Services Canada, Edmonton, AB. February 2002.
 - .3 Title: "Public Works and Government Services Canada, Phase II Environmental Site Assessment, RCMP Stony Rapids Detachment Site, DFRP 14862, Stony Rapids, Saskatchewan", submitted to Public Works and Government Services Canada, by EGE Engineering Ltd., 511 Pepperloaf Crescent, Winnipeg, MB, EGE File No. 0125 046 03, February 25, 2013.
 - .4 Title: "Supplemental Sampling Program RCMP Detachment, Stony Rapids, Saskatchewan", submitted to Public Works and Government Services Canada, by AMEC Foster Wheeler Environment & Infrastructure, 608 McLeod Street, Regina, SK. Project No. SX04344PRW, March 2015.
- .2 The assessments attached were prepared primarily for the use of the Owner and may not be complete or show current conditions.
- .3 These reports, by their nature, are provided for information to illustrate environmental conditions and remediations that have occurred on site but they cannot reveal all conditions that exist or can occur on the site.
- .4 If material designated as hazardous are encountered, stop work, take preventative measures, and notify Departmental Representative immediately. Proceed only after receipt of written instructions has been received from Departmental Representative.
- .5 Direct all questions pertaining to the existing drawings to the Departmental Representative.

1.4 EXISTING GENERATOR SHOP DRAWING

- .1 Refer to Section 01 74 21 Construction Waste Management and Disposal and Appendix 01 74 21.01.
- .2 The drawings of the existing building attached were prepared primarily for the use of the Owner and may not be complete or show current conditions.
- .3 These drawings, by their nature, are provided for information to illustrate the type of construction and size and volume of the existing building but they cannot reveal all conditions that exist or can occur on the site.

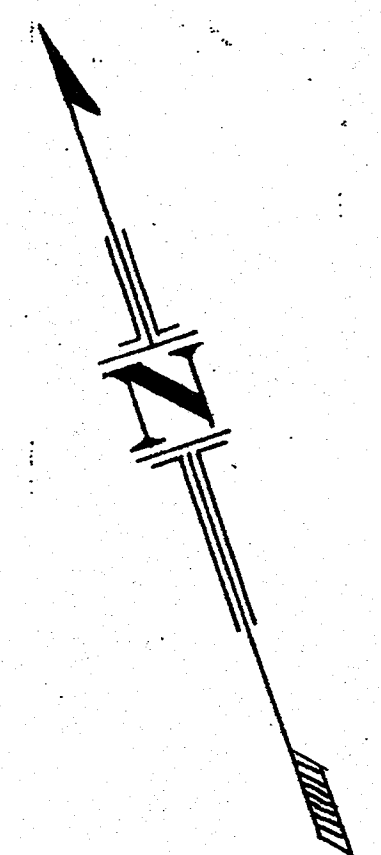
- .4 If material resembling spray or trowel-applied asbestos or any other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately. Proceed only after receipt of written instructions has been received from Departmental Representative.
- .5 Direct all questions pertaining to the existing drawings to the Departmental Representative.

PART 2 **Products**
2.1 **NOT USED**
 .1 Not used.

PART 3 **Execution**
3.1 **NOT USED**
 .1 Not used.

END OF SECTION

PLAN OF SURVEY OF
STONY RAPIDS
SUBDIVISION
LAT. 59°-15'-30" LONG. 105°-50'-00"
Saskatchewan
1948
by A.I. Bereskin D.L.S., S.L.S.
Scale: 1"=100'



NOTE

All measurements are shown in feet and decimal of a foot.
Portion to be registered is enclosed by an orange border.
Solid iron posts planted are shown thus: ————
Standard iron posts found are shown thus: ————
Calculated measurements are shown in blue.
Copied measurements are shown in purple.
The bank is taken as a boundary for definition of bank.
see section 30 of the regulations prescribed for Land Title Offices.

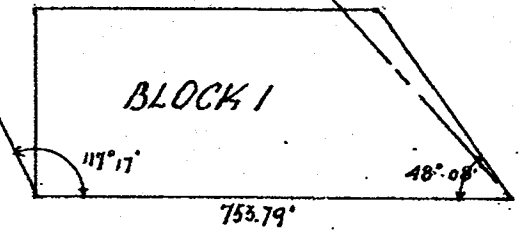
I, Abram Isaac Bereskin, Saskatchewan Land Surveyor do hereby
certify that the survey represented by this plan has been made
by me in accordance with the provisions of the Land Survey
Act, that this survey was performed between the dates of
August 12, and August 22, A.D. 1948, and that this plan is
correct and true to the best of my knowledge and belief.
Dated at Regina in the
Province of Saskatchewan
this 15 day of May, 1949.

A.I. Bereskin D.L.S., S.L.S.
Saskatchewan Land Surveyor.

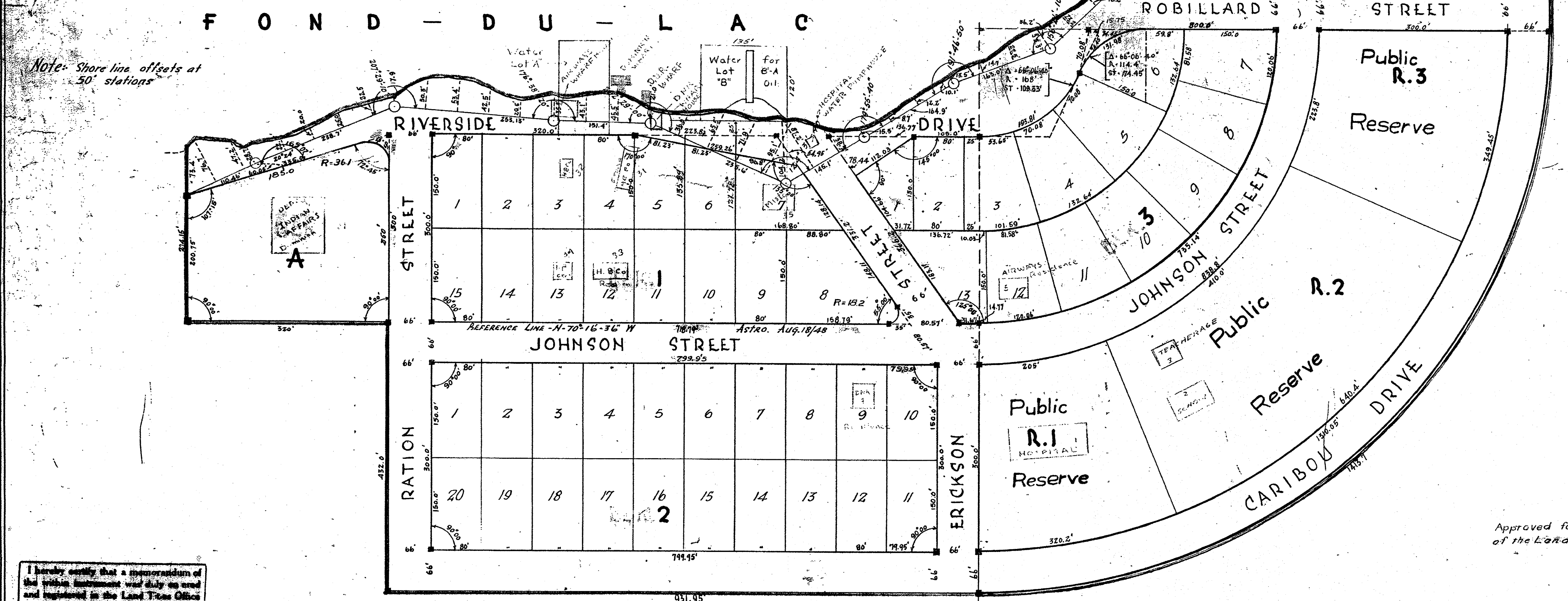
Approved: *E. G. Ch. Hogg*
Deputy Minister, Dept. of Natural Resources
Province of Saskatchewan.

Approved: *A.I. Bereskin*
Controller of Surveys.

Detail Showing
Tie of Subdivision To
Dominion Traverse
Monument S.20 on
North Side of River
Scale 1"=300'



Note: Shore line offsets at
50' stations



I hereby certify that a memorandum of
the plan instrument was duly used
and registered in the Land Titles Office
for the Prince Albert Land Registration
District at Prince Albert in the Province
of Saskatchewan at 10:26 o'clock A.M.
on the 2nd day of May
A.D. 1949. *A.I. 361*
Book _____

BOUNDARIES
checked
by FIELD OFFICER
Oct. 1951

Approved for filing under Section 92
of the Land Titles Act, R.S.S. 1940.

Nov 3 49
J. D. Dwyer

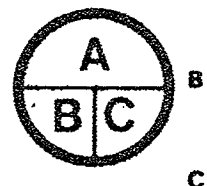


Department of Public Works
Ministère des Travaux publics

WESTERN REGION

MOORE TAYLOR
ARCHITECTS
PRINCE ALBERT
SASKATCHEWAN

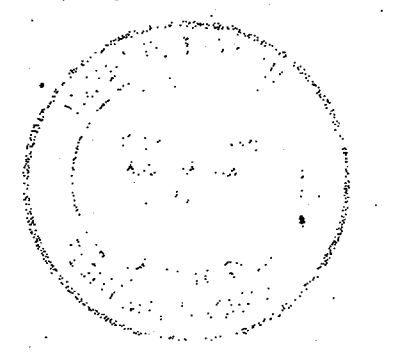
A detail no. détail no.



B location drawing no. sur dessin no.

C drawing no. dessin no.

revisions date



project title titre du projet
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

drawing title titre du dessin
SITE DEVELOPMENT

DEPT. OF PUBLIC WORKS, CANADA - WESTERN REGION
NUMBER OF PLANS IN SET 25
PLACE Stony Rapids
NATURE OF WORK RCMP Complex
PLANS FOR CONTRACT No. 45-4-3001

TRUE COPY OF DOCUMENT
EXHIBITED FOR TENDER
REGIONAL MANAGER
DESIGN & CONSTRUCTION
WESTERN REGION
D.P.W., CANADA

TRUE COPY OF PLAN
EXHIBITED FOR TENDER
REGIONAL MANAGER
DESIGN & CONSTRUCTION
WESTERN REGION
D.P.W., CANADA

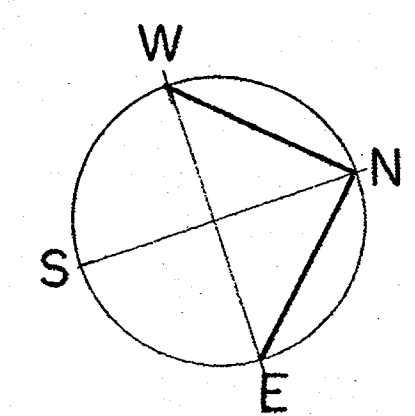
DRAWING IS PART OF THE BOCU SET
REFERRED TO AS "PLANS AND SPECIFICATIONS
AND MARKED 'A' IN THE ARTICLES OF AGREEMENT
ENTERED INTO ON THE 27 DAY OF
JULY 1974
BETWEEN HER MAJESTY THE QUEEN AND
N.C. Design Corporation Ltd.

Contractors: Please sign this
certificate on reverse of each drawing.

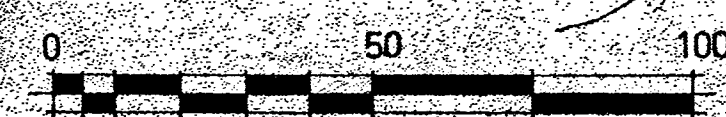
86314 M.T. 7415
drawing no. dessin no.

A01

- A MARRIED QUARTERS
- B POWERHOUSE / RELOCATE
- C GARAGE WORKSHOP / RELOCATE TEMPORARILY
- D OFFICE / RELOCATE TEMPORARILY
- E RADIO POLES / REMOVE
- F FLAGPOLE / REMOVE
- G POWER POLE
- H WELL
- I PUMP HOUSE / REMOVE
- J GAS TANK / RELOCATE
- K NEW DETACHMENT BUILDING
- L NEW FLAGPOLE
- M NEW GARAGE WORKSHOP
- N NEW GAS TANK 12' VENT POLE
- O NEW LOCATION OF 'B'
- P NEW PARKING SLABS
- Q NEW ANTENNAE SYSTEM
- R GRAVEL DRIVEWAYS
- S NEW GARBAGE STAND
- T SIGN BY RCMP
- U EXISTING SEPTIC TANK / DEMOLISH & FILL
- V EXISTING SEEPAGE PIT / DEMOLISH & FILL
- W NEW GAS PUMP, SLAB, & U.G. TANK
- X EXISTING PRIVY / DEMOLISH & FILL
- Y NEW U.G. OIL TANK
- Z NEW U.G. PUMP OUT TANK



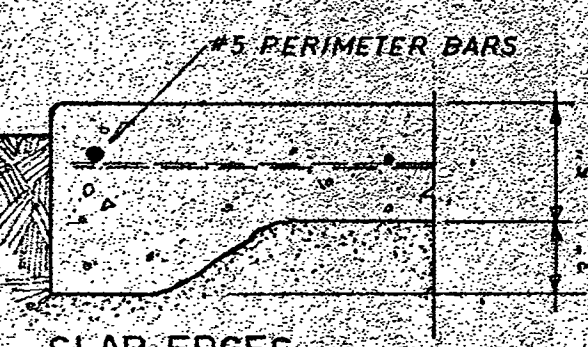
FOND DU LAC RIVER



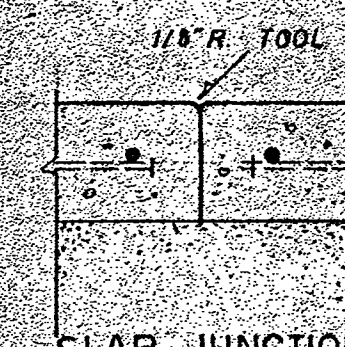
SITE PLAN 1" = 30'-0" EXISTING

5' x 10'-0" x 20'-0" REINFORCED CONCRETE SLAB
#3 REBAR 12" o.c. BOTH WAYS or 6' x 6' x 6' W.M.
SLOPE 1/4" PER 1'-0" AWAY FROM DRIVEWAYS

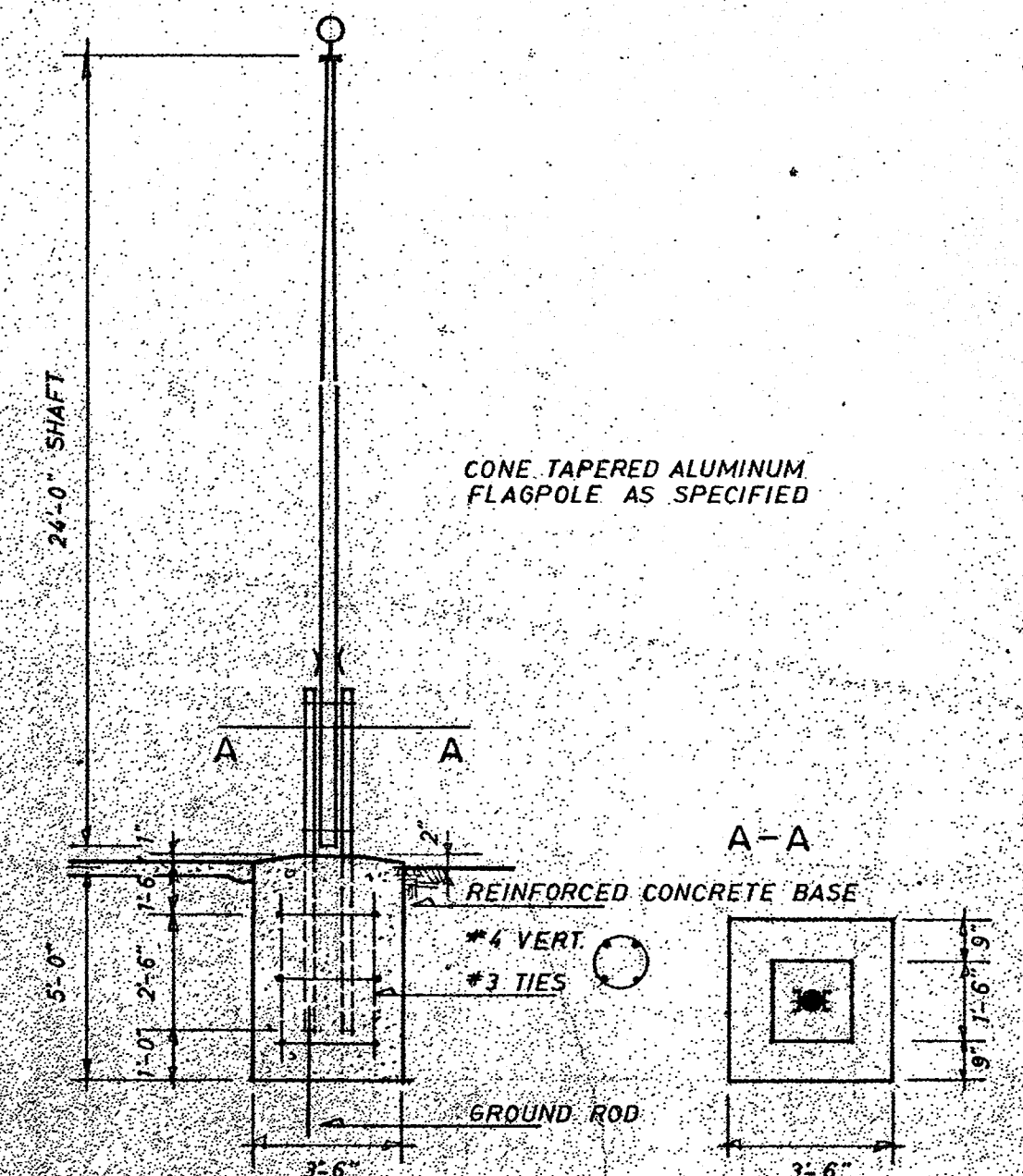
P PARKING SLAB DETAILS



SLAB EDGES



SLAB JUNCTIONS

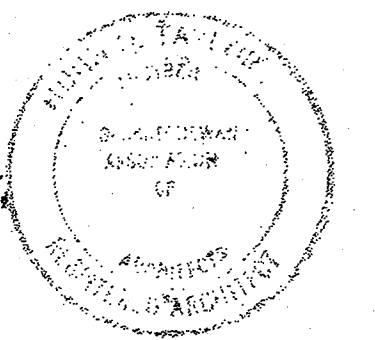


L FLAGPOLE DETAILS 1/4" = 1'-0"

SITE DEVELOPMENT THIS CONTRACT



Department of Public Works
Ministère des Travaux publics



MOORE TAYLOR
ARCHITECTS
PRINCE ALBERT, SASK.

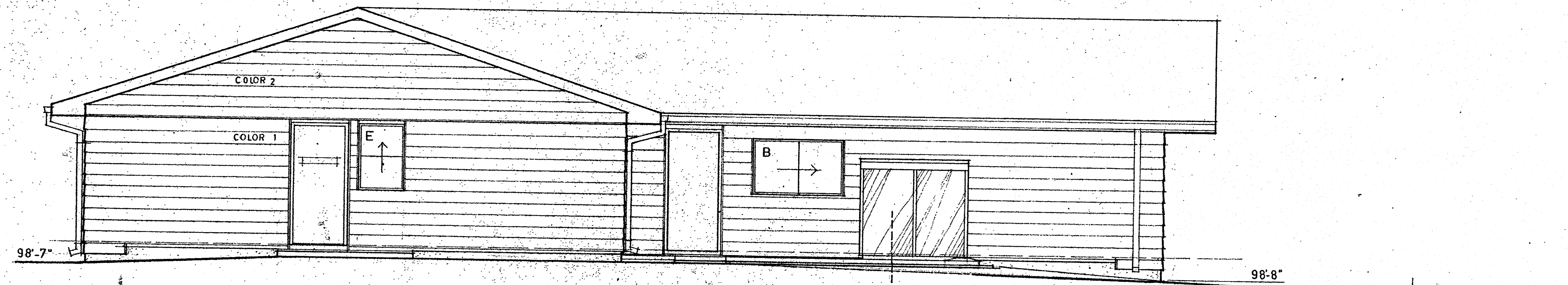
A detail no. détail no.
B location drawing no. sur dessin no.
C drawing no. dessin no.
revisions date

project title titre du projet
STONY RAPIDS
SASKATCHEWAN

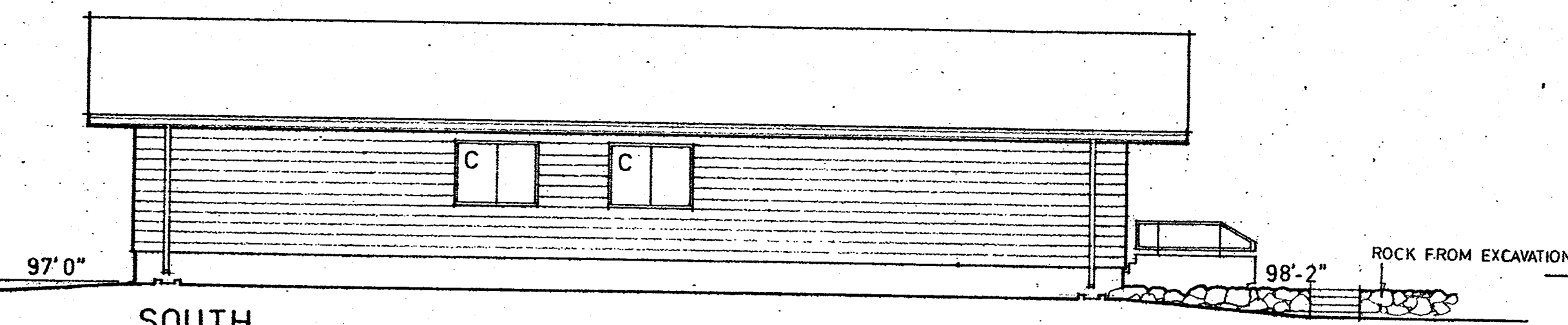
R.C.M.P. COMPLEX

drawing title titre du dessin
BUILDING ELEVATIONS

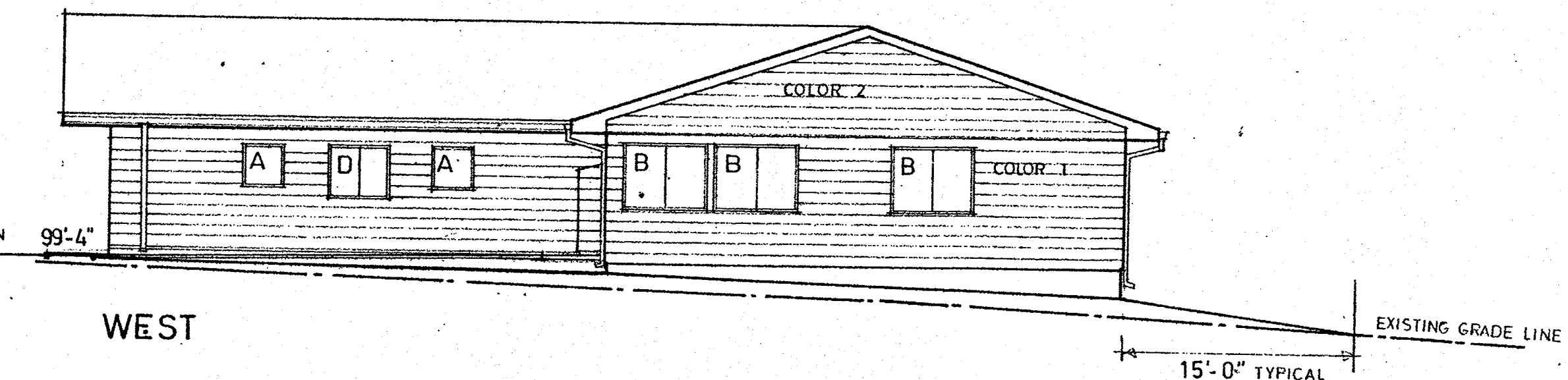
designed by conçu par
date
drawn by dessiné par
date
reviewed by examiné par
date
approved by approuvé par
date
Tender
D.P.W. Project Manager Administrateur de projets M.T.P.
project number no. du projet
86314 MT 7415
drawing no. dessin no.
A02



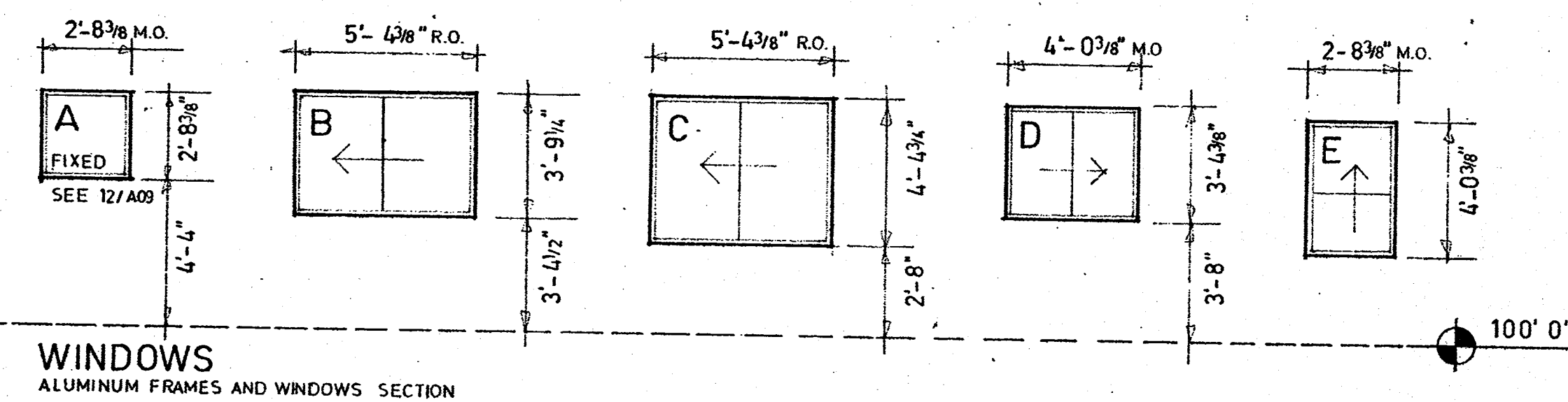
NORTH



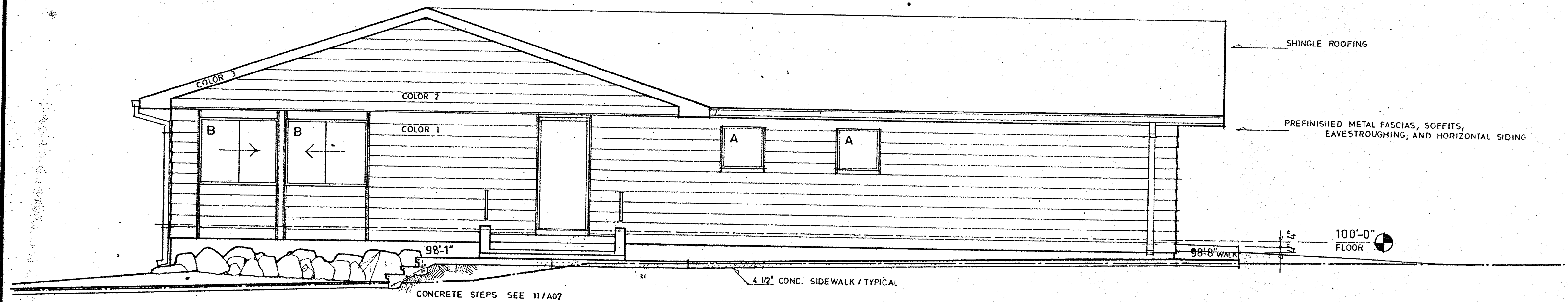
SOUTH



WEST



WINDOWS
ALUMINUM FRAMES AND WINDOWS SECTION

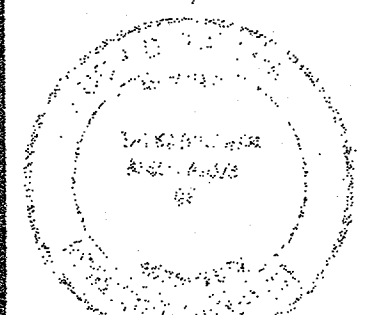


EAST 1/4" = 1'-0"



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Ministère des Travaux publics

WESTERN REGION



MOORE TAYLOR
ARCHITECTS
PRINCE ALBERT
SASKATCHEWAN

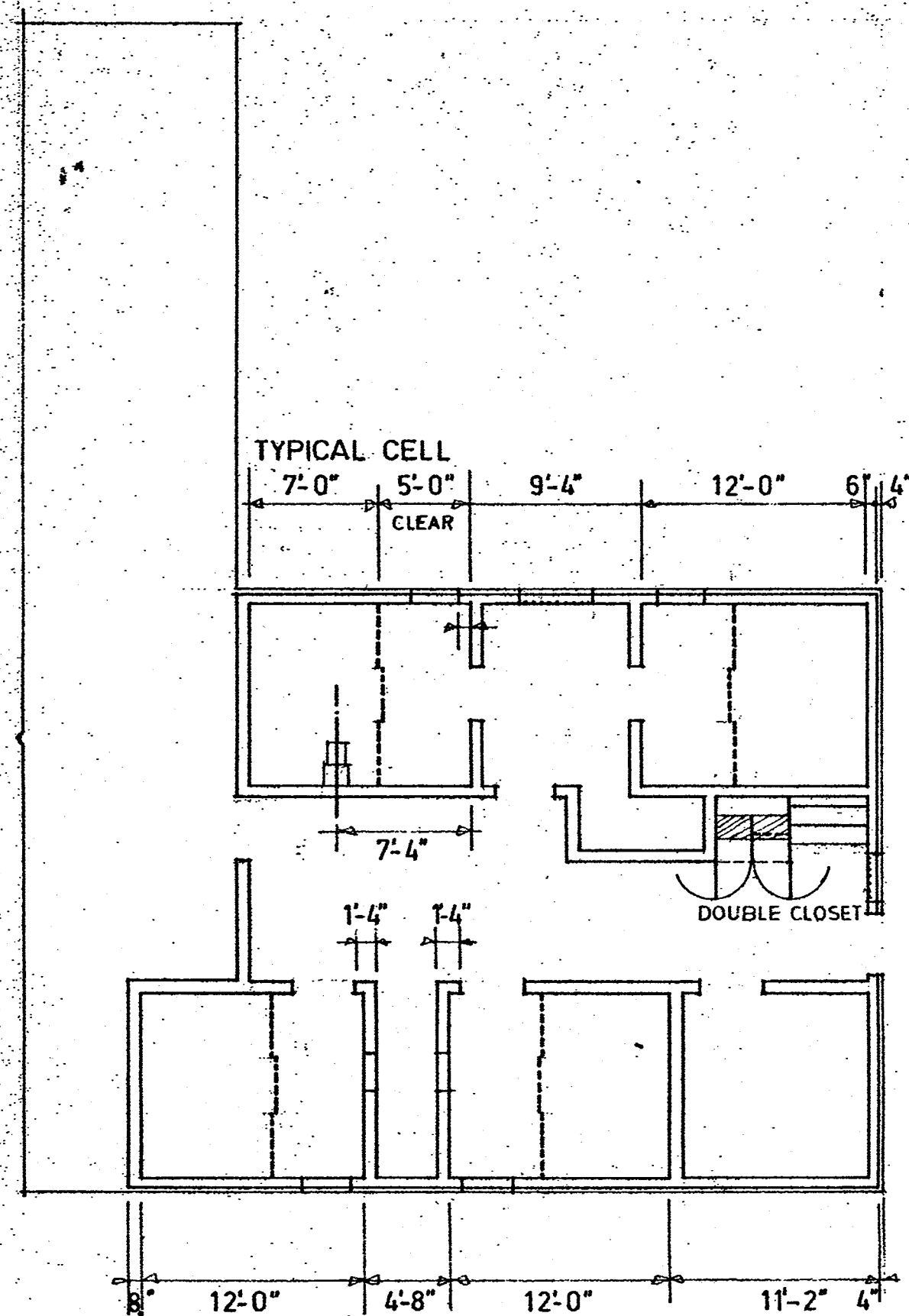
A detail no. détail no.
B location drawing no. sur dessin no.
C drawing no. dessin no.
revisions date

project title titre du projet
STONY RAPIDS
SASKATCHEWAN

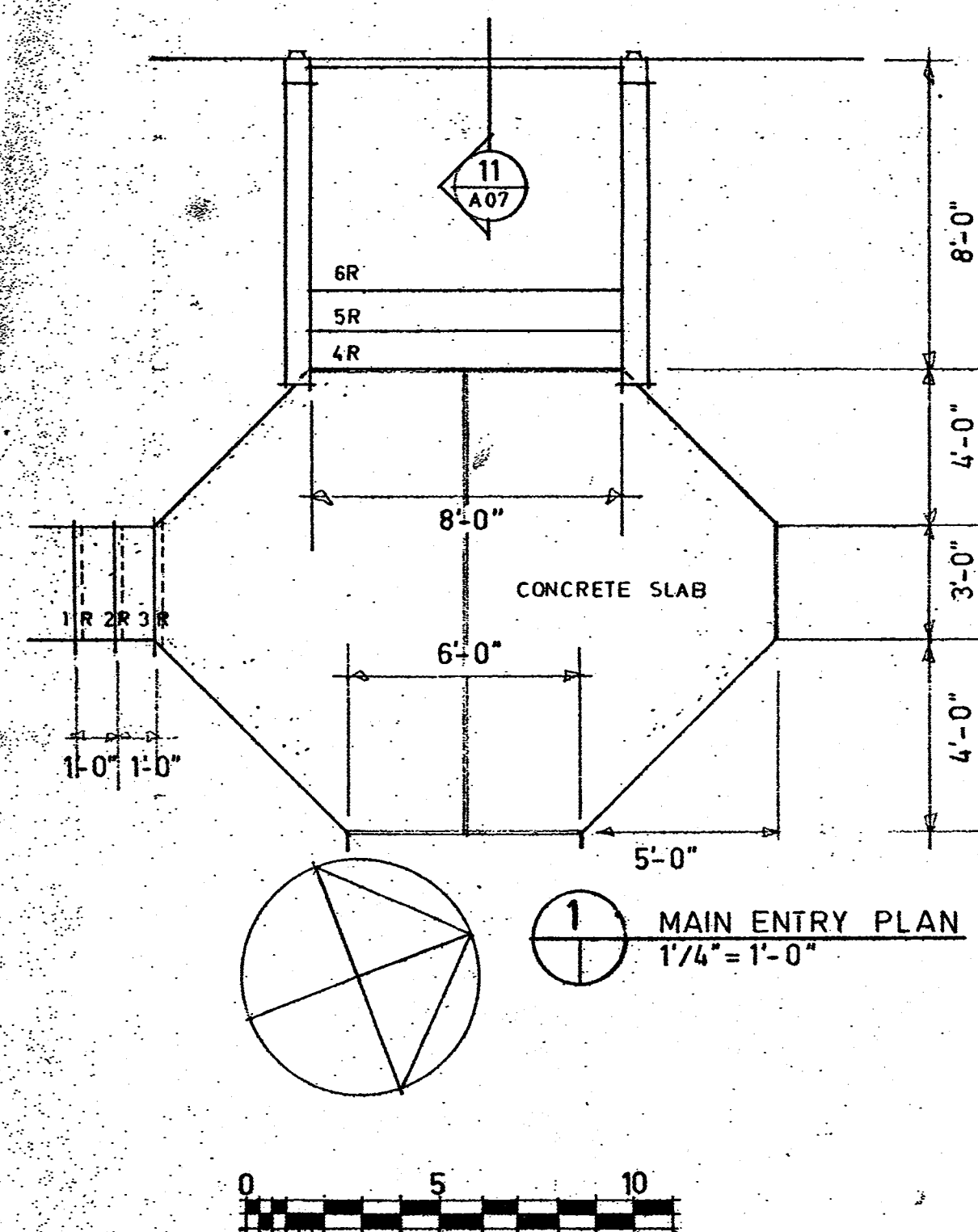
R.C.M.P. COMPLEX

drawing title titre du dessin
MAIN FLOOR PLAN

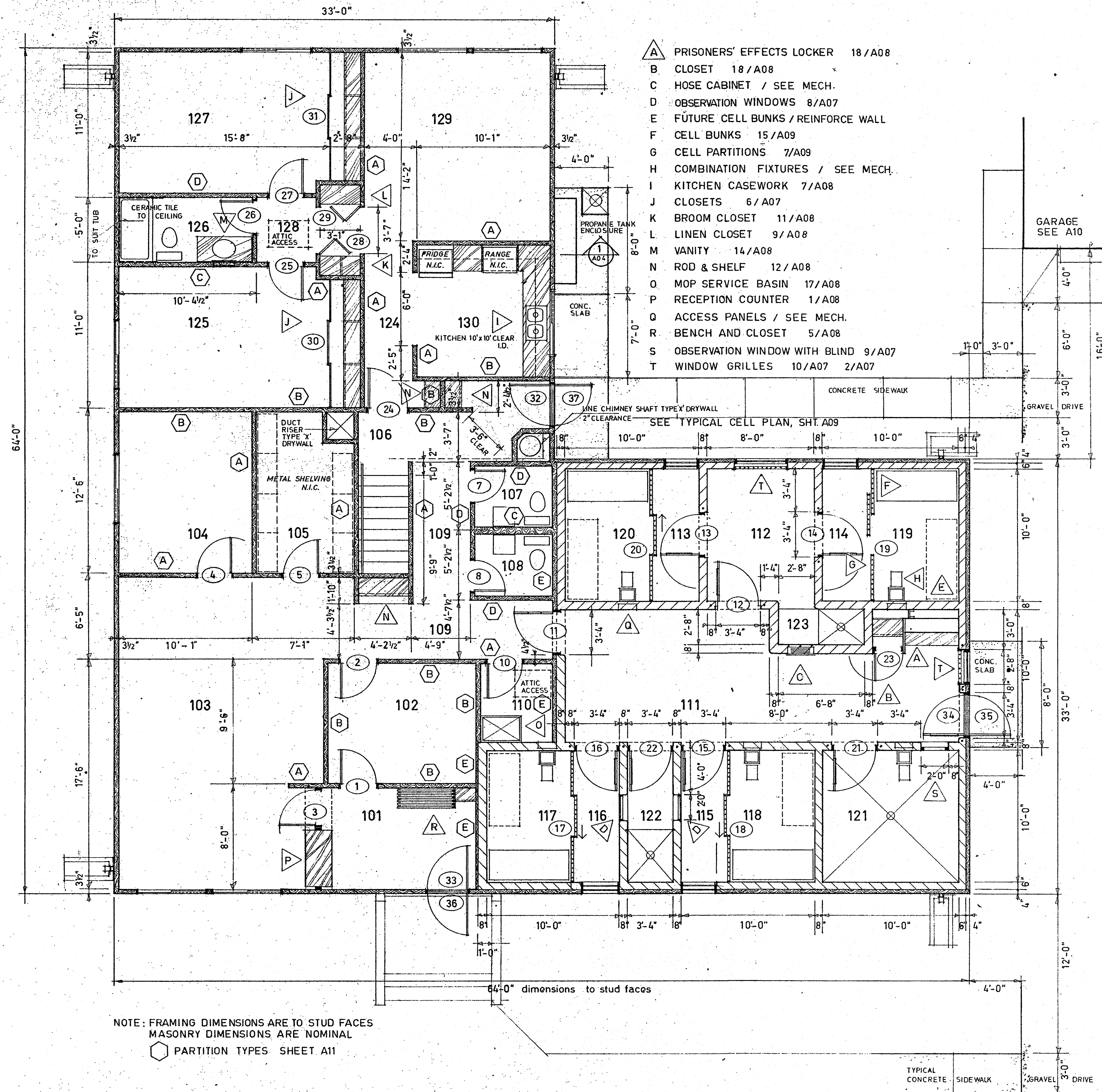
designed by conçu par
date
drawn by dessiné par
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reviewed by examiné par
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approved by approuvé par
date
Tender Submission
D.P.W. Project Manager Administrateur de projets M.T.P.
project number no. du projet
86314 MT 7415
drawing no. dessin no.
A03



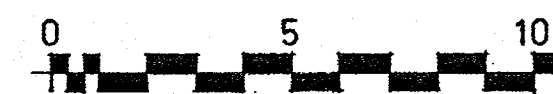
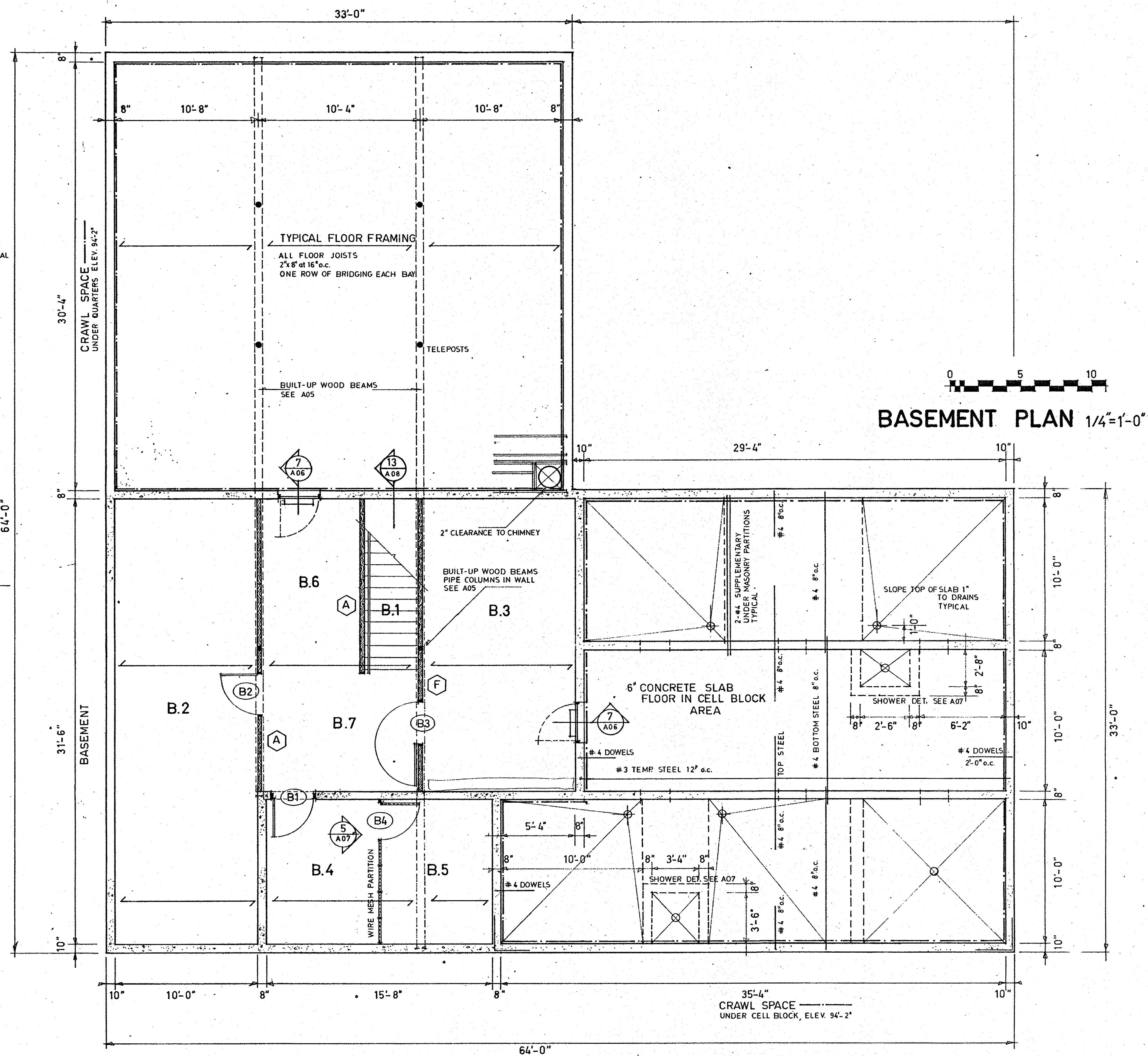
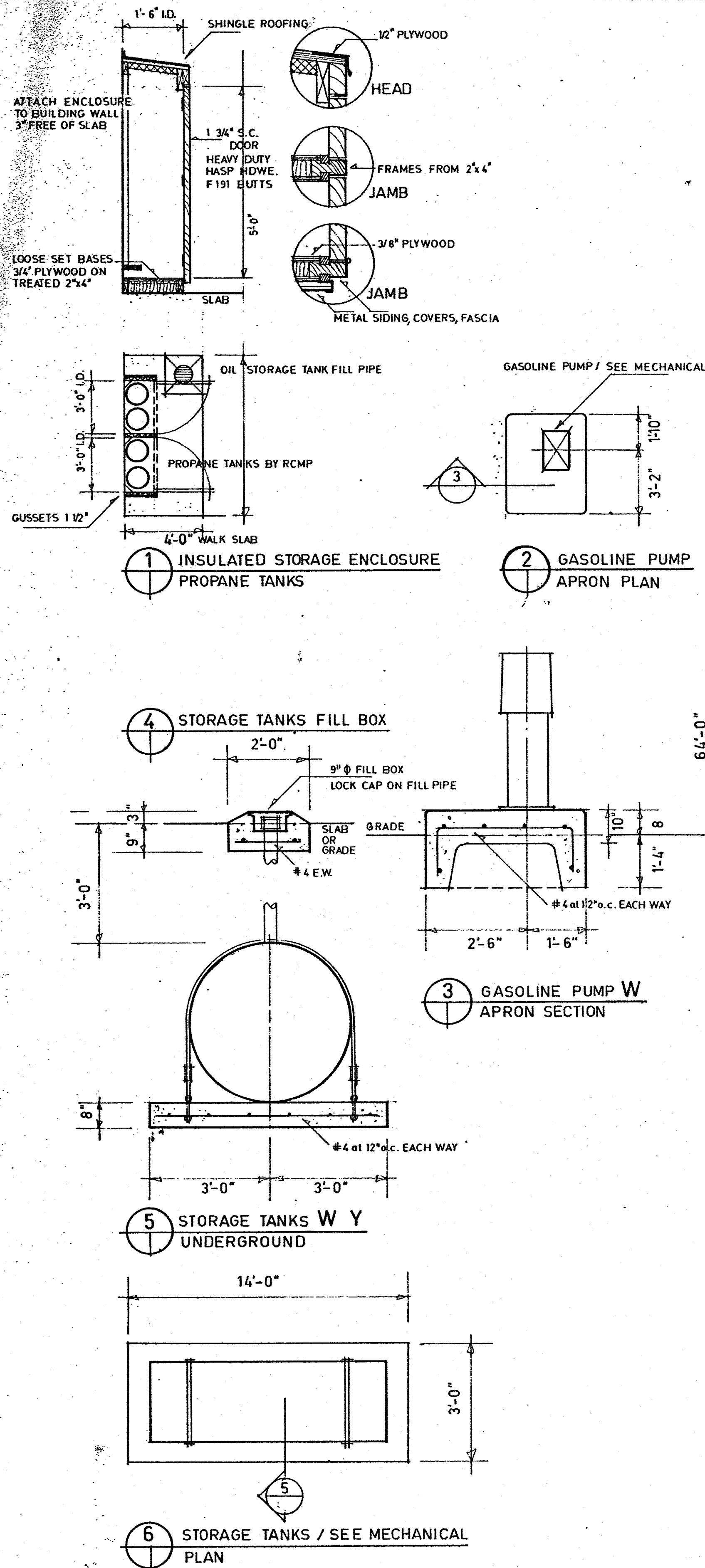
ALTERNATE PRICE NO.1.
SCHEMATIC SHOWING 2'-0" INCREASE IN CELL LENGTHS



MAIN FLOOR PLAN 1/4" = 1'-0"



NOTE: FRAMING DIMENSIONS ARE TO STUD FACES
MASONRY DIMENSIONS ARE NOMINAL
PARTITION TYPES SHEET A11

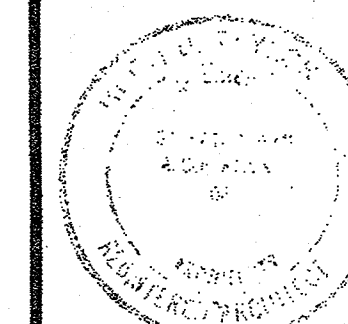


BASEMENT PLAN 1/4"=1'-0"



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Ministère des Travaux publics**

WESTERN REGION



**MOORE TAYLOR
ARCHITECTS
PRINCE ALBERT
SASKATCHEWAN**

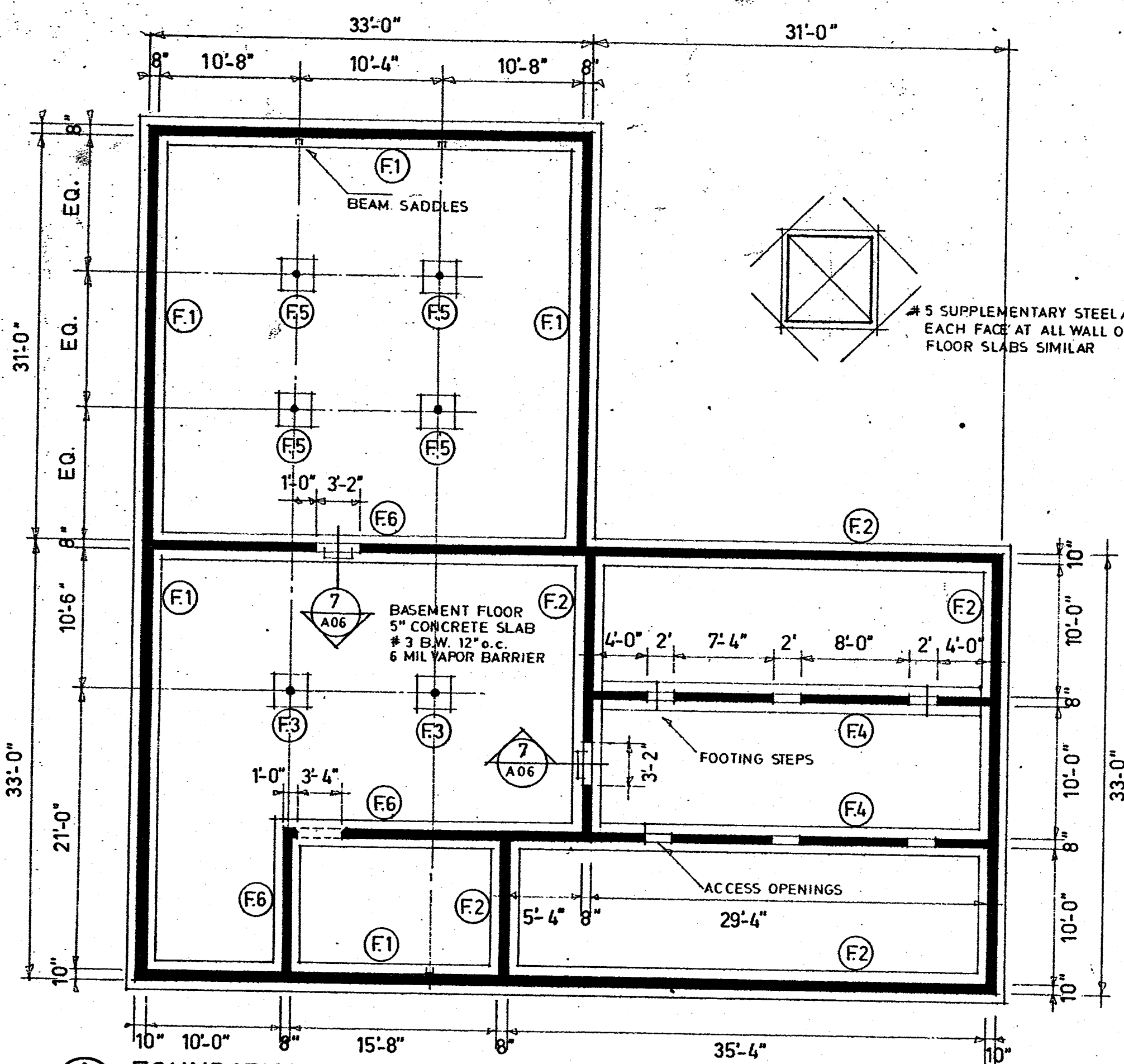
A detail no.	détail no.
B location drawing no. sur dessin no.	
C drawing no.	dessin no.
revisions	date

project title **titre du projet**
**STONY RAPIDS
SASKATCHEWAN**

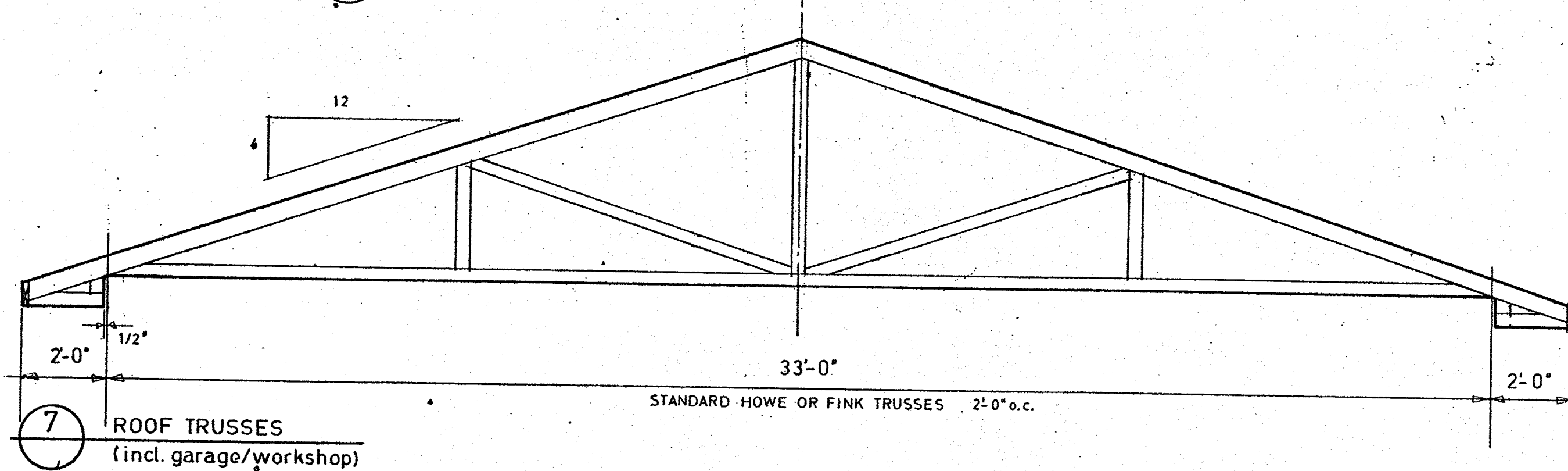
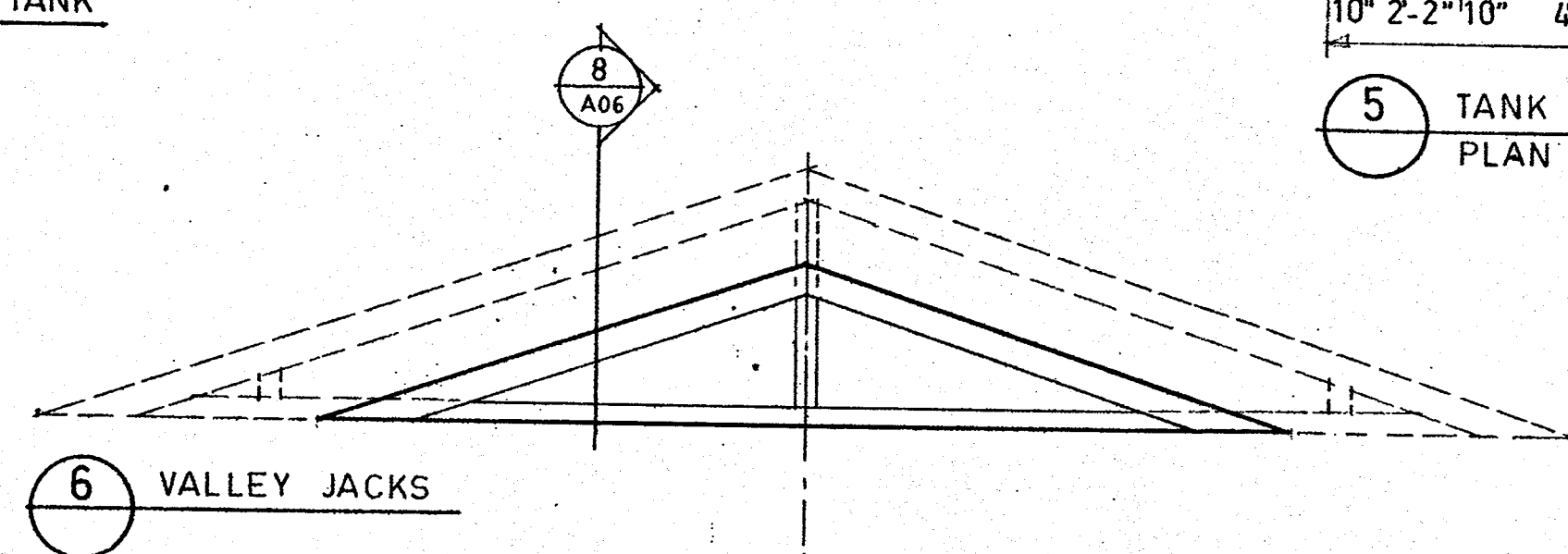
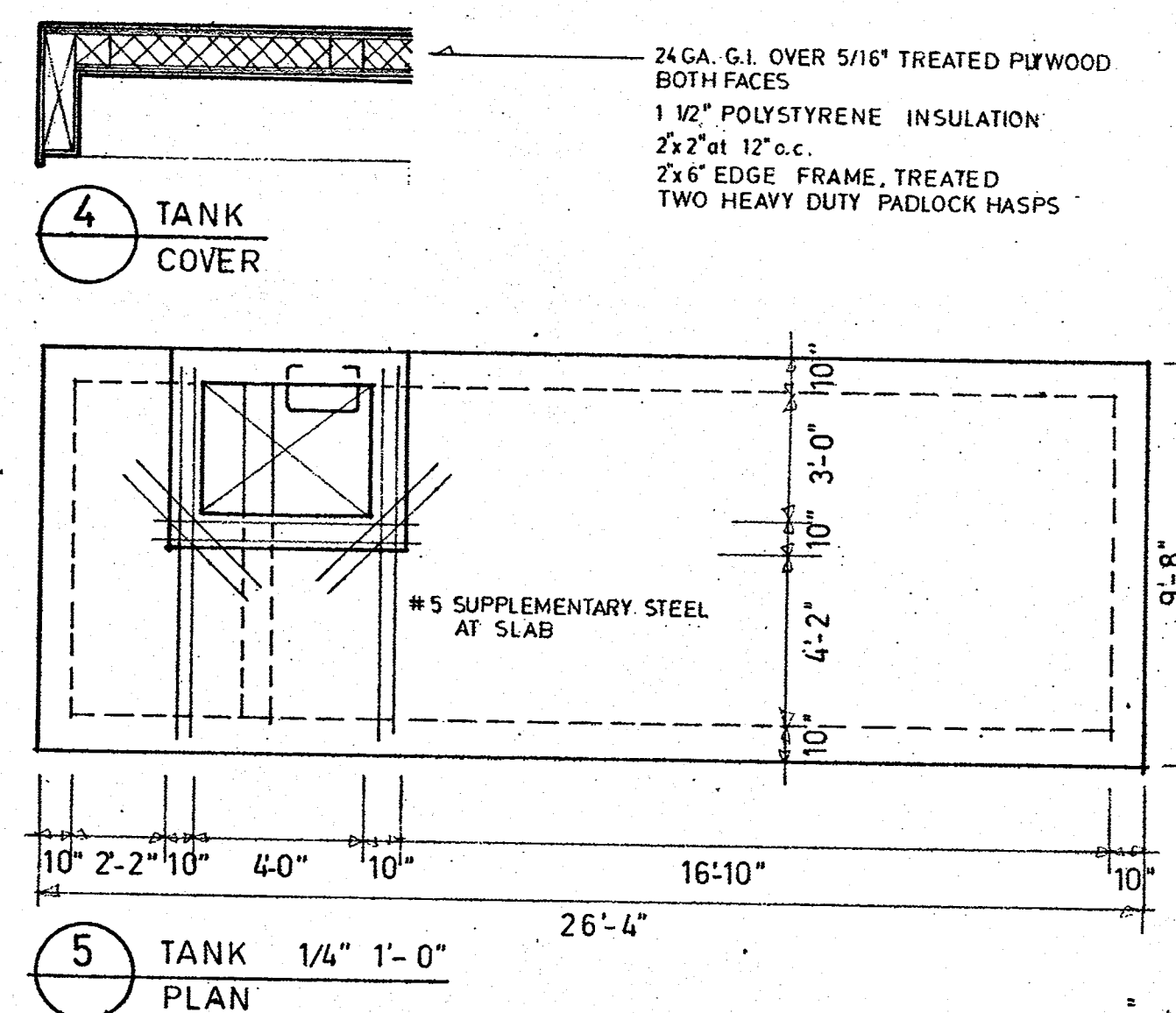
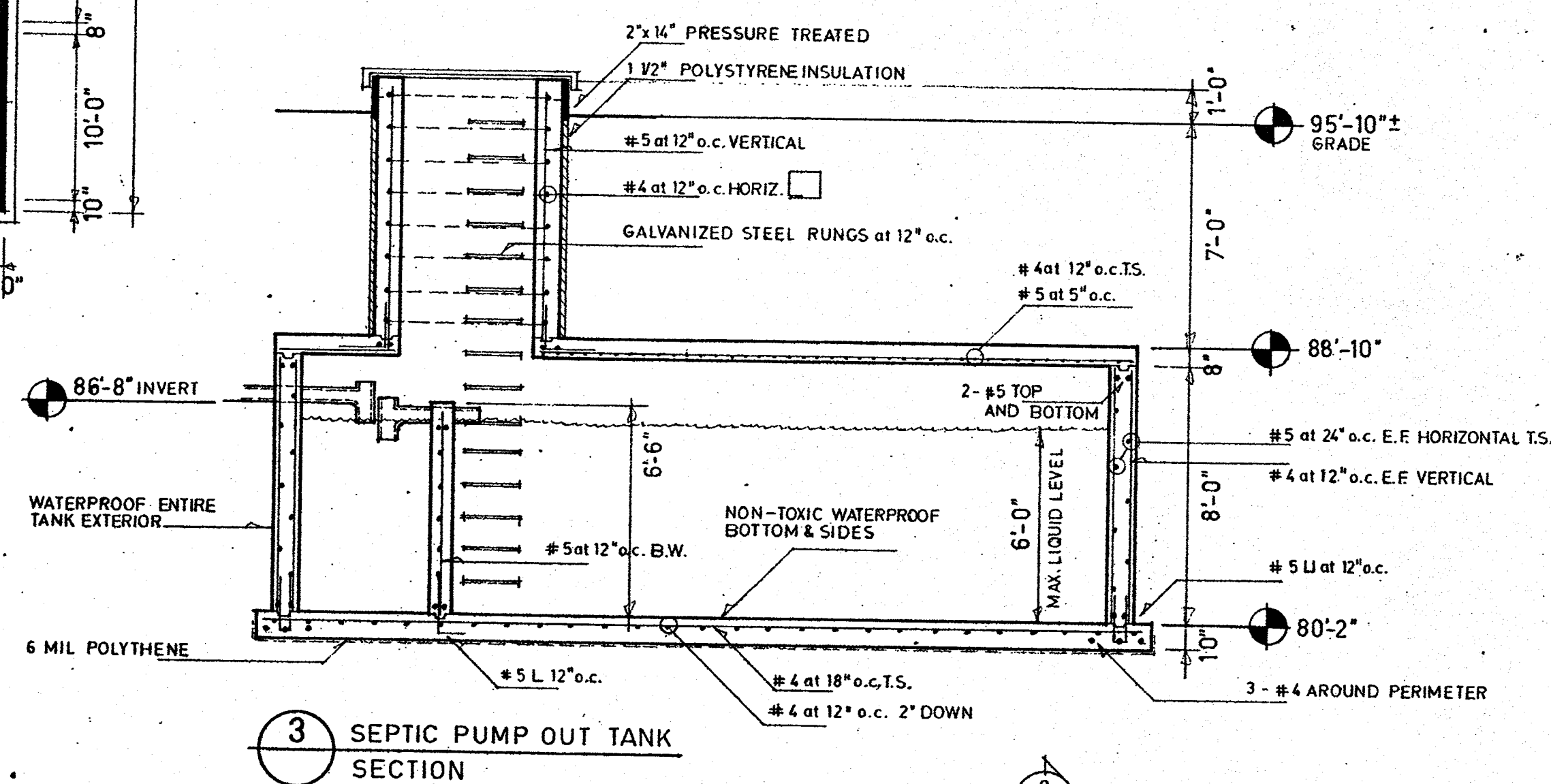
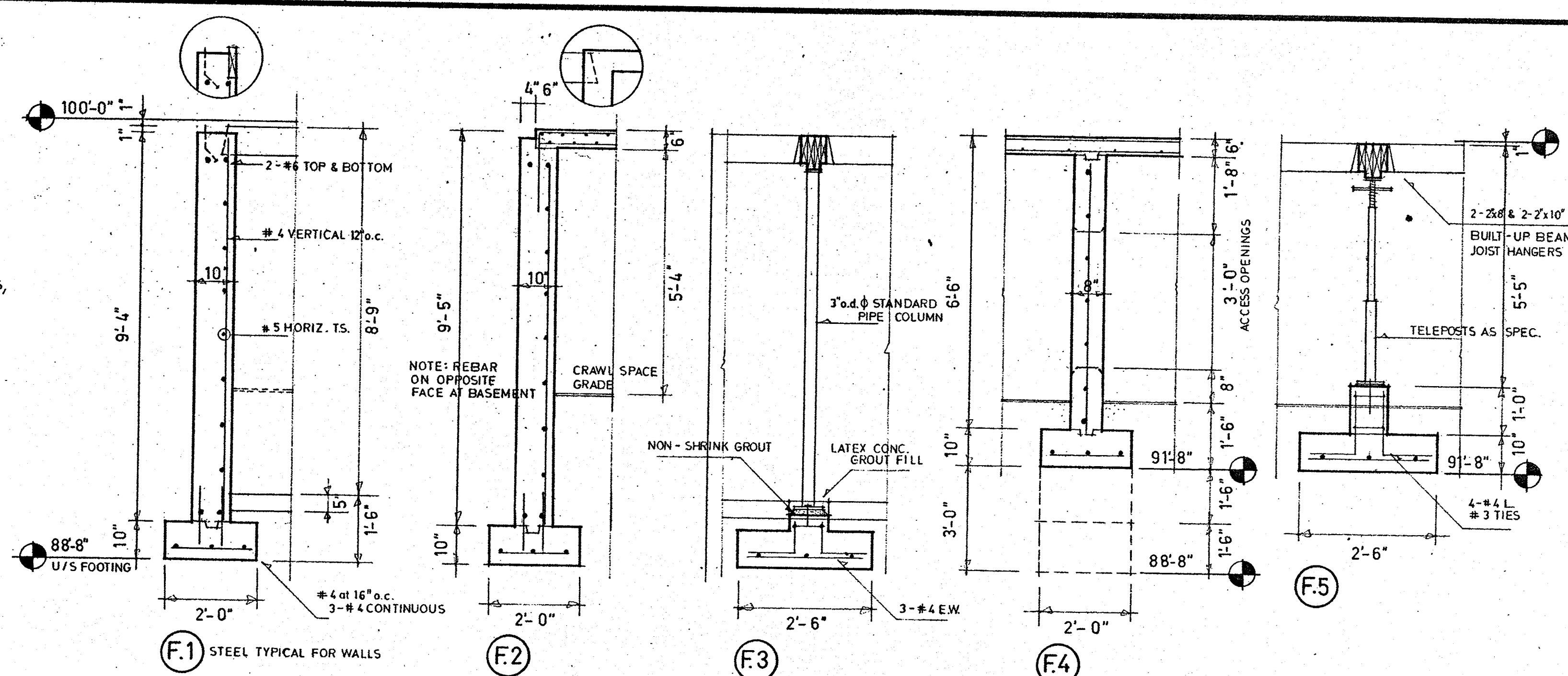
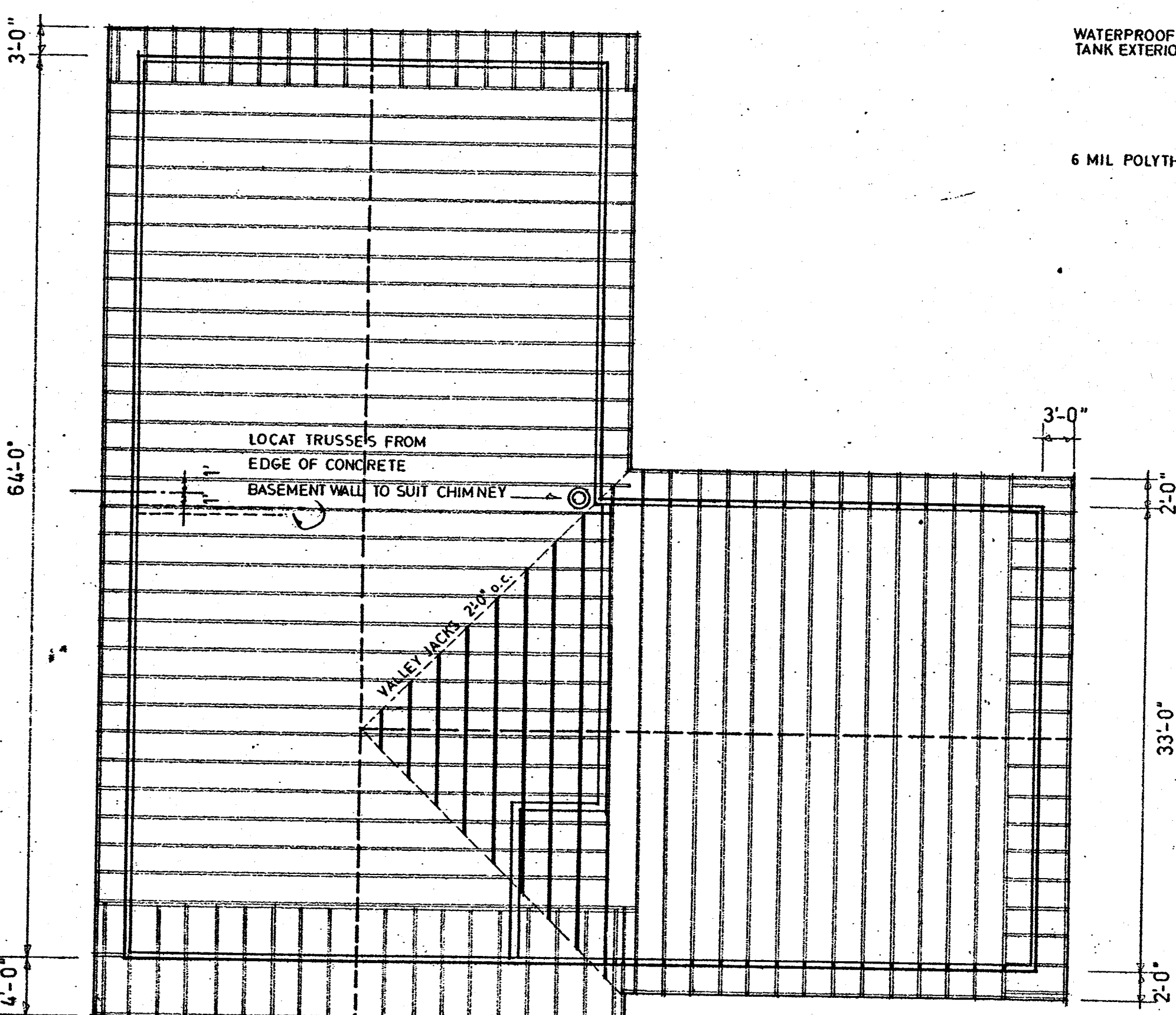
R.C.M.P. COMPLEX

drawing title **titre du dessin**
BASEMENT PLAN

designed by	conçu par
date	
drawn by	dessiné par
date	
reviewed by	examiné par
date	
approved by	approuvé par
date	
Tender	Soumission
D.P.W. Project Manager	Administrateur du projet M.T.P.
project number	no. du projet
86314	MT 7415
drawing no.	dessin no.
A04	

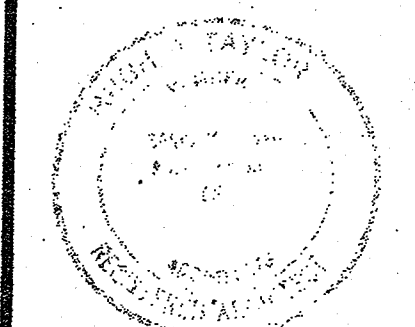


2 ROOF FRAMING SCHEMATIC



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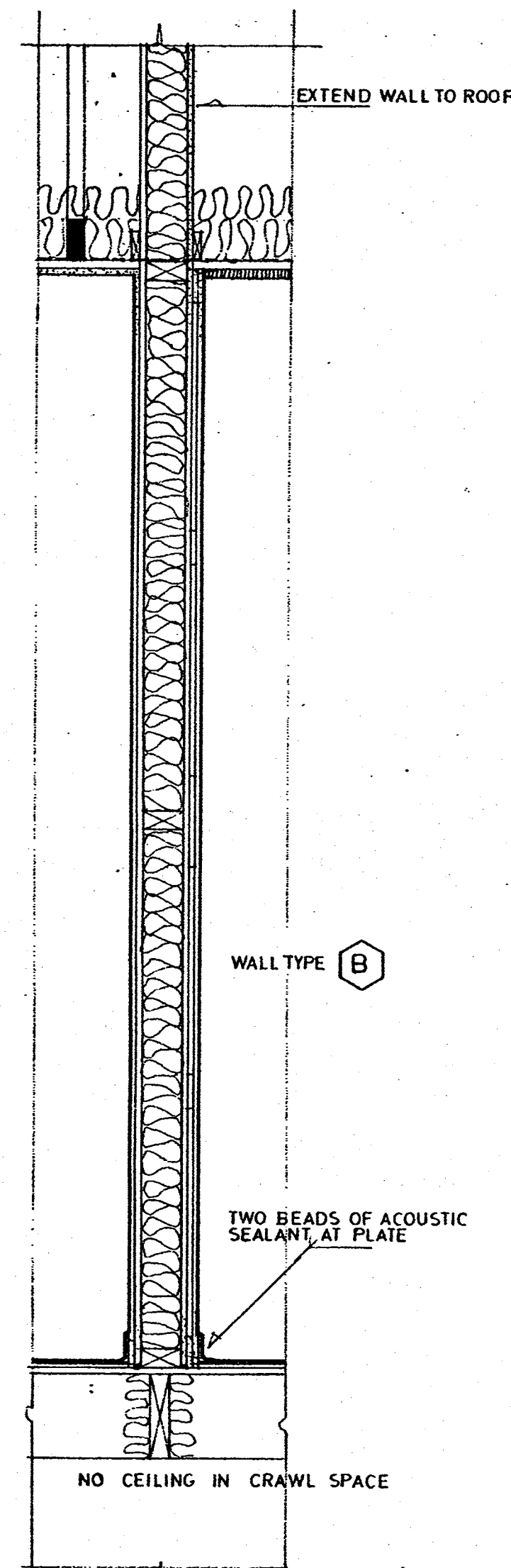
MOORE TAYLOR
ARCHITECTS
PRINCE ALBERT
SASKATCHEWAN

A detail no.	détail no.
B location drawing no. sur dessin no.	
C drawing no.	dessin no.
revisions	date

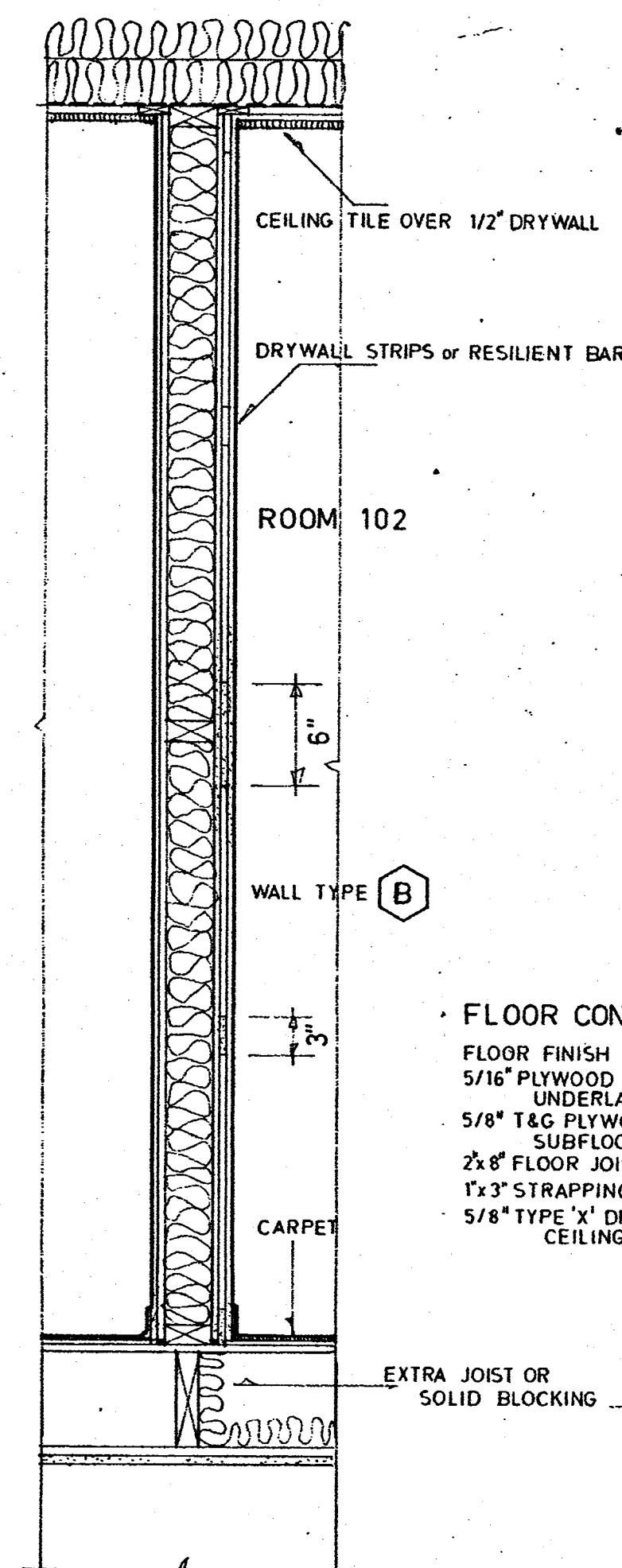
project title
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX
drawing title
STRUCTURAL

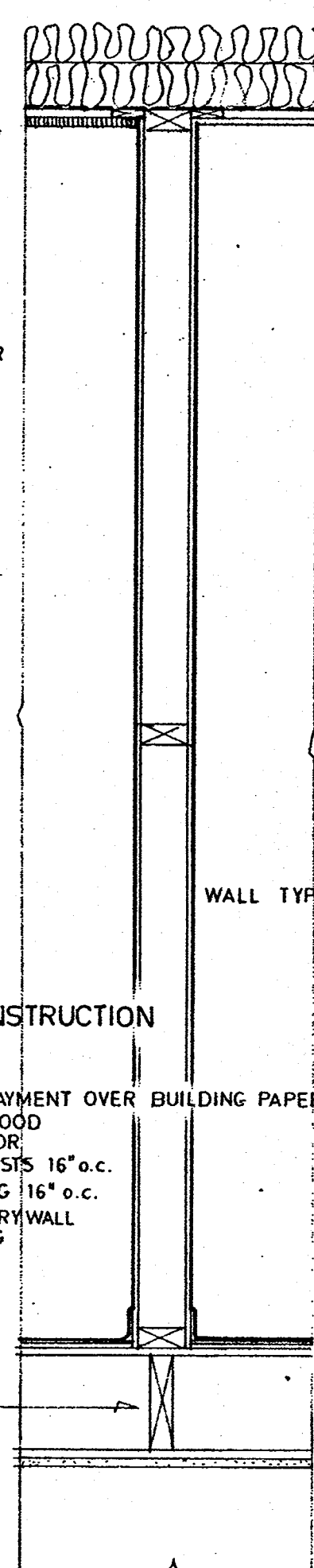
designed by	conçu par
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drawn by	dessiné par
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reviewed by	examiné par
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approved by	approuvé par
date	
Tender	Soumission
D.P.W. Project Manager	Administrateur du projet M.T.P.
project number	no. du projet
86314	M.T. 7415
drawing no.	dessin no.
A05	



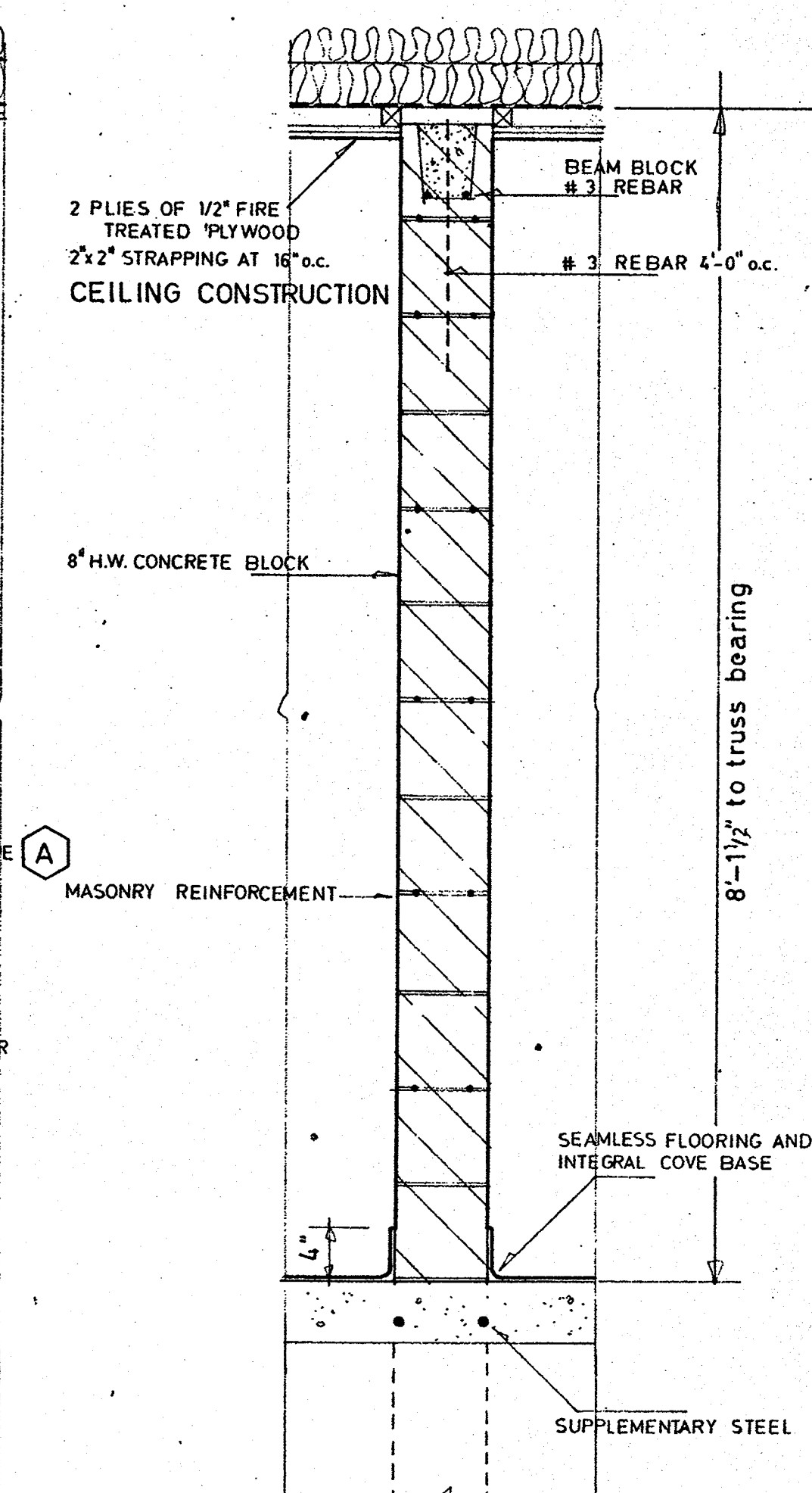
1 COMMON WALL BETWEEN
DETACHMENT & QUARTERS



2 INTERVIEW ROOM 102
WASHROOMS SIMILAR

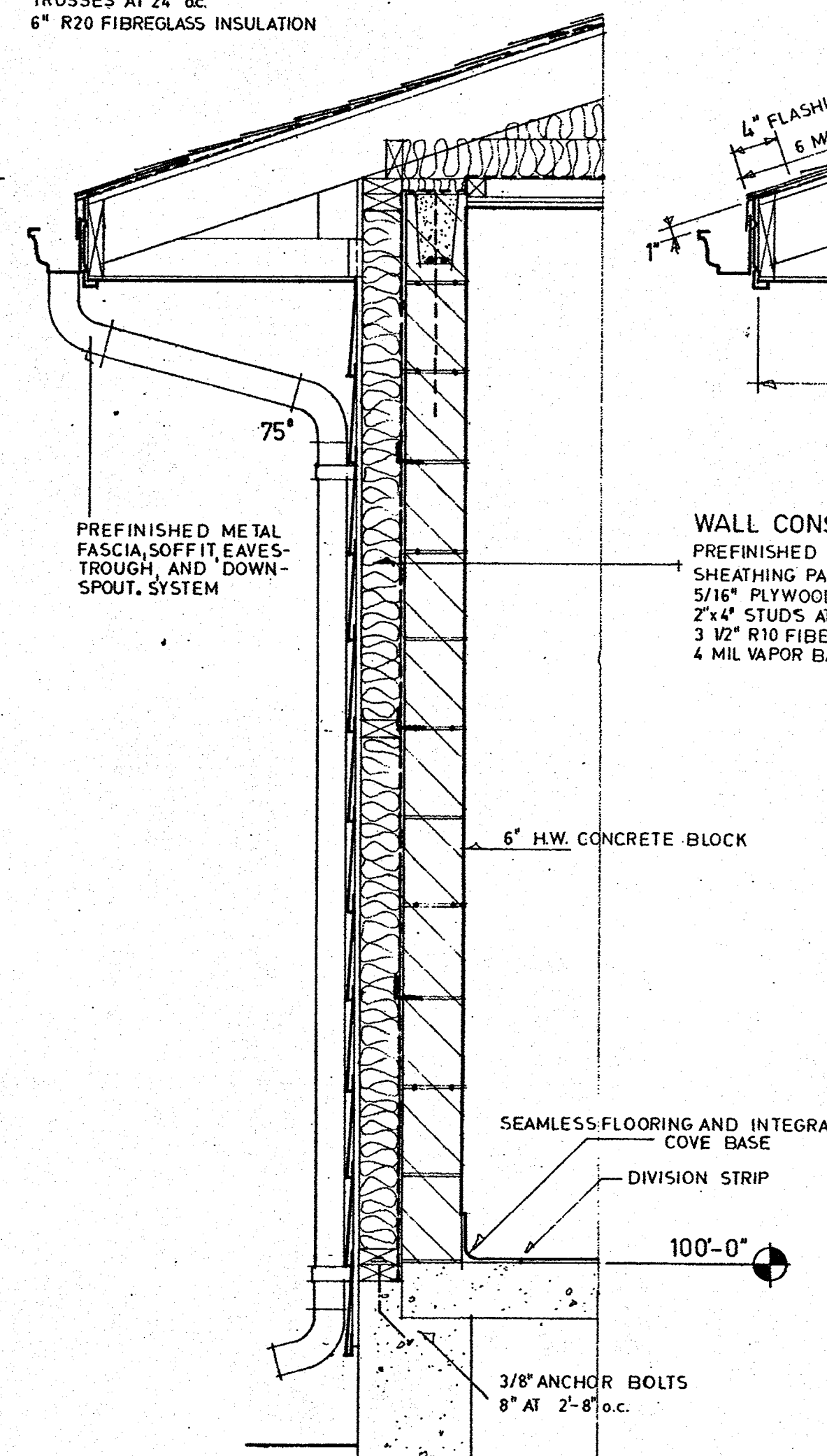


3 STANDARD PARTITIONING
INTERIOR FRAME

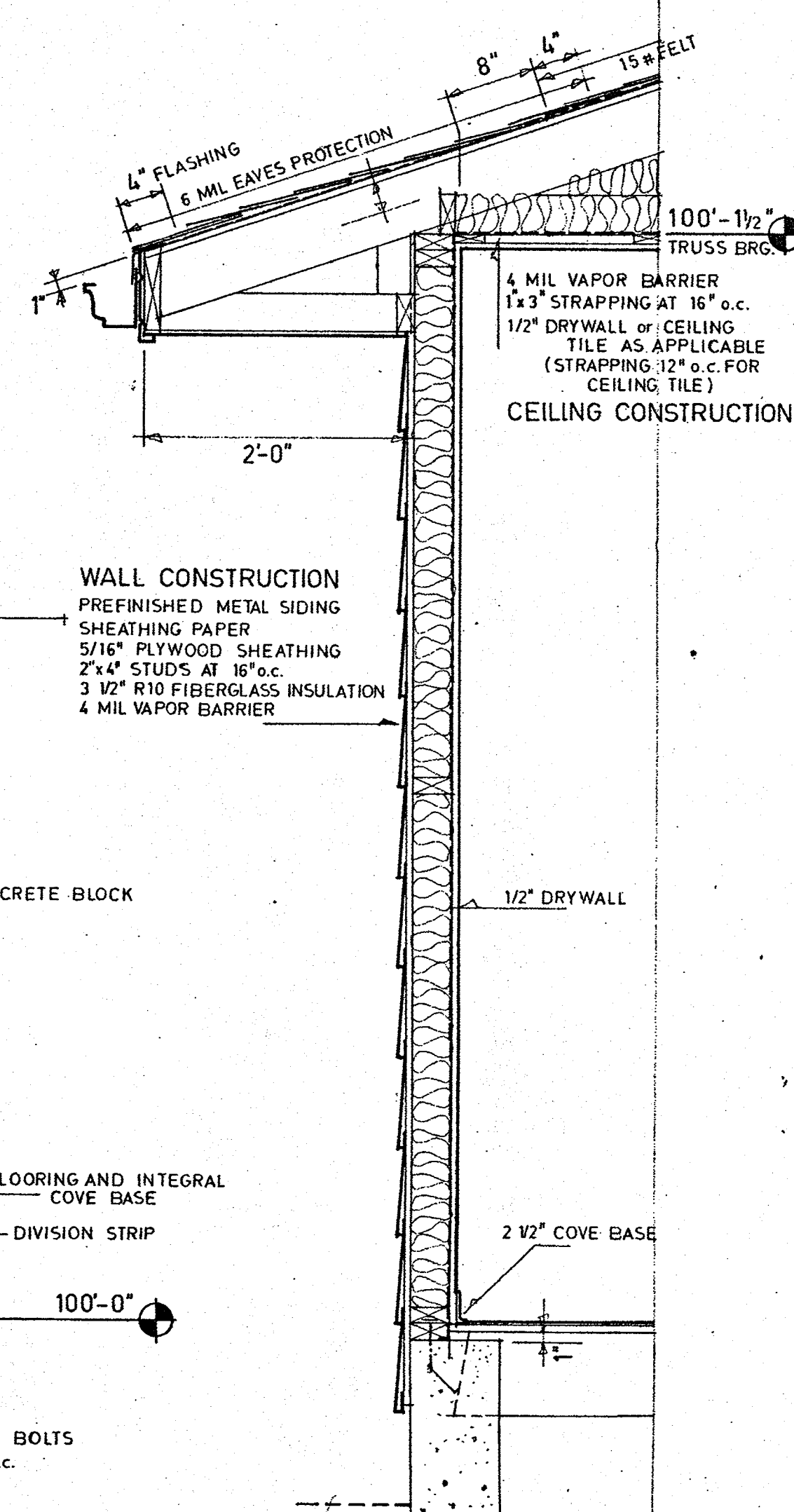


4 STANDARD PARTITIONING
INTERIOR MASONRY

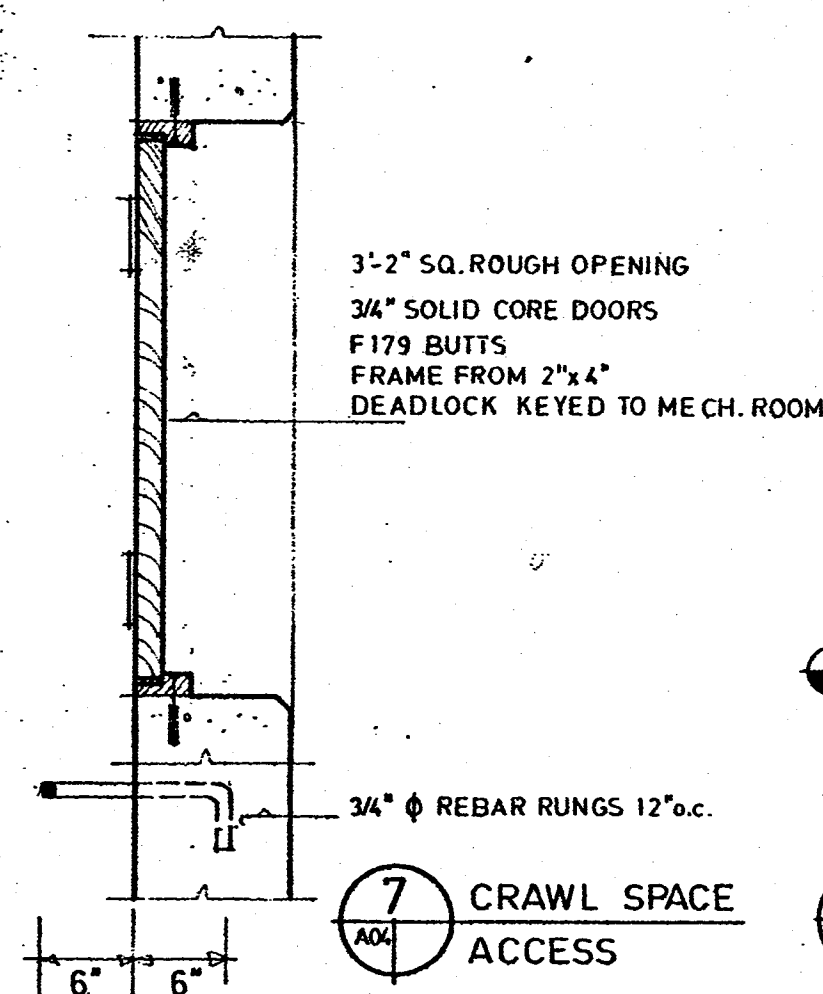
ROOF CONSTRUCTION
SHINGLE ROOFING AS SPECIFIED
1/2\"/>



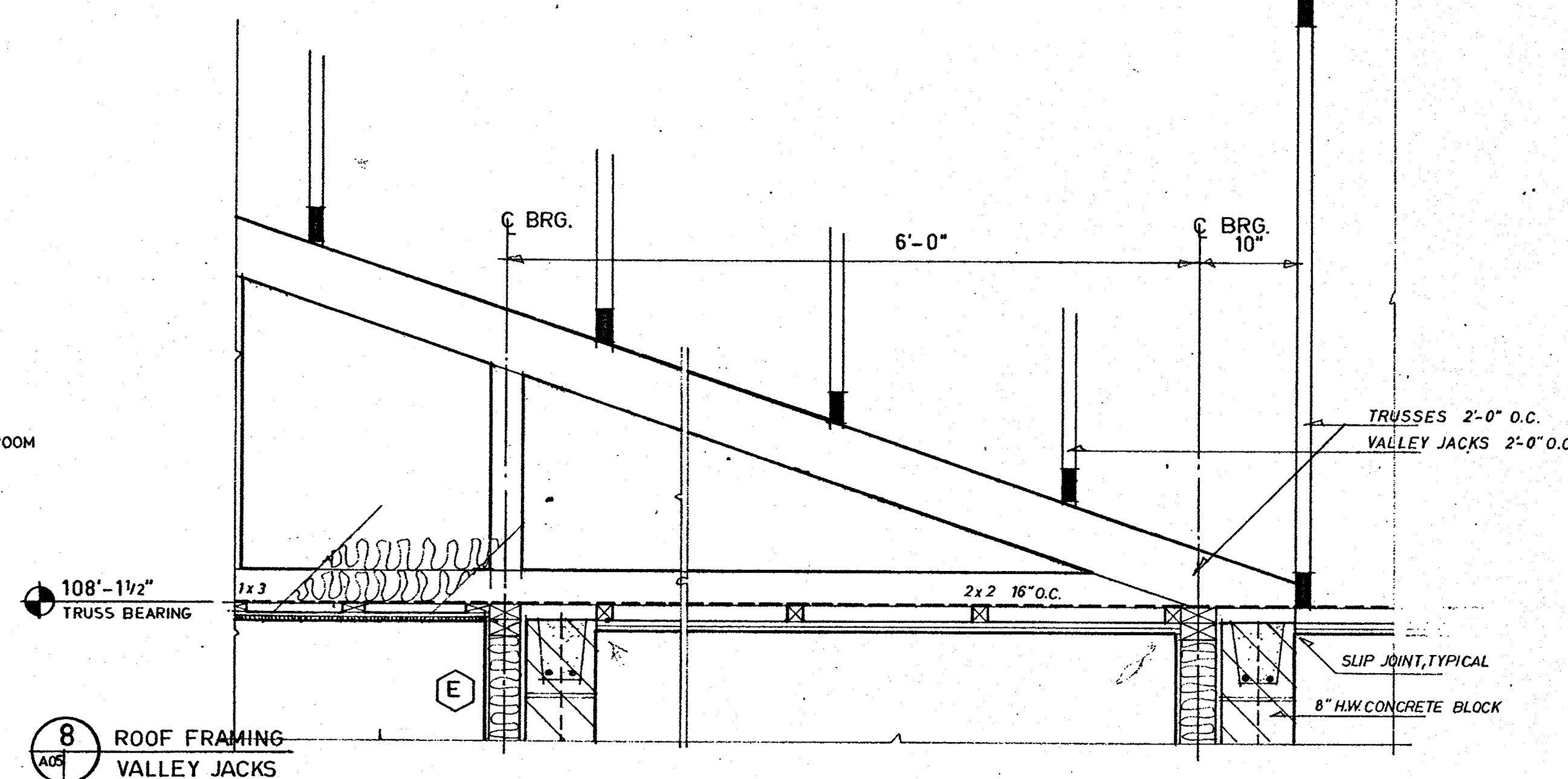
5 EXTERIOR WALL
MASONRY & FRAME



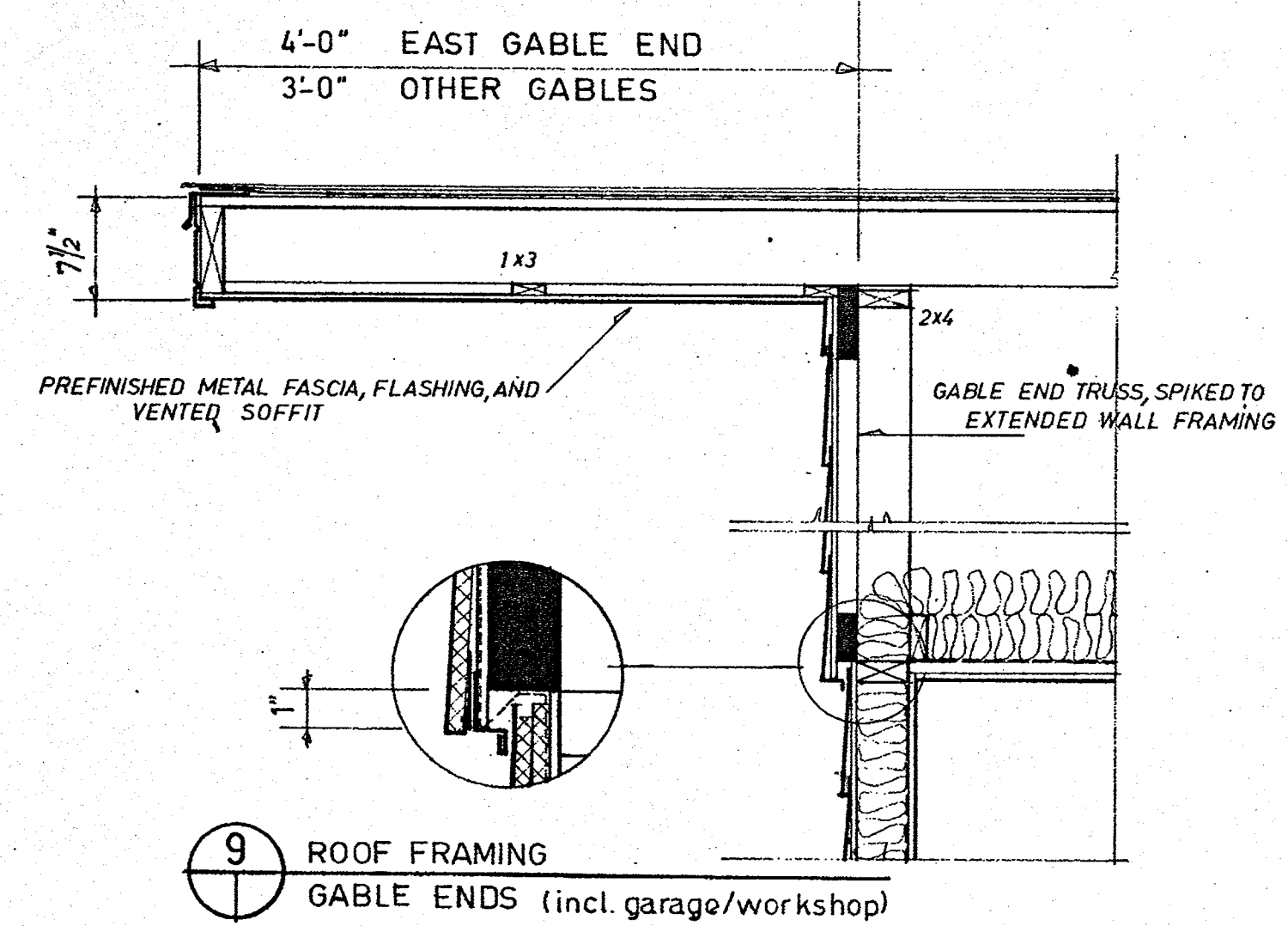
6 EXTERIOR WALL
FRAME



7 CRAWL SPACE
ACCESS



8 ROOF FRAMING
VALLEY JACKS



9 ROOF FRAMING
GABLE ENDS (incl. garage/workshop)



Department of Public Works
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ARCHITECTS
PRINCE ALBERT
SASKATCHEWAN

A detail no. détail no.
B location drawing no. sur dessin no.
C drawing no. dessin no.
revisions date

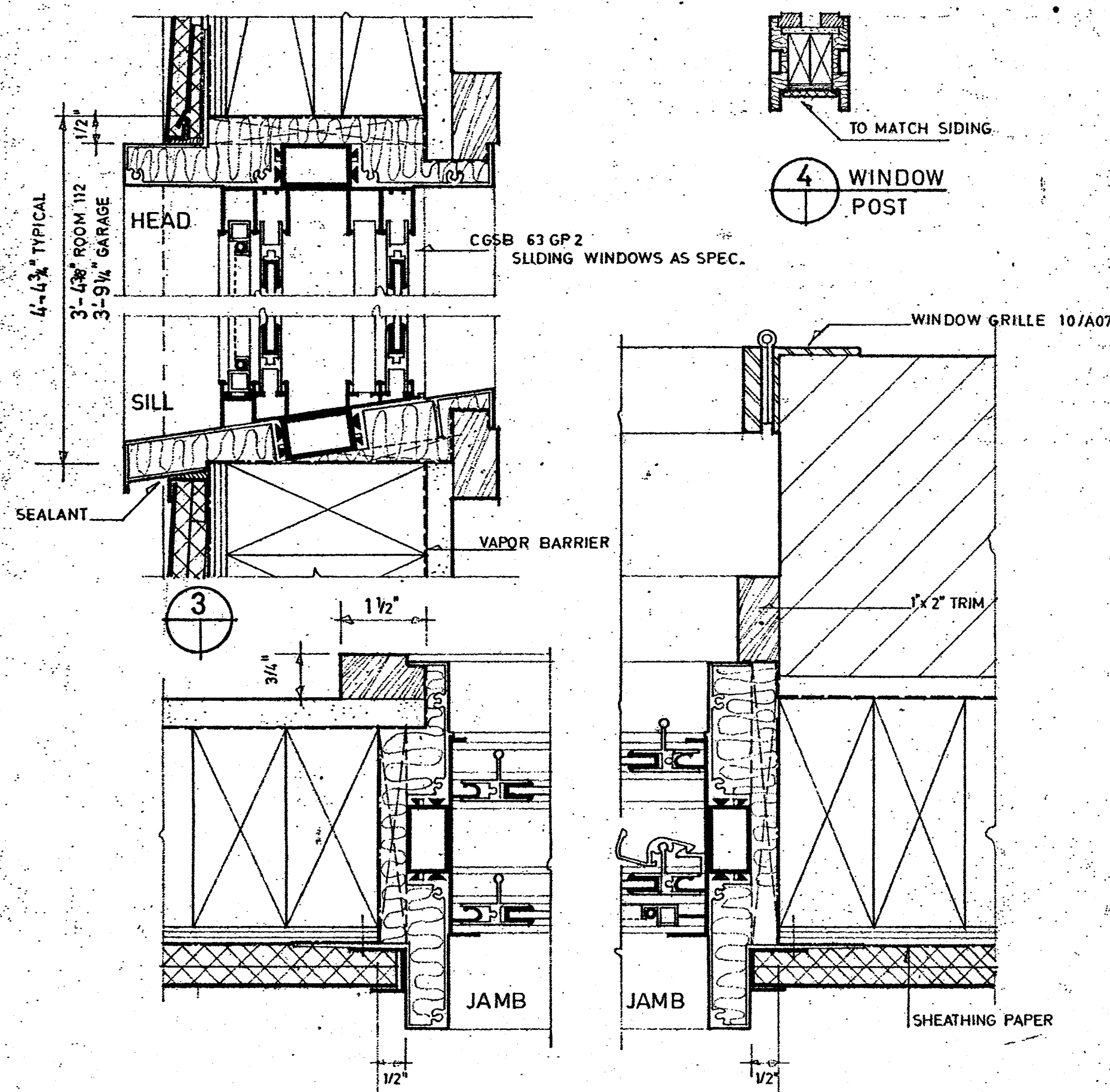
project title titre du projet
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

drawing title titre du dessin
WALL SECTIONS
AND DETAIL

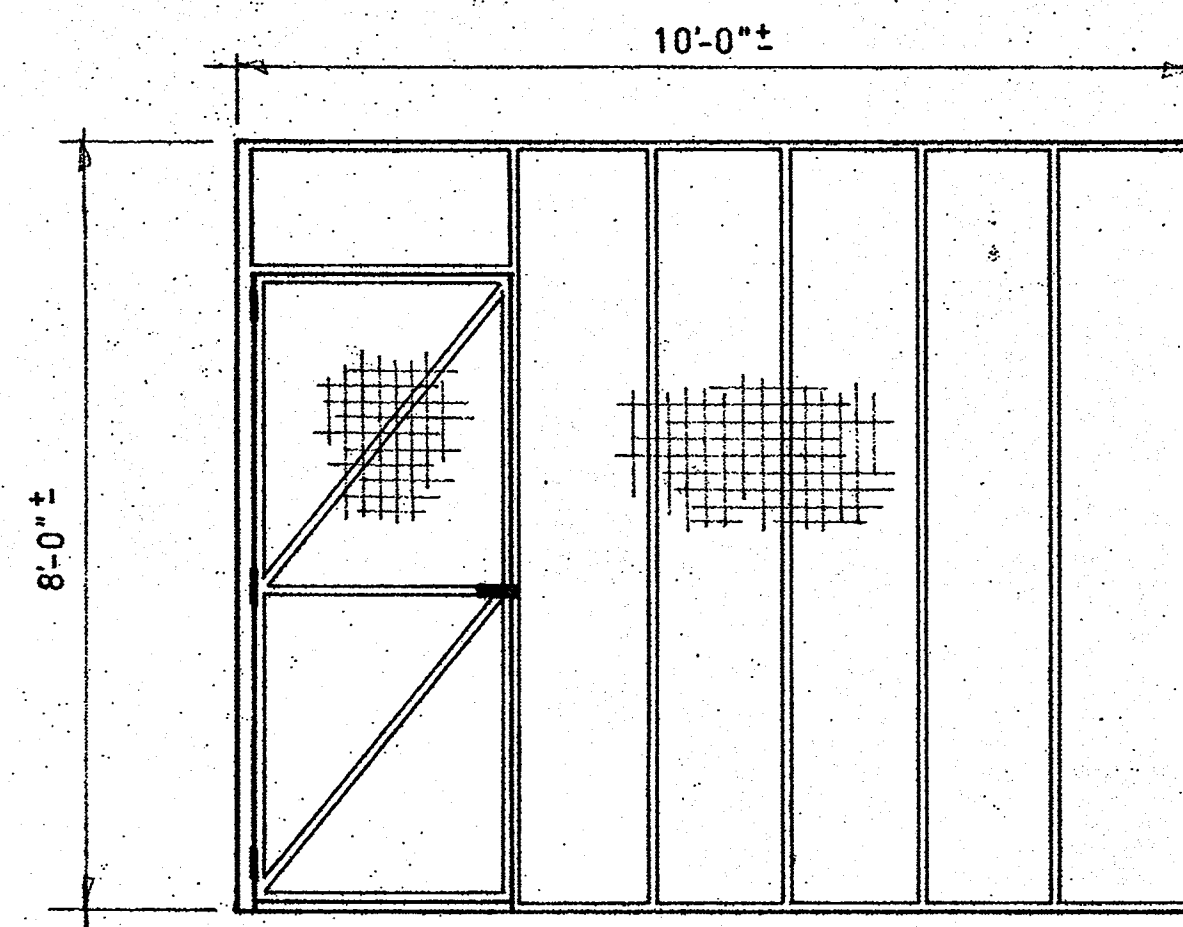
DETACHMENT BUILDING

designed by conçu par
date
drawn by dessiné par
date
reviewed by examiné par
date
approved by approuvé par
date
Tender Soumission
D.P.W. Project Manager Administrateur du projet M.T.P.
project number no. du projet
86314 M.T. 7415
drawing no. dessin no.
A06

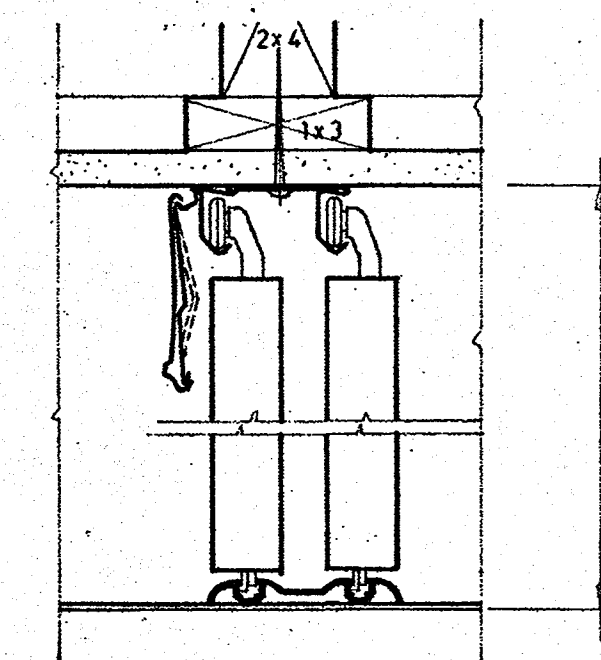


1 WINDOW V
FRAME WALL

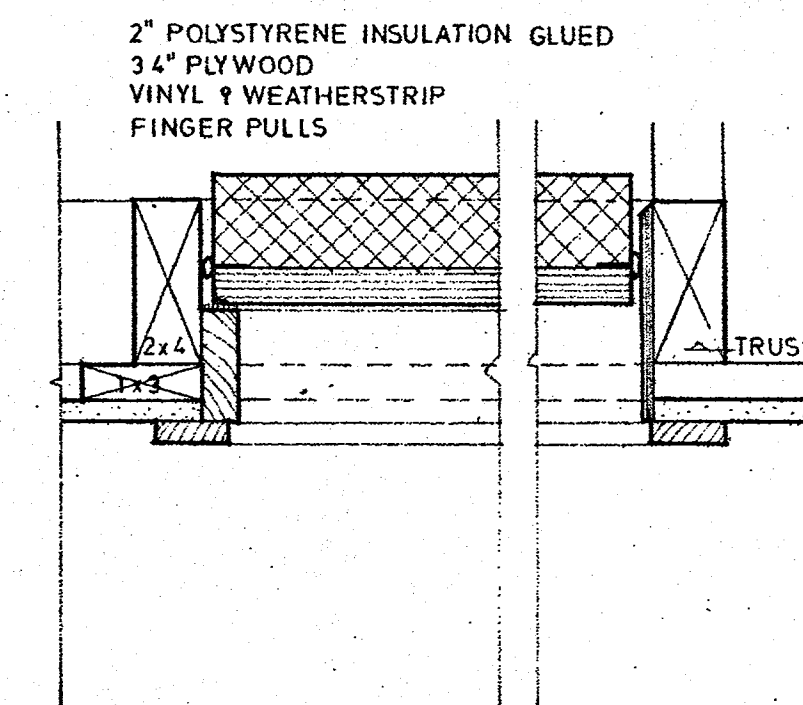
2 WINDOW T
MASONRY WALL



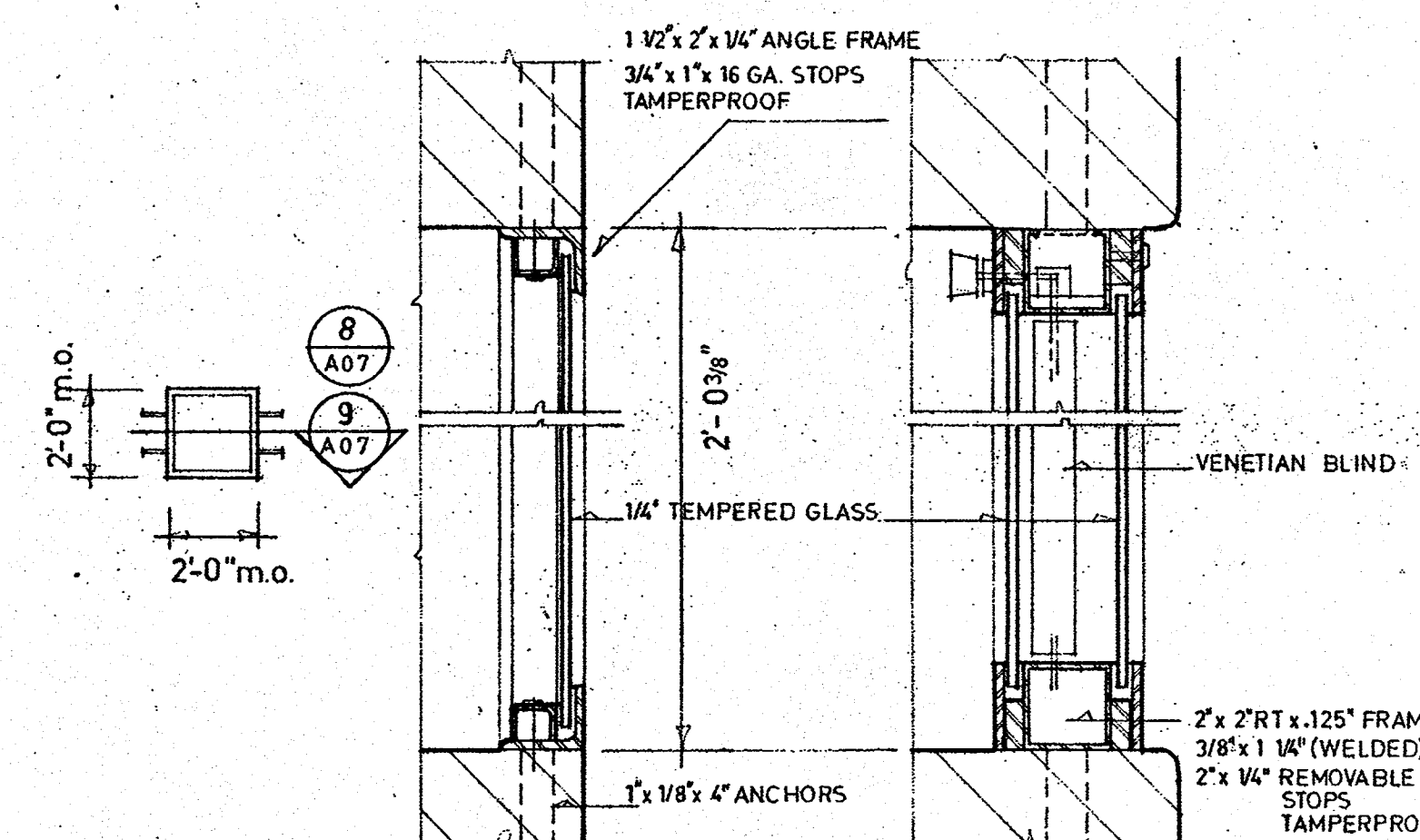
5 PARTITION 1/2\"/>



6 SLIDING DOORS J
CLOSETS

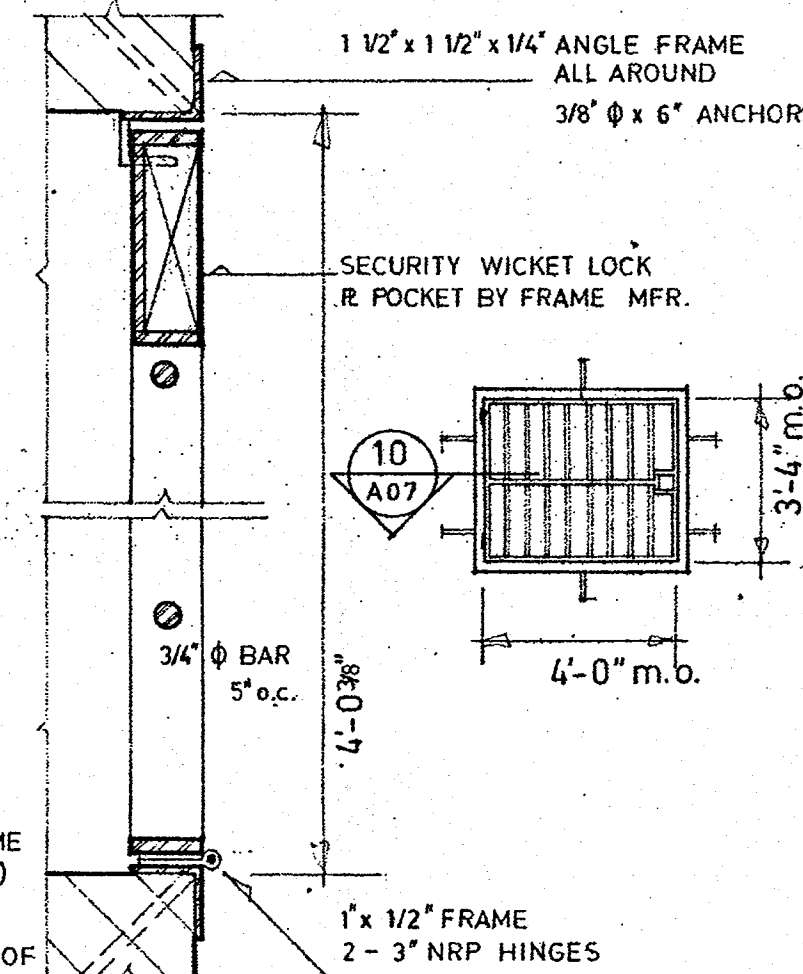


7 ATTIC ACCESS TYPICAL
HATCH 22\"/>

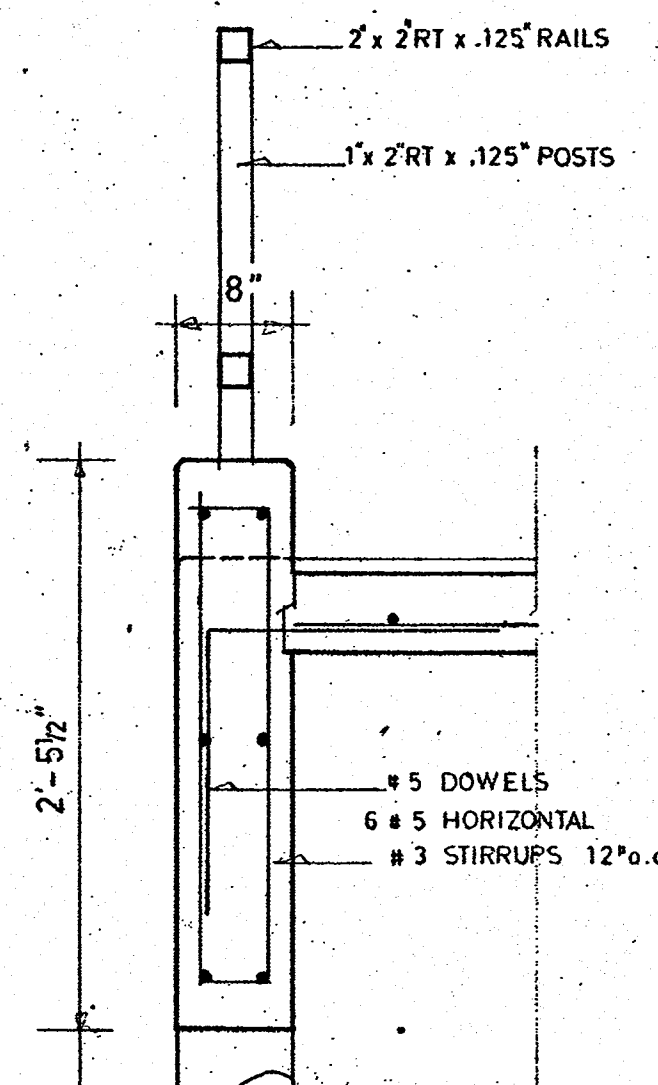


8 OBSERVATION D
TO 115 & 116

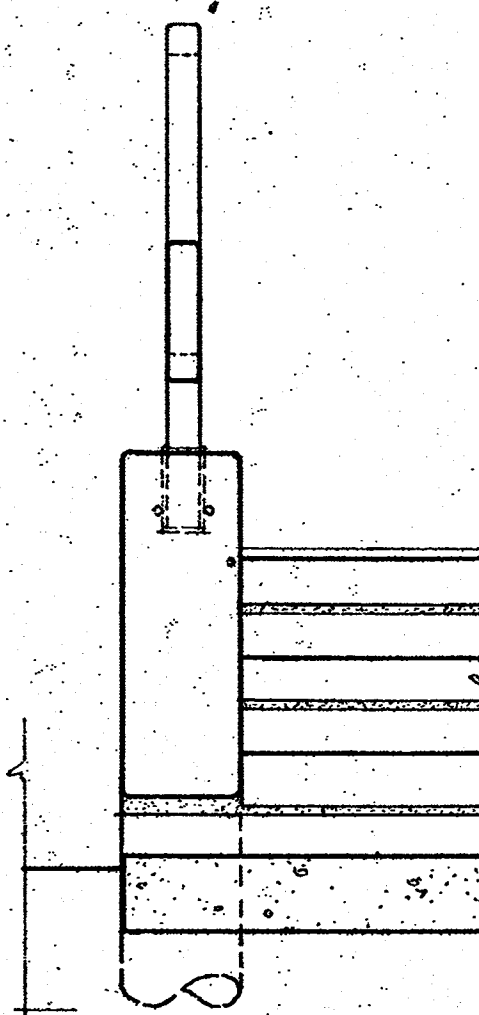
9 OBSERVATION S
TO 121



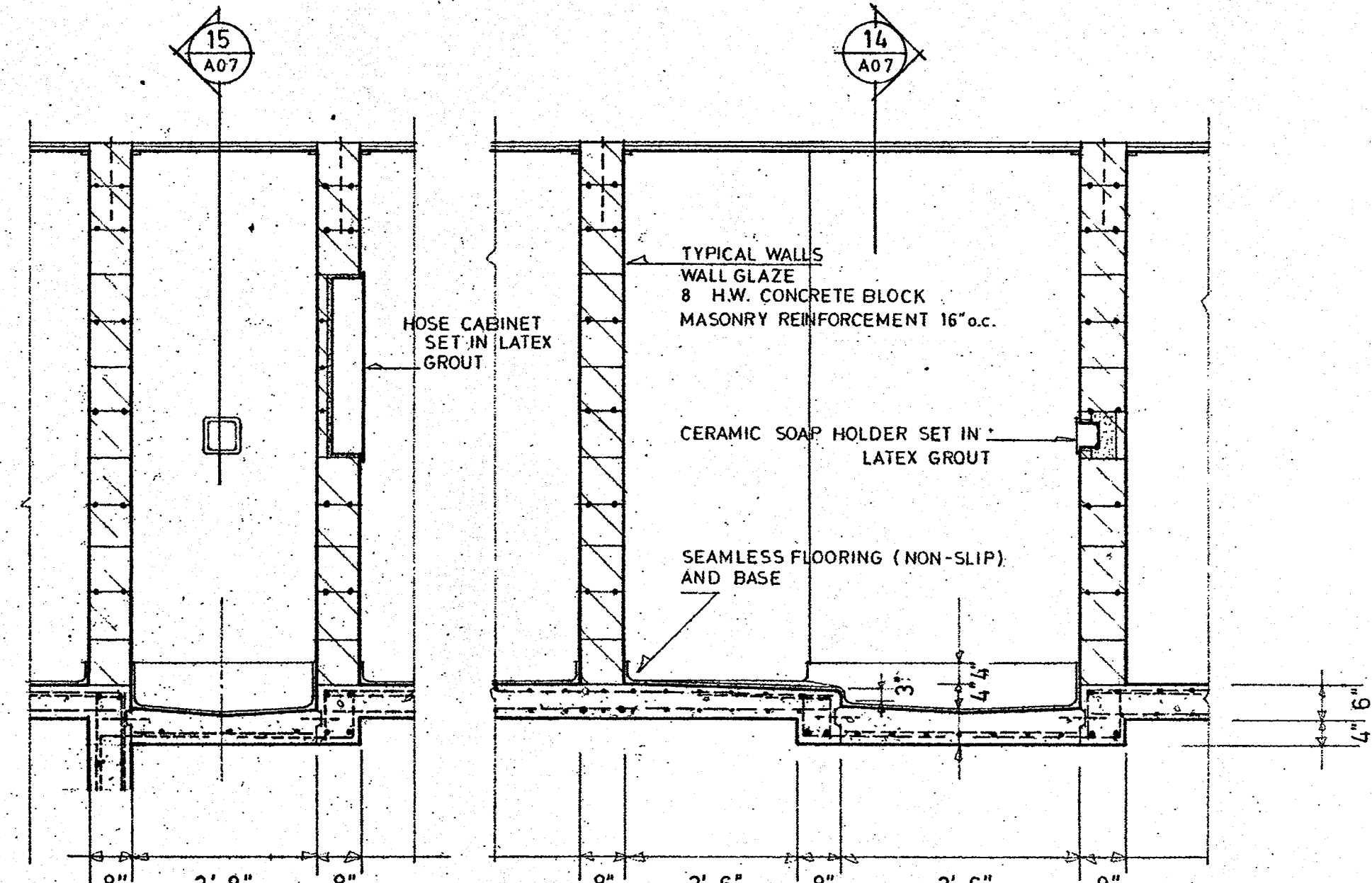
10 WINDOW GRILLES 3'-1-0\"/>



13 SECTION
ENTRY LANDING

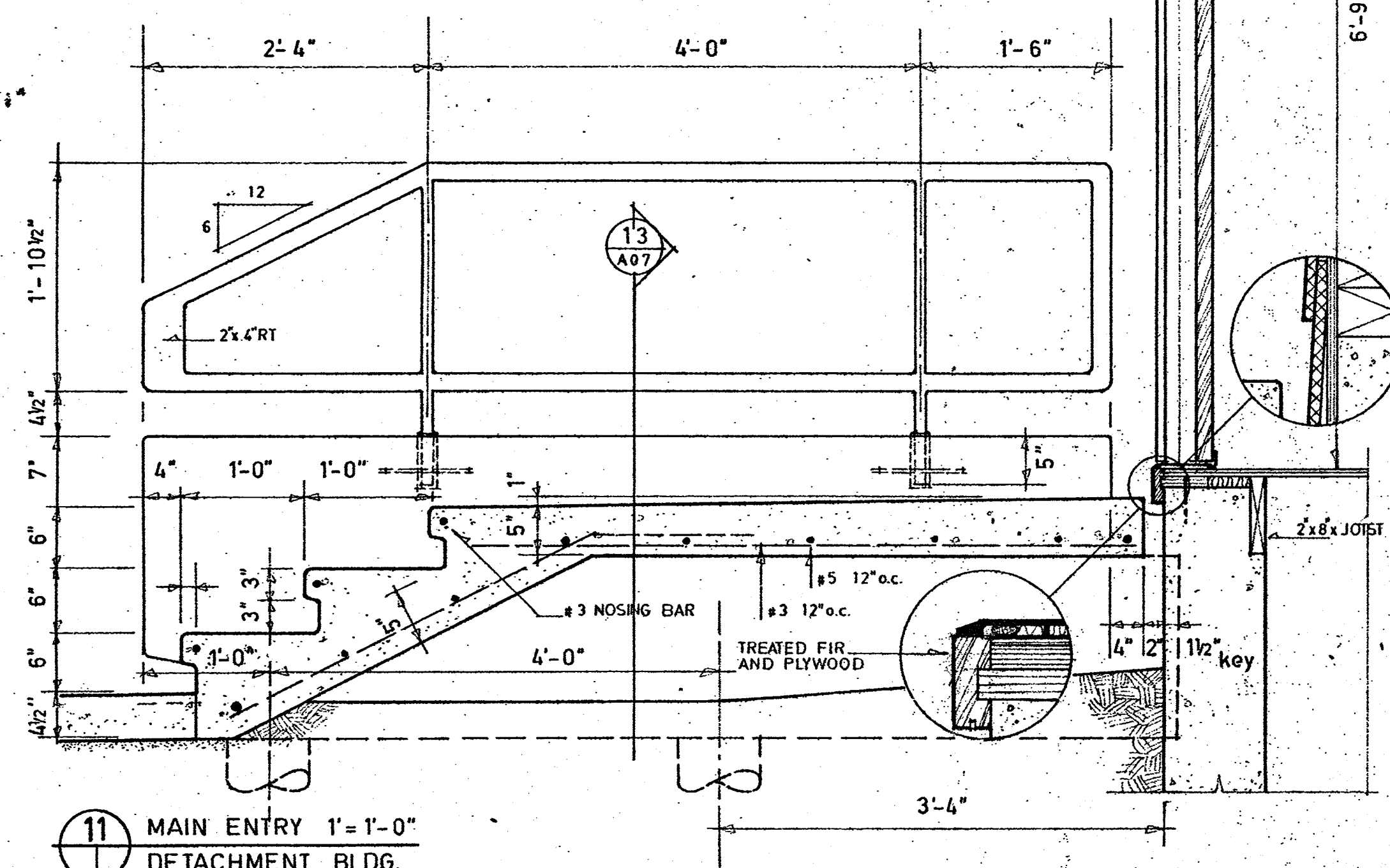


12 ELEVATION
STEPS



14 SHOWER 123
122 SIMILAR

15 SHOWER 123 1/2\"/>



11 MAIN ENTRY 1'-1-0\"/>



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PRINCE ALBERT
SASKATCHEWAN

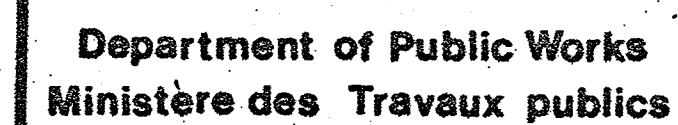
A detail no.	détail no.
B location drawing no. sur dessin no.	
C drawing no.	dessin no.
revisions	date

project title
STONY RAPIDS
SASKATCHEWAN

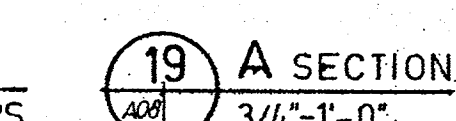
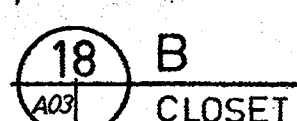
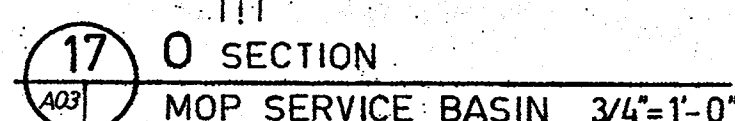
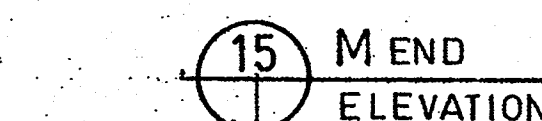
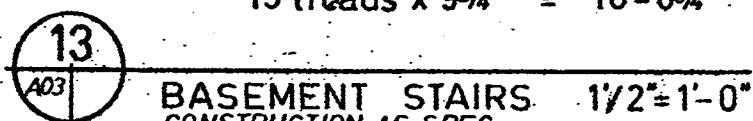
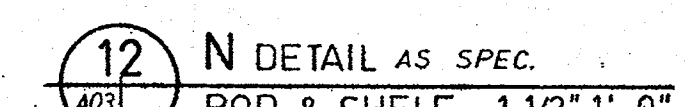
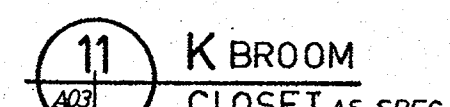
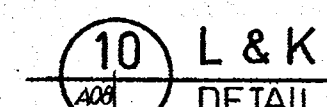
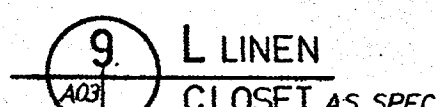
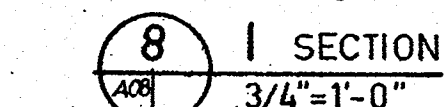
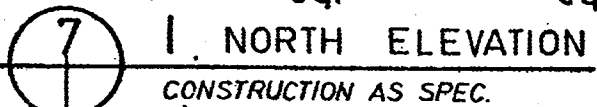
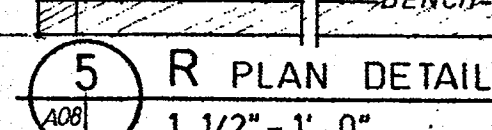
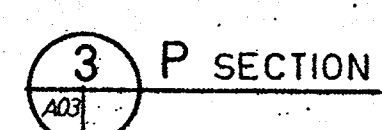
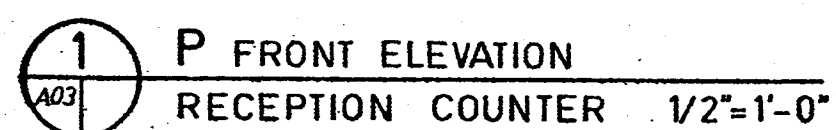
R.C.M.P. COMPLEX

drawing title
MISCELLANEOUS
DETAIL

designed by	conçu par
date	
drawn by	dessiné par
date	
reviewed by	examiné par
date	
approved by	approuvé par
date	
Tender	Soumission
D.P.W. Project Manager	Administrateur de projets M.T.P.
project number	no. du projet
86314	M.T. 7415
drawing no.	dessin no.
A07	



MOORE TAYLOR
ARCHITECTS
PRINCE ALBERT
SASKATCHEWAN



R.C.M.P. COMPLEX	
drawing title	titre du dessin
INTERIOR FINISHING AND CASEWORK	

designed by	conçu par
date	
drawn by	dessiné par
date	
reviewed by	examiné par
date	
approved by	approuvé par
date	
Tender	Soumission
D.P.W. Project Manager	Administrateur de projets M.T.P.
project number	no. du projet
86314	M.T. 7415
drawn no.	dessin no.
A08	



Department of Public Works
Ministère des Travaux publics

WESTERN REGION



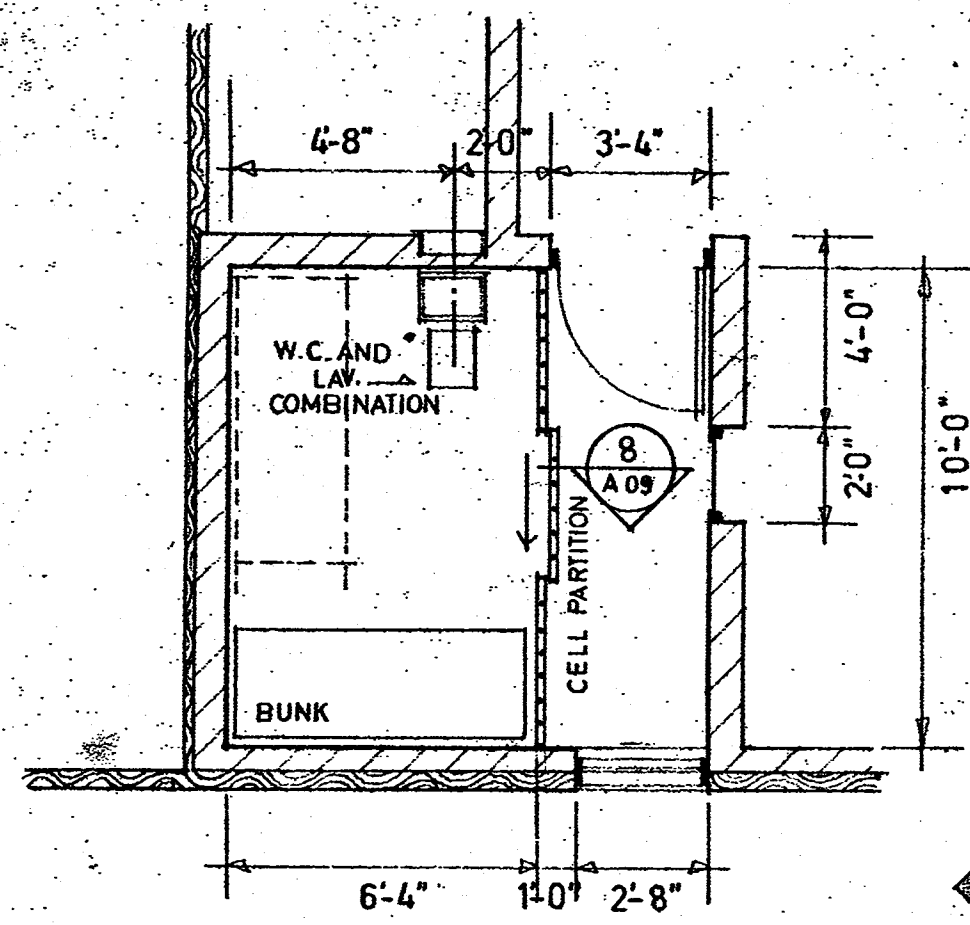
MOORE TAYLOR
ARCHITECTS
PRINCE ALBERT
SASKATCHEWAN

A detail no. détail no.
B location drawing no. sur dessin no.
C drawing no. dessin no.
revisions date

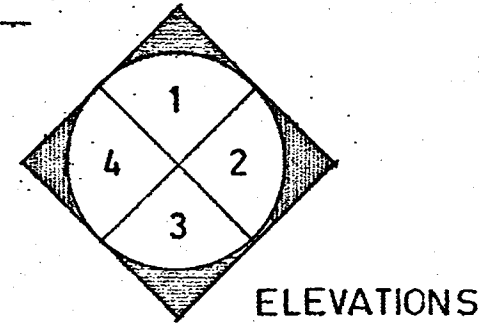
project title titre du projet
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX
drawing title titre du dessin
CELL BLOCK DETAIL

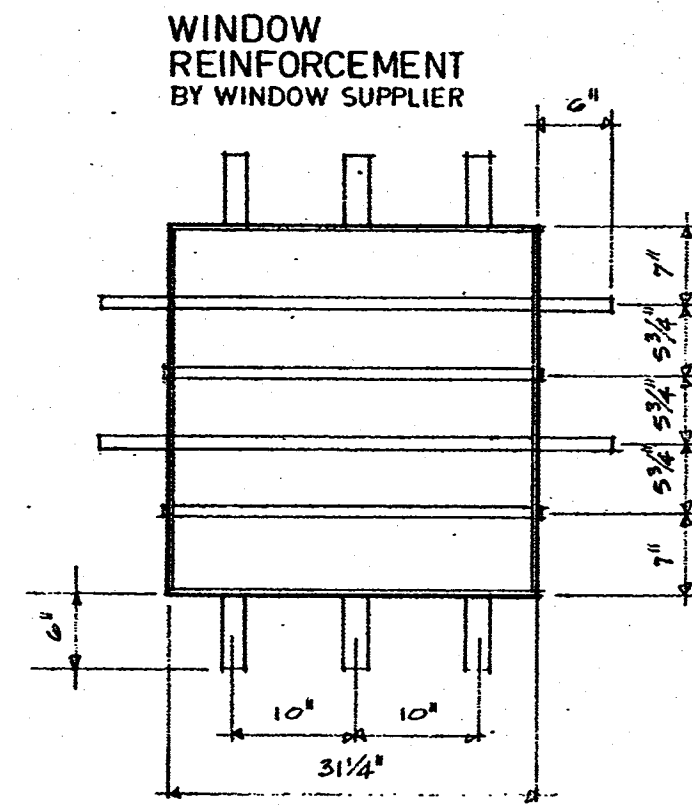
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date
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approved by approuvé par
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Tender Soumission
D.P.W. Project Manager Administrateur de projets M.T.P.
project number no. du projet
86314 M.T. 7415
drawing no. dessin no.
A09



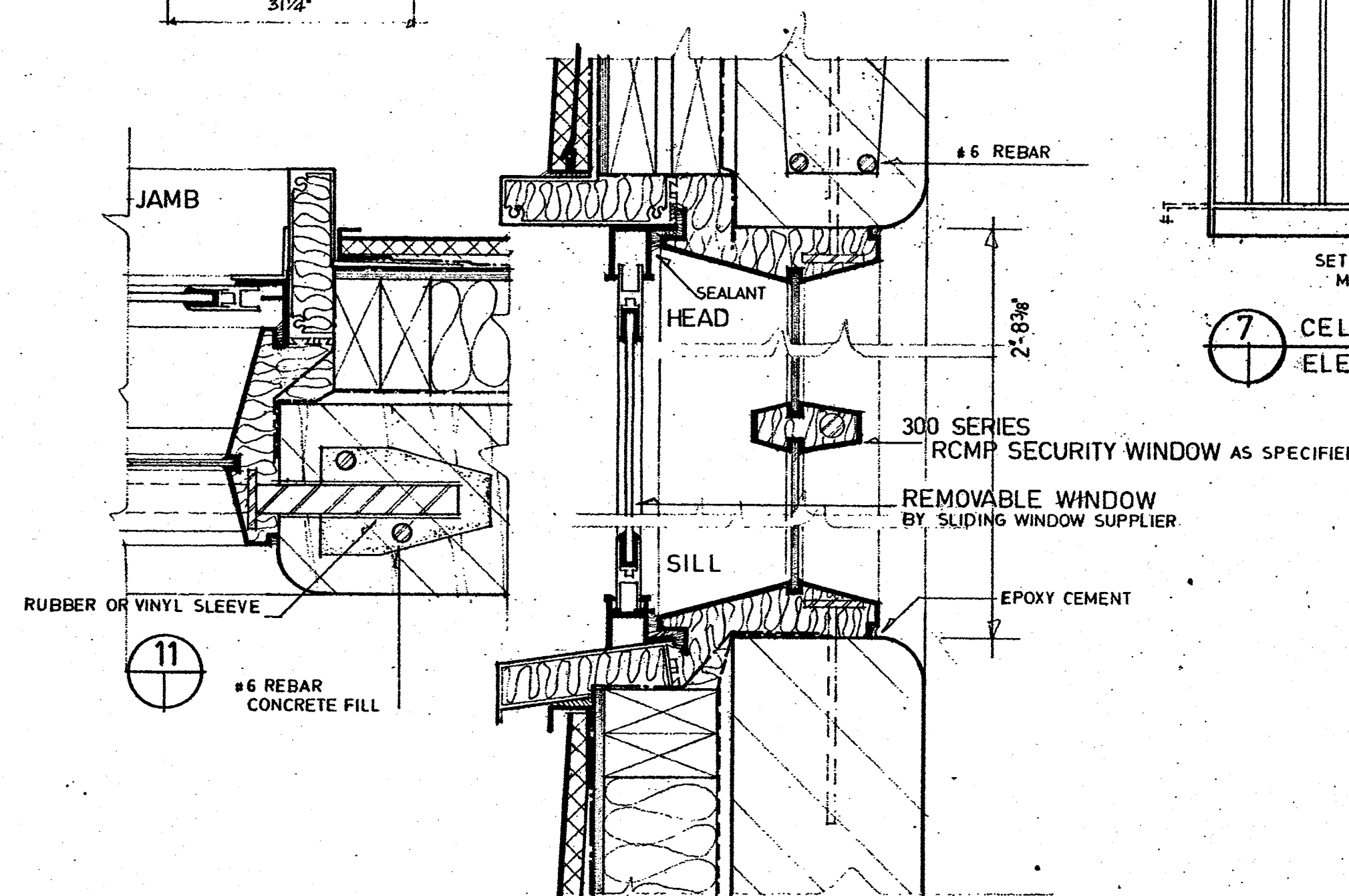
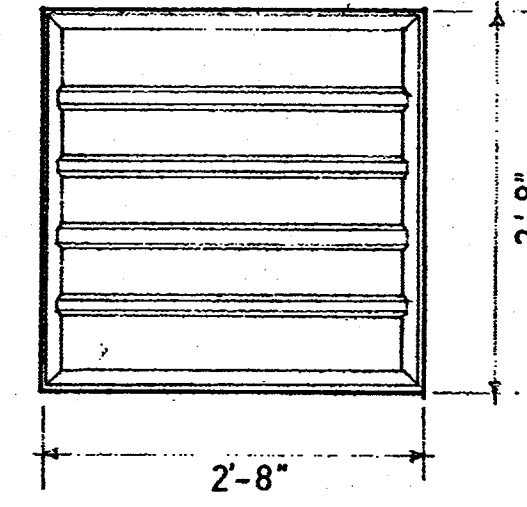
5 TYPICAL CELL PLAN
SCALE 1/4"=1'-0"



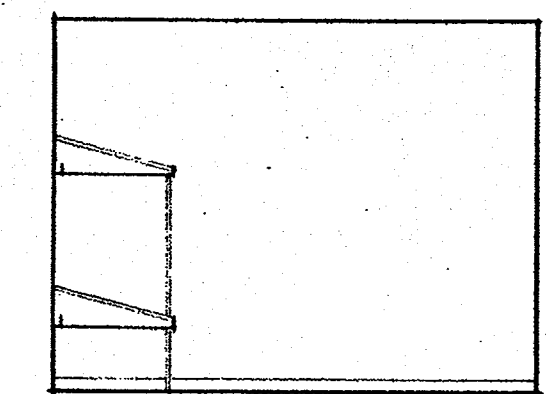
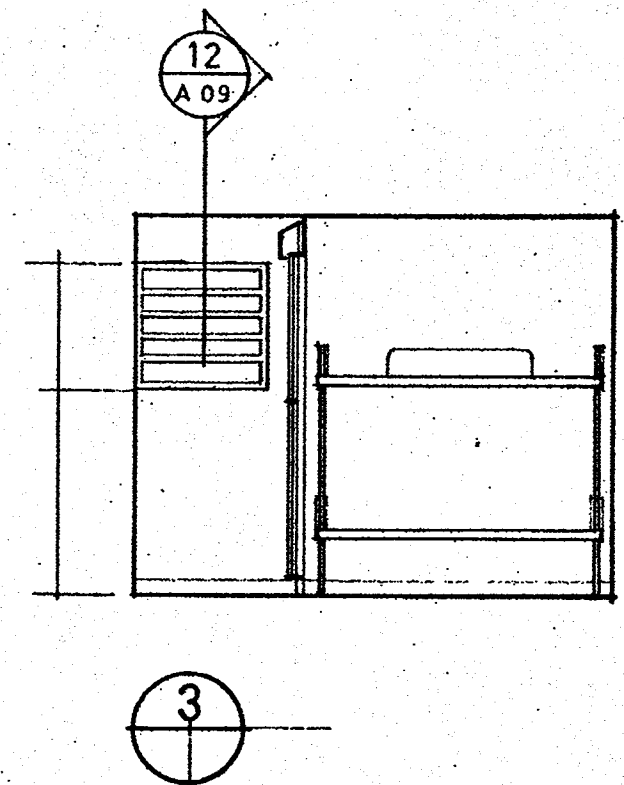
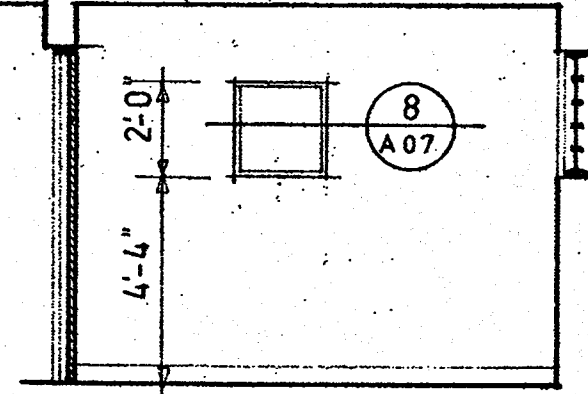
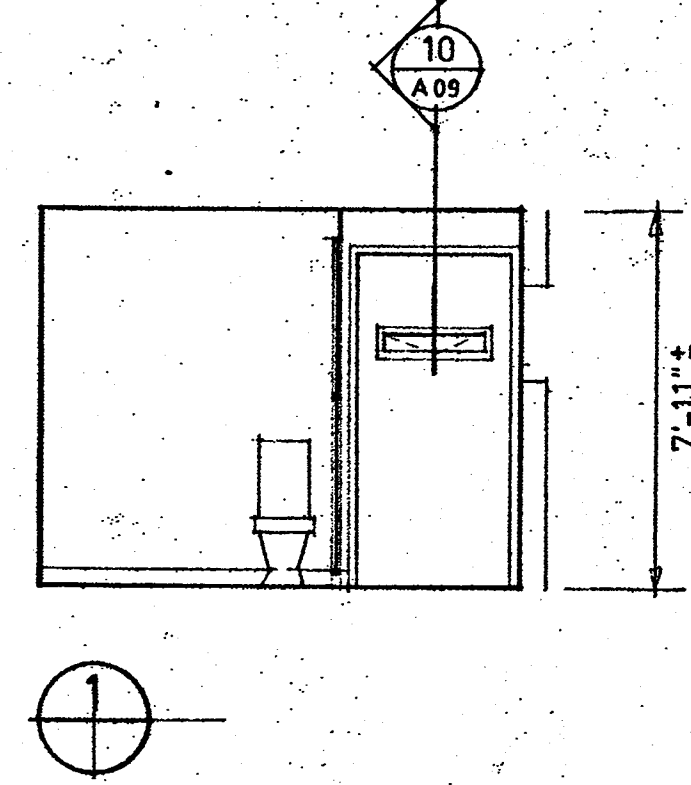
ELEVATIONS



WINDOW
ELEVATION



12 SECURITY WINDOW DETAILS
SCALE 3/4"=1'-0"

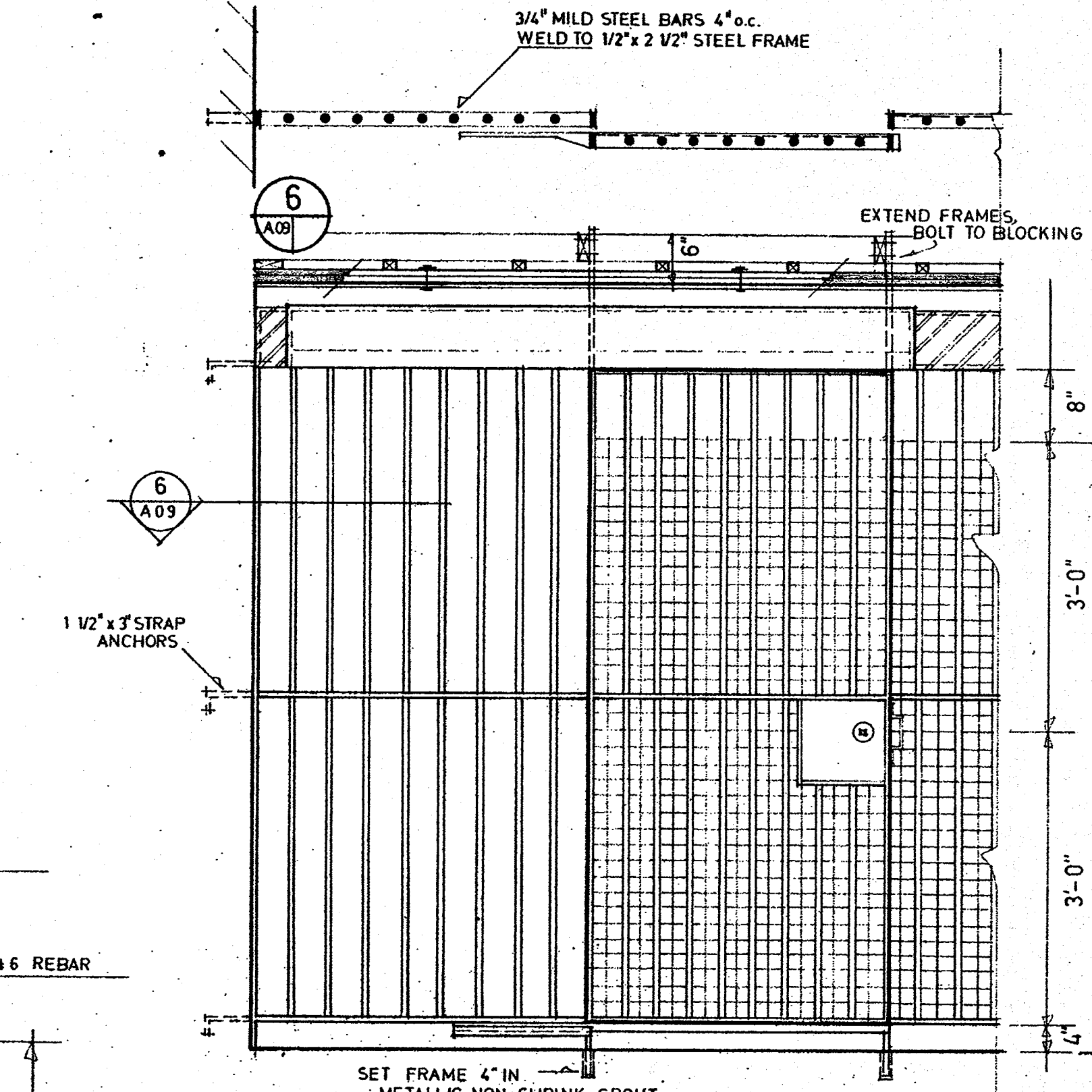


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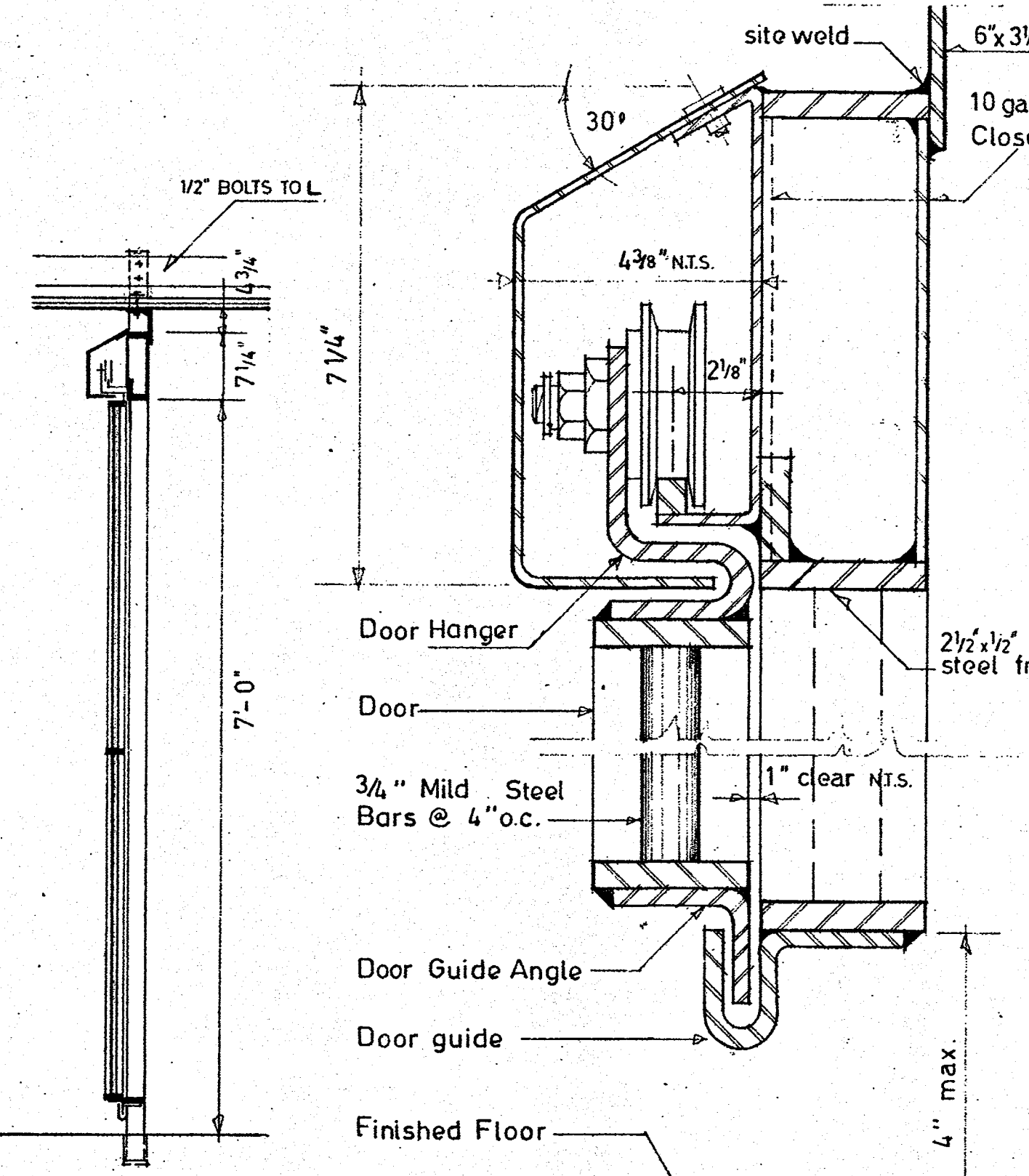
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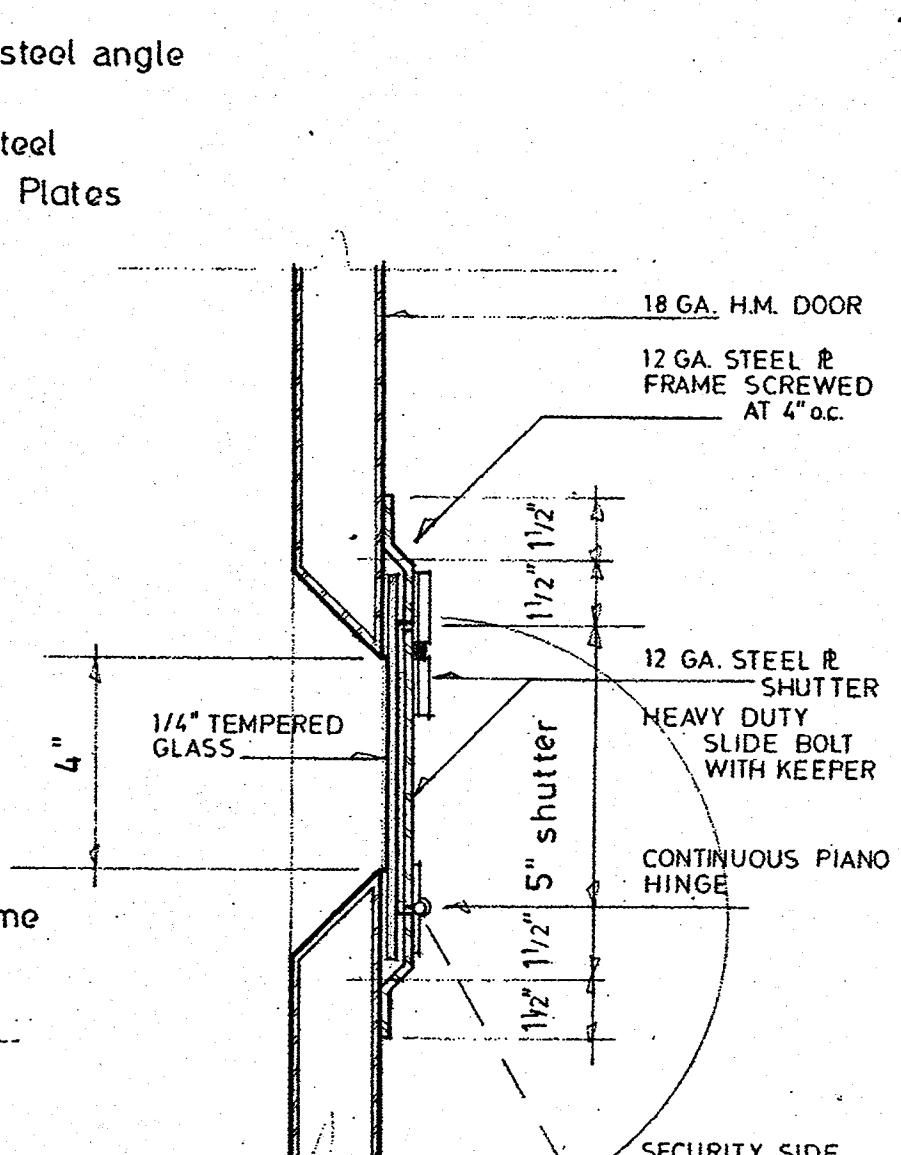
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7 CELL PARTITION
ELEVATION 3/4"=1'-0"

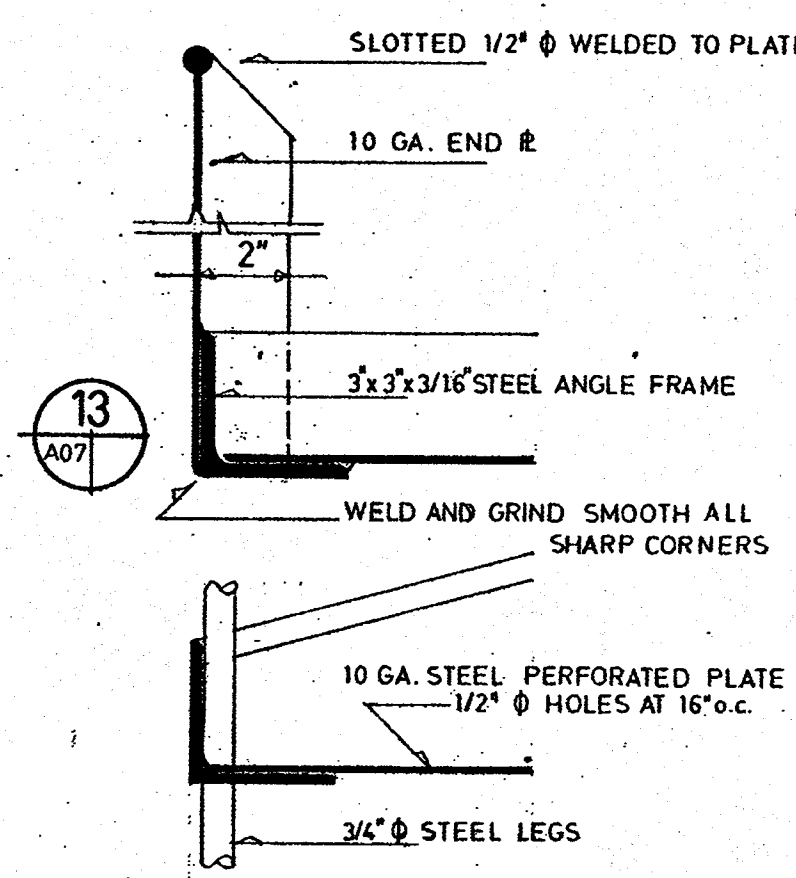


8 DOOR
SECTION

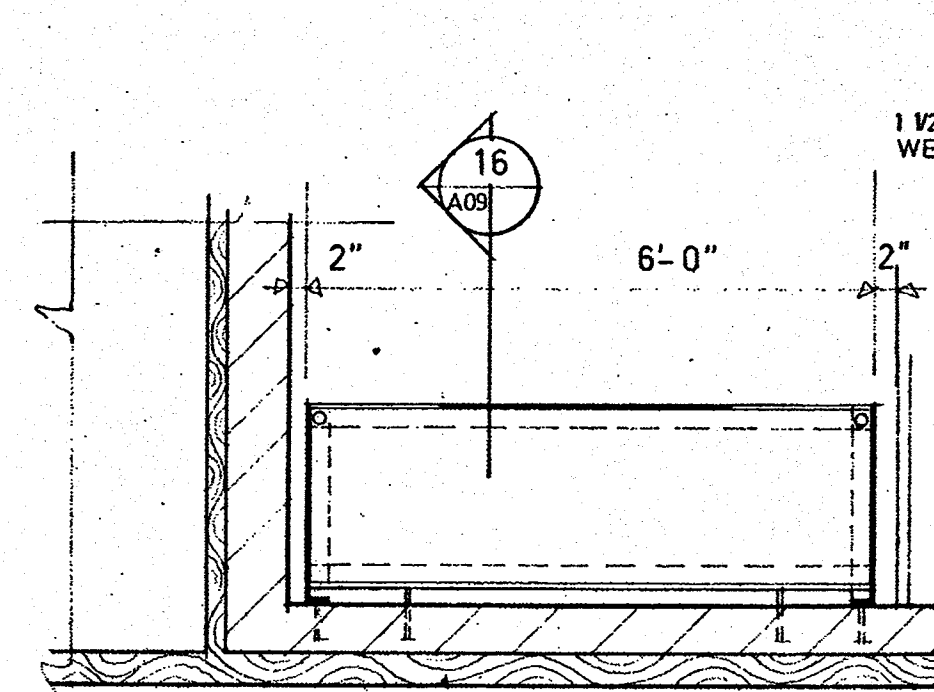


10 SECURITY DOOR
SHUTTER BAFFLE

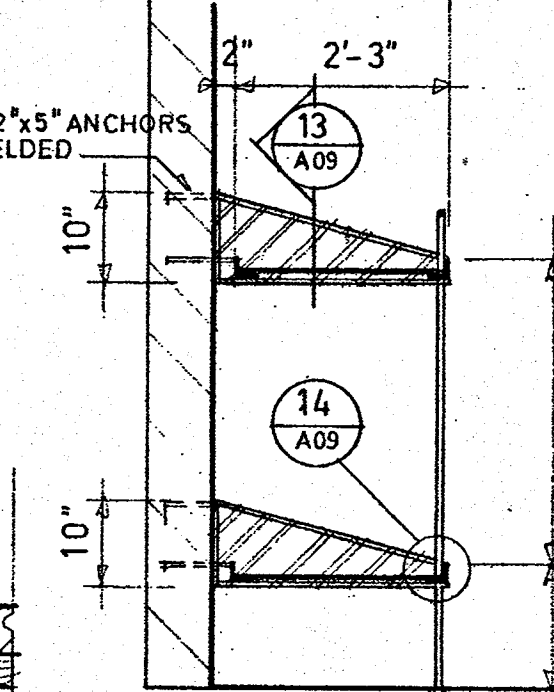
9 CELL DOOR
DETAIL



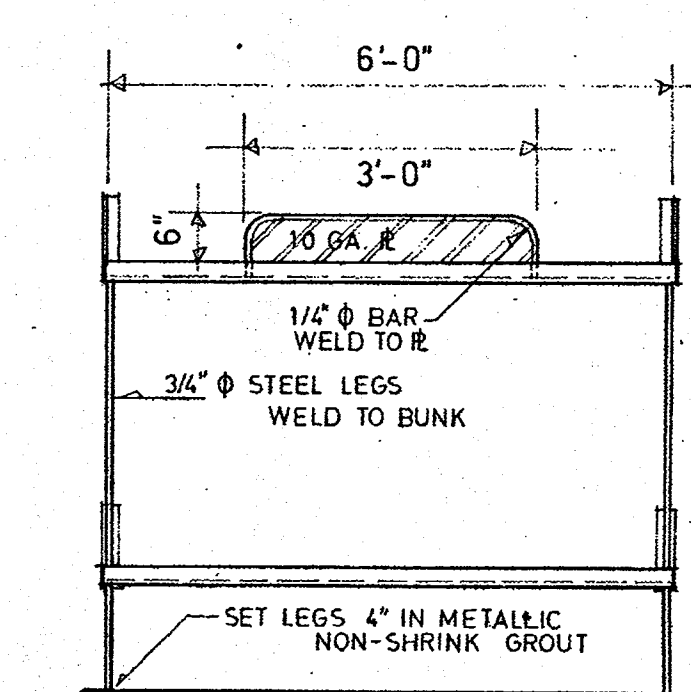
14 BUNK DETAIL
3/4"=1'-0"



15 CELL BUNK
PLAN 1/2"=1'-0"



16 BUNK
SECTION



17 BUNK
ELEVATION



Department of Public Works
Ministère des Travaux publics

WESTERN REGION

MOORE TAYLOR
ARCHITECTS
PRINCE ALBERT
SASKATCHEWAN

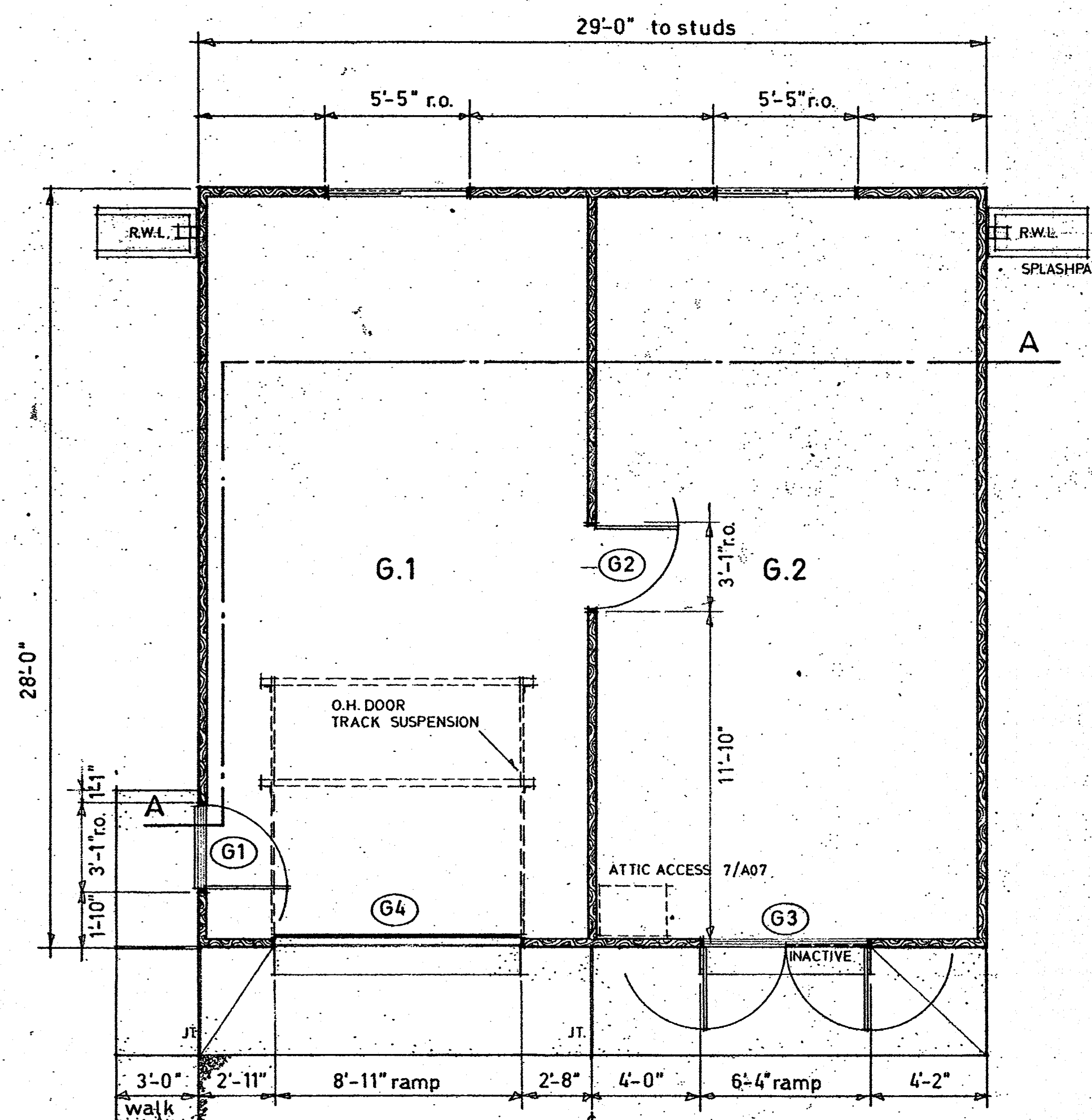
A	detail no.	détail no.
B	location drawing no. sur dessin no.	
C	drawing no.	dessin no.
revisions		date

project title
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

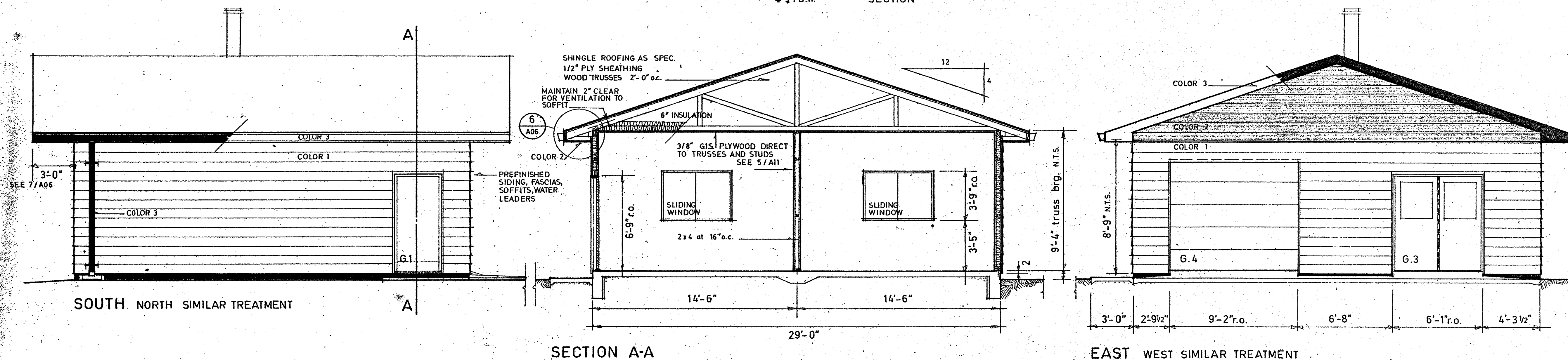
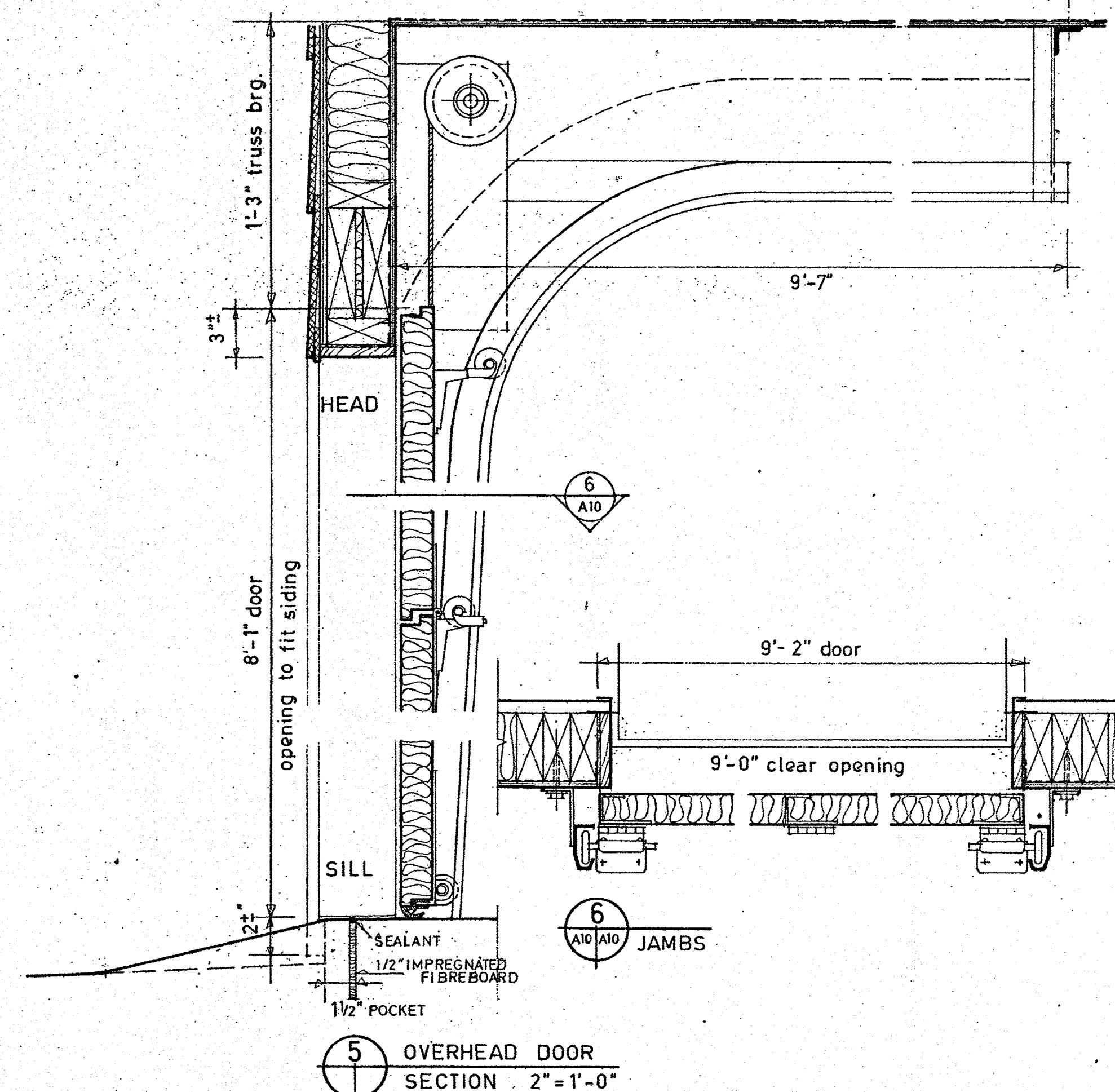
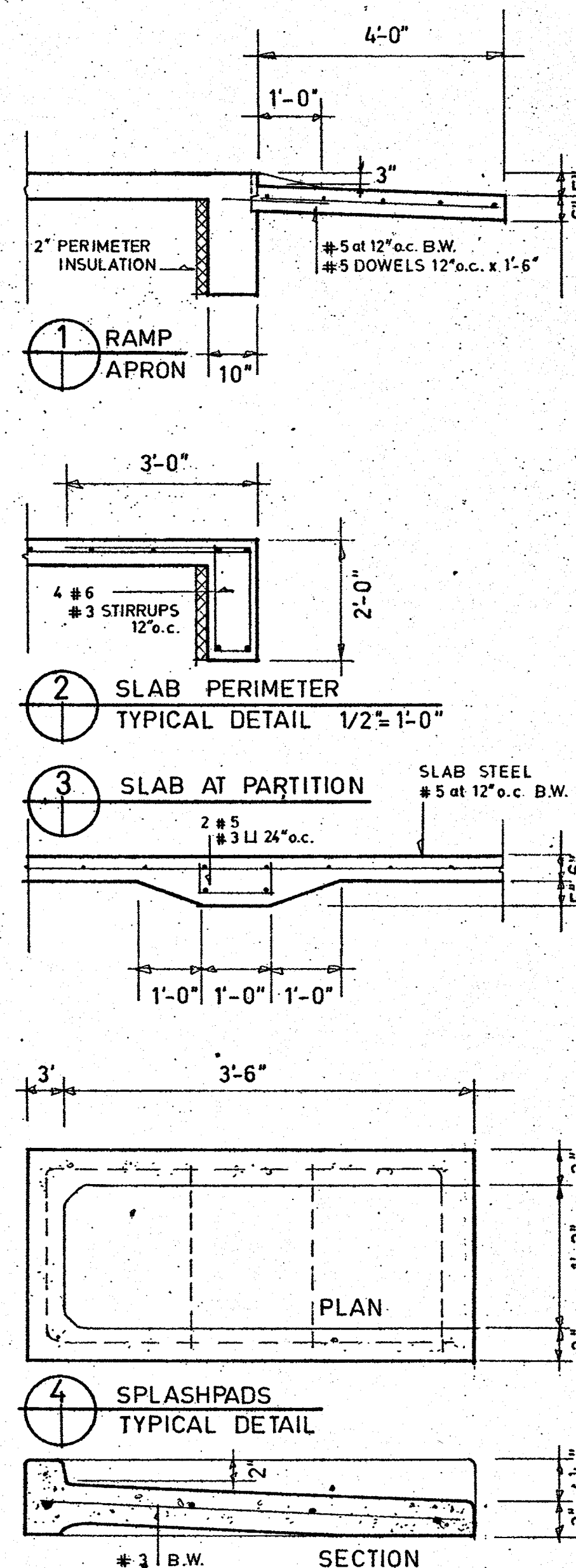
drawing title
GARAGE WORKSHOP
PLAN AND DETAIL
SPLASHPADS

designed by	conçu par
date	
drawn by	dessiné par
date	
reviewed by	examiné par
date	
approved by	approuvé par
date	
Tender	Soumission
D.P.W. Project Manager	Administrateur du projet M.T.P.
project number	no. du projet
86314	M.T. 7415
drawing no.	dessin no.
A10	



PLAN 1/4" = 1'-0"
note: dimensions are to stud faces

0 5 10
1/4" = 1'-0"



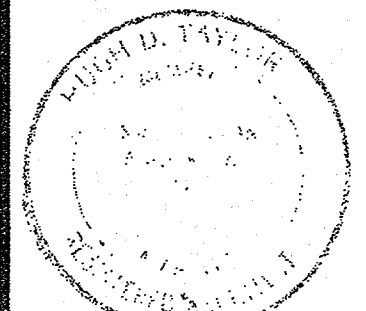
FINISH SCHEDULE

	NO. ROOM DESCRIPTION	WALLS						CEILING						FLOOR						BASE				REMARKS
		MATERIAL	FINISH	MATERIAL	FINISH	HEIGHT		MATERIAL	FINISH					MATERIAL	FINISH									
ADMINISTRATION	101 RECEPTION	D		V				A		F				W		S				C				* sound rated walls to be (B) STC 50 between administration & living quarters (C) washroom plumbing walls • staggered studs (D) washroom walls • insulate (E) STC 50 between administration & cell block
	102 INTERVIEW	D		V				A	D	F		*		W		S		C		C				
	103 GENERAL OFFICE	D		V				A		F				W		S				C				
	104 N.C.O. OFFICE	D		V				A		F				W		S				C				
	105 STORAGE	D						A	D	F		L		W		S				C				
	106 ENTRY HALL	D		V				A		F				W		S				C				
	107 WASHROOM	D		V				A	D	F		L		W		S				C				
	108 WASHROOM	D		V				A	D	F		L		W		S				C				
	109 CORRIDOR	D		V				A		F				W		S				C				
	110 SERVICE ROOM	D						A	D	F		L		W		S				C				
CELL BLOCK	111 PROVOST AREA	C						P						C		E				S				
	112 MATRON	C						P						C		E				S				
	113 CELL ANTEROOM	C						P						C		E				S				
	114 CELL ANTEROOM	C						P						C		E				S				
	115 CELL ANTEROOM	C						P						C		E				S				
	116 CELL ANTEROOM	C						P						C		E				S				
	117 CELL	C						P						C		E				S				
	118 CELL	C						P						C		E				S				
	119 CELL	C						P						C		E				S				
	120 CELL	C						P						C		E				S				
QUARTERS	121 HOLDING TANK	C						P						C		E				S				
	122 MALE SHOWER	C						P						C		E				S				
	123 FEMALE SHOWER	C						P						C		E				S				
	124 HALL	D						D				L	T	W		S				C				
	125 BEDROOM	D						D				L	T	W		S				C				
	126 BATHROOM	D						D				L	T	W		S				C				
	127 BEDROOM	D						D				L	T	W		S				C				
	128 HALL	D						D				L	T	W		S				C				
	129 LIVING ROOM	D						D				L	T	W		S				C				
	130 KITCHEN	D						D				L	T	W		S				C				
BASEMENT	B1 STAIRWAY	D	X						X		E	L	T	W				V		P				
	B2 STORAGE ROOM	D		C					X		S			C						W				
	B3 MECHANICAL ROOM		X	C					X		S			C						W				
	B4 EXHIBIT STORAGE			C	M			P	X		S			C		S				W				
	B5 EXHIBIT STORAGE			C	M			P	X		S			C		S				W				
	B6 LAUNDRY	D		C					X		L	T		C		S				C				
	B7 HALL	D							X		L	T		C		S				C				
GARAGE	G1 GARAGE		P						P		S			C						W				
	G2 WORKSHOP		P						P		S			C						W				



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WESTERN REGION



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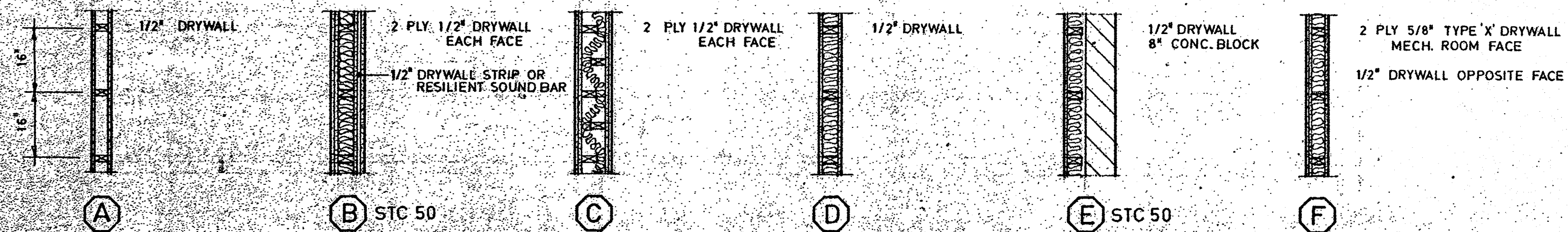
A detail no. détail no.
B location drawing no. sur dessin no.
C drawing no. dessin no.
revisions date

project title titre du projet
STONY RAPIDS
SASKATCHEWAN

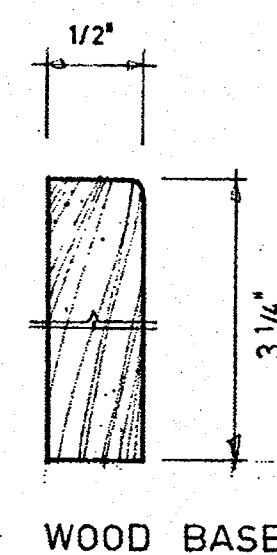
R.C.M.P. COMPLEX

drawing title titre du dessin
FINISH SCHEDULE

designed by conçu par
date
drawn by dessiné par
date
reviewed by examiné par
date
approved by approuvé par
date
Tender Soumission
D.P.W. Project Manager Administrateur de projets M.T.P.
project number no. du projet
86314 M.T. 7415
drawing no. dessin no.
A11



PARTITIONS



[illegible]

S.C.-SOLID CORE
H.C.-HOLLOW CORE
H.M.-HOLLOW METAL
P.S.F.-PRESSED STEEL FRAME
B.-BIRCH
S.F.-10 GA. STEEL FACE, 5 SCREWS 12" o.c.
S.T.-STEEL
DET.-TO DETAIL
PT.-PAINT
F.F.-FACTORY FINISH
S.M.-SECTIONAL METAL (SEE SPECIFICATIONS)
V.S.-VISION SHUTTER ON PROVOST SIDE AND ON MATRON SIDE, ONE SIDE ONLY
T.G.-1/4" TEMPERED GLASS
A.T.-ACOUSTIC TRIM
I.N.S.-INSULATED
W.D.-WOOD
F.T.-FACTORY TRIM
AL.-ANODIZED ALUMINUM
G.W.P.-GEORGIAN WIRE PLATE
SPEC.-AS SPECIFIED
ALL FASTENINGS EXCEPT SPECIAL SECURITY HDWE TO BE ALLEN HEAD


FINISH	NAME	NUMBER	REMARKS
	FOLGER	15	WINDOW GRILLES AS DETAIL
	FOLGER	66 K	
	FOLGER	32 D	
	FOLGER	82	KEY PROVOST SIDE ONLY
	FOLGER	62 K	NO KNOB ON INTERIOR OF 21
C26D	FOLGER	4 1/2	
C26D	SPEC.	FBB179	
C26D	SPEC.	FBB179	N.R.P.
C26D	SPEC.	FBB191	N.R.P. ON DOOR 34 ONLY
C26D	SPEC.	14-7826	
C26D	SPEC.	14-7825	
C26D	SPEC.	7813	
C26D	SPEC.	14-7825	DELETE INTERIOR LOCK FUNCTION
C26D	SPEC.	7765	
C26D	SPEC.	7737	
C26D	SPEC.	7715	
EN	SPEC.		
C26D	SPEC.	3430	CONCAVE-CONCEALED MOUNT
C26D	SPEC.	3380/3374	
C26	SPEC.	1200	
C32D	SPEC.	3816	8" MOUNT ON PUSH SIDE
C26D	SPEC.	3470/1010	12" CAME BOLT ON INACTIVE LEAF-C26 FINISH



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	A detail no.	détail no.
	B location drawing no.	sur dessin no.
	C drawing no.	dessin no.
revision no.		date

project title	titre du projet
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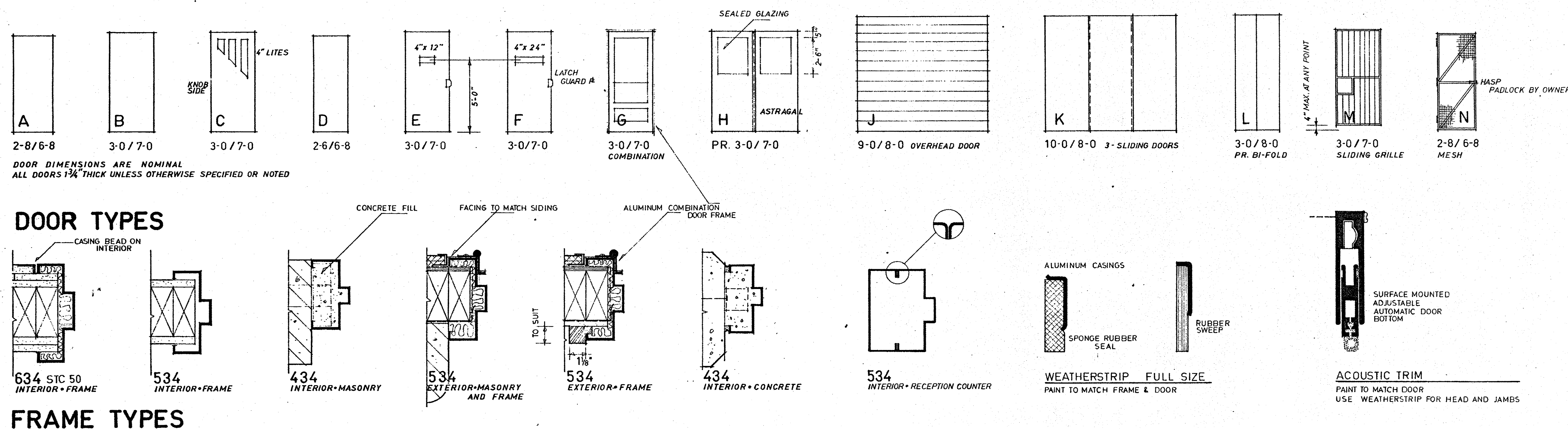
STONY RAPIDS
SASKATCHEWAN

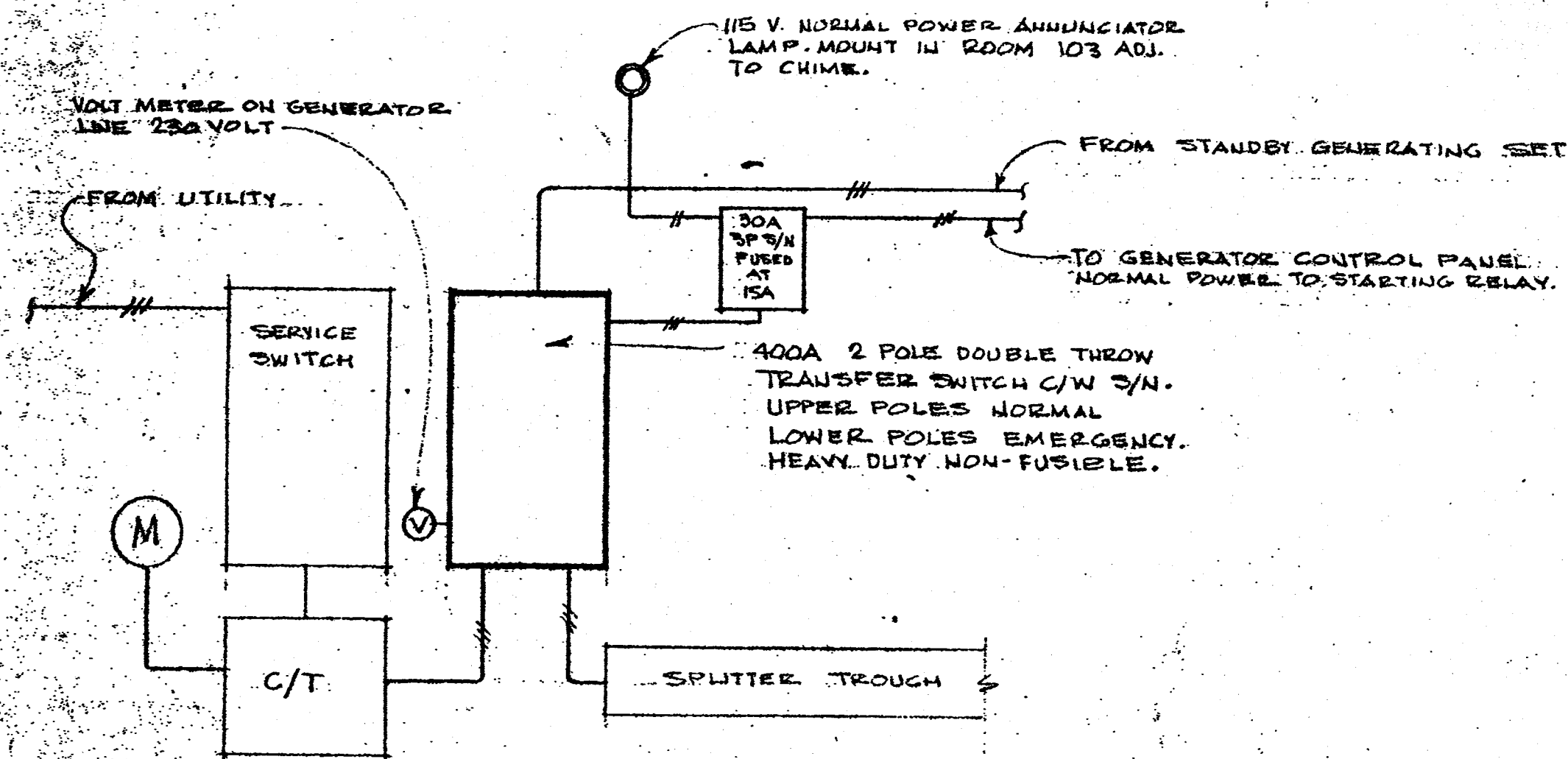
R.C.M.P. COMPLEX

drawing title	titre du dessin
DOOR & HARDWARE SCHEDULE	

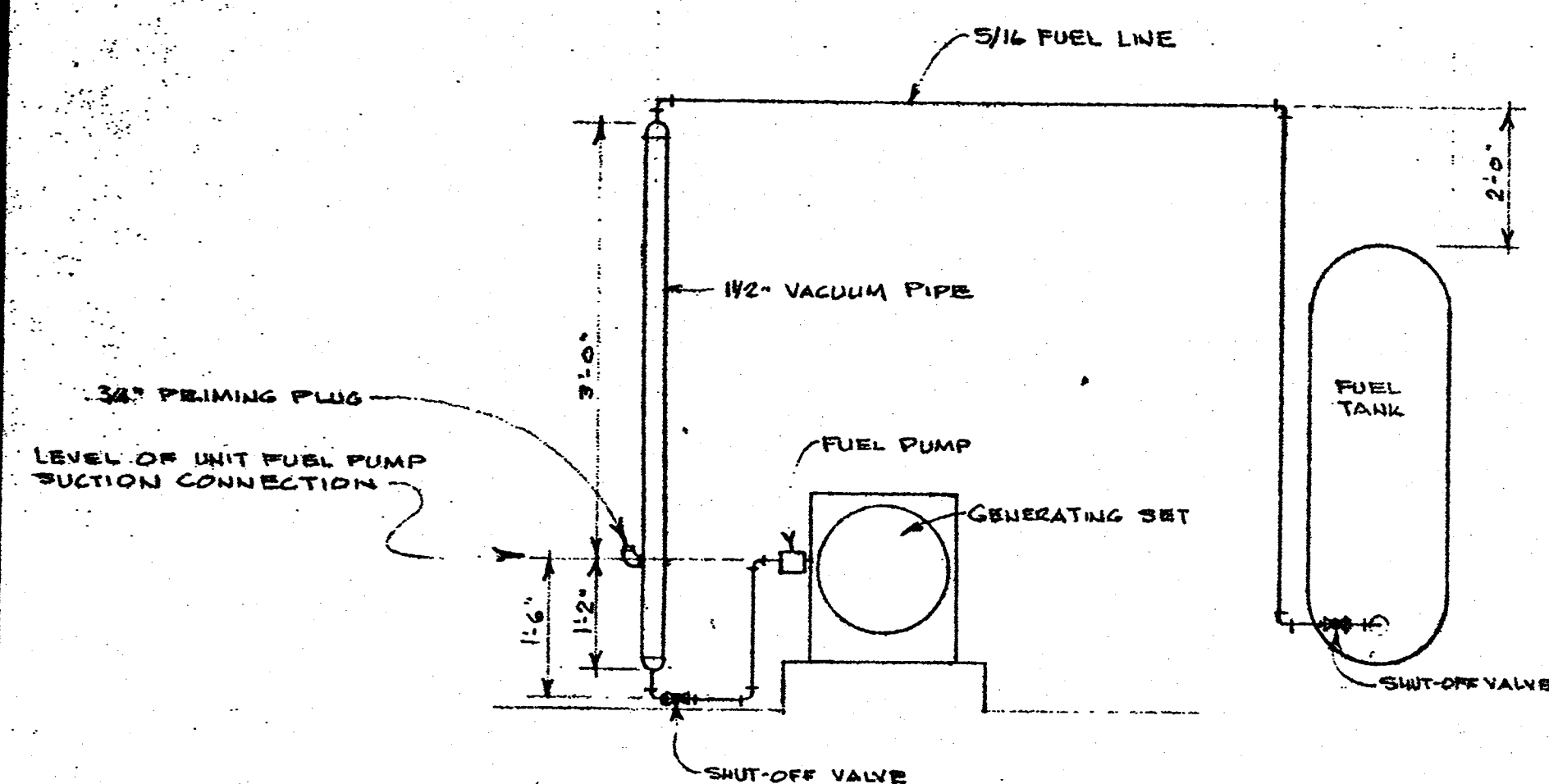
designed by	conçu par
date	
drawn by	dessiné par
date	
reviewed by	examiné par
date	
approved by	approuvé par
date	
Tender	Soumission
D.P.W. Project Manager	Administrateur de projets M.T.P.
project number	no. du projet
86314	M.T. 7415
drawing no.	dessin no.

A12

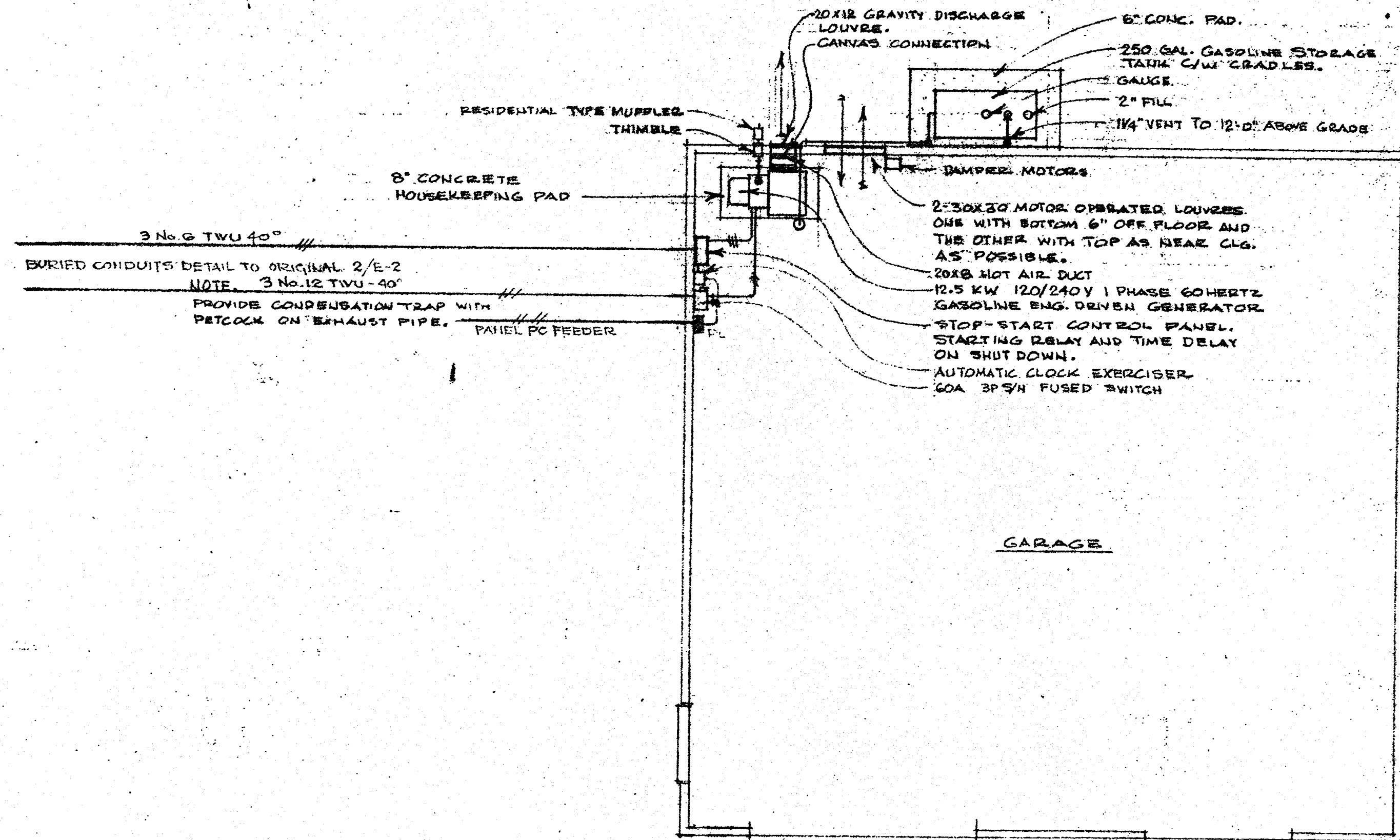




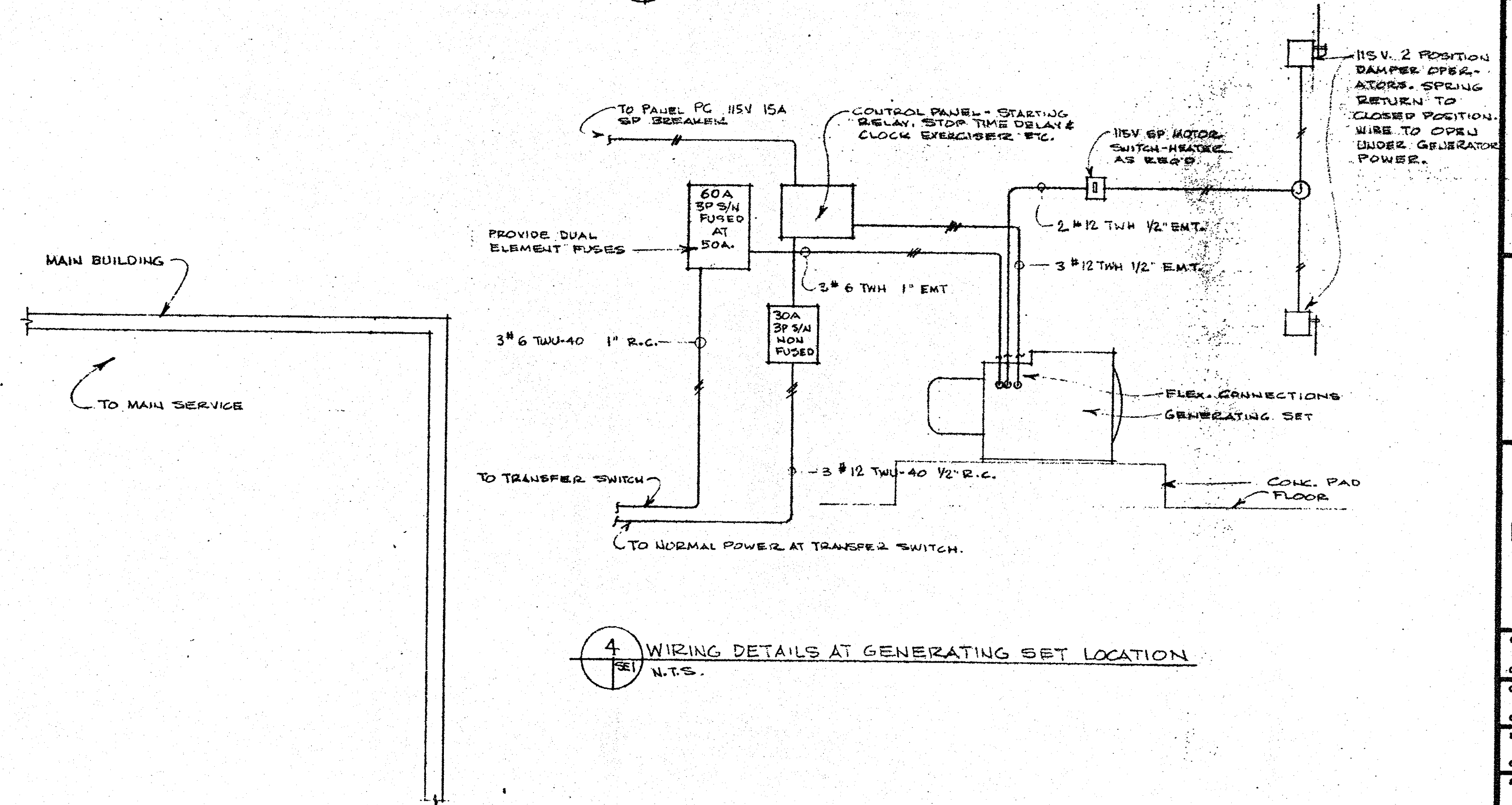
1
SE1
N.T.S.
DETAIL AT MAIN SERVICE



2
SE1
N.T.S.
FUEL CONNECTIONS



3
SE1
SCALE: 1/4" = 1'-0"
GARAGE PLAN



4
SE1
N.T.S.
WIRING DETAILS AT GENERATING SET LOCATION

AS BUILT



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SELMEC ENGINEERING LTD
PRINCE ALBERT SASK

A detail no. détail no.
B location drawing no. sur dessin no.
C drawing no. dessin no.
revisions: date

project title titre du projet
STONY RAPIDS
SASKATCHEWAN

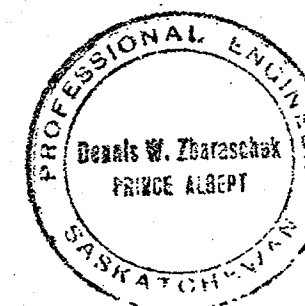
R.C.M.P. COMPLEX
drawing title titre du dessin
STANDBY POWER
PLANT INSTALLATION
DETAILS

designed by R.E. conçu par
date
drawn by R.E. dessiné par
date SEPT 30, 1974
reviewed by examiné par
date
approved by approuvé par
date
Tender Soumission
D.P.W. Project Manager Administrateur de projets M.T.P.
project number no. du projet
86314 100-74-15
drawing no. dessin no.
SE1



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SELMEC ENGINEERING LTD.
PRINCE ALBERT, SASK.

A detail no. détail no.

A
B/C B location drawing no. sur dessin no.

C drawing no. dessin no.

revisions date

project title titre du projet

STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

drawing title titre du dessin

MECHANICAL
BASEMENT DUCT REVISION

designed by conçu par

date

drawn by H.M. dessiné par

date OCT. 17/74

reviewed by examiné par

date

approved by approuvé par

date

Tender Soumission

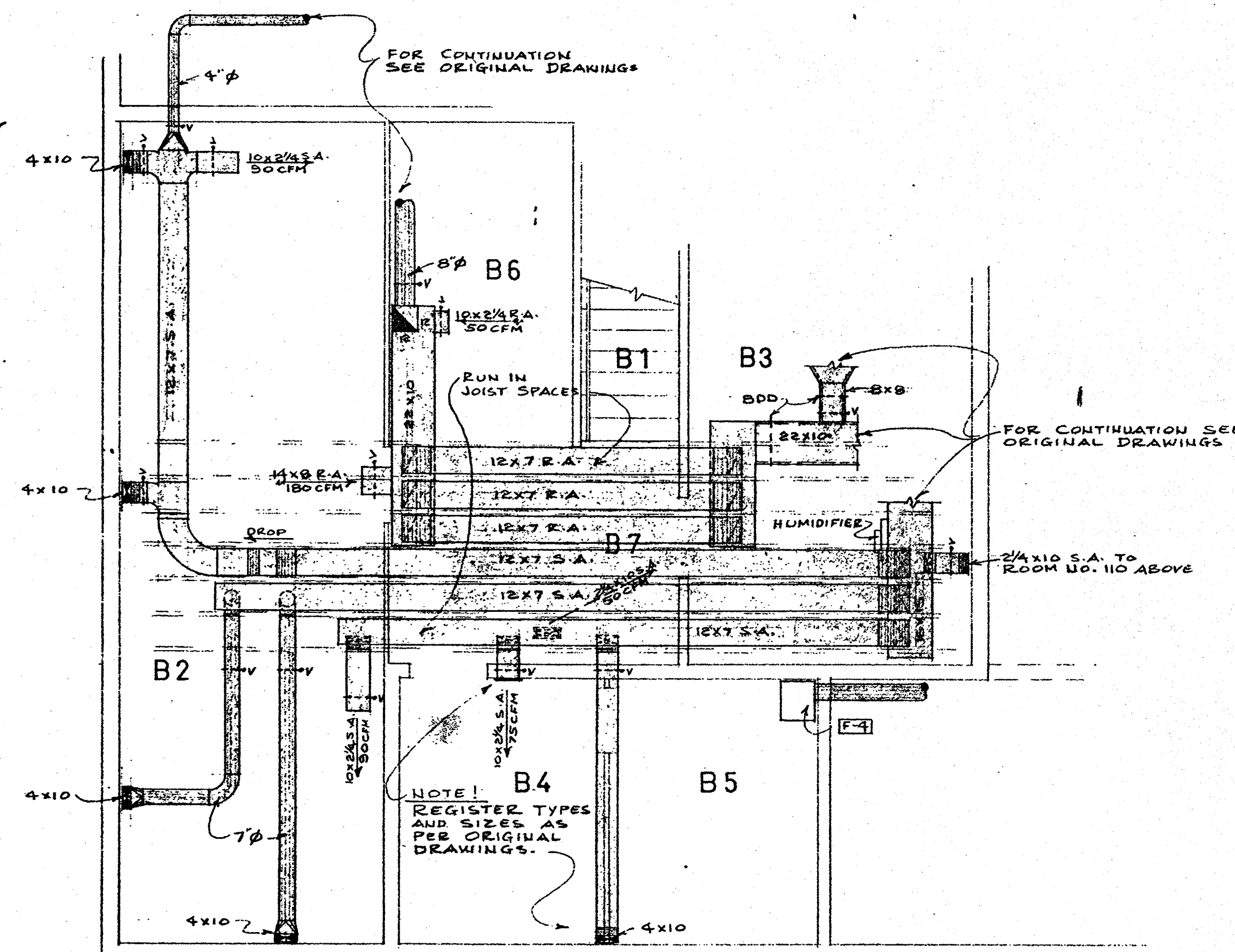
D.P.W. Project Manager Administrateur de projets M.T.P.

project number no. du projet

86314 100-7415

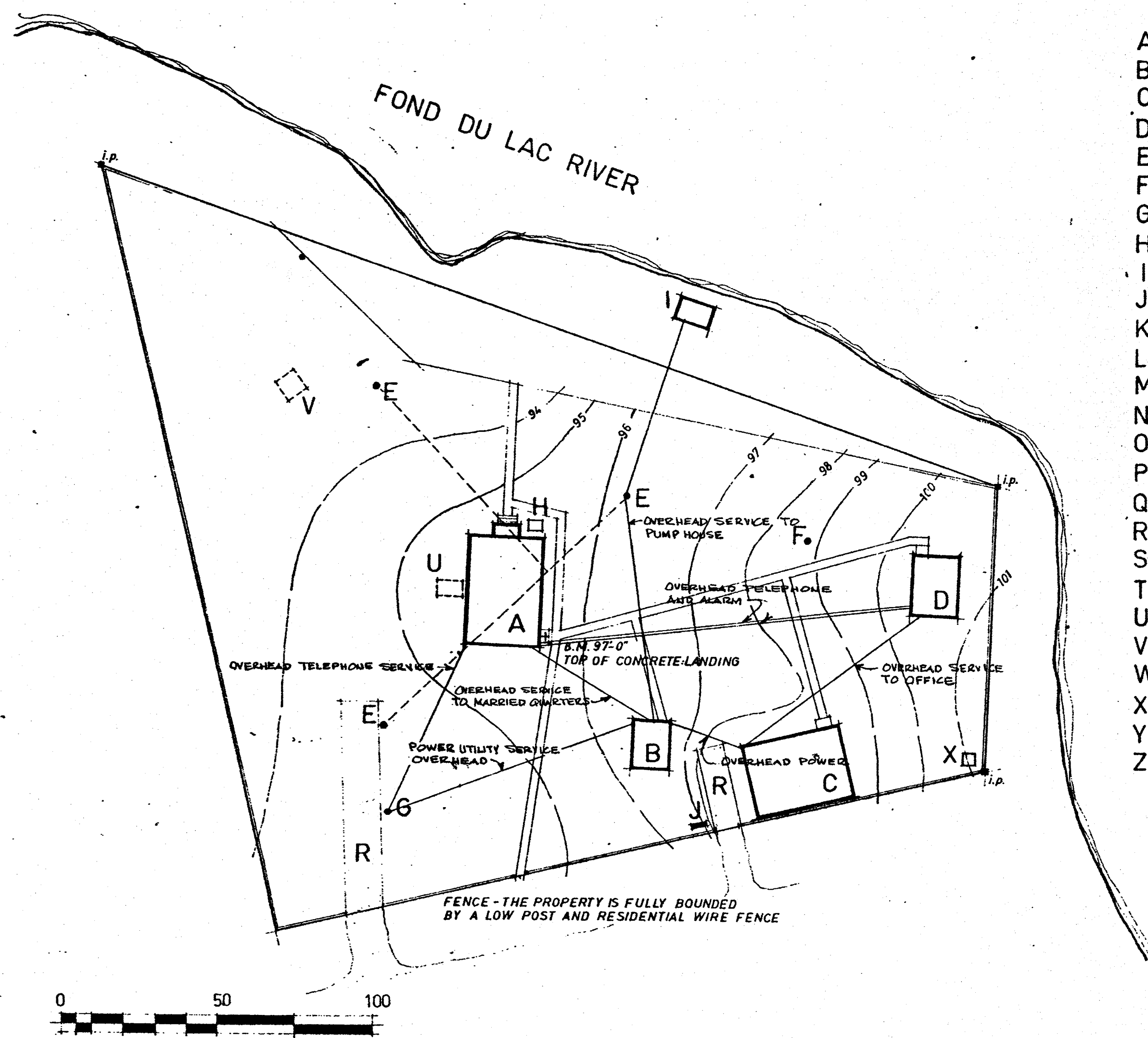
drawing no. dessin no.

MS 1



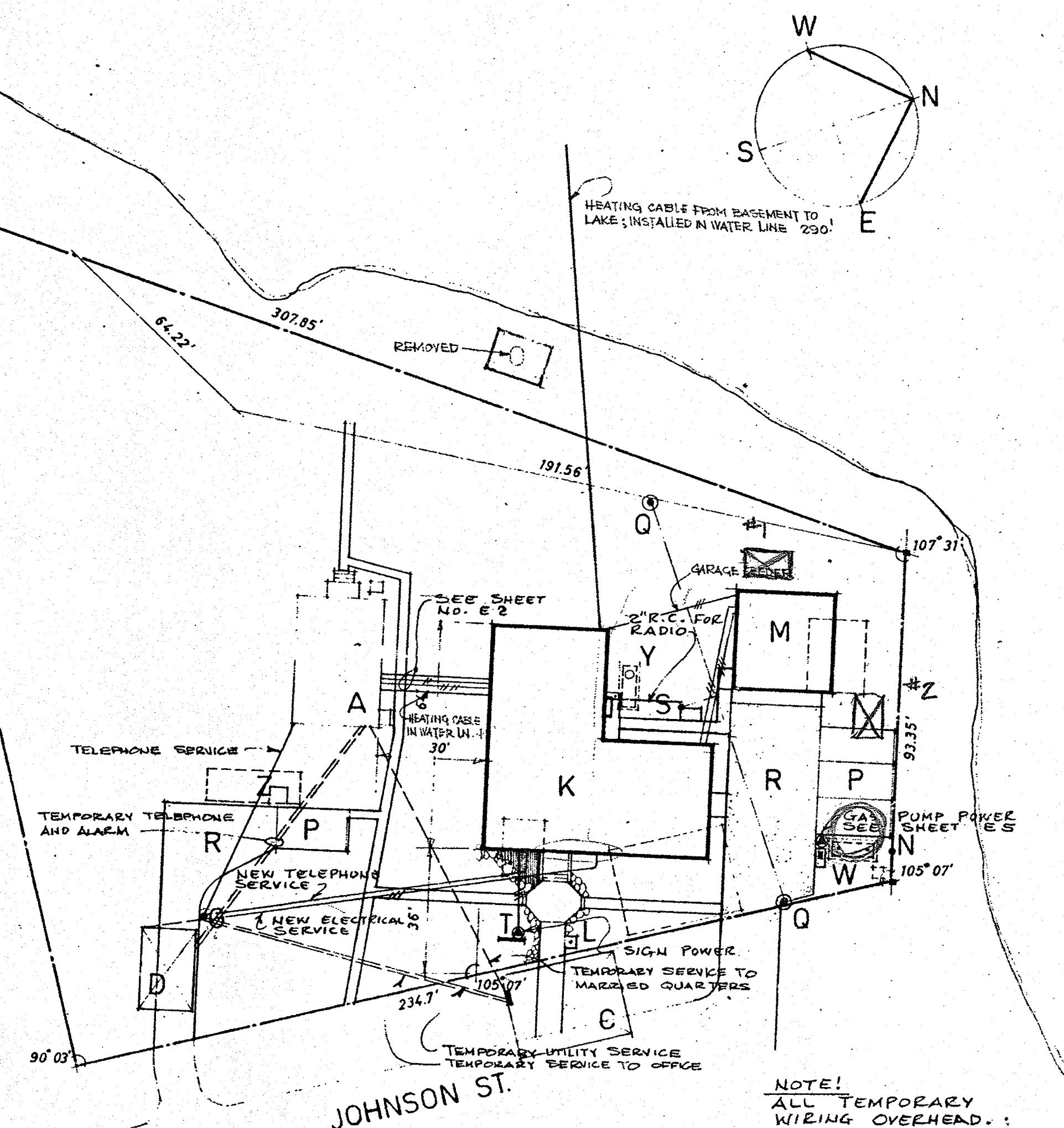
1 PARTIAL BASEMENT FLOOR PLAN - REVISED DUCTWORK
SCALE: 1/4"=1'-0"

AS BUILT



SITE PLAN 1" = 30'-0" EXISTING

- A MARRIED QUARTERS
- B POWERHOUSE / RELOCATE
- C GARAGE WORKSHOP / RELOCATE TEMPORARILY
- D OFFICE / RELOCATE TEMPORARILY
- E RADIO POLES / REMOVE
- F FLAGPOLE / REMOVE
- G POWER POLE
- H WELL
- I PUMP HOUSE / REMOVE
- J GAS TANK / RELOCATE
- K NEW DETACHMENT BUILDING
- L NEW FLAGPOLE
- M NEW GARAGE WORKSHOP
- N NEW GAS TANK 12' VENT POLE
- O NEW LOCATION OF 'B'
- P NEW PARKING SLABS
- Q NEW ANTENNAE SYSTEM
- R GRAVEL DRIVEWAYS
- S NEW GARBAGE STAND
- T SIGN BY R.C.M.P.
- U EXISTING SEPTIC TANK / DEMOLISH & FILL
- V EXISTING SEEPAGE PIT / DEMOLISH & FILL
- W NEW GAS PUMP, SLAB, & U.G. TANK
- X EXISTING PRIVY / DEMOLISH & FILL
- Y NEW U.G. OIL TANK
- Z NEW U.G. PUMP OUT TANK



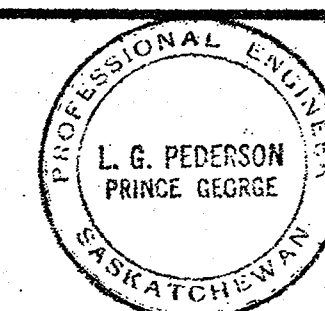
SITE DEVELOPMENT THIS CONTRACT

AS BUILT



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Ministère des Travaux publics

WESTERN REGION



SELVED ENGINEERING LTD.
PRINCE ALBERT, SASK.

A detail no.	detail no.
B location drawing no. sur dessin no.	
C drawing no.	dessin no.
revisions	date

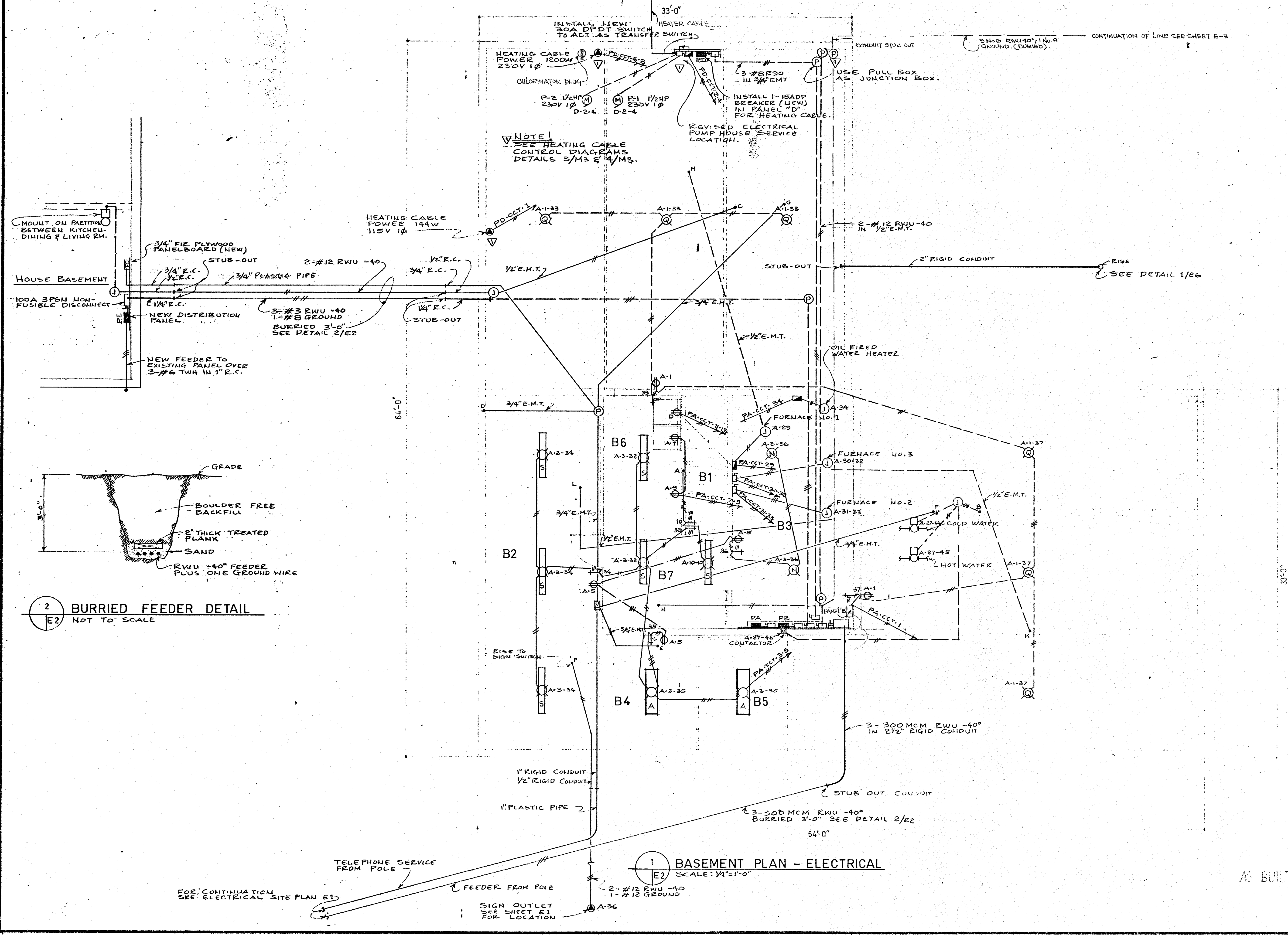
AS BUILT

project title
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

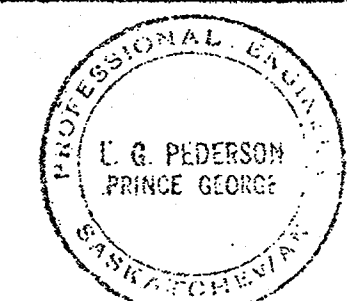
drawing title
SITE DEVELOPMENT
ELECTRICAL

designed by	conçu par
date	
drawn by H.M.	dessiné par
date APRIL 1974	
reviewed by	examiné par
date	
approved by	approuvé par
date	
Tender	Soumission
D.P.W. Project Manager	Administrateur de projets M.T.P.
project number 86314	no. du projet 100-7415
drawing no. E 1	dessin no.



Department of Public Works
Ministère des Travaux publics

WESTERN REGION



SELMEC ENGINEERING LTD.
PRINCE ALBERT, SASK.

A detail no.	détail no.
B location drawing no.	sur dessin no.
C drawing no.	dessin no.
revisions	date
1	REVISED POWER TO DOMESTIC WATER SYSTEM. ADDED HEATING CABLE WIRING. JULY 23/75
	H.M.

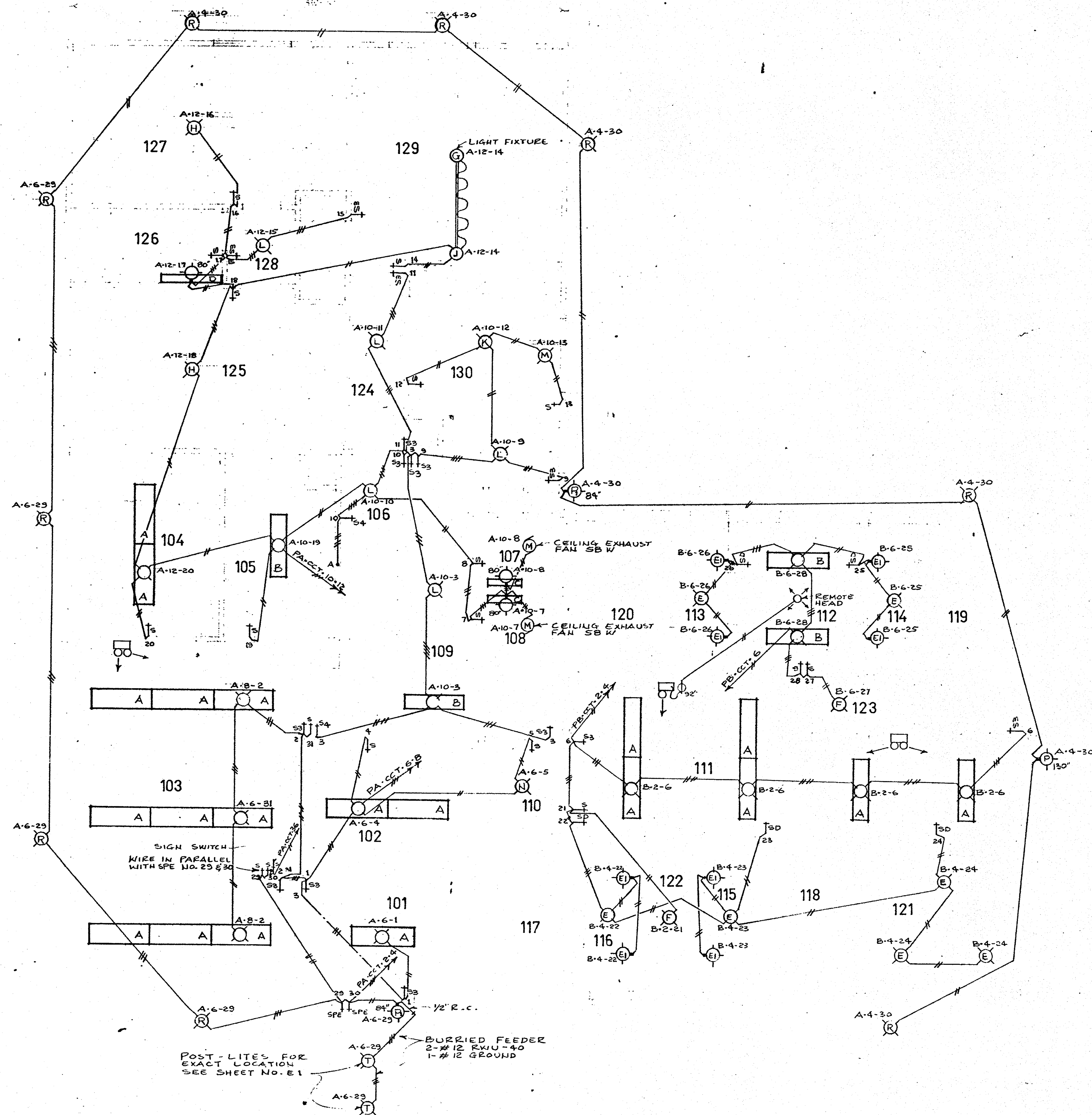
AS BUILT

STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

ELECTRICAL
BASEMENT PLAN

designed by	conçu par
date	
drawn by	H.M.
date	APRIL 1974
reviewed by	
date	
approved by	
date	
Tender	Submission
D.P.W. Project Manager	Administrateur du projet M.T.P.
project number	86314
	100-7415
drawing no.	E 2

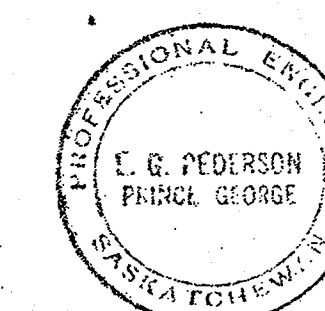


1 MAIN FLOOR PLAN - LIGHTING
E3 SCALE: 1/4" = 1'-0"



Department of Public Works
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WESTERN REGION



SELMEC ENGINEERING LTD.
PRINCE ALBERT, SASK.

A detail no. detail no.
B location drawing no. sur dessin no.
C drawing no. dessin no.
date

AS BUILT

project title titre du projet
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

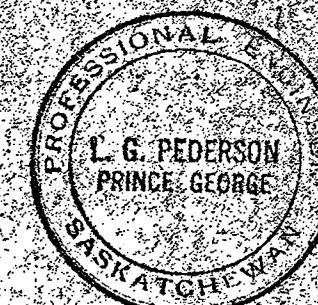
drawing title titre du dessin
ELECTRICAL
MAIN FLOOR PLAN - LIGHTING

designed by conçu par
date
drawn by H.M. dessiné par
date APRIL 1974
reviewed by examiné par
date
approved by approuvé par
date
Inspector Inspecteur
DPW Project Manager Administrateur du projet M.T.P.
project number no du projet
86314 100-7415
drawing no. dessin no.
E3



Department of Public Works
Ministère des Travaux publics

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SELMEC ENGINEERING LTD.
PRINCE ALBERT, SASK.

A detail no. _____ detail no. _____
B location drawing no. _____ not design no. _____
C drawing no. _____ design no. _____
revisions _____ date _____

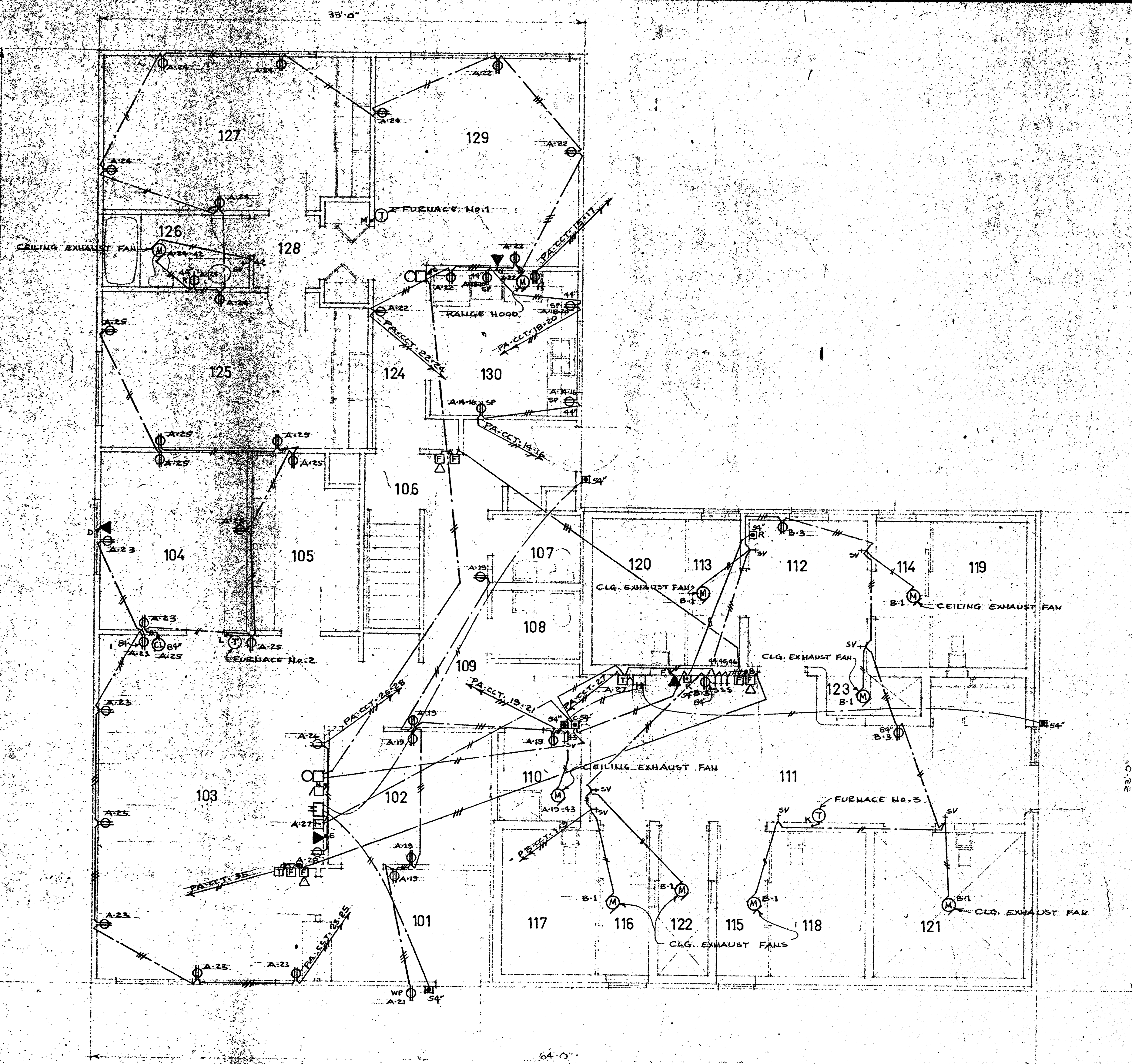
AS BUILT

project title _____ titre du projet _____
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

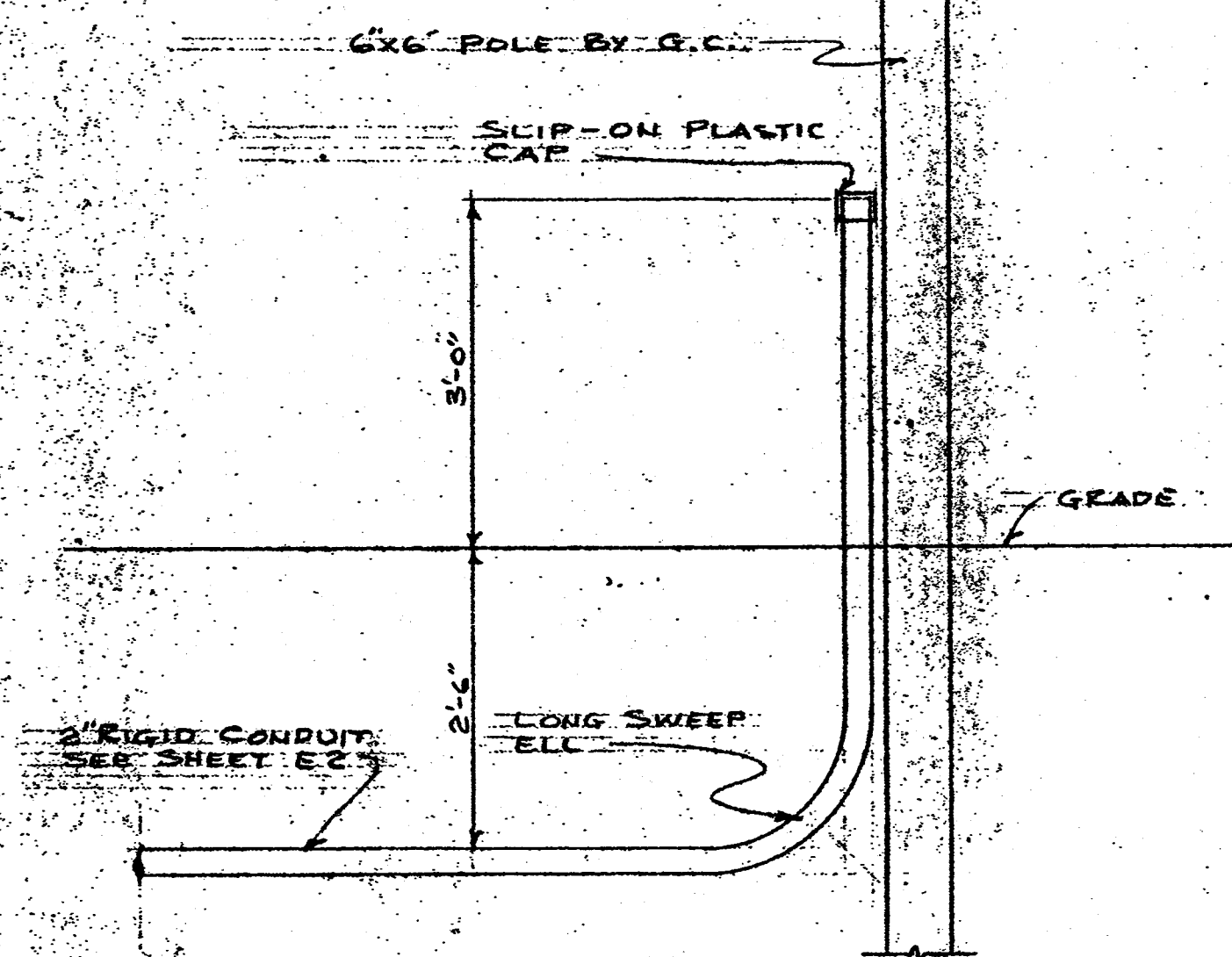
drawing title _____ titre du dessin _____
ELECTRICAL
MAIN FLOOR PLAN
POWER & COMMUNICATIONS

designed by _____	concur par _____
date _____	
drawn by _____	dessiné par _____
date APRIL 1974	
reviewed by _____	examiné par _____
date _____	
approved by _____	approuvé par _____
date _____	
Tester _____	Revisé _____
D.P.W. Project Manager _____	Administrateur de projets M.T.P. _____
project number _____	no. du projet _____
	86314 100-74-15
drawing no. _____	dessin no. _____
	E 4

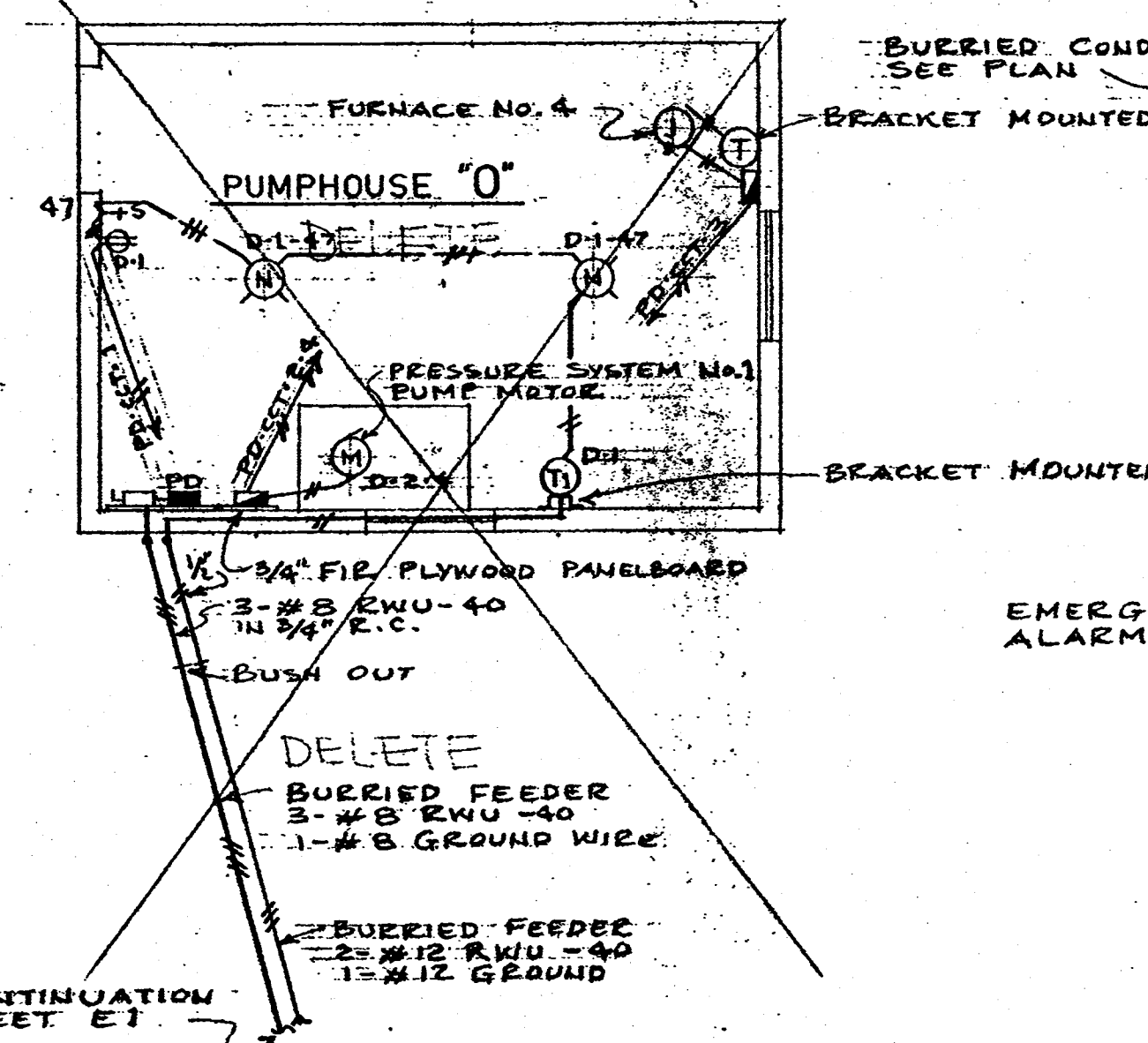


1 MAIN FLOOR PLAN - POWER & COMMUNICATIONS
SCALE: 1/4"=1'-0"

AS BUILT

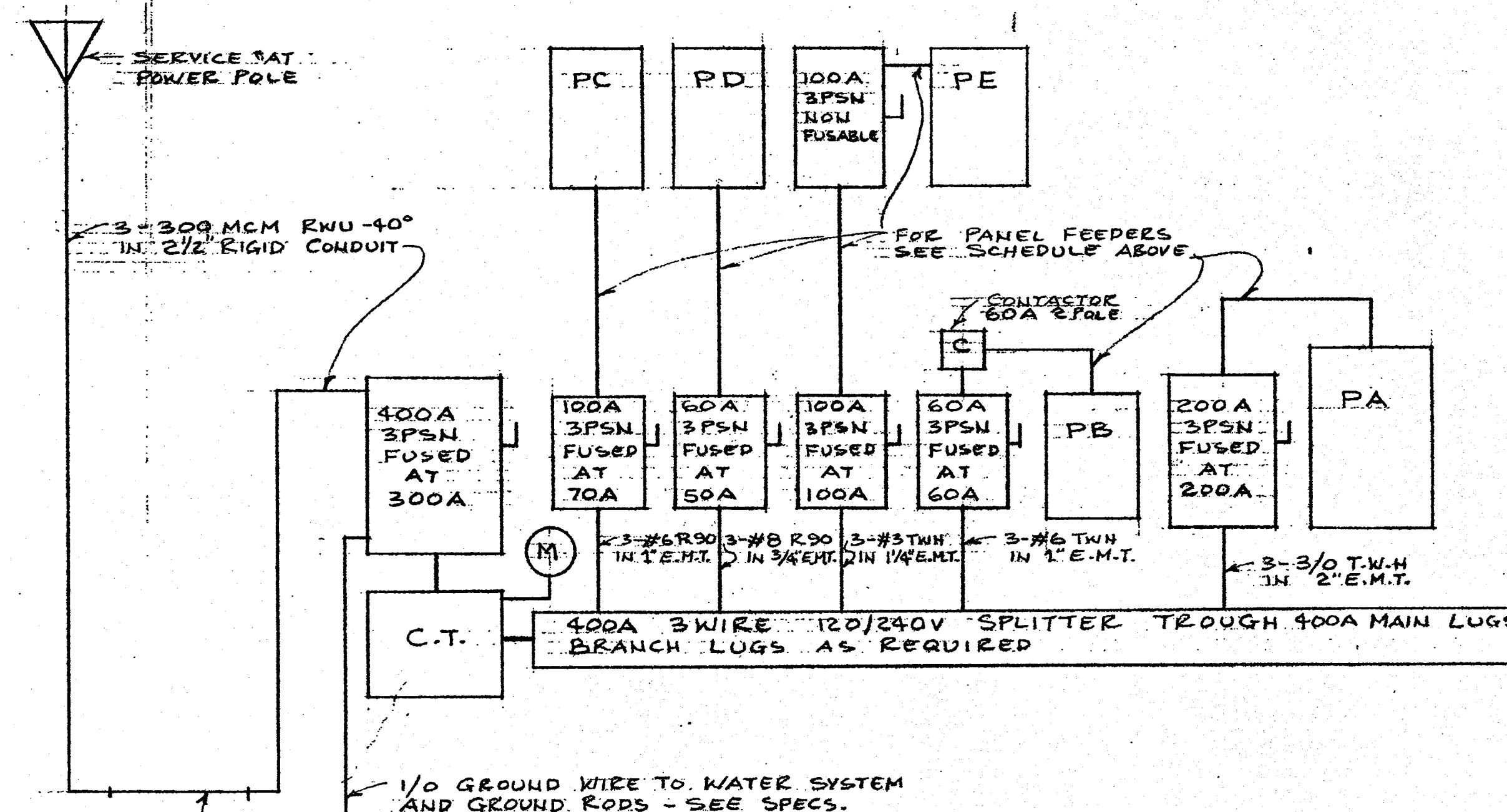


1 RADIO CONDUIT DETAIL
E2/E6
N.T.S.

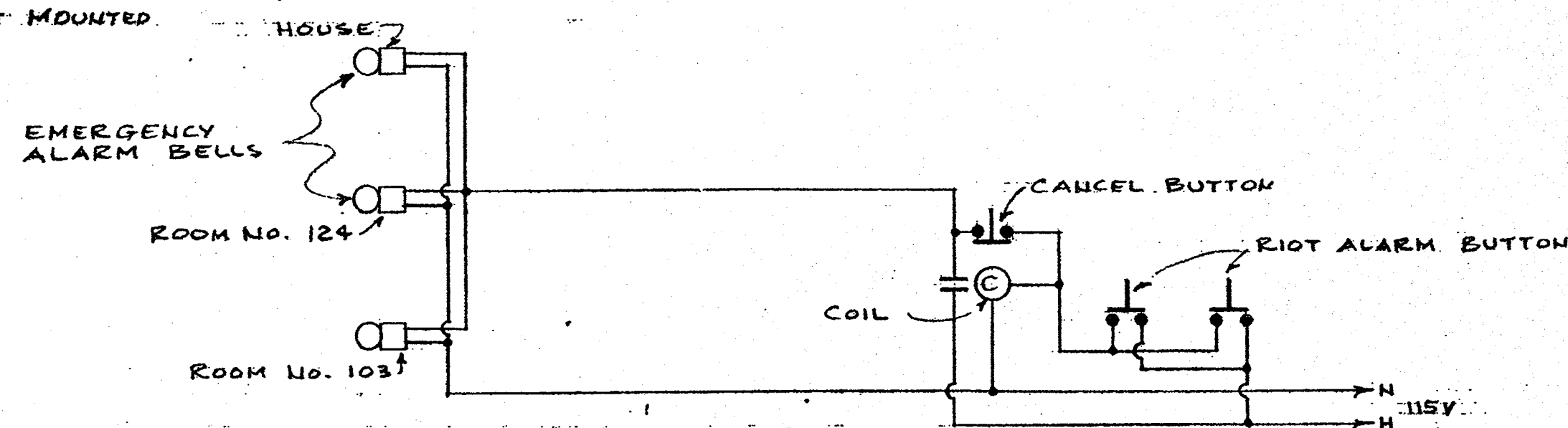


2 PUMPHOUSE PLAN - ELECTRICAL
E1/E6
SCALE: 1/4" = 1'-0"

DISTRIBUTION PANEL SCHEDULE													
MARK	LOCATION	MOUNTING	DOOR	LOCK	TYPE	SIZE	CIRCUITS	BRANCH	FEEDER	CONDUIT	REMOTE	REMARKS	
		ELUSH SURFACE				MAINS		BREAKERS	SIZE	SIZE	CONTROL		
PA	ROOM B3	✓	✓	✓	120/240V 1Ø	225A	42	1-40ADP, 1-30ADP, 1-15ADP, 24-15A SP, 6 SPACES	3-3/0TWH	2"			
PB	ROOM B3	✓	✓	✓	120/240V 1Ø	70A	8	5-15ASP, 3 SPACES	3-#6TWH	1"	✓	CONTACTOR OPERATED	
PC	GARAGE AND WORKSHOP	✓	✓	✓	120/240V 1Ø	185A	20	1-15ASP, 2-15A DP, 9 SPACES	3-#6 RWU-40 1-#8GK	1"			
PD	PUMPHOUSE	✓	✓	✓	120/240V 1Ø	70A	8	1-20ADP, 2-15ASP, 4 SPACES	3-#8 RWU-40 1-#8GK	3/4"			
PE	HOUSE	✓	✓		120/240V 1Ø	125A	24	1-60ADP, 22 SPACES	3-#5 RWU-40 1-#8GK	1/4"		60A DP BREAKER TO PROTECT EXIST. PANEL	




3 NEW 300A 115/230V 3WIRE 1Ø SERVICE DIAGRAM
E2/E6
NOT TO SCALE



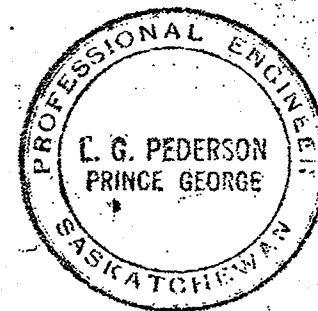
4 RIOT ALARM SCHEMATIC
E6
N.T.S.

ELECTRICAL LEGEND	
SYMBOL	DESCRIPTION
○	CEILING OUTLET
○	WALL OUTLET
⊙	CLOCK OUTLET
⊕	JUNCTION BOX
⊖	PULL BOX
⊗	MOTOR
⊙	THERMOSTAT 24V
⊕	HUMIDISTAT DUCT TYPE 24V
⊖	DUPLEX CONVENIENCE OUTLET
⊙	DUPLEX CONV. OUTLET SPLIT PLUG
⊖	DUPLEX CONV. OUTLET WEATHERPROOF
⊙	DUPLEX CONV. OUTLET WEATHERPROOF - SPLIT
⊖	RAZOR OUTLET
⊙	RANGE OUTLET 30A 115/230V 4 WIRE
⊖	DRYER OUTLET 30A 115/230V 4 WIRE
⊙	LOCAL SWITCH SINGLE POLE
⊖	LOCAL SWITCH SINGLE POLE - PILOT LIGHT
⊙	LOCAL SWITCH THREE WAY
⊖	LOCAL SWITCH FOUR WAY
⊙	DIMMER SWITCH 600W
⊖	PHOTO ELECTRIC SWITCH
⊙	VARIABLE SPEED SWITCH
—	CONDUIT CONCEALED IN WALL OR CEILING
—	CONDUIT CONCEALED IN FLOOR
—	CONDUIT EXPOSED
PACT. 2-4	HOME RUN/PANEL "A" CIRCUITS No. 2-9
A-2-7	PANEL "A" CIRCUIT No. 2 - SWITCH No. 7
PA	DISTRIBUTION PANEL "A"
⊖	DISCONNECT
⊖	MANUAL MOTOR SWITCH
⊖	MAGNETIC MOTOR STARTER
⊖	TELEPHONE
⊖	SOLENOID VALVE 115V
⊖	TELEPHONE OUTLET
⊖	TRANSFORMER 115/24V
⊖	CHIME 24V
⊖	EMERGENCY ALARM BELL 115V
⊖	PUMPHOUSE ALARM BUZZER 115V
⊖	PUSHBUTTON 24V
⊖	PUSHBUTTON RIOT ALARM 115V
⊖	CANCEL BUTTON 115V
⊖	BATTERY EMERGENCY LIGHTING UNIT
⊖	CONTACTOR
⊖	FIRE ALARM HORN
⊖	FIRE ALARM MANUAL STATION
⊖	LINE VOLTAGE THERMOSTAT
⊖	SPECIAL PURPOSE OUTLET 115V 1Ø 15A



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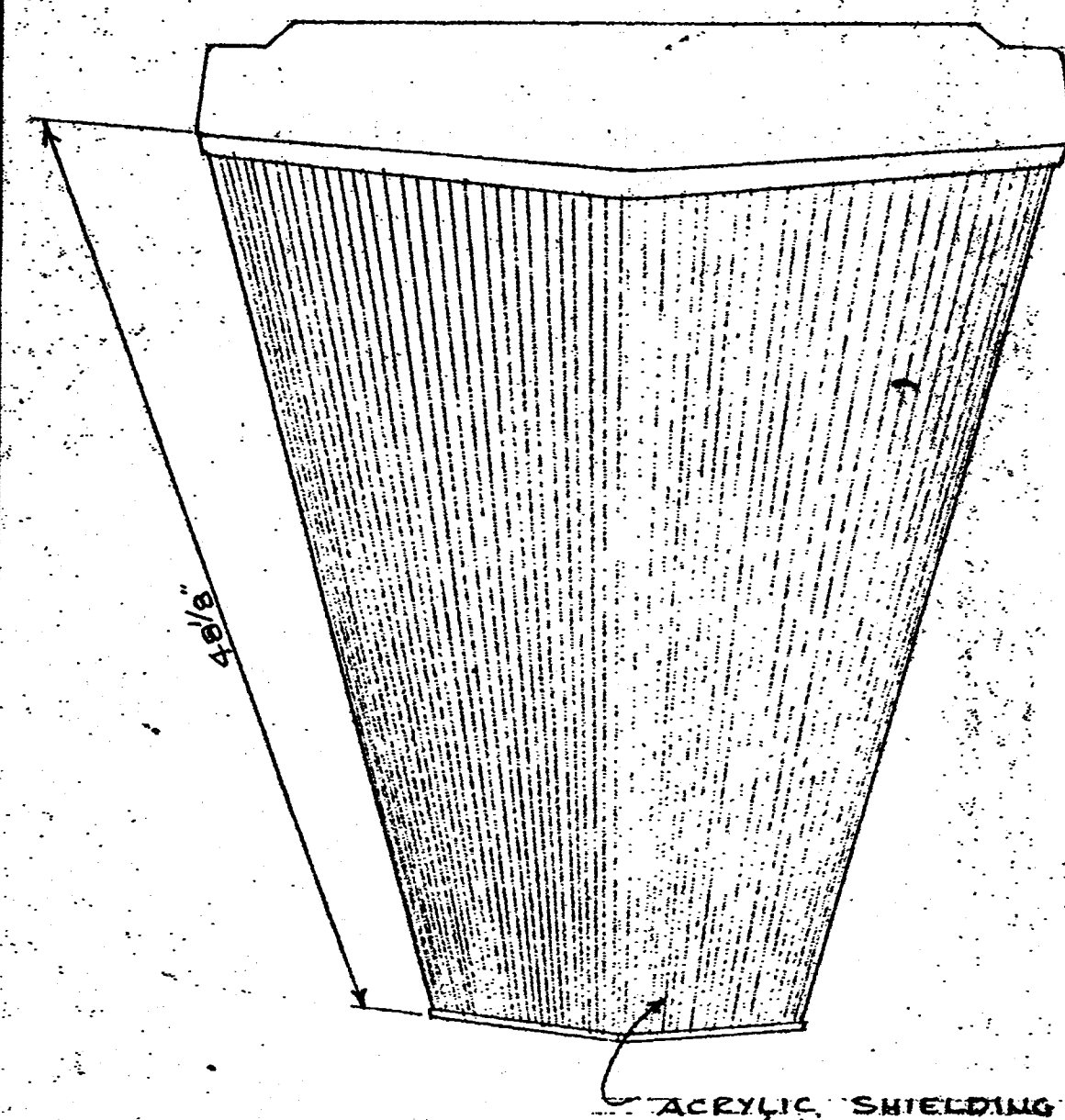
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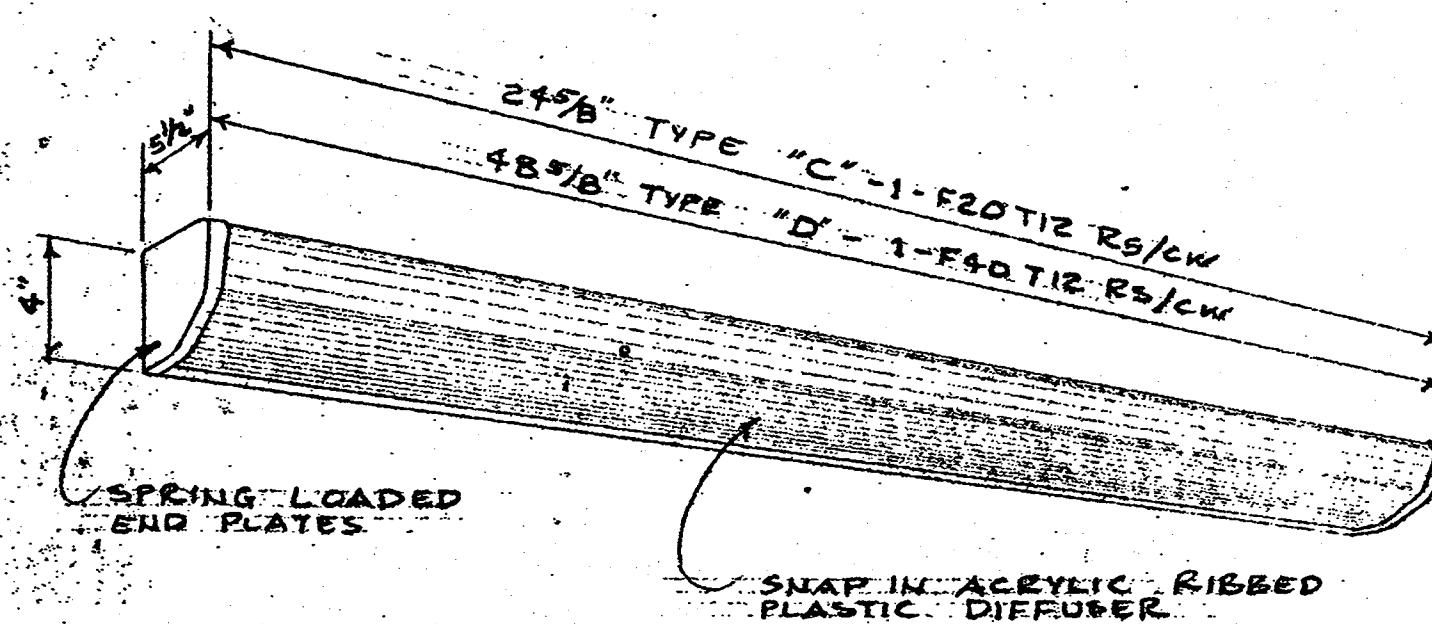
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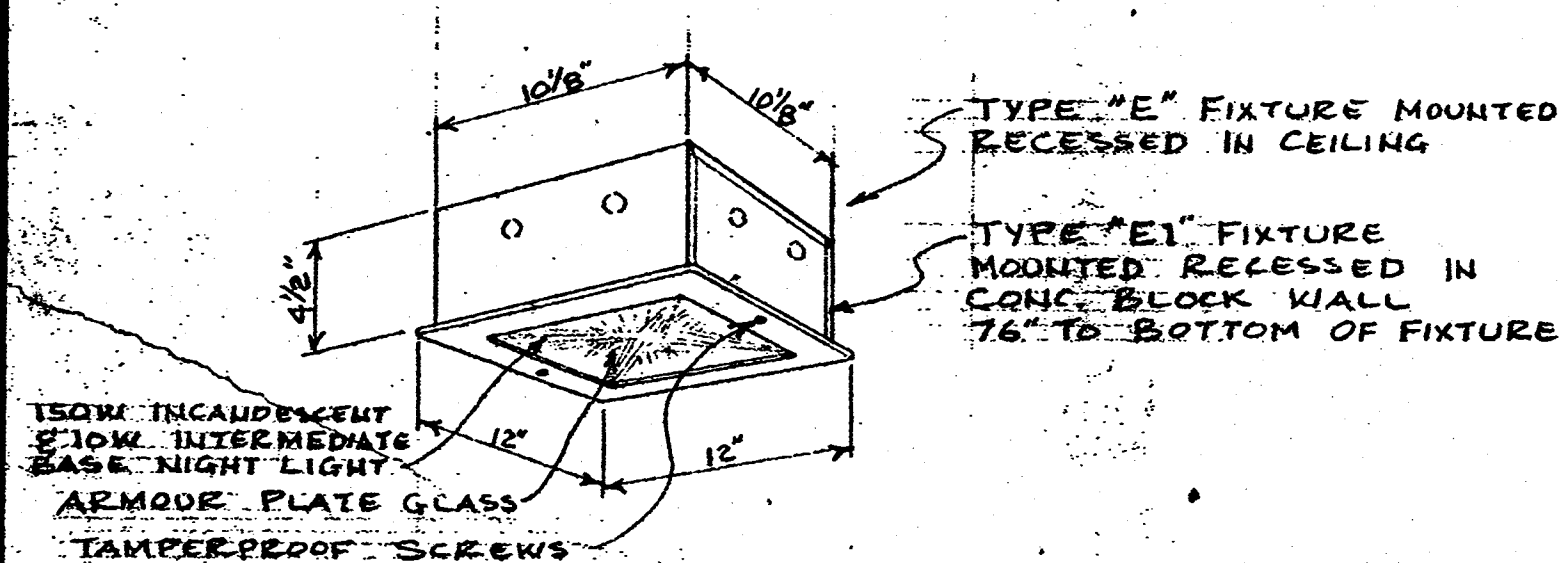
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drawing title	titre du dessin
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drawn by	dessiné par
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reviewed by	examiné par
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approved by	approuvé par
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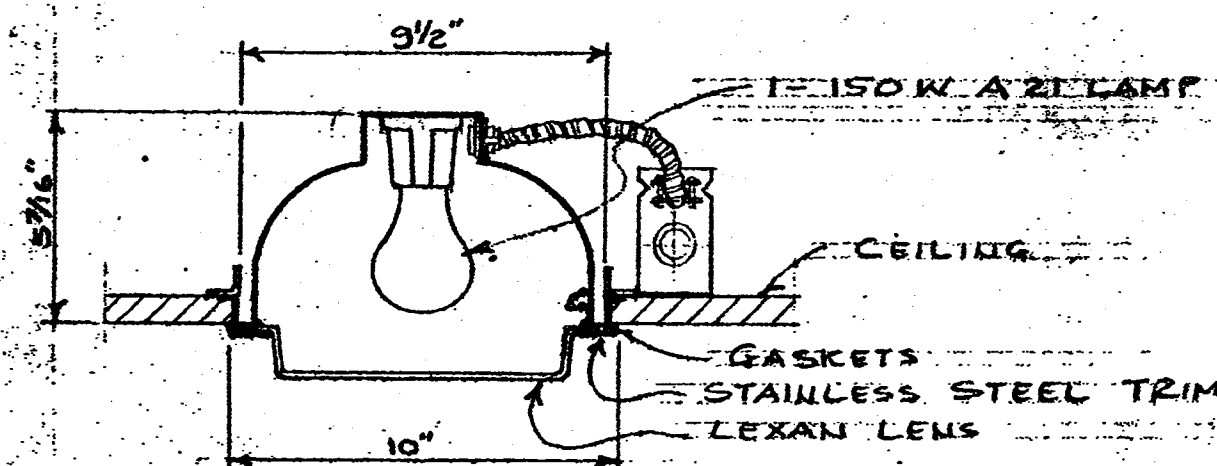
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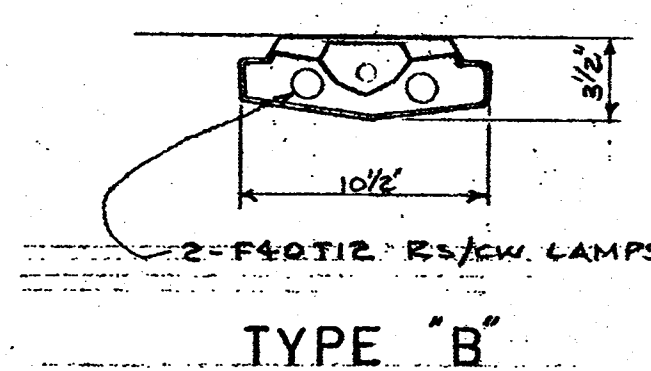
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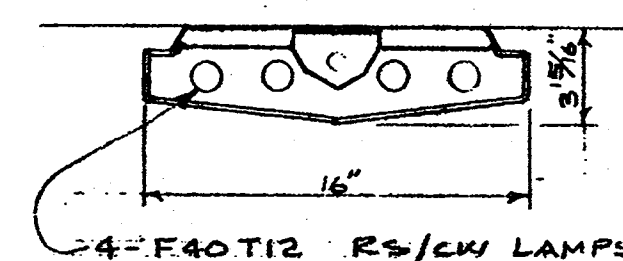
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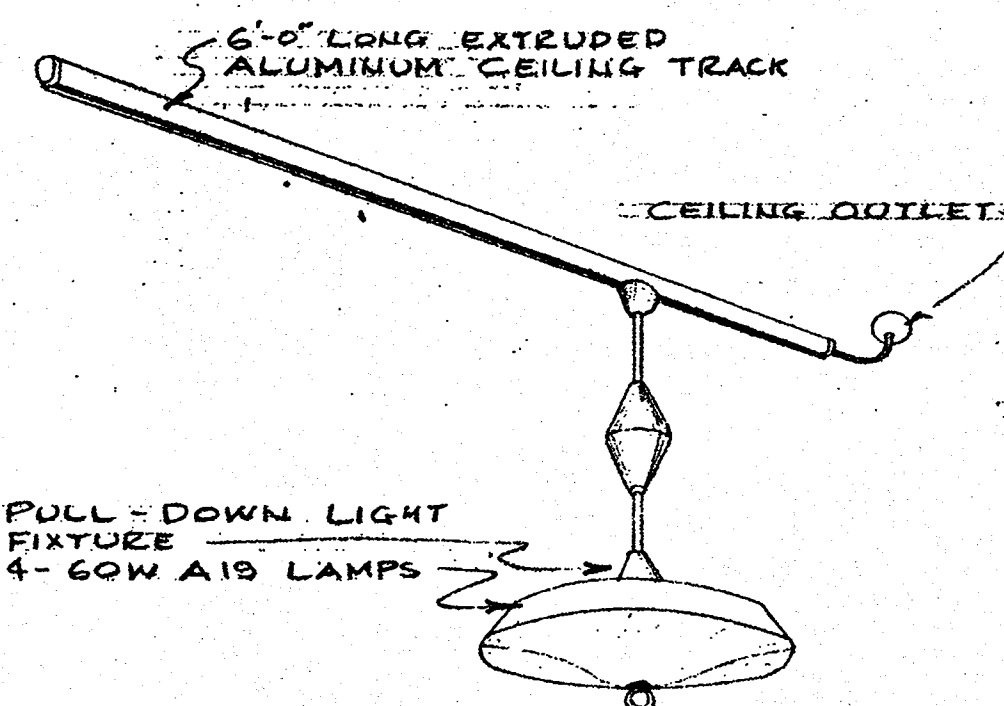
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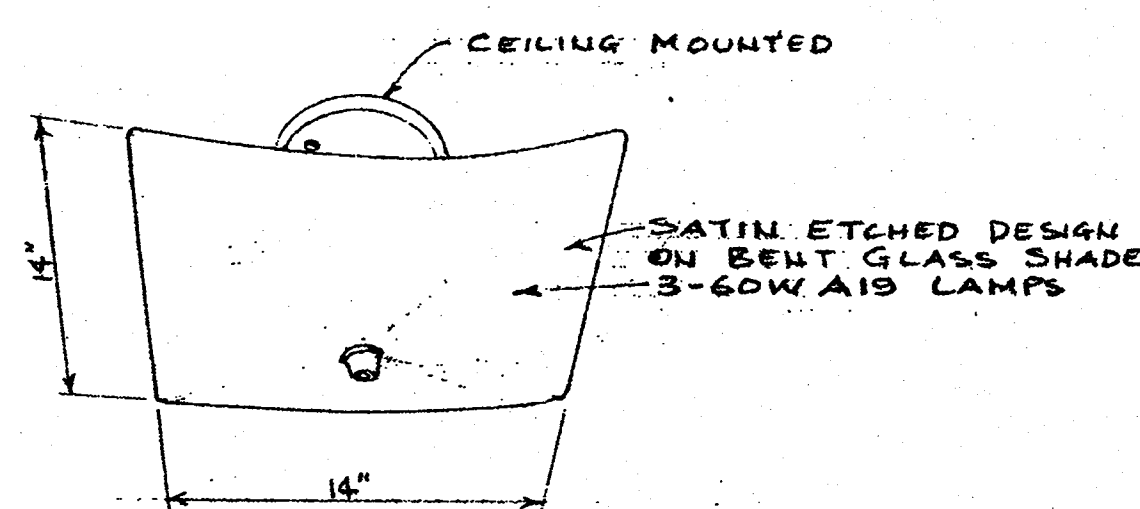
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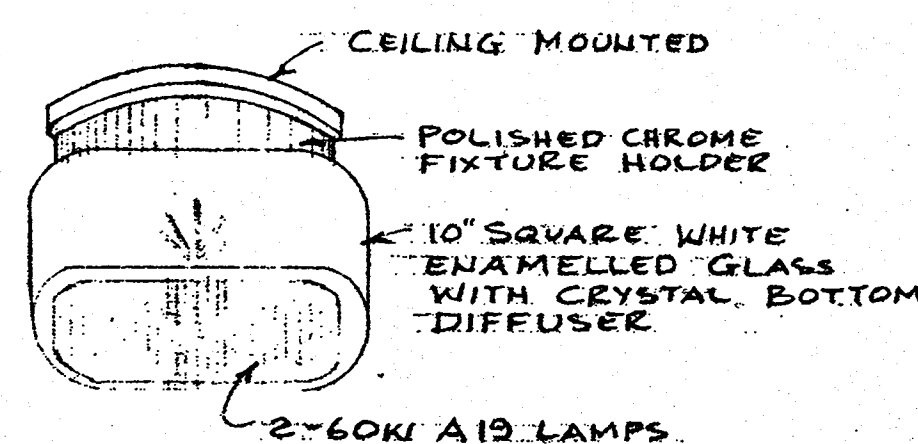
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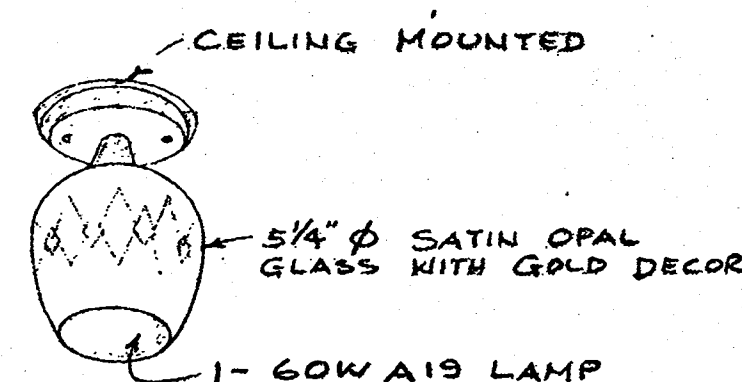
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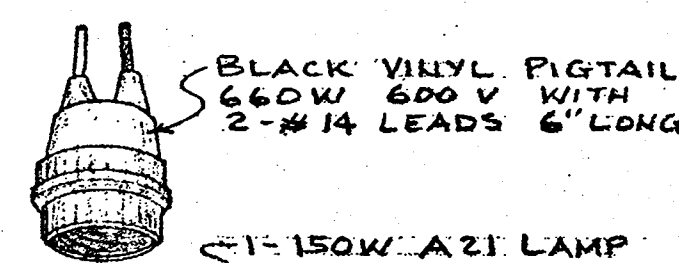
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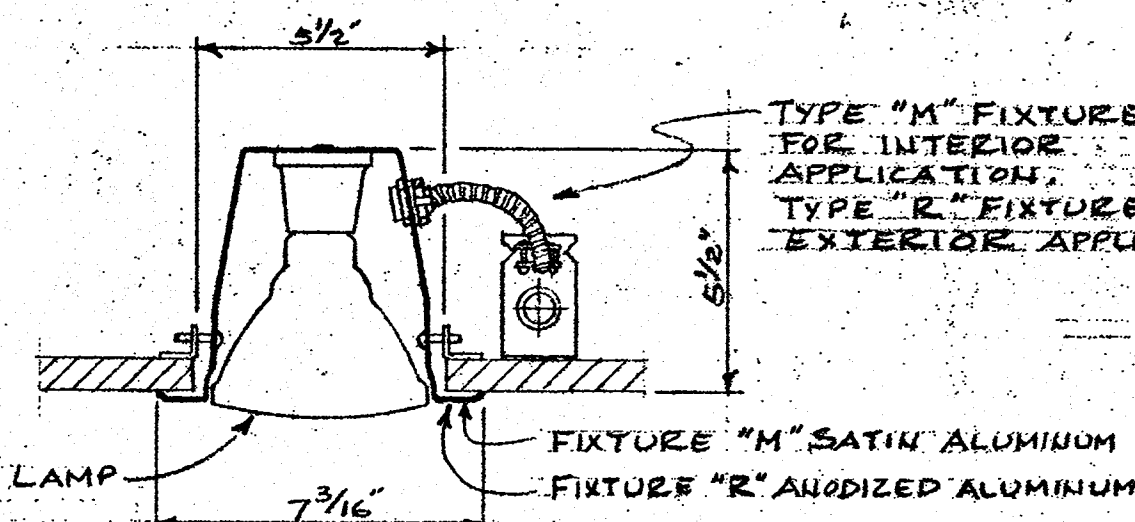
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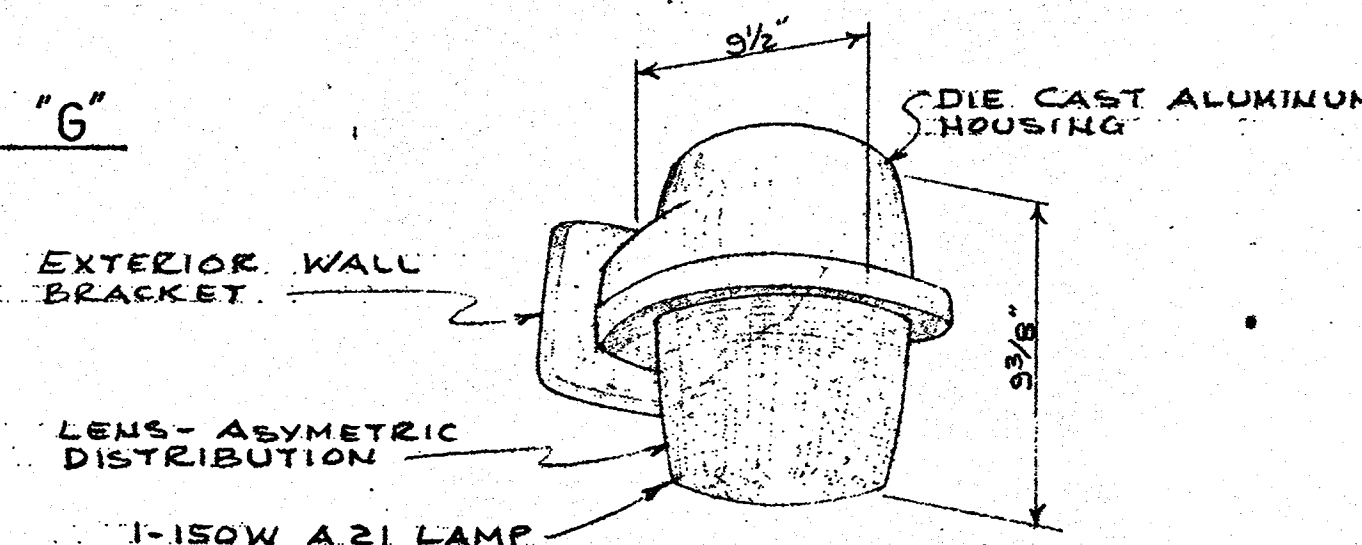
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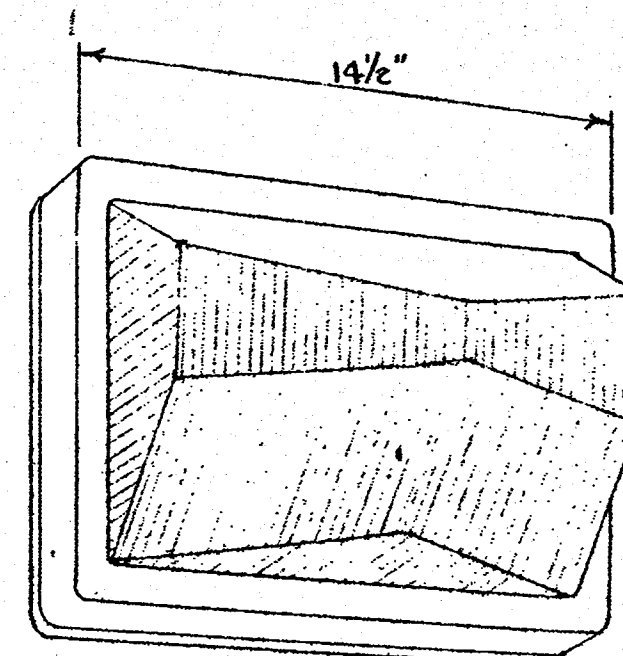
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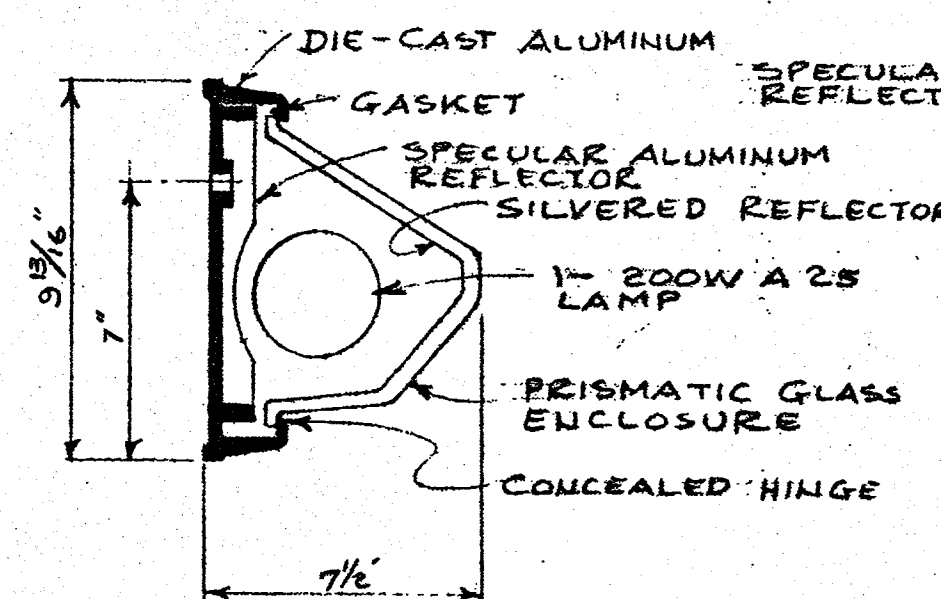
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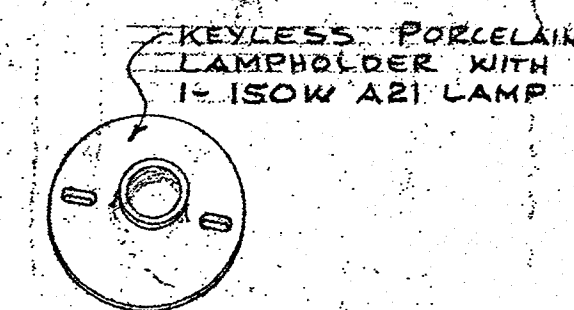


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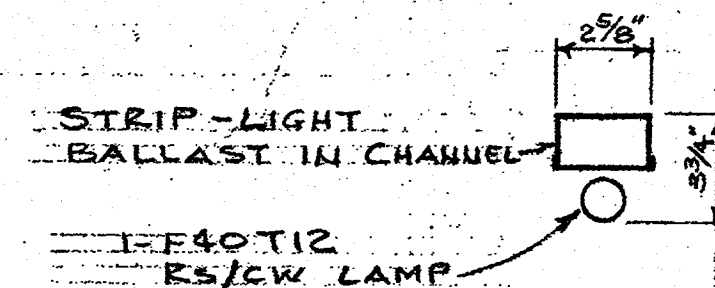


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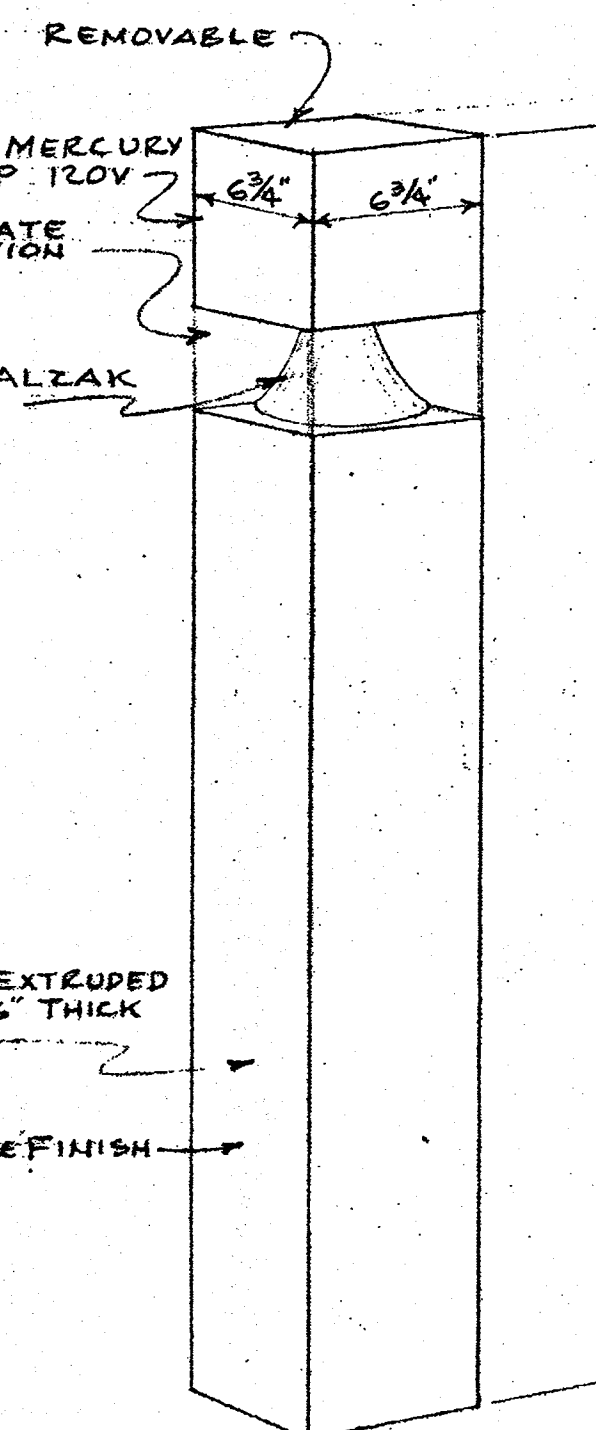
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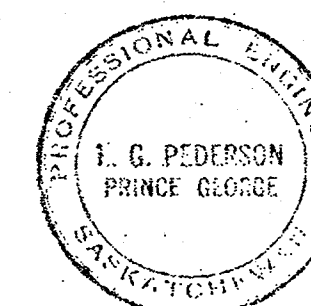


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project title titre du projet
STONY RAPIDS
SASKATCHEWAN

R.C.M.P. COMPLEX

drawing title titre du dessin
ELECTRICAL
LIGHT FIXTURE DETAILS

designed by conçu par
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drawn by H.M. dessiné par
date APRIL 1974
reviewed by examiné par
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approved by approuvé par
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Tender soumission
D.P.W. Project Manager Administrateur du projet M.T.P.
project number no. du projet
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drawing no. dessin no.
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**SITE REMEDIATION REPORT
ROYAL CANADIAN MOUNTED POLICE DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Submitted to:
Public Works and Government Services Canada
100 – 167 Lombard Street
Winnipeg, Manitoba R3C 2Z1

Attention: Ms. Marie McGregor

Submitted by:
Amec Foster Wheeler Environment & Infrastructure
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March 2017

Amec Foster Wheeler Project No: SX43441PRW

EXECUTIVE SUMMARY

Amec Foster Wheeler, was retained by Public Works and Government Services Canada (PWGSC) Environmental Services Department to conduct a remediation program at the Royal Canadian Mounted Police (RCMP) detachment in Stony Rapids, Saskatchewan, herein referred to as the Site. The purpose of the remediation program was to excavate previously identified PHC soil impacts in the area of environmental concern (AEC 1), the historic heating oil underground storage tank (UST) in the vicinity of the RCMP detachment building.

Between 2012 and 2015, five separate environmental assessments were completed at the Site. In 2012, Stantec Consulting Ltd. completed a Phase I ESA and EGE Engineering Ltd. completed a Phase II ESA. Tetra Tech WEI Inc. completed a Phase III ESA in 2013. Amec Foster Wheeler completed a supplemental sampling program and risk assessment in 2015.

The previous assessments identified two AECs. AEC 1, an area located around a former heating oil UST was determined to have an estimated 36 m³ of PHC impacted soils. AEC 2, an area located around a former gasoline UST and current gasoline AST was determined to have an estimated 192 m³ of PHC and naphthalene impacted soils. PWGSC ES requested that only the impacted soil at AEC1 be remediated at this time.

The Site was classified as a residential land use with a coarse grain soil nature under the definitions of CCME. The appropriate CCME guidelines for the protection of human health and the environment for BTEX, and PHC concentrations of fractions F1 to F4 were selected.

The Amec Foster Wheeler remediation program was started on 4 October 2016 and consisted of the excavation of approximately 20 m³ of PHC impacted soil in the area of the former heating oil UST to a maximum depth of 4.0 m bgl. During the initial excavation, the UST was encountered approximately 1.0 m bgl along the south wall of the excavation. The UST had been reportedly removed between 1989 and 1993.

An additional excavation was completed on 15 November 2016 for the removal of the UST. Approximately 18 m³ of PHC impacted soil was removed from the excavation of the UST removal. Due to considerable sloughing of soil along the south wall of the excavation, part of the concrete slab on which the UST was situated was left in place. Soil samples taken from the south wall of the excavation were collected below the remaining concrete slab to ensure there were no remaining impacts. The final depth of the UST excavation was up to 4.2 m bgl. The final extents were approximately 5.5 m north-south by 5.5 to 6.0 m east-west.

The maximum soil vapour concentration encountered during the initial excavation were considered relatively low at 50 ppm_v on the north, south, and west wall and floor. The maximum soil vapour concentration encountered along the east wall was 450 ppm_v in sample E1@2.0 m bgl and 160 ppm_v in sample E1@1.0 m bgl. Due to sample submission error, E1@3.0 m bgl was submitted for laboratory analysis. The soil vapour concentration in the remaining samples did not exceed 80 ppm_v.

The UST excavation expanded on the initial excavation to accommodate the UST removal requirements. This expansion of the excavation area included along the east wall and no evidence of potential impacts were identified along the east wall excavation extents.

The maximum soil vapour concentration encountered during the UST excavation was relatively low at 165 ppm_v in samples S12@3.05 and S13@3.05 at 3.05 m bgl.

A total of 14 soil samples, including two duplicates, from both excavations were submitted for laboratory analysis of BTEX and PHC Fraction F1 to F4. All PHC constituents did not exceed the applicable assessment guidelines.

Based on the field screening results and laboratory results, Amec Foster Wheeler considers the potential for remaining soil adjacent to the residual concrete pad to exceed the applicable assessment guidelines to be low. The residual concrete pad was left in place due to sloughing and concerns pertaining to the structural integrity of the RCMP detachment building.

The NCSCS checklist from the 2015 Risk Assessment completed by Amec Foster Wheeler was updated to include the remediation of AEC1. The score for the Site did not change due to the remaining impacts at AEC2 which were not addressed during the excavation.

In Amec Foster Wheeler's opinion, further remediation work is not required as all analytical results did not exceed applicable criteria and there are no further identified environmental concerns associated with AEC 1.

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1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler), was retained by Public Works and Government Services Canada (PWGSC) Environmental Services Branch (ES) to conduct a remediation program at the Royal Canadian Mounted Police (RCMP) detachment in Stony Rapids, Saskatchewan, herein referred to as the Site.

The purpose of the remediation program was to excavate previously identified petroleum hydrocarbon (PHC) impacts from the area of a former heating oil underground storage tank (UST) associated with the RCMP Detachment Building. During the remedial excavation the UST was encountered and subsequently removed.

The location of the Site is shown on Figure 1 (Appendix A).

1.1 SITE AND SURROUNDING LAND USE

The Site is located at the north end of Johnson Street within the Town of Stony Rapids, approximately 800 km north of Saskatoon, Saskatchewan. The Fond du Lac River borders the north and northwest property limits. The Site consists of the RCMP Detachment building with an associated garage and two RCMP employee dwellings with an associated work shop all enclosed within a chain link fence on an irregularly shaped land parcel with a total area of approximately 0.50 ha. Additional RCMP employee housing was situated south of the main compound, followed by the community Water Treatment Plant. The area of the remedial activities is located adjacent to the northwest portion of the Detachment building.

To the north is Fond Du Lac River, to the east is Johnson Street followed by residential properties, to the south is the RCMP residence followed by the Stony Rapids water treatment plant, and to the west is the Fond Du Lac River. The Site and surrounding lands were observed to be residential/parkland land uses. The surrounding land uses as observed at the time of the fieldwork are summarized in Table 1 (Appendix B) and shown on Figure 1 (Appendix A). Site photographs are provided in Appendix C.

1.2 Regional Geology

The Stony Rapids area covers a geologic area of approximately 12,800 km² and is broken down into four distinct geological areas: Mudjatik Domain (east), Dodge Domain (northwest), Tantato Domain (west) and Athabasca Group (south) (Gilboy & Ramaekers, 1981). The Mudjatik, Dodge and Tantato Domains are separated by major shear zones and are made up of crystalline rocks. The Athabasca Group unconformably overlies the basement in the southern portion of the Stony Rapids area.

1.3 Stratigraphy

The soil profile encountered during previous investigations generally consisted of a grass and topsoil surface to approximately 0.15 m bgl. Underlying the topsoil was a sand deposits in all test holes to a depth of 3.2 m bgl.

The sand was found to contain some gravel and trace silt, was well graded, medium grained, damp, medium dense and reddish brown in color. Frequent cobbles were identified approximately 0.3 m from the final depth of the test holes. All test holes were terminated due to auger refusal on suspected bedrock or cobbles at depths ranging from 0.9 m to 3.2 m bgl.

2.0 BACKGROUND

Previous environmental assessments and risk assessment for the Site include:

- Phase I Environmental Site Assessment - Stony Rapids RCMP Detachment and Attached Housing, Garage, Workshop and Two Employee Housing Facilities. DRRP# 14862, Stony Rapids, Saskatchewan. Prepared by Stantec Consulting Ltd. January 2012.
- Phase II Environmental Site Assessment RCMP Stony Rapids Detachment Site, DFRP 14862, Stony Rapids, Saskatchewan. Completed by EGE Engineering Ltd. 2012.
- 2013 Phase III Environmental Site Assessment, RCMP Detachment Site, Stony Rapids, Saskatchewan. Completed by Tetra Tech WEI Inc. 2013.
- Supplemental Sampling Program, RCMP Detachment, Stony Rapids, Saskatchewan. Completed by Amec Foster Wheeler, March 2015.
- Royal Canadian Mounted Police (RCMP) Detachment, Stony Rapids, Saskatchewan, Preliminary Quantitative Human Health Risk Assessment (PQHHRA) and Preliminary Quantitative Ecological Risk Assessment (PQERA). Completed by Amec Foster Wheeler, March 2015.

The environmental assessment reports identified two Areas of Environmental Concern (AEC) including:

- AEC 1: An estimated 36 m³ of PHC impacted soil was identified in the vicinity of the former 4,500 L heating oil UST. The heating oil UST was located north of the Detachment building and was reported to have been removed sometime between 1989 and 1993 (Stantec 2012).

Guideline exceedances in soil samples collected from the area of AEC 1 (depths included in parenthesis) included:

- SR-08-3 (1.5 m)
 - toluene (0.9 mg/kg) exceeding guideline of 0.1 mg/kg;
 - PHC Fraction F1 (300 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (2500 mg/kg) exceeding guideline of 150 mg/kg.
- SR-08-6 (3.3 m)
 - toluene (2.3 mg/kg) exceeding guideline of 0.1 mg/kg;
 - xylenes (20 mg/kg) exceeding guideline of 16 mg/kg;
 - PHC Fraction F1 (440 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (2500 mg/kg) exceeding guideline of 150 mg/kg.

Guideline exceedances in groundwater samples collected from the area of AEC 1 included:

- SR-08
 - toluene (0.81 mg/L) exceeding guideline of 0.083 mg/L;
 - PHC Fraction F1 (3.9 mg/L) exceeding guideline of 0.81 mg/L; and
 - PHC Fraction F2 (17 mg/L) exceeding guideline of 1.3 mg/L.
- AEC 2: An estimated 192 m³ of PHC and naphthalene impacted soil was identified in the vicinity of the former 4,500 L gasoline UST and current gasoline aboveground storage tank (AST) north of the driveway leading to the Detachment garage. It is unknown if the former gasoline UST was abandoned in place or removed. The soil impacts were fully delineated during Amec Foster Wheeler's supplemental sampling program (2015b).

Guideline exceedances in soil samples collected from the area of AEC 2 (depths included in parenthesis) included:

- SR-03-1 (0.3 m)
 - naphthalene (0.087 mg/kg) exceeding guideline of 0.013 mg/kg.
- SR-03-2 (0.75 m)
 - benzene (0.16 mg/kg) exceeding guideline of 0.095 mg/kg;
 - toluene (0.89 mg/kg) exceeding guideline of 0.1 mg/kg; and
 - PHC Fraction F3 (1300 mg/kg) exceeding guideline of 300 mg/kg.
- SR-20 (0.75 m)
 - PHC Fraction F2 (1500 mg/kg) exceeding guideline of 150 mg/kg.

- SR-22 (0.3 m)
 - naphthalene (0.033) exceeding guideline of 0.013 mg/kg.
- SR-22 (0.75 m)
 - naphthalene (0.36 mg/kg) exceeding guideline of 0.013 mg/kg;
 - PHC Fraction F1 (50 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (230 mg/kg) exceeding guideline of 150 mg/kg.
- SR-22 (3 m)
 - naphthalene (3.8 mg/kg) exceeding guideline of 0.013 mg/kg;
 - toluene (1.1 mg/kg) exceeding guideline of 0.1 mg/kg;
 - xylenes (120 mg/kg) exceeding guideline of 16 mg/kg;
 - PHC Fraction F1 (360 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (220 mg/kg) exceeding guideline of 150 mg/kg.
- SR-22 (3.75 m)
 - naphthalene (3.2 mg/kg) exceeding guideline of 0.013 mg/kg;
 - toluene (0.3 mg/kg) exceeding guideline of 0.1 mg/kg;
 - xylenes (62 mg/kg) exceeding guideline of 16 mg/kg;
 - PHC Fraction F1 (190 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (200 mg/kg) exceeding guideline of 150 mg/kg.
- SR-24 (0.3 m)
 - naphthalene (0.019 mg/kg) exceeding guideline of 0.013 mg/kg;
- SR-24 (0.75 m)
 - naphthalene (0.016 mg/kg) exceeding guideline of 0.013 mg/kg;
- SR-25 (1.0 m)
 - naphthalene (0.030 mg/kg) exceeding guideline of 0.013 mg/kg;
- SR-25 (1.3 m)
 - naphthalene (0.16 mg/kg) exceeding guideline of 0.013 mg/kg;

The risk assessment report assessed the risk of the AECs to potential receptors as follows:
including:

Human Health Risk Assessment

Human Health Risk Assessment concluded that there were no contaminants of potential concern (COPCs) for the soil ingestion, direct contact and inhalation outdoor air exposure pathways; and, the inhalation of indoor air exposure did not require further consideration based on the site characteristics and soil vapour data. As such, unacceptable risks have not been identified for human receptors.

Ecological Risk Assessment

In terms of the ERA, screening to soil values protective of ecological health identified a series of terrestrial COPCs including: xylenes, PHC Fraction F1 to PHC Fraction F3, benzo(g,h,i)perylene, benzo(e)pyrene, acridine, 2-methylnaphthalene and naphthalene. Ecological receptors present at the Site include terrestrial plants, soil invertebrates, mammals and birds, amphibians and reptiles which could potentially come into contact with COPCs at the Site. Exposure pathways include root uptake, direct contact with soil, incidental soil ingestion, and ingestion of food and prey (that have accumulated COPCs from soil).

Adverse effects on terrestrial plants from localized PHC fraction F1 to F3 and PAH impacts are not expected. Species at Risk terrestrial plants identified in the desktop review were not identified at the Site. Should it be found that they are present on-Site, adverse effects to these plants are not expected.

With respect to soil invertebrates, hazard quotients for all COPCs except PAHs were greater than the risk threshold of 1. However, adverse effects to soil invertebrates are not expected as contamination is localized and contamination occurs at depths greater than 1.5 m bgs which are not accessible to soil invertebrates.

Comparison of exposure estimates to toxicity reference values for xylenes, PHCs and PAHs in mammals did not indicate the potential for adverse effects. No hazard quotient above the risk threshold of 1 was calculated for the meadow vole. Similarly, no hazard quotients above 1 were calculated for exposure to on-Site COPCs by the common shrew. However, a hazard quotient for PHC Fraction F2 above the risk threshold of 1 was calculated for the common vole. Adverse effects are not expected as concentrations of PHC Fraction 2 that exceed the CCME guideline are localized and PHCs are readily metabolized in mammals and are not expected to accumulate in tissues.

Toxicity reference values for xylenes, PHCs and PAHs for birds were not available. However, adverse effects to avian species present at the Site is not expected for the following reasons: the home range for most birds is greater than the area that had increased concentrations of COPCs; risks to terrestrial plants and soil invertebrates are not expected and therefore, food supplies for bird species are not expected to be impacted; and, PHCs, and PAHs are readily metabolized by birds and are therefore, not expected to accumulate in tissues.

Similarly, toxicological reference values for xylenes, PHCs and PAHs for reptiles and amphibians were not available. However, adverse effects to reptiles and amphibians present at the Site are not expected for the following reasons: on-Site contamination is localized, therefore, the potential for contact will be minimal; and, risks to other receptor groups which may serve as a food source (i.e., soil invertebrates and terrestrial plants) are not expected to occur.

3.0 SCOPE OF WORK

The provided Terms of Reference (TOR) detailed the work to be performed at AEC 1 and the following scope of work was proposed:

- Prepare a tender package including construction cost estimates, specifications, unit bid price table, drawings, and figures;
- Provide site supervision during the remediation activities to ensure that the contractor adheres to the specifications as well as to all applicable laws and regulations;
- Monitor salvageable and non-salvageable items as required in the specification;
- Prepare a Health and Safety Plan;
- Maintain a presence on-Site during all times the contractor is on-Site during the removal of soil and groundwater (if required) and backfill and compaction of backfill;
- Ensure that the contractor has arranged for the clearance of all utility service lines on-Site prior to commencing excavation activities as well as properly capping all utilities not required such as electrical. Obtain proof from Contractor.
- If dewatering of the excavation is required, supervise dewatering activities. Sample and analyse results before discharge. Ensure that any impacted groundwater is transported to a licensed disposal facility.
- In the event that soil must be temporarily stockpiled on-Site pending transport, ensure that it is stockpiled on a polyethylene liner and covered. Monitoring of soil quality during excavation and management of excavated materials (soil segregation and stockpiling) will be required. Soils will be field screened for signs of potential contamination which will include visual assessment, olfactory observations, and measurement of soil petroleum vapour concentrations using a Photo Ionization Detector. Soils will be segregated into different piles based on field observations;
- Ensure that dust control measures are implemented as per the specification;
- Collect soil sample from potentially impacted soil and analyse to meet requirements of approved soil disposal facility;
- Collect confirmatory soil samples from the walls and base of the final tank excavation to confirm soil quality for closure purposes.
- Ensure that all hydrocarbon impacted soil excavated is transported off-Site for licensed disposal and treatment. Obtain proof from contractor;
- Ensure backfill material is provided as stated in the specification and that it is compacted as stated in the specification;
- Supervise backfilling and Site restoration activities. Complete compaction testing to ensure that backfilling is completed in accordance with industry standards and project specifications;
- Revise the NCSCS score; and
- Prepare a report summarizing all the Site activities including removal activities and soil sampling results, volumes of impacted soil removed and compaction results.

The scope of work was completed as per Amec Foster Wheeler's proposal with the exception of the following:

- Amec Foster Wheeler did not complete a Health and Safety Plan as the contractor was responsible for safety;
- Dewatering of the excavation was not required as groundwater was not encountered;
- Dust control measures were not necessary on the stockpiles due to the stockpiles being covered while on-Site;
- Stockpile samples were not collected due to field error;
- Compaction testing was not deemed necessary after discussion with Points Athabasca, PWGSC and the RCMP. The specifications did not include compaction testing at the Site, therefore, compaction testing was not completed; and
- Additional work was required due to the presence of the heating oil UST; PWGSC provided an updated TOR.

Based on the provided amendment to the TOR document dated 16 October 2016, the additional scope of work included:

- Site Supervision for the removal of the abandoned in place UST and associated PHC impacted soil.

4.0 METHODOLOGY

4.1 SAFETY

Prior to the commencement of the decommissioning activities, a pre-job safety meeting was conducted by the contractor selected for the project by PWGSC, Points Athabasca, amongst the Site personnel, including Amec Foster Wheeler and Points Athabasca, to outline the scope of work, chemical and physical hazards, and required personal protective equipment. Utility locates were completed by the prime contractor prior to Amec Foster Wheeler's arrival at the Site; upon arrival to the Site, Amec Foster Wheeler reviewed the utility clearance documentation and confirmed clearance was obtained.

4.2 SURROUNDING LAND USE

A survey of surrounding land uses was conducted as part of the supervision of site remedial activities. The purpose of the survey was to identify specific land uses (i.e. agricultural, residential, commercial or industrial) adjacent to the Site to establish the applicable land use criteria.

4.3 EXCAVATION OF CONTAMINATED SOIL

The Amec Foster Wheeler remediation program was completed between the 3rd to the 6th October 2016 and consisted of an excavation within the area of the heating oil UST, completed to a maximum depth of 4.0 m below ground level (bgl). The area of remedial activities was located adjacent to the northwest of the Detachment building. The location of the excavation is shown on Figure 2 (Appendix A).

Points Athabasca used a skid steer to remove the sod layer and a backhoe was used to excavate the contaminated soil. A pay loader was used to place the contaminated soil in the truck to be hauled to the landfill.

During the excavation, an underground heating oil tank was uncovered along the south wall of the excavation along the north wall of the detachment building.

The final excavation extent was approximately 4.2 m by 4.2 m and ranged from 3.0 m depth at the north, east, and west walls to 4.0 m depth at the south wall. A total of 36 cubic meters (m³) of soil was removed from the excavation. Of the soil that was removed, 16 m³ was deemed to be re-usable for backfilling and the remaining 20 m³ was stockpiled on a polyethylene liner on-Site before being transported for disposal.

PWGSC and RCMP personnel were informed of the discovery of the UST in place filled with sand and gravel. Due to concerns pertaining to the structural stability of the RCMP Detachment Building adjacent to the UST, the UST was left in place pending approval from PWGSC and RCMP. PWGSC and the RCMP confirmed that no additional approvals were required to complete the UST removal.

4.4 UNDERGROUND STORAGE TANK REMOVAL

The removal of the UST was initiated on 15 November 2016. The impacted fill material was removed from within the UST and stockpiled on a polyethylene liner located on the southeast portion of the Site. The clean backfill from the previous excavation was also stockpiled on-Site for reuse. The UST was removed, crushed and transported by Points Athabasca to the local landfill. Approximately three-quarters of the concrete pad below the UST was also removed and transported to the local landfill. The remaining section of the concrete pad was left in place due to safety concerns of the south wall of the excavation sloughing away from the foundation of the building. PHC impacted soil from below the UST and concrete pad was excavated following the removal of the UST and concrete pad.

Prior to the start of the excavation, the sod layer was carefully removed in order to replace it after excavation activities were complete. The air conditioner along the building was hoisted to access and remove the concrete sidewalk below it.

The final depth of the UST excavation was up to 4.0 m bgl. The final extents were approximately 4.3 to 4.5 m north-south by 5.5 to 6.0 m east-west. Although the north, east, and west walls were deemed clean during the initial excavation, the UST excavation was enlarged to accommodate the size of the UST and soil sloughing. Approximately 34 m³ of soil was removed from the excavation and stockpiled on and covered by polyethylene liners on-Site. Approximately 16 m³ of excavated soil was re-used for backfilling purposes and the remaining 18 m³ was stockpiled on a polyethylene liner on-Site. The final excavation extents are shown on Figure 2 (Appendix A). Site photographs documenting the decommissioning activities are presented in Appendix C.

4.5 CONFIRMATORY SAMPLING PROGRAMS

The confirmatory soil sampling programs were completed after each excavation on 5 October 2016 and 15 November 2016.

Soil samples were collected at 0.5 m bgl, 1.0 m bgl, 2.0 m bgl, and 3.0 m bgl as well as the floor of the initial excavation along the south wall. Samples could not be collected from the floor of the initial excavation along the north, east, and west walls due to soil sloughing. Due to the UST being present along the south wall, samples could not be collected at 2.0 m and 3.0 m bgl. Sampling locations are shown on Figure 3 (Appendix A).

Soil samples were collected at random depths along the south wall of the UST excavation only, as the other walls were deemed clean after the initial excavation. Samples could not be collected from the floor of the excavation due to considerable sloughing. Sample locations are shown on Figure 3 (Appendix A).

Soils samples for potential PHC analysis were collected and split into two portions. One portion was split and placed in 120 millilitre (mL) glass jars equipped with Teflon® lined lids with zero headspace and in a 40 mL pre-charges methanol glass vial (for possible laboratory analyses). The other portion was placed in one laboratory grade soil bag (for field screening of combustible vapours). Disposable nitrile gloves were used during the sample handling. The sample jars were labeled according to a pre-determined sample identification protocol and stored in an insulated cooler with ice while on Site and during transport to the laboratory.

In total, 38 soil samples were collected from the sidewalls and base of the initial excavation and a total of four soil samples were collected from the south wall of the UST excavation. The soil samples were field screened for volatile PHC vapours using ambient temperature headspace (ATH) techniques and an RKI Eagle combustible vapour analyzer set in the no methane response mode. The ATH method involves partially filling and sealing a plastic bag with soil and allowing the vapours to accumulate at ambient temperatures prior to analyzing the headspace. Accumulated vapours were measured in parts per million total combustible vapours (ppm_v). The field protocols and quality assurance/quality control (QA/QC) procedures utilized were in accordance with standard industry protocols.

4.6 LABORATORY ANALYSIS

A total of 14 samples, including two duplicate soil samples, were submitted for laboratory analysis to ALS Environmental in Saskatoon, Saskatchewan. Ten of the soil samples were from the initial excavation and four from the UST excavation. Samples submitted for laboratory analysis were chosen based on vapour readings and visual evidence of potential impacts.

Gasoline and heating oil associated with historical operations at the Site were the contaminants of concern (COC); therefore, the laboratory program was developed to include the analyses of benzene, toluene, ethylbenzene, xylenes (BTEX), PHC fractions F1-F4 constituents. Based on historical reports, other parameters such as metals and VOCs were not identified as COPCs and therefore not expected to be present at the Site.

One additional sample was collected during the initial excavation activities and was submitted for analysis of to meet the Saskatchewan Landfill Class II requirements for disposal purposes.

ALS's laboratory in Saskatoon is certified with the Canadian Association for Laboratory Accreditation Inc. (CALA) to ISO/IEC 17025. The laboratory QA/QC is provided in Appendix D.

4.7 SOIL DISPOSAL

The excavated soil was stockpiled on a polyethylene liner located on the southeast portion of the Site before being disposed of at the Saskatchewan Ministry of Environment licenced City of Prince Albert landfill near Prince Albert, Saskatchewan. The contaminated soil was stored on Site, in an area approved by RCMP Site personnel, before disposal. The soil was capped with a polyethylene tarp until transport to the landfill by a tri-axle end dump tractor trailer unit. The trailer was lined with polyethylene sheeting prior to being filled with the contaminated soil.

Copies of the landfill tickets are provided in Appendix E.

4.8 BACKFILLING AND SITE RESTORATION

The excavations were backfilled with material from each excavation that was deemed clean based on field screening followed by a silty grey sand provided by Points Athabasca. The source of the backfill was approximately 1 km from the Site. The backfill was compacted by Points Athabasca in 150 mm lifts until no further settlement was apparent as per the project specifications. The sod layer was replaced after compaction was complete. The majority of the concrete sidewalk that was removed prior to the excavation was no longer in usable condition; one piece was replaced to ensure a pad for the air conditioner unit.

4.9 SITE CLASSIFICATION

The CCME NCSCS pre-screening checklist was updated from the previous soil investigation on-Site (Amec Foster Wheeler 2015b). The completion of the NCSCS is in compliance with CCME (2010). The NCSCS spreadsheet is presented in Appendix F.

5.0 ASSESSMENT CRITERIA

5.1 GENERAL

Environmental assessment on Canadian Federal sites is based on the assessment criteria produced by CCME. The following documents produced by CCME were selected as being applicable to the Site based on the contaminants of concern.

- CCME Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil, 2001, revised 2008; and
- CCME Canadian Environmental Quality Guidelines, 1999 (updates to 2016).

Based on the above current CCME documents (and their precursors), Amec Foster Wheeler conducted an evaluation of the applicable exposure pathways, land uses, key receptors and predominant soil texture at the Site. The sensitivity assessment was conducted in accordance with current CCME guidelines and did not include the modification or recalculation of the formulas used to derive the criteria values.

5.2 LAND USE

The CCME CWS 2008 has been developed for four generic land uses - agricultural, residential / parkland, commercial, and industrial, that has been adopted within these guidelines. A generic exposure scenario is envisioned for each land use category based on the normal activities on these lands.

At present, the Site contains a RCMP Detachment building with an associated detached garage and RCMP residential dwellings with an associated detached work shop.

The surrounding land use consists of the Fond du Lac River to the north and west, Johnson Street to the east followed by residential / parkland land use and additional RCMP residential dwellings followed by the Hamlet of Stony Rapids water treatment plant to the south.

The residential/parkland land use default exposure scenario as defined by CCME is:

Residential/Parkland: The generic residential property is a typical detached, single family home with a backyard where children, particularly toddlers, play. The critical receptor assumed on a residential property is a toddler who receives 100% of his/her daily intake of soil, drinking water (groundwater), and air (indoors) from the property. Separate guidelines have been developed for two house foundation construction styles; below-grade concrete foundation wall and floor slab (basement) and concrete slab-on-grade foundation. Parks may serve as areas for children's play and other family activities and are therefore also included in the residential land use category.

As the exposure scenario at the Site most closely equate with the CCME residential description, Amec Foster Wheeler has chosen the residential/ parkland land use criteria for the purposes of this assessment. This designation also matches the previous investigations guideline selection (Amec Foster Wheeler 2015b).

5.3 GRAIN SIZE DESIGNATION

The CCME guidelines have been developed for coarse-grained and fine-grained soils for PHC assessments. Fine-grained soils are defined as having a median grain size of less than or equal to 75 µm; coarse-grained soils have a median grain size of greater than 75 µm. Where both fine and coarse grained strata are present, the dominant soil particle size is determined by the stratum governing horizontal and vertical migration to a receptor.

Eight grain size analyses were conducted as part of the historic investigations on the Site. Seven of the soil samples had greater than 50% of soil grains retained on the 75 µm sieve, indicating a coarse grained soil. Therefore, based on previous grain size analysis results and visual inspection of soil samples collected in the field during the excavations, a coarse grain soil designation was assigned to the Site for the purposes of this assessment.

5.4 APPLICABLE EXPOSURE PATHWAYS

CCME recognizes two soil horizons; surface soil and subsoils for PHC assessments. As indicated in CCME's 2009 A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines, surface soil is inclusive of all unconsolidated regolith material from the surface to 1.5 m (≤ 1.5 m depth) and subsoils includes the unconsolidated regolith material located below 1.5 m (>1.5 m depth). Exposure pathways are assessed individually for both horizons.

5.4.1 Human Exposure Pathways

Potential human exposure pathways include the direct contact, vapour inhalation, and protection of groundwater for potable use. The applicability of each of these potential exposure pathways are discussed in the following sections.

5.4.1.1 Direct Contact (Soil Ingestion, Dermal Contact and Soil Inhalation) Pathway

The Site is surfaced with a cover of gravel and grass. The surface cover would not provide a suitable barrier to direct contact with the soil. Therefore, to be protective from all potential direct contact exposure, the direct contact (soil ingestion, dermal contact, and soil inhalation) pathway would be considered applicable to the surface soil horizon.

The direct contact pathway is not considered applicable for the subsoil as the surface soil creates a suitable barrier to avoid contact. Additionally, CCME's Canadian Environmental Quality Guideline (EQC) has not calculated exposure guidelines for soil ingestion and dermal contact in the subsoil horizon. It is assumed that any ground disturbance in which soils at depth previously not accessible are brought to ground surface would result in short term exposure and not be considered applicable to the exposure models in which the CCME guidelines are derived.

5.4.1.2 Vapour Inhalation Pathway

The indoor vapour inhalation (basement) pathway would be considered applicable to both the surface and subsoil horizons at the Site. The Detachment building includes a basement foundation to the south of the heating oil UST.

5.4.1.3 Protection of Potable Groundwater

A search of the Water Security Agency of Saskatchewan (WSASK) water well on-line database at a radius of 3 km from the hamlet of Stony Rapids was conducted. The database indicated that there are no registered wells within the search area.

CCME considers all water bearing units as a potential potable groundwater resource, however CCME defines a water bearing unit as having a hydraulic conductivity of greater than 10^{-4} cm/s. Furthermore, most provincial jurisdictions recognize the division between impacted soil and groundwater that is not hydraulically connected to an underlying aquifer. A five meter thickness of massive unfractured saturated fine-grained material, with a bulk hydraulic conductivity less than 10^{-5} cm/s, is considered sufficient to ensure isolation of groundwater aquifers.

Based on the stratigraphy observed in the subsurface excavation, the soil above the bedrock is made up of primarily granular soils and therefore would not be considered a sufficient subsurface barrier.

The community of Stony Rapids is supplied drinking water by a central water distribution system. The water distribution system obtains raw water from the Fond du Lac River at a point approximately 300 m upstream of the Site.

Based on the lack of utilization of the shallow groundwater in the area and the existence of a municipal water distribution system which originates upstream of the Site, there is sufficient evidence to consider the protection of potable water exposure pathway not applicable to the Site.

5.4.2 Ecological Exposure Pathways

Potential ecological exposure pathways include the ecological soil contact and freshwater aquatic life pathways. The applicability of each of these potential exposure pathways are discussed in the following sections.

5.4.2.1 Ecological Soil Contact Pathway

The ecological soil contact pathway would be considered applicable to be protective of potential ecological receptor exposure, from terrestrial and subterranean organisms and plant root systems, to soils in the surface soil horizon as the Site is surfaced with gravel and grass which does not provide a suitable ground barrier.

Ecological receptor direct contact exposure to soils in the subsoil horizon is not considered applicable as the surface soil creates a suitable barrier to avoid subsoil ecological contact from organisms at the ground surface and the subsoil horizon is not typically suitable to support invertebrates or burrowing mammals.

5.4.2.2 Soil / Food Ingestion

CCME states that soil and food ingestion by cows as a representative livestock species for agricultural sites, and mule deer, meadow voles and American robins as representative wildlife species for residential/parkland sites, are considered in assessing potential impacts. The grassed areas on Site present exposure pathways to small wildlife and birds. As a result, the soil / food ingestion pathway is considered applicable on the Site.

5.4.2.3 Freshwater Aquatic Life Pathway

CCME states that the freshwater aquatic life pathway may be excluded in cases where there is no surface water body within 10 m of a site classified as fine grained and 500 m of a site classified as coarse grain for PHC components. The freshwater aquatic life pathway is excluded in cases where there is no surface water body within 500 m for all other parameters. If a surface water body is within 500 m, it must be assessed to determine whether the freshwater aquatic life pathway is applicable.

As the Fond du Lac River is located within approximately 20 m to the north and west of the Site, the freshwater aquatic life pathway is considered to be applicable at the Site.

5.4.3 Miscellaneous Criteria

As residential/parkland land use criteria are applicable to the Site, off-site migration check and soil management limits as produced by CCME for PHCs are required to be assessed to determine if they are applicable to the assessment.

5.4.3.1 Off-Site Migration Check

As there are no neighbouring properties with a more sensitive land use designation the off-site migration check does not apply to the Site.

5.4.3.2 Management Limit

The management limits for PHCs applies for soils in the surface soil and subsoil horizon.

5.5 SUMMARY OF APPLICABLE GUIDELINES

Given the residential land use designation of the Site, the coarse-grained nature of the soil, and the applicable exposure pathways as outlined in the previous sections, Amec Foster Wheeler determined assessment guidelines for each contaminant of concern. The most stringent of the applicable exposure pathway guideline values as produced by CCME was used for each contaminant for both the surface soil and subsoil horizons.

Petroleum Hydrocarbon (PHC) Soil Guidelines

Above 1.5 m below grade:

Residential/parkland values for coarse grained surface soil in a non-potable groundwater situation as limited by the:

- Indoor Vapour Inhalation (Basement) exposure pathway for benzene, xylenes and PHC Fraction F1;
- Freshwater Aquatic Life exposure pathway for toluene and ethylbenzene; and
- Ecological Soil Contact exposure pathway for PHC Fractions F2-F4.

Below 1.5 m below grade:

Residential/parkland values for coarse grained subsoil in a non-potable groundwater situation as limited by the:

- Indoor Vapour Inhalation (Basement) exposure pathway for benzene, xylenes and PHC Fractions F1 and F2;
- Freshwater Aquatic Life exposure pathway for toluene and ethylbenzene; and
- Management Limits for PHC Fractions F3 and F4.

The CCME Soil Quality Guideline for benzene provides for both a 10^{-6} (1 in 1,000,000) and 10^{-5} (1 in 100,000) incremental risk of cancer. The results obtained in this soil remediation will be compared to the 10^{-5} incremental risk guideline as per the risk assessment completed by Amec Foster Wheeler (2015a).

The applicable residential assessment guidelines are shown in Table 2 (Appendix B).

6.0 REMEDIATION RESULTS

6.1 SERVICE LOCATIONS

The Site has many public and private underground utilities present. For the purpose of this report, only relevant underground utility lines near and adjacent to the excavation are referenced. Private underground electrical lines were identified running north-south along the

building on the east side of the excavation as well as from the northwest corner of the Detachment building to the garage on the west side of the excavation. A SaskTel fibre optic line also ran north-south from the Detachment building to the garage on the west side of the excavation.

During the initial excavation, four underground lines were uncovered to run north-south from the Detachment building. The lines included: an old fuel line at 0.5 m bgl, an unidentified line at 0.5 m bgl, an old water line at 0.5 m bgl, and a second unidentified line at 1.5 m bgl. The lines were identified to be abandoned and were cut and removed from within the excavation.

All Site services utility locations are shown on Figure 2 (Appendix A).

6.2 SOIL CONDITIONS

6.2.1 Stratigraphy

Observations made by Amec Foster Wheeler during the excavation and tank removal identified topsoil to 0.3 m bgl followed by a grey stiff silt to 0.5 m bgl and a fine to medium grained light brown sand to the maximum depth of the excavation (4.0 m bgl). Below 1.5 m the sand turned to reddish brown; below 2.0 m large gravel was identified; and below 3.0 m large rocks and boulders interbedded with the sand were identified.

6.2.2 Field Observations

Soil vapour concentrations and field observations made during the field excavations on 6 October and 15 November 2016 are summarized in Table 3 (Appendix B).

The maximum soil vapour concentration encountered during the initial excavation were considered relatively low at 50 ppm_v on the north, south, and west wall and floor. The maximum soil vapour concentration encountered along the east wall was 450 ppm_v in sample E1@2.0 m bgl and 160 ppm_v in sample E1@1.0 m bgl. Due to sample submission error, E1@3.0 m bgl was submitted for laboratory analysis. The soil vapour concentration in the remaining samples did not exceed 80 ppm_v.

The UST excavation expanded on the initial excavation to accommodate the UST removal requirements. This expansion of the excavation area included along the east wall and no evidence of potential impacts were identified along the east wall excavation extents.

The maximum soil vapour concentration along the south wall during the UST excavation from the samples submitted for analysis were considered relatively low at 165 ppm_v in samples S12@3.05 and S13@3.05 at 3.05 m bgl. The soil vapour concentration in the remaining sample submitted for analysis was 80 ppm_v.

6.2.3 Soil Laboratory Results – PHCs

A total of 14 confirmatory soil samples, including two duplicates, from both excavations were submitted for laboratory analysis of BTEX and PHC Fraction F1 to F4. All PHC constituents did not exceed the applicable assessment guidelines. The results of the laboratory analysis conducted on the selected soil samples are summarized in Table 4 (Appendix B). Copies of the detailed analytical reports are provided in Appendix D.

One soil sample submitted for analysis of Class II Landfills was submitted to the City of Prince Albert Landfill as part of the soil acceptance protocols. A copy of the detailed analytical reports is provided in Appendix D.

6.3 SITE CLASSIFICATION

The CCME NCSCS completed as part of the Preliminary Quantitative Human Health Risk Assessment (PQHHRA) and Preliminary Quantitative Ecological Risk Assessment (PQERA) in 2015 by AMEC gave the Site a score of 34.1 which is a Class N “Not a priority for Action”. The NCSCS pre-screening checklist completed for the Site in 2015 by AMEC was re-evaluated following the excavation. The score for the Site did not change due to the remaining impacts at AEC2 which were not addressed during the excavation.

The NCSCS checklist is provided in Appendix F.

6.4 QUALITY ASSURANCE

6.4.1 Accreditation

The ALS laboratory located in Saskatoon, Saskatchewan is certified with the Canadian Association for Laboratory Accreditation Inc. (CALA).

6.4.2 Data Validation

Laboratory QA/QC

The laboratory incorporates various QA/QC procedures to ensure the accuracy of the laboratory results and assess the possibility of false positives attributed to analytical equipment contributions and laboratory control samples.

The laboratory QA/QC includes the completion of laboratory blanks, blank spikes and blank spike recovery. A summary of laboratory QA/QC findings is presented below:

- All samples/sample extracts were analyzed within their applicable hold times using approved analytical methods;

- Agreement between the corresponding datasets for the reference material samples, where applicable, and recoveries reported for spiked samples/blanks, where applicable, were within acceptable range; and
- Surrogate recoveries were within acceptable ranges in all cases for all samples.

Field QA/QC

Two blind field duplicates (initial excavation W1@3.0/A001 and tank decommissioning S13@3.05/A001) were collected as part of the field program.

The relative percent difference (RPD) approach can be used as a means of assessing the accuracy of the duplicate analytical results. The RPD is calculated for specific parameters using the following equation:

$$\text{Field Duplicate RPD (\%)} = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

where: RPD = relative percent difference

C1= first of two observed values from the field duplicate analysis

C2 = second of two observed values from the field duplicate analysis

RPD values can be calculated for parameters that contain detectable concentrations at least five times greater than the laboratory MDLs. The original soil samples from W1@3.0 and S13@3.05, and their respective duplicates, did not contain detectable PHC concentrations at least five times greater than the laboratory MDLs. As such, RPDs for PHCs could not be calculated.

Based on the laboratory analysis, sample collection with new nitrile gloves and laboratory supplied sample containers, sample storage, and transportation of the samples to the laboratory, had no material effect on the quality of the data collected as part of this assessment. The laboratory results for the soil samples obtained during Amec Foster Wheeler's remedial activities are considered to be valid. The results of the QA/QC analyses are detailed on the laboratory Certificates of Analyses in Appendix D.

7.0 SUMMARY

Amec Foster Wheeler, was retained by PWGSC ES to conduct a remediation program at the RCMP detachment in Stony Rapids, Saskatchewan. The purpose of the remediation program was to excavate previously identified PHC impacts in the area of the former heating oil underground storage tank.

Between 2012 and 2015, five separate environmental assessments were completed at the Site. In 2012, Stantec Consulting Ltd. completed a Phase I ESA and EGE Engineering Ltd. completed a Phase II ESA. Tetra Tech WEI Inc. completed a Phase III ESA in 2013. Amec Foster Wheeler completed a supplemental sampling program and risk assessment in 2015.

The previous assessments identified two AECs. AEC 1, an area located around a former heating oil UST was determined to have an estimated 36 m³ of PHC impacted soils. AEC 2, an area located around a former gasoline UST and current gasoline AST was determined to have an estimated 192 m³ of PHC and naphthalene impacted soils. PWGSC ES requested that only the impacted soil at AEC1 be remediated at this time.

The Site was classified as a residential land use with a coarse grain soil nature under the definitions of CCME. The appropriate CCME guidelines for the protection of human health and the environment for BTEX, and PHC concentrations of fractions F1 to F4 were selected.

The Amec Foster Wheeler remediation program was started on 4 October 2016 and consisted of the excavation of approximately 20 m³ of PHC impacted soil in the area of the former heating oil UST to a maximum depth of 4.0 m bgl. During the initial excavation, the UST was encountered approximately 1.0 m bgl along the south wall of the excavation. The UST had been reportedly removed between 1989 and 1993.

An additional excavation was completed on 15 November 2016 for the removal of the UST. Approximately 18 m³ of PHC impacted soil was removed from the excavation of the UST removal. Due to considerable sloughing of soil along the south wall of the excavation, and concern pertaining to the structural stability of the RCMP detachment building, part of the concrete slab on which the UST was situated was left in place. Soil samples taken from the south wall of the excavation were collected below the remaining concrete slab. The final depth of the UST excavation was up to 4.2 m bgl. The final extents were approximately 5.5 m north-south by 5.5 to 6.0 m east-west.

The maximum soil vapour concentration encountered during the initial excavation were considered relatively low at 50 ppm_v on the north, south, and west wall and floor. The maximum soil vapour concentration encountered along the east wall was 450 ppm_v in sample E1@2.0 m bgl and 160 ppm_v in sample E1@1.0 m bgl. Due to sample submission error, E1@3.0 m bgl was submitted for laboratory analysis. The soil vapour concentration in the remaining samples did not exceed 80 ppm_v.

The UST excavation expanded on the initial excavation to accommodate the UST removal requirements. This expansion of the excavation area included along the east wall and no evidence of potential impacts were identified along the east wall excavation extents.

The maximum soil vapour concentration encountered during the UST excavation was relatively low at 165 ppm_v in samples S12@3.05 and S13@3.05 at 3.05 m bgl.

A total of 14 soil samples, including two duplicates, from both excavations were submitted for laboratory analysis of BTEX and PHC Fraction F1 to F4. All PHC constituents did not exceed the applicable assessment guidelines.

Based on the field screening results and laboratory results, Amec Foster Wheeler considers the potential for remaining soil adjacent to the residual concrete pad to exceed the applicable assessment guidelines to be low.

The NCSCS checklist from the 2015 Risk Assessment completed by Amec Foster Wheeler was updated to include the remediation of AEC 1. The score for the Site did not change due to the remaining impacts at AEC 2 which were not addressed as part of this scope of work.

8.0 CONCLUSION

In Amec Foster Wheeler's opinion, further remediation work is not required as all analytical results did not exceed applicable criteria and there are no further identified environmental concerns associated with AEC 1.

9.0 REFERENCES

Amec Foster Wheeler Preliminary Quantitative Human Health Risk Assessment (PQHHRA) and Preliminary Quantitative ecological risk assessment (PQERA). March 2015a.

Amec Foster Wheeler Supplemental Sampling Program, RCMP Detachment, Stony Rapids, Saskatchewan. March 2015b.

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Stantec Consulting Ltd. Stony Rapids RCMP Detachment and Attached Housing, Garage, Workshop and Two Employee Housing Facilities. DRRP# 14862, Stony Rapids, Saskatchewan. January 2012.

Tetra Tech WEI Inc. 2013 Phase III Environmental Site Assessment, RCMP Detachment Site, Stony Rapids, Saskatchewan. 2013.

10.0 CLOSURE

The work performed in the preparation of this report and the conclusions presented are subject to the following: (a) The Terms and Conditions specified in Amec Foster Wheeler's contract with PWGSC under "EW699-141853/003/NCS Environmental Consulting Services – AB,SK,MB."; (b) The Scope of Services; and (c) Time and Budgetary restrictions as described in our proposal.

This report was prepared for the use of PWGSC and the RCMP, and is intended to provide a Remediation Program on the RCMP Detachment – Stoney Rapids Site at the time of the Site remediation activities. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party.

The report was prepared in accordance with generally accepted environmental science and/or engineering practices. No warranties, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the information and conclusions presented in this report. The contents of this report are based on the information collected during the remedial activities, our understanding of the actual Site conditions, and our professional opinion according to the information available at the time of preparation of this report. This report gives a professional opinion and, by consequence, no guarantee is attached to the conclusions or expert advice depicted in this report. This report does not provide a legal opinion.

The report is based on data and information collected during the Remediation Program of the property conducted by Amec Foster Wheeler. It is based solely on the conditions of the Site encountered at the time of the Site remediation activities, supplemented by a review of historical information and data obtained by Amec Foster Wheeler as described in this report, as reported herein. The conclusions presented in this report were based, in part, on visual observations of the Site and attendant structures, if present. Our conclusions cannot and are not extended to include those portions of the Site or structures, which are not reasonably available, in Amec Foster Wheeler's opinion, for direct observation.

Except as otherwise may be specified, Amec Foster Wheeler disclaims any obligation to update this report for events taking place, or with respect to information that becomes available to Amec Foster Wheeler after the time during which Amec Foster Wheeler conducted the Remediation Program.

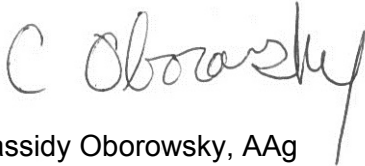
In evaluating the property, Amec Foster Wheeler has relied in good faith on information provided by other individuals noted in this report. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report. Amec Foster Wheeler has assumed that the information provided is factual and accurate. Amec Foster Wheeler accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

The objective of this report was to assess environmental conditions at the Site, within the context of our contract and existing environmental regulations within the applicable jurisdiction. Evaluating compliance of past or future owners with applicable local, provincial and federal government laws and regulations was not included in our contract for services. Amec Foster Wheeler makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

Our observations relating to the condition of environmental media at the Site are described in this report. Where testing was performed, it was carried out in accordance with the terms of our contract. Other substances, or different quantities of substances tested for, may be present on Site and may be revealed by different or other testing not provided for in our contract. The findings and conclusions presented in this report are based exclusively on the information described above, field parameters measured, and the chemical parameters tested at specific locations. It should be recognized that subsurface conditions between and beyond the sample locations may vary. Amec Foster Wheeler cannot expressly guarantee that subsurface conditions between and beyond the sample locations do not vary from the results determined at the sample locations. Consequently, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, Amec Foster Wheeler can be notified in order that they may determine if modifications to the conclusions in the report are necessary. Notwithstanding these limitations, this report is believed to provide a reasonable representation of Site conditions at the date of issue.

We trust that this report meets your present requirements. Please contact our office if you have any questions or if we can be of further assistance.

Respectively submitted,
Amec Foster Wheeler
Environment & Infrastructure



Cassidy Oborowsky, AAg
Junior Environmental Scientist



Sherry Cochran, P. Eng.
Senior Environmental Engineer
Project Manager

Reviewed by:



Michael Bertram, P.Eng.
Senior Environmental Engineer

APPENDIX A

FIGURES

LEGEND / LÉGENDE

- Provincial capital / Capitale provinciale
- Other populated places / Autres lieux habités
- Trans-Canada Highway / La Transcanadienne
- Major road / Route principale
- International boundary / Frontière internationale
- Provincial boundary / Limite provinciale

Scale / Echelle

75 0 75 150 225 km



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Sa Majesté la Reine du chef du Canada, Ressources naturelles Canada.

UNITED STATES OF AMERICA
ÉTATS-UNIS D'AMÉRIQUE

KEY PLAN



CLIENT:

PUBLIC WORKS AND GOVERNMENT SERVICES - CANADA

LEGEND:

--- SITE BOUNDARY

NOTE: SITE FEATURE LOCATIONS ARE APPROXIMATE

SITE REMEDIATION
ENVIRONMENTAL SITE ASSESSMENT

RCMP DETACHMENT

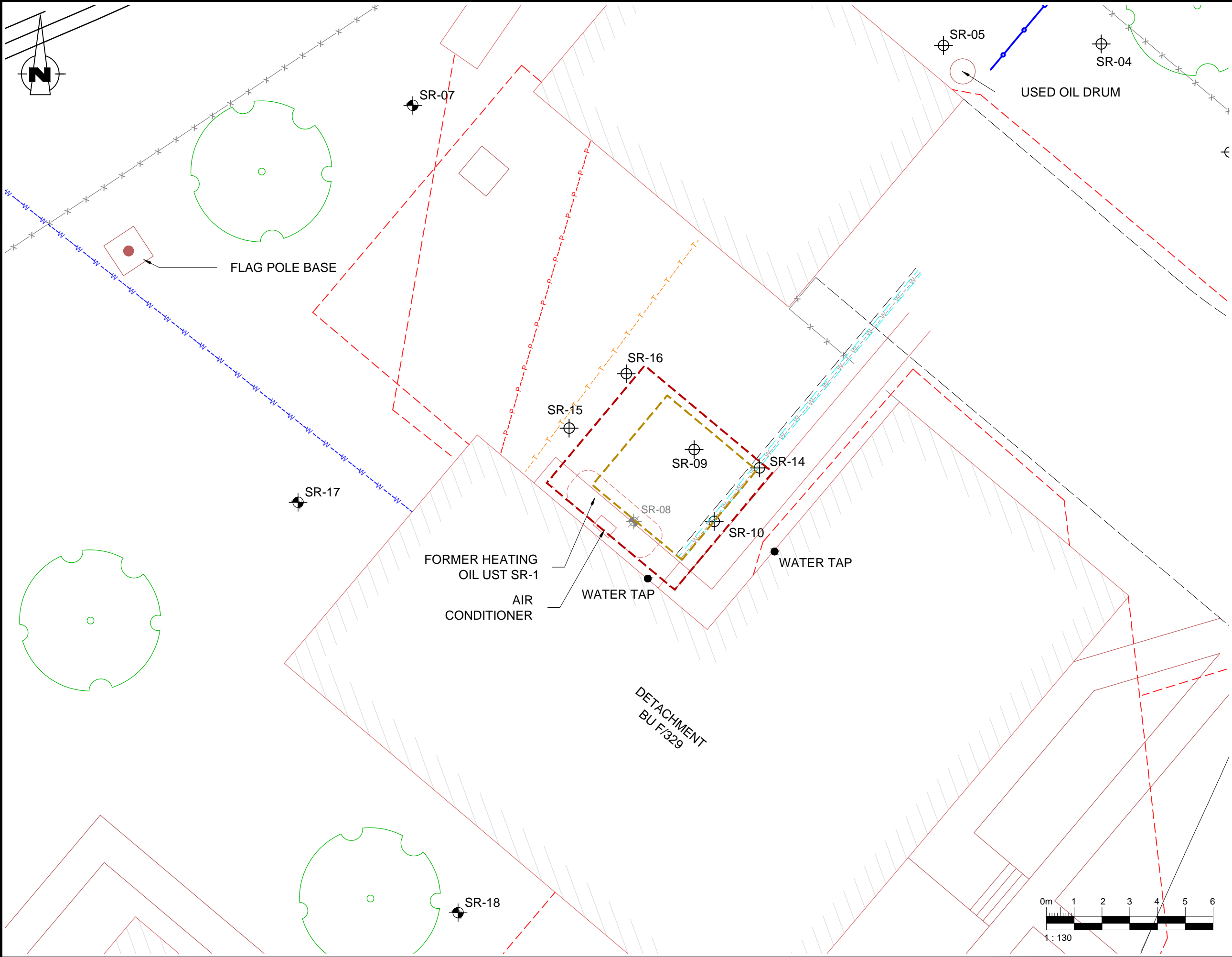
STONY RAPIDS, SASKATCHEWAN

**SITE AND SURROUNDING
LAND USE PLAN**

SCALE: AS SHOWN
DATE: MARCH 2017
DRAWN BY: C.Y.W.
PROJECT NO: SX04344

FIGURE 1




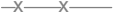








P:\Projects\SX04300\SX04344 - PWGSC Stony Rapids\DRAWING\SX04344-16.dwg - FIGURE 1 - Mar. 13, 2017 1:33pm - caroline.wu



CLIENT:

PUBLIC WORKS AND GOVERNMENT SERVICES - CANADA

LEGEND:

-  TEST HOLE (EGE ENGINEERING LTD. 2012)
-  MONITORING WELL (EGE ENGINEERING LTD. 2012)
-  MONITORING WELL DESTROYED
-  FENCE LINE
-  UNDERGROUND POWER LINE
-  WATER LINE
-  UNKNOWN LINE
-  FUEL LINE
-  POWER LINE
-  TELEPHONE LINE
-  2016 NOVEMBER EXCAVATION LIMIT
-  2016 OCTOBER EXCAVATION LIMIT

NOTE: SITE FEATURE LOCATIONS ARE APPROXIMATE
IMAGE FROM GOOGLE EARTH

SITE REMEDIATION
ENVIRONMENTAL SITE ASSESSMENT

RCMP DETACHMENT

STONY RAPIDS, SASKATCHEWAN

SITE PLAN

SCALE: 1:130

DATE: MARCH 2017

DRAWN BY: C.Y.W.

PROJECT NO: SX04344

FIGURE 2



CLIENT:
**PUBLIC WORKS AND GOVERNMENT
SERVICES - CANADA**

LEGEND:

- SAMPLE LOCATION
- GREEN INDICATES BELOW CRITERIA

NOTE: SITE FEATURE LOCATIONS ARE APPROXIMATE
IMAGE FROM GOOGLE EARTH

SITE REMEDIATION
ENVIRONMENTAL SITE ASSESSMENT

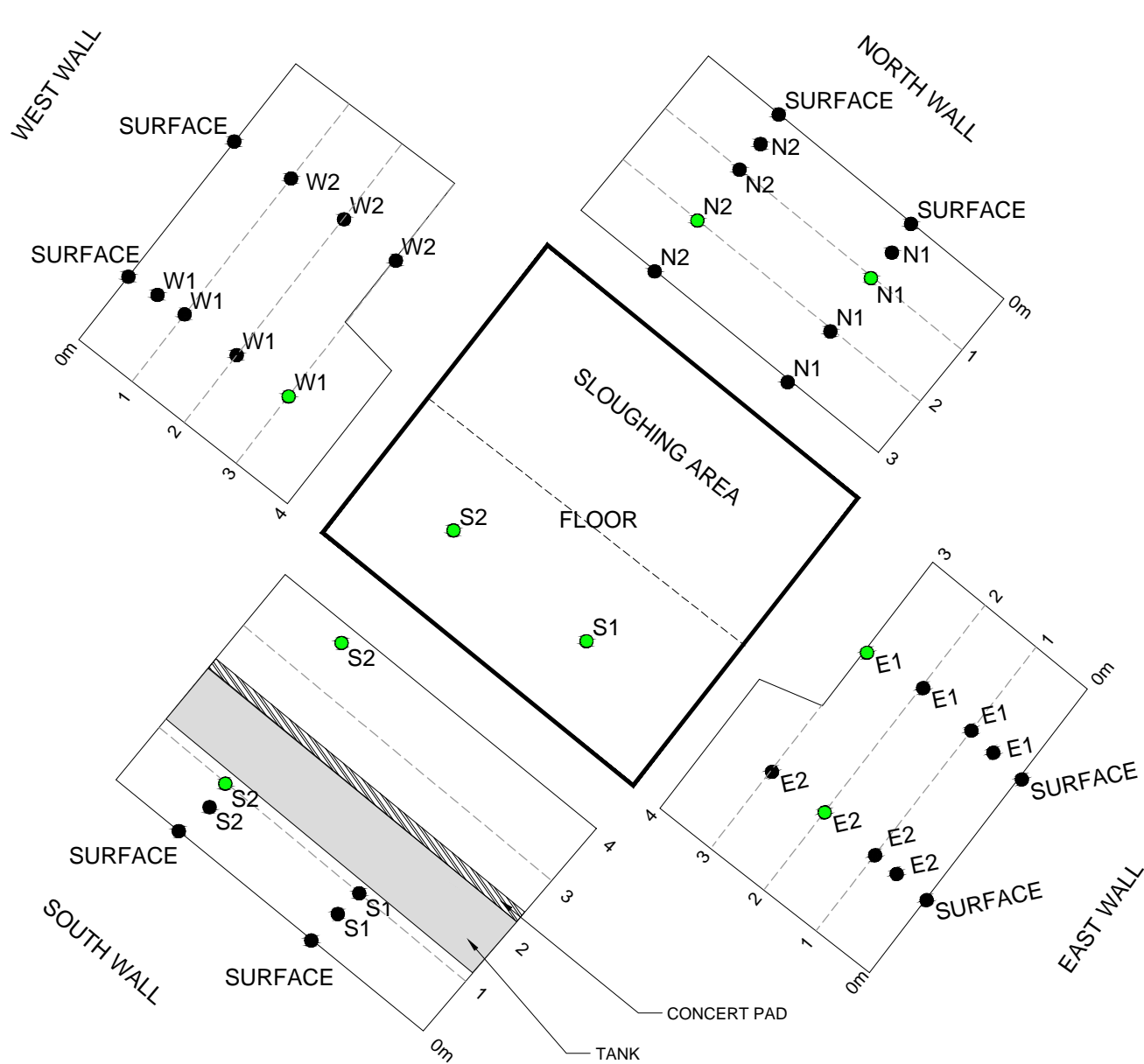
RCMP DETACHMENT

STONY RAPIDS, SASKATCHEWAN

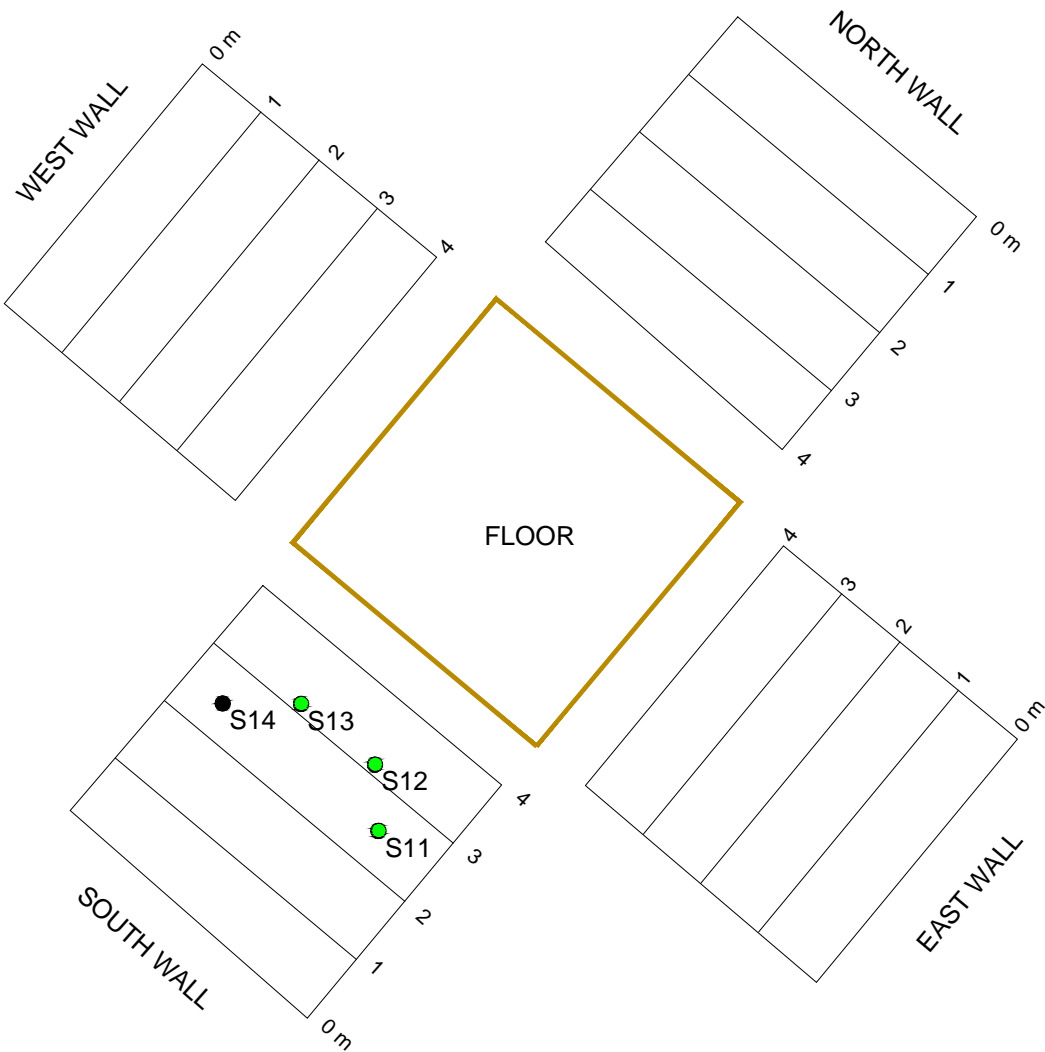
**SOIL EXCAVATION & UST
REMOVAL PLAN**

SCALE: 1:100
DATE: MARCH 2017
DRAWN BY: C.Y.W.
PROJECT NO: SX04344

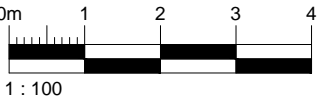
FIGURE 3



SOIL EXCAVATION



UST REMOVAL



APPENDIX B

TABLES

TABLE 1: SURROUNDING LAND USE		
Direction	Description / Land Use	Approx. Distance (m)
Site	Stoney Rapids RCMP detachment with on-Site residence, gargage and work shop	-
	Residential / Parkland	
North	Treed shoreline followed by Fond Du Lac River	Adjacent 15 m
	Residential / Parkland	
East	Johnson Street followed by Residential	Adjacent 25 m
	Residential / Parkland	
South	RCMP buildings (Residence) followed by Stony Rapids water treatment plant.	Adjacent 30 m
	Residential / Parkland	
West	Treed shoreline followed by Fond Du Lac River	Adjacent 15 m
	Residential / Parkland	

TABLE 2: ASSESSMENT GUIDELINES									
Land Use	Exposure Pathway	Coarse Grained Soil Guidelines (ug/g) (PHCs)							
		Benzene*	Toluene	Ethylbenzene	Xylenes	PHC (F1)	PHC (F2)	PHC (F3)	PHC (F4)
Residential (≤ 1.5 m depth)	Soil Ingestion	110	22,000	10,000	150,000	12,000	6,800	15,000	21,000
	Dermal Contact	250	220,000	58,000	NA				
	Indoor Vapour Inhalation	0.15	200	88	22	40	190	NA	NA
	Ecological Soil Contact	31	75	55	95	210	150	300	2,800
	Soil and Food Ingestion	NG	NG	NG	NG	NG	NG	NG	NG
	Freshwater Aquatic Life Pathway	1	0.1	50	37	970	380	NA	NA
	Management Limits	NG	NG	NG	NG	700	1,000	2,500	10,000
Residential (> 1.5 m depth)	Indoor Vapour Inhalation	0.15	200	88	22	40	190	NA	NA
	Freshwater Aquatic Life Pathway	1	0.1	50	37	970	380	NA	NA
	Management Limits	NG	NG	NG	NG	700	1,000	2,500	10,000

Notes:

- PHC (F1) - volatile petroleum hydrocarbons (C₆ – C₁₀)
- PHC (F2) - extractable petroleum hydrocarbons (C₁₀ – C₁₆)
- PHC (F3) - extractable petroleum hydrocarbons (C₁₆ – C₃₄)
- PHC (F4) - extractable petroleum hydrocarbons (C₃₄ – C₅₀)
- **BOLD** – selected guideline
- NA - not applicable, calculated value exceeds 1,000,000 mg/kg
- NC - not calculated
- NG - no guideline available
- CCME EQG Criteria – residential land use criteria as outlined in the Canadian Council of the Ministers of the Environment (CCME) "Canadian Environmental Quality Guidelines", 1999 (updates to 2016). The benzene concentration is based on one million (10⁻⁶) incremental risk of cancer.
- CCME CWS PHC Criteria - residential land use criteria as outlined in the Canadian Council of the Ministers of the Environment (CCME) "Canada-Wide Standards for Hydrocarbons in Soil", 2001, revised 2008.

TABLE 3: FIELD OBSERVATIONS AND SOIL VAPOUR TESTING						
Sample ID	Date	Wall / Base	Depth (m)	Staining Zone (m)	Soil Vapour Concentration	Submitted for Laboratory Analysis?
					Level (ppm _v)	
Initial Excavation						
N1@Surface	6-Oct-16	North Wall	Surface	None	ND	N
N1@1.0	6-Oct-16	North Wall	1.0	None	50	Y
N1@2.0	6-Oct-16	North Wall	2.0	None	30	N
N1@3.0	6-Oct-16	North Wall	3.0	None	ND	N
N2@Surface	6-Oct-16	North Wall	Surface	None	ND	N
N2@1.0	6-Oct-16	North Wall	1.0	None	ND	N
N2@2.0	6-Oct-16	North Wall	2.0	None	ND	Y
N2@3.0	6-Oct-16	North Wall	3.0	None	ND	N
E1@Surface	6-Oct-16	East Wall	Surface	None	ND	N
E1@0.5	6-Oct-16	East Wall	0.5	None	5	N
E1@1.0	6-Oct-16	East Wall	1.0	None	160	N
E1@2.0	6-Oct-16	East Wall	2.0	None	450	N
E1@3.0	6-Oct-16	East Wall	3.0	None	15	Y
E2@Surface	6-Oct-16	East Wall	Surface	None	ND	N
E2@0.5	6-Oct-16	East Wall	0.5	None	5	N
E2@1.0	6-Oct-16	East Wall	1.0	None	80	N
E2@2.0	6-Oct-16	East Wall	2.0	None	80	Y
E2@3.0	6-Oct-16	East Wall	3.0	None	80	N
S1@Surface	6-Oct-16	South Wall	Surface	None	ND	N
S1@0.5	6-Oct-16	South Wall	0.5	None	ND	N
S1@1.0	6-Oct-16	South Wall	1.0	None	15	N
S1@SH	6-Oct-16	South Wall	1.0	None	15	N
S1@Floor	6-Oct-16	Floor	4.0	None	20	Y
S2@Surface	6-Oct-16	South Wall	Surface	None	5	N
S2@0.5	6-Oct-16	South Wall	0.5	None	5	N
S2@1.0	6-Oct-16	South Wall	1.0	None	20	Y
S2@3.0	6-Oct-16	South Wall	3.0	None	ND	Y
S2@3.8	6-Oct-16	South Wall	3.8	None	ND	Y
S2@Floor	6-Oct-16	Floor	4.0	None	ND	Y
W1@Surface	6-Oct-16	West Wall	Surface	None	ND	N
W1@0.5	6-Oct-16	West Wall	0.5	None	ND	N
W1@1.0	6-Oct-16	West Wall	1.0	None	ND	N
W1@2.0	6-Oct-16	West Wall	2.0	None	ND	N
W1@3.0	6-Oct-16	West Wall	3.0	None	ND	Y
W2@Surface	6-Oct-16	West Wall	Surface	None	ND	N
W2@0.5	6-Oct-16	West Wall	0.5	None	ND	N
W2@1.0	6-Oct-16	West Wall	1.0	None	ND	N
W2@2.0	6-Oct-16	West Wall	2.0	None	ND	N
Tank Decommission						
S11@2.5	15-Nov-16	South Wall	2.5	None	80	Y
S12@3.05	15-Nov-16	South Wall	3.05	None	165	Y
S13@3.05	15-Nov-16	South Wall	3.05	None	165	Y
S14@2.5	15-Nov-16	South Wall	2.5	None	165	N

Notes:

- ppm_v - parts per million total combustible vapour
- m - metres
- ND - Non-detect

TABLE 4: SOIL ANALYTICAL RESULTS - PHCs											
Sample No.	Date Sampled (dd-mmm-yy)	Depth (m)	Soil Vapour Concentration (ppm _v)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
Initial Excavation											
N1@1.0	6-Oct-16	1.0	50	<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
S2@1.0	6-Oct-16	1.0	20	<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
CCME Residential EQG (≤1.5m depth)				0.150	0.10	50	22	NG	NG	NG	NG
CCME Residential CWS PHC – coarse grained soils (≤1.5m depth below grade)								40	150	300	2,800
Initial Excavation											
N2@2.0	6-Oct-16	2.0	ND	<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
E1@3.0	6-Oct-16	3.0	15	<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
E2@2.0	6-Oct-16	2.0	80	<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
S1@Floor	6-Oct-16	4.0	20	<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
S2@Floor	6-Oct-16	4.0	ND	<0.0050	<0.50	<0.010	<0.10	<10	<30	<50	<50
W1@3.0	6-Oct-16	3.0	ND	<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
A001				<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
S2@3.8	6-Oct-16	3.8	ND	<0.0050	0.099	0.026	0.18	<10	57	<50	<50
Tank Decommission											
S11@2.5	15-Nov-16	2.5	80	<0.0050	<0.050	<0.010	<0.10	<10	<30	<50	<50
S12@3.05	15-Nov-16	3.05	165	<0.0050	<0.050	0.019	0.27	28	86	<50	<50
S13@3.05	15-Nov-16	3.05	165	<0.0050	<0.050	0.016	0.2	18	123	<50	<50
A001				<0.0050	<0.050	0.037	0.37	35	95	<50	<50
CCME Residential EQG (>1.5m depth)				0.150	0.10	50	22	NG	NG	NG	NG
CCME Residential CWS PHC – coarse grained soils (>1.5m depth below grade)								40	190	2,500	10,000

- (mg/kg) – milligrams per kilogram
- BOLD** – exceeds the referenced guideline
- F1 – volatile petroleum hydrocarbons (C₆-C₁₀); correct for BTEX concentrations
- F2 – extractable petroleum hydrocarbons (C₁₀-C₁₆)
- F3 – extractable petroleum hydrocarbon (C₁₆-C₃₄)
- F4 – extractable petroleum hydrocarbons (C₃₄-C₅₀)
- < - less than the method detection limit
- NM - Not measured
- NA - Not applicable
- ND - Not detected
- NG - No guideline
- CCME EQG Criteria – residential land use criteria as outlined in the Canadian Council of the Ministers of the Environment (CCME) "Canadian Environmental Quality Guidelines", 1999 (updated 2016). The benzene concentration is based on one in one hundred thousand (10⁻⁵) incremental risk of cancer.
- CCME CWS PHC Criteria – residential land use criteria as outlined in the Canadian Council of the Ministers of the Environment (CCME) "Canada-Wide Standards for Hydrocarbons in Soil", 2001, revised 2008.
- See laboratory report for detection limits, testing protocols and QA/QC procedures. Laboratory analysis was performed by ALS Laboratory in Saskatoon.

APPENDIX C

SITE PHOTOGRAPHS



PHOTOGRAPH 1: View of excavation area facing east.



Old water line, fuel line and
unidentified line at 0.5 m bgl

PHOTOGRAPH 2: Uncovering abandoned lines along the east wall of the excavation facing south.



Environment & Infrastructure

**SITE PHOTOGRAPHS
REMEDIAL EXCAVATION
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: OCT 2016

Project No.: SX04344

Photo Log: 1



PHOTOGRAPH 3: Uncovering the UST during the initial excavation facing south.



PHOTOGRAPH 4: View south at the exposed tank and concrete pad.



Environment & Infrastructure

**SITE PHOTOGRAPHS
REMEDIAL EXCAVATION
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: OCT 2016

Project No.: SX04344

Photo Log: 2



PHOTOGRAPH 5: Excavating around the UST to remove.



PHOTOGRAPH 6: Excavating soil out of the UST placed during the initial excavation.



Environment & Infrastructure

**SITE PHOTOGRAPHS
REMEDIAL EXCAVATION
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: NOV 2016

Project No.: SX04344

Photo Log: 3



PHOTOGRAPH 7: Removing concrete pad the UST was situated on.



PHOTOGRAPH 8: Crushed UST waiting to be hauled to local landfill.



Environment & Infrastructure

**SITE PHOTOGRAPHS
REMEDIAL EXCAVATION
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: NOV 2016

Project No.: SX04344

Photo Log: 4



PHOTOGRAPH 9: Covered impacted soil stockpile.



PHOTOGRAPH 10: Site condition post remediation.



Environment & Infrastructure

**SITE PHOTOGRAPHS
REMEDIAL EXCAVATION
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: NOV 2016

Project No.: SX04344

Photo Log: 5

APPENDIX D

LABORATORY ANALYTICAL RESULTS



Amec Foster Wheeler plc
ATTN: SHERRY COCHRAN
4015 MILLAR AVENUE
SASKATOON SK S7K 2K6

Date Received: 07-OCT-16
Report Date: 17-OCT-16 12:29 (MT)
Version: FINAL

Client Phone: 306-975-0444

Certificate of Analysis

Lab Work Order #: L1840862
Project P.O. #: NOT SUBMITTED
Job Reference: SX04344PRW
C of C Numbers:
Legal Site Desc: STONY RAPIDS

Brian Morgan, B.Sc. Hons.
Client Services Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: #819-58th St E., Saskatoon, SK S7K 6X5 Canada | Phone: +1 306 668 8370 | Fax: +1 306 668 8383
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1840862-2 N1@1.0 Sampled By: TA on 06-OCT-16 @ 12:00 Matrix: SOIL BTEX, F1-F4 and SK Reg. PHC's. CCME BTEX Benzene <0.0050 0.0050 mg/kg 12-OCT-16 13-OCT-16 R3570905 Toluene <0.050 0.050 mg/kg 12-OCT-16 13-OCT-16 R3570905 Ethylbenzene <0.010 0.010 mg/kg 12-OCT-16 13-OCT-16 R3570905 Xylenes <0.10 0.10 mg/kg 12-OCT-16 13-OCT-16 R3570905 o-Xylene <0.050 0.050 mg/kg 12-OCT-16 13-OCT-16 R3570905 m+p-Xylene <0.050 0.050 mg/kg 12-OCT-16 13-OCT-16 R3570905 Styrene <0.050 0.050 mg/kg 12-OCT-16 13-OCT-16 R3570905 Surrogate: 1,4-Difluorobenzene 90.3 70-130 % 12-OCT-16 13-OCT-16 R3570905 Surrogate: 4-Bromofluorobenzene 88.1 70-130 % 12-OCT-16 13-OCT-16 R3570905 CCME Total Hydrocarbons F1 (C6-C10) <10 10 mg/kg 14-OCT-16 F1-BTEX <10 10 mg/kg 14-OCT-16 F2 (C10-C16) <30 30 mg/kg 14-OCT-16 F3 (C16-C34) <50 50 mg/kg 14-OCT-16 F4 (C34-C50) <50 50 mg/kg 14-OCT-16 Total Hydrocarbons (C6-C50) <50 50 mg/kg 14-OCT-16 Extractable Hydrocarbons. Tumbler/GC-FID TEH (C11-C22) <50 50 mg/kg 11-OCT-16 14-OCT-16 R3571326 TEH (C23-C60) <100 100 mg/kg 11-OCT-16 14-OCT-16 R3571326 Chrom. to baseline at nC50 YES 0 11-OCT-16 14-OCT-16 R3571326 Surrogate: 2-Bromobenzotrifluoride 83.6 70-130 % 11-OCT-16 14-OCT-16 R3571326 Miscellaneous Parameters % Moisture 8.9 1.0 % 11-OCT-16 12-OCT-16 R3568998							
L1840862-3 N2@2.0 Sampled By: TA on 06-OCT-16 @ 12:00 Matrix: SOIL BTEX, F1-F4 and SK Reg. PHC's. CCME BTEX Benzene <0.0050 0.0050 mg/kg 13-OCT-16 14-OCT-16 R3570256 Toluene <0.050 0.050 mg/kg 13-OCT-16 14-OCT-16 R3570256 Ethylbenzene <0.010 0.010 mg/kg 13-OCT-16 14-OCT-16 R3570256 Xylenes <0.10 0.10 mg/kg 13-OCT-16 14-OCT-16 R3570256 o-Xylene <0.050 0.050 mg/kg 13-OCT-16 14-OCT-16 R3570256 m+p-Xylene <0.050 0.050 mg/kg 13-OCT-16 14-OCT-16 R3570256 Styrene <0.050 0.050 mg/kg 13-OCT-16 14-OCT-16 R3570256 Surrogate: 1,4-Difluorobenzene 91.2 70-130 % 13-OCT-16 14-OCT-16 R3570256 Surrogate: 4-Bromofluorobenzene 82.3 70-130 % 13-OCT-16 14-OCT-16 R3570256 Surrogate: 3,4-Dichlorotoluene 123.5 70-130 % 13-OCT-16 14-OCT-16 R3570256 CCME Total Hydrocarbons F1 (C6-C10) <10 10 mg/kg 14-OCT-16 F1-BTEX <10 10 mg/kg 14-OCT-16 F2 (C10-C16) <30 30 mg/kg 14-OCT-16 F3 (C16-C34) <50 50 mg/kg 14-OCT-16 F4 (C34-C50) <50 50 mg/kg 14-OCT-16 Total Hydrocarbons (C6-C50) <50 50 mg/kg 14-OCT-16 Extractable Hydrocarbons. Tumbler/GC-FID TEH (C11-C22) <50 50 mg/kg 12-OCT-16 13-OCT-16 R3570052 TEH (C23-C60) <100 100 mg/kg 12-OCT-16 13-OCT-16 R3570052 Chrom. to baseline at nC50 YES 0 12-OCT-16 13-OCT-16 R3570052 Surrogate: 2-Bromobenzotrifluoride 86.6 70-130 % 12-OCT-16 13-OCT-16 R3570052							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

[illegible]

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1840862-5 E2@2.0 Sampled By: TA on 06-OCT-16 @ 12:00 Matrix: SOIL Extractable Hydrocarbons. Tumbler/GC-FID TEH (C11-C22) TEH (C23-C60) Chrom. to baseline at nC50 Surrogate: 2-Bromobenzotrifluoride Miscellaneous Parameters % Moisture	<50 <100 YES 87.3 8.5		50 100 0 70-130 1.0	mg/kg mg/kg % %	12-OCT-16 12-OCT-16 12-OCT-16 12-OCT-16 12-OCT-16	13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16	R3570052 R3570052 R3570052 R3570052 R3569918
L1840862-6 S2@1.0 Sampled By: TA on 06-OCT-16 @ 12:00 Matrix: SOIL BTEX, F1-F4 and SK Reg. PHC's. CCME BTEX Benzene Toluene Ethylbenzene Xylenes o-Xylene m+p-Xylene Styrene Surrogate: 1,4-Difluorobenzene Surrogate: 4-Bromofluorobenzene Surrogate: 3,4-Dichlorotoluene CCME Total Hydrocarbons F1 (C6-C10) F1-BTEX F2 (C10-C16) F3 (C16-C34) F4 (C34-C50) Total Hydrocarbons (C6-C50) Extractable Hydrocarbons. Tumbler/GC-FID TEH (C11-C22) TEH (C23-C60) Chrom. to baseline at nC50 Surrogate: 2-Bromobenzotrifluoride Miscellaneous Parameters % Moisture	<0.0050 <0.050 <0.010 <0.10 <0.050 <0.050 <0.050 92.3 82.5 122.3 <10 <10 <30 <50 <50 <50 <50 <50 <100 YES 88.0 7.7		0.0050 0.050 0.010 0.10 0.050 0.050 0.050 70-130 70-130 70-130 10 10 30 50 50 50 50 100 0 70-130 1.0	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg % % % mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg %	13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 12-OCT-16 12-OCT-16 12-OCT-16 12-OCT-16 12-OCT-16	14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16	R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570052 R3570052 R3570052 R3570052 R3569918
L1840862-7 S1@FLOOR Sampled By: TA on 06-OCT-16 @ 12:00 Matrix: SOIL BTEX, F1-F4 and SK Reg. PHC's. CCME BTEX Benzene Toluene Ethylbenzene Xylenes o-Xylene m+p-Xylene Styrene Surrogate: 1,4-Difluorobenzene Surrogate: 4-Bromofluorobenzene Surrogate: 3,4-Dichlorotoluene CCME Total Hydrocarbons	<0.0050 <0.050 <0.010 <0.10 <0.050 <0.050 <0.050 96.5 88.4 129.3		0.0050 0.050 0.010 0.10 0.050 0.050 0.050 70-130 70-130 70-130	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg % % %	13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16 13-OCT-16	14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16 14-OCT-16	R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570256 R3570256

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1840862-11 S2@3.8							
Sampled By: TA on 06-OCT-16 @ 12:00							
Matrix: SOIL							
BTEX, F1-F4 and SK Reg. PHC's.							
CCME BTEX							
Benzene	<0.0050		0.0050	mg/kg	13-OCT-16	14-OCT-16	R3570256
Toluene	0.099		0.050	mg/kg	13-OCT-16	14-OCT-16	R3570256
Ethylbenzene	0.026		0.010	mg/kg	13-OCT-16	14-OCT-16	R3570256
Xylenes	0.18		0.10	mg/kg	13-OCT-16	14-OCT-16	R3570256
o-Xylene	0.052		0.050	mg/kg	13-OCT-16	14-OCT-16	R3570256
m+p-Xylene	0.126		0.050	mg/kg	13-OCT-16	14-OCT-16	R3570256
Styrene	<0.050		0.050	mg/kg	13-OCT-16	14-OCT-16	R3570256
Surrogate: 1,4-Difluorobenzene	108.0		70-130	%	13-OCT-16	14-OCT-16	R3570256
Surrogate: 4-Bromofluorobenzene	119.0		70-130	%	13-OCT-16	14-OCT-16	R3570256
CCME Total Hydrocarbons							
F1 (C6-C10)	<10		10	mg/kg		14-OCT-16	
F1-BTEX	<10		10	mg/kg		14-OCT-16	
F2 (C10-C16)	57		30	mg/kg		14-OCT-16	
F3 (C16-C34)	<50		50	mg/kg		14-OCT-16	
F4 (C34-C50)	<50		50	mg/kg		14-OCT-16	
Total Hydrocarbons (C6-C50)	57		50	mg/kg		14-OCT-16	
Extractable Hydrocarbons. Tumbler/GC-FID							
TEH (C11-C22)	69		50	mg/kg	12-OCT-16	13-OCT-16	R3570052
TEH (C23-C60)	<100		100	mg/kg	12-OCT-16	13-OCT-16	R3570052
Chrom. to baseline at nC50	YES		0		12-OCT-16	13-OCT-16	R3570052
Surrogate: 2-Bromobenzotrifluoride	88.2		70-130	%	12-OCT-16	13-OCT-16	R3570052
Miscellaneous Parameters							
% Moisture	6.9		1.0	%	12-OCT-16	13-OCT-16	R3569918

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
SMI	Surrogate recovery could not be measured due to sample matrix interference.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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ETL-BTX,TVH-CCME-SK Soil CCME BTEX EPA 8260C/5021A and CWS PHC Tier 1

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The volatile organics are separated by gas chromatography using a 100% poly(dimethylsiloxane)column, with BTEX components quantified by MSD and the F1 range quantified using a flame ionization detector.

ETL-TVH,TEH-CCME-SK Soil CCME Total Hydrocarbons CCME CWS-PHC, Pub #1310, Dec 2001

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.

In samples where BTEX and F1 were analyzed, F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:

1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:

1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

PREP-MOISTURE-SK Soil % Moisture CWS for PHC in Soil - Tier 1

The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.

Reference: ASTM D2216-80

TEH-TMB-SK Soil Extractable Hydrocarbons. Tumbler/GC-FID CCME CWS-PHC, Pub #1310, Dec 2001

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2001." For C10 to C50 hydrocarbons (F2, F3, F4) and gravimetric heavy hydrocarbons (F4G-sg), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds. F2, F3 & F4 are analyzed by on-column GC/FID, and F4G-sg is analyzed gravimetrically.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg ww - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.

< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1840862

Report Date: 17-OCT-16

Page 1 of 4

Client: Amec Foster Wheeler plc
4015 MILLAR AVENUE
SASKATOON SK S7K 2K6
Contact: SHERRY COCHRAN

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ETL-BTX,TVH-CCME-SK Soil								
Batch R3570256								
WG2408766-3 LCS								
Benzene			101.2		%		70-130	13-OCT-16
Toluene			96.0		%		70-130	13-OCT-16
Ethylbenzene			88.4		%		70-130	13-OCT-16
Xylenes			88.9		%		50-150	13-OCT-16
o-Xylene			89.8		%		70-130	13-OCT-16
m+p-Xylene			88.0		%		70-130	13-OCT-16
Styrene			79.1		%		70-130	13-OCT-16
TVH: (C6-C10 / No BTEX Correction)			99.7		%		70-130	13-OCT-16
WG2408766-2 MB								
Benzene			<0.0050		mg/kg		0.005	13-OCT-16
Toluene			<0.050		mg/kg		0.05	13-OCT-16
Ethylbenzene			<0.010		mg/kg		0.01	13-OCT-16
Xylenes			<0.10		mg/kg		0.1	13-OCT-16
o-Xylene			<0.050		mg/kg		0.05	13-OCT-16
m+p-Xylene			<0.050		mg/kg		0.05	13-OCT-16
Styrene			<0.050		mg/kg		0.05	13-OCT-16
TVH: (C6-C10 / No BTEX Correction)			<10		mg/kg		10	13-OCT-16
Batch R3570905								
WG2407645-1 DUP L1840862-2								
Benzene		<0.0050	<0.0050	RPD-NA	mg/kg	N/A	40	13-OCT-16
Toluene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	13-OCT-16
Ethylbenzene		<0.010	<0.010	RPD-NA	mg/kg	N/A	40	13-OCT-16
Xylenes		<0.10	<0.10	RPD-NA	mg/kg	N/A	50	13-OCT-16
o-Xylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	13-OCT-16
m+p-Xylene		<0.050	<0.050	RPD-NA	mg/kg	N/A	40	13-OCT-16
Styrene		<0.050	<0.050	RPD-NA	mg/kg	N/A	50	13-OCT-16
TVH: (C6-C10 / No BTEX Correction)		<10	<10	RPD-NA	mg/kg	N/A	40	13-OCT-16
WG2407645-3 LCS								
Benzene			93.3		%		70-130	13-OCT-16
Toluene			89.4		%		70-130	13-OCT-16
Ethylbenzene			94.6		%		70-130	13-OCT-16
Xylenes			91.3		%		50-150	13-OCT-16
o-Xylene			91.5		%		70-130	13-OCT-16
m+p-Xylene			91.0		%		70-130	13-OCT-16
Styrene			107.8		%		70-130	13-OCT-16

Quality Control Report

Workorder: L1840862

Report Date: 17-OCT-16

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ETL-BTX,TVH-CCME-SK Soil								
Batch	R3570905							
WG2407645-3	LCS							
TVH: (C6-C10 / No BTEX Correction)			100.9		%		70-130	13-OCT-16
WG2407645-2	MB							
Benzene			<0.0050		mg/kg		0.005	13-OCT-16
Toluene			<0.050		mg/kg		0.05	13-OCT-16
Ethylbenzene			<0.010		mg/kg		0.01	13-OCT-16
Xylenes			<0.10		mg/kg		0.1	13-OCT-16
o-Xylene			<0.050		mg/kg		0.05	13-OCT-16
m+p-Xylene			<0.050		mg/kg		0.05	13-OCT-16
Styrene			<0.050		mg/kg		0.05	13-OCT-16
TVH: (C6-C10 / No BTEX Correction)			<10		mg/kg		10	13-OCT-16
PREP-MOISTURE-SK Soil								
Batch	R3568998							
WG2407642-1	DUP	L1840862-2						
% Moisture		8.9	7.9		%	12	20	12-OCT-16
WG2407642-3	LCS							
% Moisture			96.5		%		90-110	12-OCT-16
WG2407642-2	MB							
% Moisture			<1.0		%		1	12-OCT-16
Batch	R3569918							
WG2408762-3	LCS							
% Moisture			96.5		%		90-110	13-OCT-16
WG2408762-2	MB							
% Moisture			<1.0		%		1	13-OCT-16
TEH-TMB-SK Soil								
Batch	R3570052							
WG2408768-4	IRM	ALS PHC2 RM						
TEH (C11-C22)			93.0		%		70-130	13-OCT-16
TEH (C23-C60)			107.3		%		70-130	13-OCT-16
WG2408768-3	LCS							
TEH (C11-C22)			117.6		%		70-130	13-OCT-16
TEH (C23-C60)			115.8		%		70-130	13-OCT-16
WG2408768-2	MB							
TEH (C11-C22)			<50		mg/kg		50	13-OCT-16
TEH (C23-C60)			<100		mg/kg		100	13-OCT-16

Quality Control Report

Workorder: L1840862

Report Date: 17-OCT-16

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TEH-TMB-SK		Soil						
Batch	R3571326							
WG2407647-1	DUP	L1840862-2						
TEH (C11-C22)		<50	<50	RPD-NA	mg/kg	N/A	40	14-OCT-16
TEH (C23-C60)		<100	<100	RPD-NA	mg/kg	N/A	40	14-OCT-16
WG2407647-4	IRM	ALS PHC2 RM						
TEH (C11-C22)			90.1		%		70-130	14-OCT-16
TEH (C23-C60)			107.0		%		70-130	14-OCT-16
WG2407647-3	LCS							
TEH (C11-C22)			117.6		%		70-130	14-OCT-16
TEH (C23-C60)			113.5		%		70-130	14-OCT-16
WG2407647-2	MB							
TEH (C11-C22)			<50		mg/kg		50	14-OCT-16
TEH (C23-C60)			<100		mg/kg		100	14-OCT-16

Quality Control Report

Workorder: L1840862

Report Date: 17-OCT-16

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

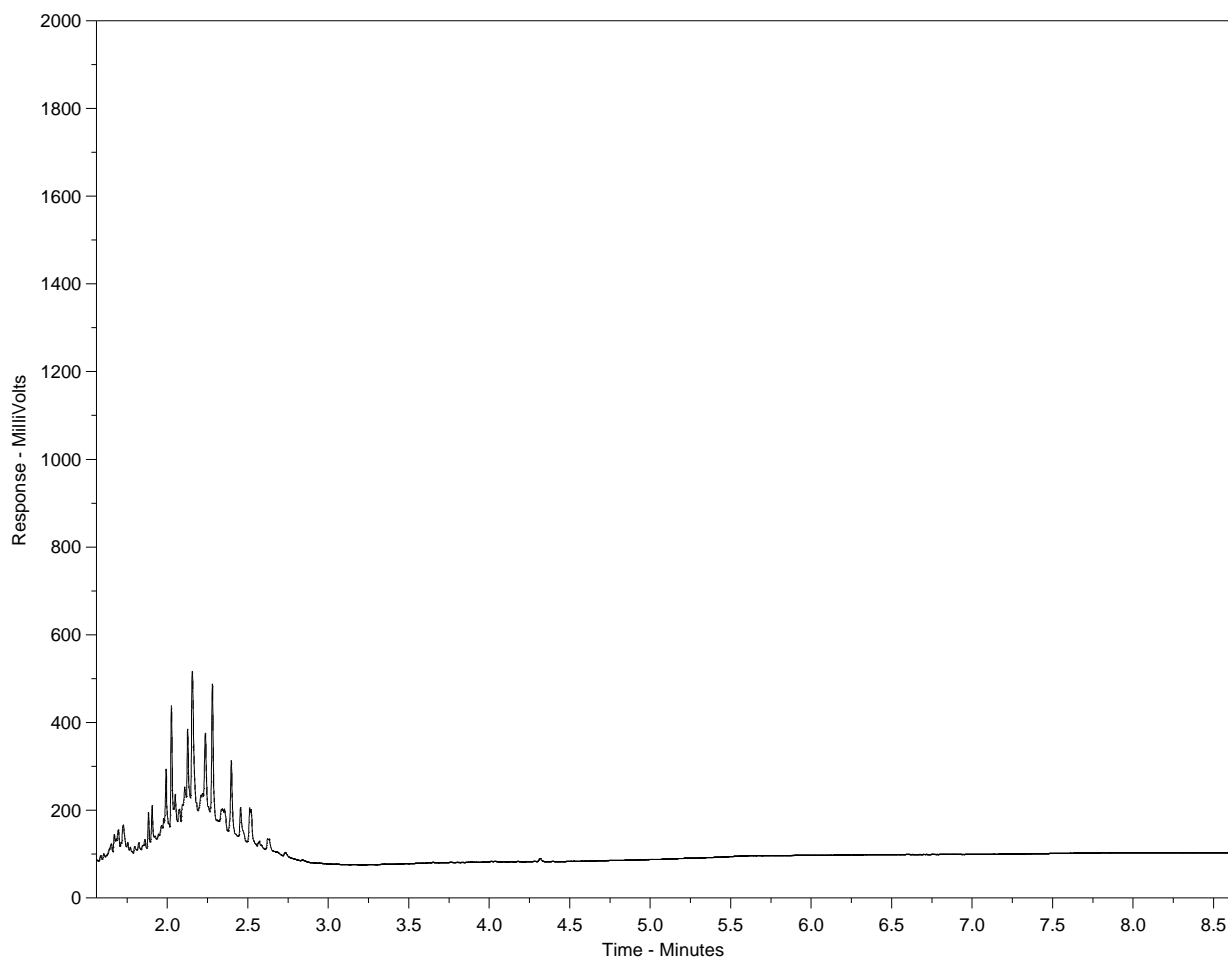
The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L1840862-11
Client ID: S2@3.8



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

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GENE 18.01 Front



Amec Foster Wheeler plc
ATTN: SHERRY COCHRAN
4015 MILLAR AVENUE
SASKATOON SK S7K 2K6

Date Received: 18-NOV-16
Report Date: 23-NOV-16 08:58 (MT)
Version: FINAL

Client Phone: 306-975-0444

Certificate of Analysis

Lab Work Order #: L1859898
Project P.O. #: NOT SUBMITTED
Job Reference: SX04344PRW
C of C Numbers:
Legal Site Desc:

Brian Morgan, B.Sc. Hons.
Client Services Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1859898-1	S11@2.5M							
Sampled By: CLIENT on 15-NOV-16 @ 15:00								
Matrix: SOIL								
BTEX, F1-F4 and SK Reg. PHC's.								
CCME BTEX								
Benzene		<0.0050		0.0050	mg/kg	21-NOV-16	22-NOV-16	R3600375
Toluene		<0.050		0.050	mg/kg	21-NOV-16	22-NOV-16	R3600375
Ethylbenzene		<0.010		0.010	mg/kg	21-NOV-16	22-NOV-16	R3600375
Xylenes		<0.10		0.10	mg/kg	21-NOV-16	22-NOV-16	R3600375
o-Xylene		<0.050		0.050	mg/kg	21-NOV-16	22-NOV-16	R3600375
m+p-Xylene		<0.050		0.050	mg/kg	21-NOV-16	22-NOV-16	R3600375
Styrene		<0.050		0.050	mg/kg	21-NOV-16	22-NOV-16	R3600375
Surrogate: 1,4-Difluorobenzene		87.7		70-130	%	21-NOV-16	22-NOV-16	R3600375
Surrogate: 4-Bromofluorobenzene		107.8		70-130	%	21-NOV-16	22-NOV-16	R3600375
Surrogate: 3,4-Dichlorotoluene		89.8		70-130	%	21-NOV-16	22-NOV-16	R3600375
CCME Total Hydrocarbons								
F1 (C6-C10)		<10		10	mg/kg		22-NOV-16	
F1-BTEX		<10		10	mg/kg		22-NOV-16	
F2 (C10-C16)		<30		30	mg/kg		22-NOV-16	
F3 (C16-C34)		<50		50	mg/kg		22-NOV-16	
F4 (C34-C50)		<50		50	mg/kg		22-NOV-16	
Total Hydrocarbons (C6-C50)		<50		50	mg/kg		22-NOV-16	
Extractable Hydrocarbons. Tumbler/GC-FID								
TEH (C11-C22)		<50		50	mg/kg	21-NOV-16	22-NOV-16	R3600292
TEH (C23-C60)		<100		100	mg/kg	21-NOV-16	22-NOV-16	R3600292
Chrom. to baseline at nC50		YES		0		21-NOV-16	22-NOV-16	R3600292
Surrogate: 2-Bromobenzotrifluoride		74.0		70-130	%	21-NOV-16	22-NOV-16	R3600292
Miscellaneous Parameters								
% Moisture		14.4		1.0	%	21-NOV-16	22-NOV-16	R3600246
L1859898-2	S12@3.05M							
Sampled By: CLIENT on 15-NOV-16 @ 15:00								
Matrix: SOIL								
BTEX, F1-F4 and SK Reg. PHC's.								
CCME BTEX								
Benzene		<0.0050		0.0050	mg/kg	21-NOV-16	22-NOV-16	R3600375
Toluene		<0.050		0.050	mg/kg	21-NOV-16	22-NOV-16	R3600375
Ethylbenzene		0.019		0.010	mg/kg	21-NOV-16	22-NOV-16	R3600375
Xylenes		0.27		0.10	mg/kg	21-NOV-16	22-NOV-16	R3600375
o-Xylene		0.138		0.050	mg/kg	21-NOV-16	22-NOV-16	R3600375
m+p-Xylene		0.136		0.050	mg/kg	21-NOV-16	22-NOV-16	R3600375
Styrene		<0.050		0.050	mg/kg	21-NOV-16	22-NOV-16	R3600375
Surrogate: 1,4-Difluorobenzene		90.0		70-130	%	21-NOV-16	22-NOV-16	R3600375
Surrogate: 4-Bromofluorobenzene		125.4		70-130	%	21-NOV-16	22-NOV-16	R3600375
Surrogate: 3,4-Dichlorotoluene		111.7		70-130	%	21-NOV-16	22-NOV-16	R3600375
CCME Total Hydrocarbons								
F1 (C6-C10)		28		10	mg/kg		22-NOV-16	
F1-BTEX		28		10	mg/kg		22-NOV-16	
F2 (C10-C16)		86		30	mg/kg		22-NOV-16	
F3 (C16-C34)		<50		50	mg/kg		22-NOV-16	
F4 (C34-C50)		<50		50	mg/kg		22-NOV-16	
Total Hydrocarbons (C6-C50)		114		50	mg/kg		22-NOV-16	
Extractable Hydrocarbons. Tumbler/GC-FID								
TEH (C11-C22)		108		50	mg/kg	21-NOV-16	22-NOV-16	R3600292
TEH (C23-C60)		<100		100	mg/kg	21-NOV-16	22-NOV-16	R3600292
Chrom. to baseline at nC50		YES		0		21-NOV-16	22-NOV-16	R3600292

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1859898-2 S12@3.05M Sampled By: CLIENT on 15-NOV-16 @ 15:00 Matrix: SOIL Extractable Hydrocarbons. Tumbler/GC-FID Surrogate: 2-Bromobenzotrifluoride Miscellaneous Parameters % Moisture	82.6 7.1		70-130 1.0	% %	21-NOV-16 21-NOV-16	22-NOV-16 22-NOV-16	R3600292 R3600246
L1859898-3 S13@3.05M Sampled By: CLIENT on 15-NOV-16 @ 15:00 Matrix: SOIL BTEX, F1-F4 and SK Reg. PHC's. CCME BTEX Benzene Toluene Ethylbenzene Xylenes o-Xylene m+p-Xylene Styrene Surrogate: 1,4-Difluorobenzene Surrogate: 4-Bromofluorobenzene Surrogate: 3,4-Dichlorotoluene CCME Total Hydrocarbons F1 (C6-C10) F1-BTEX F2 (C10-C16) F3 (C16-C34) F4 (C34-C50) Total Hydrocarbons (C6-C50) Extractable Hydrocarbons. Tumbler/GC-FID TEH (C11-C22) TEH (C23-C60) Chrom. to baseline at nC50 Surrogate: 2-Bromobenzotrifluoride Miscellaneous Parameters % Moisture	<0.0050 <0.050 0.016 0.20 0.098 0.099 <0.050 99.8 125.7 102.2 18 18 123 <50 <50 141 152 <100 YES 87.6 7.3		0.0050 0.050 0.010 0.10 0.050 0.050 0.050 70-130 70-130 70-130 10 10 30 50 50 50 50 100 0 70-130 1.0	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg % % % mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg %	21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16	22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16	R3600375 R3600375 R3600375 R3600375 R3600375 R3600375 R3600375 R3600375 R3600375 R3600375 R3600292 R3600292 R3600292 R3600292 R3600246
L1859898-4 A001 Sampled By: CLIENT on 15-NOV-16 @ 15:00 Matrix: SOIL BTEX, F1-F4 and SK Reg. PHC's. CCME BTEX Benzene Toluene Ethylbenzene Xylenes o-Xylene m+p-Xylene Styrene Surrogate: 1,4-Difluorobenzene CCME Total Hydrocarbons F1 (C6-C10) F1-BTEX F2 (C10-C16) F3 (C16-C34) F4 (C34-C50)	<0.0050 <0.050 0.037 0.37 0.172 0.198 <0.050 124.3 35 35 95 <50 <50		0.0050 0.050 0.010 0.10 0.050 0.050 0.050 70-130 10 10 30 50 50	mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg mg/kg % mg/kg mg/kg mg/kg mg/kg mg/kg	21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 21-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16	22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16 22-NOV-16	R3600375 R3600375 R3600375 R3600375 R3600375 R3600375 R3600375 R3600375 22-NOV-16

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1859898-4 A001							
Sampled By: CLIENT on 15-NOV-16 @ 15:00							
Matrix: SOIL							
CCME Total Hydrocarbons							
Total Hydrocarbons (C6-C50)	130		50	mg/kg		22-NOV-16	
Extractable Hydrocarbons. Tumbler/GC-FID							
TEH (C11-C22)	118		50	mg/kg	21-NOV-16	22-NOV-16	R3600292
TEH (C23-C60)	<100		100	mg/kg	21-NOV-16	22-NOV-16	R3600292
Chrom. to baseline at nC50	YES		0		21-NOV-16	22-NOV-16	R3600292
Surrogate: 2-Bromobenzotrifluoride	81.1		70-130	%	21-NOV-16	22-NOV-16	R3600292
Miscellaneous Parameters							
% Moisture	6.8		1.0	%	21-NOV-16	22-NOV-16	R3600246

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
SMI	Surrogate recovery could not be measured due to sample matrix interference.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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ETL-BTX,TVH-CCME-SK Soil CCME BTEX EPA 8260C/5021A and CWS PHC Tier 1

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The volatile organics are separated by gas chromatography using a 100% poly(dimethylsiloxane) column, with BTEX components quantified by MSD and the F1 range quantified using a flame ionization detector.

ETL-TVH,TEH-CCME-SK Soil CCME Total Hydrocarbons CCME CWS-PHC, Pub #1310, Dec 2001

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.

In samples where BTEX and F1 were analyzed, F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:

1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:

1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

PREP-MOISTURE-SK Soil % Moisture CWS for PHC in Soil - Tier 1

The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.

Reference: ASTM D2216-80

TEH-TMB-SK Soil Extractable Hydrocarbons. Tumbler/GC-FID CCME CWS-PHC, Pub #1310, Dec 2001

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2001." For C10 to C50 hydrocarbons (F2, F3, F4) and gravimetric heavy hydrocarbons (F4G-sg), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds. F2, F3 & F4 are analyzed by on-column GC/FID, and F4G-sg is analyzed gravimetrically.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg ww - milligrams per kilogram based on wet weight of sample
mg/kg lw - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.

< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1859898

Report Date: 23-NOV-16

Page 1 of 2

Client: Amec Foster Wheeler plc
4015 MILLAR AVENUE
SASKATOON SK S7K 2K6
Contact: SHERRY COCHRAN

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ETL-BTX,TVH-CCME-SK Soil								
Batch	R3600375							
WG2436109-3	LCS							
Benzene			100.6		%		70-130	22-NOV-16
Toluene			96.6		%		70-130	22-NOV-16
Ethylbenzene			97.1		%		70-130	22-NOV-16
Xylenes			96.2		%		50-150	22-NOV-16
o-Xylene			94.2		%		70-130	22-NOV-16
m+p-Xylene			98.2		%		70-130	22-NOV-16
Styrene			94.0		%		70-130	22-NOV-16
TVH: (C6-C10 / No BTEX Correction)			93.5		%		70-130	22-NOV-16
WG2436109-2	MB							
Benzene			<0.0050		mg/kg		0.005	22-NOV-16
Toluene			<0.050		mg/kg		0.05	22-NOV-16
Ethylbenzene			<0.010		mg/kg		0.01	22-NOV-16
Xylenes			<0.10		mg/kg		0.1	22-NOV-16
o-Xylene			<0.050		mg/kg		0.05	22-NOV-16
m+p-Xylene			<0.050		mg/kg		0.05	22-NOV-16
Styrene			<0.050		mg/kg		0.05	22-NOV-16
TVH: (C6-C10 / No BTEX Correction)			<10		mg/kg		10	22-NOV-16
PREP-MOISTURE-SK Soil								
Batch	R3600246							
WG2436106-3	LCS							
% Moisture			100.5		%		90-110	22-NOV-16
WG2436106-2	MB							
% Moisture			<1.0		%		1	22-NOV-16
TEH-TMB-SK Soil								
Batch	R3600292							
WG2436110-4	IRM	ALS PHC2 RM						
TEH (C11-C22)			83.9		%		70-130	22-NOV-16
TEH (C23-C60)			97.7		%		70-130	22-NOV-16
WG2436110-3	LCS							
TEH (C11-C22)			124.2		%		70-130	22-NOV-16
TEH (C23-C60)			117.9		%		70-130	22-NOV-16
WG2436110-2	MB							
TEH (C11-C22)			<50		mg/kg		50	22-NOV-16
TEH (C23-C60)			<100		mg/kg		100	22-NOV-16

Quality Control Report

Workorder: L1859898

Report Date: 23-NOV-16

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

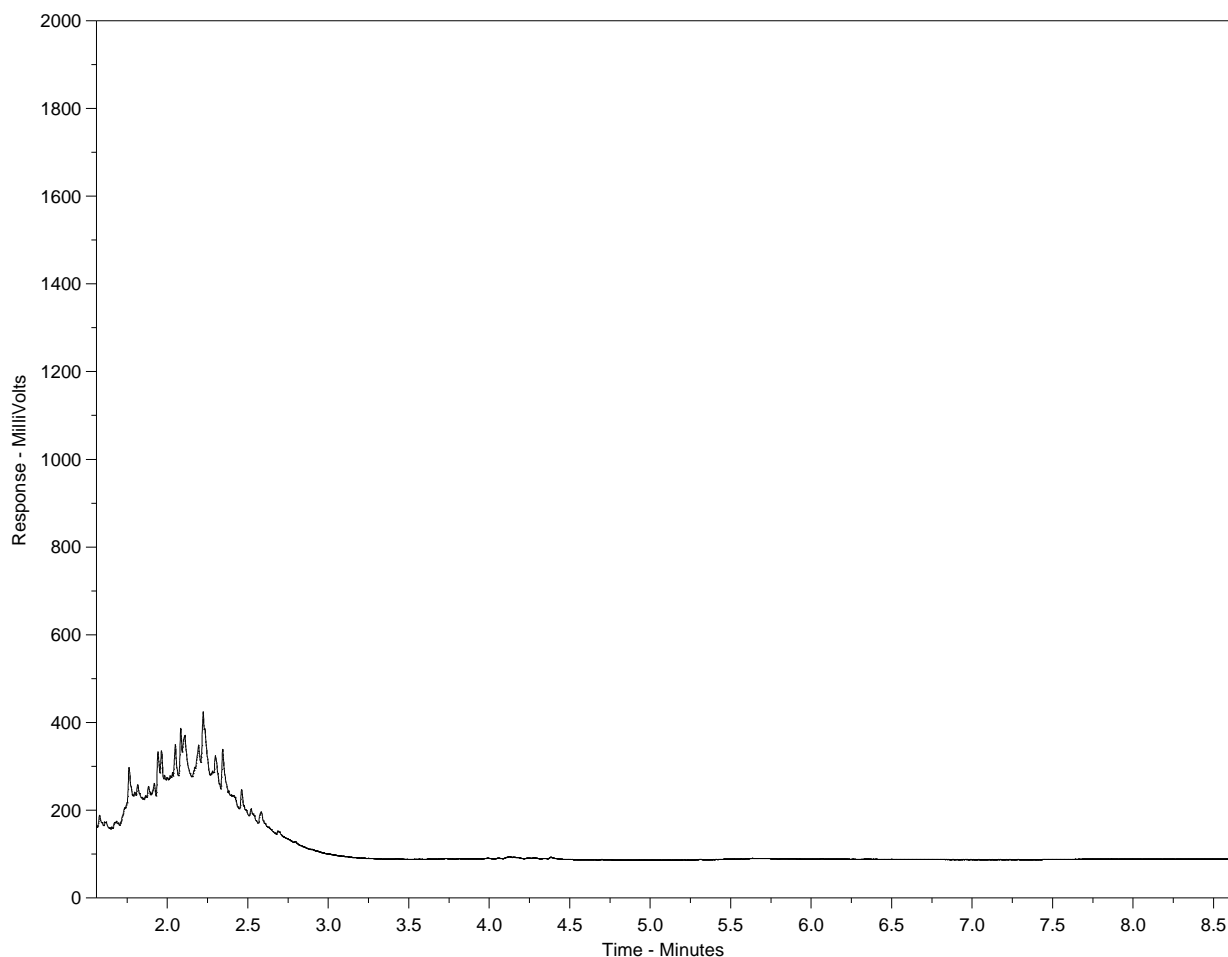
The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L1859898-2
Client ID: S12@3.05M



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

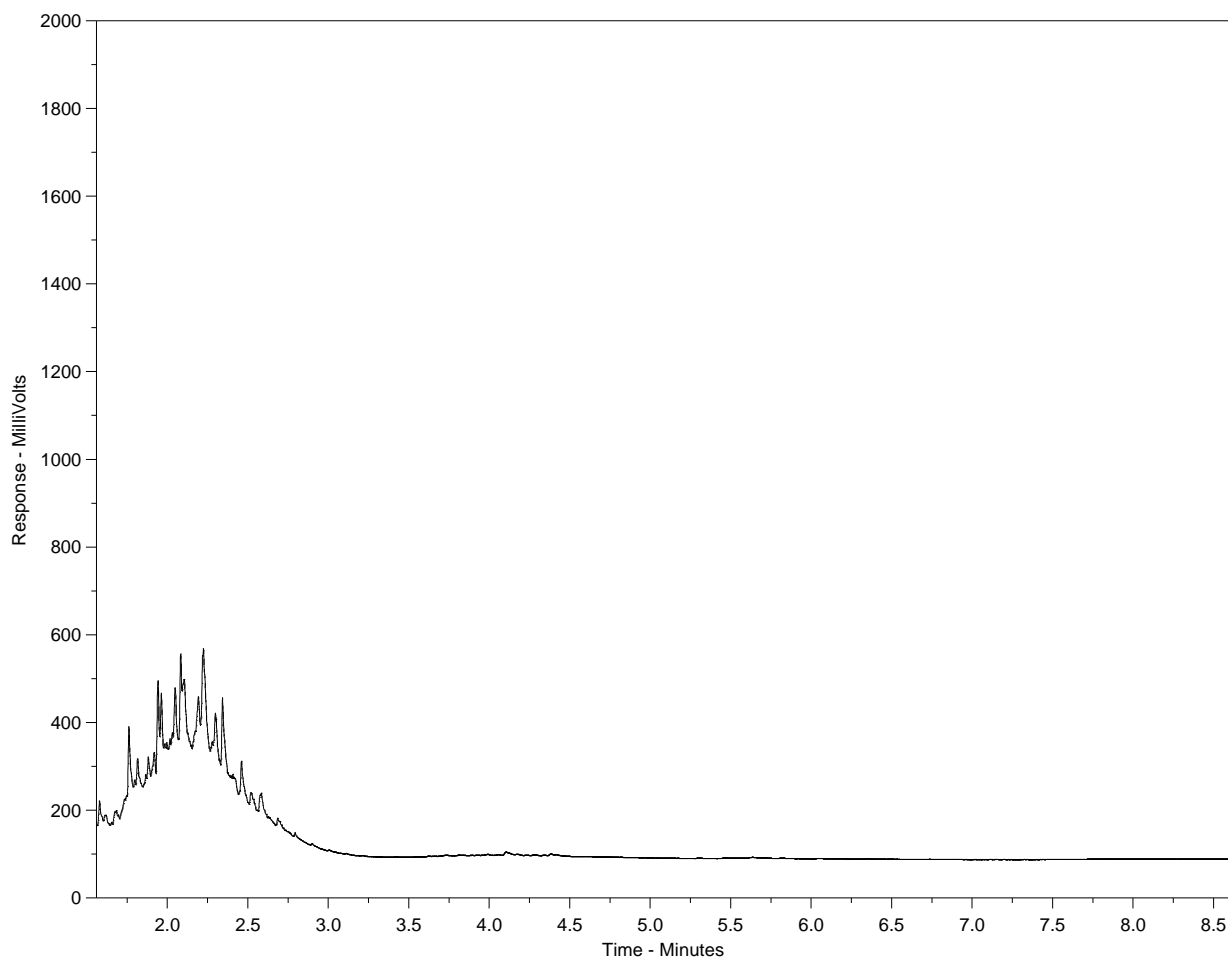
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L1859898-3
Client ID: S13@3.05M



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

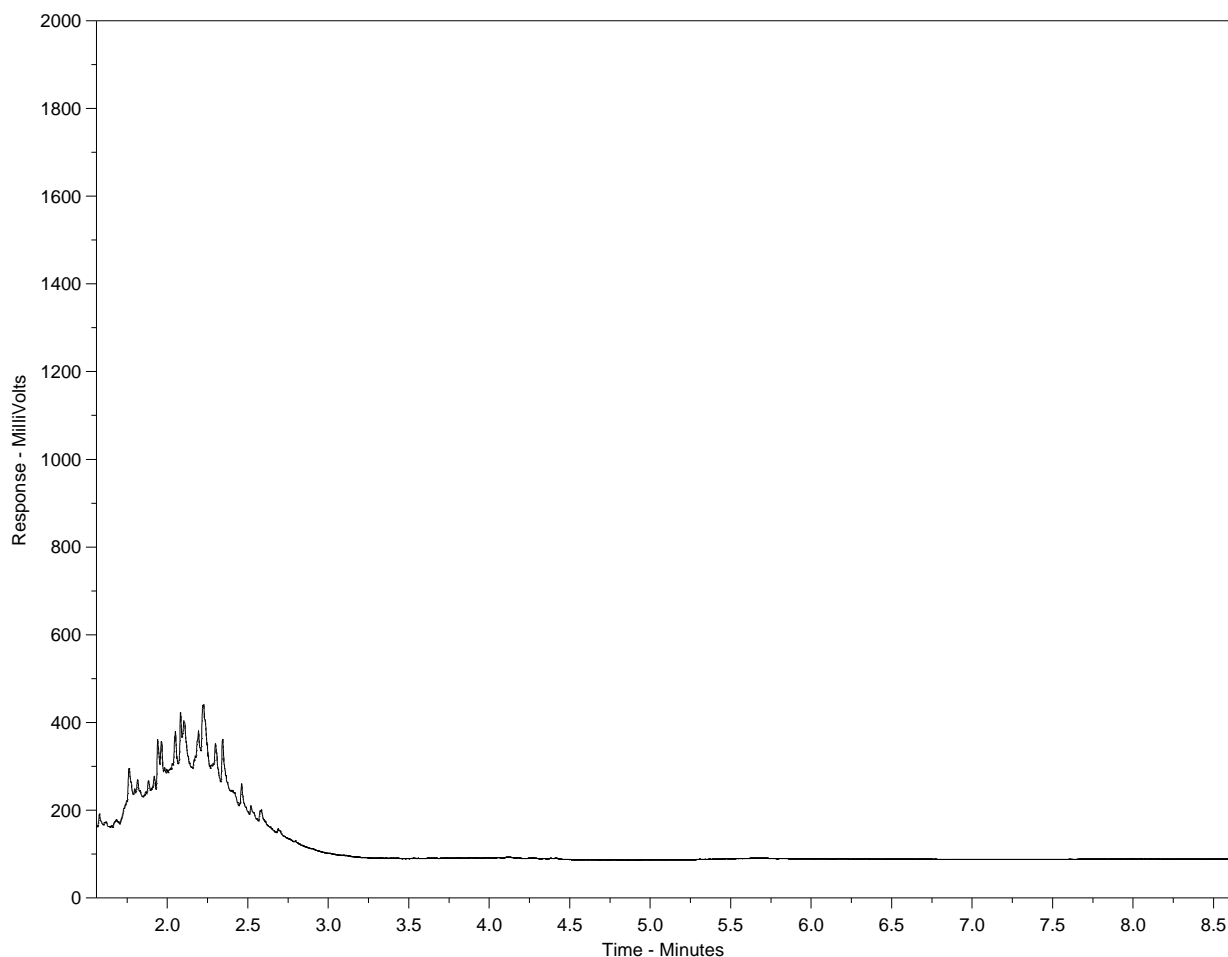
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L1859898-4
Client ID: A001



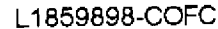
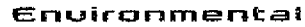
← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

Page 1 of 1

GENF 18.01 Front

APPENDIX E

LANDFILL TICKETS

City of Prince Albert Landfill
Phone: (306)953-4975

TICKET #
498009

October 24, 2016

Vehicle Id: point
Account: AMEC AMEC
Origin: The City of Prince Albert
To/From: Contaminated Soil Site
Material: Contaminated Soil
Rate: CSOIL/Contaminated Soil

In @ 16:07:54

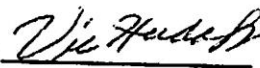
Out @ 17:46:31

Gross 31400
Tare 20975

Net	10425 Kg	Amount	\$521.25
-----	----------	--------	----------

Payment Method : ON ACCOUNT

Signature
924 HIIF



City of Prince Albert Landfill

Phone: (306)953-4975

TICKET #
498011

October 24, 2016

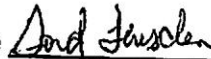
Vehicle Id: points
Account: AMEC AMEC
Origin: The City of Prince Albert
To/From: Contaminated Soil Site
Material: Contaminated Soil
Rate: CSOIL/Contaminated Soil
In @ 16:03:46 Out @ 17:53:26

Gross 31370
Tare 19535

Net	11835 Kg	Amount	\$591.75
-----	----------	--------	----------

Payment Method : ON ACCOUNT

Signature
861 HHP



PRINCE ALBERT
1084 CENTRAL AVENUE
CITY OF P.A. - LANDFILL

bert Landfill

TICKET #
502524

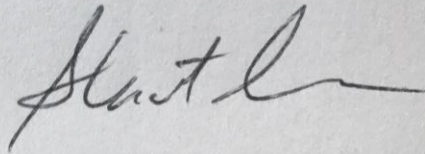
November 19, 2016

Vehicle Id: FTL
Account: 99999 CASH CUSTOMER
Origin: The City of Prince Albert
To/From: Bale Fill
Material: Contaminated Soil
Rate: CSOIL/Contaminated Soil

In @ 11:14:17

Out @ 11:30:10

Gross 37445
Tare 18300



Net	19145 Kg	Amount	\$957.25
------------	-----------------	---------------	-----------------

Payment Method : INTERAC

APPENDIX F

NATIONAL CLASSIFICATION SYSTEM FOR CONTAMINATED SITES

CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)
Pre-Screening Checklist

Question	Response (yes / no)	Comment
1. Are Radioactive material, Bacterial contamination or Biological hazards likely to be present at the site?	No	If yes, do not proceed through the NCSCS. Contact applicable regulatory agency immediately.
2. Are there no contamination exceedances (known or suspected)? Determination of exceedances may be based on: 1) CCME environmental quality guidelines; 2) equivalent provincial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium; or 3) toxicity benchmarks derived from the literature for chemicals not covered by CCME or provincial guidelines/standards.	Yes	If yes (i.e., there are no exceedances), do not proceed through the NCSCS.
3. Have partial/incompleted or no environmental site investigations been conducted for the Site?	No	If yes, do not proceed through the NCSCS.
4. Is there direct and significant evidence of impacts to humans at the site, or off-site due to migration of contaminants from the site?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
5. Is there direct and significant evidence of impacts to ecological receptors at the site, or off-site due to migration of contaminants from the site?	No	Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are considered to be severe, the site may be categorized as Class 1, regardless of the numerical total NCSCS score. For the purpose of application of the NCSCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.
6. Are there indicators of significant adverse effects in the exposure zone (i.e., the zone in which receptors may come into contact with contaminants)? Some examples are as follows: -Hydrocarbon sheen or NAPL in the exposure zone -Severely stressed biota or devoid of biota; -Presence of material at ground surface or sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, and coal tar.	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
7. Do measured concentrations of volatiles or unexploded ordnances represent an explosion hazard ?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, and do not continue until the safety risks have been addressed. Consult your jurisdiction's occupational health and safety guidance or legislation on explosive hazards and measurement of lower explosive limits.

If none of the above applies, proceed with the NCSCS scoring.

Phase I Environmental Site Assessment
for
Royal Canadian Mounted Police
Stony Rapids Detachment
Stony Rapids, Saskatchewan



Phase I Environmental Site Assessment
for
Royal Canadian Mounted Police
Stony Rapids Detachment
Stony Rapids, Saskatchewan

Environmental Services
Public Works and Government Services Canada
Edmonton, Alberta
February 2002

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1 INTRODUCTION

The RCMP requires phase 1 environmental site assessments (ESA) on several of their northern detachments to ascertain their status and environmental condition and to satisfy Treasury Board requirements. A site visit of the Stony Rapids Detachment was carried out on November 20, 2001.

The Royal Canadian Mounted Police (RCMP) Stony Rapids Detachment site has been used for RCMP operation activities for the past 44 years. The site consisted of a detachment building and garage, and two housing units with a detached garage between them at the time of the site investigation.

Phase I environmental site assessments are carried out to determine the environmental condition of a property and/or building/facility. The emphasis of such assessments is on the determination of present compliance with environmental legislation and potential future environmental liabilities. These liabilities may arise from actions such as government-initiated orders, loss of land resale value (due to contamination or perceived contamination), and litigation associated with contamination. Treasury Board Policy requires that federal government departments administer real property in a manner consistent with the principle of sustainable development. Departments must also determine whether or not remediation is necessary, in consultation with legal and environmental advisors.

2 SITE INVESTIGATION

Public Works and Government Services Canada (PWGSC) was contracted by the RCMP to conduct the phase I environmental site assessment and site investigation. The site investigation is intended to provide PWGSC and the RCMP with an understanding of the potential environmental hazards, including physical and social effects that the property poses to the wellbeing of humans, wildlife and their respective habitats. It describes what Environmental Services of PWGSC believes are known and potential concerns and where appropriate, proposes mitigative measures to reduce potentially adverse environmental effects.

Environmental Services, PWGSC conducted a site investigation of the subject property on November 20, 2001 to identify environmental liabilities and concerns associated with the property. In addition, information was obtained from a review of title searches, aerial photographs and through discussions with individuals familiar with the property. This material was used to determine compliance with existing environmental legislation, policies and guidelines. The assessment was carried out in accordance with Canadian Standards Association (CSA) Phase I Environmental Site Assessment guidelines (1994).

3 PROPERTY DESCRIPTION

Space allocation cards provided by the RCMP indicated that the property is located in the community of Stony Rapids in northern Saskatchewan (Figure 1, Appendix A). Within the community, the property is located at the intersection of Johnson and Robillard Streets.

The RCMP detachment is surrounded by residential land use. The Fond du Lac River is located along the northwest property boundary.

The approximate geographical location of Stony Rapids is: 59 ° 15' 35" N, 105 ° 15' 35" W.

3.1 Legal Description

The legal description of the property is Lots 1 and 2, Block 4, Reg'd Plan CK 361 in the community of Stony Rapids, Saskatchewan.

3.2 Physical Characteristics

Stony Rapids is located in the Taiga Shield ecozone, east of Lake Athabasca. The sub-arctic climate results in short, cool summers and long, cold winters. Discontinuous permafrost exists in the Stony Rapids area, and because of the low permeability of permafrost, the infiltration of surface water is essentially eliminated. In turn, this influences the availability and movement of groundwater.

At the time of the site visit the property consisted of a detachment building and garage, and two housing units with a detached garage between them. The detachment is located at the intersection of Johnson and Robillard Streets, facing Johnson Street. Site photographs are provided in Appendix C.

The exterior grounds inspection was limited to the building structures. No evidence of stressed vegetation or soil staining could be noted within or in the vicinity of the RCMP detachment boundaries partly due to snow cover at the time of the site investigation.

3.2.1 Detachment Building

According to the Detail Space Allocation records provided by the RCMP, the detachment building was built in 1975 of frame construction and consists of office space, a basement, utility room, a cell/lock-up area and two-bedroom apartment. The exterior of the building is stated to be clad in metal siding, and the roof covered in asphalt shingles. (Space cards are provided in Appendix D). However, at the time of the site visit, the exterior had vinyl siding.

The interior of the detachment office was examined during the site investigation. The entranceways, bathrooms and hallway had linoleum floor covering, and the rest of the detachment was carpeted. Ceilings and a partial wall were covered in tiles that were evident throughout the detachment, but did not extend into the attached apartment. The building was heated with a forced air electric furnace and was fitted with an air conditioner at the rear of the building. All appliances containing ozone-depleting substances are detailed in Appendix F.

The basement of the detachment building contained a freezer and a refrigerator. The ceiling in the basement was stucco and there was some linoleum on the concrete basement floor that was the same as that found on the main floor in the bathrooms and hallway. The fibreglass sewer and water tanks were also located in the basement. The utility room housed the electric forced air furnace. It was not possible to sample the

insulation surrounding the elbows in the piping, therefore it is not known if the insulation contains asbestos or not.

The cell/lock-up area walls were painted concrete, but the flooring material was of unknown composition, but it may have been fibreglass. The glossy, brittle nature of the flooring was suspect in regard to environmental issues, but portions of the floor could not be removed for sampling purposes.

Florescent lights provide lighting throughout the detachment building and the garage. Incandescent bulbs provide the lighting in each of the two houses on-site.

3.2.2 Detachment Garage

The garage was built in 1975 of frame construction with wood siding. It was two stalls wide and stored equipment – two snowmobiles and one four wheeled all terrain vehicle. Also stored within the garage were some hazardous materials. Two cans of kerosene, a full oil pan on the concrete pad and 20 litre pails filled with used oil were stacked in the corner.

Behind the garage there was a generator that was an enclosed, self-contained unit. That is, the diesel tank was actually part of the generator. In front of the garage was a 4550 litre above ground fuel storage tank (AST). The tank was in a fenced compound on a concrete pad foundation. Below the hose and nozzle there was no grating or spill containment. There were no stains surrounding the AST, but no staining of the adjacent area could be noted due to snow cover at the time of the site visit.

3.2.3 Housing Units

When the Uranium City RCMP detachment closed in 1985, these residences were moved from Uranium City to the Stony Rapids Detachment. The bungalows were built in 1980, but construction on the houses at the Stony Rapids site was completed in 1985, after being moved there. Both were of frame construction, one floor plus basement and both had exterior vinyl siding.

The interiors of the homes were examined during the site visit. The kitchens, bathrooms and entryway floors were covered with linoleum, and the remainders of the units were carpeted. Ceilings throughout the residences were painted stucco, and the windows were metal clad. Electric forced air furnaces heated the buildings and the appearance of the walls and floor led us to believe that new drywall and linoleum had recently been affixed in these homes.

The basements of the homes were poured concrete, and the floors were painted. The walls in the basement were painted drywall, and all piping was exposed with no coatings. There were a total of two refrigerators and two freezers in each house.

3.2.4 Detached Garage

There was a second garage on this site that was located between the two housing units. It had a concrete slab foundation, and the garage stored various items. There were approximately six empty gerry cans, some used tires, a quantity of peat moss, two

lawnmowers, two small craft boats and one four-wheeled all terrain vehicle. On the walls of the garage were three electrical panel boxes that were not hooked up.

3.3 Site History

Information on 'space allocation cards' provided by the RCMP indicated that the subject property consisted of Lots 1, 2, and 4 in Stony Rapids and that Lot 4 has been owned by the RCMP since 1958, and Lots 1 and 2 have been owned by the RCMP since 1980. The province of Saskatchewan previously owned both portions of land. Space cards are provided in Appendix D.

The findings of the historical search indicated that it is unlikely that the subject property was previously used for commercial or industrial land use.

3.4 Aerial Photographs

Aerial photographs from 1978, 1984 and 2000 were obtained from ISC Geomatics in Regina, Saskatchewan. The findings of the air photo review are described below:

1978 – The subject sites appear to be void of buildings, although development has occurred on property adjacent to the sites. Johnson and Robillard Streets seem well established, as does the other infrastructure in the town.

1984 – There is now apparently a building on the subject sites, but there does not seem to be an increased amount of development in the surrounding area from the 1978 photo.

2000 – There is not any obvious change from the 1984 photo.

Aerial photos are provided in Appendix B.

4 ENVIRONMENTAL ISSUES

Environmental concerns determined to be relevant to the site as well as those covered by environmental legislation are discussed below.

4.1 Indoor Air Quality

A walk through of the site and interviews with persons knowledgeable with the site revealed that there were no concerns relating to indoor air quality.

Conclusion

Indoor air quality posed no apparent environmental risks on this property at the time of the site visit.

Recommendations

No recommendations are required at this time.

4.2 Polychlorinated Biphenyls (PCBs)

A selection of fluorescent light ballasts was checked and none contained PCBs.

Conclusion

PCBs do not pose a significant environmental risk on this property.

Recommendations

No actions are required at this time.

4.3 Asbestos

Two samples were obtained from the site for asbestos analysis. One sample was taken from the ceiling tile that was also located on the partial wall within the office and the wall near the photocopier. The other was obtained from the flooring found in the basement, main floor bathrooms and entranceways. The samples were transported to PSC Analytical Services, in Edmonton, for laboratory analysis. Results of the analysis indicated that the ceiling tile contained no asbestos, nor did the linoleum. However, the backing, or underside of the linoleum was found to contain 20 – 40 % chrysotile asbestos. (Complete laboratory results in Appendix E).

Conclusion

Laboratory analysis confirmed the presence of chrysotile asbestos in the linoleum.

Recommendations

In the future, if any renovation and/or demolition work is scheduled for any structure containing asbestos, the asbestos should be removed by qualified personnel and disposed of according to appropriate legislation.

If transfer of the detachment occurs new owners should be made aware of the presence of asbestos containing materials on-site. This will ensure the proper management and appropriate disposal according to current regulations and guidelines during renovations or decommissioning.

4.4 Lead

Lead based paint was not suspected on this property due to the apparent recent refurbishing activities.

Conclusion

Lead paint does not pose a significant environmental risk on this property.

Recommendations

No actions are required on this issue.

4.5 Storage Tanks

There was one (1) above ground storage tank (AST) on the property at the time of the site visit. It was located in front of the detachment garage and was contained in a fenced compound with a concrete pad foundation. The tank had 4550 litre capacity, and was manufactured and installed in 1993. RCMP records indicated that the tank was of double walled steel construction, there was a mechanical device in place in the fill tube to avoid overflow and a level gauge was affixed to the painted exterior of the tank. Accounts also indicate that the tank holds unleaded gasoline; it was noted during the site visit that no grating or spill containment was in place below the hose and nozzle affixed for dispensing fuel to vehicles. Land use immediately adjacent to the tank on all sides is institutional.

RCMP records indicated that an underground storage tank (UST) was in place on the detachment property that held heating fuel, but that it was abandoned in place in 1974. Registration forms, however, indicate that the tank was not abandoned in place, but removed in 1974.

Space cards provided by RCMP indicate only one tank and pump constructed in 1975 that was intended to store and deliver unleaded gasoline to vehicles was located on the property. This tank was of 500 gallon capacity.

An environmental search conducted by Saskatchewan Environment and Resource Management indicated the registration with number OT-1027. Complete search results can be found in Appendix G.

Conclusion

The fuel storage tank on-site did not appear to pose a significant environmental concern to the property. However, the tank should be monitored to ensure that no leaks are present. Additionally, CCME Code of Practice stipulates that inventory control records must be maintained at the site.

Conflicting records make it impossible to know exactly what tanks are on the property.

Recommendations

The following recommendations should be implemented to ensure there is minimal potential impact from the storage tanks at the site:

- Continue to maintain fuel storage tanks in compliance with applicable legislation.
- Obtain a copy of inventory control records at the site.
- Monitor the AST located within the detachment property to ensure that no leaks are present.
- Determine what USTs are actually in place since records offer conflicting information.

4.6 Site Contamination

A search of the Saskatchewan Environment and Resource Management Environmental Files did not reveal any reported spills for the Stony Rapids RCMP detachment site (Appendix G). Interviews with personnel familiar with the site had no knowledge of any hazardous spills on-site, nor of any leaks or spills in the vicinity of the fuel storage tanks. No surficial staining was noted in the vicinity of the fuel storage tanks at the time of the site investigation due to snow cover.

Conclusion

Current and historical activities on-site and on adjacent properties do not pose an environmental concern to the subject property.

Recommendations

No actions are required at this time.

4.7 Ozone Depleting Substances

Refrigerators and freezers containing ozone-depleting substances in the form of refrigerants were present in each of the residences and the detachment building on-site.

Conclusion

Ozone depleting substances are located within the freezers and refrigerators as well as the air conditioning unit at the RCMP detachment site. For an inventory listing, refer to Appendix F.

Recommendations

Manage and remove ozone depleting substances in compliance with applicable federal and territorial legislation. A qualified technician should perform any work on these units.

4.8 Hazardous Materials

Hazardous materials were noticed only in consumer quantities and were stored in the detachment garage.

An environmental search conducted by Saskatchewan Environment and Resource Management suggested no reported hazardous materials spills in the area of the subject property. Complete search results can be found in Appendix G.

Conclusion

There are some small quantities of hazardous materials present at the detachment property, but this does not pose a significant environmental risk on this property.

Recommendations

Continue to maintain hazardous materials according to applicable legislation in relation to their storage, transport, use, and disposal.

5 CCME NATIONAL CLASSIFICATION SYSTEM FOR CONTAMINATED SITES

The National Classification System for Contaminated Sites (NCSCS) ranks potentially contaminated sites into five (5) general categories. These are:

- Class 1 – Action Required
- Class 2 – Action Likely Required
- Class 3 – Action May Be Required
- Class N – Action Not Likely Required
- Class I – Insufficient Information

This rating is based on the current or potential adverse impact on human health or the environment. It is used to screen sites and allows for the prioritization of higher impacted sites that may have a greater potential impact to the environment. The hazard or potential hazard of a site is evaluated by scoring site characteristics that can be grouped under one of three categories:

- I. Contaminant Characteristics – the relative hazard of contaminants present at a site
- II. Exposure Pathways – the route a contaminant may follow to a receptor (groundwater, surface water, air, direct soil contact)
- III. Receptor – living things that may be exposed to and impacted by contamination (humans, plants, animals, environmental resources)

A scoring system from 0 to 100 is used to assess the hazards of a site. This allows for sites that exhibit observable or measured impacts on the surrounding environment or have a high potential for causing negative impact to have a higher score using this system.

The information obtained during the Phase I ESA at the Stony Rapids RCMP detachment site was input into the CCME NCSCS. The detailed worksheets are available in Appendix H. The site was ranked with a score of 7.5. On the basis of that score, the site is classified as Class N, indicating that action is not likely required. However, this score is based on limited preliminary information, and additional information gained by future site assessments may change the site rank.

Typically NCSCS calculations are generated for subject properties that are known to be contaminated. The information collected from this site visit and the records held by the property management were not enough to properly conduct a NCSCS calculation. However, the RCMP required a way of ranking the sites to determine some sort of comparable liability to the properties and this was deemed the best possible solution from the limited choices available.

6 CONCLUSIONS

Based upon information acquired from the site investigation, the review of historical records, and interviews with individuals familiar with the property, potential issues of environmental concern were identified at the RCMP detachment site in Stony Rapids.

The fuel storage tank on-site did not appear to pose a significant environmental concern to the property. No holes or leaks were visible. Additionally, no signs of surface staining or stressed vegetation were observed in the vicinity of the storage tank at the time of the site investigation partly due to snow cover.

Refrigerants in the form of ozone depleting substances (ODSs) were located within the freezers, air conditioner and refrigerators at the RCMP detachment site. The appliances were in good condition, and the presence of the ODSs on-site does not pose a significant environmental risk to the property.

Small quantities of hazardous materials identified at the detachment property were stored containers considered to be in good condition. This does not pose a significant environmental risk on this property.

7 RECOMMENDATIONS

The following recommendations should be considered for the Stony Rapids RCMP property:

- Continue to maintain fuel storage tanks in compliance with applicable legislation.
- Obtain a copy of inventory control records at the site.
- Determine what USTs are actually in place on site since records offer conflicting information
- All ozone depleting substances should be managed according to applicable legislation

8 REFERENCES

Canadian Standards Association. 1994. Phase I Environmental Site Assessment (Standard Z768-94).

Canadian Commission on Building and Fire Codes National Research Council of Canada. 1992. National Fire Code 1990, Second Revisions and Errata.

Canadian Council of Ministers of the Environment. 1994. CCME Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products.

Canadian Council of Ministers of the Environment. 1992. National Classification System for Contaminated Sites. Report CCME EPC-CS39E.

Environment Canada's GreenLane.

Public Works and Government Services Canada. 1989. Property Transfer Assessment Guidelines.

Treasury Board of Canada Secretariat. 1998. Treasury Board Real Property Environment Policy. Available [online] at www.tbs-sct.gc.ca/pubs_pol/dcgpubs/RealProperty/enp_e.html.

Treasury Board Manual, Information and Administrative Management, Real Property Management, Chapter 8, Real Property – Environment, 1992.

9 CONTACTS

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Fax: (204) 984-4253
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10 LIMITATIONS

This report, entitled “Phase I Environmental Site Assessment, Royal Canadian Mounted Police, Stony Rapids Detachment, Stony Rapids, Saskatchewan” has been prepared for the exclusive use of Public Works and Government Services Canada for the purpose as described in Section 1.0 of this report. It has been prepared in accordance with the Canadian Standards Association (CSA) Phase I Environmental Site Assessment Standard and generally accepted environmental engineering practices. Use or reliance by any third party, or decisions to be made based on it, is the responsibility of such third parties.

This report has been prepared by:

Shauna Daren
Environmental Student

Environmental Services
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Edmonton, Alberta.

This report was reviewed and approved for transmittal by:

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APPENDIX A
Figures

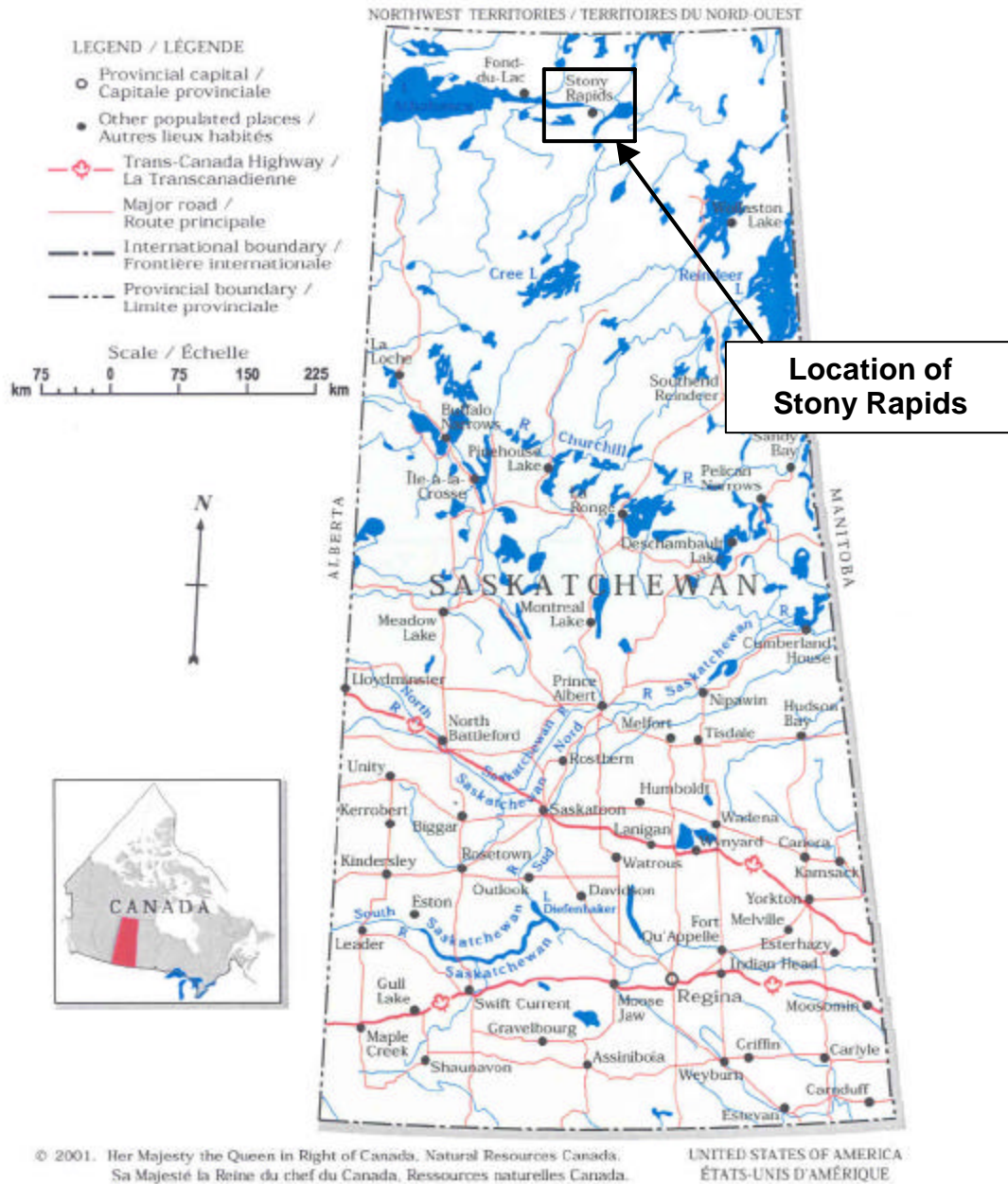


Figure 1: Map of Saskatchewan showing location of Stony Rapids.

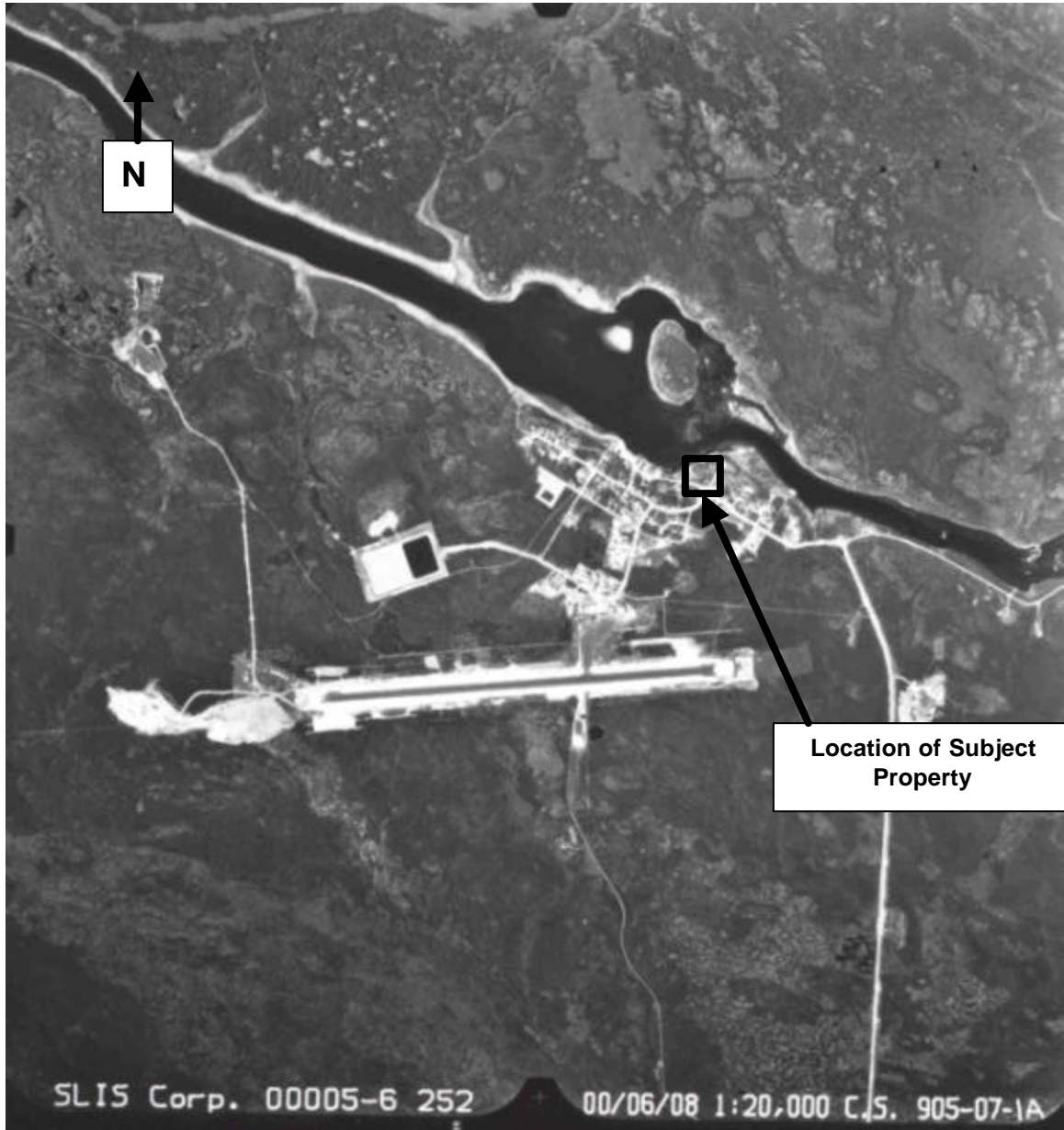
APPENDIX B
Aerial Photographs



Aerial Photo 1: 1978 - Subject property is undeveloped.



Aerial Photo 2: 1984 – A building is present on the subject property, and surrounding area appears to have changed little since 1978.



Aerial Photo 3: 2000 – Building still present on subject property. Little appears to have changed since 1984.

APPENDIX C
Site Photographs



Photo 1: View of detachment building and immediate grounds.



Photo 2: View of Detachment Garage and AST compound.



Photo 3: Interior kitchen and dining area of housing unit #2.



Photo 4: Basement freezers and fridge in housing unit #2.

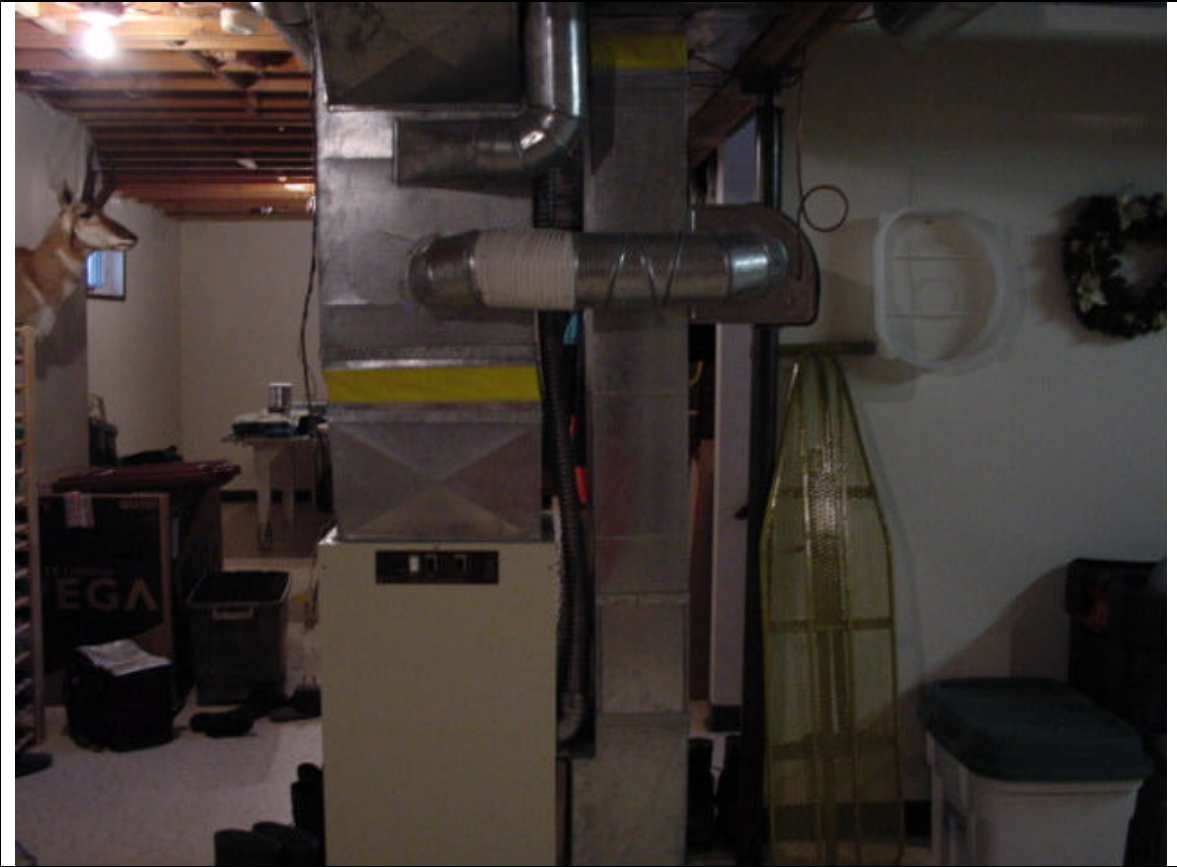


Photo 5: Electric furnace in housing unit #2.



Photo 6: Detached garage between two housing units.



Photo 7: Interior of housing garage showing empty gasoline cans.



Photo 8: Exterior of housing unit #2 and front yard area. Note the tank access.



Photo 9: Exterior of detachment building showing air conditioning unit.



Photo 10: Interior of detachment garage. Note the hazardous materials storage.



Photo 11: Interior of detachment garage. Note the oil pan.



Photo 12: View of utility room in detachment basement.



Photo 13: View of the fuel room located in the basement of the detachment building.



Photo 14: Fridge and freezer located in the basement of the detachment building.



Photo 15: View of cell/lock up area in detachment building.

APPENDIX D
RCMP Space Cards

[illegible]

Sharon WILES - New Completed Garage at Stony Rapids - Project FF055

Page

From: Sharon WILES
 To: Ron APPLETON
 Subject: New Completed Garage at Stony Rapids - Project FF055

*F0703
 Garage*

Hi Ron:

Could you kindly give me the dimensions for this building, so that I can enter it on RPIS. The building number is 060703 and it is located on Lot 4, Block 4.

CC: Lyle WILKINSON

Sharon WILES - Building Code Number - Stony Rapids Garage - New -Reply

Page

From: Stephanie Crawley
 To: FDIV_REGINA.FDIV_HQ(SWILES)
 Date: Tue, Nov 10, 1998 8:39 AM
 Subject: Building Code Number - Stony Rapids Garage - New -Reply

on site F0310

Hi Sharon

Hope thw eather is well in Regina.

Here is your building code for Stony Rapids garage 060703.

*Net & Gross Area
 73.9 m²*

Steph
 :)

*7.9 X 9.8 m² gross 44
 = 77.42 m²*

on RPIS may 31/99 /fw

STONY RAPIDS

GARAGE

060703

From: Sharon WILES
 To: Ron APPLETON
 Date: 11/12/98 3:03pm
 Subject: New Completed Garage at Stony Rapids - Project FF055

Hi Ron:

Could you kindly give me the dimensions for this building, so that I can enter it on RPIS. The building number is 060703 and it is located on Lot 4, Block

CC: Lyle WILKINSON

STONY RAPIDS GARAGE

2 / 21 # 0010 001 0001

OWNED LAND
PROPRIÉTÉS – TERRAINS

30/12

K.C.M.P. ☒ G.R.G.
O.D. ☐ A.M.Q.

OWNED LAND		PRINCE ALBERT		STONEY RAPIDS DET. & M.Q.		STONEY RAPIDS DET. & M.Q.	
PARCELS	DESCRIPTION, DIMENSIONS AND AREA IN METRES (M ²)	SECTION, TOWNSHIP AND RANGE	SECTION, TOWNSHIP AND RANGE	SECTION, TOWNSHIP AND RANGE	SECTION, TOWNSHIP AND RANGE	SECTION, TOWNSHIP AND RANGE	SECTION, TOWNSHIP AND RANGE
1.	LOT 4, BLOCK 4 SUB-DIVISION STONEY RAPIDS, SASK, PLAN 3K361. MEASURING: 93.83 m X 28.45 m X 71.54 m X 77.91 m	8243 (A)	PROV., SASK.	GRATIS ESTIMATE VALUE \$1,500.	58-01-08	GS 1390-302 COT #222 AGX GRANT AP7936 DAY BK CX6212 R84 FOLIO ACT ISSUED BY THE REGISTRAR OF LAND REG. DIST. OFFICE OF PRINCE ALBERT, SASK 58-01-08.	
2.	LOT 1 & 2 IN BLOCK 4 PLAN NO 3K361. MEASURING: 39.62 m X 55.81 m	2211 (A)	PROV. OF SASK.	\$220.00 (A)	80-03-05	COT 80PA04357 REGISTERED IN PRINCE ALBERT LRD 80-03-05 ACCEPTING ORDER IN COUNCIL PC 1980-1580 DATED 80-06-12 PROV. ORDER IN COUNCIL #198/80 DATED 80-02-05.	
<p>Most southerly 22 m of Lot 1 & 2</p> <p>LI LP</p> <p>— surplus</p> <p>He did all the paper work & sent to Steve V bottom.</p> <p>— surplus now 30/00 per Kyle</p>		DET. & M.Q. SITE		10,454 A	\$1,720 (A)	060310	S

JOHNSON ST.
STONEY RAPIDS, SASK.

RCMP GRC

4812
S-281*
REV. 27-6-87

**ROYAL CANADIAN MOUNTED POLICE
R.C.M.P. OWNED BUILDING**

ACCOMMODATION FOR
Stony Rapids Rural Detachment
Married Member
single

DIVISION SK-3-DIVISION **PRINCE ALBERT**

TYPE **1 and part basement**

NO. OF FLOORS **1**

TYPE OF CONSTRUCTION **frame**

EXTERIOR FINISH **Metal siding asphalt shingles**

AUTHORITY

BUILDING CODE NO. **060711**

SITE CODE NO. **060310**

"RC" BUILDING FILE NO. **GS 1315-16**

"RG" SITE FILE NO. **GS 1390-302**

DIV. FILE NO. **F 1315-16**

DATE **Nov/83** **DESCRIPTION** **Repairs to Water Supply System (P31-GS)** **COST** **\$10,770.00**

Nov/84 **Water Supply & Hvg. Main, Sask** **\$5824.24**

Nov/90 **Water System Repairs** **\$9670.00**

Oct/90 **Window Replacement** **\$10,366.00**

Sept/94 **River North Const.** **\$90,309.00**

REMARKS **Single quarters converted to married quarters effective 1 Jun 76 PMH tix 258/19**

REL. **ADM. OPR. OR INS.** **INV. CLASS**

BLOS. SERVICE AREA **BLOS. SERVICE AREA**

6.0 **36.7**

NET **GROSS** **NET** **GROSS** **NET** **GROSS** **TOTAL**

69.6 **75.6** **303.3** **360.0** **435.6**

YEAR CONSTRUCTED **24 Jan 1975**

COST **\$390,610.00**

IF ACQUIRED WITHOUT COST ESTIMATE VALUE **\$**

CONSTRUCTED BY NAME AND ADDRESS **A.E. Enterprises Ltd.**
Prince Albert, Sask.

IDENTIFICATION AND USE **STONY RAPIDS SASK. 060711 Det. Office**

ADDRESS AND LOCATION **Johnson Street**

5912

ALLOCATION D'ESPACE

INSTRUCTIONS ON REVERSE MUST BE CAREFULLY FOLLOWED

RECOMMENDATION FOR LOCAL OFFICER

LES DIRECTIVES AU VERSO SERONT SUIVIES À LA LETTRE

Stony Rapids Rural Detachment
Married Member

PAGE 1 OF 1
DATE 24 Mar 77

ROOM OR LOCATION	ACCOMMODATION FOR	USE OF SPACE UTILISATION DE L'ESPACE	RESIDENTIAL		OTHER		TOTAL	RESIDENTIAL	OTHER	TOTAL
			ROOMS	SQ. FT.	ROOMS	SQ. FT.				
Basement										
Rl. Det.		Stairs								
"		Storage, gen.								
"		Hall								
"		Furnace Rm.								
"		Storage, gen. & secure Exhibits, 0/nite								
1st Floor										
Rl. Det.		Office, NCO i/c								
"		Interview Rm.								
"		Storage								
"		Hall								
"		CC, Hall								
"		Janitor Rm.								
"		Hall to Engr. Qtrs.								
"		Provost								
"		CC								
"		Holding Facility								
"		Cell, Male								
"		Shower, Male Pris.								
"		Cell, Male								
"		Matron								
"		Shower, Female								
"		Cell, Female								
"		Cell, Female								
"		Washrm., Male								
"		Washrm., Female								
Rl. Det.										
"		Office, gen.								
Cumulative Total			65	749	440	1895	65	749	610	3265

Johnson St.
STONY RAPIDS, SASK.

06071 Detachment Office

FORM 1-1-77-01-15-45

[illegible]

[illegible]

F0314		8912	
R.C.M.P. OWNED BUILDING - IMMEUBLE APPARTENANT À LA G.R.C.			
Division	Sub-division - Sous-division	Act/Description 141 - Locaux d'usage	
"F"	PRINCE ALBERT	Married Quarters	
Type - Genre	Built-on-Site Bungalow		
No. of Floors - Nombre d'étages	One & Basement		
Type of Construction - Genre de construction	Frame		
Exterior Finish - Finition extérieure	Vinyl Siding		
ACQUISITION BY PURCHASE GRANT OR TRANSFER ACQUISITION SUBVENTIONNÉE OU PAR TRANSFERT			
Date Acquired - Date d'acquisition	August, '80		
Acquired From Owner and Address - Obtenu de (Nom et adresse)			
Method - Mode	14.6 X 8.5 - 141/1		
Year of Construction - Année de construction	1980		
COST - COÛT		A/E	
If acquired without cash advance value Doors in case of acquisition sans évaluation du coût au débiteur.		A/E	
CONSTRUCTED FOR R.C.M.P. - CONSTRUIT POUR LA G.R.C.			
Constructed by (Name and Address) - Construit par (Nom et adresse)		COST - Coût	
Byrnes & Hall Construction Ltd. P.O. Box 9118, Postal Station "E" EDMONTON, Alberta T5P 4K2		109,776 A	
Full Name (not Address) - Nom complet Robillard & Johnson St STONY RAPIDS, Sask.			
Code No. and Predecessor Use Code no et usage précédent		060318 MQ	
ADDITIONS AND IMPROVEMENTS ANNEXES ET AMÉLIORATIONS			
Date	Description	Cost - Coût	
Aug 81	Fencing S'toon	5525.96	
Jan 82	Carpets, Det. P.A. (Tadman's)	2681.03	
Nov 91	New Windows (F310-1-64) (Portico) Hi-Therm, Wpg. Man.	\$3890.19	
Remarks - Remarques Addition pump in basement			
RESIDENCE RÉSIDENTIELLE	ADMR. DFR OR INS. ADM. EXEC. DU INST.	INV. CLASS CLASSE DE L'INV.	
Build. Service Area Aire de service de l'immeuble	Build. Service Area Aire de service de l'immeuble	Net Montant net	
141.1	141.1	81.0 222.1	
Net Montant net	Net Montant net	Total	

[illegible]

15872

F0196

R.C.M.P. OWNED BUILDING – IMMEUBLE APPARTENANT À LA G.R.C.

Division	Subdivision – Sous-division	Accommodation for – Locaux pour
Unit	PRINCE ALBERT	Married Quarters – Stony Rapids
Type – Genre	Built-on-Site Bungalow	
No. of Floors – Nombre d'étages	One & Basement	
Type of Construction – Genre de construction	Frame	
Exterior Finish – Finishes extérieures	Vinyl Siding	

Authority – Autorité	Building Code No. – N° de code de l'imm.	Site Code No. – N° de code de l'empl.	Plotting File No. – N° de doss. - Imm.	Plotting File No. – N° de doss. - empl. de	File No. – N° de doss. de la division
	060196	060310			F.1315-15-1

ACQUISITION BY PURCHASE GRANT OR TRANSFER ACQUISITION SUBVENTIONNÉE OU PAR TRANSFERT	14.6 X 8.5	ADDITIONS AND IMPROVEMENTS ANNEXES ET AMÉLIORATIONS
Date Acquired – Date d'acquisition August, '80		Nov. 91
Acquired from (Name and Address) – Obtenue de (Nom et adresse)		New Windows (F310-1-64) (Portion Hi-Therm, Wpg. Man. \$3890.19)
Method – Mode		
Year of Construction – Année de construction		
COST – COUT		
If acquired without cash estimate value (Date of cash acquisition sans estimation du coût au préalable)		

CONSTRUCTED FOR R.C.M.P. – CONSTRUIT POUR LA G.R.C.	RELOCATED FROM Uranium City F70774 (Aug 8)
Constructed by (Name and Address) – Construit par (Nom et adresse)	Construction completed 15 Oct 84
Byrnes & Hall Construction Ltd. P.O. Box 9118, Postal Station "E" EDMONTON, Alberta T5P 4K2	
Cost – Coût	
99,576 A	
Y-A M O-D	
80 09 06	
060196 MQ	
Full Mtr. Cost Address Address multiple au complet Johnson Street Stony Rapids, Sask.	

RESIDENCE RÉSIDENTE	ADMR. OPS OR INS. ADM. EXEC. OU INST.	INV. CLASS CLASSIF. DE L'INV.
141.1		
Net Montant net	Gross Montant brut	Total
81.0	222.1	

11912

DETAIL SPACE ALLOCATION
INSTRUCTIONS ON REVERSE MUST BE CAREFULLY FOLLOWED
LES DIRECTIVES AU VERSO SERONT SUIVIES À LA LETTRE

PRINCE ALBERT **STONY RAPIDS - Married Quarters**

PAGE 1 OF 1
DATE 81 JUNE 22

ROOM OR AREA NO.	ACCOMMODATION FOR	USE OF SPACE UTILISATION DE L'ESPACE	RESIDENTIAL		OTHER		RESIDENTIAL		OTHER	
			REAR SERVICE AREA	REAR SERVICE AREA	REAR SERVICE AREA	REAR SERVICE AREA	REAR SERVICE AREA	REAR SERVICE AREA		
BASEMENT										
Mrd. Mbr	Storage, gen.		115.6							
1ST FLOOR										
Mrd. Mbr	Kitchen		11.5							
"	Dining Room		12.4							
"	Rear entry		4.5							
"	Closet, rear		0.9							
"	Shelves, rear		0.7							
"	Living Room		20.1							
"	Front Entry		2.4							
"	Closet, front		1.2							
"	Hall		6.1							
"	Shelves, hall		0.6							
"	Bathroom		5.0							
"	Bedroom No. 1		9.5							
"	Closet, bedroom		1.3							
CUMULATIVE TOTAL			133.3	58.5						
TOTAL CUMULATIF			133.3	58.5						
1ST FLOOR										
...continued										
1ST FLOOR										
Mrd. Mbr										
Bedroom No. 2										
Closet, bedroom										
Bedroom, master										
Closet, bedroom										
Bathroom										
Stairs										
CUMULATIVE TOTAL			141.1	81.0						
TOTAL CUMULATIF			141.1	81.0						
060196 - Married Quarters										
Johnson Street, Stony Rapids, Saskatchewan										

RCMP GRC 5-200 (12-00)

12812
S-263*
REV. 27-5-87

ROYAL CANADIAN MOUNTED POLICE
R.C.M.P. OWNED WORKS

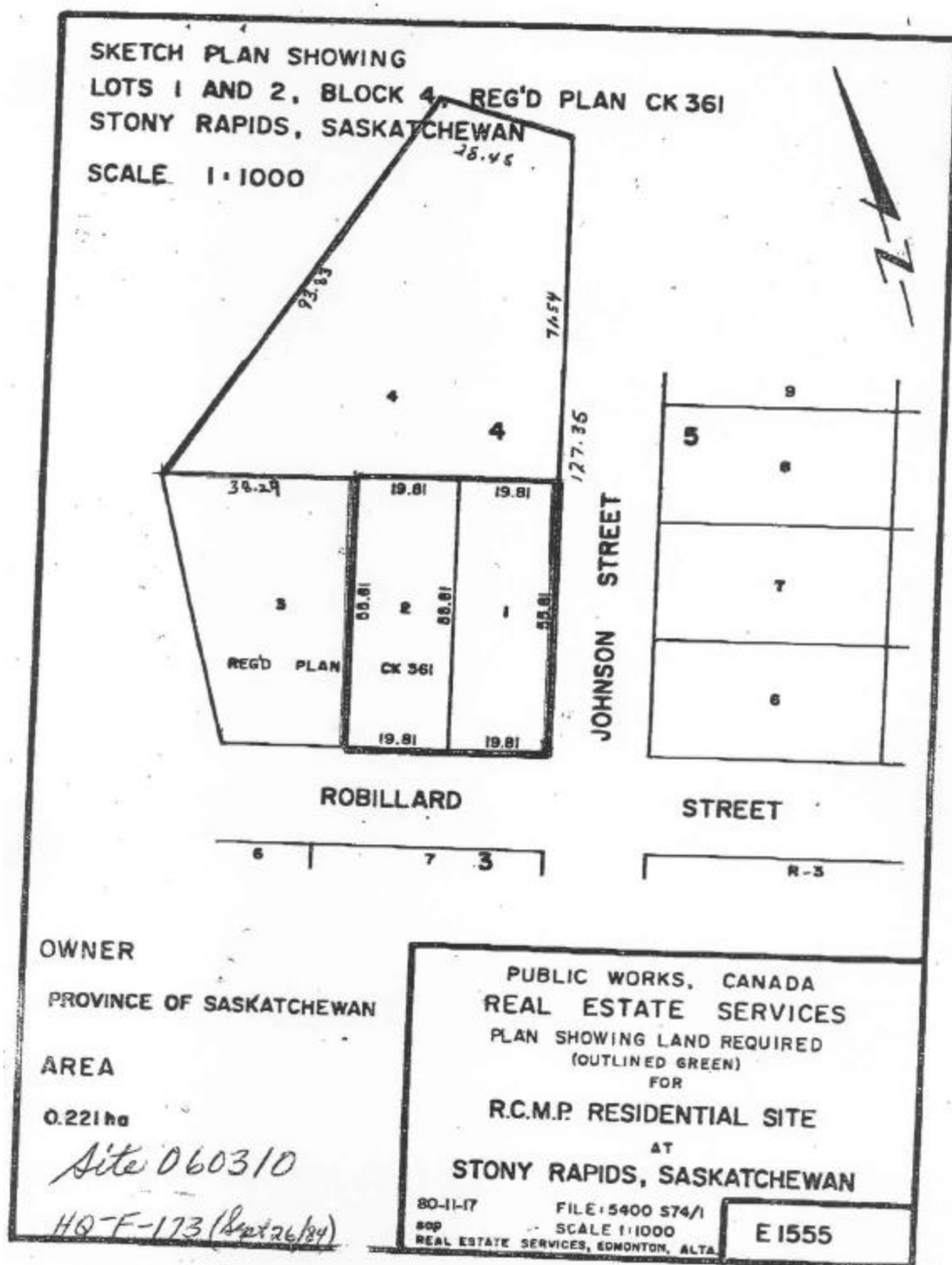
WURKE FOR

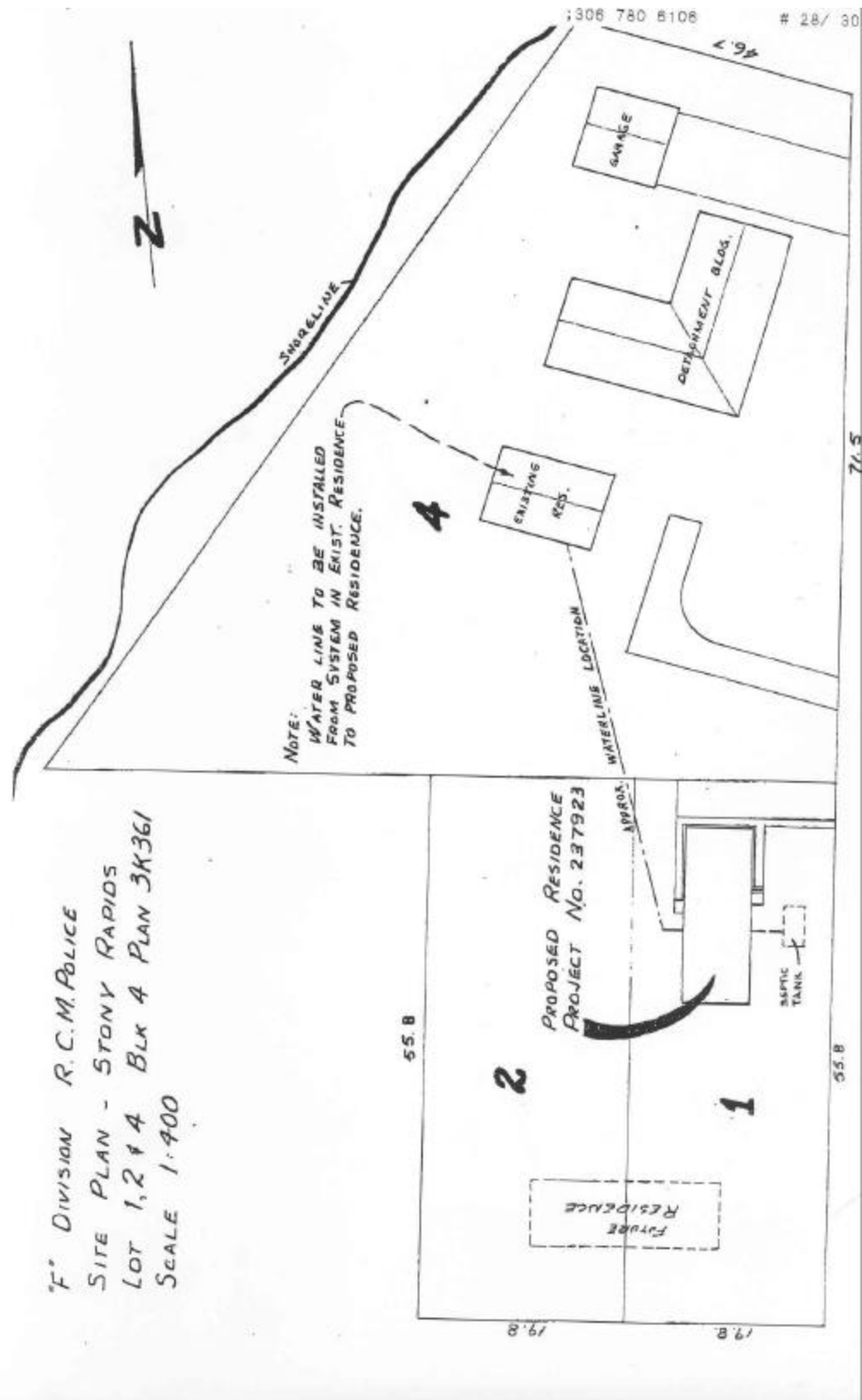
DIVISION	SUB-DIVISION	DESCRIPTION	UNIT OF MEASURE	TOTAL	CAPITAL COST A/E	AUTHORITY	FILE NO.
STG	1975	Gas pump and under-ground fuel storage (vehicle)	gal.	500 gal.			F-1315-16
DUPLICATE							
<p>84/6-10-88 5/10/88 RCMP</p>							

Stony Rapids Detachment
ite F-1310

ADDRESS AND LOCATION
Johnson Street
STONY RAPIDS, SASK.

Code No. 060704





APPENDIX E

Results of Asbestos Sampling



ANALYTICAL SERVICES

DRAFT31-Jan-02
Page 1 of 2**Interim Report**9619 42 Avenue
Edmonton, Alberta
Canada T6E 5R2
Tel 780 465 1212
Fax 780 450 4187**Reported To :**

PWGSC - ENVIRONMENTAL

Client Code PG

1000 - 9700 JASPER AVE
EDMONTON, AB
T5J 4E2Attention : LAURIE WASHINGTON
Phone : (780) 497-3892
FAX : (780) 497-3842**Project Information :**

Project ID : 406791

Requisition Forms :

Form 42206485 shipped on 24-Jan-02 received on 24-Jan-02 logged on 24-Jan-02

Remarks :

- + All organic data is blank corrected except for PCDD/F, Hi-res MS and CLP volatile analyses
- + 'MDL' = Method Detection Limit, '<' = Less than MDL, '-' = Not analyzed
- + Solids results are based on dry weight except Biota Analyses & Special Waste Oil & Grease
- + Organic analyses are not corrected for extraction recovery standards except for Isotope Dilution methods, (i.e. CARB 429 PAH, all PCDD/F and DBD/DBF analyses)
- + All Groundwater samples except BTEX/VOC's or Purgeable Hydrocarbons are decanted and/or filtered prior to analysis unless otherwise mandated by regulatory agency
- + This report shall not be reproduced except in full, without the written approval of the laboratory

Methods used by Philip are based upon those found in 'Standard Methods for the Examination of Water and Wastewater', 20th Edition, published by the American Public Health Association, or on US EPA protocols found in the 'Test Methods For Evaluating Solid Waste, Physical/Chemical Method, SW846', 3rd Edition. Other procedures are based on methodologies accepted by the appropriate regulatory agency. Methodology briefs are available by written request.

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies, quality assurance and quality control procedures except where otherwise agreed to by the client and testing company in writing. Liability for any and all use of these test results shall be limited to the actual cost of the pertinent analysis done. There is no other warranty expressed or implied. Your samples will be retained at Philip for a period of 30 days from receipt of data or as per contract.

PHILIP Project Manager: Geraldlyn Gouthro

ext. 225

Contracted out to

1-604-925-9705 - Sue

ID's → #3425 floor - (two layers) @ line
 #3426 ceiling @ underneath layer



ANALYTICAL SERVICES

31-Jan-02
Page 2 of 2INTERIM REPORT
Form 42206485Client : PWGSC - ENVIRONMENTAL
Project : 406791Philip ID : 32000832 32000833
Client ID : SR-AS-02 SR-AS-03

Sparcode	Parameter	Unit	MDL		
DISPDONE	Disposal Charge	Y/N	Yes	Yes	Yes
HOLDHOLD	Hold Sample	mg/L	0	—	? (2)
STRODONE	Storage Charge	Y/N	Yes	Yes	—
PHYSICAL ASBTFPLM	Asbestos	None		— (1)	— (3)
			Matrix :	Others	Others
			Sampled on:	02/11/19 16:00	02/11/19 16:00

Result comments and/or text results :

(1) Text results for sample 32000832 sparcode ASBTFPLM follow :

1. TAN/WHITE CHECKERED LINO
NO ASBESTOS DETECTED, 90-100% NON-FIBROUS MATERIAL
2. OFF-WHITE COMP. FIBROUS MATERIAL
20-40% CHRYSOTILE ASBESTOS, 10-30% CELLULOSE, >30% NON-FIBROUS MATERIAL

(2) No result available yet.

(3) Text results for sample 32000833 sparcode ASBTFPLM follow :

HOMO. WHITE COMPRESSED FIBROUS MATERIAL
NO ASBESTOS DETECTED
40-60% FIBROUS GLASS
10-30% CELLULOSE
>10% NON-FIBROUS

01/31/02 17:14 FAX 780 450 4187 PSC ANALYTICAL 003

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

PAGE _____ OF _____

ANALYSIS REQUEST -42006485

42206485

PHILIP ANALYTICAL SERVICES
9519 - 42nd Avenue
Edmonton, AB T6E 5H2
Phone: (780) 450-1212
Fax: (780) 450-4187
Toll Free: 1-877-465-8689

COMPANY NAME: Public Works Canada
COMPANY ADDRESS: 1000, 9500 JASPER AVE
EDMONTON, AB
T5J 4K2

PHILIP SERVICES

PHIL #1: 780 450 4187 - 3852
FAX #1: 780 450 4187 - 3852
CLIENT PROJECT ID: 42206485

PROJECT MANAGER: David Hamilton

SAMPLER NAME (PRINT): David Hamilton

FIELD SAMPLE ID	PHILIP LAB # (Lab Use Only)	MATRIX			# CONTAINERS	SAMPLING		HEADSPACE VAPOR
		GROUND WATER	SURFACE WATER	SOIL		OTHER	DATE	
1 58-AS-02	833				✓			
2 58-AS-02	833				✓	01.11.19		
3 58-AS-03	833				✓	01.11.19		
4								
5								
6								
7								
8								
9								
10								
11								
12								

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE

LAB USE ONLY

LAB INFORMATION

RECEIVED BY: Jan 31 02

RECEIVED BY: Jan 31 02

RECEIVED BY: Jan 31 02

EDT ☐

SPECIAL REPORTING OR BILLING INSTRUCTIONS

ACCOUNTING CONTACT:

RELINQUISHED BY SAMPLER:

RELINQUISHED BY:

RELINQUISHED BY:

TAT ☐ ☐ ☐ ☐ ☐

Test Week
Five Week
48 Hours
24 Hours
GDH:

CUSTODY
RECORD

DATE TIME
DATE TIME
DATE TIME

DATE TIME
DATE TIME
DATE TIME

APPENDIX F

Inventory of Ozone Depleting Substances

Inventory of appliances containing ozone-depleting substances in the housing units and detachment building of the Stony Rapids RCMP Detachment

Location	Model	Refrigerant	Quantity
Housing Unit #1			
Downstairs Fridge	RCA model #KXC215KH	R12	4.7 oz
Downstairs Freezer #1	HR3 26179	R12	8 oz
Downstairs Freezer #2	Eatons Model #FR1H818-W	R12	8 oz
Upstairs Fridge	Danby Model #SFF169000	R12	5.5 oz
Housing Unit #2			
Upstairs Fridge	No label	-	Unknown
Downstairs Fridge	No label	-	unknown
Downstairs Freezer	Baycrest Model #BC-22-1	R12	10.25 oz
Downstairs Freezer	Marquette Model #CH5-4R	R12	11.75 oz
Detachment			
Basement Fridge	Gibson (incomplete label)	Assumed R12	unknown
Basement Freezer	WCI Canada Model #CA23HW	R12	8.5 oz
Air conditioner	Model #CA2030QKB1	R22	Not listed on label

APPENDIX G

**Saskatchewan Environment and Resource Management Environmental
Search Results**

Environmental File Search Response

Shauna Daren
Public Works & Government Services Canada
1000 9700 Jasper Ave.
EDMONTON, AB T5J 4E2

File 12020-50/EFS/REQ

February 8, 2002

Reference 01-304

Your File

Shauna Daren

Pursuant to your request dated December 18, 2001 regarding:
RCMP Detachment & Housing

Located At Johnson & Robillard St.

Legal Land Description - - - W
RM of Stony Rapids, SK

Notes:

The Environmental Protection Branch offers the following information pertaining to

- Registration status and Storage facility details pursuant to the Hazardous Substances and Waste Dangerous Goods Regulations
- Reported Spills pursuant to Environmental Spill Control Regulations
- Registered Wastes pursuant to Hazardous Substances and Waste Dangerous Goods Regulations and PCB Waste Storage Regulations

Please Note

- 1 The search response is compiled by the department from a combination of manual and computerized file searches. The response is subject to the accuracy of information and material supplied by outside parties and the Department makes no representations or warranties as to the accuracy or sufficiency of it.
- 2 The integrity of the data supplied by outside parties diminishes with the age of the reported information.
- 3 The search response will be site specific and may not reflect contamination or the existence of a pollutant from an off site source.
- 4 The Department makes no representations or warranties as to whether or not the party being searched is in compliance with any provincial or federal Act, Regulation, Approval, Licence or Permit or as to the relevance of the search response.
- 5 The Department makes no representations or warranties whether or not there are any environmental concerns as to the land being searched nor as to the environmental status of the land. It is recommended that an environmental audit or site assessment be conducted by an independent third party consultant.

File Search Information

Hazardous Substances and Waste Dangerous Goods Regulations:

☐ Not Registered

QT-1027

☒ Registered

Facility Code Royal Canadian Mounted Police
Johnson Street, Stony Rapids

For more information on this registered site please contact the region as indicated below:

☐ Grassland EcoRegion - (306) 787-6205

☐ West Boreal EcoRegion - (306) 236-7673

☐ Parkland EcoRegion - (306) 933-6242

☐ Shield EcoRegion - (306) 425-4234

☐ East Boreal EcoRegion - (306) 953-2296



Saskatchewan
Environment
and Resource
Management

Environmental
Protection
Branch

Room 224, 3211 Albert Street
REGINA SK S4S 5W6

Phone: (306) 787-6542
Fax: (306) 787-0197

Environmental Spill Control Regulations:☒ **No Reported Spills**

Spill #	Date of Spill	Amount Spilled	Material Spilled	Cause
.....
.....
.....
.....
.....

For More Information Contact:

**Saskatchewan
Environment
and Resource
Management**

Environmental
Protection
Branch

Room 224, 3211 Albert Street
REGINA SK S4S 5W6

Phone: (306) 787-6542
Fax: (306) 787-0197

APPENDIX H

National Classification Standards Worksheets

Category	Evaluation Factor	Score	Rationale
Contaminant Characteristics	Degree of Hazard	0	No known contaminants at site
	Contaminant Quantity	2	No known contaminants at site
	Physical State	0	No known contaminant at site
	Special Considerations	2	No known contaminant at site
Exposure Pathways: Groundwater*	Known Contamination	0	Groundwater contamination is not suspected
	Subsurface Containment	5	No known contaminant to contain
	Confining Layer Thickness	0	No aquifer of concern at site
	Hydraulic Conductivity	0	No aquifer of concern at site
	Annual Rainfall	0.2	200mm
	Aquifer Conductivity	0.5	No aquifer of concern at site
	Special Considerations	-4	No known contamination at site
Exposure Pathways: Surface Water*	Discharge from site	0	No known discharges
	Surface Containment	5	No containment as there are no known discharges
	Distance to Surface Water	3	River is 0 to <100m from site
	Topography	0	No known contaminants
	Run-off Potential	0.2	<500mm of rainfall – no known contaminant
	Flood Potential	0.1	Selected because site is located above the lake level
	Special Considerations	-4	No known contaminants at site
Exposure Pathways: Direct Contact*	Contamination of off-site media	0	No known contamination of media off-site due to site activities
	Airborne Emissions	0	No airborne emissions
	Site Accessibility	0	No known contaminants to have access to
	Soil Gas Migration	0	No putrescible contaminants at the site
	Special Considerations	0	No known contaminants at the site

Category	Evaluation Factor	Score	Rationale
Receptors: Human and Animal Uses*	Human and animal uses	0	No suspected adverse effects on humans
	Potential Drinking Water Impacts	0	Drinking water is not known to be contaminated
	Proximity to Drinking Water Resources	0	No known contaminant at the site
	Alternate Water Supply	0	Alternate drinking water supply is not needed as no known contaminants at site
	Impact on Water Resources	0	Water resource is not known to be contaminated
	Proximity to water resources	0	Not applicable
	Human exposure	0	Land is not known to be contaminated
	Potential exposure	0	Site is in residential area of town –however there is no known contaminant at site
	Special Considerations	0	No known contamination
Receptors: Environment*	Known effects to sensitive areas	0	No designated sensitive areas in vicinity
	Distance to Sensitive Environment	0.5	Assumed that areas within 5 km of site would not be categorized as sensitive environments as defined by the CCME
	Distance to Groundwater Resources	6	Site is located 0 to <500m from lake
	Special Considerations	-5	No known sources of contamination, not close to any sensitive areas
Total score		7.5	Class N – No action required

**PUBLIC WORKS AND
GOVERNMENT SERVICES CANADA**

**Phase II Environmental Site Assessment
RCMP Stony Rapids Detachment Site
DFRP 14862
Stony Rapids, Saskatchewan**



February 2013

PWGSC Project No.: R.058406.003

Prepared for:

Public Works and Government Services Canada
Environmental Services
100 - 167 Lombard Avenue
Winnipeg, Manitoba R3C 2Z1

Prepared by:

EGE Engineering Ltd.
511 Pepperloaf Cres.
Winnipeg, Manitoba
R3R 1E6

EGE Engineering Ltd.

Engineering, Geosciences & Environmental

February 25, 2013

File: 0125 046 03

Public Works and Government Services Canada
100 -167 Lombard Avenue
Winnipeg, Manitoba
R3C 2Z1

Attention: Ms. Marie McGregor, B.Sc.
PWGSC Project Manager

RE: Phase II Environmental Site Assessment
RCMP Stony Rapids Detachment Site - DFRP 14862
Stony Rapids, Saskatchewan

Dear Ms. McGregor:

EGE Engineering Ltd. is pleased to submit the following report on the Phase II Environmental Site Assessment (ESA) completed at the Royal Canadian Mounted Police Detachment site located in Stony Rapids, Saskatchewan. The Phase II ESA was conducted to assess actual and/or potential impacts from the contaminants of concern associated with various areas of potential environmental concern that were identified during a 2011 Phase I ESA by Stantec Consulting Ltd.

Should you have any questions or require any additional information on the report please contact the undersigned at (204) 226-7378 or Mr. Peter Bohonos at (204) 771-6976.

Sincerely,

EGE ENGINEERING LTD.



Larry Bielus, M.Sc., P.Eng.
Senior Geological Engineer
Lpb/lb

Executive Summary

EGE Engineering Ltd. (EGE) was retained by Public Works and Government Services Canada (PWGSC) Environmental Services Branch - Western Region on behalf of the Royal Canadian Mounted Police (RCMP) to conduct a Phase II Environmental Site Assessment (ESA) at the Stony Rapids Detachment site located on Johnson Street in Stony Rapids, Saskatchewan.

Project Objectives

As outlined in the Terms of Reference, the specific project objectives included: delineation of the extent and volume of contamination and the likelihood for contaminant migration; recommendations for site remediation and/or risk management; and collection of all information necessary to classify the site according to the National Classification System for Contaminated Sites (NCSCS) in order to assist in the prioritization of remediation and/or risk management at the site.

Scope of Work

The Phase II ESA was conducted following the principals and general practices set out by the Canadian Standards Association guideline Z769-00 Phase II Environmental Site Investigation (R2008). The work plan included the development, and implementation, of a field and analytical program that targeted the following areas of potential environmental concern (APECs):

- Former gasoline underground storage tank (UST) and bowser, existing gasoline aboveground storage tank (AST), and burn barrel located at the northeast corner of the site;
- Diesel generator and waste oil drum located west of the Detachment garage at the northwest corner of the site;
- Former heating oil UST located on the north side of the Detachment on the north side of the site;
- Burn barrel located northwest of the Detachment workshop on the south side of the site;
- Employee housing units located in the central and southeast areas of the site, which may have had former heating oil day tanks;
- An off-site heating oil AST at the Waterfront Lodge located near the southwest corner of the site; and
- Multiple off-site ASTs at the Petro-Canada bulk plant located 200 m to the west-southwest.

An inspection of the interior basement and exterior areas around the employee housing units at the time of the site investigation program showed no evidence of any former pads or piping, and the RCMP staff on-site were not aware of any former heating oil tanks associated with the housing units. Therefore, this APEC was deleted from the targeted program. To assess the remaining APECs, the Phase II ESA included drilling sixteen test holes of which four were completed as groundwater monitoring wells.

Site Description

The RCMP Detachment site (DFRP 14862) is located on the west side of Johnson Street on the north side of the community of Stony Rapids, Saskatchewan. The community of Stony Rapids is situated along

the south bank of the Fond du Lac River, approximately 670 km north of Prince Albert and 800 km north of Saskatoon, Saskatchewan. The RCMP Detachment site consists of one irregularly shaped land parcel with a total area of 0.50 ha. Five buildings are present on the property, including: the Detachment; two employee housing units; a garage; and a workshop. The Directory of Federal Real Property (DFRP) number, Federal Contaminated Site Inventory (FCSI) number, property description, site address, property ID, and latitude and longitude of the main Detachment building are tabled below.

Property Description	Site Address	Property ID	DFRP	FCSI	Lat/Long
RCMP Stony Rapids Detachment	Stony Rapids, Saskatchewan	PR F/84	14862	00024788	59° 15' 34 N" 105° 49' 52" W

The Detachment (BU F/329) is accessed via a concrete driveway from Johnson Street, which leads east-northeast to the garage (BU F/326). Individual gravel driveways also lead from Johnson Street to employee housing unit (BU F/105), and to employee housing unit (BU F/182) and the Detachment workshop (BU F/325). Concrete sidewalks lead from the paved driveway along the front of the Detachment building towards the employee housing unit BU F/182 and from the driveway to the backdoor of the Detachment. There are also concrete sidewalks around the north sides of both employee housing units. The remaining areas of the site have grass cover, with deciduous and coniferous trees present across the site.

The surrounding land use consists of: the Water Front Lodge and the Community of Stony Rapids water treatment plant to the south followed by residential housing across a gravel roadway; residential housing across Johnson Street to the east; the south bank of the Fond du Lac River to the west and north; and the community's float plane base to the southwest along the bank of the Fond du Lac River to the southwest.

The property is gently sloped away from the various building footprints towards Johnson Street to the east and towards the Fond du Lac River to the west and northwest. There are no drainage ditches located along the adjacent roadways and there are no storm water sewers or catch basins present on or off the Detachment property. Surface runoff in the area is managed through infiltration and overland flow. There was no standing water present on the site and the site appeared to be well drained, likely due to the granular nature of the surficial soils present in the region.

Background

A Phase I ESA was conducted at the RCMP Detachment site in Stony Rapids by Stantec Consulting Ltd. in 2011, report dated January 2012. The Phase I ESA identified that two USTs were formerly located on the property, including a 4,500 litre heating oil UST north of the detachment and a 4,500 litre gasoline UST north of the driveway leading to the Detachment garage. The former heating oil UST was apparently abandoned in place in 1989, and subsequently removed sometime between 1989 and 1993. There was no information available to indicate whether the former gasoline UST was abandoned in place or removed. The former gasoline UST was located in the same general area as the current 4,500 litre AST. The current gasoline AST is used to fuel the on-site RCMP vehicles and equipment.

In addition to the former USTs and existing AST, the previous Phase I ESA also noted that a diesel generator and waste oil drum were located west of the garage, and that two burn barrels were present at the site, one west of the workshop and one at the northeast corner of the property.

A large Petro Canada bulk plant, containing more than ten large ASTs, was also noted to be located along the Fond du Lac River about 200 m west-southwest of the RCMP property, and a 29,454 litre heating oil AST was noted at the Waterfront Lodge, located adjacent to the southwest corner of the property.

Based on the findings from the Phase I ESA, PWGSC indicated that a Phase II ESA was required to determine whether on and/or off-site activities have resulted in any impacts to the soil and/or groundwater underlying the property.

Phase II ESA Findings

Based on the results of the current Phase II ESA, there is 50 m³ of petroleum hydrocarbon (PHC)/naphthalene impacted soil present at the RCMP Detachment site. The areas of impacted soil include: the area of the former gasoline UST/existing gasoline AST located at the northeast corner of the site; and the area of the former heating oil UST located on the north side of the Detachment. There were no metal or VOC impacts noted in the soil in the area of the Detachment garage or workshop, however, it should be noted that the detection limit for hexavalent chromium was raised above the Canadian Council of the Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) due to sample interference. On this basis, there is the potential that soil exceeding the guideline for hexavalent chromium may be present in the investigated areas, however, as there were no other metal exceedances or evidence of elevated metal parameters, the likelihood of this occurring is relatively low. The guideline is 0.4 mg/kg and the detection limit was also only marginally raised to 0.75 mg/kg.

PHC impacted groundwater was also noted at one well located in the area of the former heating oil UST, however, due to the limited number of wells and absence of groundwater at three of the four wells that were installed during the Phase II ESA it is not possible to accurately delineate the limit of PHC impacted groundwater. Based on the direction of groundwater flow it is expected that the groundwater plume will extend to the northwest from the impacted well, however, based on the soil results in the surrounding test holes, it is not expected to have migrated too far from the source area. There was no evidence of light non-aqueous phase liquid in the one monitoring well.

Based on the findings of the current Phase II ESA, the site was classified under the 2008 CCME NCSCS using the updated 2010 Version 1.2 spreadsheet. On the basis of the available information, the site scored 63.15 and was assigned a Site Classification Category of 2, indicating that the site is a Medium Priority for Action.

A Remedial Options Evaluation was completed for the site, of which two options were identified as being viable at this time, including: conducting a risk assessment to determine if the impacted soil/groundwater can be left in place; and natural attenuation monitoring to determine if the impacts are degrading to an acceptable level. In both cases further site assessment is required. In-situ treatment options may be

applicable if the results of the risk assessment and/or natural attenuation monitoring determine the need to reduce the contaminant concentration levels or to enhance the rate of natural degradation. Ex-situ treatment, involving soil excavation and off-site disposal, may also be applicable, if select infrastructure is removed or relocated, allowing for direct access to the areas of impact or in the case of the area north of the Detachment, verifying that the impacts do not extend beneath the building footprint.

Conclusions and Recommendations

Considering the limited extent of the impacts and the on-going product storage and handling that is occurring at one of the two impacted areas, it is recommended that natural attenuation monitoring be implemented at the site. This would include: annual monitoring and sampling of the existing on-site wells, select air quality samples within the Detachment and garage, and select soil testing to further delineate the areas of impact currently identified at the site.

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1.0 INTRODUCTION AND SCOPE

EGE Engineering Ltd. (EGE) was retained by Public Works and Government Services Canada (PWGSC) Environmental Services Branch - Western Region on behalf of the Royal Canadian Mounted Police (RCMP) to conduct a Phase II Environmental Site Assessment (ESA) at the Stony Rapids Detachment site located on Johnson Street in Stony Rapids, Saskatchewan. The program was completed under the Environmental Services Supply Agreement, PWGSC File Number R.058406.003 and in accordance with EGE's proposal for environmental services dated June 21, 2012 ⁽¹⁾.

The Phase II ESA was conducted following the principals and general practices set out by the Canadian Standards Association (CSA) guideline Z769-00 Phase II Environmental Site Investigation R2008 ⁽²⁾. As outlined in the Terms of Reference ⁽³⁾, the specific project objectives included:

- Delineation of the extent and volume of contamination and the likelihood for contaminant migration;
- Recommendations for site remediation and/or risk management; and
- Collection of all information necessary to classify the site according to the National Classification System for Contaminated Sites (NCSCS), CCME 2008 ⁽⁴⁾ in order to assist in the prioritization of remediation and/or risk management at the site.

These objectives were met by the following scope of work:

- Documenting the sources of contaminants in the vicinity of the RCMP property;
- Delineating the spatial extent of contamination;
- Documenting the contaminant type and concentrations;
- Assessing the physical, biological and chemical properties of the soil;
- Performing soil/groundwater sampling and analysis for identification/delineation of the contaminated areas;
- Characterizing the subsurface geology of the site;
- Establishing the hydrogeology of the site and potential for migration of contaminants into the groundwater or surface water bodies, where possible;
- Determining whether contamination has migrated from the source of impact;
- Identifying site characteristics, which may accelerate or impede contaminant migration;
- Determining the cost of necessary remediation and/or risk management options based on the current and/or future land use;
- Completing the NCSCS scoring worksheets and development of a NCSCS classification score for the site; and
- Preparing a Phase II ESA report for the site that details the subsurface investigation activities and findings.

The work plan included the development, and implementation, of a field and analytical program that targeted several areas of potential environmental concern (APECs) that were identified in an earlier Phase I ESA completed by Stantec Consulting Ltd., report dated January 2012 ⁽⁵⁾ and/or through a review

of the historical site information provided to EGE by PWGSC and the RCMP during preparation of the work plan. The identified APECs at the RCMP Stony Rapids Detachment site include:

- Former gasoline underground storage tank (UST) and bowser, existing gasoline aboveground storage tank (AST), and burn barrel located at the northeast corner of the site;
- Diesel generator and waste oil drum located west of the Detachment garage (BU F/326) at the northwest corner of the site;
- Former heating oil UST located on the north side of the Detachment (BU F/329) on the north side of the site;
- Burn barrel located northwest of the workshop (BU F/235) on the south side of the site;
- Employee housing units (BU F/105 and BU F/182) located in the central and southeast areas of the site, which may have had former heating oil day tanks;
- An off-site heating oil AST at the Waterfront Lodge located adjacent to the southwest corner of the site; and
- Multiple off-site ASTs at the Petro-Canada bulk plant located 200 m to the west-southwest.

Based on the identified APECs, the proposed field investigation included: drilling fifteen test holes that focused on potential impacts within the soil; and the installation of four groundwater monitoring wells, which focused on potential impacts to the underlying groundwater quality.

The following report provides: a description of the site; an overview of the previous site investigation programs; details on the current investigation methodology; a discussion on the regional and local geological, hydrological, and hydrogeological conditions; the results of the analytical program; an evaluation of applicable remedial options; and a discussion on the findings, including conclusions/recommendations.

1.1 SITE DESCRIPTION

The RCMP Detachment site (DFRP 14862) is located on the west side of Johnson Street on the north side of the community of Stony Rapids, Saskatchewan. The community of Stony Rapids is situated along the south bank of the Fond du Lac River, approximately 670 km north of Prince Albert and 800 km north of Saskatoon, Saskatchewan. A location plan is presented as Figure 01. The current features on the property and adjacent land uses are shown on Figure 02, and a plan of the site is illustrated on Figure 03.

As illustrated on Figures 02 and 03, the RCMP Detachment site consists of one irregularly shaped land parcel with a total area of 0.50 ha. Five buildings are present on the property, including: the Detachment; two employee housing units; a garage; and a workshop. The Detachment (BU F/329) is accessed via a concrete driveway from Johnson Street, which leads east-northeast to the garage (BU F/326). Individual gravel driveways also lead from Johnson Street to employee housing unit (BU F/105), and to employee housing unit (BU F/182) and the Detachment workshop (BU F/325). Concrete sidewalks lead from the paved driveway along the front of the Detachment building towards the employee housing unit BU F/182 and from the driveway to the backdoor of the Detachment. There are also concrete sidewalks around the north sides of both employee housing units. The remaining areas of the site have grass cover, with deciduous and coniferous trees present across the site.

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The surrounding land use consists of: the Water Front Lodge and the Community of Stony Rapids water treatment plant to the south followed by residential housing across a gravel roadway; residential housing across Johnson Street to the east; the south bank of the Fond du Lac River to the west and north; and the community's float plane base to the southwest along the bank of the Fond du Lac River to the southwest. Representative photographs of the surrounding lands are provided below.



Photo 01: View looking north at the Stony Rapids Water Treatment Plant, with the south side of the RCMP Employee Housing Unit BU F/105 located in the distance on the right side of the photo.



Photo 02: View looking north at the Waterfront Lodge located to the south of the subject property.



Photo 03: View looking southeast at the residential housing southeast of the subject property.



Photo 04: View looking northwest at the Fond du Lac River to the west and north of the subject property.



Photo 05: View looking southwest along the shoreline of the Fond du Lac River on the west of the site.



Photo 06: View looking west at the community's float plane base located west-southwest of the site.

1.2 SURFICIAL CONDITIONS

The Detachment property consists of: the five building footprints; a concrete driveway between Johnson Street and the Detachment garage at the northeast corner of the site; a “wye” shaped gravel driveway between Johnson Street, and the central employee housing unit and the Detachment workshop, at the southeast corner of the property; a gravel driveway from Johnson Street along the north side of the southern employee housing unit; a diesel generator on the west side of the Detachment garage at the northwest corner of the site; and various concrete sidewalks.

The remainder of the property is vegetated, with a mix of grassed landscaping, and coniferous/deciduous trees along the margins of the site and to a lesser extent around the building footprints. A gasoline AST is also located at the northeast corner of the site, an antenna is located at the southwest corner of the Detachment garage, a flagpole is located along the west property line, and a flagpole and sign are located in front of the Detachment on the east side of the site.

The property is gently sloped away from the various building footprints towards Johnson Street to the east and towards the Fond du Lac River to the west and northwest. There are no drainage ditches located along the adjacent roadways and there are no storm water sewers or catch basins present on or off the Detachment property. Surface runoff in the area is managed through infiltration and overland flow. There was no standing water present on the site and the site appeared to be well drained, likely due to the granular nature of the surficial soils present in the region.

Photos 07 through 11 below provide views of the Detachment property and the surficial conditions on the site as of August 14, 2012.



Photo 07: View looking northwest at the southeast corner of the site.



Photo 08: View looking southwest at workshop BU F/325 and employee housing unit BU F/182.



Photo 09: View looking southeast at the gasoline AST, concrete driveway and Detachment BU F/329.



Photo 10: View looking east at the diesel generator, garage BU F/326 and Detachment BU F/329.



Photo 11: View looking northeast at the west side of the property along the Fond du Lac River.

1.3 LEGAL AND FEDERAL DESCRIPTIONS

The limits of the Detachment property can be seen on Figures 02 and 03, and the property is legally described as:

- *Lots 4 and 5, Block 4, Plan CK361, Plan 101858698 in Stony Rapids, Saskatchewan.*

Legal plans for the property were not provided in the 2012 Phase I ESA report or provided to EGE as part of this project. On this basis, the property boundaries shown in the 2012 Phase I ESA report ⁽⁵⁾ and as defined on-site by the chain link fencing, were considered to be the legal limits of the Detachment site.

The Directory of Federal Real Property (DFRP) number, Federal Contaminated Site Inventory (FCSI) number, property description, site address, property ID, and latitude and longitude of the main

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Detachment building are tabled below, along with the individual building IDs for the five main buildings located on the property.

Property Description	Site Address	Property ID	DFRP	FCSI	Lat/Long
RCMP Stony Rapids Detachment	Stony Rapids, Saskatchewan	PR F/84	14862	00024788	59° 15' 34 N" 105° 49' 52" W

Building	Building ID
Detachment	BU F/329
Employee Housing	BU F/105
Employee Housing	BU F/182
Workshop	BU F/325
Garage	BU F/326

1.4 REQUIREMENT FOR PHASE II ENVIRONMENTAL SITE ASSESSMENT

The Phase I ESA undertaken by Stantec Consulting Ltd. in 2011, report dated January 2012 ⁽⁵⁾ identified that two USTs were formerly located on the property, including a 4,500 litre heating oil UST located north of the detachment (SR-1) and a 4,500 litre gasoline UST located north of the driveway leading to the Detachment garage (SR-2), as illustrated below.

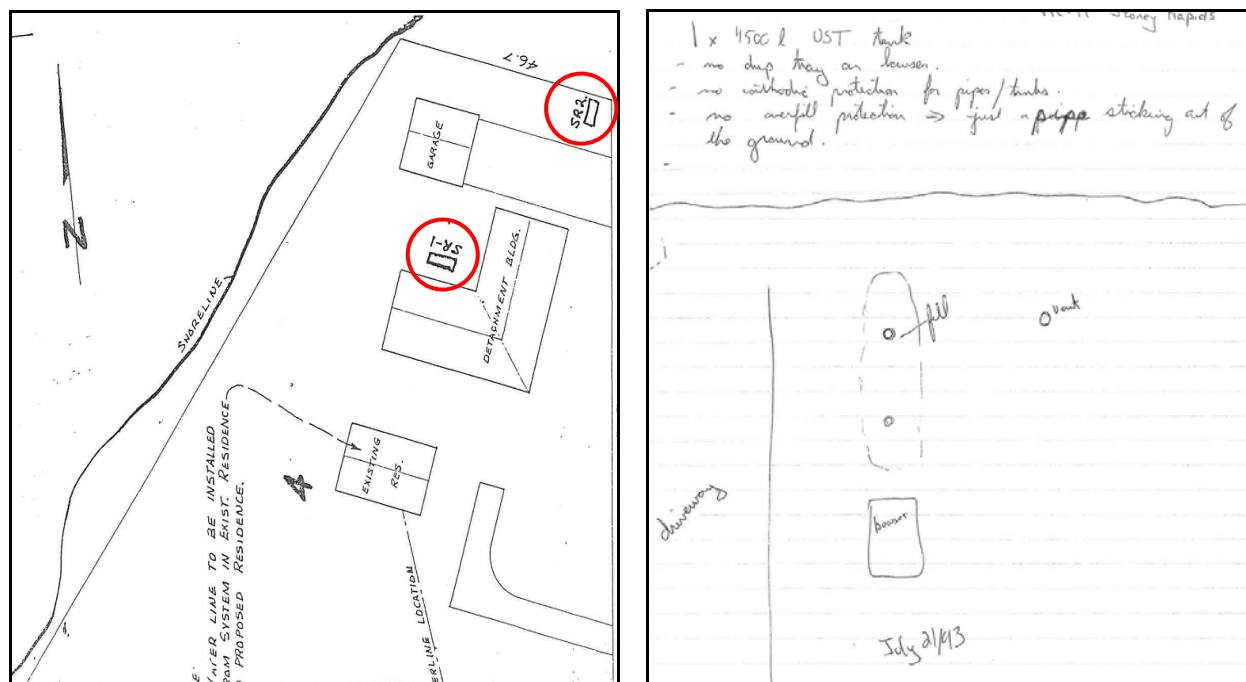


Plate 01: Former heating oil and gasoline USTs at the Stony Rapids Detachment site.

The former heating oil UST (SR-1) was apparently abandoned in place in 1989, and subsequently removed sometime between 1989 and 1993. There was no information available to indicate whether the former gasoline UST was abandoned in place or removed. The former gasoline UST was located in the same general area as the current 4,500 litre AST. The current gasoline AST is used to fuel the on-site RCMP vehicles and equipment.

In addition to the former USTs and existing AST, the previous Phase I ESA also noted that a diesel generator and waste oil drum were located west of the garage, and that two burn barrels were present at the site, one west of the workshop and one at the northeast corner of the property.

A large Petro Canada bulk plant, containing more than ten large ASTs, was also noted to be located along the Fond du Lac River about 200 m west-southwest of the RCMP property, and a 29,454 litre heating oil AST was noted at the Waterfront Lodge, located adjacent to the southwest corner of the property.

The identified APEC's are highlighted on Plates 02 and 03 below, along with representative photographs of the areas of concern, Photos 12 through 20, as taken at the time of the current Phase II ESA. Based on the findings from the Phase I ESA, PWGSC indicated that a Phase II ESA was required to determine whether on and/or off-site activities have resulted in any impacts to the soil and/or groundwater underlying the property.

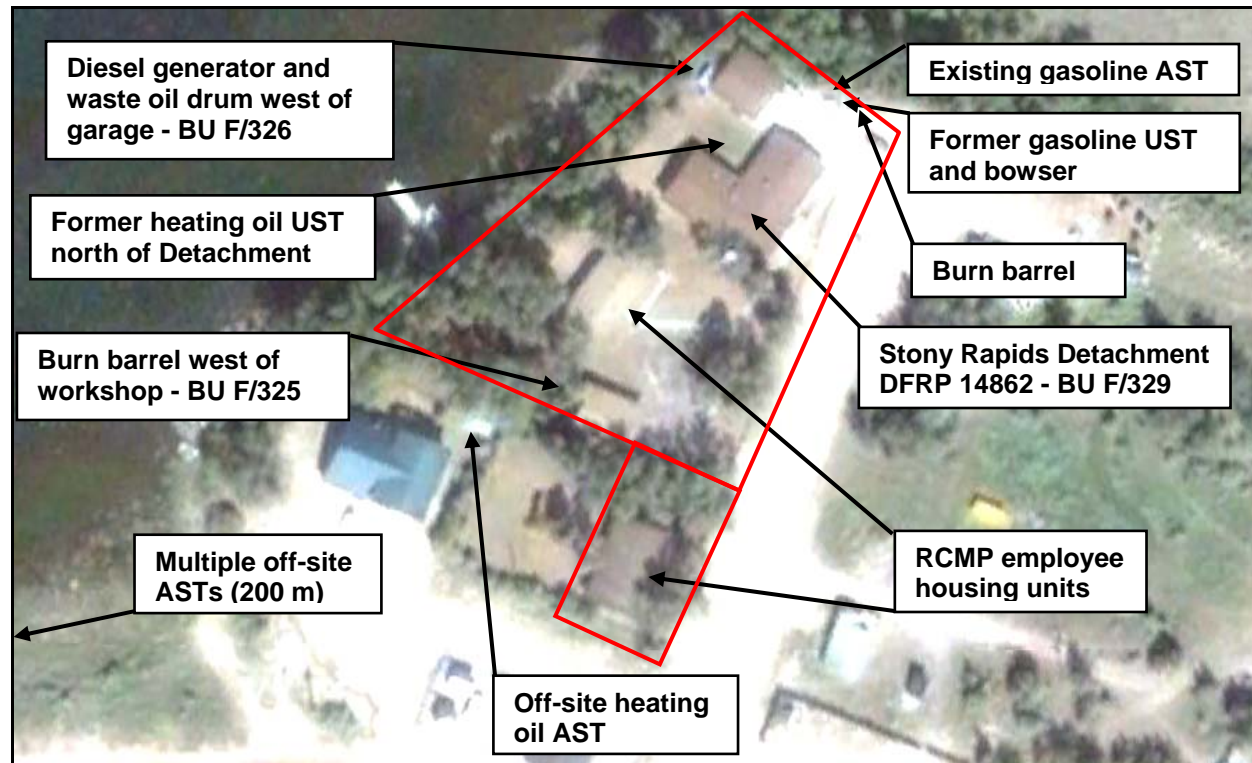


Plate 02: Areas of potential environmental concern at the Stony Rapids Detachment.



Plate 03: Off-site bulk plant near the Stony Rapids Detachment site.



Photo 12: View looking north at the gasoline AST and former UST located at the northeast corner.



Photo 13: View looking southwest at the burn barrel located near the northeast corner of the site.



Photo 14: View looking west towards the garage BU F/326.



Photo 15: View looking southeast at the waste oil barrel on the north side of the garage BU F/326.



Photo 16: View looking north at diesel generator located on the west side of the garage BU F/326.



Photo 17: View looking south at the burn barrel located on the west side of the workshop BU F/325.



Photo 18: View looking south at the former heating oil UST location on the north side of the Detachment.



Photo 19: View looking west at the workshop.



Photo 20: View looking west at the off-site ASTs.

2.0 FIELD INVESTIGATION

As outlined in Section 1.0, it was proposed to drill fifteen test holes, including:

- Four test holes in the area of the existing gasoline AST, former gasoline UST and burn barrel at the northeast corner of the site, with one test hole completed as a well;
- One test hole in the area of the waste oil drum at the northwest corner of the garage;
- Two test holes in the area of the diesel generator on the west side of the garage, with one test hole completed as a well;
- Three test holes in the area of the former heating oil AST on the north side of the Detachment, with one test hole completed as a well;
- One test hole near the burn barrel on the west side of the workshop, completed as a well and also used to assess the off-site ASTs to the southwest;
- One test hole near the workshop building to assess hazardous product storage and handling;
- One test hole at the southwest corner of the site to assess the off-site ASTs to the west-southwest; and
- One test hole at each of the two employee housing units to assess for potential impacts from former heating oil ASTs.

A general site inspection was undertaken on the morning of August 14, 2012, prior to initiation of the drilling program. The purpose of the site inspection was to review the underground utility locations and to finalize the location of the proposed test holes. The test hole locations were partially limited by site access as well as the presence of underground and overhead utilities, which resulted in minor modifications to the location of select test hole locations.

An inspection of the interior basement and exterior areas around the employee housing units at the time of the site investigation program showed no evidence of any former pads or piping, and the RCMP staff on-site were not aware of any former heating oil tanks associated with the two employee housing units. Therefore, the two test holes proposed in these areas were deleted from the program. However, based on the findings in the area of the former heating oil UST on the north side of the Detachment, three additional test holes were completed in this area of the site for a total of sixteen test holes, four of which were completed as groundwater monitoring wells.

The on-site utilities are highlighted on Figure 03 and the completed test hole/monitoring well locations are illustrated on Figure 04. The methodologies employed during the subsurface investigation program are discussed below.

2.1 HEALTH AND SAFETY

EGE is committed to providing a safe and healthy work environment for all workers. Employees at every level, including management, are responsible and held accountable for the company's overall safety and are committed to doing everything possible to prevent injuries, and to maintain a healthy work environment.

To this end:

- The company is committed to maintain a workplace health and safety system;
- Every person must integrate good workplace health and safety practices into their daily activities;
- All employees are required to support the workplace health and safety system;
- Managers are responsible for enhancing health and safety consciousness;
- Supervisors must ensure employees are trained in health and safety work procedures to obtain optimal output without incident and injuries; and
- All employees are accountable for implementing the health and safety program.

The safety officer for this project was Mr. Peter Bohonos, P.Eng.

2.2 UTILITY CLEARANCES

Prior to commencing with the intrusive investigations, all site utilities and/or underground service locations and orientations were pre-cleared and/or identified at the time of the investigation program by the appropriate authority and/or a private locator contracted by EGE. The following is a summary of the utilities and authorities that were contacted for clearances.

<u>UTILITY</u>	<u>AUTHORITY/SOURCE OF INFORMATION</u>
Power	Sask Power
Natural Gas	Sask Energy
Telephone and Fibre Optic	Sask Tel
Domestic Water	Stony Rapids
Sanitary Sewer	Stony Rapids
Private Locates	Magna Electric

Power and telephone service to the site is via overhead lines, which were pre-cleared by Sask Tel and Sask Power, respectively. Sask Energy also indicated that there is no natural gas service in the community of Stony Rapids. Electric furnaces are used to heat the Detachment and employee housing units. The on-site private utility clearances were completed on August 14, 2012. The identified on-site utilities are highlighted on Figure 03.

2.3 TEST DRILLING AND SOIL SAMPLING

To assess and delineate the identified APECs, the Phase II ESA program included drilling sixteen test holes, SR-01 through SR-16, of which four were completed as groundwater monitoring wells, SR-01, SR-07, SR-08, and SR-11. Due to limited access along the north and west sides of the garage, two test holes, SR-05 and SR-06, were completed by hand auger.

The test drilling and soil sampling program was completed between August 14 and 16, 2012. Drilling was completed using a combination of: a track-mounted Geoprobe 7822 DT drill rig equipped with 82.5 mm "direct push" tooling; and a 50 mm hand auger. As indicated above, the latter was used at two test hole locations, SR-05 and SR-06, where drill access was not feasible. Test holes SR-05 and SR-06 are

located on the north and west sides of the Detachment garage, respectively. The Geoprobe 7822 DT drill rig was supplied and operated by Intercore Environmental Services Ltd. of Maidstone, Saskatchewan. Mr. Peter Bohonos, Project Engineer with EGE, supervised the test drilling activities, including completion of the two hand auger test holes.

The test holes were drilled to depths ranging from 2.1 to 4.9 m below grade. The exceptions were the two hand auger test holes, both of which were only drilled to a depth of 0.9 m below grade. In all cases, the depth of the test holes were limited by auger refusal on suspected bedrock.

A survey of the test hole locations was completed using a Garmin Oregon 300 hand held GPS unit to obtain Universal Transverse Mercator (UTM) coordinates for each point. The coordinates are provided on the individual test hole logs presented in Appendix A. A level survey was also undertaken to obtain relative ground elevations at each point using the top of the flag pole base on the west side of the Detachment site as the local benchmark, with an assumed datum elevation of 100.000 m. The test hole locations are highlighted on Figure 04. Representative photographs of the drilling activities are presented below.



Photo 21: View looking northwest at test hole SR-07 at the southwest corner of the garage BU F/326.



Photo 22: View looking east at test hole SR-08 on the north side of the Detachment BU F/329.

Continuous soil cores were retrieved from the Geoprobe 7822 DT drill rig using 50 mm diameter PVC liners equipped with dedicated core catchers to obtain relatively undisturbed samples of the underlying soil. Soil samples were collected as grab samples from the split core tubes at approximately 0.75 m intervals. Samples from the hand augers were collected as disturbed samples directly from the auger bit. The collected samples were pared and placed in plastic bags for field screening of organic vapours using the headspace method. A portion of the sample was also placed into a clean glass container, with minimum headspace, and retained for possible laboratory analysis. Disposable nitrile gloves were used during the sample handling. A description of the soils encountered and the location of the grab samples are shown on the test hole logs presented in Appendix A.

The organic vapour survey was carried out using a RKI Eagle 2 photo-ionization detector. The organic vapour survey was completed as a guide to identifying zones of petroleum hydrocarbon impacted soil and in selecting samples for laboratory analysis. Measurement was obtained by allowing the samples to volatilize for about 20 minutes at a temperature of approximately 20 degrees Celsius. The sample bag was gently agitated for several seconds, punctured and the probe from the detector inserted into the bag to measure the soil headspace vapour. Organic vapour concentrations in parts per million (ppm) and/or percent of the lower explosive limit (% LEL), as measured by the headspace method, are profiled on the test hole logs presented in Appendix A. The organic vapour readings are also summarized in Table 1.

The soil samples retained for possible laboratory analysis were stored on ice packs in a cooler until drop-off at the receiving laboratory. The detailed chain of custody record supplied by the receiving laboratory was completed prior to leaving the project site, placed with the samples and accompanied the shipment to the laboratory. The collected samples were submitted to Maxxam Analytics Inc. (Maxxam) in Saskatoon, Saskatchewan for analysis of benzene, toluene, ethylbenzene and xylenes (the BTEX components) and the petroleum hydrocarbon (PHC) F1 to F4 Fractions. This included one sample from each test hole, with two additional samples submitted for vertical delineation, for a total of eighteen soil samples.

One soil sample from near the Detachment garage, and one soil sample from near the Detachment workshop, were also submitted for analysis of metals and volatile organic compounds (VOCs). One soil sample from near each of the two burn barrels were also submitted for metals and polycyclic aromatic hydrocarbon (PAH) analysis. Two representative samples of the soil stratigraphy were also submitted for grain size analysis. The samples that were selected for laboratory analysis, and the completed analyses, are highlighted in Table 1.

Two blind duplicate soil samples were also submitted for analysis of the BTEX components and the PHC F1 to F4 Fractions. This included samples SR-03-1 (labelled DUP-1) and SR-08-3 (labelled DUP-2). The two samples were collected from depths of 0.3 and 1.5 m below grade, respectively. The duplicate sample from SR-03-1 was also analyzed for metals and PAHs. The duplicate samples were collected by splitting the portion of the sample designated for laboratory analysis into two sample containers.

The test holes that were not completed as groundwater monitoring wells were backfilled with drill cuttings upon completion and sealed with bentonite pellets at the top of each hole. Due to the nature of the drilling method utilized and the sandy soils that were encountered at the site, there was no excess soil requiring off-site disposal.

2.4 GROUNDWATER MONITORING WELL INSTALLATIONS, MONITORING AND SAMPLING

Four new groundwater monitoring wells were installed as part of the current Phase II ESA program. This includes: SR-01, located at the northeast corner of the site near the existing gasoline AST/former gasoline UST; SR-07, located at the southwest corner of the Detachment garage near the diesel generator; SR-08, located on the north side of the Detachment in the area of the former heating oil UST; and SR-11, located near the burn barrel, west of the Detachment workshop. The completed well locations are highlighted on Figure 04.

Monitoring well construction consisted of 50 mm diameter PVC pipe with threaded internal/external flush mount joints and a PVC screen section. The wells were completed at the base with an end cap and at surface with a threaded male/female adaptor. No glued joints were used. The annular space around the screen interval was backfilled with silica sand. The remaining annulus was backfilled to just below ground surface with bentonite pellets. The top of the wells were set between 0.080 and 0.177 m below grade, and completed with at grade flush mount protective casings. The wells were installed to depths ranging from 3.0 to 4.9 m, which included 1.4 to 3.0 m of slotted screen and 1.5 m of solid PVC pipe. The well construction details are provided on the individual test hole logs presented in Appendix A.

The four wells were monitored for organic vapours, water level and light non-aqueous phase liquid product (LNAPL) on August 15, 2012. A level survey was also undertaken to obtain top of casing elevations at each point using the top of the concrete flag pole base located on the west side of the Detachment site as the local benchmark, with an assumed datum elevation of 100.000 m. The results are summarized in Table 2, along with the ground elevation, well stick-up and PVC well collar elevation for each point. As noted in Table 2, three of the four wells were dry at the time of monitoring.

The one well with measurable water, SR-08, was purged upon completion of the monitoring activities and then sampled for the contaminants of concern, using a disposable dedicated PVC bailer. The well was purged and sampled on August 15, 2012. The methodologies employed during the monitoring and sampling activities are discussed below.

Organic vapour levels were monitored at each well using a RKI Eagle 2 photo-ionization detector. The analyzer was calibrated to a hexane standard prior to transport to the job site. In each case the cover plate of the protective casing was removed to gain access to the monitoring well. The well cap was then loosened with a wrench, the cap removed, and the organic vapour level measured by inserting the end of the probe from the analyzer into the well and recording the vapour reading in ppm or % LEL. Measurements were taken with the methane elimination switch in the on position. The reading was subsequently recorded in a data field book and the probe removed from the well. The instrument was then allowed to recover to ambient background conditions prior to moving to the next well location.

LNAPL and water level monitoring were completed using a Heron Model H.01L Interface Probe. The end of the probe is lowered into the well and emits a continuous audible signal if it comes into contact with LNAPL. The depth is recorded from the calibrated wire attached to the probe using the top of the well casing as the reference datum. The probe will emit an intermittent signal when it comes into contact with water and the LNAPL thickness, if present, is calculated by subtracting the two measurements. As the depth to LNAPL (if present) and the depth to water were detected, the measurements were recorded in a data field book, and the probe removed from the well. To reduce the potential for cross contamination the probe was disinfected between each well using an Alconox soap wash and distilled water rinse.

Water sampling was completed using a dedicated disposable bailer. Prior to handling the sampling equipment and sample containers, a new pair of nitrile gloves were worn. The one groundwater sample was collected by lowering the dedicated disposable bailer into the well using dedicated twine attached to the top of the bailer. Once in contact with the formation water the bailer was allowed to fill and then

carefully pulled back up out of the well, and discharged directly into the sample containers supplied by the receiving laboratory.

All of the sample bottles were filled to the levels specified by the laboratory, immediately capped and then labelled, noting all of the pertinent information using a permanent waterproof ink marker. All sample bottles were properly identified, with a unique sample number, and the date and time of sampling. The sample containers were carefully packed into a cooler, with ice packs, to ensure they remained cold. The date and time the sample was collected was also noted in the data field book along with the well number and any other relevant observations made during the sampling process.

The sample containers were stored on ice packs in a cooler until drop-off at the receiving laboratory. The detailed chain of custody record supplied by the laboratory was completed prior to leaving the project site, placed with the sample containers and accompanied the shipment to the laboratory. The one groundwater sample was submitted to Maxxam Analytics Inc. in Saskatoon, Saskatchewan for analysis of the BTEX components and the PHC F1 to F4 Fractions.

One blind duplicate groundwater sample was also submitted from well SR-08 (labelled SR-DUP). The sample was submitted for analysis of the BTEX components and the PHC F1 to F4 Fractions. The duplicate sample containers were filled, as described above, following collection of the initial water sample.

3.0 PHYSICAL CHARACTERISTICS OF THE SITE

3.1 REGIONAL GEOLOGY

The Geological Map of Saskatchewan ⁽⁶⁾ indicates that the Stony Rapids area is underlain by bedrock of the William Lake Subgroup, which is part of the Athabasca Group and consists of non-metamorphosed, and generally sandy facies, that is exposed over the entire basin. The bedrock in the area is further classified as the Fair Point Formation, which consists of pebbly and cobbled sandstone, and to a lesser degree fluvial sandstone. According to the Geological Highway Map of Saskatchewan ⁽⁷⁾, the surficial soils consist of sandy glacio-lacustrine plains deposits generated from the Athabasca Group sandstones aged 1750 to 1700 million years ago.

3.2 LOCAL GEOLOGY

The soil stratigraphy beneath the investigated area at the Stony Rapids Detachment site consists of layers of fine to very fine grained sand, with some gravel, which extends to the maximum depth of investigation, 4.9 m below ground surface. A brief discussion of the key stratigraphic units follows. Detailed soil descriptions are also provided on the individual test hole logs that are presented in Appendix A. The locations of the test holes are shown on Figure 04.

Organics

A thin layer of organic soil, ranging from 0.05 to 0.15 m in thickness, was encountered at surface at three of the test hole locations, SR-13, SR-14 and SR-16. The layer was generally brown to black, silty, with some sand and dry. Due to the limited thickness of this unit, organic vapour levels were not measured, however, there was no evidence of odours or staining noted.

Clay

A thin layer of clay, 0.05 m in thickness, was encountered below the surficial organic layer at test hole SR-14. The clay was grey, dry and firm. Due to the limited thickness of this unit, an organic vapour level was not measured, however, there was no evidence of any odour or staining noted.

Sand

Sand was encountered from surface or below the surficial organic layer at all of the test hole locations and generally extended to the final depth of investigation at each location, which terminated with auger refusal on suspected bedrock. The sand was typically dry, fine grained and varied in colour from tan to brown to reddish brown with depth. The upper sand was silty, with occasional organics at test holes SR-07, SR-08, SR-10 and SR-11, and the lower sand contained trace to some gravel at test holes SR-02, SR-04, SR-08, SR-11, SR-12 and SR-15.

The organic vapour readings in the sand were generally non-detect, which are considered reflective of background concentrations. A slightly elevated organic vapour reading of 45 ppm was noted at a depth of 0.3 m at test hole SR-03, located east of the gasoline AST. The vapour levels quickly dropped to non-detect by a depth of 1.5 m, and there was no evidence of any staining or petroleum hydrocarbon odours.

An elevated organic vapour reading of 90 ppm was also recorded at the base of test hole SR-09 (2.95 m). Test hole SR-09 is located in the area of the former heating oil UST on the north side of the Detachment. There was no evidence of any staining or petroleum hydrocarbon odours at this location and all of the organic vapour readings in the samples collected from above this depth were non-detect.

Highly elevated organic vapour readings, ranging from 200 to 840 ppm, were recorded in the samples collected between a depth of 1.5 and 3.3 m at test hole SR-08. Test hole SR-08 is also located in the area of the former heating oil UST on the north side of the Detachment and south of test hole SR-09. There was no evidence of any staining, however, a petroleum odour was noted in the samples with the elevated organic vapour readings.

A grain size analysis was completed on a sample of the sand from test hole SR-03 at a depth of 0.75 m. The results are summarized in Table 3 and indicate that there was 75% retained on the #200 (0.075 mm) sieve, which corresponds to a coarse grained soil classification. A grain size analysis was also completed on a sample of the sand from test hole SR-08 at a depth of 3.3 m. The results are summarized in Table 3 and indicate that there was only 49% retained on the #200 (0.075 mm) sieve, which corresponds to a fine grained soil classification. However, as noted, the field classification indicates that the soil is fine grained sand, with trace gravel, which is typical of the soil in the area. The gradation result, which is only marginally fine grained, is considered to be an anomaly and not representative of the overall soil conditions.

Sand and Gravel

A layer of sand and gravel was encountered below the sand at test hole SR-03, which is located east of the gasoline AST. The sand and gravel was tan to brown, contained stone up to 25 mm in diameter and extended to a depth of 4.0 m, the depth of auger refusal on suspected bedrock at this location. The organic vapour readings in the sand and gravel layer were non-detect, which are considered reflective of background concentrations. There was also no evidence of any staining or odours in this unit.

3.3 PHYSIOGRAPHY AND TOPOGRAPHY

As referenced in the 2012 Phase I ESA report ⁽⁵⁾, the community of Stony Rapids is located within the Fond du Lac Landscape Area of the Athabasca Plain Eco-region. The Fond du Lac Landscape area is nearly level, with slopes that range from 330 m above sea level (asl) on several regional rises to 250 m asl at Richards, Engler and Riou lakes in the southern part of the area, and Fond du Lac in the north.

Sandy glacio-lacustrine plains occur at the lower elevations that border the Fond du Lac River and Black Lake. Brunisolic soils dominate the well-drained slope positions in these landscapes, with Gleysols, Organics and local Cryosols in poorly drained areas. This is also the only landscape area within the Athabasca plain that has significant mixed wood stands. Black spruce, jack pine and white birch occur in the upland areas, and stands of trembling aspen are common on the glacio-lacustrine sediments near the Fond du Lac River. White spruce and balsam poplar are also present in the region.

The topography of the Stony Rapids area is generally bedrock controlled, with a regional slope to the north towards the Fond du Lac River. The elevation at the high point of the community at the western tip

of the airstrip is 246 m asl, while the elevation at the Fond du Lac River is 208 m asl. The Detachment site is gently sloped away from the various building footprints towards Johnson Street to the east and towards the Fond du Lac River to the west and northwest. There are no drainage ditches located along the adjacent roadways and there are no storm water sewers or catch basins present on or off the Detachment property. Surface runoff in the area is managed through infiltration and overland flow. There was no standing water present on the site and the site appeared to be well drained, likely due to the granular nature of the surficial soils present in the region.

3.4 HYDROLOGY

The Detachment site is located on the south shore of the Fond du Lac River in Stony Rapids, Saskatchewan, approximately 8 km from the mouth of the river at the eastern edge of Lake Athabasca. Lake Athabasca covers about 7,850 km² and has a maximum depth of 124 m. It is the eighth largest lake in Canada. Regional drainage is provided through rivers, streams and creeks that drain into Lake Athabasca. Lake Athabasca is fed by the Athabasca and Peace Rivers, and flows north-westward via the Slave and Mackenzie River systems, eventually reaching the Arctic Ocean. The NTS map of the Stony Rapids area, depicting the various surface water features is shown on the Plate below.

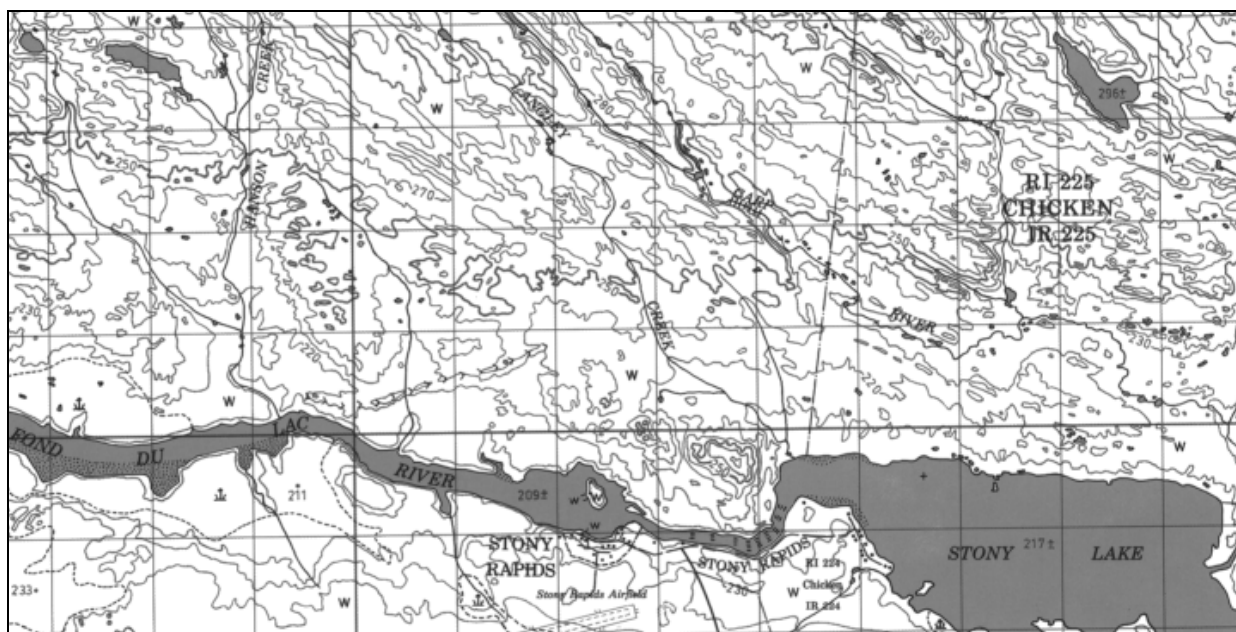


Plate 04: NTS Map showing the surface water bodies near Stony Rapids, Saskatchewan (NTS 74 P/5).

3.5 HYDROGEOLOGY

The Stony Rapids Detachment and associated buildings are connected to the Northern Village of Stony Rapids municipal water supply system. The raw water source for the village is the Fond du Lac River and the community's water treatment plant is located adjacent to the Detachment property, immediately south of the employee housing units.

There were no wells identified on the Detachment property and a search of the Saskatchewan Watershed Authority (SWA) Data Portal shows that there are no wells in the region. A map of the Stony Rapids area from the SWA Data Portal website is provided below.

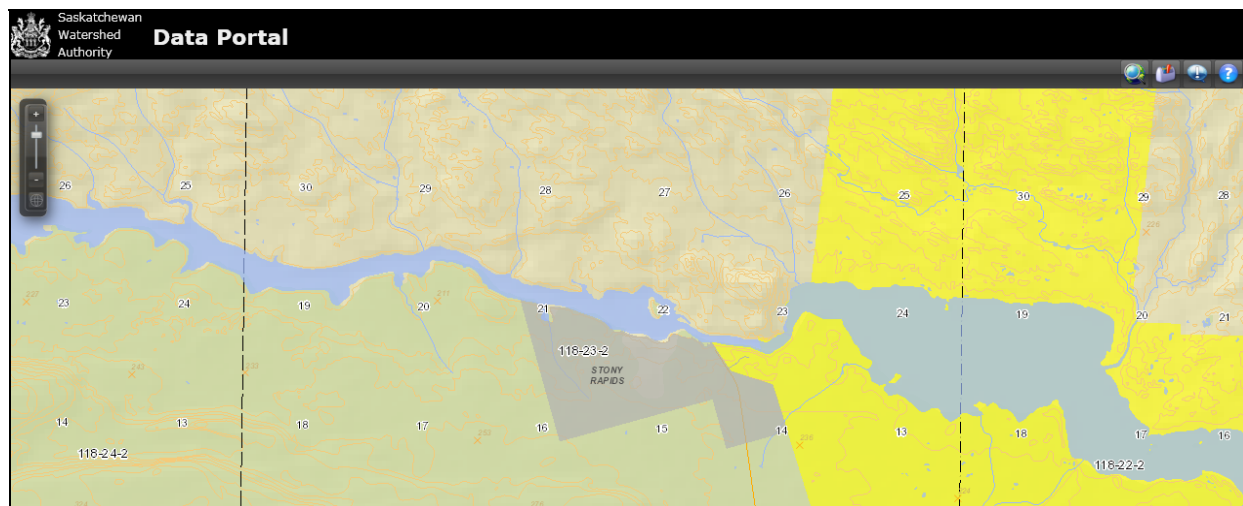


Plate 05: Map of the Stony Rapids area from the SWA Data Portal web site.

Four monitoring wells were installed as part of the Phase II ESA. However, due to refusal on suspected bedrock, the four wells were limited in depth, with groundwater encountered in only one the four wells, SR-08. The measured water level was at a depth of 1.45 m, with a relative elevation of 99.258m. It is not possible to determine the direction of groundwater flow from the one well, however, based on the local topography, groundwater flow is inferred to be towards the Fond du Lac River located along the west and northern boundaries of the Detachment property. Due to the sandy nature of the soil at the site, surface water likely infiltrates vertically downward to the underlying bedrock and then travels horizontally along the bedrock surface.

The topography of the bedrock surface is likely undulating with localized depressions. The groundwater encountered at well SR-08 may be located in one of these isolated depressions.

4.0 ANALYTICAL PROGRAM

4.1 POTENTIAL CONTAMINANTS OF CONCERN

Based on the review of the previous site information, petroleum hydrocarbons were considered to be the primary contaminants of concern, with respect to human health or ecological risk at the site. Due to the potential use and storage of hazardous materials, metals and VOCs were also considered to be secondary contaminants of concern in the soil and groundwater in the area of the Detachment garage that is located at the northeast corner of the site and the Detachment workshop located along the south side of the site. Metals and PAHs were also considered to be secondary contaminants of concern in the soil and groundwater in the area of the two burn barrels, one located at the northeast corner of the site and one located west of the Detachment workshop.

4.2 LABORATORY ANALYSIS

Eighteen soil samples and one groundwater sample were submitted for laboratory analysis of petroleum hydrocarbons. The submitted soil samples were selected based on the headspace concentration of organic vapours in air, as measured by a RKI Eagle 2 photo-ionization detector, and on visual and olfactory evidence, as noted during the test drilling program. Each of the submitted soil and groundwater samples were analyzed for benzene, toluene, ethylbenzene and xylenes (the BTEX parameters), and the four fraction analysis of petroleum hydrocarbons (the PHC F1 to F4 Fractions). In addition: four soil samples were submitted for metals analysis; two soil samples were submitted for VOC analysis; two soil samples were submitted for PAH analysis; and two soil samples were submitted for grain size analysis.

The samples were submitted for analysis to Maxxam Analytics Inc. (Maxxam) in Saskatoon, Saskatchewan. Maxxam has been accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) and participates in extensive inter-laboratory comparison programs. A copy of the analytical report is presented in Appendix B.

4.3 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

Prior to and throughout the field program communication with the laboratory was maintained to ensure that all quality assurance/quality control (QA/QC) objectives, such as detection limits, proper sample containers and sample holding times, were being met. To acquire high quality data and to reduce the potential for cross contamination between samples, all samples were also collected, transported and stored under conditions that maintained sample integrity using the general protocols presented in the *Canadian Council of Ministers of the Environment - Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites* ⁽⁸⁾.

Pre-cleaned sample containers were provided by the laboratory. The one well which was sampled was purged prior to sampling to ensure fresh formation water was collected. Monitoring equipment was decontaminated between sampling stations and a dedicated sampling system was utilized. Disposable gloves were worn during handling of all sampling equipment and containers. The samples were stored on ice packs in coolers pending transport to the laboratory and proper chain of custody was followed throughout the sample handling.

Maxxam also applies internal QA/QC protocols, including: using standard operating procedures; adhering to principles of good laboratory practice; and using standardized approved scientific methodologies. Maxxam's QA/QC program includes laboratory duplicates, method blanks and matrix spikes. Details of the internal QA/QC procedures and methodologies employed by Maxxam are presented in the laboratory report provided in Appendix B.

In addition to Maxxam's internal QA/QC program, two blind duplicate soil samples and one blind duplicate groundwater sample were submitted as part of the Phase II ESA field investigation. The samples were submitted as an independent check on data reproducibility and the field QA/QC protocols. All of the QA/QC samples were submitted for analysis of the BTEX components and the PHC F1 to F4 Fractions. This included: soil samples SR-03-1 (labelled DUP-1) and SR-08-3 (labelled DUP-2), which were collected from depths of 0.3 and 1.5 m below grade, respectively; and a groundwater sample from well SR-08 (labelled SR-DUP). The duplicate soil sample from SR-03-1 was also submitted for metals and PAH analysis.

5.0 DISCUSSION OF ANALYTICAL RESULTS

5.1 ASSESSMENT CRITERIA

The Federal Government currently reference the environmental assessment guidelines outlined in the following Canadian Council of Ministers of the Environment (CCME) and Federal Contaminated Sites Action Plan (FCSAP) documents:

- CCME Canadian Environmental Quality Guidelines (CEQG) ⁽⁹⁾;
- CCME Canada Wide Standard for Petroleum Hydrocarbons in Soil (CWS for PHCs in Soil) ⁽¹⁰⁾; and
- FCSAP Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites ⁽¹¹⁾.

Using the above documents, an assessment of the Detachment site was completed, including an evaluation of the applicable exposure pathways, land uses, key receptors and an evaluation of the predominant soil texture at the site. The assessment was conducted in accordance with current CCME guidelines and did not include the modification or recalculation of the formulas used to derive the default guideline values. The assessment is based on the following rationale:

- Land use - the site is considered a residential property based on the presence of employee housing on the site, therefore, the residential land use criteria have been selected;
- Surface soil (< 1.5 m below ground) - based on the test drilling program and the results of a gradation analysis (Table 3) coarse grained soil is present within 1.5 m of ground surface;
- Subsoil (> 1.5 m below ground) - based on the test drilling program coarse grained soil is generally present below 1.5 m of ground surface (as noted in Table 3, a gradation analysis from test hole SR-08 at a depth of 3.3 m was noted to be marginally fine grained, however, as the soils are predominantly coarse grained, this is considered to be an anomalous sample and not representative of the overall soil conditions at the site);
- Soil ingestion pathway - the surface and subsurface soils are potentially accessible to workers, undertaking construction in and around any affected areas, therefore, soil ingestion is a valid pathway;
- Soil dermal contact pathway - for the same reason as soil ingestion, soil dermal contact is a valid pathway;
- Soil vapour inhalation - for the same reason as soil ingestion, soil vapour inhalation is a valid pathway;
- Inhalation of indoor air pathways - there are several buildings on the site with concrete slab on grade foundations, therefore, the inhalation of indoor air (slab on grade) pathway is valid, however, as there are no basements, the inhalation of indoor air (basement) pathway has been excluded;
- Off-site migration check - the potential exists for off-site migration of contaminants, therefore, the off-site migration check is valid;

- Potable groundwater (drinking water) pathway - the community of Stony Rapids obtains drinking water from the Fond du Lac River for treatment at the local water treatment plant (located south of the site), and the community has a piped distribution system, which services the Detachment site, therefore, the potable groundwater pathway has been excluded;
- Produce, meat and milk pathway - there is no information available to indicate that produce, meat or milk is grown or raised near the site, therefore, this pathway has been excluded;
- Ecological soil contact - vegetation is present on the site and the area is accessible to wildlife, therefore, the ecological soil contact pathway is valid;
- Soil and food ingestion pathway - there is no information to suggest garden produce is grown on or near the site, therefore, this pathway has been excluded;
- Nutrient and energy cycling pathway - there is no agricultural development in the area, therefore, this pathway has been excluded;
- Livestock (groundwater interaction) pathway - there is no information to suggest livestock are raised near the site, therefore, this pathway has been excluded;
- Aquatic life (groundwater interaction) pathway - the nearest surface water is the Fond du Lac River, which is located along the northwest side of the Detachment property, therefore, the aquatic life pathway is valid; and
- Management limit pathway - this pathway is used in the absence of other applicable pathways, therefore, it is a valid pathway.

Based on the above rationale, the following risk management guidelines have been selected as the lowest numerical values for the soil samples from the list of applicable pathways identified above.

- CCME generic residential CEQG values for the BTEX parameters for coarse grained surface soil and subsoil. As outlined in the Health Canada document Federal Contaminated Site Risk Assessment in Canada, Part I, Guidance on Human Health Preliminary Quantitative Risk Assessment ⁽¹²⁾, an incremental lifetime cancer risk (ILCR) factor of 10^{-5} is recommended for use on Federal properties. The selected limiting exposure pathways are: inhalation of indoor air check (slab on grade) for benzene and xylenes; and groundwater check (aquatic life) for toluene and ethylbenzene.
- CCME generic residential CWS PHC values for the volatile and extractable petroleum hydrocarbons in the F1 to F4 ranges. The selected limiting exposure pathways are: vapour inhalation (slab on grade) for the PHC F1 Fraction and the PHC F2 Fraction (subsoil only); eco soil contact for the PHC F2 to F4 Fractions (surface soil only); and the management limits for the PHC F3 and F4 Fractions (subsoil only).
- CCME generic residential CEQG values for the metal parameters (there are no distinctions between surface soil and subsoil). Both the human health and environmental protection guideline values are cited.
- CCME generic residential CEQG values for the VOC parameters (there are no distinctions between surface soil and subsoil).

- CCME generic residential CEQG values for the PAH parameters. The assessment followed the three step process outlined in the 2010 update to ensure that both human health and ecological receptors are protected. This included calculating the benzo[a]pyrene (B[a]P) total potency equivalent (TPE) to ensure that humans are protected from direct contact with contaminated soil. The Index of Additive Cancer Risk (IACR) was also calculated to ensure that potable water resources are protected, although there are no potable wells in the community of Stony Rapids. The PAH parameters have also been compared individually with the appropriate soil quality guidelines (SQG) for residential land use based on the lowest of the soil contact, soil and food ingestion, freshwater life or interim soil quality guideline (CCME 1991) values.

On the basis of the preceding rationale, the following risk management guidelines have been selected as the lowest numerical values for the groundwater samples from the list of applicable pathways.

- FCSAP - FIGQG - Generic Guidelines for Residential/Parkland Land Uses - Tier 2 - Coarse Grained Soil for the BTEX parameters, and the PHC F1 and F2 Fractions (Table 2). The limiting exposure pathways are: inhalation for benzene, ethylbenzene, xylenes and the PHC F1 Fraction; and freshwater life for toluene and the PHC F2 Fraction.

The results of the BTEX/PHC, metal, VOC and PAH analyses in soil are summarized in Tables 4 through 7, respectively, along with the applicable assessment criteria. The results of the BTEX/PHC analyses in groundwater are summarized in Table 8, along with the applicable assessment criteria. A copy of the laboratory report is presented in Appendix B.

5.2 SOIL RESULTS

As presented in Section 1.0, the identified APECs at the RCMP Stony Rapids Detachment site included:

- Former gasoline UST and bowser, existing gasoline AST, and burn barrel located at the northeast corner of the site;
- Diesel generator and waste oil drum located west of the Detachment garage at the northwest corner of the site;
- Former heating oil UST located on the north side of the Detachment on the north side of the site;
- Burn barrel located northwest of the Detachment workshop on the south side of the site;
- Employee housing units located in the central and southeast areas of the site, which may have had former heating oil day tanks;
- An off-site heating oil AST at the Waterfront Lodge located adjacent to the southwest corner of the site; and
- Multiple off-site ASTs at the Petro-Canada bulk plant located 200 m to the west-southwest.

An inspection of the interior basement and exterior areas around the employee housing units at the time of the site investigation program showed no evidence of any former pads or piping, and the RCMP staff on-site were not aware of any former heating oil tanks associated with the housing units. Therefore, this APEC was deleted from the targeted program. To assess the remaining APECs, the Phase II ESA included drilling sixteen test holes, SR-01 through SR-16. The findings from the soil sampling and analytical programs are discussed below. The test hole locations are highlighted on Figure 04.

5.2.1 Organic Vapours

All of the collected soil samples were screened in the field for organic vapours using a RKI Eagle 2 photo-ionization detector, as discussed in Section 2.3. The recorded vapour readings were used as a guide to identifying zones of petroleum hydrocarbon impacted soil and in selecting samples for possible laboratory analysis. The organic vapour concentrations in ppm, as measured by the headspace method, are profiled on the individual test hole logs presented in Appendix A and are also summarized in Table 1.

As illustrated in Table 1, the majority of the test holes had reported organic vapour readings that were non-detect, reflecting background concentrations. Test holes with slightly to highly elevated organic vapour readings, included:

- SR-03 located at the northeast corner of the property east of the gasoline AST. Organic vapour readings of 45 and 5 ppm were recorded for the samples collected at depths of 0.30 and 0.75 m, respectively.
- SR-08 located in the area of the former heating oil UST on the north side of the Detachment. Organic vapour readings of 800, 200, 580 and 840 ppm were recorded for the samples collected at depths of 1.50, 2.25, 3.00 and 3.30 m, respectively.
- SR-09 located in the area of the former heating oil UST on the north side of the Detachment and north of test hole SR-08. An organic vapour reading of 90 ppm was recorded for the sample collected at a depth of 3.00 m.

At test hole SR-03, the organic vapour levels declined to non-detect below a depth of 1.50 m, whereas at test holes SR-08 and SR-09, the organic vapour levels were non-detect from surface down to a depth of 0.75 m at test hole SR-08 and 2.25 m at test hole SR-09. In the case of test holes SR-08 and SR-09, the elevated readings in the deepest samples also represent the maximum extent of drilling based on auger refusal on suspected bedrock. The highly elevated organic vapour readings at test hole SR-08 also corresponded to areas of noted petroleum odours.

5.2.2 Petroleum Hydrocarbons

Eighteen soil samples were submitted for laboratory analysis of petroleum hydrocarbons (the BTEX components and the PHC F1 to F4 Fractions). Due to the number of non-detect organic vapour readings, a minimum of one sample was submitted from each test hole location and from random depths. Representative samples were also submitted from the areas of elevated organic vapour readings, including two samples from test holes SR-03 and SR-08.

The results are summarized in Table 4, and as shown, one of the two samples with elevated organic vapour readings submitted from test hole SR-03 and both samples with elevated organic vapour readings submitted from test hole SR-08, exceeded one or more of the BTEX parameters and one or more of the PHC F1 to F3 Fractions. The impacted test hole locations and the estimated lateral extents of the impacted areas are shown on Figure 05.

The lateral extent of impact around test hole SR-03 has not been delineated as the test hole was located at the northeast corner of the property, with limited access to drill to the south due to an underground

power cable and the requirement to stay on the Detachment site. However, based on no observed impacts at test hole SR-01, which is located down gradient of SR-03, it is not expected that the impacts are widespread. The area of impact is estimated at 30 m², and assuming the impacts are confined to the upper 1.0 m of soil, the volume of impacted soil would be 30 m³.

The lateral extent of impact around test hole SR-08 has been delineated to the east, north and west. However, due to the presence of the Detachment, it was not possible to drill further to the south. There were no impacts noted in the surrounding test holes, with the exception of an elevated organic vapour reading at the base of test hole SR-09 to the north. However, a sample submitted from this location showed only a residual PHC F2 Fraction concentration that was well below the selected criteria. The impacts may extend below the detachment to the south, however, based on the limited extent of impact to the east, north and west, it is not expected that the impact would be widespread in this direction. The area of impact is estimated at 10 m², and assuming the impacts extend from a depth of 1.25 to 3.30 m, the volume of impacted soil would be 20 m³.

The total volume of PHC impacted soil at the site is therefore, 50 m³.

5.2.3 Metals

Four soil samples were submitted for metals analysis, including samples from test holes SR-03, SR-05, SR-11 and SR-12. All four samples were submitted from a depth of 0.30 m. The samples from test holes SR-03 and SR-11 were submitted to assess potential impacts from the two on-site burn barrels, which are located at the northeast corner of the property and on the west side of the Detachment workshop, respectively. The samples from test holes SR-05 and SR-12 were submitted to assess potential impacts from the historic, and on-going, maintenance and product handling/storage in the area of the Detachment garage and in the area of the Detachment workshop, respectively.

The analytical results are summarized in Table 5, and as shown, all of the reported results were either below the laboratory method detection limits or the selected criteria. Based on the results, the soil in the investigated areas does not appear to have been impacted by metals. It should be noted that the detection limit for hexavalent chromium was raised above the CCME CEQG due to sample interference. On this basis, there is the potential that soil exceeding the guideline for hexavalent chromium may be present in the investigated areas, however, as there were no other metal exceedances or evidence of elevated metal parameters, the likelihood of this occurring is relatively low. The guideline is 0.4 mg/kg and the detection limit was also only marginally raised to 0.75 mg/kg.

5.2.4 Volatile Organic Compounds

Two soil samples were submitted for VOC analysis. This included samples from test holes SR-05 and SR-12, located at the northeast corners of the Detachment garage and Detachment workshop, respectively. The sample from test hole SR-05 was submitted from a depth of 0.30 m and the sample from test hole SR-12 was submitted from a depth of 0.75 m. The samples were submitted to assess potential impacts from the historic, and on-going, maintenance and product handling/storage in the areas of the Detachment garage and workshop.

The analytical results are summarized in Table 6, and as shown, all of the reported results were either below the laboratory method detection limits or the selected criteria. Based on the results, the soil in the investigated areas does not appear to have been impacted by VOCs.

5.2.5 Polycyclic Aromatic Hydrocarbons

Two soil samples were submitted for PAH analysis, including samples from test holes SR-03 and SR-11. The samples were submitted to assess potential impacts from the two on-site burn barrels, which are located at the northeast corner of the property and on the west side of the Detachment workshop, respectively. The sample from test hole SR-03 was submitted from a depth of 0.30 m and the sample from test hole SR-11 was submitted from a depth of 0.75 m.

The analytical results are summarized in Table 7, and as shown, all of the reported results were either below the laboratory method detection limits or the selected criteria. The one exception is the reported naphthalene concentration at test hole SR-03, which exceeded the freshwater life criteria. As noted in Table 1, elevated organic vapour levels were limited to the upper 1.0 m of the soil profile at this location, with non-detect values reported at depth, and at test hole SR-01, located to the west and down gradient of test hole SR-03.

Based on the freshwater life criteria, the area of impact is estimated at 30 m², similar to the area of PHC impacted soil and assuming the impacts are confined to the upper 1.0 m of soil, the volume of impacted soil would be 30 m³. However, if the provisional soil quality guideline were used (CCME, 1997), assuming that there is no direct influence on the nearby aquatic environment, there would be no PAH exceedance.

5.3 GROUNDWATER RESULTS

To assess for potential impacts in the groundwater at the Detachment site, based on the identified APECs, the field program included installing four groundwater monitoring wells, SR-01, SR-07, SR-08, and SR-11. The proposed program was to include sampling all four wells for PHCs, and wells SR-01 and SR-11 for metals and PAHs. The latter was to assess for potential impacts from the two on-site burn barrels, which are located at the northeast corner of the property and on the west side of the Detachment workshop. However, due to refusal on suspected bedrock, the four wells were limited in depth, with groundwater encountered in only one the four wells, SR-08. Consequently, the groundwater sampling program was limited to assessing PHCs at well SR-08.

The findings from the monitoring, sampling and analytical programs are discussed below. The well locations are highlighted on Figure 04.

5.3.1 Groundwater Elevation

The four new wells, SR-01, SR-07, SR-08 and SR-11, were monitored for water levels on August 15, 2012. The well locations are highlighted on Figure 04. Well construction details, including collar elevation, ground elevation and stick-up are summarized in Table 2, along with the results of the water level monitoring. The elevations are referenced to the top of the flagpole base on the northwest side of the Detachment site, which was assigned a datum elevation of 100.000 m.

As noted above and in Table 2, three of the four monitoring wells were dry on August 15, 2012. The one well with measurable water was SR-08, with a reported water level of 1.45 m and a calculated piezometric elevation of 99.258 m. It is not possible to determine the direction of groundwater flow from the one well, however, based on the local topography, groundwater flow is inferred to be towards the Fond du Lac River located along the west and northern boundaries of the Detachment property. Due to the sandy nature of the soil at the site, surface water likely infiltrates vertically downward to the underlying bedrock and then travels horizontally along the bedrock surface.

5.3.2 Organic Vapours

The four new wells were monitored for organic vapours on August 15, 2012. The well locations are highlighted on Figure 04 and the monitoring results are summarized in Table 2. As noted in Table 2, non-detect readings were recorded at wells SR-07 and SR-11, which are located on the south side of the diesel generator and west side of the Detachment workshop, respectively. Slightly elevated readings of 20 ppm and 15% LEL were recorded at wells SR-01 and SR-08, which are located on the west side of the gasoline AST and north side of the Detachment, respectively. The latter is in the area of the former UST heating oil UST.

The slightly elevated reading at well SR-01 likely represents some residual impact from the former gasoline UST that was located in this area and the existing gasoline AST that is presently located in the area. The elevated reading at well SR-08 is likely associated with the noted PHC impacts from the former heating oil UST that was located on the north side of the Detachment.

5.3.3 Light Non-aqueous Phase Liquids

The one well with measurable groundwater, SR-08, was monitored for LNAPL on August 15, 2012. The well location is highlighted on Figure 04 and the monitoring result is summarized in Table 2. As noted in Table 2, there was no evidence of LNAPL at this location.

5.3.4 Petroleum Hydrocarbons

Upon completion of the test drilling activities, and following the groundwater monitoring described above, a representative sample of the groundwater was collected from the one new well installation with measurable groundwater, SR-08. The collected sample was submitted for analysis of the BTEX components and the PHC F1 to F4 Fractions.

The results are summarized in Table 8, and as shown, the reported toluene, PHC F1 Fraction and PHC F2 Fraction exceeded the selected criteria. Well SR-08 is located on the north side of the Detachment in the area of the former heating oil UST.

Due to the limited number of well installations and lack of groundwater, the lateral extent of PHC impacted groundwater can not be accurately delineated at this time. Based on the direction of groundwater flow it is expected to extend to the northwest from well SR-08, however, based on the soil results in the surrounding test holes, it is not expected to have migrated too far from the source area.

5.4 QA/QC RESULTS

Quality assurance/quality control (QA/QC) measures implemented during the Phase II ESA are documented under the field methodologies discussed in Section 2.0 and within the QA/QC program discussed in Section 4.3. This included the submission of two blind duplicate soil samples and one blind duplicate groundwater sample. The two duplicate soil samples were submitted from test holes SR-03 at a depth of 0.30 m (DUP-1) and SR-08 at a depth of 1.50 m (DUP-2). The duplicate sample from test hole SR-03 was submitted for PHC, metals and PAH analysis, whereas the sample from SR-08 was only submitted for PHC analysis. The duplicate groundwater sample was submitted from well SR-08 and was also only submitted for PHC analysis.

The original and duplicate soil results for the BTEX parameters and the PHC F1 to F4 Fractions are summarized in Table 9, along with the calculated relative percent difference (RPD) for each parameter. As noted, several of the results from the original and/or duplicate samples were below the laboratory method detection limits, and therefore, it is not possible to calculate a RPD for these parameters. The average RPD for the detectable parameters was 27% for the sample from SR-03/DUP-1 and 10% for the sample from SR-08/DUP-2.

The original and duplicate soil results for the metal and PAH parameters are summarized in Table 10, along with the calculated RPD for each parameter. As noted, several of the results from the original and/or duplicate samples were below the laboratory method detection limits, and therefore, it is not possible to calculate a RPD for these parameters. The average RPD for the detectable metal parameters was 6% and the average RPD for the detectable PAH parameters was 34%.

The original and duplicate groundwater results for the BTEX parameters and the PHC F1 to F4 Fractions are also summarized in Table 9, along with the calculated RPD for each parameter. As noted, the PHC F4 Fraction results from the original and duplicate samples were below the laboratory method detection limit, and therefore, it is not possible to calculate a RPD for this parameter. The average RPD for the detectable parameters was 22%.

The only regulatory guidance in Canada for RPD values is from Ontario, who have recently published an analytical protocol that provides performance criteria for RPD values in soil and groundwater in analytical results, Ontario Regulation 153/04, as amended July 1, 2011 ⁽¹³⁾. These performance criteria are applicable when the concentrations for the original and duplicate sample are five times or greater than the laboratory method detection limit, since the uncertainty increases dramatically as the concentration approaches the detection limit.

The published performance criteria for RPD values are: $\leq 30\%$ for PHCs in soil and/or groundwater; $\leq 40\%$ for PAHs in soil; and $\leq 30\%$ for metals in soil, with an individual standard of $\leq 35\%$ for hexavalent chromium and $\leq 40\%$ for mercury and hot water soluble boron. ⁽¹³⁾ As noted above, and as summarized in Tables 9 and 10, the average RPD values for the duplicate soil and groundwater samples were below the performance criteria, therefore, the analytical results are considered to be acceptable, and representative, of the soil and groundwater quality. The results also generally support the field QA/QC procedures that were implemented. A copy of the laboratory report is presented in Appendix B.

Select parameters were noted to be above the performance criteria and the higher RPD values are likely due to sample heterogeneity, however, using either the original or duplicate results had no impact on the exceeded/non-exceeded criteria, therefore, the individual results are still considered to be representative of the overall soil and groundwater quality.

6.0 NCSCS SCORE

The 2008 National Classification System for Contaminated Sites (NCSCS) ⁽⁴⁾ ranks contaminated sites into five general categories of concern (Class 1, High Priority for Action; Class 2, Medium Priority for Action; Class 3, Low Priority for Action; Class N, Not a Priority for Action; and Class INS, Insufficient Information), according to their current or potential adverse impact on human health or the environment. It is used to screen sites with respect to “need for further action” (i.e. further characterization, risk assessment, remediation, etc.). The hazard or hazard potential of a site is evaluated by scoring site characteristics (“evaluation factors”) that can be grouped under one of three categories:

- I. **Contaminant Characteristics** - the relative hazard of contaminants present at a site.
- II. **Migration Potential** - the route a contaminant may follow to a receptor (i.e. groundwater, surface water, soil vapour, sediment movement, modifying factors).
- III. **Exposure** - receptors, living things that may be exposed to and impacted by contamination (i.e. humans, plants, animals or environmental resources).

A scoring system (from 0 to 100 points) is used as a means of assessing the hazard of a site. Sites that exhibit observable or measured impacts on the surrounding environment or have a high potential for causing negative impact will score higher under the system.

Based on the site specific findings of the current Phase II ESA, the Detachment site was classified under the 2008 CCME NCSCS using the updated 2010 Version 1.2 spreadsheet. The completed scoring sheets are presented in Appendix C. On the basis of the available information, application of the NCSCS criteria produced category scores as follows:

FACTOR CATEGORY	CATEGORY SCORE	MAXIMUM SCORE
Contaminant Characteristics	18.15	33
Migration Potential	19.13	33
Exposure	25.87	34
TOTAL SCORE	63.15	100

On the basis of the above scoring and a certainty percentage of 75%, the site scored 63.15 and was assigned a Site Classification Category of 2, indicating that the site is a Medium Priority for Action.

7.0 REMEDIAL OPTIONS EVALUATION

The objective of the Remedial Options Evaluation (ROE) is to provide an assessment of the remedial alternatives applicable for the site (in-situ, ex-situ and risk management), including the advantages and disadvantages of each technique. It is understood that the objective of any remedial alternative is to: achieve concentrations of contaminants that satisfy the applicable regulatory criteria for soil, sediment and/or groundwater; or manage the identified impacts in place such that they do not pose a significant risk to human health or the environment.

As discussed in Section 5.0, based on the results of the current Phase II ESA, there is 50 m³ of PHC/naphthalene impacted soil present at the RCMP Detachment site in Stony Rapids, Saskatchewan. The areas of impacted soil are highlighted on Figure 05 and include: the area of the former gasoline UST/existing gasoline AST located at the northeast corner of the site; and the area of the former heating oil UST located on the north side of the Detachment. PHC impacted groundwater was also noted at the one well located in the area of the former heating oil UST, however, due to the limited number of wells and absence of groundwater at three of the four wells that were installed during the Phase II ESA it is not possible to accurately delineate the limit of PHC impacted groundwater.

Based on the above findings, the property has been classified according to the CCME NCSCS scoring at the upper range of the medium priority for action. The following provides a discussion on potential remedial options and an evaluation of those options relevant to addressing the impacted soil and groundwater located at the site.

In-situ Treatment Options

Based on the coarse grained soil present at the site, in-situ treatment options, including air sparging, chemical oxidation and vapour extraction, could be used to treat the impacted soil and groundwater on the property. However, based on the limited size of the impacted areas, and that there is on-going fuel storage and handling at one of the areas, these treatment options are not considered practical at this time.

Ex-situ Treatment Options

Soil excavation followed by off-site disposal is a viable option for treating the impacted soil and will also typically address any impacted groundwater in the immediate area. However, due to the existing infrastructure that is present in the impacted areas, and that there is on-going fuel storage and handling at one of the areas, this option is not considered practical at this time.

Risk Management

A human and ecological risk assessment, based on CCME and Health Canada risk assessment standards, can be conducted to determine if the impacted soil and groundwater can be left in place, without causing any adverse exposure to the on-site receptors. Potential human and ecological receptors, exposure pathways, potential frequency and duration of exposure to contaminants of concern and toxicological and hazard information would need to be considered in the assessment. The identified risks

in the impacted area would be evaluated in the context of either Federal and/or Provincial criteria or site-specific criteria developed to determine if the risks are acceptable or not. Additional field investigation would be required to further assess the extent of impacts, including air quality monitoring within the adjacent structures. The results of the risk assessment may also indicate that remedial action is still required.

A second risk management option is to take no action and monitor the site for natural attenuation (dispersion, dilution, sorption and degradation). This option would involve annual monitoring of the soil and groundwater quality within, and down gradient of the source areas for three to five years to determine if natural attenuation processes are occurring and if so, the potential rate of decline in contaminant concentrations. If occurring, monitoring of the impacted area would be continued on a reduced frequency (based on the calculated rate of decline in concentration) until such time that the contaminant levels in the impacted areas have declined below the applicable remedial criteria. However, if natural attenuation processes are not occurring, other remedial options would need to be re-considered. Additional field investigation would be required to assess the extent of impacts, including air quality monitoring within the adjacent structures.

Comparison of Applicable Remedial Options

The remedial/risk management options that are technically viable at this time include: conducting a risk assessment to determine if the impacted soil/groundwater can be left in place; and natural attenuation monitoring to determine if the impacts are degrading to an acceptable level. The following table provides a comparison of the applicable remedial options.

Comparison of Applicable Remedial Options

Assessment Criteria	Option 1 Risk Assessment	Option 2 Natural Attenuation Monitoring
Effectiveness	Moderate	Low
Applicability	No site disruption. Easy to implement.	No site disruption. Easy to implement.
Complexity	Moderate	Low
Risk to Human Health and the Environment	Will provide scientific rationale for acceptable risk mitigation.	Risk to environment not mitigated until remedial objectives met.
Timeframe	< 1 year	5 to 10 years
Cost	Low	Low
Property Ownership	Liability maintained.	Liability maintained, unless remedial objectives met.
On-Site Versus Off-Site Impacts	Impacts remain on-site.	Impacts remain on-site, unless remedial objectives met.

In-situ treatment options may be applicable if the results of the risk assessment and/or natural attenuation monitoring determine the need to reduce the contaminant concentration levels or to enhance the rate of

natural degradation. Ex-situ treatment, involving soil excavation and off-site disposal, may also be applicable if select infrastructure is removed or relocated allowing for direct access to the areas of impact or in the case of the area north of the Detachment, verifying that the impacts do not extend beneath the building footprint.

Based on the NCSCS score the site is considered a medium priority for action. Considering the limited extent of the impacts and the on-going product storage and handling that is occurring at one of the two impacted areas, it is recommended that natural attenuation monitoring be implemented at the site. This would include: annual monitoring and sampling of the existing on-site wells, select air quality samples within the Detachment and garage, and select soil testing to further delineate the areas of impact currently identified at the site. A cost breakdown of the proposed remedial options is presented under separate cover.

8.0 CONCLUSIONS AND RECOMMENDATIONS

EGE was retained by PWGSC on behalf of the RCMP to conduct a Phase II ESA at the Stony Rapids Detachment site located on Johnson Street in Stony Rapids, Saskatchewan. The program was completed under the Environmental Services Supply Agreement, PWGSC File Number R.058406.003 and in accordance with EGE's proposal for environmental services dated June 21, 2012 ⁽¹⁾.

The Phase II ESA was conducted following the principals and general practices set out by the CSA guideline Z769-00 Phase II Environmental Site Investigation R2008 ⁽²⁾. As outlined in the Terms of Reference ⁽³⁾, the specific project objectives included:

- Delineation of the extent and volume of contamination and the likelihood for contaminant migration;
- Recommendations for site remediation and/or risk management; and
- Collection of all information necessary to classify the site according to the NCSCS ⁽⁴⁾ in order to assist in the prioritization of remediation and/or risk management at the site.

The identified APECs at the RCMP Stony Rapids Detachment site included:

- Former gasoline UST and bowser, existing gasoline AST, and burn barrel located at the northeast corner of the site;
- Diesel generator and waste oil drum located west of the Detachment garage at the northwest corner of the site;
- Former heating oil UST located on the north side of the Detachment on the north side of the site;
- Burn barrel located northwest of the Detachment workshop on the south side of the site;
- Employee housing units located in the central and southeast areas of the site, which may have had former heating oil day tanks;
- An off-site heating oil AST at the Waterfront Lodge located adjacent to the southwest corner of the site; and
- Multiple off-site ASTs at the Petro-Canada bulk plant located 200 m to the west-southwest.

An inspection of the interior basement and exterior areas around the employee housing units at the time of the site investigation program showed no evidence of any former pads or piping, and the RCMP staff on-site were not aware of any former heating oil tanks associated with the housing units. Therefore, this APEC was deleted from the targeted program. To assess the remaining APECs, the Phase II ESA included drilling sixteen test holes of which four were completed as groundwater monitoring wells.

Based on the results of the current Phase II ESA, there is 50 m³ of PHC/naphthalene impacted soil present at the RCMP Detachment site in Stony Rapids, Saskatchewan. The areas of impacted soil include: the area of the former gasoline UST/existing gasoline AST located at the northeast corner of the site; and the area of the former heating oil UST located on the north side of the Detachment. There were no metal or VOC impacts noted in the soil in the area of the Detachment garage or workshop, however, it should be noted that the detection limit for hexavalent chromium was raised above the CCME CEQG due

to sample interference. On this basis, there is the potential that soil exceeding the guideline for hexavalent chromium may be present in the investigated areas, however, as there were no other metal exceedances or evidence of elevated metal parameters, the likelihood of this occurring is relatively low. The guideline is 0.4 mg/kg and the detection limit was also only marginally raised to 0.75 mg/kg.

PHC impacted groundwater was also noted at one well located in the area of the former heating oil UST, however, due to the limited number of wells and absence of groundwater at three of the four wells that were installed during the Phase II ESA it is not possible to accurately delineate the limit of PHC impacted groundwater. Based on the direction of groundwater flow it is expected to extend to the northwest from well SR-08, however, based on the soil results in the surrounding test holes, it is not expected to have migrated too far from the source area. There was no evidence of LNAPL in the one monitoring well.

Based on the findings of the current Phase II ESA, the site was classified under the 2008 CCME NCSCS using the updated 2010 Version 1.2 spreadsheet. On the basis of the available information, the site scored 63.15 and was assigned a Site Classification Category of 2, indicating that the site is a Medium Priority for Action.

A Remedial Options Evaluation was completed for the site, of which two options were identified as being viable at this time, including: conducting a risk assessment to determine if the impacted soil/groundwater can be left in place; and natural attenuation monitoring to determine if the impacts are degrading to an acceptable level. In both cases further site assessment is required. In-situ treatment options may be applicable if the results of the risk assessment and/or natural attenuation monitoring determine the need to reduce the contaminant concentration levels or to enhance the rate of natural degradation. Ex-situ treatment, involving soil excavation and off-site disposal, may also be applicable, if select infrastructure is removed or relocated, allowing for direct access to the areas of impact or in the case of the area north of the Detachment, verifying that the impacts do not extend beneath the building footprint.

Considering the limited extent of the impacts and the on-going product storage and handling that is occurring at one of the two impacted areas, it is recommended that natural attenuation monitoring be implemented at the site. This would include: annual monitoring and sampling of the existing on-site wells, select air quality samples within the Detachment and garage, and select soil testing to further delineate the areas of impact currently identified at the site.

9.0 CLOSURE

This report has been prepared by EGE for the exclusive use of PWGSC and the RCMP (the Client) for the specific application described in Section 1.0. The information and data contained herein are to be treated as confidential, and are intended for the sole use of the client, and may not be relied upon by any other persons or entity without the express written consent of EGE and the Client.

Any use of this report by a third party, or any reliance on decisions made based on it, are the responsibility of such third parties. EGE does not accept any responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The work has been conducted in accordance with generally accepted environmental engineering practices. Although every effort has been made to confirm that the information and data presented, including without limitation the results of any sampling and analyses conducted by EGE, is factual, complete and accurate, EGE makes no guarantees or warranties whatsoever, whether expressed or implied, with respect to such information or data.

The findings presented in this report are based on the conditions which existed on site at the time of the work, in the area of the work and in respect of the environmental media which were assessed. The Client, and any other parties using this report with the express written consent of the Client and EGE, should acknowledge that conditions affecting the site can vary with time, may vary in other areas of the site and that other media other than those described herein could be present on site. EGE cannot warrant against undiscovered environmental liabilities.

Should additional environmental information become available in the area of concern or in other areas of the site, EGE requests that this information be brought to our attention so that we may re-evaluate the findings and conclusions of this report.

Respectively Submitted,

EGE ENGINEERING LTD.

Peter Bohonos, P.Eng.
Project Engineer



10.0 REFERENCES

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2. Canadian Standards Association, Guideline Document Z769-00 Phase II Environmental Site Investigation (R2008), 2008.
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4. Canadian Council of Ministers of the Environment, National Classification System for Contaminated Sites, 2008, Version 1.2.
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10. Canadian Council of Ministers of the Environment, Canada Wide Standards (CWS) for Petroleum Hydrocarbons (PHCs) in Soil, January 2008.
11. Federal Contaminated Sites Action Plan (FCSAP), Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites, November 2012.
12. Health Canada, Federal Contaminated Site Risk Assessment in Canada, Part I, Guidelines on Human Health Preliminary Quantitative Risk Assessment, September 2004.
13. Ontario Ministry of Environment. Laboratory Services Branch. Ontario Regulation 153/04. Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. March 2004 amended as of July 2011.

TABLES

Table 1 - Organic Vapours in Soil
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

Test Hole	Date of Drilling (yy/mm/dd)	Sample Depth (m)	Vapour Concentration (ppm)	Laboratory Analyses
SR-01	12/08/14	0.30	0	
		0.75	0	
		1.50	0	BTEX, PHCs
		2.25	0	
		3.00	0	
		3.50	0	
SR-02	12/08/14	0.30	0	
		0.75	0	BTEX, PHCs
		1.50	0	
		2.25	0	
		3.00	0	
		3.50	0	
SR-03	12/08/14	0.30	45	BTEX, PHCs, Metals, PAHs
		0.75	5	BTEX, PHCs, Grain Size
		1.40	0	
		2.25	0	
		3.00	0	
		4.00	0	
SR-04	12/08/14	0.30	0	BTEX, PHCs
		0.75	0	
		1.50	0	
		2.25	0	
		3.00	0	
		3.50	0	
SR-05	12/08/15	0.30	0	BTEX, PHCs, Metals, VOCs
		0.60	0	
		0.90	0	
SR-06	12/08/14	0.30	0	
		0.60	0	
		0.90	0	BTEX, PHCs
SR-07	12/08/15	0.30	0	
		0.75	0	BTEX, PHCs
		1.50	0	
		2.25	0	
		3.00	0	
		3.75	0	
		4.50	0	
		4.90	0	
SR-08	12/08/15	0.30	0	
		0.75	0	
		1.50	800	BTEX, PHCs
		2.25	200	
		3.00	580	
		3.30	840	BTEX, PHCs, Grain Size

Test Hole	Date of Drilling (yy/mm/dd)	Sample Depth (m)	Vapour Concentration (ppm)	Laboratory Analyses
SR-09	12/08/15	0.30	0	
		0.75	0	
		1.50	0	
		2.25	0	
		3.00	90	BTEX, PHCs
SR-10	12/08/15	0.30	0	
		0.75	0	
		1.50	0	
		2.25	0	
		3.00	0	BTEX, PHCs
SR-11	12/08/15	0.30	0	Metals
		0.75	0	PAHs
		1.50	0	BTEX, PHCs
		2.25	0	
		3.00	0	
SR-12	12/08/15	0.30	0	Metals
		0.75	0	BTEX, PHCs, VOCs
		1.50	0	
		2.25	0	
		3.00	0	
SR-13	12/08/15	0.30	0	
		0.75	0	
		1.50	0	BTEX, PHCs
		2.25	0	
		3.00	0	
SR-14	12/08/15	0.30	0	
		0.75	0	
		1.50	0	
		2.25	0	
		3.00	0	BTEX, PHCs
SR-15	12/08/15	0.30	0	
		0.75	0	
		1.50	0	
		2.25	0	BTEX, PHCs
		3.00	0	
SR-16	12/08/15	0.30	0	
		0.75	0	
		1.50	0	
		2.10	0	BTEX, PHCs

PPM - Parts per million

All vapour readings were obtained with an Eagle RKI 2 (Photoionization 11.6 eV)

 Shaded cell indicates sample submitted for laboratory analysis.

Table 2 - Summary of Groundwater Monitoring Results
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

		Well Location			
Parameter	Date (yy/mm/dd)	SR-01	SR-07	SR-08	SR-11
Ground Elevation (m)	12/08/15	101.188	100.960	100.803	98.650
Stick-Up PVC Well Casing (m)	12/08/15	-0.120	-0.177	-0.095	-0.080
PVC Well Collar Elevation (m)	12/08/15	101.068	100.783	100.708	98.570
Water Level (m below PVC Well Collar)	12/08/15	ND	ND	1.450	ND
Groundwater Elevation (m)	12/08/15	ND	ND	99.258	ND
Free Product Thickness (m)	12/08/15	ND	ND	ND	ND
Organic Vapour Reading (ppm or % LEL)	12/08/15	20 ppm	ND	15% LEL	ND

Notes:

1. "ND" indicates not detected.
2. Water levels and free product thickness measured using a Heron Model H.01L Interface Probe.
3. Organic vapour readings were obtained with an Eagle RKI 2 (Photoionization 11.6 eV). "ppm" indicates parts per million and "% LEL" indicates percent of the lower explosive limit.
4. Water level measured from below the top of the PVC well collar.
5. Ground elevation calculated based on level survey completed on August 15, 2012. Benchmark - top of flag pole base on the northwest side of the Detachment site = 100.000 m.

Table 3 - Summary of Grain Size Analyses
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

Particle Size	Sample Location, Date Sampled and Sample Depth	
	SR-03-2 12/08/14 (0.75 m)	SR-08-6 12/08/15 (3.30 m)
Percent Retained on the #200 Sieve (> 0.075)	75.0	49.0
Percent Retained in the Pan (< 0.075)	25.0	51.0
Grain Size Classification	Coarse Grained	Fine Grained*
Field Soil Classification	Sand - fine grained	Sand - fine grained, trace gravel

* As noted, the field classification indicates that the soil is fine grained sand, with trace gravel, which is typical of the soil in the area.
The gradation result, which is only marginally fine grained, is considered to be an anomaly and not representative of the overall soil conditions.

Table 4 - Summary of Petroleum Hydrocarbon Results in Soil
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

Sample Location	Date (yy/mm/dd)	Sample Depth (m)	Vapour Concentration (ppm)	Parameter							
				Benzene	Toluene	Ethylbenzene	Xylenes	F1	F2	F3	F4
Coarse Grained Surface Soil (< 1.5 m depth) - Residential Land Use											
CCME CEQG ⁽³⁾ and CWS for PHC ⁽⁴⁾				0.095	0.1	50	14	30	150	300	2,800
SR-01-3	12/08/14	1.50	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 20 ¹	< 10
SR-02-2	12/08/14	0.75	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 10	< 10
SR-03-1	12/08/14	0.30	45	0.017	0.067	0.017	0.390	< 12	27	100	38
SR-03-2	12/08/14	0.75	5	0.160	0.890	0.082	4.7	19	35	1,300	1,300
SR-04-1	12/08/14	0.30	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 10	< 10
SR-05-1	12/08/15	0.30	0	0.0087	< 0.020	< 0.010	< 0.040	< 12	< 10	59	18
SR-06-3	12/08/14	0.90	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 10	< 10
SR-07-2	12/08/15	0.75	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 20 ¹	< 10
SR-08-3	12/08/15	1.50	800	0.017	0.900	1.6	11	300	2,500	130	< 10
SR-11-3	12/08/15	1.50	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 20 ¹	< 10	< 10
SR-12-2	12/08/15	0.75	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	26	< 10
SR-13-3	12/08/15	1.50	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 10	< 10
Coarse Grained Subsoil (> 1.5 m depth) - Residential Land Use											
CCME CEQG ⁽³⁾ and CWS for PHC ⁽⁴⁾				0.11	0.1	50	16	30	150	2,500	10,000
SR-08-6	12/08/15	3.30	840	0.041	2.3	3.1	20	440	2,500	110	< 10
SR-09-5	12/08/15	3.00	90	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	68	< 10	< 10
SR-10-5	12/08/15	3.00	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 10	< 10
SR-14-5	12/08/15	3.00	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 10	< 10
SR-15-4	12/08/15	2.25	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	21	< 20 ¹	< 10
SR-16-4	12/08/15	2.10	0	< 0.0050	< 0.020	< 0.010	< 0.040	< 12	< 10	< 10	< 10

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit (superscript "1" indicates method detection limit raised due to sample interference).
3. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained October 2012 from web page: <http://ceqg-rcqe.ccm.ca>.
Limiting exposure pathways include: Inhalation of Indoor Air Check (slab on grade) for benzene (10-5 incremental risk) and xylenes; and Groundwater Check (aquatic life) for toluene and ethylbenzene.
4. CCME CWS for PHC = Canada Wide Standard for Petroleum Hydrocarbons in Soil, January 2008 - Residential Land Use - Limiting exposure pathways include: Vapour Inhalation (slab on grade) for the PHC F1 Fraction and the PHC F2 Fraction (subsoil only); Eco Soil Contact for the PHC F2 to F4 Fractions (surface soil only); and the Management Limits for the PHC F3 and F4 Fractions (subsoil only).
5. Shaded cell with bold and white text indicates an exceedance of the selected criteria.

Table 5 - Summary of Metal Results in Soil
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

Parameter	CCME CEQG ⁽⁴⁾ Residential HH / Env	Sample Location, Date Sampled and Sample Depth			
		SR-03-1 12/08/14 (0.3 m)	SR-05-1 12/08/15 (0.3 m)	SR-11-1 12/08/15 (0.3 m)	SR-12-1 12/08/15 (0.3 m)
Antimony	20	<1.0	<1.0	<1.0	<1.0
Arsenic	12	1.1	1.4	1.4	<1.0
Barium	500	26	21	36	<10
Beryllium	4	<0.40	<0.40	<0.40	<0.40
Boron	NG	0.17	0.17	0.17	0.17
Cadmium	10	<0.10	<0.10	<0.10	<0.10
Chromium	64	11	18	23	4.5
Chromium (Hex)	0.4	<0.75 ¹	<0.75 ¹	<0.75 ¹	<0.75 ¹
Cobalt	50	1.4	1.8	3.6	<1.0
Copper	63	<5.0	<5.0	<5.0	<5.0
Lead	140	12	21	4.1	1.2
Mercury	6.6	<0.050	<0.050	<0.050	<0.050
Molybdenum	10	<0.40	<0.40	0.68	<0.40
Nickel	50	7.1	12	10	2.2
Selenium	1	<0.50	<0.50	<0.50	<0.50
Silver	20	<1.0	<1.0	<1.0	<1.0
Thallium	1	<0.30	<0.30	<0.30	<0.30
Tin	50	<1.0	<1.0	<1.0	<1.0
Uranium	23	<1.0	<1.0	1.5	<1.0
Vanadium	130	8	9.8	19	5.3
Zinc	200	32	35	18	<10

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit (superscript "1" indicates method detection limit raised due to sample interference).
3. "NG" indicates no guideline established.
4. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained October 2012 from web page <http://ceqg-rcqe.ccme.ca>. Both human health and environmental protection guideline values shown where available.

Table 6 - Summary of VOC Results in Soil
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

Parameter	CCME CEQG ⁽⁴⁾ Residential	Sample Location, Date Sampled and Sample Depth	
		SR-05-1 12/08/15 (0.30 m)	SR-12-2 12/08/15 (0.75 m)
1,1,1,2-tetrachloroethane	NG	<0.10	<0.10
1,1,2,2-tetrachloroethane	5	<0.10	<0.10
1,1,1-trichloroethane	5	<0.020	<0.020
1,1,2-trichloroethane	5	<0.020	<0.020
1,1-dichloroethane	5	<0.020	<0.020
1,1-dichloroethene	5	<0.020	<0.020
1,2-dibromoethane	NG	<0.0020	<0.0020
1,2-dichlorobenzene	1	<0.020	<0.020
1,2-dichloroethane	5	<0.0020	<0.0020
1,2-dichloropropane	5	<0.020	<0.020
1,3-dichlorobenzene	1	<0.020	<0.020
1,4-dichlorobenzene	1	<0.020	<0.020
1,2,3-trichlorobenzene	2	<0.040	<0.040
1,2,4-trichlorobenzene	2	<0.040	<0.040
1,2,4-trimethylbenzene	NG	<0.50	<0.50
1,3,5-trichlorobenzene	2	<0.040	<0.040
1,3,5-trimethylbenzene	NG	<0.50	<0.50
Benzene	0.095	0.0087	<0.0050
Bromodichloromethane	NG	<0.030	<0.030
Bromoform	NG	<0.050	<0.050
Bromomethane	NG	<0.020	<0.020
Carbon tetrachloride	5	<0.00050	<0.00050
Chlorobenzene	5	<0.0010	<0.0010
Chlorodibromomethane	NG	<0.020	<0.020
Chloroethane	NG	<0.020	<0.020
Chloroform	5	0.0077	<0.00080
Chloromethane	NG	<0.030	<0.030
cis-1,2-dichloroethene	5	<0.020	<0.020
cis-1,3-dichloropropene	5	<0.020	<0.020
Dichloromethane (Methylene Chloride)	5	<0.010	<0.010
Ethylbenzene	55	<0.010	<0.010
Methyl methacrylate	NG	<0.040	<0.040
Methyl-tert-butylether (MTBE)	NG	<0.030	<0.030
Styrene	5	<0.020	<0.020
Tetrachloroethene (PCE)	0.2	<0.020	<0.020
Toluene	75	<0.020	<0.020
trans-1,2-dichloroethene	5	<0.020	<0.020
trans-1,3-dichloropropene	5	<0.020	<0.020
Trichloroethene (TCE)	0.01	<0.010	<0.010
Trichlorofluoromethane	NG	<0.020	<0.020
Vinyl chloride	NG	<0.00030	<0.00030
Xylenes	14	<0.040	<0.040

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. "NG" indicates no guideline established.
4. CCME CEQG = Canadian Environmental Quality Guidelines. Guidelines obtained October 2012 from web page <http://ceqg-rcqe.ccme.ca>.

Table 7 - Summary of PAH Results in Soil
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

Parameter	CCME CEQG ⁽⁴⁾ Residential	Sample Location, Date Sampled and Sample Depth	
		SR-03-1 12/08/14 (0.30 m)	SR-11-2 12/08/15 (0.75 m)
<i>Benzo[a]pyrene TPE</i>	5.3	<0.10	<0.10
<i>IACR (calculated)</i>	1	0.10	0.12
Acenaphthene	0.28 (FL)	<0.0050	<0.0050
Acenaphthylene	320 (FL)	<0.0050	<0.0050
Acridine	NG	0.018	<0.010
Anthracene	2.5 (SC)	<0.0040	<0.0040
Benzo(a)anthracene	1 (I)	0.0058	<0.0050
Benzo(a)pyrene	0.6 (SF)	0.0059	<0.0050
Benzo(e)pyrene	NG	0.0087	<0.0050
Benzo(b&j)fluoranthene	1 (I)	0.0064	<0.0050
Benzo(c)phenanthrene	NG	<0.0050	<0.0050
Benzo(g,h,i)perylene	NG	0.0098	<0.0050
Benzo(k)fluoranthene	1 (I)	<0.0050	<0.0050
Chrysene	6.2 (SF)	<0.0050	<0.0050
Dibenz(a,h)anthracene	1 (I)	<0.0050	<0.0050
Fluoranthene	15.4 (SF)	0.0057	<0.0050
Fluorene	0.25 (FL)	<0.0050	<0.0050
Indeno(1,2,3-cd)pyrene	1 (I)	<0.0050	<0.0050
2-Methylnaphthalene	NG	0.16	<0.0050
Naphthalene	0.013 (FL)	0.087	<0.0050
Perylene	NG	<0.0050	<0.0050
Phenanthrene	0.046 (FL)	0.0075	<0.0050
Pyrene	7.7 (SF)	0.032	<0.0050
Quinoline	NG	<0.030 ¹	<0.010

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit (superscript "1" indicates method detection limit raised due to sample interference).
3. "NG" indicates no guideline established.
4. CCME CEQG = Canadian Environmental Quality Guidelines. PAH Fact Sheet 2010. Guideline value for B[a]P TPE (Total Potency Equivalents) is for protection of human health from contact with contaminated soil (10-5 incremental risk). Guideline value (calculated) for IACR is for protection of potable water resources. Individual parameter guidelines are for protection of environmental health. The lowest applicable pathways are: SC = soil contact; SF = soil and food ingestion; FL = freshwater life; and I = interim soil quality criteria (1991).
5. Shaded cell with bold and white text indicates an exceedance of the selected criteria.

Table 8 - Summary of Petroleum Hydrocarbon Results in Groundwater
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

		Sample Location and Date Sampled
Parameter	FCSAP ⁽⁴⁾ Residential	SR-08 12/08/15
Benzene	0.14 (INH)	0.057
Toluene	0.083 (FL)	0.810
Ethylbenzene	16 (INH)	0.250
Xylenes	3.9 (INH)	1.5
PHC F1 Fraction	0.81 (INH)	3.9
PHC F2 Fraction	1.3 (FL)	17
PHC F3 Fraction	NG	1.0
PHC F4 Fraction	NG	< 0.10

Notes:

1. All concentrations expressed in milligrams per litre (mg/L).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. "NG" indicates no guideline established.
4. FCSAP FIGQG = Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites, November 2012.
Limiting pathways for coarse grained soil - Residential/Parkland Land Use (Table 2): INH = inhalation; FL = freshwater life.
5. Shaded cell with bold and white text indicates an exceedance of the selected criteria.

**Table 9 - Relative Percent Difference - Duplicate Soil and Groundwater Samples - BTEX and PHCs
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan**

Sample Location and Date Sampled				
Parameter	SR-03-1 (0.30 m) 12/08/14	DUP-1 (Duplicate Soil) 12/08/14	Relative Percent Difference	Average RPD (Detectable Values)
Benzene	0.017	0.011	43%	27%
Toluene	0.067	0.075	11%	
Ethylbenzene	0.017	0.018	6%	
Xylenes	0.39	0.43	10%	
PHC F1 Fraction	< 12	< 12	N/A	
PHC F2 Fraction	27	18	40%	
PHC F3 Fraction	100	69	37%	
PHC F4 Fraction	38	25	41%	
Parameter	SR-08-3 (1.50 m) 12/08/15	DUP-2 (Duplicate Soil) 12/08/15	Relative Percent Difference	Average RPD (Detectable Values)
Benzene	0.017	0.013	27%	10%
Toluene	0.900	0.82	9%	
Ethylbenzene	1.6	1.4	13%	
Xylenes	11	10	10%	
PHC F1 Fraction	300	280	7%	
PHC F2 Fraction	2500	2400	4%	
PHC F3 Fraction	130	130	0%	
PHC F4 Fraction	< 10	< 10	N/A	
Parameter	SR-08 12/08/15	SR-DUP (Duplicate GW) 12/08/15	Relative Percent Difference	Average RPD (Detectable Values)
Benzene	0.057	0.056	2%	22%
Toluene	0.810	0.820	1%	
Ethylbenzene	0.250	0.250	0%	
Xylenes	1.5	1.5	0%	
PHC F1 Fraction	3.9	5.1	27%	
PHC F2 Fraction	17	6.9	85%	
PHC F3 Fraction	1.0	0.67	40%	
PHC F4 Fraction	<0.10	<0.10	N/A	

Notes:

1. All soil concentrations expressed in milligrams per kilogram (mg/kg) and all groundwater concentrations expressed in milligrams per litre (mg/L).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. The symbol "N/A" indicates RPD can not be calculated.

Table 10 - Relative Percent Difference - Duplicate Soil Samples - Metals and PAHs
2012 Phase II Environmental Site Assessment - RCMP Detachment - Stony Rapids, Saskatchewan

	Sample Location and Date Sampled			
Parameter	SR-03-1 (0.30 m) 12/08/14	DUP-1 (Duplicate Soil) 12/08/14	Relative Percent Difference	Average RPD (Detectable Values)
Metals				
Antimony	<1.0	<1.0	N/A	6%
Arsenic	1.1	1.1	0%	
Barium	26	27	4%	
Beryllium	<0.40	<0.40	N/A	
Boron	0.17	0.15	13%	
Cadmium	<0.10	<0.10	N/A	
Chromium	11	12	9%	
Chromium (Hex)	<0.75	<0.75	N/A	
Cobalt	1.4	1.5	7%	
Copper	<5.0	<5.0	N/A	
Lead	12	13	8%	
Mercury	<0.050	<0.050	N/A	
Molybdenum	<0.40	<0.40	N/A	
Nickel	7.1	7.5	5%	
Selenium	<0.50	<0.50	N/A	
Silver	<1.0	<1.0	N/A	
Thallium	<0.30	<0.30	N/A	
Tin	<1.0	<1.0	N/A	
Uranium	<1.0	<1.0	N/A	
Vanadium	8	8.5	6%	
Zinc	32	32	0%	
PAHs				
<i>Benzo[a]pyrene TPE</i>	<0.10	<0.10	N/A	34%
<i>IACR (calculated)</i>	0.10	0.10	0%	
Acenaphthene	<0.0050	<0.0050	N/A	
Acenaphthylene	<0.0050	<0.0050	N/A	
Acridine	0.018	0.012	40%	
Anthracene	<0.0040	<0.0040	N/A	
Benzo(a)anthracene	0.0058	0.0057	2%	
Benzo(a)pyrene	0.0059	0.0082	33%	
Benzo(e)pyrene	0.0087	0.012	32%	
Benzo(b&j)fluoranthene	0.0064	0.0078	20%	
Benzo(c)phenanthrene	<0.0050	<0.0050	N/A	
Benzo(g,h,i)perylene	0.0098	0.013	28%	
Benzo(k)fluoranthene	<0.0050	<0.0050	N/A	
Chrysene	<0.0050	<0.0050	N/A	
Dibenz(a,h)anthracene	<0.0050	<0.0050	N/A	
Fluoranthene	0.0057	<0.0050	N/A	
Fluorene	<0.0050	<0.0050	N/A	
Indeno(1,2,3-cd)pyrene	<0.0050	<0.0050	N/A	
2-Methylnaphthalene	0.16	0.06	91%	
Naphthalene	0.087	0.036	83%	
Perylene	<0.0050	<0.0050	N/A	
Phenanthrene	0.0075	<0.0050	N/A	
Pyrene	0.032	0.029	10%	
Quinoline	<0.030	<0.018	N/A	

Notes:

1. All concentrations expressed in milligrams per kilogram (mg/kg).
2. The symbol < indicates a concentration less than the laboratory method detection limit.
3. The symbol "N/A" indicates RPD can not be calculated.

FIGURES

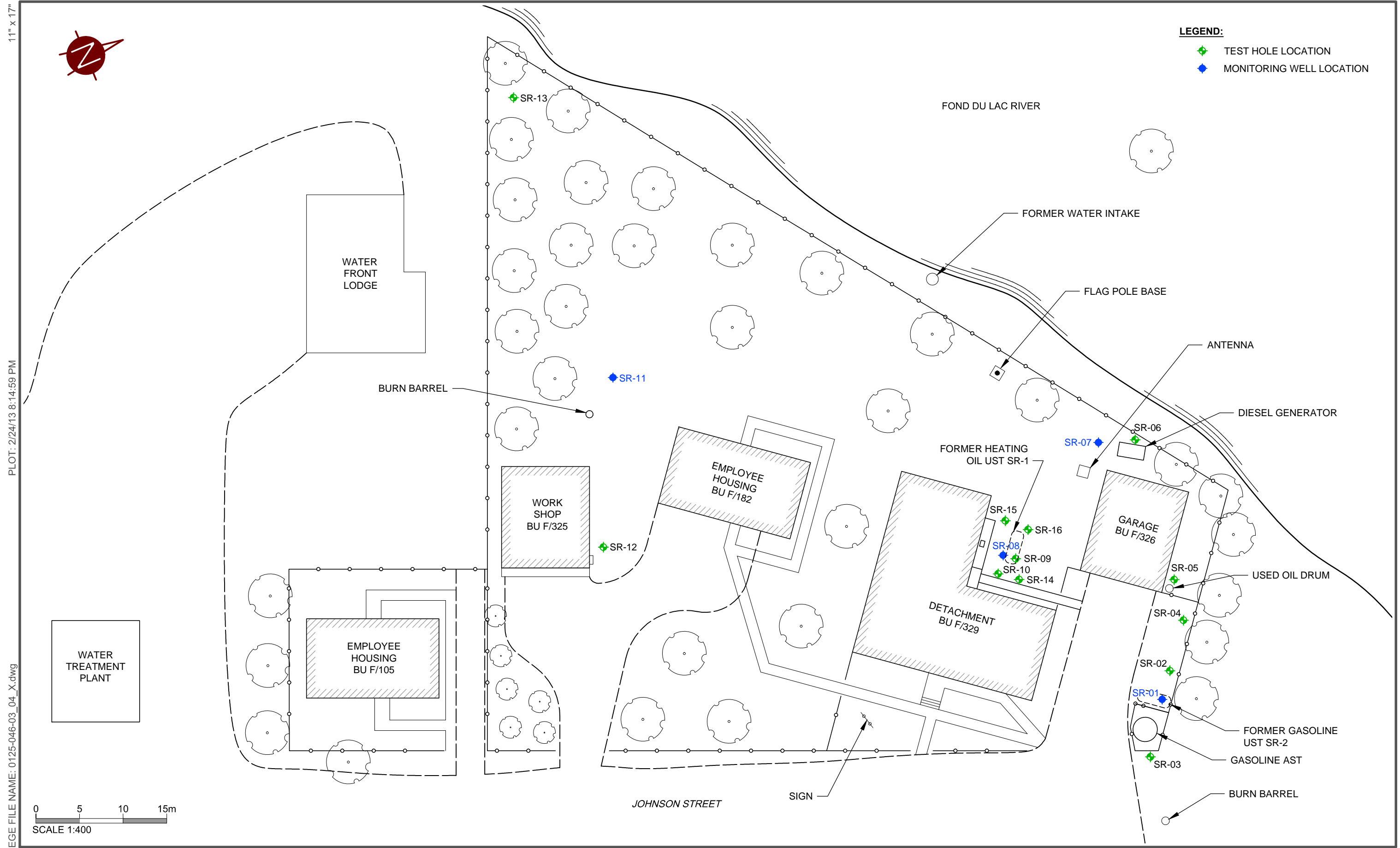


EGE

Public Works & Government Services Canada
RCMP Stony Rapids Detachment Site (DFRP 14862)
2012 Phase II Environmental Site Assessment

**Surrounding
Land Use**

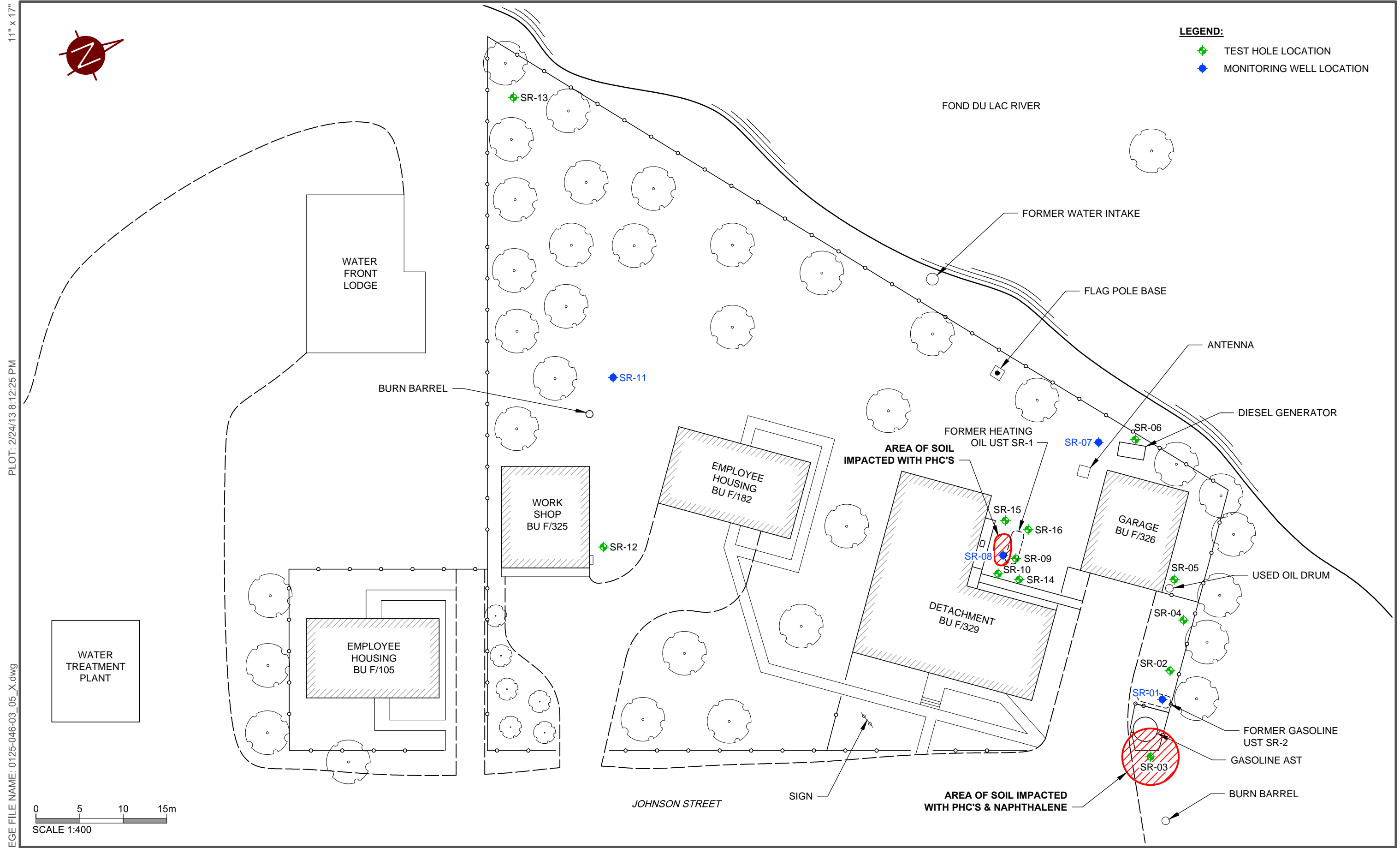
Figure 02



11" x 17"

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APPENDIX A
TEST HOLES LOGS

TEST HOLE: SR-01

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 11.7 m E of NE corner of garage, 1.1 m S of north fence line, 13V 452619E, 6569279N

Elev.: 101.188 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							101.2
0		SAND - tan - dry - fine grained		1	●	100		Well Collar Elevation = 101.068 m WL = Dry on 12/08/16 Soil sample submitted for BTEX, PHC F1 to F4	
1		- very fine grained		2	●	100			100.0
2				3	●	100			99.0
3				4	●	100			98.0
4		End of Test Hole @ 3.7 m. Refusal on suspected bedrock. No seepage or sloughing. Monitoring well installed.		5	●	100			97.0
5				6	●	100			96.0
6									95.0
7									

EGE Engineering Ltd.

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511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroupp@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/14

Completion: 12/08/14

TEST HOLE: SR-02

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 8.3 m E of NE corner of garage, 1.1 m S of north fence line, 13V 452616E, 6569281N

Elev.: 101.080 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							101.1
		SAND - tan to brown - dry - fine grained - trace gravel		1	■	100		Soil sample submitted for BTEX, PHC F1 to F4	
1				2	■	100			100.0
				3	■	100			99.0
2		- very fine grained		4	■	100			98.0
3				5	■	100			97.0
				6	■	100			96.0
4		End of Test Hole @ 3.5 m. Refusal on suspected bedrock. No seepage or sloughing.							95.0
5									
6									
7									

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Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/14

Completion: 12/08/14

TEST HOLE: SR-03

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 18.0 m E of NE corner of garage, 1.0 m S of north fence line, 13V 452626E, 6569276N

Elev.: 101.279 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							101.3
		SAND - tan - dry - fine grained		1	☛	100		Soil sample submitted for BTEX, PHC F1 to F4, PAHs, Metals Soil sample submitted for BTEX, PHC F1 to F4, Grain Size	
1				2	☛	100			
		SAND AND GRAVEL - brown to tan - up to 25 mm stone - dry		3	☛	100			100.0
2				4	☛	100			99.0
3				5	☛	100			98.0
4				6	☛	100			97.0
		End of Test Hole @ 4.0 m. Refusal on suspected bedrock. No seepage or sloughing.							
5									96.0
6									95.0
7									

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Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroup@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/14

Completion: 12/08/14

TEST HOLE: SR-04

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 2.3 m E of NE corner of garage, 1.0 m S of north fence line, 13V 452612E, 6569284N

Elev.: 101.378 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							101.4
		SAND - brown - trace gravel - dry		1	■	100		Soil sample submitted for BTEX, PHC F1 to F4	101.0
1		SAND - tan - dry - fine grained to very fine grained with depth		2	■	100			100.0
				3	■	100			
2		SAND - brown - some gravel - dry		4	■	100			99.0
				5	■	100			
3		SAND - tan - dry - fine grained		6	■	100			98.0
4		End of Test Hole @ 3.7 m. Refusal on suspected bedrock. No seepage or sloughing.							97.0
5									96.0
6									95.0
7									

EGE Engineering Ltd.

Engineering, Geosciences and Environmental

511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroup@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/14

Completion: 12/08/14

TEST HOLE: SR-05

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

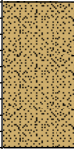
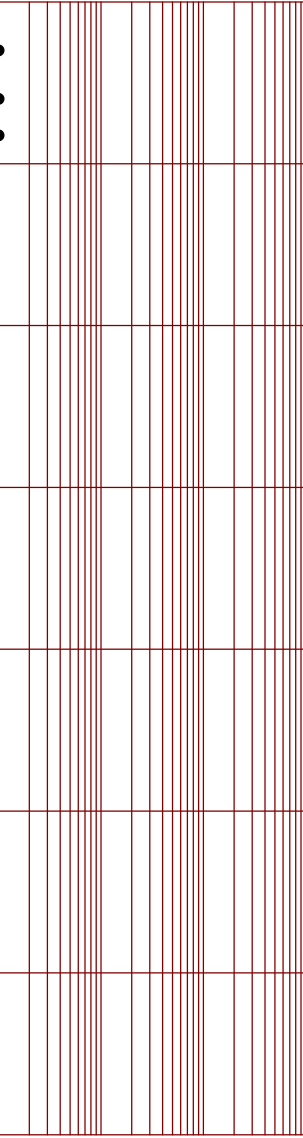
Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 1.9 m W, 1.0 m N of NE corner of garage, 13V 452607E, 6569284N

Elev.: 101.445 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface						Soil sample submitted for BTEX, PHC F1 to F4, VOCs, Metals	101.4
		SAND - tan - dry - fine grained		1	■	100			101.0
				2	■	100			
				3	■	100			
1		End of Test Hole @ 0.9 m. Refusal on suspected bedrock. No seepage or sloughing.							100.0
2									99.0
3									98.0
4									97.0
5									96.0
6									95.0
7									

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Engineering, Geosciences and Environmental

511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroup@mts.net

Drilling Contractor: EGE Engineering Ltd.

Drilling Method: 50 mm Hand Auger

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-06

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

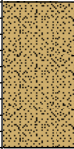
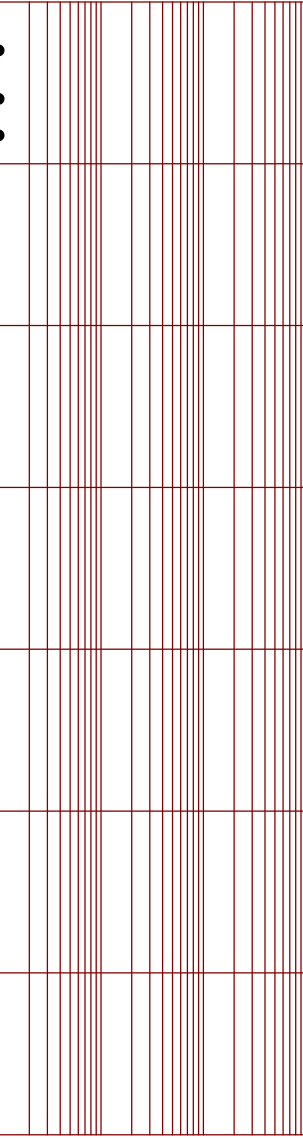
Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 3.7 m W, 2.3 m N of SW corner of garage, 13V 452591E, 6569284N

Elev.: 100.946 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface						Soil sample submitted for BTEX, PHC F1 to F4	100.9
		SAND - tan - dry - fine grained		1	▲	100			
				2	▲	100			
				3	▲	100			
1		End of Test Hole @ 0.9 m. Refusal on suspected bedrock. No seepage or sloughing.							100.0
2									99.0
3									98.0
4									97.0
5									96.0
6									95.0
7									94.0

EGE Engineering Ltd.

Engineering, Geosciences and Environmental

511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroup@mts.net

Drilling Contractor: EGE Engineering Ltd.

Drilling Method: 50 mm Hand Auger

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/14

Completion: 12/08/14

TEST HOLE: SR-07

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 2.8 m W, 1.8 m S of SW corner of garage, 13V 452590E, 6569279N

Elev.: 100.960 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							101.0
		SAND - brown - some silt and organics - dry, fine grained		1		100			
		SAND - reddish brown - dry - fine grained		2		100			
1		SAND - tan - dry - very fine grained		3		100			
		SAND - reddish brown - dry - fine grained		4		100			
2				5		100			
				6		100			
3				7		100			
				8		100			
5		End of Test Hole @ 4.9 m. Refusal on suspected bedrock. No seepage. Sloughing to 4.7 m. Monitoring well installed.							
6									
7									

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511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroupp@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-08

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

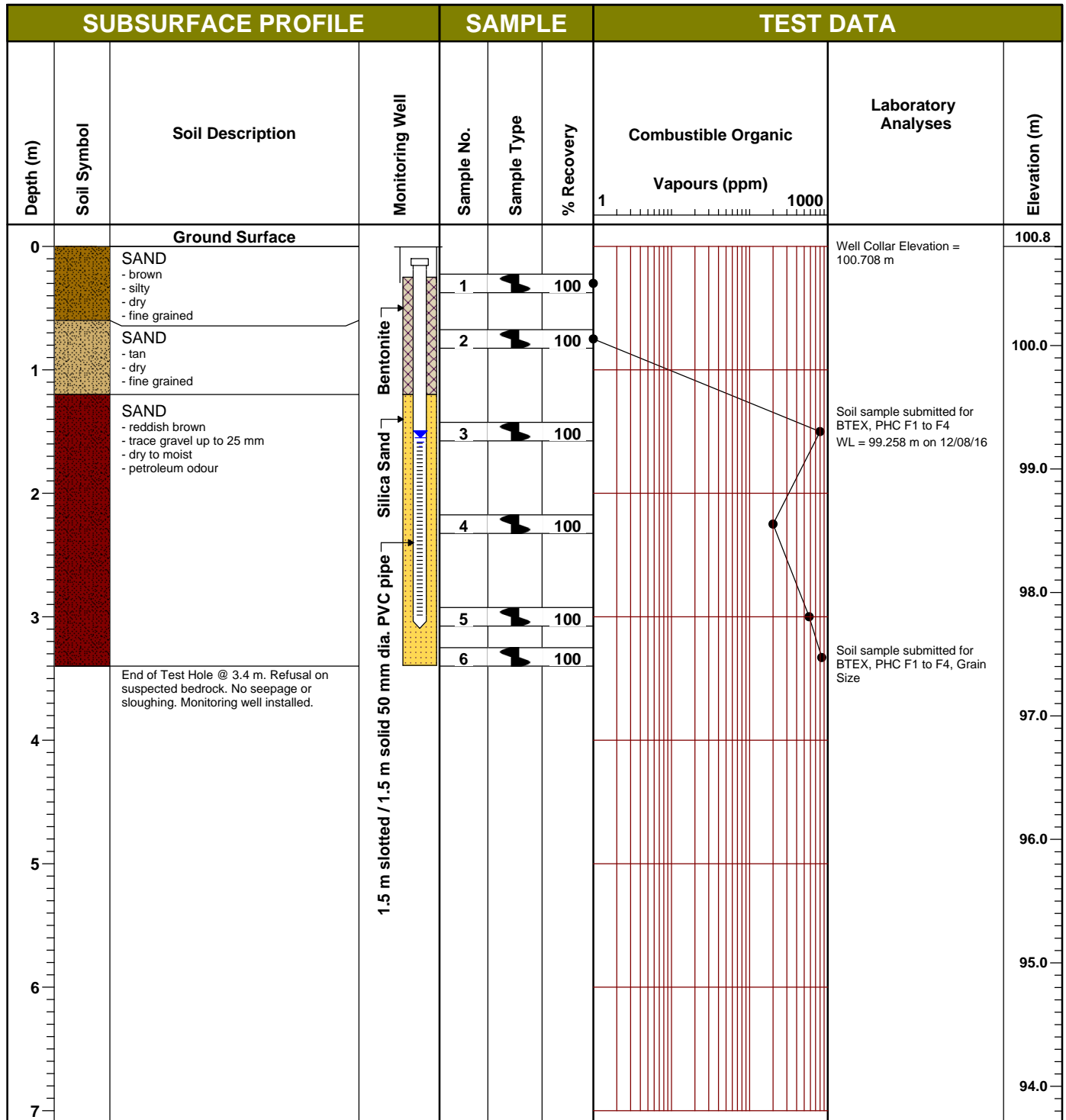
Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 4.5 m W, 3.1 m N of Detachment back door, 13V 452600E, 6569266N

Elev.: 100.803 m



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 Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroupp@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-09

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 4.5 m W, 4.6 m N of Detachment back door, 13V 452600E, 6569297N

Elev.: 100.823 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							100.8
		SAND - tan - dry - fine grained		1	☛	100			
1				2	☛	100			100.0
				3	☛	100			99.0
2		SAND - reddish brown - dry - fine grained		4	☛	100			98.0
3		End of Test Hole @ 3.05 m. Refusal on suspected bedrock. No seepage or sloughing.		5	☛	100		Soil sample submitted for BTEX, PHC F1 to F4	97.0
4									96.0
5									95.0
6									94.0
7									

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Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-10

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 2.3 m W, 3.1 m N of Detachment back door, 13V 452601E, 6569264N

Elev.: 100.830 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							100.8
		SAND - brown - silty, some organics - dry - fine grained		1	☛	100			
1				2	☛	100			100.0
				3	☛	100			99.0
2		SAND - reddish brown - moist - fine grained		4	☛	100			98.0
3		End of Test Hole @ 3.0 m. Refusal on suspected bedrock. No seepage or sloughing.		5	☛	100		Soil sample submitted for BTEX, PHC F1 to F4	97.0
4									96.0
5									95.0
6									94.0
7									

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Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroupp@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-11

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 10.2 m W, 2.7 m N of NW corner of workshop, 13V 452569E, 6569229N

Elev.: 98.650 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							98.7
		SAND - brown - silty - dry - fine grained		1	●	100		Well Collar Elevation = 98.570 m Soil sample submitted for Metals WL = Dry on 12/08/16 Soil sample submitted for PAHs Soil sample submitted for BTEX, PHC F1 to F4	98.0
1		SAND - reddish brown - fine grained - dry to moist		2	●	100			97.0
				3	●	100			96.0
2				4	●	100			95.0
3				5	●	100			94.0
		End of Test Hole @ 3.05 m. Refusal on suspected bedrock. No seepage or sloughing. Monitoring well installed.							93.0
4									92.0
5									
6									
7									

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Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-12

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 2.4 m W, 1.6 m N of NE corner of workshop, 13V 452587E, 6569222N

Elev.: 99.369 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							99.4
		SAND - tan to brown - dry - fine grained		1	☛	100		Soil sample submitted for Metals Soil sample submitted for BTEX, PHC F1 to F4, VOCs	99.0
1				2	☛	100			98.0
				3	☛	100			97.0
2		SAND - brown - moist - some gravel		4	☛	100			96.0
3				5	☛	100			95.0
		End of Test Hole @ 3.05 m. Refusal on suspected bedrock. No seepage or sloughing.							94.0
4									93.0
5									
6									
7									

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Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroupp@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-13

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 7.0 m E, 3.0 m N of SW corner of property, 13V 452535E, 6569226N

Elev.: 97.720 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							97.7
		ORGANICS - black - silty, with sand - dry		1	■	100		Soil sample submitted for BTEX, PHC F1 to F4	
		SAND - brown - dry - fine grained		2	■	100			97.0
1									
		SAND - tan - dry - fine grained		3	■	100			96.0
2									
				4	■	100			95.0
3		End of Test Hole @ 3.05 m. Refusal on suspected bedrock. No seepage or sloughing.		5	■	100			94.0
4									93.0
5									92.0
6									91.0
7									

EGE Engineering Ltd.

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511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroup@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-14

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 2.3 m W, 4.6 m N of Detachment back door, 13V 452600E, 6569267N

Elev.: 100.868 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							100.9
		ORGANICS - brown - silty, with sand - dry		1	■	100			
		CLAY - grey - dry, firm		2	■	100			100.0
1		SAND - brown - dry to moist - fine grained		3	■	100			99.0
2				4	■	100			98.0
3		End of Test Hole @ 3.05 m. Refusal on suspected bedrock. No seepage or sloughing.		5	■	100		Soil sample submitted for BTEX, PHC F1 to F4	97.0
4									96.0
5									95.0
6									94.0
7									

EGE Engineering Ltd.

Engineering, Geosciences and Environmental

511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroup@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-15

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 8.4 m W, 2.3 m N of Detachment back door, 13V 452600E, 6569267N

Elev.: 100.640 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							100.6
		SAND - tan to pink - dry - fine grained		1	■	100			
		SAND - tan - dry - fine grained		2	■	100			100.0
1		- very fine grained							
		SAND - reddish brown - dry - fine grained		3	■	100			99.0
2		SAND - reddish brown - dry - some gravel up to 25 mm		4	■	100			98.0
3		End of Test Hole @ 3.05 m. Refusal on suspected bedrock. No seepage or sloughing.		5	■	100		Soil sample submitted for BTEX, PHC F1 to F4	97.0
4									96.0
5									95.0
6									94.0
7									

EGE Engineering Ltd.

Engineering, Geosciences and Environmental

511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroup@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

TEST HOLE: SR-16

Client: Public Works & Government Services Canada

Project: 2012 Phase II Environmental Site Assessment

Project Location: Stony Rapids, Saskatchewan

Project No: 0125-046-03

Page: 1 of 1

Test Hole Location: 8.1 m W, 5.1 m N of Detachment back door, 13V 452600E, 6569269N

Elev.: 100.816 m

SUBSURFACE PROFILE				SAMPLE			TEST DATA		
Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm)	Laboratory Analyses	Elevation (m)
0		Ground Surface							100.8
		ORGANICS - brown - silty, with sand - dry		1	■	100			
		SAND - tan - dry - very fine grained		2	■	100			100.0
1									
		SAND - reddish brown - dry - fine grained		3	■	100			99.0
2		End of Test Hole @ 2.1 m. Refusal on suspected bedrock. No seepage or sloughing.		4	■	100		Soil sample submitted for BTEX, PHC F1 to F4	
									98.0
3									
									97.0
4									
									96.0
5									
									95.0
6									
									94.0
7									

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Engineering, Geosciences and Environmental

511 Pepperloaf Cres., Winnipeg, Manitoba, R3R 1E6

Ph: (204) 226-7378; Fax: (204) 837-6473; e-mail: egegroup@mts.net

Drilling Contractor: Intercore Environmental Services Ltd.

Drilling Method: GeoProbe 7822DT - Continuous Sampler

Logged By: P.Bohonos

Checked By: L.Bielus

Start Date: 12/08/15

Completion: 12/08/15

APPENDIX B
ANALYTICAL REPORT

Your P.O. #: R.058406.002
Your Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your C.O.C. #: 32384301, 323843-01-01, 323843-02-01

Attention: PETER BOHONOS
EGE ENGINEERING
511 PEPPERLOAF CRESCENT
WINNIPEG, MB
CANADA R3R 1E6

Report Date: 2012/08/24

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B273271
Received: 2012/08/16, 09:00

Sample Matrix: Soil
Samples Received: 23

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Boron (Hot Water Soluble)	5	2012/08/22	2012/08/23	AB SOP-00042	EPA 200.7
BTEX/F1 by HS GC/MS (MeOH extract)	2	2012/08/17	2012/08/22	AB SOP-00039	CCME, EPA 8260C
BTEX/F1 by HS GC/MS (MeOH extract)	17	2012/08/18	2012/08/22	AB SOP-00039	CCME, EPA 8260C
BTEX/F1 by HS GC/MS (MeOH extract)	1	2012/08/18	2012/08/23	AB SOP-00039	CCME, EPA 8260C
Hexavalent Chromium	4	2012/08/22	2012/08/22	CAL SOP-00056	SM 3500-Cr B
Hexavalent Chromium	1	2012/08/23	2012/08/22	CAL SOP-00056	SM 3500-Cr B
CCME Hydrocarbons (F2-F4 in soil)	7	2012/08/18	2012/08/22	AB SOP-00040	CCME PHC-CWS
				AB SOP-00036	
CCME Hydrocarbons (F2-F4 in soil)	13	2012/08/18	2012/08/23	AB SOP-00040	CCME PHC-CWS
				AB SOP-00036	
CCME Hydrocarbons (F4G in soil)	1	2012/08/18	2012/08/23	AB SOP-00040	CCME PHC-CWS
				AB SOP-00036	
Elements by ICPMS - Soils	1	2012/08/22	2012/08/22	AB SOP-00043	EPA 200.8
Elements by ICPMS - Soils	3	2012/08/22	2012/08/23	AB SOP-00043	EPA 200.8
Elements by ICPMS - Soils	1	2012/08/23	2012/08/23	AB SOP-00043	EPA 200.8
Moisture	23	N/A	2012/08/19	AB SOP-00002	CCME PHC-CWS
Benzo[a]pyrene Equivalency	2	N/A	2012/08/23	AB SOP-00003	EPA 8270D
Benzo[a]pyrene Equivalency	1	N/A	2012/08/24	AB SOP-00003	EPA 8270D
Polycyclic Aromatic Hydrocarbons in soil	1	2012/08/18	2012/08/22	AB SOP-00003	EPA 3540C/8270D
				AB SOP-00036	
Polycyclic Aromatic Hydrocarbons in soil	2	2012/08/18	2012/08/23	AB SOP-00003	EPA 3540C/8270D
				AB SOP-00036	
Particle Size by Sieve (75 micron)	2	N/A	2012/08/23	AB SOP-00022	SSMA 55.4
VOCs in Soil by HS GC/MS (Std List)	2	2012/08/17	2012/08/23	CAL SOP-00227	EPA 8260 C
VOCs in Soil by HS GC/MS Low (Std List)	2	2012/08/21	2012/08/23	AB SOP-00056	EPA5021A/ 8260C

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
BTEX/F1 in Water by HS GC/MS	2	N/A	2012/08/21	AB SOP-00039	CCME, EPA 8260C
CCME Hydrocarbons (F2-F4 in water)	2	2012/08/19	2012/08/19	CAL SOP-00086	EPA3510C/CCME PHCCWS
				AB SOP-00037	

../2

Your P.O. #: R.058406.002
Your Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your C.O.C. #: 32384301, 323843-01-01, 323843-02-01

Attention: PETER BOHONOS
EGE ENGINEERING
511 PEPPERLOAF CRESCENT
WINNIPEG, MB
CANADA R3R 1E6

Report Date: 2012/08/24

CERTIFICATE OF ANALYSIS

-2-

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Anna Gordon, Project Manager
Email: AGordon@maxxam.ca
Phone# (403) 291-3077

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		EF6246	EF6247	EF6249	EF6251	EF6252	EF6253		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/15		
COC Number		323843-01-01	323843-01-01	323843-01-01	323843-01-01	323843-01-01	323843-01-01		
	UNITS	SR-01-3	SR-02-2	SR-03-1	SR-03-2	SR-04-1	SR-05-1	RDL	QC Batch

Elements									
Soluble (Hot water) Boron (B)	mg/kg			0.17			<0.10	0.10	6108075
Hex. Chromium (Cr 6+)	mg/kg			<0.75 (1)			<0.75 (1)	0.75	6106891
Physical Properties									
Moisture	%	4.6	2.5	5.7	7.6	2.1	3.9	0.30	6095030
Sieve - Pan	%				25			0.20	6108132
Sieve - #200 (>0.075mm)	%				75			0.20	6108132
Grain Size	%				COARSE			0.20	6108132

RDL = Reportable Detection Limit
(1) Detection limits raised due to matrix interference.

Maxxam ID		EF6254		EF6255	EF6257	EF6258	EF6259		
Sampling Date		2012/08/14		2012/08/14	2012/08/15	2012/08/15	2012/08/15		
COC Number		323843-01-01		323843-01-01	323843-02-01	323843-02-01	323843-02-01		
	UNITS	SR-06-3	QC Batch	DUP-1	SR-07-2	SR-08-3	SR-08-6	RDL	QC Batch

Elements									
Soluble (Hot water) Boron (B)	mg/kg		6108075	0.15				0.10	6108075
Hex. Chromium (Cr 6+)	mg/kg		6106891	<0.75 (1)				0.75	6108242
Physical Properties									
Moisture	%	4.3	6095030	5.6	4.9	9.4	12	0.30	6095030
Sieve - Pan	%		6108132				51	0.20	6108132
Sieve - #200 (>0.075mm)	%		6108132				49	0.20	6108132
Grain Size	%		6108132				FINE	0.20	6108132

RDL = Reportable Detection Limit
(1) Detection limits raised due to matrix interference.

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
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Sampler Initials: PRB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		EF6260	EF6261	EF6262			EF6263		
Sampling Date		2012/08/15	2012/08/15	2012/08/15			2012/08/15		
COC Number		323843-02-01	323843-02-01	323843-02-01			323843-02-01		
	UNITS	SR-09-5	SR-10-5	SR-14-5	RDL	QC Batch	SR-11-1	RDL	QC Batch

Elements									
Soluble (Hot water) Boron (B)	mg/kg				0.10	6108075	<0.10	0.10	6108075
Hex. Chromium (Cr 6+)	mg/kg				0.75	6108242	<0.15	0.15	6106891
Physical Properties									
Moisture	%	5.0	9.1	2.9	0.30	6095030	7.4	0.30	6095030
RDL = Reportable Detection Limit									

Maxxam ID		EF6264	EF6265		EF6266	EF6267	EF6268		
Sampling Date		2012/08/15	2012/08/15		2012/08/15	2012/08/15	2012/08/15		
COC Number		323843-02-01	323843-02-01		323843-02-01	323843-02-01	323843-02-01		
	UNITS	SR-13-3	SR-11-2	QC Batch	SR-11-3	SR-12-1	SR-12-2	RDL	QC Batch

Elements									
Soluble (Hot water) Boron (B)	mg/kg			6108075		<0.10		0.10	6108075
Hex. Chromium (Cr 6+)	mg/kg			6106891		<0.15		0.15	6106891
Physical Properties									
Moisture	%	4.0	4.7	6095030	3.9	7.7	10	0.30	6095193
RDL = Reportable Detection Limit									

Maxxam ID		EF6269	EF6270	EF6271		
Sampling Date		2012/08/15	2012/08/14	2012/08/15		
COC Number		323843-02-01	323843-02-01	323843-02-01		
	UNITS	SR-15-4	SR-16-4	SR-DUP2	RDL	QC Batch

Physical Properties						
Moisture	%	4.8	5.0	10	0.30	6095193
RDL = Reportable Detection Limit						

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
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Sampler Initials: PRB

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		EF6246		EF6247	EF6249	EF6251	EF6252		
Sampling Date		2012/08/14		2012/08/14	2012/08/14	2012/08/14	2012/08/14		
COC Number		323843-01-01		323843-01-01	323843-01-01	323843-01-01	323843-01-01		
	UNITS	SR-01-3	RDL	SR-02-2	SR-03-1	SR-03-2	SR-04-1	RDL	QC Batch

Ext. Pet. Hydrocarbon									
F2 (C10-C16 Hydrocarbons)	mg/kg	<10	10	<10	27	35	<10	10	6105352
F3 (C16-C34 Hydrocarbons)	mg/kg	<20 (1)	20	<10	100	1300	<10	10	6105352
F4 (C34-C50 Hydrocarbons)	mg/kg	<10	10	<10	38	1300	<10	10	6105352
Reached Baseline at C50	mg/kg	Yes		Yes	Yes	No	Yes		6105352
F4G-SG (Heavy Hydrocarbons-Grav.)	mg/kg					4100		500	6105397
Surrogate Recovery (%)									
O-TERPHENYL (sur.)	%	95		100	95	92	116		6105352

RDL = Reportable Detection Limit
(1) Detection limit raised due to interferent.

Maxxam ID		EF6253	EF6254	EF6255		EF6257		
Sampling Date		2012/08/15	2012/08/14	2012/08/14		2012/08/15		
COC Number		323843-01-01	323843-01-01	323843-01-01		323843-02-01		
	UNITS	SR-05-1	SR-06-3	DUP-1	RDL	SR-07-2	RDL	QC Batch

Ext. Pet. Hydrocarbon								
F2 (C10-C16 Hydrocarbons)	mg/kg	<10	<10	18	10	<10	10	6105352
F3 (C16-C34 Hydrocarbons)	mg/kg	59	<10	69	10	<20 (1)	20	6105352
F4 (C34-C50 Hydrocarbons)	mg/kg	18	<10	25	10	<10	10	6105352
Reached Baseline at C50	mg/kg	Yes	Yes	Yes		Yes		6105352
Surrogate Recovery (%)								
O-TERPHENYL (sur.)	%	98	107	97		109		6105352

RDL = Reportable Detection Limit
(1) Detection limit raised due to interferent.

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		EF6258	EF6259	EF6260	EF6261	EF6262		
Sampling Date		2012/08/15	2012/08/15	2012/08/15	2012/08/15	2012/08/15		
COC Number		323843-02-01	323843-02-01	323843-02-01	323843-02-01	323843-02-01		
	UNITS	SR-08-3	SR-08-6	SR-09-5	SR-10-5	SR-14-5	RDL	QC Batch

Ext. Pet. Hydrocarbon								
F2 (C10-C16 Hydrocarbons)	mg/kg	2500	2500	68	<10	<10	10	6105352
F3 (C16-C34 Hydrocarbons)	mg/kg	130	110	<10	<10	<10	10	6105352
F4 (C34-C50 Hydrocarbons)	mg/kg	<10	<10	<10	<10	<10	10	6105352
Reached Baseline at C50	mg/kg	Yes	Yes	Yes	Yes	Yes		6105352
Surrogate Recovery (%)								
O-TERPHENYL (sur.)	%	104	105	97	107	101		6105352
RDL = Reportable Detection Limit								

Maxxam ID		EF6264		EF6266		EF6268		EF6269		
Sampling Date		2012/08/15		2012/08/15		2012/08/15		2012/08/15		
COC Number		323843-02-01		323843-02-01		323843-02-01		323843-02-01		
	UNITS	SR-13-3	RDL	SR-11-3	RDL	SR-12-2	RDL	SR-15-4	RDL	QC Batch

Ext. Pet. Hydrocarbon										
F2 (C10-C16 Hydrocarbons)	mg/kg	<10	10	<20 (1)	20	<10	10	21	10	6105352
F3 (C16-C34 Hydrocarbons)	mg/kg	<10	10	<10	10	26	10	<20 (1)	20	6105352
F4 (C34-C50 Hydrocarbons)	mg/kg	<10	10	<10	10	<10	10	<10	10	6105352
Reached Baseline at C50	mg/kg	Yes		Yes		Yes		Yes		6105352
Surrogate Recovery (%)										
O-TERPHENYL (sur.)	%	96		106		100		102		6105352
RDL = Reportable Detection Limit										
(1) Detection limit raised due to interferent.										

Maxxam Job #: B273271
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EGE ENGINEERING
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Sampler Initials: PRB

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		EF6270	EF6271		
Sampling Date		2012/08/14	2012/08/15		
COC Number		323843-02-01	323843-02-01		
	UNITS	SR-16-4	SR-DUP2	RDL	QC Batch

Ext. Pet. Hydrocarbon					
F2 (C10-C16 Hydrocarbons)	mg/kg	<10	2400	10	6105352
F3 (C16-C34 Hydrocarbons)	mg/kg	<10	130	10	6105352
F4 (C34-C50 Hydrocarbons)	mg/kg	<10	<10	10	6105352
Reached Baseline at C50	mg/kg	Yes	Yes		6105352
Surrogate Recovery (%)					
O-TERPHENYL (sur.)	%	94	96		6105352
RDL = Reportable Detection Limit					

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
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Site Location: RCMP
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Sampler Initials: PRB

SEMIVOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		EF6249			EF6255			EF6265		
Sampling Date		2012/08/14			2012/08/14			2012/08/15		
COC Number		323843-01-01			323843-01-01			323843-02-01		
	UNITS	SR-03-1	RDL	QC Batch	DUP-1	RDL	QC Batch	SR-11-2	RDL	QC Batch

Polycyclic Aromatics										
Acenaphthene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Benzo[a]pyrene equivalency	mg/kg	<0.10	0.10	6094299	<0.10	0.10	6105341	<0.10	0.10	6094299
Acenaphthylene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Acridine	mg/kg	0.018	0.010	6105337	0.012	0.010	6106443	<0.010	0.010	6105337
Anthracene	mg/kg	<0.0040	0.0040	6105337	<0.0040	0.0040	6106443	<0.0040	0.0040	6105337
Benzo(a)anthracene	mg/kg	0.0058	0.0050	6105337	0.0057	0.0050	6106443	<0.0050	0.0050	6105337
Benzo(b&j)fluoranthene	mg/kg	0.0064	0.0050	6105337	0.0078	0.0050	6106443	<0.0050	0.0050	6105337
Benzo(k)fluoranthene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Benzo(g,h,i)perylene	mg/kg	0.0098	0.0050	6105337	0.013	0.0050	6106443	<0.0050	0.0050	6105337
Benzo(c)phenanthrene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Benzo(a)pyrene	mg/kg	0.0059	0.0050	6105337	0.0082	0.0050	6106443	<0.0050	0.0050	6105337
Benzo[e]pyrene	mg/kg	0.0087	0.0050	6105337	0.012	0.0050	6106443	<0.0050	0.0050	6105337
Chrysene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Dibenz(a,h)anthracene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Fluoranthene	mg/kg	0.0057	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Fluorene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Indeno(1,2,3-cd)pyrene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
2-Methylnaphthalene	mg/kg	0.16	0.0050	6105337	0.060	0.0050	6106443	<0.0050	0.0050	6105337
Naphthalene	mg/kg	0.087	0.0050	6105337	0.036	0.0050	6106443	<0.0050	0.0050	6105337
Phenanthrene	mg/kg	0.0075	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Perylene	mg/kg	<0.0050	0.0050	6105337	<0.0050	0.0050	6106443	<0.0050	0.0050	6105337
Pyrene	mg/kg	0.032	0.0050	6105337	0.029	0.0050	6106443	<0.0050	0.0050	6105337
Quinoline	mg/kg	<0.030 (1)	0.030	6105337	<0.018 (1)	0.018	6106443	<0.010	0.010	6105337
Surrogate Recovery (%)										
D10-ANTHRACENE (sur.)	%	90		6105337	99		6106443	91		6105337
D12-BENZO(A)PYRENE (sur.)	%	68		6105337	104		6106443	74		6105337
D8-ACENAPHTHYLENE (sur.)	%	96		6105337	109		6106443	96		6105337
TERPHENYL-D14 (sur.)	%	98		6105337	115		6106443	98		6105337

RDL = Reportable Detection Limit

(1) Detection limits raised due to matrix interference.

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
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Sampler Initials: PRB

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		EF6249	EF6253		EF6255		EF6263		
Sampling Date		2012/08/14	2012/08/15		2012/08/14		2012/08/15		
COC Number		323843-01-01	323843-01-01		323843-01-01		323843-02-01		
	UNITS	SR-03-1	SR-05-1	QC Batch	DUP-1	QC Batch	SR-11-1	RDL	QC Batch

Elements									
Total Antimony (Sb)	mg/kg	<1.0	<1.0	6106281	<1.0	6109984	<1.0	1.0	6106281
Total Arsenic (As)	mg/kg	1.1	1.4	6106281	1.1	6109984	1.4	1.0	6106281
Total Barium (Ba)	mg/kg	26	21	6106281	27	6109984	36	10	6106281
Total Beryllium (Be)	mg/kg	<0.40	<0.40	6106281	<0.40	6109984	<0.40	0.40	6106281
Total Cadmium (Cd)	mg/kg	<0.10	<0.10	6106281	<0.10	6109984	<0.10	0.10	6106281
Total Chromium (Cr)	mg/kg	11	18	6106281	12	6109984	23	1.0	6106281
Total Cobalt (Co)	mg/kg	1.4	1.8	6106281	1.5	6109984	3.6	1.0	6106281
Total Copper (Cu)	mg/kg	<5.0	<5.0	6106281	<5.0	6109984	<5.0	5.0	6106281
Total Lead (Pb)	mg/kg	12	21	6106281	13	6109984	4.1	1.0	6106281
Total Mercury (Hg)	mg/kg	<0.050	<0.050	6106281	<0.050	6109984	<0.050	0.050	6106281
Total Molybdenum (Mo)	mg/kg	<0.40	<0.40	6106281	<0.40	6109984	0.68	0.40	6106281
Total Nickel (Ni)	mg/kg	7.1	12	6106281	7.5	6109984	10	1.0	6106281
Total Selenium (Se)	mg/kg	<0.50	<0.50	6106281	<0.50	6109984	<0.50	0.50	6106281
Total Silver (Ag)	mg/kg	<1.0	<1.0	6106281	<1.0	6109984	<1.0	1.0	6106281
Total Thallium (Tl)	mg/kg	<0.30	<0.30	6106281	<0.30	6109984	<0.30	0.30	6106281
Total Tin (Sn)	mg/kg	<1.0	<1.0	6106281	<1.0	6109984	<1.0	1.0	6106281
Total Uranium (U)	mg/kg	<1.0	<1.0	6106281	<1.0	6109984	1.5	1.0	6106281
Total Vanadium (V)	mg/kg	8.0	9.8	6106281	8.5	6109984	19	1.0	6106281
Total Zinc (Zn)	mg/kg	32	35	6106281	32	6109984	18	10	6106281

RDL = Reportable Detection Limit

Maxxam Job #: B273271
Report Date: 2012/08/24

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Your P.O. #: R.058406.002
Sampler Initials: PRB

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		EF6267		
Sampling Date		2012/08/15		
COC Number		323843-02-01		
	UNITS	SR-12-1	RDL	QC Batch

Elements				
Total Antimony (Sb)	mg/kg	<1.0	1.0	6106282
Total Arsenic (As)	mg/kg	<1.0	1.0	6106282
Total Barium (Ba)	mg/kg	<10	10	6106282
Total Beryllium (Be)	mg/kg	<0.40	0.40	6106282
Total Cadmium (Cd)	mg/kg	<0.10	0.10	6106282
Total Chromium (Cr)	mg/kg	4.5	1.0	6106282
Total Cobalt (Co)	mg/kg	<1.0	1.0	6106282
Total Copper (Cu)	mg/kg	<5.0	5.0	6106282
Total Lead (Pb)	mg/kg	1.2	1.0	6106282
Total Mercury (Hg)	mg/kg	<0.050	0.050	6106282
Total Molybdenum (Mo)	mg/kg	<0.40	0.40	6106282
Total Nickel (Ni)	mg/kg	2.2	1.0	6106282
Total Selenium (Se)	mg/kg	<0.50	0.50	6106282
Total Silver (Ag)	mg/kg	<1.0	1.0	6106282
Total Thallium (Tl)	mg/kg	<0.30	0.30	6106282
Total Tin (Sn)	mg/kg	<1.0	1.0	6106282
Total Uranium (U)	mg/kg	<1.0	1.0	6106282
Total Vanadium (V)	mg/kg	5.3	1.0	6106282
Total Zinc (Zn)	mg/kg	<10	10	6106282
RDL = Reportable Detection Limit				

Maxxam Job #: B273271
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EGE ENGINEERING
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Sampler Initials: PRB

VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		EF6246	EF6247	EF6249	EF6251	EF6252		
Sampling Date		2012/08/14	2012/08/14	2012/08/14	2012/08/14	2012/08/14		
COC Number		323843-01-01	323843-01-01	323843-01-01	323843-01-01	323843-01-01		
	UNITS	SR-01-3	SR-02-2	SR-03-1	SR-03-2	SR-04-1	RDL	QC Batch

Volatiles								
Benzene	mg/kg	<0.0050	<0.0050	0.017	0.16	<0.0050	0.0050	6099033
Toluene	mg/kg	<0.020	<0.020	0.067	0.89	<0.020	0.020	6099033
Ethylbenzene	mg/kg	<0.010	<0.010	0.017	0.082	<0.010	0.010	6099033
Xylenes (Total)	mg/kg	<0.040	<0.040	0.39	4.7	<0.040	0.040	6099033
m & p-Xylene	mg/kg	<0.040	<0.040	0.22	3.0	<0.040	0.040	6099033
o-Xylene	mg/kg	<0.020	<0.020	0.17	1.7	<0.020	0.020	6099033
F1 (C6-C10) - BTEX	mg/kg	<12	<12	<12	19	<12	12	6099033
(C6-C10)	mg/kg	<12	<12	<12	25	<12	12	6099033
Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	101	100	100	100	99		6099033
4-BROMOFLUOROBENZENE (sur.)	%	97	94	90	99	90		6099033
D10-ETHYLBENZENE (sur.)	%	92	89	90	96	98		6099033
D4-1,2-DICHLOROETHANE (sur.)	%	98	102	101	97	99		6099033

RDL = Reportable Detection Limit

Maxxam Job #: B273271
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VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		EF6253		EF6254	EF6255	EF6257		
Sampling Date		2012/08/15		2012/08/14	2012/08/14	2012/08/15		
COC Number		323843-01-01		323843-01-01	323843-01-01	323843-02-01		
	UNITS	SR-05-1	QC Batch	SR-06-3	DUP-1	SR-07-2	RDL	QC Batch

Volatiles								
Benzene	mg/kg	0.0087	6104876	<0.0050	0.011	<0.0050	0.0050	6099033
Bromodichloromethane	mg/kg	<0.030	6104876				0.030	
Toluene	mg/kg	<0.020	6099033	<0.020	0.075	<0.020	0.020	6099033
Bromoform	mg/kg	<0.050	6104876				0.050	
Ethylbenzene	mg/kg	<0.010	6099033	<0.010	0.018	<0.010	0.010	6099033
Bromomethane	mg/kg	<0.020	6104876				0.020	
Xylenes (Total)	mg/kg	<0.040	6099033	<0.040	0.43	<0.040	0.040	6099033
Carbon tetrachloride	mg/kg	<0.00050	6101179				0.00050	
m & p-Xylene	mg/kg	<0.040	6099033	<0.040	0.25	<0.040	0.040	6099033
Chlorobenzene	mg/kg	<0.0010	6101179				0.0010	
o-Xylene	mg/kg	<0.020	6099033	<0.020	0.18	<0.020	0.020	6099033
Chlorodibromomethane	mg/kg	<0.020	6104876				0.020	
F1 (C6-C10) - BTEX	mg/kg	<12	6099033	<12	<12	<12	12	6099033
Chloroethane	mg/kg	<0.020	6104876				0.020	
(C6-C10)	mg/kg	<12	6099033	<12	<12	<12	12	6099033
Chloroform	mg/kg	0.0077	6101179				0.00080	
Chloromethane	mg/kg	<0.030	6104876				0.030	
1,2-dibromoethane	mg/kg	<0.0020	6101179				0.0020	
1,2-dichlorobenzene	mg/kg	<0.020	6104876				0.020	
1,3-dichlorobenzene	mg/kg	<0.020	6104876				0.020	
1,4-dichlorobenzene	mg/kg	<0.020	6104876				0.020	
1,1-dichloroethane	mg/kg	<0.020	6104876				0.020	
1,2-dichloroethane	mg/kg	<0.0020	6101179				0.0020	
1,1-dichloroethene	mg/kg	<0.020	6104876				0.020	
cis-1,2-dichloroethene	mg/kg	<0.020	6104876				0.020	
trans-1,2-dichloroethene	mg/kg	<0.020	6104876				0.020	
Dichloromethane	mg/kg	<0.010	6104876				0.010	
1,2-dichloropropane	mg/kg	<0.020	6104876				0.020	
cis-1,3-dichloropropene	mg/kg	<0.020	6104876				0.020	
trans-1,3-dichloropropene	mg/kg	<0.020	6104876				0.020	
Ethylbenzene	mg/kg	<0.010	6104876				0.010	
Methyl methacrylate	mg/kg	<0.040	6104876				0.040	
RDL = Reportable Detection Limit								

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		EF6253		EF6254	EF6255	EF6257		
Sampling Date		2012/08/15		2012/08/14	2012/08/14	2012/08/15		
COC Number		323843-01-01		323843-01-01	323843-01-01	323843-02-01		
	UNITS	SR-05-1	QC Batch	SR-06-3	DUP-1	SR-07-2	RDL	QC Batch
Methyl-tert-butylether (MTBE)	mg/kg	<0.030	6104876				0.030	
Styrene	mg/kg	<0.020	6104876				0.020	
1,1,1,2-tetrachloroethane	mg/kg	<0.10	6104876				0.10	
1,1,2,2-tetrachloroethane	mg/kg	<0.10	6104876				0.10	
Tetrachloroethene	mg/kg	<0.020	6104876				0.020	
Toluene	mg/kg	<0.020	6104876				0.020	
1,2,3-trichlorobenzene	mg/kg	<0.040	6104876				0.040	
1,2,4-trichlorobenzene	mg/kg	<0.040	6104876				0.040	
1,3,5-trichlorobenzene	mg/kg	<0.040	6104876				0.040	
1,1,1-trichloroethane	mg/kg	<0.020	6104876				0.020	
1,1,2-trichloroethane	mg/kg	<0.020	6104876				0.020	
Trichloroethene	mg/kg	<0.010	6104876				0.010	
Trichlorofluoromethane	mg/kg	<0.020	6104876				0.020	
1,2,4-trimethylbenzene	mg/kg	<0.50	6104876				0.50	
1,3,5-trimethylbenzene	mg/kg	<0.50	6104876				0.50	
Vinyl chloride	mg/kg	<0.00030	6101179				0.00030	
Xylenes (Total)	mg/kg	<0.040	6104876				0.040	
m & p-Xylene	mg/kg	<0.040	6104876				0.040	
o-Xylene	mg/kg	<0.020	6104876				0.020	
Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	101	6099033	101	99	104		6099033
4-BROMOFLUOROBENZENE (sur.)	%	90	6099033	91	95	94		6099033
D10-ETHYLBENZENE (sur.)	%	93	6099033	92	93	89		6099033
D4-1,2-DICHLOROETHANE (sur.)	%	99	6099033	103	101	104		6099033
4-BROMOFLUOROBENZENE (sur.)	%	95	6104876					
D10-ETHYLBENZENE (sur.)	%	104	6104876					
D4-1,2-DICHLOROETHANE (sur.)	%	91	6104876					
D8-TOLUENE (sur.)	%	101	6104876					
1,4-Difluorobenzene (sur.)	%	99	6101179					
4-BROMOFLUOROBENZENE (sur.)	%	87	6101179					
D10-ETHYLBENZENE (sur.)	%	106	6101179					
D4-1,2-DICHLOROETHANE (sur.)	%	96	6101179					
RDL = Reportable Detection Limit								

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		EF6258	EF6259	EF6260	EF6261	EF6262		
Sampling Date		2012/08/15	2012/08/15	2012/08/15	2012/08/15	2012/08/15		
COC Number		323843-02-01	323843-02-01	323843-02-01	323843-02-01	323843-02-01		
	UNITS	SR-08-3	SR-08-6	SR-09-5	SR-10-5	SR-14-5	RDL	QC Batch

Volatiles								
Benzene	mg/kg	0.017	0.041	<0.0050	<0.0050	<0.0050	0.0050	6099033
Toluene	mg/kg	0.90	2.3	<0.020	<0.020	<0.020	0.020	6099033
Ethylbenzene	mg/kg	1.6	3.1	<0.010	<0.010	<0.010	0.010	6099033
Xylenes (Total)	mg/kg	11	20	<0.040	<0.040	<0.040	0.040	6099033
m & p-Xylene	mg/kg	7.3	14	<0.040	<0.040	<0.040	0.040	6099033
o-Xylene	mg/kg	3.7	6.8	<0.020	<0.020	<0.020	0.020	6099033
F1 (C6-C10) - BTEX	mg/kg	300	440	<12	<12	<12	12	6099033
(C6-C10)	mg/kg	310	470	<12	<12	<12	12	6099033
Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	95	100	100	101	101		6099033
4-BROMOFLUOROBENZENE (sur.)	%	103	109	94	95	90		6099033
D10-ETHYLBENZENE (sur.)	%	98	94	101	97	90		6099033
D4-1,2-DICHLOROETHANE (sur.)	%	95	95	90	94	99		6099033

RDL = Reportable Detection Limit

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		EF6264	EF6266	EF6268	EF6269	EF6270		
Sampling Date		2012/08/15	2012/08/15	2012/08/15	2012/08/15	2012/08/14		
COC Number		323843-02-01	323843-02-01	323843-02-01	323843-02-01	323843-02-01		
	UNITS	SR-13-3	SR-11-3	SR-12-2	SR-15-4	SR-16-4	RDL	QC Batch

Volatiles								
Benzene	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	6099033
Bromodichloromethane	mg/kg			<0.030			0.030	6104876
Toluene	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6099033
Bromoform	mg/kg			<0.050			0.050	6104876
Ethylbenzene	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	6099033
Bromomethane	mg/kg			<0.020			0.020	6104876
Xylenes (Total)	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	6099033
Carbon tetrachloride	mg/kg			<0.00050			0.00050	6101179
m & p-Xylene	mg/kg	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	6099033
Chlorobenzene	mg/kg			<0.0010			0.0010	6101179
o-Xylene	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6099033
Chlorodibromomethane	mg/kg			<0.020			0.020	6104876
F1 (C6-C10) - BTEX	mg/kg	<12	<12	<12	<12	<12	12	6099033
Chloroethane	mg/kg			<0.020			0.020	6104876
(C6-C10)	mg/kg	<12	<12	<12	<12	<12	12	6099033
Chloroform	mg/kg			<0.00080			0.00080	6101179
Chloromethane	mg/kg			<0.030			0.030	6104876
1,2-dibromoethane	mg/kg			<0.0020			0.0020	6101179
1,2-dichlorobenzene	mg/kg			<0.020			0.020	6104876
1,3-dichlorobenzene	mg/kg			<0.020			0.020	6104876
1,4-dichlorobenzene	mg/kg			<0.020			0.020	6104876
1,1-dichloroethane	mg/kg			<0.020			0.020	6104876
1,2-dichloroethane	mg/kg			<0.0020			0.0020	6101179
1,1-dichloroethene	mg/kg			<0.020			0.020	6104876
cis-1,2-dichloroethene	mg/kg			<0.020			0.020	6104876
trans-1,2-dichloroethene	mg/kg			<0.020			0.020	6104876
Dichloromethane	mg/kg			<0.010			0.010	6104876
1,2-dichloropropane	mg/kg			<0.020			0.020	6104876
cis-1,3-dichloropropene	mg/kg			<0.020			0.020	6104876
trans-1,3-dichloropropene	mg/kg			<0.020			0.020	6104876
Ethylbenzene	mg/kg			<0.010			0.010	6104876
Methyl methacrylate	mg/kg			<0.040			0.040	6104876

RDL = Reportable Detection Limit

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		EF6264	EF6266	EF6268	EF6269	EF6270		
Sampling Date		2012/08/15	2012/08/15	2012/08/15	2012/08/15	2012/08/14		
COC Number		323843-02-01	323843-02-01	323843-02-01	323843-02-01	323843-02-01		
	UNITS	SR-13-3	SR-11-3	SR-12-2	SR-15-4	SR-16-4	RDL	QC Batch

Methyl-tert-butylether (MTBE)	mg/kg			<0.030			0.030	6104876
Styrene	mg/kg			<0.020			0.020	6104876
1,1,1,2-tetrachloroethane	mg/kg			<0.10			0.10	6104876
1,1,2,2-tetrachloroethane	mg/kg			<0.10			0.10	6104876
Tetrachloroethene	mg/kg			<0.020			0.020	6104876
Toluene	mg/kg			<0.020			0.020	6104876
1,2,3-trichlorobenzene	mg/kg			<0.040			0.040	6104876
1,2,4-trichlorobenzene	mg/kg			<0.040			0.040	6104876
1,3,5-trichlorobenzene	mg/kg			<0.040			0.040	6104876
1,1,1-trichloroethane	mg/kg			<0.020			0.020	6104876
1,1,2-trichloroethane	mg/kg			<0.020			0.020	6104876
Trichloroethene	mg/kg			<0.010			0.010	6104876
Trichlorofluoromethane	mg/kg			<0.020			0.020	6104876
1,2,4-trimethylbenzene	mg/kg			<0.50			0.50	6104876
1,3,5-trimethylbenzene	mg/kg			<0.50			0.50	6104876
Vinyl chloride	mg/kg			<0.00030			0.00030	6101179
Xylenes (Total)	mg/kg			<0.040			0.040	6104876
m & p-Xylene	mg/kg			<0.040			0.040	6104876
o-Xylene	mg/kg			<0.020			0.020	6104876
Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	101	98	99	100	90		6099033
4-BROMOFLUOROBENZENE (sur.)	%	89	89	89	91	76		6099033
D10-ETHYLBENZENE (sur.)	%	95	99	94	101	85		6099033
D4-1,2-DICHLOROETHANE (sur.)	%	96	96	98	98	87		6099033
4-BROMOFLUOROBENZENE (sur.)	%			95				6104876
D10-ETHYLBENZENE (sur.)	%			104				6104876
D4-1,2-DICHLOROETHANE (sur.)	%			85				6104876
D8-TOLUENE (sur.)	%			101				6104876
1,4-Difluorobenzene (sur.)	%			98				6101179
4-BROMOFLUOROBENZENE (sur.)	%			80				6101179
D10-ETHYLBENZENE (sur.)	%			113				6101179
D4-1,2-DICHLOROETHANE (sur.)	%			91				6101179

RDL = Reportable Detection Limit

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

VOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		EF6271		
Sampling Date		2012/08/15		
COC Number		323843-02-01		
	UNITS	SR-DUP2	RDL	QC Batch
Volatiles				
Benzene	mg/kg	0.013	0.0050	6099033
Toluene	mg/kg	0.82	0.020	6099033
Ethylbenzene	mg/kg	1.4	0.010	6099033
Xylenes (Total)	mg/kg	10	0.040	6099033
m & p-Xylene	mg/kg	6.7	0.040	6099033
o-Xylene	mg/kg	3.4	0.020	6099033
F1 (C6-C10) - BTEX	mg/kg	280	12	6099033
(C6-C10)	mg/kg	290	12	6099033
Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	96		6099033
4-BROMOFLUOROBENZENE (sur.)	%	103		6099033
D10-ETHYLBENZENE (sur.)	%	100		6099033
D4-1,2-DICHLOROETHANE (sur.)	%	90		6099033
RDL = Reportable Detection Limit				

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		EF6248	EF6250		
Sampling Date		2012/08/15 14:00	2012/08/15 14:00		
COC Number		323843-01-01	323843-01-01		
	UNITS	SR-08	SR-DUP	RDL	QC Batch

Ext. Pet. Hydrocarbon					
F2 (C10-C16 Hydrocarbons)	mg/L	17	6.9	0.10	6095095
F3 (C16-C34 Hydrocarbons)	mg/L	1.0	0.67	0.10	6095095
F4 (C34-C50 Hydrocarbons)	mg/L	<0.10	<0.10	0.10	6095095
Reached Baseline at C50	mg/L	Yes	Yes		6095095
Surrogate Recovery (%)					
O-TERPHENYL (sur.)	%	61	61		6095095

RDL = Reportable Detection Limit

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		EF6248	EF6250		
Sampling Date		2012/08/15 14:00	2012/08/15 14:00		
COC Number		323843-01-01	323843-01-01		
	UNITS	SR-08	SR-DUP	RDL	QC Batch
Volatiles					
Benzene	ug/L	57	56	0.40	6095961
Toluene	ug/L	810	820	0.40	6095961
Ethylbenzene	ug/L	250	250	0.40	6095961
o-Xylene	ug/L	560	570	0.40	6095961
m & p-Xylene	ug/L	930	950	0.80	6095961
Xylenes (Total)	ug/L	1500	1500	0.80	6095961
F1 (C6-C10) - BTEX	ug/L	3900	5100	100	6095961
(C6-C10)	ug/L	6500	7700	100	6095961
Surrogate Recovery (%)					
1,4-Difluorobenzene (sur.)	%	92	92		6095961
4-BROMOFLUOROBENZENE (sur.)	%	97	86		6095961
D4-1,2-DICHLOROETHANE (sur.)	%	98	93		6095961
RDL = Reportable Detection Limit					

Maxxam Job #: B273271
Report Date: 2012/08/24

EGE ENGINEERING
Client Project #: 0125 046 03 STONY RAPIDS
Site Location: RCMP
Your P.O. #: R.058406.002
Sampler Initials: PRB

General Comments

Results relate only to the items tested.

EGE ENGINEERING
 Attention: PETER BOHONOS
 Client Project #: 0125 046 03 STONY RAPIDS
 P.O. #: R.058406.002
 Site Location: RCMP

Quality Assurance Report
 Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6095030 DLO	Method Blank	Moisture	2012/08/19	<0.30		%	
	RPD	Moisture	2012/08/19	0		%	20
6095095 DO1	Matrix Spike [EF6248-01]	O-TERPHENYL (sur.)	2012/08/19		48 (1)	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2012/08/19		NC	%	50 - 130
		F4 (C34-C50 Hydrocarbons)	2012/08/19		57	%	50 - 130
	Spiked Blank	O-TERPHENYL (sur.)	2012/08/19		83	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2012/08/19		87	%	70 - 130
		F3 (C16-C34 Hydrocarbons)	2012/08/19		76	%	70 - 130
		F4 (C34-C50 Hydrocarbons)	2012/08/19		80	%	70 - 130
	Method Blank	O-TERPHENYL (sur.)	2012/08/19		78	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2012/08/19	<0.10		mg/L	
		F3 (C16-C34 Hydrocarbons)	2012/08/19	<0.10		mg/L	
		F4 (C34-C50 Hydrocarbons)	2012/08/19	<0.10		mg/L	
	RPD	F2 (C10-C16 Hydrocarbons)	2012/08/19	NC		%	40
		F3 (C16-C34 Hydrocarbons)	2012/08/19	NC		%	40
		F4 (C34-C50 Hydrocarbons)	2012/08/19	NC		%	40
6095193 DLO	Method Blank	Moisture	2012/08/19	<0.30		%	
	RPD [EF6270-01]	Moisture	2012/08/19	0		%	20
6095961 MJ0	Matrix Spike	1,4-Difluorobenzene (sur.)	2012/08/21		94	%	70 - 130
		4-BROMOFLUOROBENZENE (sur.)	2012/08/21		94	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/21		98	%	70 - 130
		Benzene	2012/08/21		79	%	70 - 130
		Toluene	2012/08/21		86	%	70 - 130
		Ethylbenzene	2012/08/21		83	%	70 - 130
		o-Xylene	2012/08/21		84	%	70 - 130
		m & p-Xylene	2012/08/21		84	%	70 - 130
		(C6-C10)	2012/08/21		82	%	70 - 130
	Spiked Blank	1,4-Difluorobenzene (sur.)	2012/08/20		99	%	70 - 130
		4-BROMOFLUOROBENZENE (sur.)	2012/08/20		100	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/20		98	%	70 - 130
		Benzene	2012/08/20		76	%	70 - 130
		Toluene	2012/08/20		82	%	70 - 130
		Ethylbenzene	2012/08/20		79	%	70 - 130
		o-Xylene	2012/08/20		80	%	70 - 130
		m & p-Xylene	2012/08/20		80	%	70 - 130
		(C6-C10)	2012/08/20		82	%	70 - 130
	Method Blank	1,4-Difluorobenzene (sur.)	2012/08/20		96	%	70 - 130
		4-BROMOFLUOROBENZENE (sur.)	2012/08/20		94	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/20		100	%	70 - 130
		Benzene	2012/08/20	<0.40		ug/L	
		Toluene	2012/08/20	<0.40		ug/L	
		Ethylbenzene	2012/08/20	<0.40		ug/L	
		o-Xylene	2012/08/20	<0.40		ug/L	
		m & p-Xylene	2012/08/20	<0.80		ug/L	
		Xylenes (Total)	2012/08/20	<0.80		ug/L	
		F1 (C6-C10) - BTEX	2012/08/20	<100		ug/L	
		(C6-C10)	2012/08/20	<100		ug/L	
	RPD	Benzene	2012/08/21	4.9		%	40
		Toluene	2012/08/21	NC		%	40
		Ethylbenzene	2012/08/21	NC		%	40
		o-Xylene	2012/08/21	NC		%	40
		m & p-Xylene	2012/08/21	NC		%	40
		Xylenes (Total)	2012/08/21	NC		%	40
		F1 (C6-C10) - BTEX	2012/08/21	NC		%	40

EGE ENGINEERING
 Attention: PETER BOHONOS
 Client Project #: 0125 046 03 STONY RAPIDS
 P.O. #: R.058406.002
 Site Location: RCMP

Quality Assurance Report (Continued)

Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6095961 MJ0	RPD	(C6-C10)	2012/08/21	8.8		%	40
6099033 WZ0	Matrix Spike [EF6262-01]	1,4-Difluorobenzene (sur.)	2012/08/22		101	%	60 - 140
		4-BROMOFLUOROBENZENE (sur.)	2012/08/22		105	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/22		104	%	60 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/22		96	%	60 - 140
		Benzene	2012/08/22		97	%	60 - 140
		Toluene	2012/08/22		97	%	60 - 140
		Ethylbenzene	2012/08/22		104	%	60 - 140
		m & p-Xylene	2012/08/22		107	%	60 - 140
		o-Xylene	2012/08/22		105	%	60 - 140
		(C6-C10)	2012/08/22		61	%	60 - 140
	Spiked Blank	1,4-Difluorobenzene (sur.)	2012/08/22		99	%	60 - 140
		4-BROMOFLUOROBENZENE (sur.)	2012/08/22		96	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/22		97	%	60 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/22		93	%	60 - 140
		Benzene	2012/08/22		90	%	60 - 140
		Toluene	2012/08/22		91	%	60 - 140
		Ethylbenzene	2012/08/22		99	%	60 - 140
		m & p-Xylene	2012/08/22		102	%	60 - 140
		o-Xylene	2012/08/22		102	%	60 - 140
		(C6-C10)	2012/08/22		61	%	60 - 140
	Method Blank	1,4-Difluorobenzene (sur.)	2012/08/22		98	%	60 - 140
		4-BROMOFLUOROBENZENE (sur.)	2012/08/22		89	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/22		96	%	60 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/22		95	%	60 - 140
		Benzene	2012/08/22	<0.0050		mg/kg	
		Toluene	2012/08/22	<0.020		mg/kg	
		Ethylbenzene	2012/08/22	<0.010		mg/kg	
		Xylenes (Total)	2012/08/22	<0.040		mg/kg	
		m & p-Xylene	2012/08/22	<0.040		mg/kg	
		o-Xylene	2012/08/22	<0.020		mg/kg	
		F1 (C6-C10) - BTEX	2012/08/22	<12		mg/kg	
		(C6-C10)	2012/08/22	<12		mg/kg	
	RPD [EF6262-01]	Benzene	2012/08/22	NC		%	50
		Toluene	2012/08/22	NC		%	50
		Ethylbenzene	2012/08/22	NC		%	50
		Xylenes (Total)	2012/08/22	NC		%	50
		m & p-Xylene	2012/08/22	NC		%	50
		o-Xylene	2012/08/22	NC		%	50
		F1 (C6-C10) - BTEX	2012/08/22	NC		%	50
		(C6-C10)	2012/08/22	NC		%	50
6101179 PK1	Matrix Spike	1,4-Difluorobenzene (sur.)	2012/08/24		102	%	60 - 140
		4-BROMOFLUOROBENZENE (sur.)	2012/08/24		97	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/24		113	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/24		95	%	60 - 140
		Chlorobenzene	2012/08/24		118	%	60 - 140
		Chloroform	2012/08/24		133	%	60 - 140
		1,2-dibromoethane	2012/08/24		112	%	60 - 140
		1,2-dichloroethane	2012/08/24		125	%	60 - 140
		Vinyl chloride	2012/08/24		109	%	60 - 140
	Spiked Blank	1,4-Difluorobenzene (sur.)	2012/08/24		102	%	60 - 140
		4-BROMOFLUOROBENZENE (sur.)	2012/08/24		108	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/24		102	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/24		103	%	60 - 140

EGE ENGINEERING
 Attention: PETER BOHONOS
 Client Project #: 0125 046 03 STONY RAPIDS
 P.O. #: R.058406.002
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Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6101179 PK1	Spiked Blank	Carbon tetrachloride	2012/08/24		138	%	60 - 140
		Chlorobenzene	2012/08/24		108	%	60 - 140
		Chloroform	2012/08/24		120	%	60 - 140
		1,2-dibromoethane	2012/08/24		103	%	60 - 140
		1,2-dichloroethane	2012/08/24		121	%	60 - 140
		Vinyl chloride	2012/08/24		85	%	60 - 140
	Method Blank	1,4-Difluorobenzene (sur.)	2012/08/23		99	%	60 - 140
		4-BROMOFLUOROBENZENE (sur.)	2012/08/23		93	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/23		103	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/23		92	%	60 - 140
		Carbon tetrachloride	2012/08/23	<0.00050		mg/kg	
		Chlorobenzene	2012/08/23	<0.0010		mg/kg	
	RPD	Chloroform	2012/08/23	<0.00080		mg/kg	
		1,2-dibromoethane	2012/08/23	<0.0020		mg/kg	
		1,2-dichloroethane	2012/08/23	<0.0020		mg/kg	
		Vinyl chloride	2012/08/23	<0.00030		mg/kg	
		Carbon tetrachloride	2012/08/23	NC		%	50
		Chlorobenzene	2012/08/23	NC		%	50
		Chloroform	2012/08/23	NC		%	50
		1,2-dibromoethane	2012/08/23	NC		%	50
		1,2-dichloroethane	2012/08/23	NC		%	50
		Vinyl chloride	2012/08/23	NC		%	50
6104876 ARA	Matrix Spike	4-BROMOFLUOROBENZENE (sur.)	2012/08/23		101	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/23		107	%	60 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/23		90	%	60 - 140
		D8-TOLUENE (sur.)	2012/08/23		103	%	60 - 140
		Benzene	2012/08/23		102	%	60 - 140
		Bromodichloromethane	2012/08/23		98	%	60 - 140
		Bromoform	2012/08/23		87	%	60 - 140
		Bromomethane	2012/08/23		89	%	60 - 140
		Chlorodibromomethane	2012/08/23		94	%	60 - 140
		Chloroethane	2012/08/23		95	%	60 - 140
		Chloromethane	2012/08/23		92	%	60 - 140
		1,2-dichlorobenzene	2012/08/23		97	%	60 - 140
		1,3-dichlorobenzene	2012/08/23		102	%	60 - 140
		1,4-dichlorobenzene	2012/08/23		102	%	60 - 140
		1,1-dichloroethane	2012/08/23		106	%	60 - 140
		1,1-dichloroethene	2012/08/23		111	%	60 - 140
		cis-1,2-dichloroethene	2012/08/23		102	%	60 - 140
		trans-1,2-dichloroethene	2012/08/23		108	%	60 - 140
		Dichloromethane	2012/08/23		97	%	60 - 140
		1,2-dichloropropane	2012/08/23		93	%	60 - 140
		cis-1,3-dichloropropene	2012/08/23		80	%	60 - 140
		trans-1,3-dichloropropene	2012/08/23		60	%	60 - 140
		Ethylbenzene	2012/08/23		107	%	60 - 140
		Methyl methacrylate	2012/08/23		80	%	60 - 140
		Methyl-tert-butylether (MTBE)	2012/08/23		91	%	60 - 140
		Styrene	2012/08/23		106	%	60 - 140
		1,1,1,2-tetrachloroethane	2012/08/23		102	%	60 - 140
		1,1,2,2-tetrachloroethane	2012/08/23		82	%	60 - 140
		Tetrachloroethene	2012/08/23		114	%	60 - 140
		Toluene	2012/08/23		102	%	60 - 140
		1,2,3-trichlorobenzene	2012/08/23		97	%	60 - 140
		1,2,4-trichlorobenzene	2012/08/23		98	%	60 - 140
		1,3,5-trichlorobenzene	2012/08/23		105	%	60 - 140

EGE ENGINEERING
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 Client Project #: 0125 046 03 STONY RAPIDS
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6104876 ARA	Matrix Spike	1,1,1-trichloroethane	2012/08/23		113	%	60 - 140
		1,1,2-trichloroethane	2012/08/23		90	%	60 - 140
		Trichloroethene	2012/08/23		107	%	60 - 140
		Trichlorofluoromethane	2012/08/23		111	%	60 - 140
		1,2,4-trimethylbenzene	2012/08/23		112	%	60 - 140
		1,3,5-trimethylbenzene	2012/08/23		116	%	60 - 140
		m & p-Xylene	2012/08/23		102	%	60 - 140
		o-Xylene	2012/08/23		104	%	60 - 140
		4-BROMOFLUOROBENZENE (sur.)	2012/08/23		103	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/23		107	%	60 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/23		93	%	60 - 140
		D8-TOLUENE (sur.)	2012/08/23		102	%	60 - 140
		Benzene	2012/08/23		108	%	60 - 140
		Bromodichloromethane	2012/08/23		104	%	60 - 140
		Bromoform	2012/08/23		94	%	60 - 140
	Spiked Blank	Bromomethane	2012/08/23		90	%	60 - 140
		Chlorodibromomethane	2012/08/23		100	%	60 - 140
		Chloroethane	2012/08/23		100	%	60 - 140
		Chloromethane	2012/08/23		97	%	60 - 140
		1,2-dichlorobenzene	2012/08/23		104	%	60 - 140
		1,3-dichlorobenzene	2012/08/23		111	%	60 - 140
		1,4-dichlorobenzene	2012/08/23		109	%	60 - 140
		1,1-dichloroethane	2012/08/23		111	%	60 - 140
		1,1-dichloroethene	2012/08/23		115	%	60 - 140
		cis-1,2-dichloroethene	2012/08/23		107	%	60 - 140
		trans-1,2-dichloroethene	2012/08/23		115	%	60 - 140
		Dichloromethane	2012/08/23		103	%	60 - 140
		1,2-dichloropropane	2012/08/23		97	%	60 - 140
		cis-1,3-dichloropropene	2012/08/23		80	%	60 - 140
		trans-1,3-dichloropropene	2012/08/23		57 (2)	%	60 - 140
		Ethylbenzene	2012/08/23		110	%	60 - 140
		Methyl methacrylate	2012/08/23		82	%	60 - 140
		Methyl-tert-butylether (MTBE)	2012/08/23		96	%	60 - 140
		Styrene	2012/08/23		106	%	60 - 140
		1,1,1,2-tetrachloroethane	2012/08/23		107	%	60 - 140
		1,1,1,2,2-tetrachloroethane	2012/08/23		90	%	60 - 140
		Tetrachloroethene	2012/08/23		119	%	60 - 140
		Toluene	2012/08/23		108	%	60 - 140
		1,2,3-trichlorobenzene	2012/08/23		111	%	60 - 140
		1,2,4-trichlorobenzene	2012/08/23		110	%	60 - 140
		1,3,5-trichlorobenzene	2012/08/23		113	%	60 - 140
		1,1,1-trichloroethane	2012/08/23		119	%	60 - 140
		1,1,2-trichloroethane	2012/08/23		96	%	60 - 140
		Trichloroethene	2012/08/23		111	%	60 - 140
		Trichlorofluoromethane	2012/08/23		116	%	60 - 140
		1,2,4-trimethylbenzene	2012/08/23		113	%	60 - 140
		1,3,5-trimethylbenzene	2012/08/23		116	%	60 - 140
		m & p-Xylene	2012/08/23		105	%	60 - 140
		o-Xylene	2012/08/23		108	%	60 - 140
	Method Blank	4-BROMOFLUOROBENZENE (sur.)	2012/08/23		96	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2012/08/23		108	%	60 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2012/08/23		87	%	60 - 140
		D8-TOLUENE (sur.)	2012/08/23		101	%	60 - 140
		Benzene	2012/08/23	<0.0050		mg/kg	
		Bromodichloromethane	2012/08/23	<0.030		mg/kg	

EGE ENGINEERING

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QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6104876 ARA	Method Blank	Bromoform	2012/08/23	<0.050		mg/kg	
		Bromomethane	2012/08/23	<0.020		mg/kg	
		Chlorodibromomethane	2012/08/23	<0.020		mg/kg	
		Chloroethane	2012/08/23	<0.020		mg/kg	
		Chloromethane	2012/08/23	<0.030		mg/kg	
		1,2-dichlorobenzene	2012/08/23	<0.020		mg/kg	
		1,3-dichlorobenzene	2012/08/23	<0.020		mg/kg	
		1,4-dichlorobenzene	2012/08/23	<0.020		mg/kg	
		1,1-dichloroethane	2012/08/23	<0.020		mg/kg	
		1,1-dichloroethene	2012/08/23	<0.020		mg/kg	
		cis-1,2-dichloroethene	2012/08/23	<0.020		mg/kg	
		trans-1,2-dichloroethene	2012/08/23	<0.020		mg/kg	
		Dichloromethane	2012/08/23	<0.010		mg/kg	
		1,2-dichloropropane	2012/08/23	<0.020		mg/kg	
		cis-1,3-dichloropropene	2012/08/23	<0.020		mg/kg	
		trans-1,3-dichloropropene	2012/08/23	<0.020		mg/kg	
		Ethylbenzene	2012/08/23	<0.010		mg/kg	
		Methyl methacrylate	2012/08/23	<0.040		mg/kg	
		Methyl-tert-butylether (MTBE)	2012/08/23	<0.030		mg/kg	
		Styrene	2012/08/23	<0.020		mg/kg	
		1,1,1,2-tetrachloroethane	2012/08/23	<0.10		mg/kg	
		1,1,2,2-tetrachloroethane	2012/08/23	<0.10		mg/kg	
		Tetrachloroethene	2012/08/23	<0.020		mg/kg	
		Toluene	2012/08/23	<0.020		mg/kg	
		1,2,3-trichlorobenzene	2012/08/23	<0.040		mg/kg	
		1,2,4-trichlorobenzene	2012/08/23	<0.040		mg/kg	
		1,3,5-trichlorobenzene	2012/08/23	<0.040		mg/kg	
		1,1,1-trichloroethane	2012/08/23	<0.020		mg/kg	
		1,1,2-trichloroethane	2012/08/23	<0.020		mg/kg	
		Trichloroethene	2012/08/23	<0.010		mg/kg	
		Trichlorofluoromethane	2012/08/23	<0.020		mg/kg	
		1,2,4-trimethylbenzene	2012/08/23	<0.50		mg/kg	
		1,3,5-trimethylbenzene	2012/08/23	<0.50		mg/kg	
		Xylenes (Total)	2012/08/23	<0.040		mg/kg	
		m & p-Xylene	2012/08/23	<0.040		mg/kg	
		o-Xylene	2012/08/23	<0.020		mg/kg	
	RPD	Bromodichloromethane	2012/08/23	NC		%	50
		Bromoform	2012/08/23	NC		%	50
		Bromomethane	2012/08/23	NC		%	50
		Chlorodibromomethane	2012/08/23	NC		%	50
		Chloroethane	2012/08/23	NC		%	50
		Chloromethane	2012/08/23	NC		%	50
		1,2-dichlorobenzene	2012/08/23	NC		%	50
		1,3-dichlorobenzene	2012/08/23	NC		%	50
		1,4-dichlorobenzene	2012/08/23	NC		%	50
		1,1-dichloroethane	2012/08/23	NC		%	50
		1,1-dichloroethene	2012/08/23	NC		%	50
		cis-1,2-dichloroethene	2012/08/23	NC		%	50
		trans-1,2-dichloroethene	2012/08/23	NC		%	50
		Dichloromethane	2012/08/23	NC (3)		%	50
		1,2-dichloropropane	2012/08/23	NC		%	50
		cis-1,3-dichloropropene	2012/08/23	NC		%	50
		trans-1,3-dichloropropene	2012/08/23	NC		%	50
		Methyl methacrylate	2012/08/23	NC		%	50
		Methyl-tert-butylether (MTBE)	2012/08/23	NC		%	50

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6104876 ARA	RPD	Styrene	2012/08/23	NC		%	50
		1,1,1,2-tetrachloroethane	2012/08/23	NC		%	50
		1,1,2,2-tetrachloroethane	2012/08/23	NC		%	50
		Tetrachloroethene	2012/08/23	NC		%	50
		1,2,3-trichlorobenzene	2012/08/23	NC		%	50
		1,2,4-trichlorobenzene	2012/08/23	NC		%	50
		1,3,5-trichlorobenzene	2012/08/23	NC		%	50
		1,1,1-trichloroethane	2012/08/23	NC		%	50
		1,1,2-trichloroethane	2012/08/23	NC		%	50
		Trichloroethene	2012/08/23	NC		%	50
		Trichlorofluoromethane	2012/08/23	NC		%	50
		1,2,4-trimethylbenzene	2012/08/23	NC		%	50
		1,3,5-trimethylbenzene	2012/08/23	NC		%	50
6105337 VP4	Matrix Spike [EF6249-01]	D10-ANTHRACENE (sur.)	2012/08/22		87	%	50 - 130
		D12-BENZO(A)PYRENE (sur.)	2012/08/22		67	%	50 - 130
		D8-ACENAPHTHYLENE (sur.)	2012/08/22		90	%	50 - 130
		TERPHENYL-D14 (sur.)	2012/08/22		100	%	50 - 130
		Acenaphthene	2012/08/22		93	%	50 - 130
		Acenaphthylene	2012/08/22		94	%	50 - 130
		Acridine	2012/08/22		75	%	50 - 130
		Anthracene	2012/08/22		93	%	50 - 130
		Benzo(a)anthracene	2012/08/22		95	%	50 - 130
		Benzo(b&j)fluoranthene	2012/08/22		72	%	50 - 130
		Benzo(k)fluoranthene	2012/08/22		75	%	50 - 130
		Benzo(g,h,i)perylene	2012/08/22		81	%	50 - 130
		Benzo(c)phenanthrene	2012/08/22		87	%	50 - 130
		Benzo(a)pyrene	2012/08/22		68	%	50 - 130
		Benzo[e]pyrene	2012/08/22		62	%	50 - 130
	Spiked Blank	Chrysene	2012/08/22		87	%	50 - 130
		Dibenz(a,h)anthracene	2012/08/22		92	%	50 - 130
		Fluoranthene	2012/08/22		97	%	50 - 130
		Fluorene	2012/08/22		96	%	50 - 130
		Indeno(1,2,3-cd)pyrene	2012/08/22		88	%	50 - 130
		2-Methylnaphthalene	2012/08/22		100	%	50 - 130
		Naphthalene	2012/08/22		91	%	50 - 130
		Phenanthrene	2012/08/22		93	%	50 - 130
		Perylene	2012/08/22		81	%	50 - 130
		Pyrene	2012/08/22		104	%	50 - 130
		Quinoline	2012/08/22		83	%	50 - 130
		D10-ANTHRACENE (sur.)	2012/08/22		91	%	50 - 130
		D12-BENZO(A)PYRENE (sur.)	2012/08/22		70	%	50 - 130
		D8-ACENAPHTHYLENE (sur.)	2012/08/22		99	%	50 - 130
		TERPHENYL-D14 (sur.)	2012/08/22		89	%	50 - 130
		Acenaphthene	2012/08/22		95	%	50 - 130
		Acenaphthylene	2012/08/22		101	%	50 - 130
		Acridine	2012/08/22		76	%	50 - 130
		Anthracene	2012/08/22		93	%	50 - 130
		Benzo(a)anthracene	2012/08/22		84	%	50 - 130
		Benzo(b&j)fluoranthene	2012/08/22		70	%	50 - 130
		Benzo(k)fluoranthene	2012/08/22		82	%	50 - 130
		Benzo(g,h,i)perylene	2012/08/22		88	%	50 - 130
		Benzo(c)phenanthrene	2012/08/22		80	%	50 - 130
		Benzo(a)pyrene	2012/08/22		69	%	50 - 130
		Benzo[e]pyrene	2012/08/22		63	%	50 - 130

EGE ENGINEERING
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Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6105337 VP4	Spiked Blank	Chrysene	2012/08/22		79	%	50 - 130
		Dibenz(a,h)anthracene	2012/08/22		95	%	50 - 130
		Fluoranthene	2012/08/22		88	%	50 - 130
		Fluorene	2012/08/22		90	%	50 - 130
		Indeno(1,2,3-cd)pyrene	2012/08/22		92	%	50 - 130
		2-Methylnaphthalene	2012/08/22		101	%	50 - 130
		Naphthalene	2012/08/22		92	%	50 - 130
		Phenanthrene	2012/08/22		94	%	50 - 130
		Perylene	2012/08/22		88	%	50 - 130
		Pyrene	2012/08/22		78	%	50 - 130
	Method Blank	Quinoline	2012/08/22		90	%	50 - 130
		D10-ANTHRACENE (sur.)	2012/08/22		93	%	50 - 130
		D12-BENZO(A)PYRENE (sur.)	2012/08/22		80	%	50 - 130
		D8-ACENAPHTHYLENE (sur.)	2012/08/22		99	%	50 - 130
		TERPHENYL-D14 (sur.)	2012/08/22		102	%	50 - 130
		Acenaphthene	2012/08/22	<0.0050		mg/kg	
		Acenaphthylene	2012/08/22	<0.0050		mg/kg	
		Acridine	2012/08/22	<0.010		mg/kg	
		Anthracene	2012/08/22	<0.0040		mg/kg	
		Benzo(a)anthracene	2012/08/22	<0.0050		mg/kg	
	RPD [EF6249-01]	Benzo(b&j)fluoranthene	2012/08/22	<0.0050		mg/kg	
		Benzo(k)fluoranthene	2012/08/22	<0.0050		mg/kg	
		Benzo(g,h,i)perylene	2012/08/22	<0.0050		mg/kg	
		Benzo(c)phenanthrene	2012/08/22	<0.0050		mg/kg	
		Benzo(a)pyrene	2012/08/22	<0.0050		mg/kg	
		Benzo[e]pyrene	2012/08/22	<0.0050		mg/kg	
		Chrysene	2012/08/22	<0.0050		mg/kg	
		Dibenz(a,h)anthracene	2012/08/22	<0.0050		mg/kg	
		Fluoranthene	2012/08/22	<0.0050		mg/kg	
		Fluorene	2012/08/22	<0.0050		mg/kg	
		Indeno(1,2,3-cd)pyrene	2012/08/22	<0.0050		mg/kg	
		2-Methylnaphthalene	2012/08/22	<0.0050		mg/kg	
		Naphthalene	2012/08/22	<0.0050		mg/kg	
		Phenanthrene	2012/08/22	<0.0050		mg/kg	
		Perylene	2012/08/22	<0.0050		mg/kg	
		Pyrene	2012/08/22	<0.0050		mg/kg	
		Quinoline	2012/08/22	<0.010		mg/kg	
		Acenaphthene	2012/08/22	NC		%	50
		Acenaphthylene	2012/08/22	NC		%	50
		Acridine	2012/08/22	NC		%	50
		Anthracene	2012/08/22	NC		%	50
		Benzo(a)anthracene	2012/08/22	NC		%	50
		Benzo(b&j)fluoranthene	2012/08/22	NC		%	50
		Benzo(k)fluoranthene	2012/08/22	NC		%	50
		Benzo(g,h,i)perylene	2012/08/22	NC		%	50
		Benzo(c)phenanthrene	2012/08/22	NC		%	50
		Benzo(a)pyrene	2012/08/22	NC		%	50
		Benzo[e]pyrene	2012/08/22	NC		%	50
		Chrysene	2012/08/22	NC		%	50
		Dibenz(a,h)anthracene	2012/08/22	NC		%	50
		Fluoranthene	2012/08/22	NC		%	50
		Fluorene	2012/08/22	NC		%	50
		Indeno(1,2,3-cd)pyrene	2012/08/22	NC		%	50
		2-Methylnaphthalene	2012/08/22	3.9		%	50
		Naphthalene	2012/08/22	1.7		%	50

EGE ENGINEERING
 Attention: PETER BOHONOS
 Client Project #: 0125 046 03 STONY RAPIDS
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Quality Assurance Report (Continued)

Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6105337 VP4	RPD [EF6249-01]	Phenanthrene	2012/08/22	NC		%	50
		Perylene	2012/08/22	NC		%	50
		Pyrene	2012/08/22	1.3		%	50
		Quinoline	2012/08/22	NC		%	50
6105352 LQ	Matrix Spike [EF6249-01]	O-TERPHENYL (sur.)	2012/08/22		95	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2012/08/22		95	%	50 - 130
		F3 (C16-C34 Hydrocarbons)	2012/08/22		101	%	50 - 130
		F4 (C34-C50 Hydrocarbons)	2012/08/22		105	%	50 - 130
	Spiked Blank	O-TERPHENYL (sur.)	2012/08/22		93	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2012/08/22		96	%	70 - 130
		F3 (C16-C34 Hydrocarbons)	2012/08/22		104	%	70 - 130
		F4 (C34-C50 Hydrocarbons)	2012/08/22		105	%	70 - 130
	Method Blank	O-TERPHENYL (sur.)	2012/08/22		95	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2012/08/22	<10		mg/kg	
		F3 (C16-C34 Hydrocarbons)	2012/08/22	<10		mg/kg	
		F4 (C34-C50 Hydrocarbons)	2012/08/22	<10		mg/kg	
	RPD [EF6249-01]	F2 (C10-C16 Hydrocarbons)	2012/08/22	NC		%	50
		F3 (C16-C34 Hydrocarbons)	2012/08/22	3.0		%	50
		F4 (C34-C50 Hydrocarbons)	2012/08/22	NC		%	50
6105397 MP7	Spiked Blank	F4G-SG (Heavy Hydrocarbons-Grav.)	2012/08/23		118	%	70 - 130
	Method Blank	F4G-SG (Heavy Hydrocarbons-Grav.)	2012/08/23	<500		mg/kg	
6106281 TDB	Matrix Spike	Total Antimony (Sb)	2012/08/23		87	%	75 - 125
		Total Arsenic (As)	2012/08/23		98	%	75 - 125
		Total Barium (Ba)	2012/08/23		NC	%	75 - 125
		Total Beryllium (Be)	2012/08/23		97	%	75 - 125
		Total Cadmium (Cd)	2012/08/23		96	%	75 - 125
		Total Chromium (Cr)	2012/08/23		97	%	75 - 125
		Total Cobalt (Co)	2012/08/23		95	%	75 - 125
		Total Copper (Cu)	2012/08/23		101	%	75 - 125
		Total Lead (Pb)	2012/08/23		94	%	75 - 125
		Total Mercury (Hg)	2012/08/23		102	%	75 - 125
		Total Molybdenum (Mo)	2012/08/23		96	%	75 - 125
		Total Nickel (Ni)	2012/08/23		NC	%	75 - 125
		Total Selenium (Se)	2012/08/23		98	%	75 - 125
		Total Silver (Ag)	2012/08/23		97	%	75 - 125
		Total Thallium (Tl)	2012/08/23		90	%	75 - 125
		Total Tin (Sn)	2012/08/23		100	%	75 - 125
		Total Uranium (U)	2012/08/23		92	%	75 - 125
		Total Vanadium (V)	2012/08/23		101	%	75 - 125
		Total Zinc (Zn)	2012/08/23		NC	%	75 - 125
	QC Standard	Total Arsenic (As)	2012/08/22		121	%	50 - 150
		Total Barium (Ba)	2012/08/22		108	%	69 - 131
		Total Chromium (Cr)	2012/08/22		100	%	41 - 159
		Total Cobalt (Co)	2012/08/22		100	%	75 - 125
		Total Copper (Cu)	2012/08/22		98	%	72 - 127
		Total Lead (Pb)	2012/08/22		102	%	54 - 146
		Total Nickel (Ni)	2012/08/22		105	%	61 - 139
		Total Vanadium (V)	2012/08/22		118	%	50 - 150
		Total Zinc (Zn)	2012/08/22		105	%	72 - 128
	Spiked Blank	Total Antimony (Sb)	2012/08/22		99	%	75 - 125
		Total Arsenic (As)	2012/08/22		98	%	75 - 125
		Total Barium (Ba)	2012/08/22		93	%	75 - 125
		Total Beryllium (Be)	2012/08/22		91	%	75 - 125
		Total Cadmium (Cd)	2012/08/22		98	%	75 - 125

EGE ENGINEERING

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Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6106281 TDB	Spiked Blank	Total Chromium (Cr)	2012/08/22		91	%	75 - 125
		Total Cobalt (Co)	2012/08/22		90	%	75 - 125
		Total Copper (Cu)	2012/08/22		92	%	75 - 125
		Total Lead (Pb)	2012/08/22		92	%	75 - 125
		Total Mercury (Hg)	2012/08/22		103	%	75 - 125
		Total Molybdenum (Mo)	2012/08/22		93	%	75 - 125
		Total Nickel (Ni)	2012/08/22		92	%	75 - 125
		Total Selenium (Se)	2012/08/22		103	%	75 - 125
		Total Silver (Ag)	2012/08/22		96	%	75 - 125
		Total Thallium (Tl)	2012/08/22		88	%	75 - 125
		Total Tin (Sn)	2012/08/22		96	%	75 - 125
		Total Uranium (U)	2012/08/22		95	%	75 - 125
		Total Vanadium (V)	2012/08/22		93	%	75 - 125
		Total Zinc (Zn)	2012/08/22		101	%	75 - 125
	Method Blank	Total Antimony (Sb)	2012/08/22	<1.0		mg/kg	
		Total Arsenic (As)	2012/08/22	<1.0		mg/kg	
		Total Barium (Ba)	2012/08/22	<10		mg/kg	
		Total Beryllium (Be)	2012/08/22	<0.40		mg/kg	
		Total Cadmium (Cd)	2012/08/22	<0.10		mg/kg	
		Total Chromium (Cr)	2012/08/22	<1.0		mg/kg	
		Total Cobalt (Co)	2012/08/22	<1.0		mg/kg	
		Total Copper (Cu)	2012/08/22	<5.0		mg/kg	
		Total Lead (Pb)	2012/08/22	<1.0		mg/kg	
		Total Mercury (Hg)	2012/08/22	<0.050		mg/kg	
		Total Molybdenum (Mo)	2012/08/22	<0.40		mg/kg	
		Total Nickel (Ni)	2012/08/22	<1.0		mg/kg	
		Total Selenium (Se)	2012/08/22	<0.50		mg/kg	
		Total Silver (Ag)	2012/08/22	<1.0		mg/kg	
		Total Thallium (Tl)	2012/08/22	<0.30		mg/kg	
		Total Tin (Sn)	2012/08/22	<1.0		mg/kg	
		Total Uranium (U)	2012/08/22	<1.0		mg/kg	
		Total Vanadium (V)	2012/08/22	<1.0		mg/kg	
		Total Zinc (Zn)	2012/08/22	<10		mg/kg	
	RPD	Total Antimony (Sb)	2012/08/22	NC		%	35
		Total Arsenic (As)	2012/08/22	3.0		%	35
		Total Barium (Ba)	2012/08/22	NC		%	35
		Total Beryllium (Be)	2012/08/22	NC		%	35
		Total Cadmium (Cd)	2012/08/22	NC		%	35
		Total Chromium (Cr)	2012/08/22	6.5		%	35
		Total Cobalt (Co)	2012/08/22	11.4		%	35
		Total Copper (Cu)	2012/08/22	NC		%	35
		Total Lead (Pb)	2012/08/22	2.1		%	35
		Total Mercury (Hg)	2012/08/22	NC		%	35
		Total Molybdenum (Mo)	2012/08/22	NC		%	35
		Total Nickel (Ni)	2012/08/22	7.8		%	35
		Total Selenium (Se)	2012/08/22	NC		%	35
		Total Silver (Ag)	2012/08/22	NC		%	35
		Total Thallium (Tl)	2012/08/22	NC		%	35
		Total Tin (Sn)	2012/08/22	NC		%	35
		Total Uranium (U)	2012/08/22	NC		%	35
		Total Vanadium (V)	2012/08/22	3.4		%	35
		Total Zinc (Zn)	2012/08/22	0.4		%	35
6106282 TDB	Matrix Spike	Total Antimony (Sb)	2012/08/23		85	%	75 - 125
		Total Arsenic (As)	2012/08/23		91	%	75 - 125
		Total Barium (Ba)	2012/08/23		NC	%	75 - 125

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Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6106282 TDB	Matrix Spike	Total Beryllium (Be)	2012/08/23		90	%	75 - 125
		Total Cadmium (Cd)	2012/08/23		88	%	75 - 125
		Total Chromium (Cr)	2012/08/23		89	%	75 - 125
		Total Cobalt (Co)	2012/08/23		85	%	75 - 125
		Total Copper (Cu)	2012/08/23		81	%	75 - 125
		Total Lead (Pb)	2012/08/23		84	%	75 - 125
		Total Mercury (Hg)	2012/08/23		88	%	75 - 125
		Total Molybdenum (Mo)	2012/08/23		88	%	75 - 125
		Total Nickel (Ni)	2012/08/23		87	%	75 - 125
		Total Selenium (Se)	2012/08/23		92	%	75 - 125
		Total Silver (Ag)	2012/08/23		87	%	75 - 125
		Total Thallium (Tl)	2012/08/23		81	%	75 - 125
		Total Tin (Sn)	2012/08/23		91	%	75 - 125
		Total Uranium (U)	2012/08/23		86	%	75 - 125
		Total Vanadium (V)	2012/08/23		95	%	75 - 125
	QC Standard	Total Zinc (Zn)	2012/08/23		NC	%	75 - 125
		Total Arsenic (As)	2012/08/23		114	%	50 - 150
		Total Barium (Ba)	2012/08/23		102	%	69 - 131
		Total Chromium (Cr)	2012/08/23		98	%	41 - 159
		Total Cobalt (Co)	2012/08/23		100	%	75 - 125
		Total Copper (Cu)	2012/08/23		95	%	72 - 127
		Total Lead (Pb)	2012/08/23		99	%	54 - 146
		Total Nickel (Ni)	2012/08/23		105	%	61 - 139
		Total Vanadium (V)	2012/08/23		115	%	50 - 150
		Total Zinc (Zn)	2012/08/23		100	%	72 - 128
	Spiked Blank	Total Antimony (Sb)	2012/08/23		99	%	75 - 125
		Total Arsenic (As)	2012/08/23		100	%	75 - 125
		Total Barium (Ba)	2012/08/23		94	%	75 - 125
		Total Beryllium (Be)	2012/08/23		97	%	75 - 125
		Total Cadmium (Cd)	2012/08/23		99	%	75 - 125
		Total Chromium (Cr)	2012/08/23		93	%	75 - 125
		Total Cobalt (Co)	2012/08/23		93	%	75 - 125
		Total Copper (Cu)	2012/08/23		96	%	75 - 125
		Total Lead (Pb)	2012/08/23		95	%	75 - 125
		Total Mercury (Hg)	2012/08/23		100	%	75 - 125
		Total Molybdenum (Mo)	2012/08/23		94	%	75 - 125
		Total Nickel (Ni)	2012/08/23		95	%	75 - 125
		Total Selenium (Se)	2012/08/23		106	%	75 - 125
		Total Silver (Ag)	2012/08/23		98	%	75 - 125
		Total Thallium (Tl)	2012/08/23		91	%	75 - 125
		Total Tin (Sn)	2012/08/23		98	%	75 - 125
		Total Uranium (U)	2012/08/23		98	%	75 - 125
		Total Vanadium (V)	2012/08/23		96	%	75 - 125
		Total Zinc (Zn)	2012/08/23		102	%	75 - 125
	Method Blank	Total Antimony (Sb)	2012/08/23	<1.0		mg/kg	
		Total Arsenic (As)	2012/08/23	<1.0		mg/kg	
		Total Barium (Ba)	2012/08/23	<1.0		mg/kg	
		Total Beryllium (Be)	2012/08/23	<0.40		mg/kg	
		Total Cadmium (Cd)	2012/08/23	<0.10		mg/kg	
		Total Chromium (Cr)	2012/08/23	1.2, RDL=1.0		mg/kg	
		Total Cobalt (Co)	2012/08/23	<1.0		mg/kg	
		Total Copper (Cu)	2012/08/23	<5.0		mg/kg	
		Total Lead (Pb)	2012/08/23	<1.0		mg/kg	
		Total Mercury (Hg)	2012/08/23	<0.050		mg/kg	
		Total Molybdenum (Mo)	2012/08/23	<0.40		mg/kg	

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QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6106282 TDB	Method Blank	Total Nickel (Ni)	2012/08/23	<1.0		mg/kg	
		Total Selenium (Se)	2012/08/23	<0.50		mg/kg	
		Total Silver (Ag)	2012/08/23	<1.0		mg/kg	
	RPD	Total Thallium (Tl)	2012/08/23	<0.30		mg/kg	
		Total Tin (Sn)	2012/08/23	<1.0		mg/kg	
		Total Uranium (U)	2012/08/23	<1.0		mg/kg	
		Total Vanadium (V)	2012/08/23	<1.0		mg/kg	
		Total Zinc (Zn)	2012/08/23	<10		mg/kg	
		Total Antimony (Sb)	2012/08/23	NC		%	35
		Total Arsenic (As)	2012/08/23	NC		%	35
		Total Barium (Ba)	2012/08/23	8.8		%	35
		Total Beryllium (Be)	2012/08/23	NC		%	35
		Total Cadmium (Cd)	2012/08/23	NC		%	35
		Total Chromium (Cr)	2012/08/23	3.5		%	35
		Total Cobalt (Co)	2012/08/23	NC		%	35
		Total Copper (Cu)	2012/08/23	NC		%	35
		Total Lead (Pb)	2012/08/23	8.9		%	35
		Total Mercury (Hg)	2012/08/23	NC		%	35
		Total Molybdenum (Mo)	2012/08/23	NC		%	35
		Total Nickel (Ni)	2012/08/23	8.5		%	35
		Total Selenium (Se)	2012/08/23	NC		%	35
		Total Silver (Ag)	2012/08/23	NC		%	35
		Total Thallium (Tl)	2012/08/23	NC		%	35
		Total Tin (Sn)	2012/08/23	NC		%	35
		Total Uranium (U)	2012/08/23	NC		%	35
		Total Vanadium (V)	2012/08/23	2.3		%	35
		Total Zinc (Zn)	2012/08/23	NC		%	35
6106443 SJ1	Matrix Spike	D10-ANTHRACENE (sur.)	2012/08/23		86	%	50 - 130
		D12-BENZO(A)PYRENE (sur.)	2012/08/23		88	%	50 - 130
		D8-ACENAPHTHYLENE (sur.)	2012/08/23		96	%	50 - 130
	Spiked Blank	TERPHENYL-D14 (sur.)	2012/08/23		101	%	50 - 130
		Acenaphthene	2012/08/23		95	%	50 - 130
		Acenaphthylene	2012/08/23		100	%	50 - 130
		Acridine	2012/08/23		75	%	50 - 130
		Anthracene	2012/08/23		93	%	50 - 130
		Benzo(a)anthracene	2012/08/23		100	%	50 - 130
		Benzo(b&j)fluoranthene	2012/08/23		97	%	50 - 130
		Benzo(k)fluoranthene	2012/08/23		114	%	50 - 130
		Benzo(g,h,i)perylene	2012/08/23		93	%	50 - 130
		Benzo(c)phenanthrene	2012/08/23		90	%	50 - 130
		Benzo(a)pyrene	2012/08/23		93	%	50 - 130
		Benzo[e]pyrene	2012/08/23		87	%	50 - 130
		Chrysene	2012/08/23		94	%	50 - 130
		Dibenz(a,h)anthracene	2012/08/23		103	%	50 - 130
		Fluoranthene	2012/08/23		100	%	50 - 130
		Fluorene	2012/08/23		99	%	50 - 130
		Indeno(1,2,3-cd)pyrene	2012/08/23		98	%	50 - 130
		2-Methylnaphthalene	2012/08/23		100	%	50 - 130
		Naphthalene	2012/08/23		90	%	50 - 130
		Phenanthrene	2012/08/23		96	%	50 - 130
		Perylene	2012/08/23		86	%	50 - 130
		Pyrene	2012/08/23		102	%	50 - 130
		Quinoline	2012/08/23		97	%	50 - 130
		D10-ANTHRACENE (sur.)	2012/08/23		85	%	50 - 130
		D12-BENZO(A)PYRENE (sur.)	2012/08/23		91	%	50 - 130

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QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6106443 SJ1	Spiked Blank	D8-ACENAPHTHYLENE (sur.)	2012/08/23		93	%	50 - 130
		TERPHENYL-D14 (sur.)	2012/08/23		99	%	50 - 130
		Acenaphthene	2012/08/23		90	%	50 - 130
		Acenaphthylene	2012/08/23		94	%	50 - 130
		Acridine	2012/08/23		73	%	50 - 130
		Anthracene	2012/08/23		87	%	50 - 130
		Benzo(a)anthracene	2012/08/23		96	%	50 - 130
		Benzo(b&j)fluoranthene	2012/08/23		94	%	50 - 130
		Benzo(k)fluoranthene	2012/08/23		96	%	50 - 130
		Benzo(g,h,i)perylene	2012/08/23		96	%	50 - 130
		Benzo(c)phenanthrene	2012/08/23		89	%	50 - 130
		Benzo(a)pyrene	2012/08/23		91	%	50 - 130
		Benzo[e]pyrene	2012/08/23		87	%	50 - 130
		Chrysene	2012/08/23		92	%	50 - 130
		Dibenz(a,h)anthracene	2012/08/23		98	%	50 - 130
		Fluoranthene	2012/08/23		96	%	50 - 130
		Fluorene	2012/08/23		88	%	50 - 130
		Indeno(1,2,3-cd)pyrene	2012/08/23		96	%	50 - 130
		2-Methylnaphthalene	2012/08/23		95	%	50 - 130
		Naphthalene	2012/08/23		85	%	50 - 130
	Method Blank	Phenanthrene	2012/08/23		91	%	50 - 130
		Perylene	2012/08/23		87	%	50 - 130
		Pyrene	2012/08/23		94	%	50 - 130
		Quinoline	2012/08/23		93	%	50 - 130
		D10-ANTHRACENE (sur.)	2012/08/23		88	%	50 - 130
		D12-BENZO(A)PYRENE (sur.)	2012/08/23		87	%	50 - 130
		D8-ACENAPHTHYLENE (sur.)	2012/08/23		93	%	50 - 130
		TERPHENYL-D14 (sur.)	2012/08/23		97	%	50 - 130
		Acenaphthene	2012/08/23	<0.0050		mg/kg	
		Acenaphthylene	2012/08/23	<0.0050		mg/kg	
		Acridine	2012/08/23	<0.010		mg/kg	
		Anthracene	2012/08/23	<0.0040		mg/kg	
		Benzo(a)anthracene	2012/08/23	<0.0050		mg/kg	
		Benzo(b&j)fluoranthene	2012/08/23	<0.0050		mg/kg	
		Benzo(k)fluoranthene	2012/08/23	<0.0050		mg/kg	
		Benzo(g,h,i)perylene	2012/08/23	<0.0050		mg/kg	
		Benzo(c)phenanthrene	2012/08/23	<0.0050		mg/kg	
		Benzo(a)pyrene	2012/08/23	<0.0050		mg/kg	
		Benzo[e]pyrene	2012/08/23	<0.0050		mg/kg	
		Chrysene	2012/08/23	<0.0050		mg/kg	
		Dibenz(a,h)anthracene	2012/08/23	<0.0050		mg/kg	
		Fluoranthene	2012/08/23	<0.0050		mg/kg	
		Fluorene	2012/08/23	<0.0050		mg/kg	
		Indeno(1,2,3-cd)pyrene	2012/08/23	<0.0050		mg/kg	
		2-Methylnaphthalene	2012/08/23	<0.0050		mg/kg	
		Naphthalene	2012/08/23	<0.0050		mg/kg	
		Phenanthrene	2012/08/23	<0.0050		mg/kg	
		Perylene	2012/08/23	<0.0050		mg/kg	
		Pyrene	2012/08/23	<0.0050		mg/kg	
		Quinoline	2012/08/23	<0.010		mg/kg	
RPD		Acenaphthene	2012/08/23	NC		%	50
		Acenaphthylene	2012/08/23	NC		%	50
		Acridine	2012/08/23	NC		%	50
		Anthracene	2012/08/23	NC		%	50
		Benzo(a)anthracene	2012/08/23	NC		%	50

EGE ENGINEERING
 Attention: PETER BOHONOS
 Client Project #: 0125 046 03 STONY RAPIDS
 P.O. #: R.058406.002
 Site Location: RCMP

Quality Assurance Report (Continued)

Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6106443 SJ1	RPD	Benzo(b&j)fluoranthene	2012/08/23	NC		%	50
		Benzo(k)fluoranthene	2012/08/23	NC		%	50
		Benzo(g,h,i)perylene	2012/08/23	NC		%	50
		Benzo(c)phenanthrene	2012/08/23	NC		%	50
		Benzo(a)pyrene	2012/08/23	NC		%	50
		Benzo[e]pyrene	2012/08/23	NC		%	50
		Chrysene	2012/08/23	NC		%	50
		Dibenz(a,h)anthracene	2012/08/23	NC		%	50
		Fluoranthene	2012/08/23	NC		%	50
		Fluorene	2012/08/23	NC		%	50
		Indeno(1,2,3-cd)pyrene	2012/08/23	NC		%	50
		2-Methylnaphthalene	2012/08/23	NC		%	50
		Naphthalene	2012/08/23	NC		%	50
		Phenanthrene	2012/08/23	NC		%	50
		Perylene	2012/08/23	15.3		%	50
		Pyrene	2012/08/23	NC		%	50
		Quinoline	2012/08/23	NC		%	50
6106891 AHE	Matrix Spike Spiked Blank Method Blank RPD	Hex. Chromium (Cr 6+)	2012/08/22		93	%	75 - 125
		Hex. Chromium (Cr 6+)	2012/08/22		94	%	75 - 125
		Hex. Chromium (Cr 6+)	2012/08/22	<0.15		mg/kg	
		Hex. Chromium (Cr 6+)	2012/08/22	NC		%	35
6108075 PK0	Matrix Spike Spiked Blank Method Blank RPD	Soluble (Hot water) Boron (B)	2012/08/23		95	%	75 - 125
		Soluble (Hot water) Boron (B)	2012/08/23		99	%	75 - 125
		Soluble (Hot water) Boron (B)	2012/08/23	<0.10		mg/kg	
		Soluble (Hot water) Boron (B)	2012/08/23	1.6		%	35
6108132 YU	QC Standard RPD	Sieve - Pan	2012/08/23		101	%	97 - 103
		Sieve - #200 (>0.075mm)	2012/08/23		98	%	92 - 108
		Sieve - Pan	2012/08/23	3.6		%	35
		Sieve - #200 (>0.075mm)	2012/08/23	0.4		%	35
6108242 AVP	Matrix Spike Spiked Blank Method Blank RPD	Hex. Chromium (Cr 6+)	2012/08/23		NC	%	75 - 125
		Hex. Chromium (Cr 6+)	2012/08/23		90	%	75 - 125
		Hex. Chromium (Cr 6+)	2012/08/23	<0.15		mg/kg	
		Hex. Chromium (Cr 6+)	2012/08/23	NC		%	35
6109984 TDB	Matrix Spike	Total Antimony (Sb)	2012/08/23		86	%	75 - 125
		Total Arsenic (As)	2012/08/23		93	%	75 - 125
		Total Barium (Ba)	2012/08/23		NC	%	75 - 125
		Total Beryllium (Be)	2012/08/23		95	%	75 - 125
		Total Cadmium (Cd)	2012/08/23		92	%	75 - 125
		Total Chromium (Cr)	2012/08/23		92	%	75 - 125
		Total Cobalt (Co)	2012/08/23		93	%	75 - 125
		Total Copper (Cu)	2012/08/23		93	%	75 - 125
		Total Lead (Pb)	2012/08/23		91	%	75 - 125
		Total Mercury (Hg)	2012/08/23		99	%	75 - 125
		Total Molybdenum (Mo)	2012/08/23		95	%	75 - 125
		Total Nickel (Ni)	2012/08/23		NC	%	75 - 125
		Total Selenium (Se)	2012/08/23		94	%	75 - 125
		Total Silver (Ag)	2012/08/23		96	%	75 - 125
		Total Thallium (Tl)	2012/08/23		86	%	75 - 125
		Total Tin (Sn)	2012/08/23		100	%	75 - 125
		Total Uranium (U)	2012/08/23		92	%	75 - 125
		Total Vanadium (V)	2012/08/23		106	%	75 - 125
		Total Zinc (Zn)	2012/08/23		NC	%	75 - 125
	QC Standard	Total Arsenic (As)	2012/08/23		114	%	50 - 150
		Total Barium (Ba)	2012/08/23		111	%	69 - 131
		Total Chromium (Cr)	2012/08/23		105	%	41 - 159

EGE ENGINEERING
 Attention: PETER BOHONOS
 Client Project #: 0125 046 03 STONY RAPIDS
 P.O. #: R.058406.002
 Site Location: RCMP

Quality Assurance Report (Continued)

Maxxam Job Number: CB273271

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6109984 TDB	QC Standard	Total Cobalt (Co)	2012/08/23		101	%	75 - 125
		Total Copper (Cu)	2012/08/23		100	%	72 - 127
		Total Lead (Pb)	2012/08/23		103	%	54 - 146
		Total Nickel (Ni)	2012/08/23		109	%	61 - 139
		Total Vanadium (V)	2012/08/23		122	%	50 - 150
	Spiked Blank	Total Zinc (Zn)	2012/08/23		100	%	72 - 128
		Total Antimony (Sb)	2012/08/23		91	%	75 - 125
		Total Arsenic (As)	2012/08/23		96	%	75 - 125
		Total Barium (Ba)	2012/08/23		95	%	75 - 125
		Total Beryllium (Be)	2012/08/23		95	%	75 - 125
		Total Cadmium (Cd)	2012/08/23		92	%	75 - 125
		Total Chromium (Cr)	2012/08/23		95	%	75 - 125
		Total Cobalt (Co)	2012/08/23		96	%	75 - 125
		Total Copper (Cu)	2012/08/23		96	%	75 - 125
		Total Lead (Pb)	2012/08/23		94	%	75 - 125
		Total Mercury (Hg)	2012/08/23		103	%	75 - 125
		Total Molybdenum (Mo)	2012/08/23		94	%	75 - 125
		Total Nickel (Ni)	2012/08/23		97	%	75 - 125
		Total Selenium (Se)	2012/08/23		97	%	75 - 125
		Total Silver (Ag)	2012/08/23		97	%	75 - 125
		Total Thallium (Tl)	2012/08/23		92	%	75 - 125
		Total Tin (Sn)	2012/08/23		97	%	75 - 125
		Total Uranium (U)	2012/08/23		98	%	75 - 125
		Total Vanadium (V)	2012/08/23		98	%	75 - 125
		Total Zinc (Zn)	2012/08/23		94	%	75 - 125
	Method Blank	Total Antimony (Sb)	2012/08/23	<1.0		mg/kg	
		Total Arsenic (As)	2012/08/23	<1.0		mg/kg	
		Total Barium (Ba)	2012/08/23	<10		mg/kg	
		Total Beryllium (Be)	2012/08/23	<0.40		mg/kg	
		Total Cadmium (Cd)	2012/08/23	<0.10		mg/kg	
		Total Chromium (Cr)	2012/08/23	<1.0		mg/kg	
		Total Cobalt (Co)	2012/08/23	<1.0		mg/kg	
		Total Copper (Cu)	2012/08/23	<5.0		mg/kg	
		Total Lead (Pb)	2012/08/23	<1.0		mg/kg	
		Total Mercury (Hg)	2012/08/23	<0.050		mg/kg	
		Total Molybdenum (Mo)	2012/08/23	<0.40		mg/kg	
		Total Nickel (Ni)	2012/08/23	<1.0		mg/kg	
		Total Selenium (Se)	2012/08/23	<0.50		mg/kg	
		Total Silver (Ag)	2012/08/23	<1.0		mg/kg	
		Total Thallium (Tl)	2012/08/23	<0.30		mg/kg	
		Total Tin (Sn)	2012/08/23	<1.0		mg/kg	
		Total Uranium (U)	2012/08/23	<1.0		mg/kg	
		Total Vanadium (V)	2012/08/23	<1.0		mg/kg	
		Total Zinc (Zn)	2012/08/23	<10		mg/kg	
	RPD	Total Antimony (Sb)	2012/08/23	NC		%	35
		Total Arsenic (As)	2012/08/23	1.6		%	35
		Total Barium (Ba)	2012/08/23	NC		%	35
		Total Beryllium (Be)	2012/08/23	NC		%	35
		Total Cadmium (Cd)	2012/08/23	NC		%	35
		Total Chromium (Cr)	2012/08/23	30.6		%	35
		Total Cobalt (Co)	2012/08/23	1.7		%	35
		Total Copper (Cu)	2012/08/23	NC		%	35
		Total Lead (Pb)	2012/08/23	3.2		%	35
		Total Mercury (Hg)	2012/08/23	NC		%	35
		Total Molybdenum (Mo)	2012/08/23	NC		%	35

EGE ENGINEERING
 Attention: PETER BOHONOS
 Client Project #: 0125 046 03 STONY RAPIDS
 P.O. #: R.058406.002
 Site Location: RCMP

Quality Assurance Report (Continued)

Maxxam Job Number: CB273271

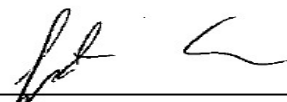
QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	UNITS	QC Limits
6109984 TDB	RPD	Total Nickel (Ni)	2012/08/23	10.7		%	35
		Total Selenium (Se)	2012/08/23	NC		%	35
		Total Silver (Ag)	2012/08/23	NC		%	35
		Total Thallium (Tl)	2012/08/23	NC		%	35
		Total Tin (Sn)	2012/08/23	NC		%	35
		Total Uranium (U)	2012/08/23	NC		%	35
		Total Vanadium (V)	2012/08/23	2.3		%	35
		Total Zinc (Zn)	2012/08/23	NC		%	35

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
 Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
 QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
 Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
 Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
 Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
 NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
 NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
 (1) Surrogate recovery below acceptance criteria due to matrix interference. Unable to reanalyze due to insufficient sample.
 (2) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
 (3) Detection limit raised due to interferent.


Validation Signature Page

Maxxam Job #: B273271

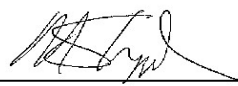
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



 Justin Allan, BSc, Data Validation



 Luba Shymushovska, Senior Analyst, Organic Department



 Michael Sheppard, Organics Supervisor

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#10605 PUBLIC WORKS & GOVERNMENT SER	Company Name:	#24375 EGE ENGINEERING	Quotation #:	Rw6SL	MAXXAM JOB #:	BOTTLE ORDER #:
Contact Name:	MARIE MCGREGOR	Contact Name:	PETER BOHONOS	P.O. #:	R.058406.002	B273271	323843
Address:	100-167 LOMBARD AVE WINNIPEG MB R3C 2Z1	Address:	511 PEPPERLOAF CRESCENT WINNIPEG MB R3R 1E6	Project #:	0125 046 03	CHAIN OF CUSTODY #:	PROJECT MANAGER:
Phone:	(204)984-4510 Fax: (204)984-7701	Phone:	(204)771-6976 Fax: (204)837-6473	Project Name:	Stony Rapids RCMP PRG	CH323843-01-01	Anna Gordon
Email:	Marie.McGregor@pwgsc-tpsgc.gc.ca	Email:	pbohonos@mts.net	Site #:			
				Sampled By:			

REGULATORY CRITERIA:	SPECIAL INSTRUCTIONS	ANALYSIS REQUESTED (Please be specific):										TURNAROUND TIME (TAT) REQUIRED:	
<input type="checkbox"/> ATI <input checked="" type="checkbox"/> CCME <input type="checkbox"/> OTHER	HOLD SAMPLES SR-01-6 SR-05-2 SR-02-4 SR-03-6 SR-04-3	Metals Field Filtered? (Y/N) AT1 BTEX and F1-F4 in Water Polycyclic Aromatic Hydrocarbons Elements by ICPMS - Dissolved BTEX F1-F4 PAH Metals VOCs GRAMS SIZES										PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS Regular (Standard) TAT: (will be applied if Rush TAT is not specified) Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details. <input checked="" type="checkbox"/>	
Job Specific Rush TAT (if applies to entire submission) Date Required: <input type="checkbox"/> Rush Confirmation Number: (call lab for #)													

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered? (Y/N)	AT1 BTEX and F1-F4 in Water	Polycyclic Aromatic Hydrocarbons	Elements by ICPMS - Dissolved	BTEX F1-F4	PAH	Metals	VOCs	GRAMS	SIZES	# of Bottles	Comments
1	SR-01-3	12/8/14		Soil		X			X						1	
2	SR-02-2	12/8/14		Soil		X			X						1	
3	SR-08	12/8/15	14:00	Water		X									5	
4	SR-03-1	12/8/14		Soil		X	X	X	X	X	X				3	
5	SR-DUP	12/8/15	14:00	Water		X	X	X							5	
6	SR-03-2	12/8/14		Soil		X			X				X		2	
7	SR-04-1	12/8/14		Soil		X			X						1	
8	SR-05-1	12/8/15		Soil		X			X	X	X				3	
9	SR-06-3	12/8/14		Soil		X			X						1	
10	DUP-1	12/8/14		Soil		X	X	X	X	X	X				3	

RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted	Laboratory Use Only		
P. Bohonos	12/08/15	18:00	P. Bohonos	12/08/16	10:00	100 incl.	Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
							<input type="checkbox"/>		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
 ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

Jan 10
JASON BIL
12/08/17
0850

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#10605 PUBLIC WORKS & GOVERNMENT SER	Company Name:	#24375 EGE ENGINEERING	Quotation #:	PWGSC	MAXXAM JOB #:	BOTTLE ORDER #:
Contact Name:	MARIE MCGREGOR	Contact Name:	PETER BOHONOS	P.O. #:	R.058406.002		
Address:	100-167 LOMBARD AVE WINNIPEG MB R3C 2Z1	Address:	511 PEPPERLOAF CRESCENT WINNIPEG MB R3R 1E6	Project #:	0125 046 03		
Phone:	(204)984-4510 Fax: (204)984-7701	Phone:	(204)771-6976 Fax: (204)837-6473	Project Name:	Sony Rapids RCMP	CHAIN OF CUSTODY #:	PROJECT MANAGER:
Email:	Marie.McGregor@pwgsc-lpsgc.gc.ca	Email:	pbohonos@mts.net	Site #:			
				Sampled By:	PRB		

REGULATORY CRITERIA:	SPECIAL INSTRUCTIONS	ANALYSIS REQUESTED (Please be specific):	TURNAROUND TIME (TAT) REQUIRED:
<input type="checkbox"/> ATI <input checked="" type="checkbox"/> CCME <input type="checkbox"/> OTHER	HAND SAMPLES SR07-4 SR08-5	Metals Field Filtered ? (Y/N) ATT-BTEX and F1-F4 in Water Polycyclic Aromatic Hydrocarbons Elements by ICPMS - Dissolved BTEX F1-F4 PAHs Metals VOCs GRAIN SIZE	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS Regular (Standard) TAT: (will be applied if Rush TAT is not specified): Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details. Job Specific Rush TAT (if applies to entire submission) Date Required: <input type="checkbox"/> Rush Confirmation Number: <input type="checkbox"/> (call lab for #)

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM									
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y/N)	ATT-BTEX and F1-F4 in Water	Polycyclic Aromatic Hydrocarbons	Elements by ICPMS - Dissolved	
1	SR-07-2	12/8/15		Soil					X
2	SR-08-3	12/8/15							X
3	SR-08-6	12/8/15		Soil					X
4	SR-09-5								X
5	SR-10-5 SR-14-5								X
6	SR-11-1								X
7	SR-11-2								X
8	SR-12-1								X
9	SR-15-4								X
10	SR-DUP 2	12/8/15		Soil					X

RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted	Laboratory Use Only
<i>[Signature]</i>	2012/8/15	18:00	<i>[Signature]</i>	12/08/16	ice incl.		Time Sensitive: <input type="checkbox"/> Temperature (°C) on Receipt: <input type="checkbox"/> Custody Seal Intact on Cooler? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

APPENDIX C
NCSCS SCORING SHEETS

CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)
Pre-Screening Checklist

Question	Response (yes / no)	Comment
1. Are Radioactive material, Bacterial contamination or Biological hazards likely to be present at the site?	No	If yes, do not proceed through the NCSCS. Contact applicable regulatory agency immediately.
2. Are there no contamination exceedances (known or suspected)? Determination of exceedances may be based on: 1) CCME environmental quality guidelines; 2) equivalent provincial guidelines/standards if no CCME guideline exists for a specific chemical in a relevant medium; or 3) toxicity benchmarks derived from the literature for chemicals not covered by CCME or provincial guidelines/standards.	No	If yes (i.e., there are no exceedances), do not proceed through the NCSCS.
3. Have partial/incompleted or no environmental site investigations been conducted for the Site?	No	If yes, do not proceed through the NCSCS.
4. Is there direct and significant evidence of impacts to humans at the site, or off-site due to migration of contaminants from the site?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
5. Is there direct and significant evidence of impacts to ecological receptors at the site, or off-site due to migration of contaminants from the site?	No	Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are considered to be severe, the site may be categorized as Class 1, regardless of the numerical total NCSCS score. For the purpose of application of the NCSCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction.
6. Are there indicators of significant adverse effects in the exposure zone (i.e., the zone in which receptors may come into contact with contaminants)? Some examples are as follows: -Hydrocarbon sheen or NAPL in the exposure zone -Severely stressed biota or devoid of biota; -Presence of material at ground surface or sediment with suspected high concentration of contaminants such as ore tailings, sandblasting grit, slag, and coal tar.	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, regardless of the total score obtained should one be calculated (e.g., for comparison with other Class 1 sites).
7. Do measured concentrations of volatiles or unexploded ordnances represent an explosion hazard ?	No	If yes, automatically rate the site as Class 1, a priority for remediation or risk management, and do not continue until the safety risks have been addressed. Consult your jurisdiction's occupational health and safety guidance or legislation on exposive hazards and measurement of lower explosive limits.

If none of the above applies, proceed with the NCSCS scoring.

CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)
Summary of Site Conditions

Subject Site:	RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan	
Civic Address: <i>(or other description of location)</i>	Stony Rapids, Saskatchewan	
Site Common Name : <i>(if applicable)</i>	RCMP Stony Rapids Detachment Site	
Site Owner or Custodian: <i>(Organization and Contact Person)</i>	Royal Canadian Mounted Police	
Legal description or metes and bounds:	Lots 4 and 5, Block 4, Plan CK361, Plan 101858698 in Stony Rapids, Saskatchewan.	
Approximate Site area:	0.50 ha	
PID(s): <i>(or Parcel Identification Numbers [PIN] if untitled Crown land)</i>	DFRP 14862 PR F/84	
Centre of site: <i>(provide latitude/longitude or UTM coordinates)</i>	Latitude:	59 degrees 15 min 34 secs
	Longitude:	105 degrees 49 min 52 secs
	UTM Coordinate:	
Site Land Use:	Current:	RCMP Detachment with employee housing units, workshop and garage
	Proposed:	Same
Site Plan	To delineate the bounds of the Site a site plan MUST be attached. The plan must be drawn to scale indicating the boundaries in relation to well-defined reference points and/or legal descriptions. Delineation of the contamination should also be indicated on the site plan.	
Provide a brief description of the Site:	<p>The RCMP Detachment site (DFRP 14862) is located on the west side of Johnson Street on the north side of the community of Stony Rapids, Saskatchewan. The community of Stony Rapids is situated along the south bank of the Fond du Lac River, approximately 670 km north of Prince Albert and 800 km north of Saskatoon, Saskatchewan. The RCMP Detachment site consists of one irregularly shaped land parcel with a total area of 0.50 ha. Five buildings are present on the property, including: the Detachment; two employee housing units; a garage; and a workshop. The Detachment (BU F/329) is accessed via a concrete driveway from Johnson Street, which leads east-northeast to the garage (BU F/326). Individual gravel driveways also lead from Johnson Street to employee housing unit (BU F/105), and to employee housing unit (BU F/182) and the Detachment workshop (BU F/325). Concrete sidewalks lead from the paved driveway along the front of the Detachment building towards the employee housing unit BU F/182 and from the driveway to the backdoor of the Detachment. There are also concrete sidewalks around the north sides of both employee housing units. The remaining areas of the site have grass cover, with deciduous and coniferous trees present across the site.</p> <p>The surrounding land use consists of: the Water Front Lodge and water treatment plant to the south followed by residential housing across a gravel roadway; residential housing to the east; the south bank of the Fond du Lac River to the west and north; and the community's float plane base to the southwest along the bank of the Fond du Lac River to the southwest.</p>	

CCME National Classification System for Contaminated Sites (2008, 2010 v 1.2)
Summary of Site Conditions

Affected media and Contaminants of Potential Concern (COPC):	Soil impacted with PHCs above the residential guidelines was identified at two areas on the property, including: 30 m3 in the area of the former gasoline UST/exisitng gasoline AST at the northeast corner of the site; and 20 m3 in the area of the former heating oil UST on the north side of the Detachment. The area of the former gasoline UST/existing gasoline AST is also impacted with naphthalene. PHC impacted groundwater was also noted in the one well located in the area of the former heating oil UST on the north side of the Detachment. Due to the limited number of well installations and absence of groundwtaer at three of the four installed wells, it is not possible to delineate the lateral extent of PHC impcated groundwater at this time..
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Please fill in the "letter" that best describes the level of information available for the site being assessed

Site Letter Grade

C

If letter grade is F, do not continue, you must have a minimum of a Phase I Environmental Site Assessment or equivalent.

Scoring Completed By:	Peter Bohonos, P.Eng.
Date Scoring Completed:	05-Oct-12

CCME National Classification System (2008, 2010 v 1.2)
(I) Contaminant Characteristics

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
1. Residency Media (replaces physical state)				
Which of the following residency media are known (or strongly suspected) to have one or more exceedances of the applicable CCME guidelines? yes = has an exceedance or strongly suspected to have an exceedance no = does not have an exceedance or strongly suspected not to have an exceedance		The Phase II ESA reported: soil exceedances of the CEQG and CWS for PHCs for one or more of the BTEX and PHC F1 to F3 Fractions, and naphthalene in the area of the former gasoline UST/existing gasoline AST; and soil and groundwater exceedances of the CEQG, CWS for PHCs and the FCSAP FIGQG for one or more of the BTEX and PHC F1 to F3 Fractions in the area of the former heating oil UST that was located on the north side of the Detachment. Surface water and sediment samples were not collected as part of the Phase II ESA. The Fond du Lac River is located adjacent to the west-northwest sides of the site, however, surface water and sediment are not suspected to be impacted as a result of the contaminants present on the Detachment Site.	The overall score is calculated by adding the individual scores from each residency media (having one or more exceedance of the most conservative media specific and land-use appropriate CCME guideline). Summary tables of the Canadian Environmental Quality Guidelines for soil, water (aquatic life, non-potable groundwater environments, and agricultural water uses) and sediment are available on the CCME website at http://www.ccme.ca/publications/ceqg_rcqe.html?category_id=124 . For potable groundwater environments, guidelines for Canadian Drinking Water Quality (for comparison with groundwater monitoring data) are available on the Health Canada website at http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html .	An increasing number of residency media containing chemical exceedances often equates to a greater potential risk due to an increase in the number of potential exposure pathways.
A. Soil	Yes			
Yes No Do Not Know				
B. Groundwater	Yes			
Yes No Do Not Know				
C. Surface water	No			
Yes No Do Not Know				
D. Sediment	No			
Yes No Do Not Know				
"Known" -score	4			
"Potential" - score	---			
2. Chemical Hazard				
What is the relative degree of chemical hazard of the contaminant in the list of hazard rankings proposed by the Federal Contaminated Sites Action Plan (FCSAP)? High Medium Low Do Not Know	High	The hazard ranking for benzene and the the PHC F1 Fraction, which are present on the site above the CCME CEQG and CWS, is high.	The relative degree of chemical hazard should be selected based on the most hazardous contaminant known or suspected to be present at the site. The degree of hazard has been defined by the Federal Contaminated Sites Action Plan (FCSAP) and a list of substances with their associated hazard (Low, Medium and High) has been provided as a separate sheet in this file. <i>See Attached Reference Material for Contaminant Hazard Rankings.</i>	Hazard as defined in the revised NCS pertains to the physical properties of a chemical which can cause harm. Properties can include toxic potency, propensity to biomagnify, persistence in the environment, etc. Although there is some overlap between hazard and contaminant exceedance factor below, it will not be possible to derive contaminant exceedance factors for many substances which have a designated chemical hazard designation, but don't have a CCME guideline. The purpose of this category is to avoid missing a measure of toxic potential.
"Known" -score	8			
"Potential" - score	---			
3. Contaminant Exceedance Factor				
What is the ratio between the measured contaminant concentration and the applicable CCME guidelines (or other "standards")? Mobile NAPL High (>100x) Medium (10x to 100x) Low (1x to 10x) Do Not Know	Medium (10x to 100x)	The reported concentrations are generally between 10 and 100 times the CCME CWS.	Ranking of contaminant "exceedance" is determined by comparing contaminant concentrations with the <i>most conservative media-specific and land-use appropriate CCME</i> environmental quality guidelines. Ranking should be based on contaminant with greatest exceedance of CCME guidelines. Ranking of contaminant hazard as high, medium and low is as follows: High = One or more measured contaminant concentration is greater than 100 X appropriate CCME guidelines Medium = One or more measured contaminant concentration is 10 - 99.99 X appropriate CCME guidelines Low = One or more measured contaminant concentration is 1 - 9.99 X appropriate CCME guidelines Mobile NAPL = Contaminant is a non-aqueous phase liquid (i.e., due to its low solubility, it does not dissolve in water, but remains as a separate liquid) and is present at a sufficiently high saturation (i.e., greater than residual NAPL saturation) such that there is significant potential for mobility either downwards or laterally. Other standards may include local background concentration or published toxicity benchmarks. Results of toxicity testing with site samples can be used as an alternative. This approach is only relevant for contaminants that do not biomagnify in the food web, since toxicity tests would not indicate potential effects at higher trophic levels. High = lethality observed. Medium = no lethality, but sub lethal effects observed. Low = neither lethal nor sub lethal effects observed.	In the event that elevated levels of a material with no associated CCME guidelines are present, check provincial and USEPA environmental criteria. Hazard Quotients (sometimes referred to as a screening quotient in risk assessments) refer to the ratio of measured concentration to the concentration believed to be the threshold for toxicity. A similar calculation is used here to determine the contaminant exceedance factor (CEF). Concentrations greater than one times the applicable CCME guideline (i.e., CEF>=1) indicate that risks are possible. Mobile NAPL has the highest associated score (8) because of its highly concentrated nature and potential for increase in the size of the impacted zone.
"Known" -score	4			
"Potential" - score	---			

CCME National Classification System (2008, 2010 v 1.2)

(I) Contaminant Characteristics

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method of Evaluation	Notes
4. Contaminant Quantity (known or strongly suspected)				
What is the known or strongly suspected quantity of all contaminants? <div> <div>>10 hectare (ha) or 5000 m³</div> <div>2 to 10 ha or 1000 to 5000 m³</div> <div><2 ha or 1000 m³</div> <div>Do Not Know</div> </div>	<2 ha or 1000 m ³	The total volume of PHC/Naphthalene impacted soil is estimated to be 50 m ³ . The area of PHC impacted groundwater was not delineated.	Measure or estimate the area or quantity of total contamination (i.e. all contaminants known or strongly suspected to be present on the site). The "Area of Contamination" is defined as the area or volume of contaminated media (soil, sediment, groundwater, surface water) exceeding appropriate environmental criteria.	A larger quantity of a potentially toxic substance can result in a larger frequency of exposure as well as a greater probability of migration, therefore, larger quantities of these substances earn a higher score.
"Known" -score	2			
"Potential" - score	---			
5. Modifying Factors				
Does the chemical fall in the class of persistent chemicals based on its behavior in the environment? <div> <div>Yes</div> <div>No</div> <div>Do Not Know</div> </div>	No	The BTEX parameters, PHC F1 t F3 Fractions and naphthalene are not considered persistent chemicals.	Persistent chemicals, e.g., PCBs, chlorinated pesticides etc. either do not degrade or take longer to degrade, and therefore may be available to cause effects for a longer period of time. Canadian Environmental Protection Act (CEPA) classifies a chemical as persistent when it has at least one of the following characteristics: (a) in air, (i) its half-life is equal to or greater than 2 days, or (ii) it is subject to atmospheric transport from its source to a remote area; (b) in water, its half-life is equal to or greater than 182 days; (c) in sediments, its half-life is equal to or greater than 365 days; or (d) in soil, its half-life is equal to or greater than 182 days. This list does not include metals or metalloids, which in their elemental form do not degrade. However metals and metalloids form chemical species in the environment, many of which are not readily bioavailable.	<i>Examples of Persistent Substances are provided in attached Reference Materials</i>
Are there contaminants present that could cause damage to utilities and infrastructure, either now or in the future, given their location? <div> <div>Yes</div> <div>No</div> <div>Do Not Know</div> </div>	Yes	The presence of impacted soil and groundwater, has the potential to affect the utilities near the impacted areas.		Some contaminants may react or absorb into underground utilities and infrastructure. For example, organic solvents may degrade some plastics, and salts could cause corrosion of metal.
How many different contaminant classes have representative CCME guideline exceedances? <div> <div>one</div> <div>two to four</div> <div>five or more</div> <div>Do Not Know</div> </div>	two to four	Four classes: volatile petroleum hydrocarbons (BTEX parameters); light extractable petroleum hydrocarbons (PHC F1 and F2 Fractions); heavy extractable hydrocarbons (PHC F3 Fraction); and PAHs (naphthalene).	For the purposes of the revised NCS ranking system, the following chemicals represent distinct chemical "classes": inorganic substances (including metals), volatile petroleum hydrocarbons, light extractable petroleum hydrocarbons, heavy extractable petroleum hydrocarbons, PAHs, phenolic substances, chlorinated hydrocarbons, halogenated methanes, phthalate esters, pesticides.	<i>Refer to the Reference Material sheet for a list of example substances that fall under the various chemical classes.</i>
"Known" - Score	4			
"Potential" - Score	---			

Contaminant Characteristic Total

Raw Total Scores- "Known"	22
Raw Total Scores- "Potential"	0
Raw Combined Total Scores	22
Total Score (Raw Combined / 40 * 33)	18.2

(II) Migration Potential (Evaluation of contaminant migration pathways)

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
1. Groundwater Movement				
A. Known COPC exceedances and an operable groundwater pathway within and/or beyond the property boundary.				
<p>i) For potable groundwater environments, 1) groundwater concentrations exceed background concentrations and 1X the Guideline for Canadian Drinking Water Quality (GCDWQ) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater contamination. For non-potable environments (typically urban environments with municipal services), 1) groundwater concentrations exceed 1X the applicable non-potable guidelines or modified generic guidelines (which exclude ingestion of drinking water pathway) or 2) there is known contact of contaminants with groundwater, based on physical evidence of groundwater impacts.</p>	12	One groundwater sample was collected during the Phase II ESA and exceeded the FCSAP FICG for toluene, and the PHC F1 and F2 Fractions. The sample was collected from the area of the former heating oil UST on the north side of the Detachment. Groundwater is not used as a potable water supply in the area, therefore, the potential has been assessed.	<p>Review chemical data and evaluate groundwater quality.</p> <p>The evaluation method concentrates on 1) a potable or non-potable groundwater environment; 2) the groundwater flow system and its potential to be an exposure pathway to known or potential receptors</p> <p>An aquifer is defined as a geologic unit that yields groundwater in usable quantities and drinking water quality. The aquifer can currently be used as a potable water supply or could have the potential for use in the future. Non-potable groundwater environments are defined as areas that serviced with a reliable alternative water supply (most commonly provided in urban areas). The evaluation of a non-potable environment will be based on a site specific basis.</p> <p>Physical evidence includes significant sheens, liquid phase contamination, or contaminant saturated soils.</p> <p>Seeps and springs are considered part of the groundwater pathway.</p> <p>In Arctic environments, the potability and evaluation of the seasonal active layer (above the permafrost) as a groundwater exposure pathway will be considered on a site-specific basis.</p>	<p>The 1992 NCS rationale evaluated the off-site migration as a regulatory issue. The exposure assessment and classification of hazards should be evaluated regardless of the property boundaries.</p> <p>Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a groundwater supply source in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resources such as internet links.</p> <p>Note that for potable groundwater that also daylight into a nearby surface water body, the more stringent guidelines for both drinking water and protection of aquatic life should be considered.</p> <p>Selected References</p> <p>Potable Environments.</p> <p>Guidelines for Canadian Drinking Water Quality www.hc-sc.gc.ca/nwh/semt/pubs/water-gau/doc_sup-appui/sum_guide-res_recom/index_e.html</p> <p>Non-Potable Environments.</p> <p>Canadian Water Quality Guidelines for Protection of Aquatic Life. CCME. 1999 www.ccme.ca</p> <p>Compilation and Review of Canadian Remediation Guidelines, Standards and Regulations. Science Applications International Corporation (SAIC Canada), report to Environment Canada, January 4, 2002.</p>
<p>ii) Same as (i) except the information is not known but strongly suspected based on indirect observations.</p>	9			
<p>iii) Meets GCDWQ for potable environments, meets non-potable criteria or modified generic criteria (excludes ingestion of drinking water pathway) for non-potable environments or</p> <p>Absence of groundwater exposure pathway (i.e., there is no aquifer (see definition at right) at the site or there is an adequate isolating layer between the aquifer and the contamination, and within 5 km of the site there are no aquatic receiving environments and the groundwater does not daylight).</p>	0			
Go to Potential	---			
Score				
NOTE: If a score is assigned here for Known COPC Exceedances, then you can skip Part B (Potential for groundwater pathway) and go to Section 2 (Surface Water Pathway)				
B. Potential for groundwater pathway.				
<p>a. Relative Mobility</p> <p>High</p> <p>Moderate</p> <p>Low</p> <p>Insignificant</p> <p>Do Not Know</p>	High	The log Koc for toluene is 2.6, therefore, the mobility is considered to be high.	<p>Organics Koc (L/kg)</p> <p>Koc < 500 (i.e., log Koc < 2.7)</p> <p>Koc = 500 to 5000 (i.e., log Koc = 2.7 to 3.7)</p> <p>Koc = 5,000 to 100,000 (i.e., log Koc = 3.7 to 5)</p> <p>Koc > 100,000 (i.e., log Koc > 5)</p> <p>Metals with higher mobility at acidic conditions</p> <p>pH < 5</p> <p>pH = 5 to 6</p> <p>pH > 6</p> <p>Metals with higher mobility at alkaline conditions</p> <p>pH > 8.5</p> <p>pH = 7.5 to 8.5</p> <p>pH < 7.5</p>	Reference: US EPA Soil Screening Guidance (Part 5 - Table 39)
Score	4			
<p>b. Presence of engineered sub-surface containment?</p> <p>No containment</p> <p>Partial containment</p> <p>Full containment</p> <p>Do Not Know</p>	No containment	There is no engineered containment and coarse soils are present in the surface and subsurface soils.	<p>Review the existing engineered systems or natural attenuation processes for the site and determine if full or partial containment is achieved.</p> <p>Full containment is defined as an engineered system or natural attenuation processes, monitored being effective, which provide for full capture and/or treatment of contaminants. All chemicals of concern must be contained for "Full Containment" scoring. Natural attenuation must have sufficient data, and reports cited with monitoring data to support steady state conditions and the attenuation processes. If there is no containment or insufficient natural attenuation process, this category is evaluated as high. If there is less than full containment or if uncertain, then evaluate as medium.</p> <p>Arctic environments, permafrost will be evaluated, as appropriate, based on detailed evaluations, effectiveness and reliability to contain/control contaminant migration.</p>	<p>Someone experienced must provide a thorough description of the sources researched to determine the containment of the source at the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps, geotechnical reports or natural attenuation studies and other resources such as internet links.</p> <p>Selected Resources:</p> <p>United States Environmental Protection Agency (USEPA) 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. EPA/600/R-98/128.</p> <p>Environment Canada – Ontario Region – Natural Attenuation Technical Assistance Bulletins (TABS) Number 19 –21.</p>
<p>c. Thickness of confining layer over aquifer of concern o groundwater exposure pathway</p> <p>3 m or less including no confining layer or discontinuous confining layer</p> <p>3 to 10 m</p> <p>> 10 m</p> <p>Do Not Know</p>	3 to 10 m	The overburden thickness generally ranged from 3.0 to 4.9 m at the site.	<p>The term "confining layer" refers to geologic material with little or no permeability or hydraulic conductivity (such as unfractured clay); water does not pass through this layer or the rate of movement is extremely slow.</p> <p>Measure the thickness and extent of materials that will impede the migration of contaminants to the groundwater exposure pathway.</p> <p>The evaluation of this category is based on:</p> <p>1) The presence and thickness of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as drinking water sources or</p> <p>2) The presence and thickness of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated zone (e.g., water table aquifer, first hydrostratigraphic unit or other groundwater pathway).</p>	
Score	0.5			
<p>d. Hydraulic conductivity of confining layer</p> <p>>10⁻⁴ cm/s or no confining layer</p> <p>10⁻⁴ to 10⁻⁶ cm/s</p> <p><10⁻⁶ cm/s</p> <p>Do Not Know</p>	>10 ⁻⁴ cm/s	The overburden consists of fine grained sand with trace to some gravel therefore a high conductivity is assumed.	<p>Determine the nature of geologic materials and estimate hydraulic conductivity from published material (or use "Range of Values of Hydraulic Conductivity and Permeability" figure in the Reference Material sheet). Unfractured clays should be scored low. Silts should be scored medium. Sand, gravel should be scored high. The evaluation of this category is based on:</p> <p>1) The presence and hydraulic conductivity ("K") of saturated subsurface materials that impede the vertical migration of contaminants to lower aquifer units which can or are used as a drinking water source, groundwater exposure pathway or</p> <p>2) The presence and permeability ("K") of unsaturated subsurface materials that impede the vertical migration of contaminants from the source location to the saturated water table aquifer, first hydrostratigraphic unit or other groundwater pathway.</p>	
Score	1			

CCME National Classification System (2008, 2010 v 1.2)

(II) Migration Potential (Evaluation of contaminant migration pathways)

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for groundwater pathway.				
e. Precipitation infiltration rate (Annual precipitation factor x surface soil relative permeability factor) High Moderate Low Very Low None Do Not Know	<div>Moderate 0.6</div>	Annual precipitation = 440 mm = 0.4 Surface soil is sand = 0.6 0.4 x 0.6 = 0.24 for precipitation infiltration rate	Precipitation Refer to Environment Canada precipitation records for relevant areas. Divide annual precipitation by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score). Permeability For surface soil relative permeability (i.e., infiltration) assume: gravel (1), sand (0.6), loam (0.3) and pavement or clay (0). Multiply the surface soil relative permeability factor with precipitation factor to obtain the score for precipitation infiltration rate.	
f. Hydraulic conductivity of aquifer >10 ⁻² cm/s 10 ⁻² to 10 ⁻⁴ cm/s <10 ⁻⁴ cm/s Do Not Know	<div><10⁻⁴ cm/s 0</div>	Bedrock conductivity for Sandstone is 10-4 to 10-8 cm/s.	Determine the nature of geologic materials and estimate hydraulic conductivity of all aquifers of concern from published material (refer to "Range of Values of Hydraulic Conductivity and Permeability" in the Reference Material sheet).	
Potential groundwater pathway total	9.1			
Allowed Potential score	9.1	Note: If a "known" score is provided, the "potential" score is disallowed.		
Groundwater pathway total	9.1			
2. Surface Water Movement				
A. Demonstrated migration of COPC in surface water above background conditions				
Known concentrations of surface water: i) Concentrations exceed background concentrations and exceed CCME CWQG for protection of aquatic life, irrigation, livestock water, and/or recreation (whichever uses are applicable at the site) by >1 X; or There is known contact of contaminants with surface water based on site observations. or In the absence of CWQG, chemicals have been proven to be toxic based on site specific testing (e.g. toxicity testing; or other indicator testing of exposure). ii) Same as (i) except the information is not known but <u>strongly suspected</u> based on indirect observations. iii) Meets CWQG or absence of surface water exposure pathway (i.e., Distance to nearest surface water is > 5 km.)	<div>12 8 0 0</div>	The Fond du Lac River is located adjacent to the west-northwest sides of the property, however, surface water and sediment are not suspected to be impacted as a result of the contaminants present on the Detachment Site. Therefore, a score of zero has been assigned.	Collect all available information on quality of surface water near to site. Evaluate available data against Canadian Water Quality Guidelines (select appropriate guidelines based on local water uses e.g., recreation, irrigation, aquatic life, livestock watering, etc.). The evaluation method concentrates on the surface water flow system and its potential to be an exposure pathway. Contamination is present on the surface (above ground) and has the potential to impact surface water bodies. Surface water is defined as a water body that supports one of the following uses: recreation, irrigation, livestock watering, aquatic life.	General Notes: Someone experienced must provide a thorough description of the sources researched to classify the surface water body in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resources such as internet links. Selected References: CCME. 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life www.ccme.ca CCME. 1999. Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) www.ccme.ca Health and Welfare Canada. 1992. Guidelines for Canadian Recreational Water Quality.
NOTE: If a score is assigned here for Demonstrated Migration in Surface Water, then you can skip Part B (Potential for migration of COPCs in surface water) and go to Section 3 (Surface Soils)				
B. Potential for migration of COPCs in surface water				
a. Presence of containment No containment Partial containment Full containment Do Not Know	<div>Do Not Know 3</div>		Review the existing engineered systems and relate these structures to site conditions and proximity to surface water and determine if full containment is achieved: score low if there is full containment such as capping, berms, dikes; score medium if there is partial containment such as natural barriers, trees, ditches, sedimentation ponds; score high if there are no intervening barriers between the site and nearby surface water. Full containment must include containment of all chemicals.	
b. Distance to Surface Water 0 to <100 m 100 - 300 m >300 m Do Not Know	<div>Do Not Know 2</div>		Review available mapping and survey data to determine distance to nearest surface water bodies.	
c. Topography Contaminants above ground level and slope is steep Contaminants at or below ground level and slope is steep Contaminants above ground level and slope is intermediate Contaminants at or below ground level and slope is intermediate Contaminants above ground level and slope is flat Contaminants at or below ground level and slope is flat Do Not Know	<div>Do Not Know 1</div>		Review engineering documents on the topography of the site and the slope of surrounding terrain. Steep slope = >50% Intermediate slope = between 5 and 50% Flat slope = < 5% Note: Type of fill placement (e.g., trench, above ground, etc.).	

CCME National Classification System (2008, 2010 v 1.2)

(II) Migration Potential (Evaluation of contaminant migration pathways)

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
d. Run-off potential High (rainfall run-off score > 0.6) Moderate (0.4 < rainfall run-off score < 0.6) Low (0.2 < rainfall run-off score < 0.4) Very Low (0 < rainfall run-off score < 0.2) None (rainfall run-off score = 0) Do Not Know	<div>Do Not Know</div> <div>0.4</div>		Rainfall Refer to Environment Canada precipitation records for relevant areas. Divide rainfall by 1000 and round to nearest tenth (e.g., 667 mm = 0.7 score). The former definition of "annual rainfall" did not include the precipitation as snow. This minor adjustment has been made. The second modification was the inclusion of permeability of surface materials as an evaluation factor. Permeability For infiltration assume: gravel (0), sand (0.3), loam (0.6) and pavement or clay (1). Multiply the infiltration factor with precipitation factor to obtain rainfall run off score.	Selected Sources: Environment Canada web page link www.msc.ec.gc.ca Snow to rainfall conversion apply ratio of 15 (snow):1(water)
e. Flood potential 1 in 2 years 1 in 10 years 1 in 50 years Not in floodplain Do Not Know	<div>Do Not Know</div> <div>0.5</div>		Review published data such as flood plain mapping or flood potential (e.g., spring or mountain run-off) and Conservation Authority records to evaluate flood potential of nearby water courses both up and down gradient. Rate zero if site not in flood plain.	
Potential surface water pathway total	6.9			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
Surface water pathway total	0			
3. Surface Soils (potential for dust, dermal and ingestion exposure)				
A. Demonstrated concentrations of COPC in surface soils (top 1.5 m)				
COPCs measured in surface soils exceed the CCME soil quality guideline. Strongly suspected that soils exceed guidelines COPCs in surface soils does not exceed the CCME soil quality guideline or is not present (i.e., bedrock).	<div>12</div> <div>9</div> <div>0</div> <div>12</div> <div>12</div>	There were surface soil (upper 1.5 m) exceedances reported for one or more of the BTEX parameters and the PHC F1 to F3 Fractions, therefore, a maximum score of 12 is assigned.	Collect all available information on quality of surface soils (i.e., top 1.5 metres) at the site. Evaluate available data against Canadian Soil Quality Guidelines. Select appropriate guidelines based on current (or proposed future) land use (i.e., agricultural, residential/parkland, commercial, or industrial), and soil texture if applicable (i.e., coarse or fine).	Selected References: CCME: 1999. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health www.ccme.ca
NOTE: If a score is assigned here for Demonstrated Concentrations in Surface Soils, then you can skip Part B (Potential for a surface soils migration pathway) and go to Section 4 (Vapour)				
B. Potential for a surface soils (top 1.5 m) migration pathway				
a. Are the soils in question covered? Exposed Vegetated Landscaped Paved Do Not Know	<div>Do Not Know</div> <div>4</div>	N/A	Consult engineering or risk assessment reports for the site. Alternatively, review photographs or perform a site visit. Landscaped surface soils must include a minimum of 0.5 m of topsoil.	The possibility of contaminants in blowing snow have not been included in the revised NC as it is difficult to assess what constitutes an unacceptable concentration and secondly, spills to snow or ice are most efficiently mitigated while freezing conditions remain.
b. For what proportion of the year does the site remain covered t snow? 0 to 10% of the yea 10 to 30% of the yea More than 30% of the yea Do Not Know	<div>Do Not Know</div> <div>3</div>	N/A	Consult climatic information for the site. The increments represent the full span from soils which are always wet or covered with snow (and therefore less likely to generate dust) to those soils which are predominantly dry and not covered by snow (and therefore are more likely to generate dust).	
Potential surface soil pathway total	7			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
Soil pathway total	12			
4. Vapour				
A. Demonstrated COPCs in vapour.				
Vapour has been measured (indoor or outdoor) in concentrations exceeding risk based concentrations. Strongly suspected (based on observations and/or modelling) Vapour has not been measured and volatile hydrocarbons have not been found in site soils or groundwater.	<div>12</div> <div>9</div> <div>0</div> <div>Go to Potential</div> <div>---</div>	Slightly to elevated organic vapours were noted at three test hole locations, therefore, the potential has been assessed.	Consult previous investigations, including human health risk assessments, for reports of vapours detected.	
NOTE: If a score is assigned here for Demonstrated COPCs in Vapour, then you can skip Part B (Potential for COPCs in vapour) and go to Section 5 (Sediment)				
B. Potential for COPCs in vapour				
a. Relative Volatility based on Henry's Law Constant, f (dimensionless) High (f > 1.0E-1) Moderate (f = 1.0E-1 to 1.0E-3) Low (f < 1.0E-3) Not Volatile Do Not Know	<div>High</div> <div>4</div>	The Henry's Law constant for benzene is > 1.0E-1.	Reference: US EPA Soil Screening Guidance (Part 5 - Table 36) <i>Provided in Attached Reference Materials</i>	If the Henry's Law Constant for a substance indicates that it is not volatile, and a score of zero is assigned here for relative volatility, then the other three questions in this section on Potential for COPCs will be automatically assigned scores of zero and you can skip to section 5.

CCME National Classification System (2008, 2010 v 1.2)

(II) Migration Potential (Evaluation of contaminant migration pathways)

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
b. What is the soil grain size? Fine Coarse Do Not Know		The predominant surface soil and subsurface soil grain type is coarse.	Review soil permeability data in engineering reports. The greater the permeability of soils, the greater the possible movement of vapours.	
	Coarse			
Score	4			
c. Is the depth to the source less than 10m? Yes No Do Not Know		The impacted soil is present within 10 m.	Review groundwater depths below grade for the site.	
	Yes			
Score	2			
d. Are there any preferential pathways? Yes No Do Not Know		There are utility conduits that pass through the impacted areas.	Visit the site during dry summer conditions and/or review available photographs. Where bedrock is present, fractures would likely act as preferential pathways.	Preferential pathways refer to areas where vapour migration is more likely to occur because there is lower resistance to flow than in the surrounding materials. For example, underground conduits such as sewer and utility lines, drains, or septic systems may serve as preferential pathways. Features of the building itself that may also be preferential pathways include earthen floors, expansion joints, wall cracks, or foundation perforations for subsurface features such as utility pipes, sumps, and drains.
	Yes			
Score	2			
Potential vapour pathway total	12			
Allowed Potential score	12	Note: If a "known" score is provided, the "potential" score is disallowed.		
Vapour pathway total	12			
5. Sediment Movement				
A. Demonstrated migration of sediments containing COPCs				
There is evidence to suggest that sediments originally deposited to the site (exceeding the CCME sediment quality guidelines) have migrated.	12		Review sediment assessment reports. Evidence of migration of contaminants in sediments must be reported by someone experienced in this area.	Usually not considered a significant concern in lakes/marine environments, but could be very important in rivers where transport downstream could be significant.
Strongly suspected (based on observations and/or modelling)	9			
Sediments have been contained and there is no indication that sediments will migrate in future.	0	The Fond du Lac River is located adjacent to the west-northwest sides of the property, however, sediment is not suspected to be impacted as a result of the contaminants present on the Detachment Site. Therefore, a score of zero has been assigned.		
or				
Absence of sediment exposure pathway (i.e., within 5 km of the site there are no aquatic receiving environments, and therefore no sediments).				
	0			
Score	0			
NOTE: If a score is assigned here for Demonstrated Migration of Sediments, then you can skip Part B (Potential for Sediment Migration) and go to Section 6 (Modifying Factors)				
B. Potential for sediment migration				
a. Are the sediments having COPC exceedances capped with sediments having no exceedances ("clean sediments")? Yes No Do Not Know	Do Not Know		Review existing sediment assessments. If sediment coring has been completed, it may indicate that historically contaminated sediments have been covered over by newer "clean" sediments. This assessment will require that cores collected demonstrate a low concentration near the top and higher concentration with sediment depth.	
	2			
b. For lakes and marine habitats, are the contaminated sediments in shallow water and therefore likely to be affected by tidal action, wave action or propeller wash? Yes No Do Not Know	Do Not Know		Review existing sediment assessments. If the sediments present at the site are in a river, select "no" for this question.	
	2			
c. For rivers, are the contaminated sediments in an area prone to sediment scouring? Yes No Do Not Know	Do Not Know		Review existing sediment assessments. It is important that the assessment is made under worst case flows (high yearly flows). Under high yearly flows, areas which are commonly depositional may be scoured.	
	2			
Potential sediment pathway total	6			
Allowed Potential score	---	Note: If a "known" score is provided, the "potential" score is disallowed.		
Sediment pathway total	0			
6. Modifying Factors				
Are there subsurface utility conduits in the area affected by contamination? Yes No Do Not Know	Yes	There are utility conduits that pass through the impacted areas.	Consult existing engineering reports. Subsurface utilities can act as conduits for contaminant migration.	
Known	4			
Potential	0			
Migration Potential Total				
Raw "known" total	16			
Raw "potential" total	21.1			
Raw combined total	37.1	Note: If "Known" and "Potential" scores are provided, the checklist defaults to known. Therefore, the total "Potential" Score may not reflect the sum of the individual "Potential" scores.		
Total (max 33)	19.1			

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(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
1. Human				
A. Known exposure				
Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to humans as a result of the contaminated site. (Class 1 Site*)	22		*Where adverse effects on humans are documented, the site should be automatically designated as Class 1 site (i.e., action required). There is no need to proceed through the NCS in this case. However, a scoring guideline (22) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class 1 sites).	Known adverse impact includes domestic and traditional food sources. Adverse effects based on food chain transfer to humans and/or animals can be scored in this category. However, the weight of evidence must show a direct link of a contaminated food source/supply and subsequent ingestion/transfer to humans. Any associated adverse effects to the environment are scored separately later in this worksheet.
Same as above, but "Strongly Suspected" based on observations or indirect evidence.	10		This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients >1 for noncarcinogenic chemicals and incremental cancer risks that exceed acceptable levels defined by the jurisdiction for carcinogenic chemicals (for most jurisdictions this is typically either >10 ⁻⁶ or >10 ⁻⁵). Known impacts can also be evaluated based on blood testing (e.g. blood lead >10 ug/dL) or other health based testing.	Someone experienced must provide a thorough description of the sources researched to evaluate and determine the quantified exposure/impact (adverse effect) in the vicinity of the contaminated site.
No quantified or suspected exposures/impacts in humans.	0	PHC/naphthalene impacted soil and PHC groundwater is present at the site. The site is not generally accessible to the public, but includes residential use. Employees and workers may be exposed to impacted soil and dust. Therefore, the potential has been assessed.	This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 0.2 for non-carcinogenic chemicals and incremental lifetime cancer risks for carcinogenic chemicals that are within acceptable levels as defined by the jurisdiction (for most jurisdictions this is less than either 10 ⁻⁶ or 10 ⁻⁵).	Selected References: Health Canada – Federal Contaminated Site Risk Assessment in Canada Parts 1 and 2 Guidance on Human Health Screening Level Risk Assessments www.hc-sc.gc.ca/ewh-semt/pubs/contam/site/index_e.html United States Environmental Protection Agency, Integrated Risk Information System (IRIS) http://toxnet.nlm.nih.gov
Score	---			
NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Human Exposure) and go to Section 2 (Human Exposure Modifying Factors)				
B. Potential for human exposure				
a) Land use (provides an indication of potential human exposure scenarios) Agricultural Residential / Parkland Commercial Industrial Do Not Know			Review zoning and land use maps over the distances indicated. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is more sensitive human receptors (e.g., children). Agricultural land use is defined as uses of land where the activities are related to the production of food or fibre. Commercial land use is defined as uses of land where the activities are related to the production of goods or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	This is the main "receptor" factor used in site scoring. A higher score implies a greater exposure and/or exposure of more sensitive human receptors (e.g., children).
Score	2	The property is considered residential since two employee housing units are present at the RCMP Detachment site.		
b. Indicate the level of accessibility to the contaminated portion of the site (e.g., the potential for coming in contact with contamination) Limited barriers to prevent site access; contamination not covered Moderate access or no intervening barriers, contaminants are covered. Remote locations in which contaminants not covered. Controlled access or remote location and contaminants are covered Do Not Know			Review location and structures and contaminants at the site and determine if there are intervening barriers between the site and humans. A low rating should be assigned to a (covered) site surrounded by a fence or in a remote location, whereas a high score should be assigned to a site that has no cover, fence, natural barriers or buffer.	
Score	2	PHC/naphthalene impacted soil is present in the surface soil at one of the two impacted areas.		
B. Potential for human exposure				
c) Potential for intake of contaminated soil, water, sediment or foods for operable or potentially operable pathways, as identified in Worksheet II (Migration Potential). i) direct contact Is dermal contact with contaminated surface water, groundwater, sediments or soils anticipated? Yes No Do Not Know			If soils or potable groundwater are present exceeding their respective CCME guidelines, dermal contact is assumed. Exposure to surface water, non-potable groundwater or sediments exceeding their respective CCME guidelines will depend on the site. Select "Yes" if dermal exposure to surface water, non-potable groundwater or sediments is expected. For instance, dermal contact with sediments would not be expected in an active port. Only soils in the top 1.5 m are defined by CCME (2003) as surface soils. If contaminated soils are only located deeper than 1.5 m, direct contact with soils is not anticipated to be an operable contaminant exposure pathway.	Exposure via the skin is generally believed to be a minor exposure route. However for some organic contaminants, skin exposure can play a very important component of overall exposure. Dermal exposure can occur while swimming in contaminated waters, bathing with contaminated surface water/groundwater and digging in contaminated dirt, etc.
Score	3	Direct contact (dermal) with the PHC/naphthalene impacted soil is possible as impacts are present in the surface soil at one of the two impacted areas.		
ii) inhalation (i.e., inhalation of dust, vapour) Vapour - Are there inhabitable buildings on the site within 30 m of soils or groundwater with volatile contamination as determined in Worksheet II (Migration Potential)? Yes No Do Not Know			If inhabitable buildings are on the site within 30 m of soils or groundwater exceeding their respective guidelines for volatile chemicals, there is a potential of risk to human health (Health Canada, 2004). Review site investigations for location of soil samples (having exceedances of volatile substances) relative to buildings. Refer to (II) Migration Potential worksheet, 4B.a) Potential for COPCs in Vapour for a definition of volatility.	Exposure via the lungs (inhalation) can be a very important exposure pathway. Inhalation can be via both particulates (dust) and gas (vapours). Vapours can be a problem where buildings have been built on former industrial sites or where volatile contaminants have migrated below buildings resulting in the potential for vapour intrusion.
Score	3	Five buildings are present on-site, with two of the buildings located within 30 m of the impacted areas. A maximum score of 3 is assigned.	Consult grain size data for the site. If soils (containing exceedances of the CCME soil quality guidelines) predominantly consist of fine material (having a median grain size of 75 microns; as defined by CCME (2006)) then these soils are more likely to generate dusts.	Assesses the potential for humans to be exposed to vapours originating from site soils. The closer the receptor is to a source of volatile chemicals in soil, the greater the potential of exposure. Also, coarser-grained soil will convey vapour much more efficiently in the soil than finer grained material such as clays and silts.
Dust - If there is contaminated surface soil (e.g. top 1.5 m), indicate whether the soil is fine or coarse textured. If it is known that surface soil is not contaminated, enter a score of zero. Fine Coarse Surface soil is not contaminated or absent (bedrock) Do Not Know Texture		The surface soil and subsoil are coarse grained.		General Notes: Someone experienced must provide a thorough description of the sources researched to determine the presence/absence of a vapour migration and/or dust generation in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.
Score	Coarse			Selected References: Canadian Council of Ministers of the Environment (CCME): 2006. Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. PN 1332 www.ccme.ca Golder, 2004. Soil Vapour Intrusion Guidance for Health Canada Screening Level Risk Assessment (SLRA) Submitted to Health Canada, Burnaby, BC
Score	1			
Inhalation total	4			

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(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for human exposure				
<p>iii) Ingestion (i.e., ingestion of food items, water and soils [for children, including traditional foods].</p> <p>Drinking Water: Choose a score based on the proximity to a drinking water supply, to indicate the potential for contamination (present or future).</p> <p>0 to 100 m 100 to 300 m 300 m to 1 km 1 to 5 km No drinking water present Do Not Know</p> <p>Score</p> <p>Is an alternative water supply readily available?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Is human ingestion of contaminated soils possible?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Are food items consumed by people, such as plants, domestic animals or wildlife harvested from the contaminated land and its surroundings?</p> <p>Yes No Do Not Know</p> <p>Score</p> <p>Ingestion total</p>	<p>100 to 300 m</p> <p>2.5</p> <p>Yes</p> <p>0</p> <p>Yes</p> <p>3</p> <p>Do Not Know</p> <p>0.5</p> <p>6</p>	<p>There are no groundwater wells located in the community. The water source is the Fond du Lac River, which is located adjacent to the soye, however the location of the intake is not known.</p> <p>Bottled or trucked water is available.</p> <p>Contaminated soils are present at or near the surface and ingestion is possible.</p> <p>There are no food items harvested directly from the impacted areas, however, wildlife and fish (from the adjacent river) may be consumed by the local people. The likelihood for impact is low, however, the potential is unknown.</p>	<p>Review available site data to determine if drinking water (groundwater, surface water, private, commercial or municipal supply) is known or suspected to be contaminated above Guidelines for Canadian Drinking Water Quality. If drinking water supply is known to be contaminated, some immediate action (e.g., provision of alternate drinking water supply) should be initiated to reduce or eliminate exposure.</p> <p>The evaluation of significant potential for exceedances of the water supply in the future may be based on the capture zones of the drinking water wells; contaminant travel times; computer modelling of flow and contaminant transport.</p> <p>If contaminated soils are located within the top 1.5 m, it is assumed that ingestion of soils is an operable exposure pathway. Exposure to soils deeper than 1.5 m is possible, but less likely, and the duration is shorter. Refer to human health risk assessment reports for the site in question.</p> <p>Use human health risk assessment reports (or others) to determine if there is significant reliance on traditional food sources associated with the site. Is the food item in question going to spend a large proportion of its time at the site (e.g., large mammals may spend a very small amount of time at a small contaminated site)? Human health risk assessment reports for the site in question will also provide information on potential bioaccumulation of the COPC in question.</p>	<p>Selected References: Guidelines for Canadian Drinking Water Quality www.hc-sc.gc.ca/hecs-sesc/water/publications/drinking_water_quality_guidelines/toc.htm</p> <p>Drinking water can be an extremely important exposure pathway to humans. If site groundwater or surface water is not used for drinking, then this pathway is considered to be inoperable.</p> <p>Consider both wild foods such as salmon, venison, caribou, as well as agricultural sources of food items if the contaminated site is on or adjacent to agricultural land uses.</p>
Human Health Total "Potential" Score	17	Note if a "Known" Human Health score is provided, the "Potential" score is disallowed.		
Allowed "Potential" Score	17			
2. Human Exposure Modifying Factors				
<p>a) Strong reliance of local people on natural resources for survival (i.e., food, water, shelter, etc.)</p> <p>Yes No Do Not Know</p> <p>Known</p> <p>Potential</p> <p>Raw Human "known" total</p> <p>Raw Human "potential" total</p> <p>Raw Human Exposure Total Score</p> <p>Human Health Total (max 22)</p>	<p>Yes</p> <p>6</p> <p>---</p> <p>6</p> <p>17</p> <p>23</p> <p>22.0</p>	<p>Hunting, trapping and fishing are important aspects of life for residents of Stony Rapids.</p>		
3. Ecological				
A. Known exposure				
<p>Documented adverse impact or high quantified exposure which has or will result in an adverse effect, injury or harm or impairment of the safety to terrestrial or aquatic organisms as a result of the contaminated site.</p> <p>Score</p>	<p>18</p> <p>12</p> <p>0</p> <p>Go to Potential</p> <p>---</p>	<p>Some low levels of impact to ecological receptors are considered acceptable, particularly on commercial and industrial land uses. However, if ecological effects are deemed to be severe, the site may be categorized as class one (i.e., a priority for remediation or risk management), regardless of numerical total NCS score. For the purpose of application of the NCS, effects that would be considered severe include observed effects on survival, growth or reproduction which could threaten the viability of a population of ecological receptors at the site. Other evidence that qualifies as severe adverse effects may be determined based on professional judgement and in consultation with the relevant jurisdiction. If ecological effects are determined to be severe and an automatic Class 1 is assigned, there is no need to proceed through the NCS. However, a scoring guideline (18) is provided in case a numerical score for the site is still desired (e.g., for comparison with other Class 1 sites).</p> <p>This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients >1. Alternatively, known impacts can also be evaluated based on a weight of evidence assessment involving a combination of site observations, tissue testing, toxicity testing and quantitative community assessments. Scoring of adverse effects on individual rare or endangered species will be completed on a case-by-case basis with full scientific justification.</p> <p>This category can be based on the outcomes of risk assessments and applies to studies which have reported Hazard Quotients of less than 1 and no other observable or measurable sign of impacts. Alternatively, it can be based on a combination of other lines of evidence showing no adverse effects, such as site observations, tissue testing, toxicity testing and quantitative community assessments.</p>	<p>CCME, 1999: Canadian Water Quality Guidelines for the Protection of Aquatic Life www.ccme.ca</p> <p>CCME, 1999: Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses www.ccme.ca</p> <p>Sensitive receptors- review: Canadian Council on Ecological Areas www.ccea.org</p> <p>Ecological effects should be evaluated at a population or community level, as opposed to at the level of individuals. For example, population-level effects could include reduced reproduction, growth or survival in a species. Community-level effects could include reduced species diversity or relative abundances. Further discussion of ecological assessment endpoints is provided in <i>A Framework for Ecological Risk Assessment: General Guidance</i> (CCME 1996).</p> <p>Notes: Someone experienced must provide a thorough description of the sources researched to classify the environmental receptors in the vicinity of the contaminated site. This information must be documented in the NCS Site Classification Worksheet including contact names, phone numbers, e-mail correspondence and/or reference maps/reports and other resource such as internet links.</p>	
<p>NOTE: If a score is assigned here for Known Exposure, then you can skip Part B (Potential for Ecological Exposure) and go to Section 4 (Ecological Exposure Modifying Factors)</p>				

CCME National Classification System (2008, 2010 v 1.2)

(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
B. Potential for ecological exposure (for the contaminated portion of the site)				
a) Terrestrial i) Land use Agricultural (or Wild lands) Residential/Parkland Commercial Industrial Do Not Know	<div>Residential/Parkland</div> <div>Score2</div>	The property is considered residential as two employee housing units are present on the site.	Review zoning and land use maps. If the proposed future land use is more "sensitive" than the current land use, evaluate this factor assuming the proposed future use is in place (indicate in the worksheet that future land use is the consideration). Agricultural land use is defined as uses of land where the activities are related to the productive capability of the land or facility (e.g., greenhouse) and are agricultural in nature, or activities related to the feeding and housing of animals as livestock. Wild lands are grouped with agricultural land due to the similarities in receptors that would be expected to occur there (e.g., herbivorous mammals and birds) and the similar need for a high level of protection to ensure ecological functioning. Residential/Parkland land uses are defined as uses of land on which dwelling on a permanent, temporary, or seasonal basis is the activity (residential), as well as uses on which the activities are recreational in nature and require the natural or human designed capability of the land to sustain that activity (parkland). Commercial/Industrial land uses are defined as land on which the activities are related to the buying, selling, or trading of merchandise or services (commercial), as well as land uses which are related to the production, manufacture, or storage of materials (industrial).	
ii) Uptake potential Direct Contact - Are plants and/or soil invertebrates likely exposed to contaminated soils at the site? Yes No Do Not Know	<div>Yes</div> <div>Score1</div>	The PHC impacts are present within 3.0 m and may be exposed to ecological receptors.	If contaminated soils are located within the top 1.5 m, it is assumed that direct contact of soils with plants and soil invertebrates is an operable exposure pathway. Exposure to soils deeper than 1.5 m is possible, but less likely.	
iii) Ingestion (i.e., wildlife or domestic animals ingesting contaminated food items, soils or water) Are terrestrial animals likely to be ingesting contaminated water at the site? Yes No Do Not Know	<div>No</div> <div>Score0</div>	Terrestrial animals are not likely to ingest contaminated water at the site as there is no surface water present on-site.	Refer to an Ecological Risk Assessment for the site. If there is contaminated surface water at the site, assume that terrestrial organisms will ingest it.	
Are terrestrial animals likely to be ingesting contaminated soils at the site? Yes No Do Not Know	<div>Yes</div> <div>Score1</div>	Terrestrial animals could ingest contaminated soil at the site as shallow PHC.naphthalene impacted soil is present.	Refer to an Ecological Risk Assessment report. Most animals will co-ingest some soil while eating plant matter or soil invertebrates.	
Can the contamination identified bioaccumulate? Yes No Do Not Know	<div>No</div> <div>Score0</div>	The log Kow is not greater than 5 for the BTEX and PHC Fractions, therefore the contaminants are not considered to bioaccumulate.	Bioaccumulation of contaminants within food items is considered possible if: 1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics worksheet) and concentrations in soils exceed the most conservative CCME soil quality guideline for the intended land use, or 2) The contaminant in collected tissue samples exceeds the Canadian Tissue Residue Guidelines.	
Distance to sensitive terrestrial ecological area 0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know	<div>0 to 300 m</div> <div>Score3</div>	An aquatic receiving environment is located adjacent to the Detachment site and would be considered as a sensitive ecological area.	It is considered that within 300 m of a site, there is a concern for contamination. Therefore an environmental receptor located within this area of the site will be subject to further evaluations. It is also considered that any environmental receptor located greater than 5 km will not be a concern for evaluation. Review Conservation Authority mapping and literature including Canadian Council on Ecological Areas link: www.ccea.org	Environmental receptors include: local, regional or provincial species of interest or significance; arctic environments (on a site specific basis); nature preserves, habitats for species at risk, sensitive forests, natural parks or forests.
Raw Terrestrial Total Potential	7	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
Allowed Terrestrial Total Potential	7			
B. Potential for ecological exposure (for the contaminated portion of the site)				
b) Aquatic i) Classification of aquatic environment Sensitive Typical Not Applicable (no aquatic environment present) Do Not Know	<div>Typical</div> <div>Score1</div>	The Fond du Lac River is considered a typical aquatic environment.	"Sensitive aquatic environments" include those in or adjacent to shellfish or fish harvesting areas, marine parks, ecological reserves and fish migration paths. Also includes those areas deemed to have ecological significance such as for fish food resources, spawning areas or having rare or endangered species. "Typical aquatic environments" include those in areas other than those listed above.	
ii) Uptake potential Does groundwater daylighting to an aquatic environment exceed the CCME water quality guidelines for the protection of aquatic life at the point of contact? Yes No (or Not Applicable) Do Not Know	<div>No</div> <div>Score0</div>	There is no evidence that impacted groundwater is daylighting to an aquatic environment. There are test holes between the impacted areas and the aquatic environment that do not show any evidence of impact.	Groundwater concentrations of contaminants at the point of contact with an aquatic receiving environment can be estimated in three ways: 1) by comparing collected nearshore groundwater concentrations to the CCME water quality guidelines (this will be a conservative comparison, as contaminant concentrations in groundwater often decrease between nearshore wells and the point of discharge). 2) by conducting groundwater modeling to estimate the concentration of groundwater immediately before discharge. 3) by installing water samplers, "peepers", in the sediments in the area of daylighting groundwater.	
Distance from the contaminated site to an important surface water resource 0 to 300 m 300 m to 1 km 1 to 5 km > 5 km Do Not Know	<div>0 to 300 m</div> <div>Score3</div>	The Fond du Lac River is located adjacent to the Detachment site.	It is considered that within 300 m of a site, there is a concern for contamination. Therefore an environmental receptor or important water resource located within this area of the site will be subject to further evaluation. It is also considered that any environmental receptor located greater than 5 km away will not be a concern for evaluation. Review Conservation Authority mapping and literature including Canadian Council on Ecological Areas link: www.ccea.org	Environmental receptors include: local, regional or provincial species of interest or significance, sensitive wetlands and other aquatic environment
Are aquatic species (i.e., forage fish, invertebrates or plants) that are consumed by predatory fish or wildlife consumers, such as mammals and birds, likely to accumulate contaminants in their tissues? Yes No Do Not Know	<div>No</div>	Given the presence of test holes between the impacted area and the surface water that do not show exceedances for the COPCs, it is considered unlikely that aquatic species are accumulating contaminants and then being consumed by predators.	Bioaccumulation of food items is possible if: 1) The Log(Kow) of the contaminant is greater than 4 (as per the chemical characteristics worksheet) and concentrations in sediments exceed the CCME ISQGs. 2) The contaminant in collected tissue samples exceeds the CCME tissue quality guidelines.	

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(III) Exposure (Demonstrates the presence of an exposure pathway and receptors)

RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan

Definition	Score	Rationale for Score (document any assumptions, reports, or site-specific information; provide references)	Method Of Evaluation	Notes
Score	0			
Raw Aquatic Total Potential	4	Note if a "Known" Ecological Effects score is provided, the "Potential" score is disallowed.		
Allowed Aquatic Total Potential	4			
4. Ecological Exposure Modifying Factors				
a) Known occurrence of a species at risk. Is there a potential for a species at risk to be present at the site? Yes No Do Not Know	Yes 2 ---	The project site is located adjacent to the Fond du Lac River, which may contain species at risk. Given the nature of activities on-site, it is possible for transient wildlife to be present on the RCMP Detachment site, however, habitat opportunities are severely limited.	Consult any ecological risk assessment reports. If information is not present, utilize on-line databases such as Eco Explorer, Regional, Provincial (Environment Ministries), or Federal staff (Fisheries and Oceans or Environment Canada) should be able to provide some guidance.	Species at risk include those that are extirpated, endangered, threatened, or of special concern. For a list of species at risk, consult Schedule 1 of the federal Species at Risk Act (http://www.sararegistry.gc.ca/species/schedules_e.cfm?id=1). Many provincial governments may also provide regional applicable lists of species at risk. For example, in British Columbia, consult: BCMWLP, 2005. Endangered Species and Ecosystems in British Columbia. Provincial red and blue lists. Ministry of Sustainable Resource Management and Water, Land and Air Protection (http://smwww.gov.bc.ca/atrisk/red-blue.htm)
Score	---			
b) Potential impact of aesthetics (e.g., enrichment of a lake or tainting of food flavor). Is there evidence of aesthetic impact to receiving water bodies? Yes No Do Not Know Is there evidence of olfactory impact (i.e., unpleasant smell)? Yes No Do Not Know Is there evidence of increase in plant growth in the lake or water body? Yes No Do Not Know Is there evidence that fish or meat taken from or adjacent to the site smells or tastes different? Yes No Do Not Know	No 0 --- No 0 --- No 0 --- No 0 --- No 0 ---	There is no evidence that the impacts on the property have impacted the aesthetics of the river. No olfactory impacts were detected during the Phase II ESA. No abnormal plant growth was observed during the Phase II ESA. There was no information found.	Documentation may consist of environmental investigation reports, press articles, petitions or other records. Examples of olfactory change can include the smell of a COPC or an increase in the rate of decay in an aquatic habitat. A distinct increase of plant growth in an aquatic environment may suggest enrichment. Nutrients e.g., nitrogen or phosphorous releases to an aquatic body can act as a fertilizer. Some contaminants can result in a distinctive change in the way food gathered from the site tastes or smells.	This item will require some level of documentation by user, including contact names, addresses, phone numbers, e-mail addresses. Evidence of changes must be documented, please attach copy of report containing relevant information.
Ecological Modifying Factors Total - Known	2			
Ecological Modifying Factors Total - Potential	---			
Raw Ecological Total - Known	2			
Raw Ecological Total - Potential	11			
Raw Ecological Total	13			
Ecological Total (Max 18)	13.0			
5. Other Potential Contaminant Receptors				
a) Exposure of permafrost (leading to erosion and structural concerns) Are there improvements (roads, buildings) at the site dependant upon the permafrost for structural integrity? Yes No Do Not Know Is there a physical pathway which can transport soils released by damaged permafrost to a nearby aquatic environment? Yes No Do Not Know	No 0 --- No 0 ---	No evidence of permafrost was observed at the property. There is no permafrost at the property.	Consult engineering reports, site plans or air photos of the site. When permafrost melts, the stability of the soil decreases, leading to erosion. Human structures, such as roads and/or buildings are often dependent on the stability that the permafrost provides. Melting permafrost leads to a decreased stability of underlying soils. Wind or surface run-off erosion can carry soils into nearby aquatic habitats. The increased soil loadings into a river can cause an increase in total dissolved solids and a resulting decrease in aquatic habitat quality. In addition, the erosion can bring contaminants from soils to aquatic environments.	Plants and lichens provide a natural insulating layer which will help prevent thawing of the permafrost during the summer. Plants and lichens may also absorb less solar radiation. Solar radiation is turned into heat which can also cause underlying permafrost to melt.
Other Potential Receptors Total - Known	0			
Other Potential Receptors Total - Potential	0			
Exposure Total				
Raw Human Health + Ecological Total - Known	8	Only includes "Allowed potential" - if a "Known" score was supplied under a given category then the "Potential" score was not included.		
Raw Human Health + Ecological Total - Potential	28			
Raw Total	36			
Exposure Total (max 34)	26.6			

CCME National Classification System (2008, 2010 v 1.2) **Score Summary**

Scores from individual worksheets are tallied in this worksheet.
Refer to this sheet after filling out the revised NCS completely.

I. Contaminant Characteristics	Known	Potential
1. Residency Media	4	---
2. Chemical Hazard	8	---
3. Contaminant Exceedance Factor	4	---
4. Contaminant Quantity	2	---
5. Modifying Factors	4	---
Raw Total Score	22	0
Raw Total Score (Known + Potential)	22	
Adjusted Total Score (Raw Total / 40 * 33)	18.2	(max 33)

II. Migration Potential	Known	Potential
1. Groundwater Movement	---	9.1
2. Surface Water Movement	0	---
3. Soil	12	---
4. Vapour	---	12
5. Sediment Movement	0	---
6. Modifying Factors	4	0
Raw Total Score	16	21.1
Raw Total Score (Known + Potential)	37.1	
Adjusted Total Score (Raw Total / 64 * 33)	19.1	(max 33)

III. Exposure	Known	Potential
1. Human Receptors		
A. Known Impact	---	
B. Potential		
a. Land Use		2
b. Accessibility		2
c. Exposure Route		
i. Direct Contact		3
ii. Inhalation		4
iii. Ingestion		6
2. Human Receptors Modifying Factors	6	---
Raw Total Human Score	6	17
Raw Total Human Score (Known + Potential)	23	
Adjusted Total Human Score	22.0	(maximum 22)
3. Ecological Receptors		
A. Known Impact	---	
B. Potential		
a. Terrestrial		7
b. Aquatic		4
4. Ecological Receptors Modifying Factors	2	---
Raw Total Ecological Score	2	11
Raw Total Ecological Score (Known + Potential)	13	
Adjusted Total Ecological Score	13.0	(maximum 18)
5. Other Receptors	0	0
Total Other Receptors Score (Known + Potential)	0	
Total Exposure Score (Human + Ecological + Other)	35.0	
Adjusted Total Exposure Score (Total Exposure / 46 * 34)	25.9	(max 34)

Site Score	
RCMP Stony Rapids Detachment Site, Stony Rapids, Saskatchewan	
Site Letter Grade	C
Certainty Percentage	75%
% Responses that are "Do Not Know"	2%
Total NCSCS Score for site	63.1
Site Classification Category	2

Site Classification Categories*:

- Class 1 - High Priority for Action (Total NCS Score >70)
- Class 2 - Medium Priority for Action (Total NCS Score 50 - 69.9)
- Class 3 - Low Priority for Action (Total NCS Score 37 - 49.9)
- Class N - Not a Priority for Action (Total NCS Score <37)
- Class INS - Insufficient Information (>15% of responses are "Do Not Know")

* NOTE: The term "action" in the above categories does not necessarily refer to remediation, but could also include risk assessment, risk management or further site characterization and data collection.



**SUPPLEMENTAL SAMPLING PROGRAM
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Submitted to:
Public Works and Government Services Canada
100 – 167 Lombard Street
Winnipeg, Manitoba R3C 2Z1

Attention: Ms. Joan La Rue-van Es

Submitted by:
Amec Foster Wheeler Environment & Infrastructure
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Regina, Saskatchewan
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March 2015

Amec Foster Wheeler Project No: SX04344PRW

EXECUTIVE SUMMARY

Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler), was retained by Public Works and Government Services Canada (PWGSC) Environmental Services Department to conduct a supplemental sampling program at the Royal Canadian Mounted Police (RCMP) detachment in Stony Rapids, Saskatchewan, herein referred to as the Site. The purpose of the supplemental sampling program was to delineate previously identified petroleum hydrocarbon (PHC) and polycyclic aromatic hydrocarbon (PAH) impacts, as well as to collect site information in order to complete a Preliminary Quantitative Human Health Risk Assessment (PQHHRA) and Ecological Risk Assessment (ERA) and determine a National Classification System for Contaminated Sites (NCSCS) score.

At the time of the investigation, the Site and surrounding areas were snow covered.

Between 2012 and 2013, three separate environmental assessments were completed at the Site. In 2012, Stantec Consulting Ltd. completed a Phase I ESA and EGE Engineering Ltd. completed a Phase II ESA. Tetra Tech WEI Inc. completed a Phase III ESA in 2013.

The previous assessments identified two areas of environmental concern (AEC). AEC 1, an area located around a former heating oil underground storage tank (UST) was determined to have an estimated 36 cubic meters (m³) of petroleum hydrocarbon (PHC) impacted soils. AEC 2, an area located around a former gasoline UST and current gasoline aboveground storage tank (AST) was determined to have an estimated 192 m³ of PHC and naphthalene impacted soils. Chamberlain

The PQHHRA, ERA and NCSCS will be reported under separate cover.

The Site was classified as a residential land use with a coarse grain soil nature under the definitions of Canadian Council of Ministers of the Environment (CCME). The appropriate CCME guidelines for the protection of human health and the environment for benzene, toluene, ethylbenzene, xylenes (BTEX), PHC concentrations of fractions F1 to F4, and polycyclic aromatic hydrocarbons (PAH), including naphthalene, were selected. Applicable surface water assessment guidelines under CCME, based on freshwater aquatic life exposure pathway, were also employed. The CCME guidelines were augmented by the Alberta Environment and Sustainable Resource Development (ESRD) Tier II remediation surface water guidelines for parameters without CCME guidelines.

The Amec Foster Wheeler supplemental soil sampling program was completed on 9 and 10 December 2014 and consisted of the advancement of six test holes (TH01-14 to TH06-14) to a maximum depth of 3.2 m below grade level (bgl). All test holes were terminated due to auger refusal on suspected bedrock or cobbles at depths ranging from 0.9 m to 3.2 m bgl.

The soil profile encountered at the test hole locations generally consisted of sand from ground surface to 3.2 m bgl (the maximum assessment depth). Test holes TH05-14 and TH06-14 had a surface cover of grass and topsoil in the top 0.15 m overlying the sand. The sand was observed to contain some gravel and trace silt, was well graded, medium grained, damp, medium dense and reddish brown in color. Frequent cobbles were identified approximately 0.3 m from the final depth of the test holes.

The maximum soil vapour concentration encountered during the test hole drilling was 55 parts per million combustible vapours (ppm_v) in TH03-14 at a depth of 1.4 m bgl. The remaining soil vapour concentrations did not exceed 35 ppm_v. Soil staining was not observed in any of the test holes.

A total of 14 soil samples were submitted for laboratory analysis of BTEX, PHC Fraction F1 to F4 and PAHs. All constituent concentrations were not detected above the laboratory's method detection limits, and therefore did not exceed the applicable assessment guidelines.

As part of the supplemental sampling program, existing groundwater monitoring wells were monitored for combustible headspace vapour concentrations and depth to groundwater. Monitoring well headspace vapour concentrations ranged from non-detectable (<5ppm_v) in monitoring wells SR-01, SR-17, SR-18 and SR-24 to 110 ppm_v in monitoring well SR-22. Groundwater samples were not collected as all monitored wells were found to be dry.

Surface water samples were collected from three locations along the Fond du Lac River. One sample was collected approximately 80 m upstream of AEC 2 (SWS3-14), one sample was collected approximately 50 m downstream of AEC 2 (SWS2-14) and one sample was collected cross gradient to AEC 2 (SWS1-14).

At the time of the Site visit, the Fond du Lac River was frozen along the banks with fast flowing open water in the middle of the river.

Testing of the ice indicated that the river was sufficiently frozen along the banks extending out between 2 and 10 m. Surface water sample SWS1-14 was collected approximately 10 m from the edge of the river, SWS2-14 was collected approximately 7 m from the edge of the river, and SWS3-14 was collected approximately 3m from the edge of the river.

All three surface water samples were submitted for laboratory analysis for BTEX and PHC fraction F1 and PAHs. All PHC and PAH constituents were not detected above the laboratory's method detection limits, with exception of one toluene detection at the method detection limit, and therefore did not exceed the applicable assessment guidelines.

Sediment samples were scheduled to be collected at the same time and locations as the surface water samples. As surface water samples were collected away from shore, sediments could not be accessed at the sample locations for sampling.

Seepage/spring water samples were to be collected from the toe of the embankment adjacent to AEC 2. Seepage/spring water was not observed at the time of the Site visit, due to winter/frozen conditions.

As no further impacts were identified outside test holes SR-03, SR-20, SR-22, SR-24 and SR-25 in AEC 2, it appears delineation of AEC 2 has been achieved both horizontally and vertically to the south, southeast, and a portion of the north and northeast. The PQHHRA and ERA at the Site (Amec Foster Wheeler 2015) did not identify any data gaps in the sampling data indicating the previously estimated volume of impacted soils (AEC 2 – 192 m³) is still valid.

In Amec Foster Wheeler's opinion, further assessment work is not required to prioritize the Site for further work

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1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler), was retained by Public Works and Government Services Canada (PWGSC) Environmental Services Branch (ES) to conduct a supplemental sampling program at the Royal Canadian Mounted Police (RCMP) detachment in Stony Rapids, Saskatchewan, herein referred to as the Site.

The purpose of the supplemental sampling program was to delineate previously identified petroleum hydrocarbon (PHC) and polycyclic aromatic hydrocarbon (PAH) impacts, as well as to collect site information in order to complete a Preliminary Quantitative Human Health Risk Assessment (PQHHRA) and Ecological Risk Assessment (ERA) and determine a National Classification System for Contaminated Sites (NCSCS) score.

The Preliminary Quantitative Human Health Risk Assessment (PQHHRA) and Ecological Risk Assessment (ERA) will be reported under separate cover.

The location of the Site and surrounding land use are shown on Figure 1 (Appendix A) and land usage is summarized on Table 1 (Appendix B).

1.1 SITE AND SURROUNDING LAND USE

The RCMP detachment in Stony Rapids is located at the north end of Johnson Street along the eastern shoreline of the Fond du Lac River. The Site consists of the Detachment building with an associated garage and two RCMP employee dwellings with an associated work shop all enclosed within a chain link fence. Additional RCMP employee housing was situated south of the main compound followed by the community Water Treatment Plant. The area of investigation was located at the north east corner of the fenced compound

The surrounding land uses as observed at the time of the fieldwork are summarized in Table 1 (Appendix B) and shown on Figure 1 (Appendix A). The Site details are shown on Figure 2 (Appendix A). Site photographs are provided in Appendix C.

2.0 BACKGROUND

The Site is located at the north end of Johnson Street within the Town of Stony Rapids, approximately 800 kilometers (km) north of Saskatoon, Saskatchewan. The Fond du Lac River borders the north and northwest property limits. The Site consists of one irregularly shaped land parcel with a total area of approximately 0.50 hectares (ha). Five buildings are present on the Site; including the Detachment building, two employee housing units, a garage, and a workshop.

Previous environmental assessments for the Site include:

- Phase I Environmental Site Assessment - Stony Rapids RCMP Detachment and Attached Housing, Garage, Workshop and Two Employee Housing Facilities. DRRP# 14862, Stony Rapids, Saskatchewan. Prepared by Stantec Consulting Ltd. January 2012.
- Phase II Environmental Site Assessment RCMP Stony Rapids Detachment Site, DFRP 14862, Stony Rapids, Saskatchewan. Completed by EGE Engineering Ltd. 2012.
- 2013 Phase III Environmental Site Assessment, RCMP Detachment Site, Stony Rapids, Saskatchewan. Completed by Tetra Tech WEI Inc. 2013.

The reports identified two Areas of Environmental Concern (AEC) including:

- AEC 1: An estimated 36 cubic metres (m³) of PHC impacted soil was identified in the vicinity of the former 4,500 litre (L) heating oil underground storage tank (UST). The heating oil UST was located north of the Detachment building and was removed sometime between 1989 and 1993.

Guideline exceedances in soil samples collected from the area of AEC 1 (depths included in parenthesis) included:

- SR-08-3 (1.5 m)
 - toluene (0.9 mg/kg) exceeding guideline of 0.1 mg/kg;
 - PHC Fraction F1 (300 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (2500 mg/kg) exceeding guideline of 150 mg/kg.
- SR-08-6 (3.3 m)
 - toluene (2.3 mg/kg) exceeding guideline of 0.1 mg/kg;
 - xylenes (20 mg/kg) exceeding guideline of 16 mg/kg;
 - PHC Fraction F1 (440 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (2500 mg/kg) exceeding guideline of 150 mg/kg.

Guideline exceedances in groundwater samples collected from the area of AEC 1 included:

- SR-08
 - toluene (0.81 mg/L) exceeding guideline of 0.083 mg/L;
 - PHC Fraction F1 (3.9 mg/L) exceeding guideline of 0.81 mg/L; and
 - PHC Fraction F2 (17 mg/L) exceeding guideline of 1.3 mg/L.

- AEC 2: An estimated 192 m³ of PHC and naphthalene impacted soil was identified in the vicinity of the former 4,500 L gasoline UST and current gasoline aboveground storage tank (AST) north of the driveway leading to the Detachment garage. It is unknown if the former gasoline UST was abandoned in place or removed. The soil impacts were not fully delineated.

Guideline exceedances in soil samples collected from the area of AEC 2 (depths included in parenthesis) included:

- SR-03-1 (0.3 m)
 - naphthalene (0.087 mg/kg) exceeding guideline of 0.013 mg/kg.
- SR-03-2 (0.75 m)
 - benzene (0.16 mg/kg) exceeding guideline of 0.095 mg/kg;
 - toluene (0.89 mg/kg) exceeding guideline of 0.1 mg/kg; and
 - PHC Fraction F3 (1300 mg/kg) exceeding guideline of 300 mg/kg.
- SR-20 (0.75 m)
 - PHC Fraction F2 (1500 mg/kg) exceeding guideline of 150 mg/kg.
- SR-22 (0.3 m)
 - naphthalene (0.033) exceeding guideline of 0.013 mg/kg.
- SR-22 (0.75 m)
 - naphthalene (0.36 mg/kg) exceeding guideline of 0.013 mg/kg;
 - PHC Fraction F1 (50 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (230 mg/kg) exceeding guideline of 150 mg/kg.
- SR-22 (3 m)
 - naphthalene (3.8 mg/kg) exceeding guideline of 0.013 mg/kg;
 - toluene (1.1 mg/kg) exceeding guideline of 0.1 mg/kg;
 - xylenes (120 mg/kg) exceeding guideline of 16 mg/kg;
 - PHC Fraction F1 (360 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (220 mg/kg) exceeding guideline of 150 mg/kg.
- SR-22 (3.75 m)
 - naphthalene (3.2 mg/kg) exceeding guideline of 0.013 mg/kg;
 - toluene (0.3 mg/kg) exceeding guideline of 0.1 mg/kg;
 - xylenes (62 mg/kg) exceeding guideline of 16 mg/kg;
 - PHC Fraction F1 (190 mg/kg) exceeding guideline of 30 mg/kg; and
 - PHC Fraction F2 (200 mg/kg) exceeding guideline of 150 mg/kg.

- SR-24 (0.3 m)
 - naphthalene (0.019 mg/kg) exceeding guideline of 0.013 mg/kg;
- SR-24 (0.75 m)
 - naphthalene (0.016 mg/kg) exceeding guideline of 0.013 mg/kg;
- SR-25 (1.0 m)
 - naphthalene (0.030 mg/kg) exceeding guideline of 0.013 mg/kg;
- SR-25 (1.3 m)
 - naphthalene (0.16 mg/kg) exceeding guideline of 0.013 mg/kg;

3.0 SCOPE OF WORK

Based on the provided Terms of Reference (TOR) and a review of the provided environmental reports for this project, the following scope of work was proposed:

- Complete a safety file;
- Conduct ground disturbance / utility locates at the Site;
- Complete up to 10 test holes at the Site in the vicinity of AEC 2. It was anticipated that up to seven test holes would be completed with a track mounted direct push drill rig and that up to three test holes would be completed with a hand auger.
 - Soil samples were to be collected at 0.6 m intervals and classified according to the Modified Unified Soil Classification system;
- Monitor existing monitoring wells and collect up to four groundwater samples (if groundwater was encountered);
- Collect up to four seepage/spring water samples (if discharging along sloped embankment between the Site and the Fond Du Lac River);
- Collect up to four surface water samples from the Fond du Lac River.
- Collect up to four sediment samples from the shore of the Fond du Lac River.
- Submit soil, groundwater, surface water and sediment samples for laboratory analysis to ALS Laboratory Group in Saskatoon, Saskatchewan for:
 - PHC constituents; BTEX and the CCME PHC fractions F1 to F4.
 - PAHs including naphthalene.
- Collect survey elevations of the Site and surrounding area including the Fond du Lac River and sloped embankment to assess the profile/gradient.
- Complete a report summarizing field methodology, results and significance of findings (PQHHRA, ERA and NCSCS will be reported under separate cover).

The scope of work was completed as per Amec Foster Wheeler's proposal S14-P3929 with the exception of the following:

- Hand auger test holes were not advanced at the Site due to frozen ground conditions, cobbles and tree roots. Four test holes were drilled using solid stem auguring as direct push was determined to be ineffective in the soil conditions. In total, six test holes were advanced;
- Due to the frost and unexpected auger refusal, some samples were collected at irregular depths where it was deemed appropriate by Amec Foster Wheeler field personnel;
- Groundwater samples were not collected as monitored groundwater wells were found to be dry;
- Seepage/spring water samples were not collected due to frozen/winter conditions;
- Sediment samples were not collected as thick, near shore ice forced the collection of surface water samples towards the middle of the river where sediment could not be accessed; and
- Area survey was not completed due to equipment malfunction.

4.0 METHODOLOGY

4.1 SAFETY

Prior to the start of the supplemental sampling program, Amec Foster Wheeler contacted SaskTel, SaskPower, SaskEnergy and the Hamlet of Stony Rapids to identify and mark their individual services.

A pre-job safety meeting was conducted by Mr. Justin Huberdeau of Amec Foster Wheeler at the Site with the drilling company personnel to outline the scope of work, chemical and physical hazards, required personal protective equipment and drill rig safety.

4.2 SURROUNDING LAND USE

A survey of surrounding land uses was conducted as part of the Site visit. The purpose of the survey was to identify specific land uses (i.e. agricultural, residential, commercial or industrial) adjacent to the Site to establish the applicable land use criteria.

4.3 SOIL SAMPLING PROGRAM

The Amec Foster Wheeler supplemental soil sampling program was completed on 9 and 10 December 2014 and consisted of the advancement of six test holes (TH01-14 to TH06-14), completed to a maximum depth of 3.2 m bgl. The test holes were advanced with a track mounted geoprobe drill rig, supplied and operated by Intercore Environmental of Maidstone, Saskatchewan. The area of investigation was located at the north east corner of the fenced compound, adjacent to an existing gasoline AST. All test holes advanced as part of this

investigation were completed outside the chain link fence. Test holes TH01-14 through TH04-14 were completed within gravelled portions of Johnson Street and test holes TH05-14 and TH06-14 were completed within grassy areas adjacent to Johnson Street and north of the AST and fence line. The test hole locations are shown on Figure 2 (Appendix A).

Soil samples from TH01-14 and TH02-14 were collected through the use of track-mounted DT drill rig equipped with 82.5 mm direct push tooling. However due to deep frost and granular ground conditions, the direct push method was ineffective and was abandoned in favour of a 152 millimetre (mm) diameter solid stem auger for the remaining test holes. Soil samples were collected as disturbed samples from the auger bit.

Soil samples from TH01-14, TH02-14, TH05-14 and TH06-14 were collected at approximate depth intervals of 0.3 m, while samples from TH03-14 and TH04-14 were collected at approximate 0.6 m intervals. All soil samples were classified according to the Modified Unified Soil Classification system and visually assessed for evidence of impact.

Soils samples for potential PHC and PAH analysis were collected and split into two portions. One portion was placed in 120 millilitre (mL) glass jars equipped with Teflon® lined lids with zero headspace (for possible laboratory analyses) and one laboratory grade soil bag (for field screening of combustible vapours). Disposable nitrile gloves were used during the sample handling. The sample jars were labeled according to a pre-determined sample identification protocol and stored in an insulated cooler with ice while on Site and during transport to the laboratory.

Soil samples were field screened for volatile PHC vapours using ambient temperature headspace (ATH) techniques and an RKI Eagle combustible vapour analyzer set in the no methane response mode. The ATH method involves partially filling and sealing a plastic bag with soil and allowing the vapours to accumulate at ambient temperatures prior to analyzing the headspace. Accumulated vapours were measured in parts per million total combustible vapours (ppmv). The field protocols and quality assurance/quality control (QA/QC) procedures utilized were in accordance with standard industry protocols.

4.4 GROUNDWATER MONITORING WELL SAMPLING PROGRAM

As part of the supplemental sampling program, existing groundwater monitoring wells were monitored for combustible headspace vapour concentrations and depth to groundwater. Groundwater samples were not collected as all monitored wells were found to be dry.

Well headspace vapour concentrations were measured with an RKI Eagle vapour analyzer set in the methane elimination mode.

4.5 SURFACE WATER SAMPLING PROGRAM

Surface water samples were collected from three locations along the Fond du Lac River. One sample was collected approximately 80 m upstream of AEC 2 (SWS3-14), one sample was collected approximately 50 m downstream of AEC 2 (SWS2-14) and one sample was collected cross gradient to AEC 2 (SWS1-14).

At the time of the Site visit the Fond du Lac River was frozen along the banks with fast flowing open water in the middle of the river.

Care was taken to ensure proper ice thickness was present before sampling was attempted. The Metric Gold Formula, used by Manitoba Transportation and Government Services, was used as a guide. Holes were advanced through the ice, the thickness was measured and compared to the bearing capacity chart.

Testing of the ice indicated that the river was sufficiently frozen along the banks extending out between 2 and 10 m. Surface water sample SWS1-14 was collected approximately 10 m from the edge of the river, SWS2-14 was collected approximately 7 m from the edge of the river and SWS3-14 was collected approximately 3m from the edge of the river.

4.6 SEDIMENT SAMPLING PROGRAM

Sediment samples were scheduled to be collected at the same time and locations as the surface water samples. Winter conditions encountered during the field program included the river shoreline consisting of only ice along the edge of the river. The locations where water was available to collect was overlain by approximately 0.3 m of hardpack snow and approximately 0.6 m of ice. Sediment sampling equipment was not able reach the sediment for sample collection from the depths encountered at the edge of the ice.

4.7 SEEPAGE/SPRING WATER SAMPLING PROGRAM

Seepage/spring water samples were to be collected from the toe of the embankment adjacent to AEC 2. Seepage/spring water was not observed at the time of the Site visit, due to winter/frozen conditions.

4.8 LABORATORY ANALYSIS

A total of 17 samples, plus one duplicate soil sample, were submitted for laboratory analysis to ALS Environmental in Saskatoon, Saskatchewan.

Gasoline and heating oil associated with historical operations at the Site were the contaminants of concern (COC); therefore, the laboratory program was developed to include the analyses of BTEX, PHC fractions F1-F4 and PAH constituents, including naphthalene, for soil and water.

ALS's laboratory in Saskatoon is certified with the Canadian Association for Laboratory Accreditation Inc. (CALA) to ISO/IEC 17025. The laboratory QA/QC is provided in Appendix E.

5.0 ASSESSMENT CRITERIA

5.1 GENERAL

Environmental assessment on Canadian Federal sites is based on the assessment criteria produced by CCME. The following documents produced by CCME were selected as being applicable to the Site based on the contaminants of concern.

- CCME Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil, 2001, revised 2008; and
- CCME Canadian Environmental Quality Guidelines, 1999 (updates to 2014).

Based on the above current CCME documents (and their precursors), Amec Foster Wheeler conducted an evaluation of the applicable exposure pathways, land uses, key receptors and predominant soil texture at the Site. The sensitivity assessment was conducted in accordance with current CCME guidelines and did not include the modification or recalculation of the formulas used to derive the criteria values.

5.2 LAND USE

The CCME 2008 has been developed for four generic land uses - agricultural, residential / parkland, commercial, and industrial, that has been adopted within these guidelines. A generic exposure scenario is envisioned for each land use category based on the normal activities on these lands. The four land use default exposure scenarios as defined by CCME are:

Agricultural lands: Agricultural land encompasses a wide range of activities including dairy, livestock and/or crop production. Most farms include a homestead, so the possible presence of an onsite residence (similar to those specified for residential/parkland sites, below) is considered in the default scenario. Agricultural lands are generally accessible by the farmer and his/her family members, including children, which represent the more sensitive human receptor category. Therefore, the critical human receptor in the agricultural land use category is assumed to be a toddler who receives 100% of his/her daily intake of soil and drinking water (groundwater) from the property.

Residential/Parkland: The generic residential property is a typical detached, single family home with a backyard where children, particularly toddlers, play. The critical receptor assumed on a residential property is a toddler who receives 100% of his/her daily intake of soil, drinking water (groundwater), and air (indoors) from the property. Separate guidelines have been developed for two house foundation construction styles; below-grade concrete foundation wall and floor slab (basement) and concrete slab-on-grade foundation. Parks may serve as areas for children's play and other family activities and are therefore also included in the residential land use category.

Commercial: Commercial properties span a wide variety of uses with varying degrees of public access. For purposes of criteria, the generic commercial property is assumed to contain a daycare facility, a sensitive commercial property use that is permitted in many municipal jurisdictions in Canada. It is assumed that the critical receptor (toddler) spends a substantial portion of the weekdays at a daycare. In particular, it is assumed that the toddler spends 10 hours per day, 5 days per week for 48 weeks per year at the daycare. The toddler thereby receives an amount of his/her daily intake of drinking water (groundwater), and air (indoors) from the commercial property proportional to the number of hours per day, days per week and weeks per year spent at the facility. Intake via direct contact with soil (soil ingestion and dermal contact) is proportional to the days per week and weeks per year spent at the facility. Most commercial buildings are constructed with concrete slab-on-grade foundations.

Industrial: Industrial properties span a wide variety of uses but generally do not permit direct public access and therefore, children are not likely or frequently present. For purposes of deriving criteria, the generic industrial property is assumed to be a site with a building frequented by an adult worker who spends 10 hours per day, 5 days per week for 48 weeks per year on the property. The adult receptor thereby receives an amount of his/her daily intake of drinking water (groundwater), and air (indoors) from the industrial property proportional to the number of hours per day, days per week and weeks per year spent at the facility. Intake via direct contact with soil (soil ingestion and dermal contact) is proportional to the days per week and weeks per year spent at the facility. Most industrial buildings are constructed with concrete slab-on-grade foundations.

At present, the Site contains a RCMP Detachment building with an associated detached garage and RCMP residential dwellings with an associated detached work shop.

The surrounding land use consists of the Fond du Lac River to the north and west, Johnson Street to the east followed by residential / parkland land use and additional RCMP residential dwellings followed by the Hamlet of Stony Rapids water treatment plant to the south.

As the exposure scenario with respect to the residential dwelling at the Site most closely equate with the CCME residential description, Amec Foster Wheeler has chosen the residential land use criteria for the purposes of this assessment. This designation also matches the previous investigations guideline selection.

5.3 GRAIN SIZE DESIGNATION

The CCME guidelines have been developed for coarse-grained and fine-grained soils for PHC assessments. Fine-grained soils are defined as having a median grain size of less than or equal to 75 µm; coarse-grained soils have a median grain size of greater than 75 µm. Where both fine and coarse grained strata are present, the dominant soil particle size is determined by the stratum governing horizontal and vertical migration to a receptor.

Grain size analysis was conducted as part of the previous investigations in 2012 and 2013. In total, eight soil samples were submitted from the Site, seven of which had greater than 50% of soil grains retained on the 75 µm sieve, indicating a coarse grained soil.

Therefore, based on previous grain size analysis results and visual inspection of soil samples collected in the field, a coarse grain soil designation was assigned to the Site for the purposes of this assessment.

5.4 APPLICABLE EXPOSURE PATHWAYS

CCME recognizes two soil horizons; surface soil and subsoils for PHC assessments. As indicated in CCME's 2009 A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines, surface soil is inclusive of all unconsolidated regolith material from the surface to 1.5 m (≤ 1.5 m depth) and subsoils includes the unconsolidated regolith material located below 1.5 m (>1.5 m depth). Exposure pathways are assessed individually for both horizons.

PAH assessment is independent of depth and, therefore, the soil horizons are not applied.

5.4.1 Human Exposure Pathways

Potential human exposure pathways include the direct contact, vapour inhalation, and protection of groundwater for potable use. The applicability of each of these potential exposure pathways are discussed in the following sections.

5.4.1.1 Direct Contact (Soil Ingestion, Dermal Contact and Soil Inhalation) Pathway

The Site is surfaced with a cover of gravel and grass. The surface cover would not provide a suitable barrier to direct contact with the soil. Therefore, to be protective from all potential direct contact exposure, the direct contact (soil ingestion, dermal contact, and soil inhalation) pathway would be considered applicable to the surface soil horizon.

The direct contact pathway is not considered applicable for the subsoil as the surface soil creates a suitable barrier to avoid contact. Additionally, CCME's Canadian Environmental Quality Guideline (EQC) has not calculated exposure guidelines for soil ingestion and dermal contact in the subsoil horizon. It is assumed that any ground disturbance in which soils at depth previously not accessible are brought to ground surface would result in short term exposure and not be considered applicable to the exposure models in which the CCME guidelines are derived.

5.4.1.2 Vapour Inhalation Pathway

The indoor vapour inhalation (slab of grade) pathway would be considered applicable to both the surface and subsoil horizons at the Site as there are several occupied buildings with inferred slab on grade foundations located on or near the site.

5.4.1.3 Protection of Potable Groundwater

A search of the Water Security Agency of Saskatchewan (WSASK) water well on-line database at a radius of 3 km from the hamlet of Stony Rapids was conducted. The database indicated that there are no registered wells within the search area.

CCME considers all water bearing units as a potential potable groundwater resource, however CCME defines a water bearing unit as having a hydraulic conductivity of greater than 10^{-4} cm/s. Furthermore, most provincial jurisdictions recognize the division between impacted soil and groundwater that is not hydraulically connected to an underlying aquifer. A five meter thickness of massive unfractured saturated fine-grained material, with a bulk hydraulic conductivity less than 10^{-5} cm/s, is considered sufficient to ensure isolation of groundwater aquifers.

Based on the stratigraphy observed in the subsurface investigation, the soil above the bedrock is made up of primarily granular soils and therefore would not be considered a sufficient subsurface barrier.

The community of Stony Rapids is supplied drinking water by a central water distribution system. The water distribution system obtains raw water from the Fond du Lac River at a point approximately 300 m upstream of the Site, as shown on Figure 2 (Appendix A).

Based on the lack of utilization of the shallow groundwater in the area and the existence of a municipal water distribution system which originates upstream of the Site, there is sufficient evidence to consider the protection of potable water exposure pathway not applicable to the Site.

5.4.2 Ecological Exposure Pathways

Potential ecological exposure pathways include the ecological soil contact and freshwater aquatic life pathways. The applicability of each of these potential exposure pathways are discussed in the following sections.

5.4.2.1 Ecological Soil Contact Pathway

The ecological soil contact pathway would be considered applicable to be protective of potential ecological receptor exposure, from terrestrial and subterranean organisms and plant root systems, to soils in the surface soil horizon as the Site is surfaced with gravel and grass which does not provide a suitable ground barrier.

Ecological receptor direct contact exposure to soils in the subsoil horizon is not considered applicable as the surface soil creates a suitable barrier to avoid subsoil ecological contact from organisms at the ground surface and the subsoil horizon is not typically suitable to support invertebrates or burrowing mammals.

5.4.2.2 Soil / Food Ingestion

CCME states that soil and food ingestion by cows as a representative livestock species for agricultural sites, and mule deer, meadow voles and American robins as representative wildlife species for residential/parkland sites, are considered in assessing potential impacts. The grassed areas on Site present exposure pathways to small wildlife and birds. As a result, the soil / food ingestion pathway is considered applicable on the Site.

5.4.2.3 Freshwater Aquatic Life Pathway

CCME states that the freshwater aquatic life pathway may be excluded in cases where there is no surface water body within 10 m of a site classified as fine grained and 500 m of a site classified as coarse grain for PHC components. The freshwater aquatic life pathway is excluded in cases where there is no surface water body within 500 m for all other parameters. If a surface water body is within 500 m, it must be assessed to determine whether the freshwater aquatic life pathway is applicable.

As the Fond du Lac River is located within approximately 20 m to the north and west of the Site, the freshwater aquatic life pathway is considered to be applicable at the Site.

5.4.3 Miscellaneous Criteria

As residential land use criteria are applicable to the Site, off-site migration check and soil management limits as produced by CCME for PHCs are required to be assessed to determine if they are applicable to the assessment.

5.4.3.1 Off-Site Migration Check

As there are no neighbouring properties with a more sensitive land use designation the off-site migration check does not apply to the Site.

5.4.3.2 *Management Limit*

The management limits for PHCs applies for soils in the surface soil and subsoil horizon.

5.4.3.3 *CCME 1991 Interim Criteria*

CCME initially developed interim criteria for many potential contaminants in 1991. With the publishing of the Canadian Environmental Quality Guidelines in 1999 (and subsequent updates), CCME adopted a risk based scientific approach to determining soil quality guidelines. While many of the interim criteria have been superseded by scientifically derived guidelines, there are still contaminants, including several PAH parameters, in which new guidelines have not yet been developed for all exposure pathways and, in some cases, the interim criteria still remain as the only guideline for assessment comparison. Note that even though some interim criteria are more stringent, the scientifically derived guidelines are considered more defensible and therefore will take precedent over the interim criteria.

5.5 SUMMARY OF APPLICABLE GUIDELINES

Given the residential land use designation of the Site, the coarse-grained nature of the soil, and the applicable exposure pathways as outlined in the previous sections, Amec Foster Wheeler determined assessment guidelines for each contaminant of concern. The most stringent of the applicable exposure pathway guideline values as produced by CCME was used for each contaminant for both the surface soil and subsoil horizons.

Petroleum Hydrocarbon (PHC) Soil Guidelines

Above 1.5 m below grade:

Residential values for coarse grained surface soil in a non-potable groundwater situation as limited by the:

- Indoor Vapour Inhalation (Slab on Grade) exposure pathway for benzene, xylenes and PHC Fraction F1;
- Freshwater Aquatic Life exposure pathway for toluene and ethylbenzene; and
- Ecological Soil Contact exposure pathway for PHC Fractions F2-F4.

Below 1.5 m below grade:

Residential values for coarse grained subsoil in a non-potable groundwater situation as limited by the:

- Indoor Vapour Inhalation (Slab on Grade) exposure pathway for benzene, xylenes and PHC Fractions F1 and F2;
- Freshwater Aquatic Life exposure pathway for toluene and ethylbenzene; and

- Management Limits for PHC Fractions F3 and F4.

The CCME Soil Quality Guideline for benzene provides for both a 10^{-6} (1 in 1,000,000) and 10^{-5} (1 in 100,000) incremental risk of cancer. The results obtained in this soil investigation will be compared to the 10^{-5} incremental risk guideline.

Petroleum Hydrocarbon (PHC) Surface Water Guidelines

- CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life for benzene, toluene and ethylbenzene; and
- As there are no CCME surface water guidelines for xylenes and PHC Fractions F1 to F4, Amec Foster Wheeler has referenced the Alberta Government "Environmental Quality Guidelines for Alberta Surface Waters" for xylenes and PHC fractions F1 and F2.

Polycyclic Aromatic Hydrocarbon (PAH) Soil Guidelines

Residential values for soils in a non-potable groundwater situation as limited by the:

- Soil Contact exposure pathway for anthracene and B(a)p TEP;
- Soil and Food Ingestion exposure pathway for benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, and pyrene;
- Protection of Freshwater Life exposure pathway for acenaphthene, acenaphthylene, fluorene, naphthalene and phenanthrene; and
- Interim Soil Quality Criteria (CCME 1991) for dibenz(a,h)anthracene, and ideno(1,2,3-cd) pyrene.

Polycyclic Aromatic Hydrocarbon (PAH) Surface Water Guidelines

- CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life for acenaphthene, acridine, anthracene, benz(a)anthracene, benzo(a)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene and quinoline.

The applicable residential assessment guidelines are shown in Table 2 (Appendix B).

6.0 ASSESSMENT RESULTS

6.1 SERVICE LOCATIONS

The Site has many public and private underground utilities present. For this investigation, only relevant underground utility lines near and adjacent to the test hole locations are referenced.

Private underground electrical lines were identified running north-south along the eastern property limit as well as running east-west from the AST to the northeast corner of the garage along the northern property limit.

Portions of the town's sewer and water supply system were identified running north-south down the middle of Johnston Street.

All Site services utility locations are shown on Figure 2 (Appendix A).

6.2 SOIL CONDITIONS

6.2.1 Regional Geology

The Stony Rapids area covers a geologic area of approximately 12,800 km² and is broken down into four distinct geological areas: Mudjatik Domain (east), Dodge Domain (northwest), Tantato Domain (west) and Athabasca Group (south) (Gilboy & Ramaekers, 1981). The Mudjatik, Dodge and Tantato Domains are separated by major shear zones and are made up of crystalline basement rocks. The Athabasca Group unconformably overlies the basement in the southern portion of the area.

6.2.2 Stratigraphy

The soil profile encountered at the test hole locations (TH01-14 through TH06-14) generally consisted of sand from ground surface to 3.2 m bgl (the maximum assessment depth). Test holes TH05-14 and TH06-14 had a surface cover of grass and topsoil in the top 0.15 m overlying the sand.

The sand was found to contain some gravel and trace silt, was well graded, medium grained, damp, medium dense and reddish brown in color. Frequent cobbles were identified approximately 0.3 m from the final depth of the test holes. All test holes were terminated due to auger refusal on suspected bedrock or cobbles at depths ranging from 0.9 m to 3.2 m bgl.

The subsurface soil stratigraphy encountered at the test hole locations is summarized in detail on the test hole logs provided in Appendix D.

6.2.3 Field Observations

Soil vapour concentrations and field observations made during the field investigation on 9 and 10 December 2014 are summarized in Table 3 (Appendix B) and detailed on the test hole logs (Appendix D).

The maximum soil vapour concentration encountered during the test hole drilling was 55 ppm_v in TH03-14 at a depth of 1.4 m bgl. The remaining soil vapour concentrations did not exceed 35 ppm_v.

Soil staining was not observed in any of the test holes.

Auger refusal was encountered at two distinct depths. Test holes TH01-14 through TH04-14 encountered refusal between 0.9 and 1.8 m bgl, while test holes TH05-14 and TH06-14 had refusal between 2.9 and 3.2 m bgl. Test holes TH01-14 through TH04-14 were all situated within the gravelled roadway of Johnson Street while TH05-14 and TH06-14 were located outside the roadway along a bush line. The shallower refusal experience in TH01-14 through TH04-14 could be attributed to the rock and cobble used for the road construction.

6.2.4 Soil Laboratory Results – PHCs

A total of six soil samples were submitted for laboratory analysis of BTEX and PHC Fraction F1 to F4. The collected duplicate was not analyzed to due laboratory error. All PHC constituents were not detected above the laboratory's method detection limits, and therefore did not exceed the applicable assessment guidelines.

The results of the laboratory analysis conducted on the selected soil samples are summarized in Table 4 (Appendix B) and shown on Figure 3 (Appendix A). Copies of the detailed analytical reports are provided in Appendix E.

6.2.5 Soil Laboratory Results – PAHs

A total of eight soil samples, plus one duplicate, were submitted for laboratory analysis of PAHs. All PAH constituents were not detected above the laboratory's method detection limits, and therefore did not exceed the applicable assessment guidelines.

The results of the laboratory analysis conducted on the selected soil samples are summarized in Table 5 (Appendix B) and shown on Figure 4 (Appendix A). Copies of the detailed analytical reports are provided in Appendix E.

6.3 GROUNDWATER CONDITIONS

6.3.1 Site Hydrogeology

Monitoring wells SR-01, SR-08, SR-17, SR-18, SR-19, SR-22 and SR-24 were located and were in acceptable condition for monitoring. Monitoring wells SR-20 and SR-21 could not be located. SR-07 and SR-11 were not monitored due to the distance from AEC2. Based on the monitoring event completed on 10 December 2014, the following comments are offered.

Well Vapour Concentrations

Monitoring well vapour concentrations ranged from non-detectable (<5ppm_v) in monitoring wells SR-01, SR-17, SR-18 and SR-24 to 110 ppm_v in monitoring well SR-22.

Groundwater Levels

All monitoring wells that were located and monitored were found to be dry. Results of the groundwater monitoring program are summarized in Table 6 (Appendix B).

6.4 SURFACE WATER CONDITIONS

Surface water samples were collected from three locations along the Fond du Lac River. One sample was collected approximately 80 m upstream of AEC 2 (SWS3-14), one sample was collected approximately 50 m downstream of AEC 2 (SWS2-14) and one sample was collected cross gradient to AEC 2 (SWS1-14).

At the time of the Site visit the Fond du Lac River was frozen along the banks with fast flowing open water in the middle of the river.

Testing of the ice showed the river was sufficiently frozen along the banks extending out between 2 and 10 m. Surface water sample SWS1-14 was collected approximately 10 m from the edge of the river, SWS2-14 was collected approximately 7 m from the edge of the river and SWS3-14 was collected approximately 3m from the edge of the river.

6.4.1 Surface Water Laboratory Results

All three surface water samples were submitted for laboratory analysis for BTEX and PHC Fraction F1 and PAHs. All PHC and PAH constituents were not detected above the laboratory's method detection limits, with exception of one toluene detection at the method detection limit, and therefore did not exceed the applicable assessment guidelines.

The results of the laboratory analysis conducted on the surface water samples are summarized in Tables 7 and 8 (Appendix B) and shown on Figure 5 (Appendix A). Copies of the detailed analytical reports are provided in Appendix E.

6.5 QUALITY ASSURANCE

6.5.1 Accreditation

The ALS laboratory located in Saskatoon, Saskatchewan is certified with the Canadian Association for Laboratory Accreditation Inc. (CALA).

6.5.2 Data Validation

Laboratory QA/QC

The laboratory incorporates various QA/QC procedures to ensure the accuracy of the laboratory results and assess the possibility of false positives attributed to analytical equipment contributions and laboratory control samples.

The laboratory QA/QC includes the completion of laboratory blanks, blank spikes and blank spike recovery. A summary of laboratory QA/QC findings is presented below:

- All samples/sample extracts were analyzed within their applicable hold times using approved analytical methods;
- Agreement between the corresponding datasets for the reference material samples, where applicable, and recoveries reported for spiked samples/blanks, where applicable, were within acceptable range; and
- Surrogate recoveries were within acceptable ranges in all cases for all samples.

Field QA/QC

The relative percent difference (RPD) approach can be used as a means of assessing the accuracy of the duplicate analytical results. The RPD is calculated for specific parameters using the following equation:

$$\text{Field Duplicate RPD (\%)} = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

where: RPD = relative percent difference

C1= first of two observed values from the field duplicate analysis

C2 = second of two observed values from the field duplicate analysis

Relative Percent Difference could not be calculated due to results not being greater than 5x the detection limits.

Based on the laboratory analysis, sample collection, sample storage, and transportation of the samples to the laboratory, had no material effect on the quality of the data collected as part of this assessment. The laboratory results for soil and surface water samples obtained during Amec Foster Wheeler's investigation are considered to be valid. The results of the QA/QC analyses are detailed on the laboratory Certificates of Analyses in Appendix E.

7.0 DISCUSSION

The purpose of the supplemental sampling program was to delineate previously identified PHC and PAH impacts at AEC 2, as well as to collect site information in order to complete a PQHHRA and ERA and determine a NCSCS score.

PHC and/or PAH impacts were previously identified in test holes SR-03 (EGE), SR-20, SR-24 and SR-25 (Tetra Tech).

Historical and recent analytical results from soil samples submitted from test holes surrounding the estimated plume area, did not contain PHC or PAH parameters exceeding the applicable guidelines. [EGE in August 2012 (SR-01) and Tetra Tech in August 2013 (SR-21 and SR-23) (Tetra Tech) as well as recent results from Amec Foster Wheeler (TH01-14 through TH06-14)].

In addition, surface water samples recently collected from the nearby Fond du Lac river did not contain PHC or PAH parameters exceeding the applicable guidelines.

As no further impacts were identified outside test holes SR-03, SR-20, SR-22, SR-24 and SR-25 in AEC 2, it appears delineation of AEC 2 has been achieved both horizontally and vertically to the south, southeast, and a portion of the north and northeast. The PQHHRA and ERA at the Site (Amec Foster Wheeler 2015) did not identify any data gaps in the sampling data indicating the previously estimated volume of impacted soils (AEC 2 – 192 m³) is still valid.

In Amec Foster Wheeler's opinion, further assessment work is not required to prioritize the Site for further work.

8.0 SUMMARY

Amec Foster Wheeler, was retained by PWGSC ES to conduct a supplemental sampling program at the RCMP detachment in Stony Rapids, Saskatchewan. The purpose of the supplemental sampling program was to delineate previously identified PHC and PAH impacts, as well as to collect site information in order to complete a PQHHRA and ERA and determine a NCSCS score.

Between 2012 and 2013, three separate environmental assessments were completed at the Site. In 2012, Stantec Consulting Ltd. completed a Phase I ESA and EGE Engineering Ltd. completed a Phase II ESA. Tetra Tech WEI Inc. completed a Phase III ESA in 2013.

The previous assessments identified two AEC. AEC 1, an area located around a former heating oil UST was determined to have an estimated 36 m³ of PHC impacted soils. AEC 2, an area located around a former gasoline UST and current gasoline AST was determined to have an estimated 192 m³ of PHC and naphthalene impacted soils.

The PQHHRA and ERA is reported under separate cover.

The Site was classified as a residential land use with a coarse grain soil nature under the definitions of Canadian Council of Ministers of the Environment (CCME). The appropriate CCME guidelines for the protection of human health and the environment for benzene, toluene, ethylbenzene, xylenes (BTEX), PHC concentrations of fractions F1 to F4, and polycyclic aromatic hydrocarbons (PAH), including naphthalene, were selected. Applicable surface water assessment guidelines under CCME, based on freshwater aquatic life exposure pathway, were also employed. The CCME guidelines were augmented by the Alberta Environment and

Sustainable Resource Development (ESRD) Tier II remediation surface water guidelines for parameters without CCME guidelines.

The Amec Foster Wheeler supplemental soil sampling program was completed on 9 and 10 December 2014 and consisted of the advancement of six test holes (TH01-14 to TH06-14) to a maximum depth of 3.2 m bgl. All test holes were terminated due to auger refusal on suspected bedrock or cobbles at depths ranging from 0.9 m to 3.2 m bgl.

The maximum soil vapour concentration encountered during the test hole drilling was 55 ppm_v in TH03-14 at a depth of 1.4 m bgl. The remaining soil vapour concentrations did not exceed 35 ppm_v.

A total of 14 soil samples were submitted for laboratory analysis of BTEX, PHC Fraction F1 to F4 and PAHs. All constituent concentrations were not detected above the laboratory's method detection limits, and therefore did not exceed the applicable assessment guidelines.

As part of the supplemental sampling program, existing groundwater monitoring wells were monitored for combustible headspace vapour concentrations and depth to groundwater. Monitoring well headspace vapour concentrations ranged from non-detectable (<5ppm_v) in monitoring wells SR-01, SR-17, SR-18 and SR-24 to 110 ppm_v in monitoring well SR-22. Groundwater samples were not collected as all monitored wells were found to be dry.

Surface water samples were collected from three locations along the Fond du Lac River. One sample was collected approximately 80 m upstream of AEC 2 (SWS3-14), one sample was collected approximately 50 m downstream of AEC 2 (SWS2-14) and one sample was collected cross gradient to AEC 2 (SWS1-14).

At the time of the Site visit, the Fond du Lac River was frozen along the banks with fast flowing open water in the middle of the river.

Testing of the ice indicated that the river was sufficiently frozen along the banks extending out between 2 and 10 m. Surface water sample SWS1-14 was collected approximately 10 m from the edge of the river, SWS2-14 was collected approximately 7 m from the edge of the river, and SWS3-14 was collected approximately 3m from the edge of the river.

All three surface water samples were submitted for laboratory analysis for BTEX and PHC fraction F1 and PAHs. All PHC and PAH constituents were not detected above the laboratory's method detection limits, with exception of one toluene detection at the method detection limit, and therefore did not exceed the applicable assessment guidelines.

Sediment samples were scheduled to be collected at the same time and locations as the surface water samples. As surface water samples were collected away from shore, sediments could not be accessed at the sample locations for sampling.

Seepage/spring water samples were to be collected from the toe of the embankment adjacent to AEC 2. Seepage/spring water was not observed at the time of the Site visit, due to winter/frozen conditions.

9.0 REFERENCES

Amec Foster Wheeler Preliminary Quantitative Human Health Risk Assessment (PQHHRA) and Preliminary Quantitative ecological risk assessment (PQERA), March 2015.

Alberta Government Environmental Quality Guidelines for Alberta Surface Waters, Table 1, 14 July 2014.

Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Soil Quality Guidelines, 1999, updates to 2014.

Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999.

Canadian Council of Ministers of the Environment (CCME) Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil, 2001, revised 2008.

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10.0 CLOSURE

The work performed in the preparation of this report and the conclusions presented are subject to the following: (a) The Terms and Conditions specified in Amec Foster Wheeler's contract with PWGSC under "EW699-141853/003/NCS Environmental Consulting Services – AB,SK,MB."; (b) The Scope of Services; and (c) Time and Budgetary restrictions as described in our proposal.

This report was prepared for the use of PWGSC, and is intended to provide a Supplemental Sampling Program on the RCMP Detachment – Stoney Rapids Site at the time of the Site investigation. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party.

The report was prepared in accordance with generally accepted environmental science and/or engineering practices. No warranties, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the information and conclusions presented in this report. The contents of this report are based on the information collected during the investigation activities, our understanding of the actual Site conditions, and our professional opinion according to the information available at the time of preparation of this report. This report gives a professional opinion and, by consequence, no guarantee is attached to the conclusions or expert advice depicted in this report. This report does not provide a legal opinion.

The report is based on data and information collected during the Supplemental Sampling Program of the property conducted by Amec Foster Wheeler. It is based solely on the conditions of the Site encountered at the time of the Site investigation, supplemented by a review of historical information and data obtained by Amec Foster Wheeler as described in this report, as reported herein. The conclusions presented in this report were based, in part, on visual observations of the Site and attendant structures, if present. Our conclusions cannot and are not extended to include those portions of the Site or structures, which are not reasonably available, in Amec Foster Wheeler's opinion, for direct observation.

Except as otherwise may be specified, Amec Foster Wheeler disclaims any obligation to update this report for events taking place, or with respect to information that becomes available to Amec Foster Wheeler after the time during which Amec Foster Wheeler conducted the Supplemental Sampling Program .

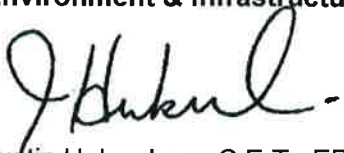
In evaluating the property, Amec Foster Wheeler has relied in good faith on information provided by other individuals noted in this report. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report. Amec Foster Wheeler has assumed that the information provided is factual and accurate. Amec Foster Wheeler accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

The objective of this report was to assess environmental conditions at the Site, within the context of our contract and existing environmental regulations within the applicable jurisdiction. Evaluating compliance of past or future owners with applicable local, provincial and federal government laws and regulations was not included in our contract for services. Amec Foster Wheeler makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

Our observations relating to the condition of environmental media at the Site are described in this report. Where testing was performed, it was carried out in accordance with the terms of our contract. Other substances, or different quantities of substances tested for, may be present on Site and may be revealed by different or other testing not provided for in our contract. The findings and conclusions presented in this report are based exclusively on the information described above, field parameters measured, and the chemical parameters tested at specific locations. It should be recognized that subsurface conditions between and beyond the sample locations may vary. Amec Foster Wheeler cannot expressly guarantee that subsurface conditions between and beyond the sample locations do not vary from the results determined at the sample locations. Consequently, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, Amec Foster Wheeler can be notified in order that they may determine if modifications to the conclusions in the report are necessary. Notwithstanding these limitations, this report is believed to provide a reasonable representation of Site conditions at the date of issue.

We trust that this report meets your present requirements. Please contact our office if you have any questions or if we can be of further assistance.

Respectfully submitted,
Amec Foster Wheeler
Environment & Infrastructure



Justin Huberdeau, C.E.T., EP
Environmental Technologist



Sherry Cochran, P. Eng.
Senior Environmental Engineer
Project Manager

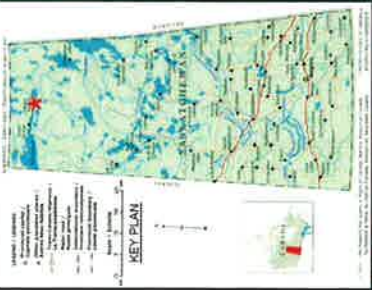
Reviewed by:



Michael Bertram, P.Eng.
Senior Environmental Engineer

APPENDIX A

FIGURES



Amec Foster Wheeler
Environment & Infrastructure
1000-100 Avenue
Winnipeg, Manitoba, R2V 1A6
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CLIENT

PUBLIC WORKS AND GOVERNMENT SERVICES - CANADA

LEGEND

— SITE LOCATION

NOTE:

- SITE FEATURE LOCATIONS ARE APPROXIMATE AND BASED ON AERIAL IMAGES FROM GOOGLE EARTH PRO

REVISION

NO.	REVISION	DATE	BY

SUPPLEMENTAL SAMPLING PROGRAM

ROAD DETAIL CHART

STONEY RAPIDS, SASKATCHEWAN

SITE AND SURROUNDING LAND USE PLAN

SCALE: AS SHOWN

DATE: MARCH 2015

DRAWN BY: MD

PROJECT NO.: SX4544

FIGURE 1



NO.	REVISION	DATE	BY

SUPPLEMENTAL SAMPLING PROGRAM

RCMP DETACHMENT
 STONY RAPIDS, SASKATCHEWAN

TEST HOLE AND SURFACE
 WATER SAMPLING LOCATIONS

SCALE	AS SHOWN	FIGURE 2
DATE	MARCH 2015	MD
DRAWN BY		
PROJECT NO.	SX4344	



OCME Resistant CWS PHC – coarse grained soils	0.015
B (mg)	0.1
T (mg)	50
E (mg)	22
X (mg)	40
F1 (mg)	20
F2 (mg)	150
F3 (mg)	300
F4 (mg)	2000

NOTE:
- SITE FEATURE LOCATIONS ARE
APPROXIMATE
- IMAGES FROM GOOGLE EARTH PRO

[illegible]

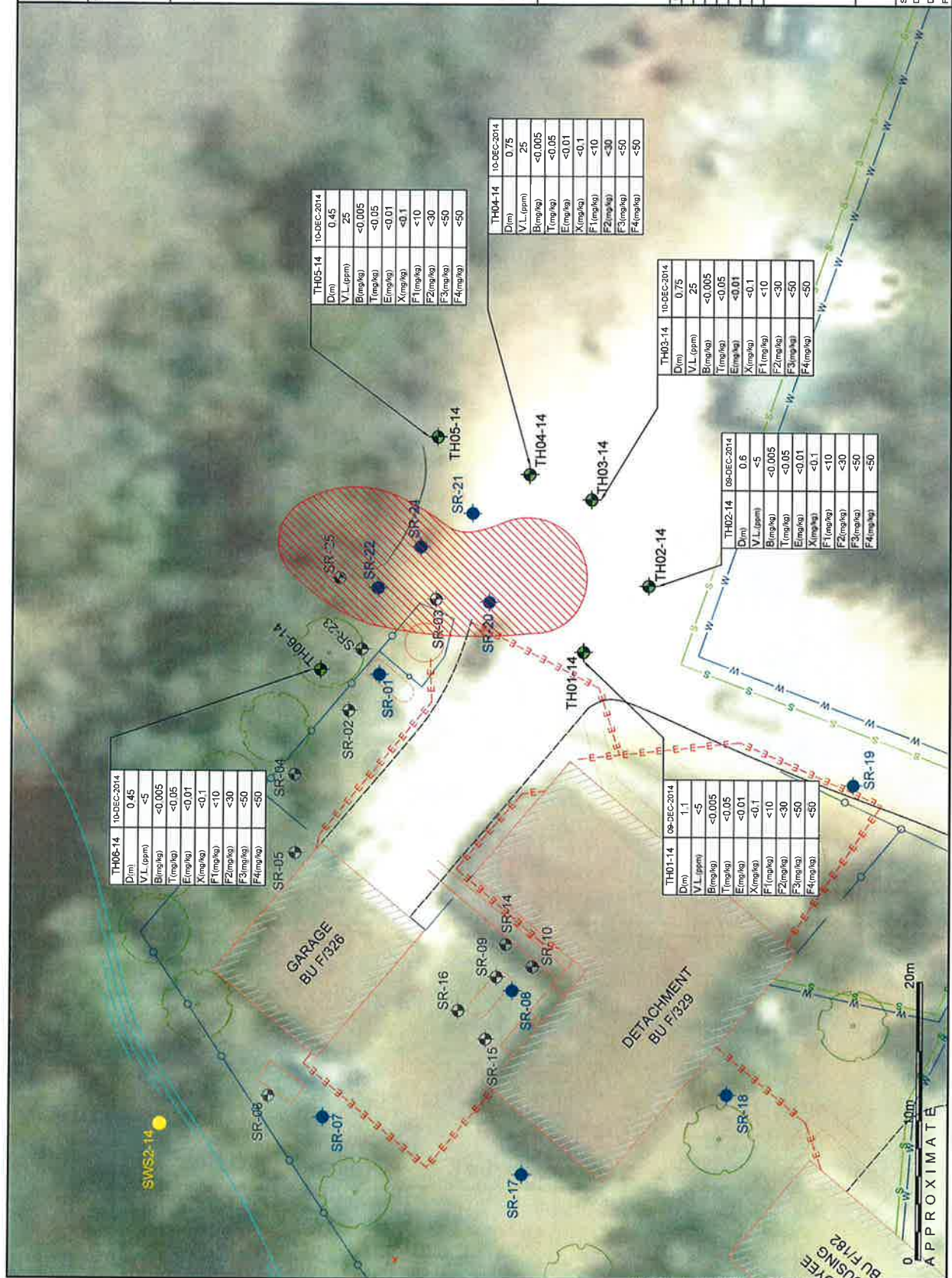
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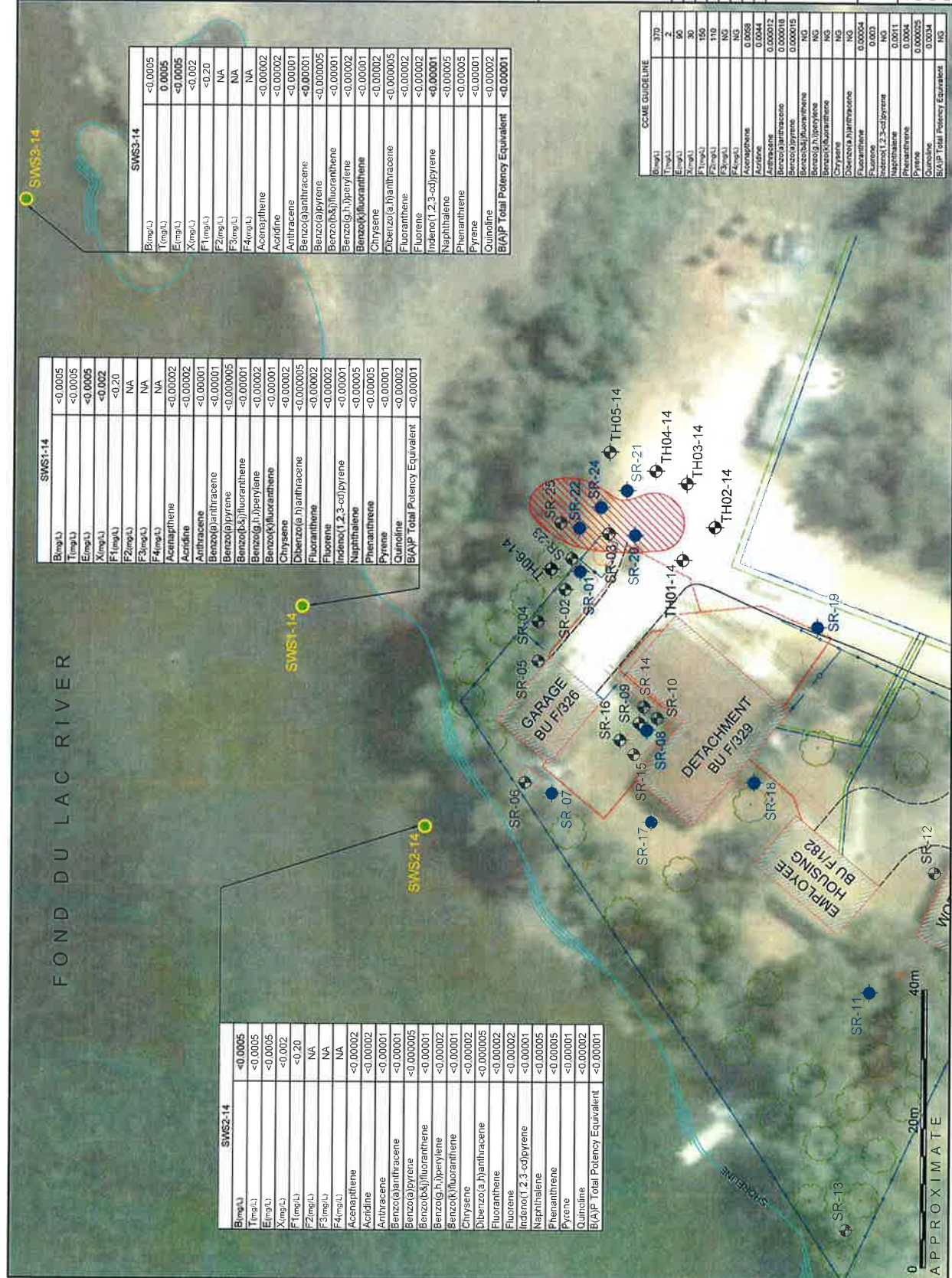
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN

SOIL ANALYTICAL RESULTS (PHCs)

SCALE:	AS SHOWN
DATE	MARCH 2015
DRAWN BY:	MD
PROJECT NO.	SX-4344

FIGURE 3





APPENDIX B

TABLES

TABLE 1: SURROUNDING LAND USE		
Direction	Description / Land Use	Approx. Distance (m)
Site	Stoney Rapids RCMP detachment with on-Site residence, gargage and work shop	-
	Residential / Parkland	
North	Treed shoreline followed by Fond Du Lac River	Adjacent 15 m
	Residential / Parkland	
East	Johnson Street followed by Residential	Adjacent 25 m
	Residential / Parkland	
South	RCMP buildings (Residence) followed by Stoney Rapids water treatment plant.	Adjacent 30 m
	Residential / Parkland	
West	Treed shoreline followed by Fond Du Lac River	Adjacent 15 m
	Residential	



TABLE 2: ASSESSMENT GUIDELINES									
Land Use	Exposure Pathway	Coarse Grained Soil Guidelines (ug/g) (PHCs)							
		Benzene*	Toluene	Ethylbenzene	Xylenes	PHC (F1)	PHC (F2)	PHC (F3)	PHC (F4)
Residential (≤ 1.5 m depth)	Soil Ingestion	11	22000	10000	150000	12000	6800	15000	21000
	Dermal Contact	25	220000	58000	NA				
	Indoor Vapour Inhalation (Basement)	0.015	200	88	22	40	190	NA	NA
	Ecological Soil Contact	31	75	55	95	210	180	300	2800
	Soil and Food Ingestion	NG	NG	NG	NG	NG	NG	NG	NG
	Freshwater Aquatic Life Pathway	1	0.1	50	37	970	380	NA	NA
	Management Limits	NG	NG	NG	NG	700	1000	2500	10000
Residential (> 1.5 m depth)	Indoor Vapour Inhalation	0.015	200	88	22	40	190	NA	NA
	Freshwater Aquatic Life Pathway	1	0.1	50	37	970	380	NA	NA
	Management Limits	NG	NG	NG	NG	700	1000	2500	10000

Land Use	Exposure Pathway	Soil Guidelines (ug/g) PAHs							
		Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Chrysene
Residential	Soil Contact (SQG _{SC})	NC	NC	2.5	NC	20	NC	NC	NC
	Soil and Food Ingestion (SQG _I)	21.5	NC	2.5	0.2***	0.6	0.2***	0.2***	0.2
	Protection of Freshwater Life (SQG _{FL})	0.24	320	NA	NA	8800	NA	NA	NA
	Provisional (SQG _E CCME 1997)	NG	NG	NG	NG	0.7	NG	NG	NG
	Interim Soil Quality Criteria (CCME 1991)	No Value	No Value	No Value	1	No Value	1	1	No Value

Land Use	Exposure Pathway	Soil Guidelines (ug/g) PAHs							
		Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Ideno (1,2,3-cd) pyrene	Naphthalene	Phenanthrene	Pyrene	B(a)p TEP*
Residential	Soil Contact (SQG _{SC})	NC	50	NC	NC	NC	NC	NC	0.6
	Soil and Food Ingestion (SQG _I)	NC	15.4	15.4	NC	8.8	43	7.7	NG
	Protection of Freshwater Life (SQG _{FL})	NA	NA	0.25	NA	0.013	0.046	NA	NG
	Provisional (SQG _E CCME 1997)	NG	NG	NG	NG	0.6	NG	NG	NG
	Interim Soil Quality Criteria (CCME 1991)	1	No Value	No Value	1	No Value	5	10	NG

Land Use	Exposure Pathway	Surface Water Guidelines (ug/L) - PHCs							
		Benzene*	Toluene	Ethylbenzene	Xylenes	PHC (F1)	PHC (F2)	PHC (F3)	PHC (F4)
Residential	Freshwater Aquatic Life Pathway	370	2	90	30 ^A (Chronic) ^a	150 ^A (Acute) ^a	110 ^A (Acute) ^a	NG	NG

Land Use	Exposure Pathway	Surface Water Guidelines (ug/L) - PAHs						
		Acenaphthene	Acridine	Anthracene	Benzo(a) anthracene	Benzo(a)pyrene	Fluoranthene	Fluorene
Residential	Freshwater Aquatic Life Pathway	5.8	4.4	0.012	0.018	0.015	0.04	3

Land Use	Exposure Pathway	Surface Water Guidelines (ug/L) - PAHs		
		Phenanthrene	Pyrene	Quinoline
Residential	Freshwater Aquatic Life Pathway	0.4	0.025	3.4

Notes:

- * Benzene and B(a)p TEP guidelines were selected based on the 10⁻⁶ incremental risk for human health
- ** PAH guidelines are independent of soil grain size or sample depth. Note - only parameters with guidelines included in CCME documentation are included in guideline table
- *** Interim Criteria based on non-scientific rationale. In the case where a scientific defensible value established for an exposure pathway is greater than the interim criteria value, the scientific defensible value will be considered applicable.
- ^a Environmental Quality Guidelines for Alberta Surface Waters - Table 1
- ^b PHC (F1) - volatile petroleum hydrocarbons (C₆ - C₁₀)
- ^c PHC (F2) - extractable petroleum hydrocarbons (C₁₀ - C₁₄)
- ^d PHC (F3) - extractable petroleum hydrocarbons (C₁₄ - C₂₀)
- ^e PHC (F4) - extractable petroleum hydrocarbons (C₂₀ - C₃₀)
- ^f B(a)p TEP - Benzo(a)pyrene Total Potency Equivalents: equation in which the sum is the estimated cancer potency relative to B(a)p for all potentially carcinogenic PAHs
- ^g ug/g - concentration in micrograms per gram
- ^h ug/L - concentration in micrograms per litre
- *** - Human Health Guideline
- ^{ex} - Environmental Health Guideline
- ^{bold} - selected guideline
- NA - not applicable, calculated value exceeds 1,000,000 mg/kg
- NC - not calculated
- NG - no guideline available
- CCME EQG Criteria - residential land use criteria as outlined in the Canadian Council of the Ministers of the Environment (CCME [Canadian Environmental Quality Guidelines](#), 1999 (updates to 2013)). The benzene concentration is based on one million (10⁻⁶) incremental risk of cancer.
- CCME CVS PHC Criteria - residential land use criteria as outlined in the Canadian Council of the Ministers of the Environment (CCME [Canada Wide Standards for Hydrocarbons in Soil](#), 2001, revised 2006).
- ^A ALBERTA GOVERNMENT Environmental Quality Guidelines for Alberta Surface Waters - Table 1 (14 July 2014)

TABLE 3: FIELD OBSERVATIONS AND SOIL VAPOUR TESTING				
Test Hole	Test Hole Depth (m)	Staining Zone (m)	Max. Soil Vapour Concentration	
			Level (ppm _v)	Depth (m)
TH01-14	1.8	none	25	1.8
TH02-14	0.9	none	<5	0 - 0.9
TH03-14	1.4	none	55	1.4
TH04-14	1.7	none	25	0.8
TH05-14	3.2	none	35	0 - 0.3
TH06-14	2.9	none	5	0.3 - 0.6

Notes:

- ppm_v - parts per million total combustible vapour
- m - metres



TABLE 4: SOIL ANALYTICAL RESULTS - PHCS

Sample No.	Date Sampled (dd-mm-yy)	Depth (m)	Soil Vapour Concentration (ppm _v)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
TH01-14	2014/12/09	1.1	<5	<0.005	<0.05	<0.01	<0.1	<10	<30	<50	<50
TH02-14	2014/12/09	0.6	<5	<0.005	<0.05	<0.01	<0.1	<10	<30	<50	<50
TH03-14	2014/12/10	0.75	25	<0.005	<0.05	<0.01	<0.1	<10	<30	<50	<50
TH04-14	2014/12/10	0.75	25	<0.005	<0.05	<0.01	<0.1	<10	<30	<50	<50
TH05-14	2014/12/10	0.45	25	<0.005	<0.05	<0.01	<0.1	<10	<30	<50	<50
TH06-14	2014/12/10	0.45	<5	<0.005	<0.05	<0.01	<0.1	<10	<30	<50	<50
CCME Residential EQG (≤1.5m depth)				0.015	0.10	50	22	NG	NG	NG	NG
CCME Residential CWS PHC – coarse grained soils (≤1.5m depth below grade)											
								40	150	300	2800

Notes:

- ppm_v – parts per million combustible vapour
- (mg/kg) – milligrams per kilogram
- **BOLD** – exceeds the referenced guideline
- F1 – volatile petroleum hydrocarbons (C₆-C₁₀); correct for BTEX concentrations
- F2 – extractable petroleum hydrocarbons (C₁₀-C₁₆)
- F3 – extractable petroleum hydrocarbon (C₁₆-C₃₄)
- F4 – extractable petroleum hydrocarbons (C₃₄-C₅₀)
- < - less than the method detection limit
- CCME EQG Criteria – residential land use criteria as outlined in the Canadian Council of the Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines, 1999 (updated 2014). The benzene concentration is based on one in one hundred thousand (10⁵) incremental risk of cancer.
- CCME CWS PHC Criteria - residential land use criteria as outlined in the Canadian Council of the Ministers of the Environment (CCME) Canada-Wide Standards for Hydrocarbons in Soil, 2001, revised 2008.
- See laboratory report for detection limits, testing protocols and QA/QC procedures. Laboratory analysis was performed by ALS Laboratory in Saskatoon.



TABLE 5: SOIL ANALYTICAL RESULTS - POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) mg/kg										
Parameter	TH01-14 (1.5 m)	TH02-14 (0.9 m)	TH03-14 (1.4 m)	TH04-14 (1.7 m)	TH05-14 (1.1 m)	DUP 2 (TH05-14 @ 1.1 m)	TH05-14 (3.0 m)	TH06-14 (1.7 m)	TH06-14 (2.8 m)	Guideline
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.28
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	320
Anthracene	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	2.5
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6.2
Benzo(a)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.6
Benzo(b&j)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6.2
Benzo(g,h,i)perylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NG
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6.2
Chrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6.2
Dibenzo(a,h)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1
Fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	15.4
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.25
Indeno(1,2,3-cd)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1
2-methylnaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NG
Naphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.013
Phenanthrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.046
Pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	10
Quinoline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NG
B(A)P Total Potency Equivalent	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.6
IACR (CCME)	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	NG

Notes:

- B(a)p TPE - Benzo (a) pyrene total potency equivalent (CCME 2010)
- CCME - Canadian Council of Ministers for the Environment (CCME), Canadian Environmental Quality Guidelines for the Protection of Environmental and Human Health (accessed 2014)
- () - depth in metres below grade level
- mg/kg - concentration in milligrams per kilogram
- NG - no guideline available
- BOLD** - exceeds the applicable criteria

TABLE 6 : MONITORING WELL DATA						
Monitor Well No.	Date Measured	Depth to Water	LNAPL Thickness	Combustible Vapours Well Headspace	Combustible Vapours Groundwater Headspace	Comments
		(m B.TOP)	(mm)	ppm _v	ppm _v	
SR01	11-Dec-14	Dry	ND	<5	NM	Broken Lid
SR07	11-Dec-14	Not Measured				
SR08	10-Dec-14	Dry	ND	35	NM	
SR11	11-Dec-14	Not Measured				
SR17	10-Dec-14	Dry	ND	<5	NM	
SR18	10-Dec-14	Dry	ND	<5	NM	
SR19	11-Dec-14	Dry	ND	10	NM	
SR20	11-Dec-14	Could not locate				Potentially buried in Gravel Driveway
SR21	11-Dec-14	Could not locate				Potentially missing Well Casing
SR22	11-Dec-14	Dry	ND	110	NM	
SR24	09-Dec-14	Dry	ND	<5	NM	

Notes:

- m - meters
- m B.TOP - meters below top of pipe
- ppm_v - parts per million organic vapour
- LNAPL - light non-aqueous phase liquids
- mm - millimeters
- DO - dissolved oxygen
- EC - electrical conductivity
- ORP - oxidation/reduction potential
- mg/L - milligrams per litre
- µS/cm - microSiemens per centimetre
- mV - millivolts
- ND - not detected
- NA - not analyzed
- NM - not measured
- %LEL - percent lower explosive limit

TABLE 7: SURFACE WATER ANALYTICAL RESULTS - PHCs

Sample No.	Date Sampled (dd-mm-yy)	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	F1 (mg/L)	F2 (mg/L)	F3 (mg/L)	F4 (mg/L)
SWS1-14	2014/12/10	<0.0005	<0.0005	<0.0005	<0.002	<0.20	NA	NA	NA
SWS2-14	2014/12/10	<0.0005	<0.0005	<0.0005	<0.002	<0.20	NA	NA	NA
SWS3-14	2014/12/10	<0.0005	0.0005	<0.0005	<0.002	<0.20	NA	NA	NA
CCME EQG - Protection of Aquatic Life		370	2	90	NG	NG	NG	NG	NG
ALBERTA GOVERNMENT - Environmental Quality Guidelines for Alberta Surface Waters					30 ^A	150 ^A	110 ^A	NG	NG

Notes:

- ppm_v – parts per million combustible vapour
- LEL – lower explosive limit (mg/L) – milligrams per litre
- **BOLD** – exceeds the referenced guideline
- FI – volatile petroleum hydrocarbons (C₆-C₁₀); correct for BTEX concentrations
- F2 – extractable petroleum hydrocarbons (C₁₀-C₁₆)
- F3 – extractable petroleum hydrocarbon (C₁₆-C₃₄)
- F4 – extractable petroleum hydrocarbons (C₃₄-C₅₀)
- < – less than the method detection limit
- CCME EQG - Canadian Council of the Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines - "Canadian Water Quality Guidelines for the Protection of Aquatic Life", 1999.

^A ALBERTA GOVERNMENT Environmental Quality Guidelines for Alberta Surface Waters - Table 1 (14 July 2014)

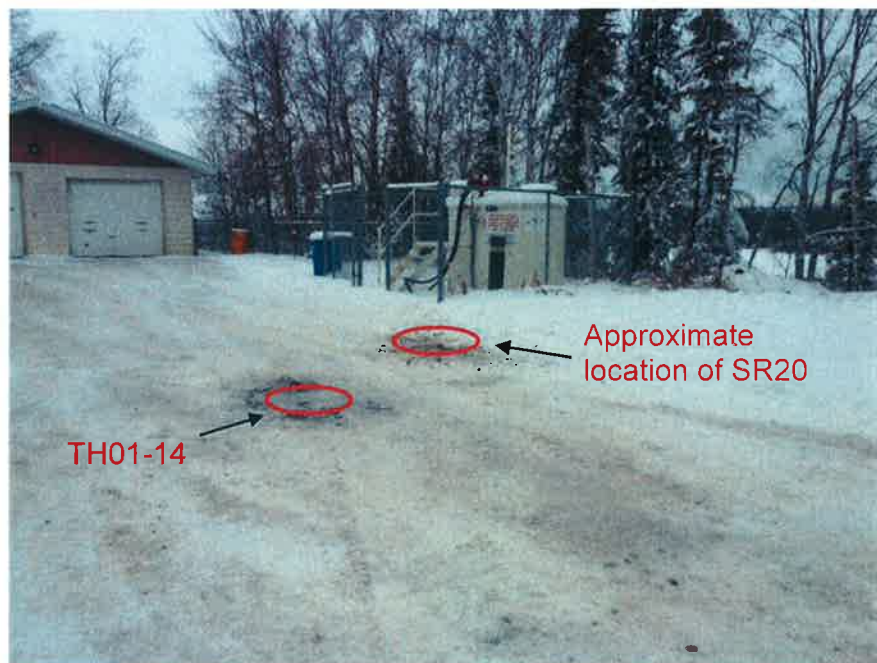
TABLE 8: SURFACE WATER ANALYTICAL RESULTS - POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)				
Parameter	SWS1-14	SWS2-14	SWS3-14	Guideline
Acenaphthene	<0.00002	<0.00002	<0.00002	0.0058
Acridine	<0.00002	<0.00002	<0.00002	0.0044
Anthracene	<0.00001	<0.00001	<0.00001	0.000012
Benzo(a)anthracene	<0.00001	<0.00001	<0.00001	0.000018
Benzo(a)pyrene	<0.000005	<0.000005	<0.000005	0.000015
Benzo(b&j)fluoranthene	<0.00001	<0.00001	<0.00001	NG
Benzo(g,h,i)perylene	<0.00002	<0.00002	<0.00002	NG
Benzo(k)fluoranthene	<0.00001	<0.00001	<0.00001	NG
Chrysene	<0.00002	<0.00002	<0.00002	NG
Dibenzo(a,h)anthracene	<0.000005	<0.000005	<0.000005	NG
Fluoranthene	<0.00002	<0.00002	<0.00002	0.00004
Fluorene	<0.00002	<0.00002	<0.00002	0.003
Indeno(1,2,3-cd)pyrene	<0.00001	<0.00001	<0.00001	NG
Naphthalene	<0.00005	<0.00005	<0.00005	0.0011
Phenanthrene	<0.00005	<0.00005	<0.00005	0.0004
Pyrene	<0.00001	<0.00001	<0.00001	0.000025
Quinoline	<0.00002	<0.00002	<0.00002	0.0034
B(A)P Total Potency Equivalent	<0.00001	<0.00001	<0.00001	NG

Notes:

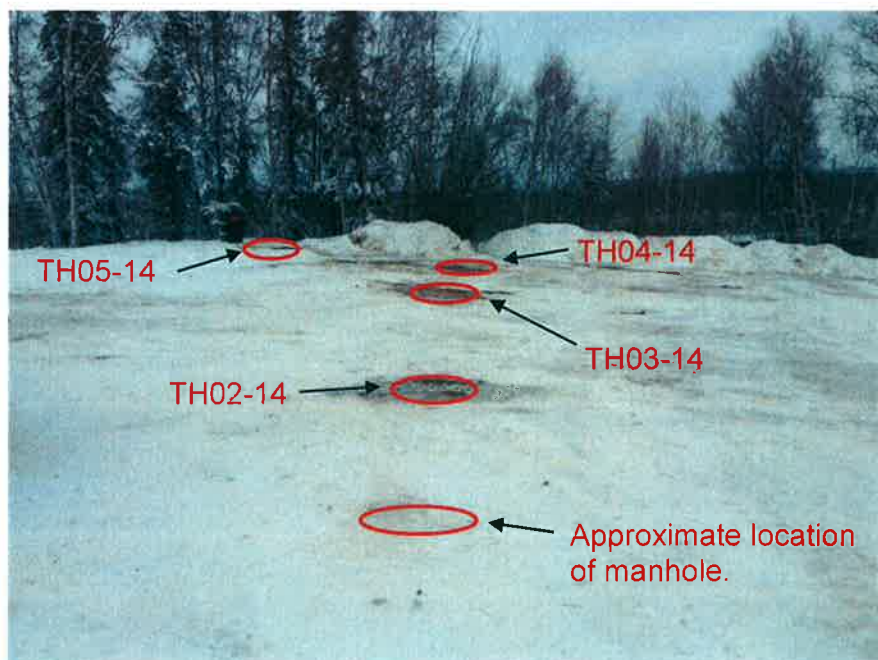
- B(a)p TPE - Benzo (a) pyrene total potency equivalent (CCME 2010)
- CCME - Canadian Council of Ministers for the Environment (CCME), [Canadian Environmental Quality Guidelines for the Protection of Environmental and Human Health](#) (accessed 2014)
- mg/kg - concentration in milligrams per kilogram
- NG - no guideline available
- **BOLD** - exceeds the applicable criteria

APPENDIX C

SITE PHOTOGRAPHS



PHOTOGRAPH 1: Looking west from Johnson Street at AEC 2 and AST.



PHOTOGRAPH 2: Looking north from centre line of Johnson Street.



Environment & Infrastructure

**SITE PHOTOGRAPHS
SUPPLEMENTAL SAMPLING PROGRAM
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: DEC 2015

Project No.: SX04344

Photo Log: 1



PHOTOGRAPH 3: Looking east across Johnson Street.



PHOTOGRAPH 4: Looking east across AEC 2 at existing burn barrel.



Environment & Infrastructure

**SITE PHOTOGRAPHS
SUPPLEMENTAL SAMPLING PROGRAM
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: DEC 2015

Project No.: SX04344

Photo Log: 2



PHOTOGRAPH 5: Looking west down northern property (fence) line.



PHOTOGRAPH 6: Looking east up embankment at diesel generator from SWS2-14.



Environment & Infrastructure

**SITE PHOTOGRAPHS
SUPPLEMENTAL SAMPLING PROGRAM
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: DEC 2015

Project No.: SX04344

Photo Log: 3



PHOTOGRAPH 7: Looking north east at northern embankment near SWS2-14.



PHOTOGRAPH 8: Looking south down western embankment.



Environment & Infrastructure

**SITE PHOTOGRAPHS
SUPPLEMENTAL SAMPLING PROGRAM
RCMP DETACHMENT
STONY RAPIDS, SASKATCHEWAN**

Date: DEC 2015

Project No.: SX04344

Photo Log: 4

APPENDIX D
TEST HOLE LOGS

PROJECT: Supplemental Sampling		DRILLED BY: Intercore Environmental		TEST HOLE NO: TH01-14	
CLIENT: Public Works & Government Services Canada		DRILL RIG: Geoprobe		PROJECT NO: SX04344	
LOCATION: Stony Rapids, Saskatchewan		DRILL TYPE: Solid Stem Auger		ELEVATION:	
SAMPLE TYPE		<input checked="" type="checkbox"/> Shelby Tube	<input type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT Test (N)	<input type="checkbox"/> Grab Sample
BACKFILL TYPE		<input checked="" type="checkbox"/> Bentonite	<input type="checkbox"/> Pea Gravel	<input type="checkbox"/> Drill Cuttings	<input type="checkbox"/> Grout
				<input checked="" type="checkbox"/> Split-Pen	<input type="checkbox"/> Core
				<input checked="" type="checkbox"/> Bentonite Chips	<input type="checkbox"/> Sand

Depth (m)	COMBUSTIBLE VAPOUR (ppm)	SOIL SYMBOL	USCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	OTHER TESTS COMMENTS	Depth (m)
0				SAND - some gravel, trace silt, well graded, medium grain, medium dense, dry to damp, reddish brown, frozen to 0.6 m, occasional cobble				
1	●		SW			1		1
	●			- frequent cobble below 1.4 m		2		
	●					3		
2				End of Test Hole at 1.8 m below grade due to auger refusal Notes: No monitoring well installed. Test hole backfilled with bentonite and auger cuttings.				2
3								3
4								

SX04344 - STONEY RAPIDS.GPJ 15/02/02 11:28 AM (CO-OP ENV)

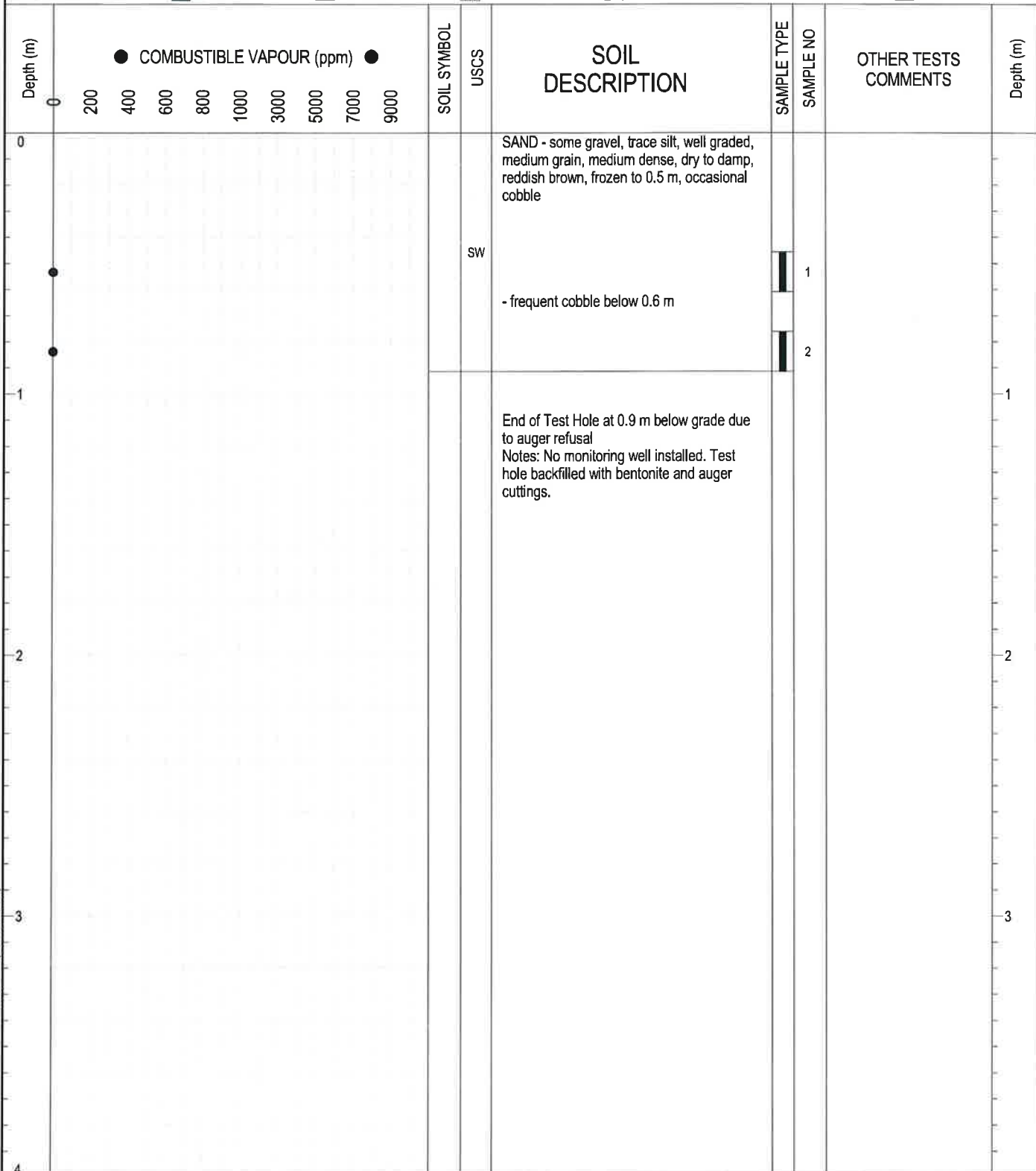


Amec Foster Wheeler Environment & Infrastructure
Winnipeg, Manitoba


LOGGED BY: JH
REVIEWED BY: SC

COMPLETION DEPTH: 1.8 m
COMPLETION DATE: 9 December 2014

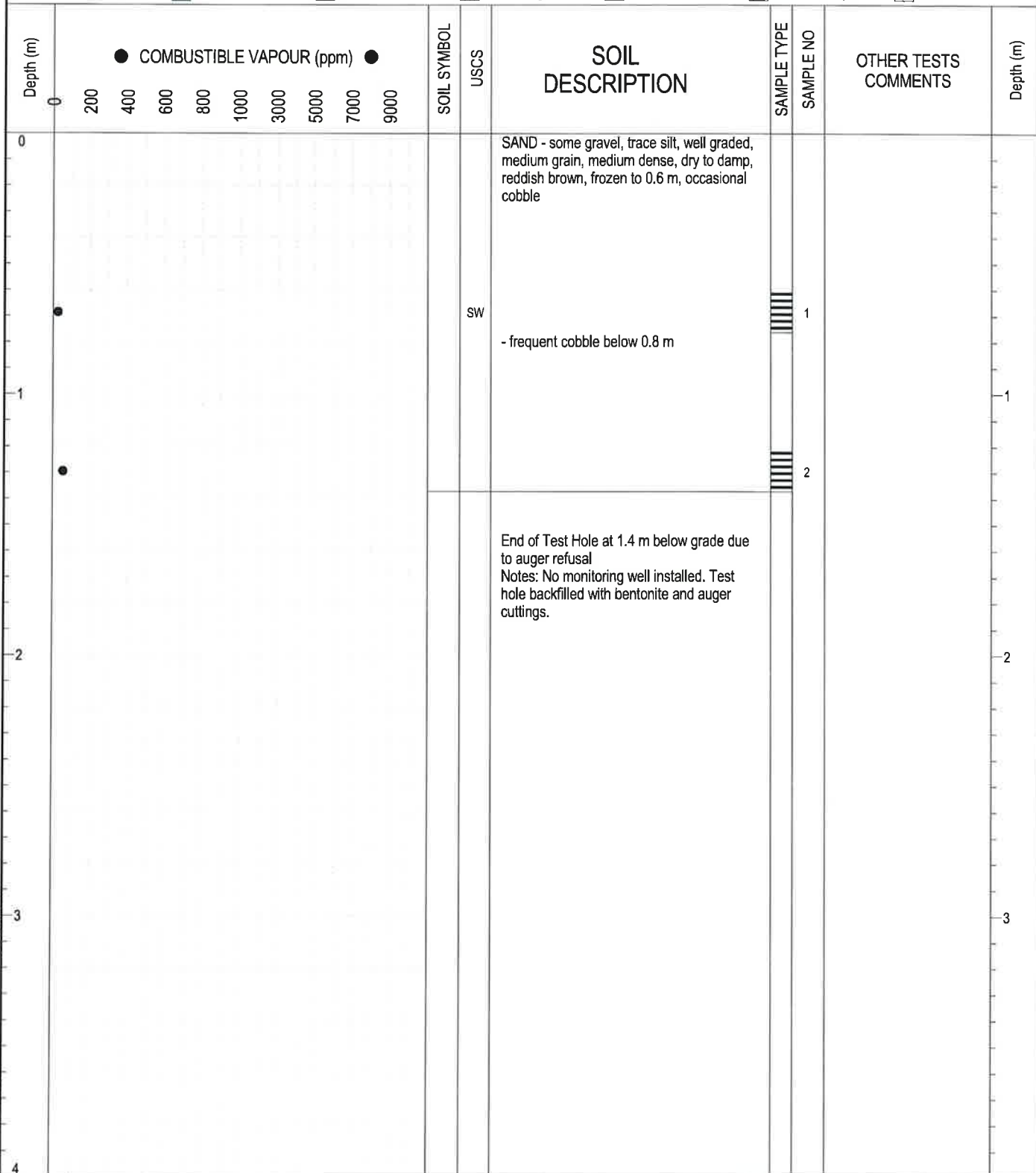
PROJECT: Supplemental Sampling		DRILLED BY: Intercore Environmental		TEST HOLE NO: TH02-14	
CLIENT: Public Works & Government Services Canada		DRILL RIG: Geoprobe		PROJECT NO: SX04344	
LOCATION: Stony Rapids, Saskatchewan		DRILL TYPE: Solid Stem Auger		ELEVATION:	
SAMPLE TYPE	<input checked="" type="checkbox"/> Shelby Tube	<input checked="" type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT Test (N)	<input checked="" type="checkbox"/> Grab Sample	<input checked="" type="checkbox"/> Split-Pen
BACKFILL TYPE	<input checked="" type="checkbox"/> Bentonite	<input checked="" type="checkbox"/> Pea Gravel	<input checked="" type="checkbox"/> Drill Cuttings	<input checked="" type="checkbox"/> Grout	<input checked="" type="checkbox"/> Bentonite Chips
				<input checked="" type="checkbox"/> Core	<input checked="" type="checkbox"/> Sand



SX04344 - STONEY RAPIDS.GPJ 15/02/02 11:28 AM (CO-OP ENV)


 Amec Foster Wheeler Environment & Infrastructure Winnipeg, Manitoba	LOGGED BY: JH	COMPLETION DEPTH: 0.9 m
	REVIEWED BY: SC	COMPLETION DATE: 9 December 2014
	Page 1 of 1	

PROJECT: Supplemental Sampling		DRILLED BY: Intercore Environmental		TEST HOLE NO: TH03-14	
CLIENT: Public Works & Government Services Canada		DRILL RIG: Geoprobe		PROJECT NO: SX04344	
LOCATION: Stony Rapids, Saskatchewan		DRILL TYPE: Solid Stem Auger		ELEVATION:	
SAMPLE TYPE	<input checked="" type="checkbox"/> Shelby Tube	<input checked="" type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT Test (N)	<input checked="" type="checkbox"/> Grab Sample	<input checked="" type="checkbox"/> Split-Pen
BACKFILL TYPE	<input checked="" type="checkbox"/> Bentonite	<input type="checkbox"/> Pea Gravel	<input type="checkbox"/> Drill Cuttings	<input type="checkbox"/> Grout	<input checked="" type="checkbox"/> Bentonite Chips
					<input type="checkbox"/> Sand

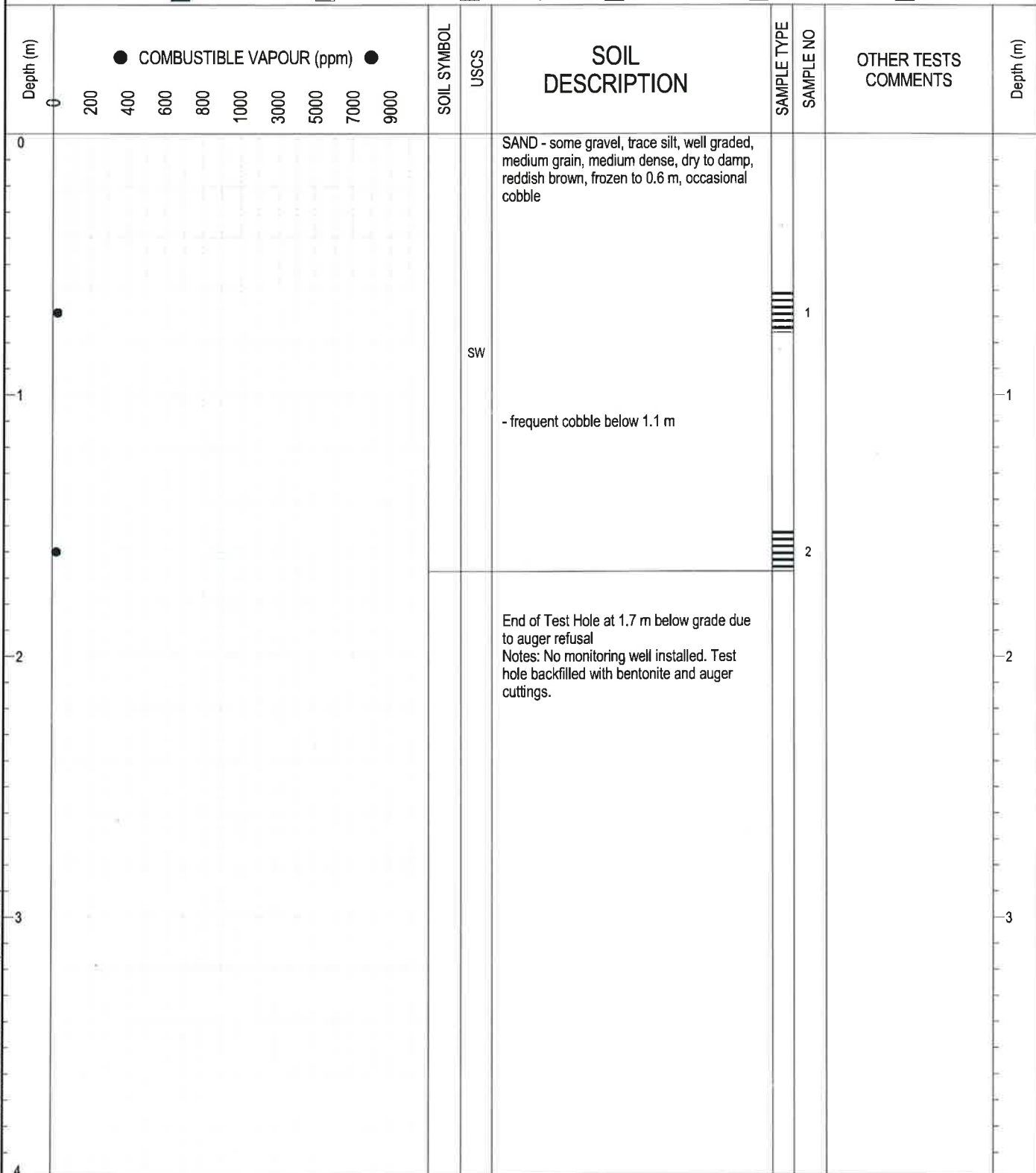


End of Test Hole at 1.4 m below grade due to auger refusal
Notes: No monitoring well installed. Test hole backfilled with bentonite and auger cuttings.

SX04344 - STONEY RAPIDS.GPJ 15/02/02 11:28 AM (CO-OP ENV)

	Amec Foster Wheeler Environment & Infrastructure Winnipeg, Manitoba	LOGGED BY: JH	COMPLETION DEPTH: 1.4 m
		REVIEWED BY: SC	COMPLETION DATE: 10 December 2014
		Page 1 of 1	

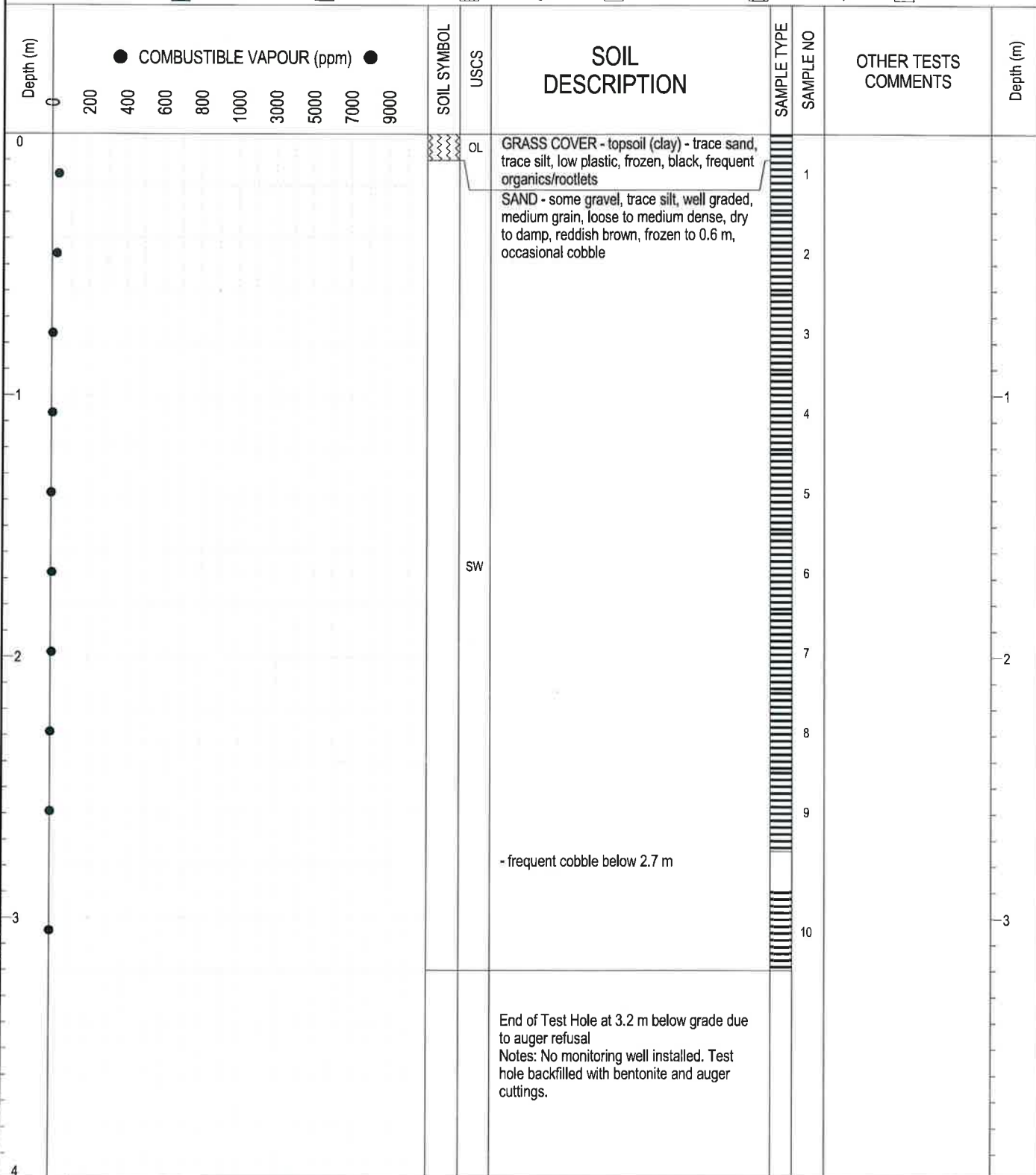
PROJECT: Supplemental Sampling		DRILLED BY: Intercore Environmental		TEST HOLE NO: TH04-14	
CLIENT: Public Works & Government Services Canada		DRILL RIG: Geoprobe		PROJECT NO: SX04344	
LOCATION: Stony Rapids, Saskatchewan		DRILL TYPE: Solid Stem Auger		ELEVATION:	
SAMPLE TYPE	<input checked="" type="checkbox"/> Shelby Tube	<input checked="" type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT Test (N)	<input checked="" type="checkbox"/> Grab Sample	<input checked="" type="checkbox"/> Split-Pen
BACKFILL TYPE	<input checked="" type="checkbox"/> Bentonite	<input checked="" type="checkbox"/> Pea Gravel	<input checked="" type="checkbox"/> Drill Cuttings	<input checked="" type="checkbox"/> Grout	<input checked="" type="checkbox"/> Bentonite Chips
				<input checked="" type="checkbox"/> Core	<input checked="" type="checkbox"/> Sand



SX04344 - STONEY RAPIDS.GPJ 15/02/02 11:28 AM (CO-OP ENV)

	Amec Foster Wheeler Environment & Infrastructure Winnipeg, Manitoba	LOGGED BY: JH	COMPLETION DEPTH: 1.7 m
		REVIEWED BY: SC	COMPLETION DATE: 10 December 2014
		Page 1 of 1	

PROJECT: Supplemental Sampling		DRILLED BY: Intercore Environmental		TEST HOLE NO: TH05-14	
CLIENT: Public Works & Government Services Canada		DRILL RIG: Geoprobe		PROJECT NO: SX04344	
LOCATION: Stony Rapids, Saskatchewan		DRILL TYPE: Solid Stem Auger		ELEVATION:	
SAMPLE TYPE	<input checked="" type="checkbox"/> Shelby Tube	<input type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT Test (N)	<input type="checkbox"/> Grab Sample	<input type="checkbox"/> Split-Pen
BACKFILL TYPE	<input checked="" type="checkbox"/> Bentonite	<input type="checkbox"/> Pea Gravel	<input type="checkbox"/> Drill Cuttings	<input type="checkbox"/> Grout	<input type="checkbox"/> Bentonite Chips
				<input type="checkbox"/> Sand	<input type="checkbox"/> Core



End of Test Hole at 3.2 m below grade due to auger refusal
Notes: No monitoring well installed. Test hole backfilled with bentonite and auger cuttings.

SX04344 - STONEY RAPIDS.GPJ 15/02/02 11:28 AM (CO-OP ENV)

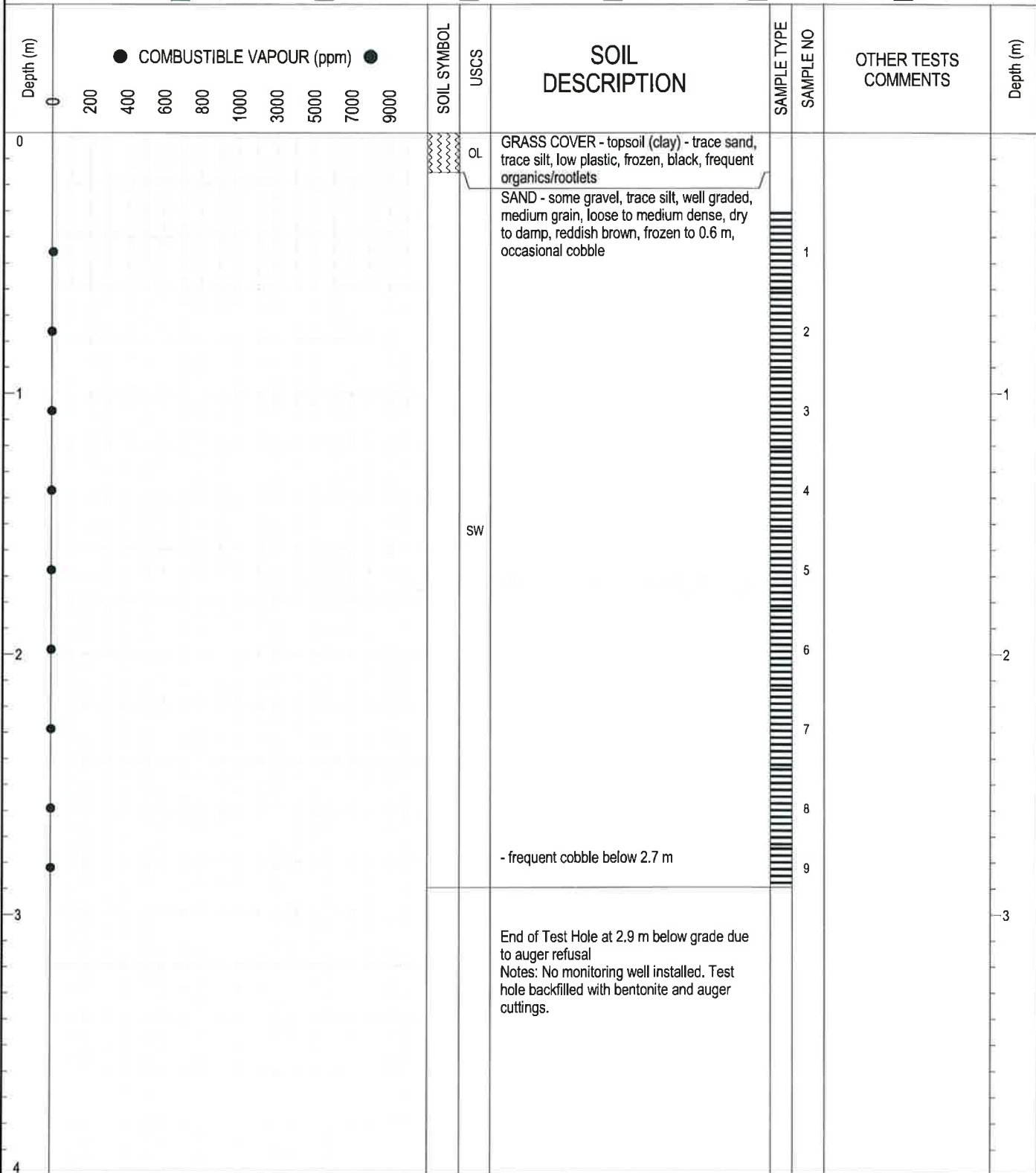



Amec Foster Wheeler Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: JH
REVIEWED BY: SC

COMPLETION DEPTH: 3.2 m
COMPLETION DATE: 10 December 2014

PROJECT: Supplemental Sampling		DRILLED BY: Intercore Environmental		TEST HOLE NO: TH06-14	
CLIENT: Public Works & Government Services Canada		DRILL RIG: Geoprobe		PROJECT NO: SX04344	
LOCATION: Stony Rapids, Saskatchewan		DRILL TYPE: Solid Stem Auger		ELEVATION:	
SAMPLE TYPE	<input checked="" type="checkbox"/> Shelby Tube	<input checked="" type="checkbox"/> No Recovery	<input checked="" type="checkbox"/> SPT Test (N)	<input checked="" type="checkbox"/> Grab Sample	<input type="checkbox"/> Split-Pen
BACKFILL TYPE	<input checked="" type="checkbox"/> Bentonite	<input type="checkbox"/> Pea Gravel	<input type="checkbox"/> Drill Cuttings	<input type="checkbox"/> Grout	<input checked="" type="checkbox"/> Bentonite Chips
					<input type="checkbox"/> Core
					<input type="checkbox"/> Sand



	Amec Foster Wheeler Environment & Infrastructure Winnipeg, Manitoba	LOGGED BY: JH	COMPLETION DEPTH: 2.9 m
		REVIEWED BY: SC	COMPLETION DATE: 10 December 2014
		Page 1 of 1	

SX04344 - STONEY RAPIDS.GPJ 15/02/02 11:28 AM (CO-OP ENV)

APPENDIX E

LABORATORY ANALYTICAL RESULTS



Amec Foster Wheeler plc
ATTN: SHERRY COCHRAN
4015 MILLAR AVENUE
SASKATOON SK S7K 2K6

Date Received: 15-DEC-14
Report Date: 06-FEB-15 14:53 (MT)
Version: FINAL REV. 2

Client Phone: 306-975-0444

Certificate of Analysis

Lab Work Order #: L1558541
Project P.O. #: NOT SUBMITTED
Job Reference: SX04344 PWGSC STONEY RAPIDS
C of C Numbers:
Legal Site Desc:

Comments:

6-FEB-2015 Revised sampler

Brian Morgan
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: #819-58th St E., Saskatoon, SK S7K 6X5 Canada | Phone: +1 306 668 8370 | Fax: +1 306 668 8383
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-1 TH01-14 @ 1.1M							
Sampled By: JH on 09-DEC-14							
Matrix: SOIL							
BTEX, F1-F4 and SK Reg. PHC's.							
CCME BTEX							
Benzene	<0.0050		0.0050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Toluene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Ethylbenzene	<0.010		0.010	mg/kg	16-DEC-14	17-DEC-14	R3121648
Xylenes	<0.10		0.10	mg/kg	16-DEC-14	17-DEC-14	R3121648
o-Xylene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
m+p-Xylene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Styrene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Surrogate: 1,4-Difluorobenzene	110.1		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 4-Bromofluorobenzene	96.8		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 3,4-Dichlorotoluene	99.1		70-130	%	16-DEC-14	17-DEC-14	R3121648
CCME Total Hydrocarbons							
F1 (C6-C10)	<10		10	mg/kg		17-DEC-14	
F1-BTEX	<10		10	mg/kg		17-DEC-14	
F2 (C10-C16)	<30		30	mg/kg		17-DEC-14	
F3 (C16-C34)	<50		50	mg/kg		17-DEC-14	
F4 (C34-C50)	<50		50	mg/kg		17-DEC-14	
Total Hydrocarbons (C6-C50)	<50		50	mg/kg		17-DEC-14	
Extractable Hydrocarbons. Tumbler/GC-FID							
TEH (C11-C22)	<50		50	mg/kg	16-DEC-14	17-DEC-14	R3121687
TEH (C23-C60)	<100		100	mg/kg	16-DEC-14	17-DEC-14	R3121687
Chrom. to baseline at nC50	YES		0		16-DEC-14	17-DEC-14	R3121687
Surrogate: 2-Bromobenzotrifluoride	101.8		70-130	%	16-DEC-14	17-DEC-14	R3121687
Miscellaneous Parameters							
% Moisture	10.0		1.0	%	16-DEC-14	17-DEC-14	R3121491
L1558541-2 TH01-14 @ 1.5M							
Sampled By: JH on 09-DEC-14							
Matrix: SOIL							
Miscellaneous Parameters							
% Moisture	2.18		0.10	%	17-DEC-14	18-DEC-14	R3122237
CCME PAHs							
Naphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Quinoline	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Phenanthrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Anthracene	<0.0040		0.0040	mg/kg	17-DEC-14	18-DEC-14	R3123676
Pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluorene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Indeno(1,2,3-cd)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Dibenzo(a,h)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
2-methylnaphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
B(A)P Total Potency Equivalent	<0.020		0.020	mg/kg	17-DEC-14	18-DEC-14	R3123676
IACR (CCME)	<0.15		0.15	mg/kg	17-DEC-14	18-DEC-14	R3123676

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-2	TH01-14 @ 1.5M							
Sampled By:	JH on 09-DEC-14							
Matrix:	SOIL							
CCME PAHs								
Surrogate: d10-Acenaphthene		87.2		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Phenanthrene		89.0		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d12-Chrysene		93.5		60-130	%	17-DEC-14	18-DEC-14	R3123676
L1558541-3	TH02-14 @ 0.6M							
Sampled By:	JH on 09-DEC-14							
Matrix:	SOIL							
BTEX, F1-F4 and SK Reg. PHC's.								
CCME BTEX								
Benzene		<0.0050		0.0050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Toluene		<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Ethylbenzene		<0.010		0.010	mg/kg	16-DEC-14	17-DEC-14	R3121648
Xylenes		<0.10		0.10	mg/kg	16-DEC-14	17-DEC-14	R3121648
o-Xylene		<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
m+p-Xylene		<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Styrene		<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Surrogate: 1,4-Difluorobenzene		112.9		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 4-Bromofluorobenzene		100.5		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 3,4-Dichlorotoluene		95.2		70-130	%	16-DEC-14	17-DEC-14	R3121648
CCME Total Hydrocarbons								
F1 (C6-C10)		<10		10	mg/kg		17-DEC-14	
F1-BTEX		<10		10	mg/kg		17-DEC-14	
F2 (C10-C16)		<30		30	mg/kg		17-DEC-14	
F3 (C16-C34)		<50		50	mg/kg		17-DEC-14	
F4 (C34-C50)		<50		50	mg/kg		17-DEC-14	
Total Hydrocarbons (C6-C50)		<50		50	mg/kg		17-DEC-14	
Extractable Hydrocarbons. Tumbler/GC-FID								
TEH (C11-C22)		<50		50	mg/kg	16-DEC-14	17-DEC-14	R3121687
TEH (C23-C60)		<100		100	mg/kg	16-DEC-14	17-DEC-14	R3121687
Chrom. to baseline at nC50		YES		0		16-DEC-14	17-DEC-14	R3121687
Surrogate: 2-Bromobenzotrifluoride		99.8		70-130	%	16-DEC-14	17-DEC-14	R3121687
Miscellaneous Parameters								
% Moisture		5.7		1.0	%	16-DEC-14	17-DEC-14	R3121491
L1558541-4	TH02-14 @ 0.9M							
Sampled By:	JH on 09-DEC-14							
Matrix:	SOIL							
Miscellaneous Parameters								
% Moisture		4.54		0.10	%	17-DEC-14	18-DEC-14	R3122237
CCME PAHs								
Naphthalene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Quinoline		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthylene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Phenanthrene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Anthracene		<0.0040		0.0040	mg/kg	17-DEC-14	18-DEC-14	R3123676
Pyrene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)anthracene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

[illegible]

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-6 TH03-14 @ 1.4M Sampled By: JH on 10-DEC-14 Matrix: SOIL CCME PAHs							
Pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluoroanthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluorene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Indeno(1,2,3-cd)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Dibenzo(a,h)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
2-methylnaphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
B(A)P Total Potency Equivalent	<0.020		0.020	mg/kg	17-DEC-14	18-DEC-14	R3123676
IACR (CCME)	<0.15		0.15	mg/kg	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Acenaphthene	91.4		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Phenanthrene	93.0		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d12-Chrysene	97.4		60-130	%	17-DEC-14	18-DEC-14	R3123676
L1558541-7 TH04-14 @ 0.75M Sampled By: JH on 10-DEC-14 Matrix: SOIL BTEX, F1-F4 and SK Reg. PHC's.							
CCME BTEX							
Benzene	<0.0050		0.0050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Toluene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Ethylbenzene	<0.010		0.010	mg/kg	16-DEC-14	17-DEC-14	R3121648
Xylenes	<0.10		0.10	mg/kg	16-DEC-14	17-DEC-14	R3121648
o-Xylene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
m+p-Xylene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Styrene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Surrogate: 1,4-Difluorobenzene	91.2		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 4-Bromofluorobenzene	85.5		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 3,4-Dichlorotoluene	98.0		70-130	%	16-DEC-14	17-DEC-14	R3121648
CCME Total Hydrocarbons							
F1 (C6-C10)	<10		10	mg/kg		17-DEC-14	
F1-BTEX	<10		10	mg/kg		17-DEC-14	
F2 (C10-C16)	<30		30	mg/kg		17-DEC-14	
F3 (C16-C34)	<50		50	mg/kg		17-DEC-14	
F4 (C34-C50)	<50		50	mg/kg		17-DEC-14	
Total Hydrocarbons (C6-C50)	<50		50	mg/kg		17-DEC-14	
Extractable Hydrocarbons. Tumbler/GC-FID							
TEH (C11-C22)	<50		50	mg/kg	16-DEC-14	17-DEC-14	R3121687
TEH (C23-C60)	<100		100	mg/kg	16-DEC-14	17-DEC-14	R3121687
Chrom. to baseline at nC50	YES		0		16-DEC-14	17-DEC-14	R3121687
Surrogate: 2-Bromobenzotrifluoride	101.1		70-130	%	16-DEC-14	17-DEC-14	R3121687
Miscellaneous Parameters							
% Moisture	9.5		1.0	%	16-DEC-14	17-DEC-14	R3121491
L1558541-8 TH04-14 @ 1.7M Sampled By: JH on 10-DEC-14 Matrix: SOIL Miscellaneous Parameters							
% Moisture	5.18		0.10	%	17-DEC-14	18-DEC-14	R3122237

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-8 TH04-14 @ 1.7M							
Sampled By: JH on 10-DEC-14							
Matrix: SOIL							
CCME PAHs							
Naphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Quinoline	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Phenanthrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Anthracene	<0.0040		0.0040	mg/kg	17-DEC-14	18-DEC-14	R3123676
Pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluoroanthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluorene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Indeno(1,2,3-cd)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Dibenzo(a,h)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
2-methylnaphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
B(A)P Total Potency Equivalent	<0.020		0.020	mg/kg	17-DEC-14	18-DEC-14	R3123676
IACR (CCME)	<0.15		0.15	mg/kg	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Acenaphthene	93.3		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Phenanthrene	93.8		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d12-Chrysene	97.6		60-130	%	17-DEC-14	18-DEC-14	R3123676
L1558541-9 TH05-14 @ 0.45M							
Sampled By: JH on 10-DEC-14							
Matrix: SOIL							
BTEX, F1-F4 and SK Reg. PHC's.							
CCME BTEX							
Benzene	<0.0050		0.0050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Toluene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Ethylbenzene	<0.010		0.010	mg/kg	16-DEC-14	17-DEC-14	R3121648
Xylenes	<0.10		0.10	mg/kg	16-DEC-14	17-DEC-14	R3121648
o-Xylene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
m+p-Xylene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Styrene	<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Surrogate: 1,4-Difluorobenzene	108.8		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 4-Bromofluorobenzene	99.4		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 3,4-Dichlorotoluene	84.8		70-130	%	16-DEC-14	17-DEC-14	R3121648
CCME Total Hydrocarbons							
F1 (C6-C10)	<10		10	mg/kg		17-DEC-14	
F1-BTEX	<10		10	mg/kg		17-DEC-14	
F2 (C10-C16)	<30		30	mg/kg		17-DEC-14	
F3 (C16-C34)	<50		50	mg/kg		17-DEC-14	
F4 (C34-C50)	<50		50	mg/kg		17-DEC-14	
Total Hydrocarbons (C6-C50)	<50		50	mg/kg		17-DEC-14	
Extractable Hydrocarbons. Tumbler/GC-FID							
TEH (C11-C22)	<50		50	mg/kg	16-DEC-14	17-DEC-14	R3121687
TEH (C23-C60)	<100		100	mg/kg	16-DEC-14	17-DEC-14	R3121687
Chrom. to baseline at nC50	YES		0		16-DEC-14	17-DEC-14	R3121687
Surrogate: 2-Bromobenzotrifluoride	102.0		70-130	%	16-DEC-14	17-DEC-14	R3121687
Miscellaneous Parameters							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-9 TH05-14 @ 0.45M Sampled By: JH on 10-DEC-14 Matrix: SOIL % Moisture	6.4		1.0	%	16-DEC-14	17-DEC-14	R3121491
L1558541-10 TH05-14 @ 1.1M Sampled By: JH on 10-DEC-14 Matrix: SOIL Miscellaneous Parameters % Moisture	2.42		0.10	%	17-DEC-14	18-DEC-14	R3122237
CCME PAHs Naphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Quinoline	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Phenanthrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Anthracene	<0.0040		0.0040	mg/kg	17-DEC-14	18-DEC-14	R3123676
Pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluoroanthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluorene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Indeno(1,2,3-cd)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Dibenzo(a,h)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
2-methylnaphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
B(A)P Total Potency Equivalent	<0.020		0.020	mg/kg	17-DEC-14	18-DEC-14	R3123676
IACR (CCME)	<0.15		0.15	mg/kg	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Acenaphthene	78.1		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Phenanthrene	82.0		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d12-Chrysene	104.9		60-130	%	17-DEC-14	18-DEC-14	R3123676
L1558541-11 TH05-14 @ 3.0M Sampled By: JH on 10-DEC-14 Matrix: SOIL Miscellaneous Parameters % Moisture	5.86		0.10	%	17-DEC-14	18-DEC-14	R3122237
CCME PAHs Naphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Quinoline	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Phenanthrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Anthracene	<0.0040		0.0040	mg/kg	17-DEC-14	18-DEC-14	R3123676
Pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluoroanthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluorene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-11	TH05-14 @ 3.0M							
Sampled By: JH on 10-DEC-14								
Matrix: SOIL								
CCME PAHs								
Indeno(1,2,3-cd)pyrene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Dibenzo(a,h)anthracene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
2-methylnaphthalene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
B(A)P Total Potency Equivalent		<0.020		0.020	mg/kg	17-DEC-14	18-DEC-14	R3123676
IACR (CCME)		<0.15		0.15	mg/kg	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Acenaphthene		92.6		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Phenanthrene		94.5		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d12-Chrysene		95.5		60-130	%	17-DEC-14	18-DEC-14	R3123676
L1558541-12	TH06-14 @ 0.45M							
Sampled By: JH on 10-DEC-14								
Matrix: SOIL								
BTEX, F1-F4 and SK Reg. PHC's.								
CCME BTEX								
Benzene		<0.0050		0.0050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Toluene		<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Ethylbenzene		<0.010		0.010	mg/kg	16-DEC-14	17-DEC-14	R3121648
Xylenes		<0.10		0.10	mg/kg	16-DEC-14	17-DEC-14	R3121648
o-Xylene		<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
m+p-Xylene		<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Styrene		<0.050		0.050	mg/kg	16-DEC-14	17-DEC-14	R3121648
Surrogate: 1,4-Difluorobenzene		119.3		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 4-Bromofluorobenzene		112.0		70-130	%	16-DEC-14	17-DEC-14	R3121648
Surrogate: 3,4-Dichlorotoluene		94.1		70-130	%	16-DEC-14	17-DEC-14	R3121648
CCME Total Hydrocarbons								
F1 (C6-C10)		<10		10	mg/kg		17-DEC-14	
F1-BTEX		<10		10	mg/kg		17-DEC-14	
F2 (C10-C16)		<30		30	mg/kg		17-DEC-14	
F3 (C16-C34)		<50		50	mg/kg		17-DEC-14	
F4 (C34-C50)		<50		50	mg/kg		17-DEC-14	
Total Hydrocarbons (C6-C50)		<50		50	mg/kg		17-DEC-14	
Extractable Hydrocarbons. Tumbler/GC-FID								
TEH (C11-C22)		<50		50	mg/kg	16-DEC-14	17-DEC-14	R3121687
TEH (C23-C60)		<100		100	mg/kg	16-DEC-14	17-DEC-14	R3121687
Chrom. to baseline at nC50		YES		0		16-DEC-14	17-DEC-14	R3121687
Surrogate: 2-Bromobenzo-trifluoride		89.1		70-130	%	16-DEC-14	17-DEC-14	R3121687
Miscellaneous Parameters								
% Moisture		4.0		1.0	%	16-DEC-14	17-DEC-14	R3121491
L1558541-13	TH06-14 @ 1.7M							
Sampled By: JH on 10-DEC-14								
Matrix: SOIL								
Miscellaneous Parameters								
% Moisture		3.16		0.10	%	17-DEC-14	18-DEC-14	R3122237
CCME PAHs								
Naphthalene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Quinoline		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthylene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Phenanthrene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Anthracene		<0.0040		0.0040	mg/kg	17-DEC-14	18-DEC-14	R3123676
Pyrene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene		<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

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Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-13 TH06-14 @ 1.7M Sampled By: JH on 10-DEC-14 Matrix: SOIL CCME PAHs							
Benzo(a)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluoroanthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluorene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Indeno(1,2,3-cd)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Dibenzo(a,h)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
2-methylnaphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
B(A)P Total Potency Equivalent	<0.020		0.020	mg/kg	17-DEC-14	18-DEC-14	R3123676
IACR (CCME)	<0.15		0.15	mg/kg	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Acenaphthene	92.6		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Phenanthrene	93.0		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d12-Chrysene	96.3		60-130	%	17-DEC-14	18-DEC-14	R3123676
L1558541-14 TH06-14 @ 2.8M Sampled By: JH on 10-DEC-14 Matrix: SOIL Miscellaneous Parameters							
% Moisture	3.09		0.10	%	17-DEC-14	18-DEC-14	R3122237
CCME PAHs							
Naphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Quinoline	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Phenanthrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Anthracene	<0.0040		0.0040	mg/kg	17-DEC-14	18-DEC-14	R3123676
Pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluoroanthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluorene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Indeno(1,2,3-cd)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Dibenzo(a,h)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
2-methylnaphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
B(A)P Total Potency Equivalent	<0.020		0.020	mg/kg	17-DEC-14	18-DEC-14	R3123676
IACR (CCME)	<0.15		0.15	mg/kg	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Acenaphthene	83.2		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Phenanthrene	83.1		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d12-Chrysene	96.0		60-130	%	17-DEC-14	18-DEC-14	R3123676
L1558541-15 DUP 2 Sampled By: JH on 10-DEC-14 Matrix: SOIL Miscellaneous Parameters							
% Moisture	2.38		0.10	%	17-DEC-14	18-DEC-14	R3122237
CCME PAHs							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

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Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-15 DUP 2							
Sampled By: JH on 10-DEC-14							
Matrix: SOIL							
CCME PAHs							
Naphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Quinoline	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Acenaphthylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Phenanthrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Anthracene	<0.0040		0.0040	mg/kg	17-DEC-14	18-DEC-14	R3123676
Pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(g,h,i)perylene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Chrysene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(b&j)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(k)fluoranthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Benzo(a)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluoroanthene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Fluorene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Indeno(1,2,3-cd)pyrene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
Dibenzo(a,h)anthracene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
2-methylnaphthalene	<0.010		0.010	mg/kg	17-DEC-14	18-DEC-14	R3123676
B(A)P Total Potency Equivalent	<0.020		0.020	mg/kg	17-DEC-14	18-DEC-14	R3123676
IACR (CCME)	<0.15		0.15	mg/kg	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Acenaphthene	100.6		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d10-Phenanthrene	99.8		60-130	%	17-DEC-14	18-DEC-14	R3123676
Surrogate: d12-Chrysene	104.0		60-130	%	17-DEC-14	18-DEC-14	R3123676
L1558541-16 SWS1-14							
Sampled By: JH on 10-DEC-14							
Matrix: WATER							
BTEX and F1 (C6-C10)							
Benzene	<0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
Toluene	<0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
EthylBenzene	<0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
Xylenes	<0.0020		0.0020	mg/L	18-DEC-14	22-DEC-14	R3123848
o-Xylene	<0.0010		0.0010	mg/L	18-DEC-14	22-DEC-14	R3123848
m+p-Xylene	<0.0010		0.0010	mg/L	18-DEC-14	22-DEC-14	R3123848
F1(C6-C10)	<0.20		0.20	mg/L	18-DEC-14	22-DEC-14	R3123848
F1-BTEX	<0.20		0.20	mg/L	18-DEC-14	22-DEC-14	R3123848
Surrogate: 1,4-Difluorobenzene	99.9		70-130	%	18-DEC-14	22-DEC-14	R3123848
Surrogate: 4-Bromofluorobenzene	85.5		70-130	%	18-DEC-14	22-DEC-14	R3123848
Surrogate: 3,4-Dichlorotoluene	82.8		70-130	%	18-DEC-14	22-DEC-14	R3123848
CCME PAHs							
Naphthalene	<0.000050		0.000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Quinoline	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Acenaphthene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Fluorene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Phenanthrene	<0.000050		0.000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Anthracene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Acridine	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Fluoranthene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Pyrene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(a)anthracene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Chrysene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-16 SWS1-14							
Sampled By: JH on 10-DEC-14							
Matrix: WATER							
CCME PAHs							
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(a)pyrene	<0.0000050		0.0000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Dibenzo(a,h)anthracene	<0.0000050		0.0000050	mg/L	18-DEC-14	19-DEC-14	R3123662
B(A)P Total Potency Equivalent	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Surrogate: d10-Acenaphthene	81.0		60-130	%	18-DEC-14	19-DEC-14	R3123662
Surrogate: d10-Phenanthrene	88.1		60-130	%	18-DEC-14	19-DEC-14	R3123662
Surrogate: d12-Chrysene	94.2		60-130	%	18-DEC-14	19-DEC-14	R3123662
L1558541-17 SWS2-14							
Sampled By: JH on 10-DEC-14							
Matrix: WATER							
BTEX and F1 (C6-C10)							
Benzene	<0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
Toluene	<0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
EthylBenzene	<0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
Xylenes	<0.0020		0.0020	mg/L	18-DEC-14	22-DEC-14	R3123848
o-Xylene	<0.0010		0.0010	mg/L	18-DEC-14	22-DEC-14	R3123848
m+p-Xylene	<0.0010		0.0010	mg/L	18-DEC-14	22-DEC-14	R3123848
F1(C6-C10)	<0.20		0.20	mg/L	18-DEC-14	22-DEC-14	R3123848
F1-BTEX	<0.20		0.20	mg/L	18-DEC-14	22-DEC-14	R3123848
Surrogate: 1,4-Difluorobenzene	101.4		70-130	%	18-DEC-14	22-DEC-14	R3123848
Surrogate: 4-Bromofluorobenzene	94.7		70-130	%	18-DEC-14	22-DEC-14	R3123848
Surrogate: 3,4-Dichlorotoluene	85.3		70-130	%	18-DEC-14	22-DEC-14	R3123848
CCME PAHs							
Naphthalene	<0.000050		0.000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Quinoline	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Acenaphthene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Fluorene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Phenanthrene	<0.000050		0.000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Anthracene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Acridine	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Fluoranthene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Pyrene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(a)anthracene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Chrysene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(a)pyrene	<0.0000050		0.0000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Dibenzo(a,h)anthracene	<0.0000050		0.0000050	mg/L	18-DEC-14	19-DEC-14	R3123662
B(A)P Total Potency Equivalent	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Surrogate: d10-Acenaphthene	84.6		60-130	%	18-DEC-14	19-DEC-14	R3123662
Surrogate: d10-Phenanthrene	90.2		60-130	%	18-DEC-14	19-DEC-14	R3123662
Surrogate: d12-Chrysene	93.1		60-130	%	18-DEC-14	19-DEC-14	R3123662
L1558541-18 SWS3-14							
Sampled By: JH on 10-DEC-14							
Matrix: WATER							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1558541-18 SWS3-14							
Sampled By: JH on 10-DEC-14							
Matrix: WATER							
BTEX and F1 (C6-C10)							
Benzene	<0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
Toluene	0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
EthylBenzene	<0.00050		0.00050	mg/L	18-DEC-14	22-DEC-14	R3123848
Xylenes	<0.0020		0.0020	mg/L	18-DEC-14	22-DEC-14	R3123848
o-Xylene	<0.0010		0.0010	mg/L	18-DEC-14	22-DEC-14	R3123848
m+p-Xylene	<0.0010		0.0010	mg/L	18-DEC-14	22-DEC-14	R3123848
F1(C6-C10)	<0.20		0.20	mg/L	18-DEC-14	22-DEC-14	R3123848
F1-BTEX	<0.20		0.20	mg/L	18-DEC-14	22-DEC-14	R3123848
Surrogate: 1,4-Difluorobenzene	97.7		70-130	%	18-DEC-14	22-DEC-14	R3123848
Surrogate: 4-Bromofluorobenzene	98.5		70-130	%	18-DEC-14	22-DEC-14	R3123848
Surrogate: 3,4-Dichlorotoluene	77.4		70-130	%	18-DEC-14	22-DEC-14	R3123848
CCME PAHs							
Naphthalene	<0.000050		0.000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Quinoline	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Acenaphthene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Fluorene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Phenanthrene	<0.000050		0.000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Anthracene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Acridine	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Fluoranthene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Pyrene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(a)anthracene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Chrysene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(b&j)fluoranthene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(k)fluoranthene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(a)pyrene	<0.000050		0.000050	mg/L	18-DEC-14	19-DEC-14	R3123662
Benzo(g,h,i)perylene	<0.000020		0.000020	mg/L	18-DEC-14	19-DEC-14	R3123662
Indeno(1,2,3-cd)pyrene	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Dibenzo(a,h)anthracene	<0.000050		0.000050	mg/L	18-DEC-14	19-DEC-14	R3123662
B(A)P Total Potency Equivalent	<0.000010		0.000010	mg/L	18-DEC-14	19-DEC-14	R3123662
Surrogate: d10-Acenaphthene	83.2		60-130	%	18-DEC-14	19-DEC-14	R3123662
Surrogate: d10-Phenanthrene	90.9		60-130	%	18-DEC-14	19-DEC-14	R3123662
Surrogate: d12-Chrysene	94.5		60-130	%	18-DEC-14	19-DEC-14	R3123662

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BTX,F1-SK	Water	BTEX and F1 (C6-C10)	EPA 5012A/8260B HS/GC/FID/MSD
Samples are transferred to glass vials with salt and methanol. The vial is then heated and agitated in a headspace auto-sampler. An aliquot of the headspace is injected into a gas chromatograph where sample flow is split into 2 directions. One split of the sample is passed through a DB-1 column to an FID detector where hydrocarbons in the F1 range are quantified.			
References: EPA Method 8260B, Volatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS), Revision 2, December 1996. EPA Method 5012A, Volatile Organic Compounds in Various Sample Matrices Using Equilibrium Headspace Analysis, Revision 1, June 2003.			
ETL-BTX,TVH-CCME-SK	Soil	CCME BTEX	CCME CWS-PHC DEC-2000 - PUB 1310
Fraction F1, C6 - C10 Hydrocarbons, is determined by extracting a 5 gram soil sample with methanol, separating the methanol from the soil, then adding the methanol extract to a purge-and-trap unit for release of volatile organics. The volatile organics are separated by gas chromatography using a 100% poly(dimethylsiloxane)column, with BTEX components quantified by MSD and the F1 range quantified using a flame ionization detector.			
Note: The result of a BTEX analysis is subtracted to give the final result.			
Reference: Modified EPA SW846 Methods 5030/ 8260, CCME CSW PHC Dec 2000			
ETL-TVH,TEH-CCME-SK	Soil	CCME Total Hydrocarbons	CCME CWS-PHC DEC-2000 - PUB 1310
Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.			
Hydrocarbon results are expressed on a dry weight basis.			
In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.			
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.			
In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.			
Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:			
1. All extraction and analysis holding times were met.			
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.			
3. Linearity of gasoline response within 15% throughout the calibration range.			
Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:			
1. All extraction and analysis holding times were met.			
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.			
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.			
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.			
PAH-CCME-CL	Soil	CCME PAHs	EPA 3570/8270-GC/MS
PAH-CCME-CL	Water	CCME PAHs	EPA 3510/8270-GC/MS
PREP-MOISTURE-CL	Soil	% Moisture	Oven dry 105C-Gravimetric
PREP-MOISTURE-SK	Soil	% Moisture	Oven dry 105C-Gravimetric
The weighed portion of soil is placed in a 105 C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.			
Reference: ASTM D2216-80			
TEH-TMB-SK	Soil	Extractable Hydrocarbons. Tumbler/GC-FID	CWS-PHC DEC 2000 (SOIL)
This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For C10 to C50 hydrocarbons (F2, F3, F4) and gravimetric heavy hydrocarbons (F4G-sg), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds. F2, F3 & F4 are analyzed by on-column GC/FID, and F4G-sg is analyzed gravimetrically.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
Laboratory Definition Code	Laboratory Location		
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA		
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA		

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

- mg/kg - milligrams per kilogram based on dry weight of sample
- mg/kg wwt - milligrams per kilogram based on wet weight of sample
- mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
- mg/L - unit of concentration based on volume, parts per million.
- < - Less than.
- D.L. - The reporting limit.
- N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1558541

Report Date: 06-FEB-15

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Client: Amec Foster Wheeler plc
4015 MILLAR AVENUE
SASKATOON SK S7K 2K6
Contact: SHERRY COCHRAN

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BTX,F1-SK		Water						
Batch	R3123848							
WG2016239-21 LCS								
Benzene			104.5		%		70-130	22-DEC-14
Toluene			102.6		%		70-130	22-DEC-14
EthylBenzene			103.1		%		70-130	22-DEC-14
Xylenes			103.4		%		70-130	22-DEC-14
o-Xylene			103.9		%		70-130	22-DEC-14
m+p-Xylene			102.8		%		70-130	22-DEC-14
F1(C6-C10)			90.4		%		70-130	22-DEC-14
WG2016239-20 MB								
Benzene			<0.00050		mg/L		0.0005	22-DEC-14
Toluene			<0.00050		mg/L		0.0005	22-DEC-14
EthylBenzene			<0.00050		mg/L		0.0005	22-DEC-14
Xylenes			<0.0020		mg/L		0.002	22-DEC-14
o-Xylene			<0.0010		mg/L		0.001	22-DEC-14
m+p-Xylene			<0.0010		mg/L		0.001	22-DEC-14
F1(C6-C10)			<0.20		mg/L		0.2	22-DEC-14
Surrogate: 1,4-Difluorobenzene			98.1		%		70-130	22-DEC-14
Surrogate: 4-Bromofluorobenzene			89.0		%		70-130	22-DEC-14
Surrogate: 3,4-Dichlorotoluene			95.8		%		70-130	22-DEC-14
PAH-CCME-CL		Water						
Batch	R3123662							
WG2017756-2 LCS								
Naphthalene			94.7		%		50-130	19-DEC-14
Quinoline			100.4		%		60-130	19-DEC-14
Acenaphthene			98.6		%		60-130	19-DEC-14
Fluorene			101.2		%		60-130	19-DEC-14
Phenanthrene			100.9		%		60-130	19-DEC-14
Anthracene			99.2		%		60-130	19-DEC-14
Acridine			101.4		%		60-130	19-DEC-14
Fluoranthene			103.1		%		60-130	19-DEC-14
Pyrene			104.2		%		60-130	19-DEC-14
Benzo(a)anthracene			105.4		%		60-130	19-DEC-14
Chrysene			101.8		%		60-130	19-DEC-14
Benzo(b&j)fluoranthene			103.7		%		60-130	19-DEC-14
Benzo(k)fluoranthene			99.6		%		60-130	19-DEC-14



Quality Control Report

Workorder: L1558541

Report Date: 06-FEB-15

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-CCME-CL	Water							
Batch	R3123662							
WG2017756-2	LCS							
Benzo(a)pyrene			96.8		%		60-130	19-DEC-14
Benzo(g,h,i)perylene			92.9		%		60-130	19-DEC-14
Indeno(1,2,3-cd)pyrene			79.0		%		60-130	19-DEC-14
Dibenzo(a,h)anthracene			106.4		%		60-130	19-DEC-14
WG2017756-1	MB							
Naphthalene			<0.000050		mg/L		0.00005	19-DEC-14
Quinoline			<0.000020		mg/L		0.00002	19-DEC-14
Acenaphthene			<0.000020		mg/L		0.00002	19-DEC-14
Fluorene			<0.000020		mg/L		0.00002	19-DEC-14
Phenanthrene			<0.000050		mg/L		0.00005	19-DEC-14
Anthracene			<0.000010		mg/L		0.00001	19-DEC-14
Acridine			<0.000020		mg/L		0.00002	19-DEC-14
Fluoranthene			<0.000020		mg/L		0.00002	19-DEC-14
Pyrene			<0.000010		mg/L		0.00001	19-DEC-14
Benzo(a)anthracene			<0.000010		mg/L		0.00001	19-DEC-14
Chrysene			<0.000020		mg/L		0.00002	19-DEC-14
Benzo(b&j)fluoranthene			<0.000010		mg/L		0.00001	19-DEC-14
Benzo(k)fluoranthene			<0.000010		mg/L		0.00001	19-DEC-14
Benzo(a)pyrene			<0.0000050		mg/L		0.000005	19-DEC-14
Benzo(g,h,i)perylene			<0.000020		mg/L		0.00002	19-DEC-14
Indeno(1,2,3-cd)pyrene			<0.000010		mg/L		0.00001	19-DEC-14
Dibenzo(a,h)anthracene			<0.0000050		mg/L		0.000005	19-DEC-14
Surrogate: d10-Acenaphthene			91.8		%		60-130	19-DEC-14
Surrogate: d10-Phenanthrene			94.9		%		60-130	19-DEC-14
Surrogate: d12-Chrysene			101.3		%		60-130	19-DEC-14
ETL-BTX,TVH-CCME-SK	Soil							
Batch	R3121648							
WG2014886-3	LCS							
Benzene			96.8		%		70-130	17-DEC-14
Toluene			93.9		%		70-130	17-DEC-14
Ethylbenzene			101.8		%		70-130	17-DEC-14
Xylenes			97.3		%		70-130	17-DEC-14
o-Xylene			98.0		%		70-130	17-DEC-14
m+p-Xylene			96.6		%		70-130	17-DEC-14



Quality Control Report

Workorder: L1558541

Report Date: 06-FEB-15

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ETL-BTX,TVH-CCME-SK Soil								
Batch R3121648								
WG2014886-3 LCS								
Styrene			90.6		%		50-150	17-DEC-14
TVH: (C6-C10 / No BTEX Correction)			112.6		%		70-130	17-DEC-14
WG2014886-2 MB								
Benzene			<0.0050		mg/kg		0.005	17-DEC-14
Toluene			<0.050		mg/kg		0.05	17-DEC-14
Ethylbenzene			<0.010		mg/kg		0.01	17-DEC-14
Xylenes			<0.10		mg/kg		0.1	17-DEC-14
o-Xylene			<0.050		mg/kg		0.05	17-DEC-14
m+p-Xylene			<0.050		mg/kg		0.05	17-DEC-14
Styrene			<0.050		mg/kg		0.05	17-DEC-14
TVH: (C6-C10 / No BTEX Correction)			<10		mg/kg		10	17-DEC-14
PAH-CCME-CL Soil								
Batch R3123676								
WG2017942-3 DUP L1558541-2								
Naphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Acenaphthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Quinoline		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Acenaphthylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Phenanthrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Anthracene		<0.0040	<0.0040	RPD-NA	mg/kg	N/A	50	18-DEC-14
Pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Benzo(g,h,i)perylene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Benzo(a)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Chrysene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Benzo(b&j)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Benzo(k)fluoranthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Benzo(a)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Fluoroanthene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Fluorene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Indeno(1,2,3-cd)pyrene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
Dibenzo(a,h)anthracene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
2-methylnaphthalene		<0.010	<0.010	RPD-NA	mg/kg	N/A	50	18-DEC-14
WG2017942-1 LCS								
Naphthalene			98.6		%		50-130	18-DEC-14
Acenaphthene			97.5		%		60-130	18-DEC-14



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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-CCME-CL	Soil							
Batch	R3123676							
WG2017942-1	LCS							
Quinoline			74.4		%		60-130	18-DEC-14
Acenaphthylene			95.5		%		60-130	18-DEC-14
Phenanthrene			96.4		%		60-130	18-DEC-14
Anthracene			90.4		%		60-130	18-DEC-14
Pyrene			96.5		%		60-130	18-DEC-14
Benzo(g,h,i)perylene			97.4		%		60-130	18-DEC-14
Benzo(a)anthracene			92.7		%		60-130	18-DEC-14
Chrysene			94.7		%		60-130	18-DEC-14
Benzo(b&j)fluoranthene			93.6		%		60-130	18-DEC-14
Benzo(k)fluoranthene			95.9		%		60-130	18-DEC-14
Benzo(a)pyrene			88.5		%		60-130	18-DEC-14
Fluoroanthene			97.7		%		60-130	18-DEC-14
Fluorene			96.0		%		60-130	18-DEC-14
Indeno(1,2,3-cd)pyrene			104.3		%		60-130	18-DEC-14
Dibenzo(a,h)anthracene			98.8		%		60-130	18-DEC-14
2-methylnaphthalene			95.6		%		60-130	18-DEC-14
WG2017942-2	MB							
Naphthalene			<0.010		mg/kg		0.01	18-DEC-14
Acenaphthene			<0.010		mg/kg		0.01	18-DEC-14
Quinoline			<0.010		mg/kg		0.01	18-DEC-14
Acenaphthylene			<0.010		mg/kg		0.01	18-DEC-14
Phenanthrene			<0.010		mg/kg		0.01	18-DEC-14
Anthracene			<0.0040		mg/kg		0.004	18-DEC-14
Pyrene			<0.010		mg/kg		0.01	18-DEC-14
Benzo(g,h,i)perylene			<0.010		mg/kg		0.01	18-DEC-14
Benzo(a)anthracene			<0.010		mg/kg		0.01	18-DEC-14
Chrysene			<0.010		mg/kg		0.01	18-DEC-14
Benzo(b&j)fluoranthene			<0.010		mg/kg		0.01	18-DEC-14
Benzo(k)fluoranthene			<0.010		mg/kg		0.01	18-DEC-14
Benzo(a)pyrene			<0.010		mg/kg		0.01	18-DEC-14
Fluoroanthene			<0.010		mg/kg		0.01	18-DEC-14
Fluorene			<0.010		mg/kg		0.01	18-DEC-14
Indeno(1,2,3-cd)pyrene			<0.010		mg/kg		0.01	18-DEC-14
Dibenzo(a,h)anthracene			<0.010		mg/kg		0.01	18-DEC-14



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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-CCME-CL	Soil							
Batch	R3123676							
WG2017942-2 MB								
2-methylnaphthalene			<0.010		mg/kg		0.01	18-DEC-14
Surrogate: d10-Acenaphthene			80.6		%		60-130	18-DEC-14
Surrogate: d10-Phenanthrene			80.4		%		60-130	18-DEC-14
Surrogate: d12-Chrysene			89.0		%		60-130	18-DEC-14
PREP-MOISTURE-CL	Soil							
Batch	R3122237							
WG2016289-1 DUP		L1558541-2						
% Moisture		2.18	1.83		%	17	20	18-DEC-14
TEH-TMB-SK	Soil							
Batch	R3121687							
WG2014890-3 LCS								
TEH (C11-C22)			95.3		%		70-130	17-DEC-14
TEH (C23-C60)			96.0		%		70-130	17-DEC-14
WG2014890-2 MB								
TEH (C11-C22)			<50		mg/kg		50	17-DEC-14
TEH (C23-C60)			<100		mg/kg		100	17-DEC-14

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



in of Custody (COC) / Analytical
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L1558541-COFC

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COC Number: 14 -

Page 1 of 2

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(lab use only)

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)	
Company: Amec Foster Wheeler, Environment & Infrastructure		Select Report Format: <input type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)		<input checked="" type="checkbox"/> Regular (Standard TAT if received by 3 pm - business days)	
Contact: Sherry Cochran		Quality Control (QC) Report with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT	
Address: 4015 Millar Ave, Saskatoon, SK S7K 2K6		<input type="checkbox"/> Criteria on Report - provide details below if box checked		<input checked="" type="checkbox"/> Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT	
Phone: 306-975-3602		Select Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		<input checked="" type="checkbox"/> Same day or weekend emergency - contact ALS to confirm TAT and surcharge	
Email 1 or Fax: sherry.cochran@amecfw.com		Email 1 or Fax: sherry.cochran@amecfw.com		Specify Date Required for E2,E or P:	
Email 2: justin.huberdeau@amecfw.com		Email 2: justin.huberdeau@amecfw.com		Analysis Request	
Invoice Distribution		Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX			
Email 1 or Fax: sherry.cochran@amecfw.com		Email 1 or Fax: sherry.cochran@amecfw.com			
Email 2: lana.thompson@amecfw.com		Email 2: lana.thompson@amecfw.com			
Oil and Gas Required Fields (client use)		ALS Contract:		Number of Containers	
Approver ID:		ALS Contract:			
GL Account:		Date (dd-mm-yy)			
Activity Code:		Time (h:mm)			
Location:		Sample Type			
ALS Lab Work Order # (lab use only)		Date			
Sample Identification and/or Coordinates (This description will appear on the report)		Time			
TH01-14 @ 1.1 m		09-Dec-14		Soil	
TH01-14 @ 1.5 m		09-Dec-14		Soil	
TH02-14 @ 0.6 m		09-Dec-14		Soil	
TH02-14 @ 0.9 m		09-Dec-14		Soil	
TH03-14 @ 0.75 m		10-Dec-14		Soil	
TH03-14 @ 1.4 m		10-Dec-14		Soil	
TH04-14 @ 0.75 m		10-Dec-14		Soil	
TH04-14 @ 1.7 m		10-Dec-14		Soil	
TH05-14 @ 0.45 m		10-Dec-14		Soil	
TH05-14 @ 1.1 m		10-Dec-14		Soil	
TH05-14 @ 3.0 m		10-Dec-14		Soil	
Drinking Water (DW) Samples (client use)		Special Instructions / Specify Criteria to add on report (client use)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System?				Frozen <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No	
Are samples for human drinking water use?				Ice packs <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Custody seal intact <input type="checkbox"/> Yes <input type="checkbox"/> No	
				Cooling initiated <input type="checkbox"/> Yes <input type="checkbox"/> No	
				INITIAL COOLER TEMPERATURES °C	
				FINAL COOLER TEMPERATURES °C	
				INITIAL SHIPMENT RECEPTION (lab use only)	
				Received by: <u>S. Cochran</u> Date: <u>15-Dec-14</u> Time: <u>3:25</u>	
				SHIPMENT RELEASE (client use)	
				Released by: <u>S. Cochran</u> Date: <u>15-Dec-14</u> Time: <u>15:10</u>	
				REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION	

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Select Report Format: <input type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> BMD (DIGITAL)							
Quality Control (QC) Report with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No							
<input type="checkbox"/> Criteria on Report - provide details below if box checked							
Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX							
Email 1 or Fax sherry.cochran@amecwf.com							
Email 2 justin.huberdeau@amecwf.com							
Invoice Distribution <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX							
Email 1 or Fax sherry.cochran@amecwf.com							
Email 2 lana.thompson@amecwf.com							
Oil and Gas Required Fields (client use)							
Approver ID:		Cost Center:					
GL Account:		Routing Code:					
Activity Code:							
Location:							
ALS Contact:		BM		Sampler:		CW	
Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)	Time (hh:mm)		Sample Type		
TH06-14 @ 0.45 m		10-Dec-14			Soil		
TH06-14 @ 1.7 m		10-Dec-14			Soil		
TH06-14 @ 2.8 m		10-Dec-14			Soil		
Dup 2		10-Dec-14			Water		
SWS1-14		10-Dec-14			Water		
SWS2-14		10-Dec-14			Water		
SWS3-14		10-Dec-14			Water		
Special Instructions / Specify Criteria to add on report (client use)							
Drinking Water (DW) Samples ¹ (client use)							
Are samples taken from a Regulated DW System? <input type="checkbox"/> Yes <input type="checkbox"/> No							
Are samples for human drinking water use? <input type="checkbox"/> Yes <input type="checkbox"/> No							
Released by: S. Cochran		Date: 15 Dec 14		Time: 15:10		SHIPMENT RELEASE (client use)	
Received by:		Date:		Time:		INITIAL SHIPMENT RECEPTION (lab use only)	
WHITE - LABORATORY COPY		YELLOW - CLIENT COPY		YELLOW - CLIENT COPY		YELLOW - CLIENT COPY	

PART 1 General

1.1 GEOTECHNICAL REPORTS

- .1 A copy of a detailed geotechnical investigation report with respect to the building site at Stony Rapids, SK is included as follows:
 - .1 Title: "New Detachment – Geotechnical Investigation, Stony Rapids, Saskatchewan. File No. S2106"
 - .2 Date: July 27, 2015
 - .3 Prepared by: Clifton Associates Ltd., #4-1925 1st Avenue North, Saskatoon, SK, S7K 6W1 (now 116 Research Drive #101, Saskatoon, SK S7N 3R3).
- .2 A copy of a detailed geotechnical investigation report with respect to the building site at Black Lake, SK is included as follows:
 - .1 Title: "Geotechnical Report Proposed RCMP Detachment, Black Lake, Saskatchewan File S1981"
 - .2 Date: 05 December 2013
 - .3 Prepared by: Clifton Associates Ltd., 340 Maxwell Crescent, Regina, Saskatchewan, S4N 5Y5.
- .3 These reports record properties of the soils and recommendations for the design of foundations, prepared primarily for the use of the Consultant. The recommendations given shall not be construed as a requirement of this Contract unless also contained in the Contract Documents.
- .4 The geotechnical reports, by their nature, cannot reveal all conditions that exist or can occur on the site. Should subsurface conditions, in the opinion of the Consultant, be found to vary substantially from the report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to the Owner.
- .5 Direct all questions pertaining to the geotechnical investigation report to the Departmental Representative.

PART 2 Products

2.1 NOT USED

- .1 Not used.

PART 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

File S2106

RCMP

Geotechnical Investigation

New Detachment
Stony Rapids, SK

Clifton Associates





27 July 2015

Attention: Mr. Cory Schneider, Project Manager
Company: Royal Canadian Mounted Police
National Project Delivery Office, Regina
Address: P.O. Box 6500
Regina, Saskatchewan S4P 3J7

RCMP**File S2106**

**New Detachment – Geotechnical Investigation
Stony Rapids, SK**

We are pleased to present to you our Geotechnical Report regarding the above subject.

We thank you for the opportunity to work with you on this project. If you have any questions regarding this report, please contact me.

Yours truly,

Clifton Associates Ltd.

Richard T Yoshida PEng
Senior Geotechnical Engineer
JO/RTY/djb

Distribution: Company - 3 copies
Clifton Associates Ltd. - 1 copy

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Appendices

Appendix A: Figures

Drawing No. S2106-01 Site Location Plan

Drawing No. S2106-02 Borehole Location Plan

Appendix B: Borehole Logs and Laboratory Test Data

Appendix C: Recommendations for Granular Materials

Appendix D: Certificate of Analysis – pH Testing Results

List of Tables

Table 5.1 Seismic Data

Table 5.2 Earth Pressure Coefficients

Table 6.1 Resistance Factors for Shallow and Deep Foundations

Table 6.2 Summary of Ultimate Pile Design Parameters – Driven Piles

Table 6.3 Coefficient of Horizontal Subgrade Reaction, K_s

1.0 Introduction

This report presents results of a geotechnical investigation conducted for the RCMP for the new detachment to be constructed in Stony Rapids, SK (Site). Authorization to proceed was provided by RCMP Purchase Order No. 7203693, dated 23 March 2015, which was sent via email to Mr. Jon Osback of Clifton Associates Ltd. (Clifton) by Ms. Bonny Manz, Senior Contracting Officer, RCMP.

In general, the objectives of this work were:

- To define the subsurface soil strata and groundwater conditions in the area of the proposed development.
- To provide recommendations for suitable methods of foundation support for proposed structure.
- To provide roadway surfacing structure recommendations.
- To provide recommendations for excavations, backfill, and drainage.
- To provide general site development criteria.
- To provide commentary on pertinent geotechnical issues identified during the subsurface investigation.

2.0 Description of the Site and Proposed Structures

The Site is located at the existing RCMP detachment in Stony Rapids, SK. The Site is bounded by the Fond Du Lac River to the north and east, an existing RCMP residence to the west and Johnson Street to the south. The Site location is shown on Drawing No. S2106-01.

Existing structures on the Site during the investigation include an RCMP residence in the northwest corner, two garages (one on the west edge and one in the northeast corner), a fuel tank in the southeast corner, and the existing RCMP detachment, which is planned to be demolished and replaced with the new structure. The Site is enclosed by a chain link fence and is accessed via a driveway on the southwest corner.

Utilities on Site include an overhead power line running south from the existing residence to a power pole east of the Site access driveway. An underground power line also runs from the aforementioned power pole to the southwest corner of the existing detachment. Underground sewer and water lines run from the west side of the existing detachment to a manhole southwest of the existing residence. The Site has two underground tanks; one to the west and one to the northeast of the existing detachment.

The proposed new detachment will consist of two single storey modular structures on an unheated crawlspace.

Drainage of surface water was observed to flow south down Johnson Street. Birch trees were observed throughout the Site with a few pine trees interspersed.

General foundation recommendations contained herein are provided for the proposed structures. These recommendations can be revised for specific loadings or configurations, if required, once additional details are known. This office must be advised of any changes so that the applicability of these recommendations can be assessed.

3.0 Field and Laboratory Investigation

Subsurface conditions were investigated by drilling three boreholes as shown on Drawing No. S2106-02. Boreholes were drilled on 7 April 2015 using a CME-75 truck mounted drilling rig equipped with 125 mm diameter solid stem auger. The maximum depth of exploration was 9.2m.

Representative soil samples were recovered for laboratory analysis. Sampling was started at a depth of 0.75 m and continued at a 0.75 m interval to 4.6 m. After this depth, the sampling interval was increased to 1.5 m. Standard Penetration Testing (SPT) and sampling was conducted in all boreholes, and disturbed cutting samples were collected as required.

Piezometers were installed in Boreholes BH101 and BH102 to monitor groundwater levels. Piezometers were constructed of 50 mm diameter Schedule 40 PVC pipe with a machined screen section. The annulus around the screen was filled with filter sand and isolated with a layer of bentonite. The remainder of the annulus was backfilled with cuttings.

The natural water content of each sample was determined. Other testing included determination of grain size distribution, pH and water soluble sulphate content of selected representative samples. Laboratory testing was conducted in accordance with procedures and methodologies described in ASTM standards.

Observations made during the field investigation, visual descriptions, and the results of laboratory tests are recorded in the Borehole Logs, and the Summary of Sampling and Laboratory Test Data, appended to this report. An explanation of the symbols and terms used in the borehole logs is included in Appendix B.

4.0 Analysis

4.1 Stratigraphy

Stratigraphy at Site consisted generally of till. Till had a silty sand matrix with a trace of clay and a trace of gravel and cobbles. The USC classification of the material was SM. Surficial soil to a depth of 1.2 m in Borehole BH101 was silt with a USC classification of ML. The colour of till varied from light brown (7.5YR 6/3) to dark brown (7.5YR 3/4). Sand varied from fine to coarse grained and was moist. It was wet below a depth of about 5.8 m. SPT N values ranged from about 55 blows to 85 blows for 300 mm of penetration, corresponding to a dense to very dense. Occasional higher or lower SPT N values were observed, which are attributed to the presence of cobbles or boulders, or sloughing at the base of the borehole, respectively.

The estimated angle of internal friction of sand was about 40° based on a correlation with the SPT blow count. A composite sample was combined using samples collected in the upper 3 m of the boreholes for a standard Proctor test. The maximum dry density and optimum water content of the sand determined in accordance with the standard Proctor test were 2,105 kg/m³ and 7.5%. The estimated CBR for sand till was 11.0 based on its grain size distribution and calculated Group Index.

4.2 Groundwater Regime

Seepage was encountered as high as about 5.8 m below ground surface during drilling, and water was measured at the same elevation prior to borehole backfilling. Groundwater levels are expected to fluctuate with the level of development in the area, as well as seasonal changes in precipitation, infiltration, and evaporation.

5.0 General Discussion

The major geotechnical issues associated with this project are:

- Frost penetration.
- Foundations to support the proposed structures.
- Excavations.
- Roadway surfacing.
- Site development criteria.

5.1 Seismic Site Response

The site classification for seismic site response, as described in NBCC 2010 (Table 4.1.8.4A), can be based on the average estimated undrained shear strength or average standard penetration test blow count in the upper 30 m. Shear wave velocity was

not measured for this site. SPT blow counts averaged more than 50 in sand till. Assuming that soil below is of equal or greater density, the weighted average SPT blow count is estimated to be greater than 50. On this basis, design can assume Site Class C conditions for seismic response.

For Site Class C conditions, the acceleration based site coefficient, $F_a = 1.0$ and the velocity based site coefficient, $F_v = 1.0$. The peak ground acceleration (PGA) and the 5% damped spectral response acceleration values for 0.2, 0.5, 1.0, and 2.0 second periods, $S_a(T)$, for the site are summarized in Table 5.1.

Table 5.1 Seismic Data				
$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
0.095	0.057	0.026	0.008	0.036

5.2 Potential for Liquefaction

Factors influencing liquefaction include soil type, relative density, confining pressure, soil drainage conditions, and seismic conditions. Sand can be susceptible to liquefaction if it is loose and has poor drainage, and if ground accelerations associated with an earthquake or other event is sufficient.

An assessment of liquefaction compares the cyclic shear stress developed by the design earthquake (cyclic stress ratio, CSR) and the resistance to liquefaction possessed by the soil due to its density (cyclic resistance ratio, CRR). The factor of safety against liquefaction is assumed to be the ratio, CRR/CSR.

In simplified terms, the cyclic shear stress caused by an earthquake is assumed to be proportional to the peak ground surface acceleration, which is 0.036 for Stony Rapids. For this Site, CSR is calculated to be about 0.005. As a comparison, the CSR for Richmond, British Columbia would be at least about 15 times higher, or about 0.075, depending on factors such as depth and effective stress.

For the Stony Rapids Site, sand till was dense to very dense, with an estimated SPT N blow count of 40 to over 50. This suggests a CRR of about 0.4 to 0.5. As a comparison, the estimated CRR for loose Fraser River sand is about 0.085.

On this basis, the estimated factor of safety against liquefaction for the site is about 80 or higher. This suggests that it is unlikely that sufficient seismic activity is present that would result in liquefaction.

5.3 Frost

Sand till with silt and clay sized particles will be frost susceptible. The depth of freezing in this area will vary, depending on air temperature, ground cover, the type of any fill material utilized during development, and other factors. The depth of freezing will

be greatest for sand with low water content. Where groundwater is not present or is present at great depth, the risk of ice segregation and associated heave is reduced. Frost heave can be an issue for unheated structures. In general, frost heave will be a potential issue for foundations constructed less than about 3 m from surface. At this Site, the risk can be minimized by constructing footings below the depth of freezing.

The depth of the foundation can be reduced if the foundation is insulated. This will only apply to a structure without a crawlspace or a heated crawlspace. Insulation can be incorporated into an unheated structure, although the amount of insulation required can be substantial.

5.4 Foundation Alternatives

The selection of a suitable foundation will depend on the magnitude of loading and the required performance. Foundation alternatives at this Site include:

- Spread footings.
- Driven steel or timber piles.
- Helical piles.

Issues related to foundation construction will include:

- Potential for seepage and poor standup conditions in excavations.
- Cobbles and boulders within the sand till stratum.
- Frost penetration.

Shallow spread footings can be supported on the dense surficial sand till stratum. Foundations should be constructed below the anticipated depth of freezing to minimize the risk of frost heave. Foundations may incorporate insulation to limit heat loss and the depth of freezing. Potential heave associated with freezing of till with a water content of about 4.5% is estimated to be about 8 mm per metre depth of soil below the foundation and to the estimated depth of freezing, which is based on the void ratio of sand and the volumetric increase as water freezes. Heave may be greater if ice segregation occurs.

Settlement of shallow spread footings constructed on dense sand till will be predominantly elastic. The magnitude of settlement can be controlled by adjusting footing to limit settlement, and by ensuring good subgrade preparation. The amount of settlement will increase as the size of the footing increases for a constant bearing pressure. The bearing pressure utilized will be controlled by settlement rather than bearing failure.

Augered cast-in-place concrete piles are not considered to be a suitable alternative at this Site. Although standup conditions were relatively good in the small diameter boreholes, significant sloughing is anticipated in larger excavations required for piles, especially below about 6m, where groundwater was encountered during drilling. This would, at a minimum, require the use of temporary sleeving to ensure that excavations were free of sloughing soil and water prior to concreting.

Continuous flight auger (CFA) piles are not considered to be a suitable alternative because of generally high mobilization costs and the need to specify concrete with specific aggregate and admixture requirements.

Driven steel or timber piles are a foundation alternative, although moderately difficult driving conditions are anticipated in the very dense sand and till due to the random presence of cobbles or boulders. Driven piles may be designed on the basis of skin friction and end bearing. Piles will likely refuse in the very dense sand till, or boulders. Steel pipe piles may be driven open ended and filled with concrete after they have been driven to final depth. A soil plug will form while driving, which will increase the effect end bearing area to the gross cross section of the pipe. The box area of an H section pile, defined as the width times the depth, may be used to calculate the end bearing of an H section steel pile. Settlement of piles driven to refusal in the very dense sand till is expected to be less than 5 mm to 8 mm.

Helical piles developing their capacity on the basis of skin friction and end bearing may be a suitable alternative. Skin friction along the pile shaft is generally considered to contribute to capacity for a shaft diameter greater than 100 mm. The lateral load carrying capacity of helical piles should be verified as part of the structural design where significant moment associated with lateral loading is present.

5.5 Coefficient of Earth Pressure

Active and passive earth pressure can be calculated using active earth pressure coefficients. Table 5.2 provides a summary of these properties. The angle of internal friction for till provided is estimated for a reduced density rather than the in situ soil density.

Table 5.2 Earth Pressure Coefficients

Material	Angle of Internal Friction (°)	Total Unit Weight (kN/m ³)	Earth Pressure Coefficients		
			Active	At Rest	Passive
Sand Till	33	21.1	0.29	0.46	3.4
Granular Fill	38	20.0	0.24	0.38	4.2

5.6 Coefficient of Friction for Sliding

The friction angle between concrete and soil for concrete poured directly on soil can be assumed to be equal to the angle of internal friction for soil provided in Table 5.2. This assumes a rough contact surface between soil and concrete. For smooth concrete against soil, the tangent of the angle of internal friction should be reduced by 20 percent.

5.7 Modulus of Subgrade Reaction

The modulus of subgrade reaction, k_s (MPa), was estimated using an empirical correlation with the ultimate bearing capacity. On this basis, a value of 20 MN/m³ may be assumed. The value for the modulus of subgrade reaction should be varied over a range of about $\pm 50\%$ to assess the sensitivity of performance to the assumed value.

5.8 Permeability

The permeability or hydraulic conductivity of sand has been estimated to be about 10^{-2} m/s to 10^{-3} m/s, based on the measured grain size distribution.

5.9 Floors

It is our understanding that the proposed structures will have an unheated crawlspace. Structurally supported floors are discussed in Section 8.0 of this report.

5.10 Excavations

Groundwater was encountered during drilling at a depth of about 6 m; therefore, significant dewatering is not expected in shallow excavations. Groundwater levels may fluctuate seasonally and with precipitation.

Soil in this area will be a type 3 soil as defined by Occupational Health and Safety regulations. In general, excavations should be no steeper than about 1 horizontal to 1 vertical (1:1). Although excavations through these materials may stand in the short term at steeper angles, over steepened slopes will slough and collapse if they are left open for long periods of time or if water is allowed to infiltrate. Groundwater seepage may lead to ravelling or erosion of cut slopes in sand. Excavation conditions must be carefully monitored, and slopes flattened during construction if conditions warrant. Failure may be sudden and may endanger personnel and equipment working in the vicinity.

5.11 Roadway Surfacing Structures

The subgrade soil available at this Site is sand and silt or silty sand. A design CBR value of 11.0 for this subgrade soil has been assumed because of the presence of as much as 50% of fines in surficial silt. Sand till will be a superior material for subgrade construction. Soil will be frost susceptible, which means that drainage is important for good performance.

For a gravel surface, 100 mm to 150 mm thickness of crushed base course or traffic gravel can be placed on the existing subgrade in order to prepare driving surfaces. This type of structure will require periodic maintenance, including blading and reapplication of a gravel surface.

5.12 General Site Development

5.12.1 Construction Equipment

Standard excavation equipment may be used for Site development; no unusual excavation conditions are anticipated. Large vibratory smooth steel drum compacting equipment should be used to compact sand and granular soil.

5.12.2 Topsoil, Cobbles, and Boulders

Significant topsoil was not noted during drilling; however, any organic topsoil that is present should be removed prior to placement of any fill to minimize the potential for settlement.

Cobbles were commonly encountered during drilling. Cobbles and boulders can be expected in excavations and during piling.

5.12.3 Groundwater

Groundwater seepage was noted at about 6 m during drilling, and can be expected below this depth. Groundwater levels are expected to fluctuate seasonally and with precipitation.

5.12.4 Suitability of On-Site Soil for Compacted Fill

Sand at this Site should be an acceptable material for construction of embankments or fills, although it may be sensitive to small changes in water content when compacting.

5.12.5 Shrinkage Factors

For estimates of earthwork volumes, a shrinkage factor of 15% to 20% may be used for sand.

5.12.6 Engineered Fill

If required, engineered fills supporting important structures should utilize local sand or pit run gravel. Specifications for pit run gravel and sand, and crushed base course material, are appended to this report.

5.12.7 Cut or Fill Slopes

Cut or fill slopes in sand will possess long term stability at slopes of 2 horizontal to 1 vertical (2:1), but may be subject to increased rates of erosion. Flatter slopes are preferred for landscaping purposes. Vegetation can be used to maintain slopes. Where vegetation is not desirable, a gravel surface with a minimum thickness of 150 mm is recommended on these slopes to reduce the potential for erosion.

Drainage swales and ditches should be constructed with gentle slopes, if possible, as the soil will be easily eroded, particularly if water velocities are greater than 2 m/s.

It is desirable to have road subgrades at least 1.0 m above natural ground on fill sections or to have at least a 1.0 m ditch in cut-fill sections. The surface of the subgrade should have enough cross-slope to ensure positive surface drainage prior to surfacing, nominally 5%.

5.12.8 Site Grading

The Site should be graded to ensure positive drainage throughout the construction phase. Grades should be created to direct water away from excavations and trenches. Within excavations, the subgrade should be graded with a cross slope so that any accumulated water can be removed by pumping.

Proper site grading design is critical to ensure good long term performance of shallow footings. Grades should ensure that water from precipitation or snowmelt does not accumulate near structures. A positive slope away from structures of at least 5% for about 3 m is recommended. Infiltration rate into the sand is expected to be high.

5.13 Compaction Specifications

Compaction specifications must consider the desired properties of the fill. Specifications will typically require compaction to a percentage of the maximum dry density determined in accordance with the standard Proctor test, and may include a range of water contents that are desirable. Depending on the desired properties for the compacted soil, the water content is often provided as a guide to the contractor, since the compactive effort will usually be minimized if the soil is compacted close to the optimum water content determined in accordance with the standard Proctor test. If the soil is wet of optimum, it will be possible to attain a specified density if greater compactive effort or more work is applied to the soil.

The compaction water content will have an impact on the properties of the compacted soil. Soil strength and compressibility is better if the water content is lower than optimum. Soil compacted wet of optimum to the necessary density may be more compressible under low pressure and may have reduced strength.

The following recommendations are provided for compaction:

- The excavated subgrade should be uniformly compacted to 95% of its maximum dry density, determined in accordance with ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)]. The water content of the subgrade should be close to optimum water content.
- Soft areas in the subgrade should be subcut and backfilled with local sand or well graded pit run gravel that is uniformly compacted to at least 100% of its maximum dry density, determined in accordance with ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)].
- If considered, granular pads for shallow spread footings should be constructed with local sand or a well graded pit run gravel that conforms to the recommended gradations for granular materials appended to this report. The material should be compacted to a minimum average 98% of maximum dry density for four (4) consecutive tests, with no single test less than 96%, determined in accordance with the standard Proctor test. Lift thickness should not exceed 200 mm.
- Crushed base course that will be under a floor slab or spread footing should be compacted to a minimum 98% of its maximum dry density, determined in accordance with the standard Proctor test.
- Fill material that will be under a parking area or roadway should be compacted to a minimum 98% of maximum dry density, determined in accordance with the standard Proctor test, in lifts no thicker than 150 mm in compacted thickness. Fill under landscaped areas does not generally require high density, although some compaction is required to reduce the amount of settlement. A suggested level of compaction is a minimum 90% of maximum dry density, determined in accordance with the standard Proctor test.

- Backfill of trenches in areas that already have been compacted should be with new subbase material as specified previously, and compacted to a minimum 98% of maximum dry density, determined in accordance with the standard Proctor test.
- Backfill and compact simultaneously each side of walls in layers of 300 mm to ensure that excessive pressure is not applied to one side of the wall.

5.14 Potential for Sulphate Attack

Water soluble sulphate contents measured by dry weight of soil were determined to be 0.04 and 0.06% in the laboratory. According to CSA A23.1, the potential for sulphate attack is low. On this basis, general use (Type GU) cement may be specified for concrete. Additional recommendations regarding sulphate resistant cement may be found in CSA A23.1.

5.15 pH

Sample numbers MS09 and MS11 from Borehole BH102 were submitted to ALS Laboratory Group in Saskatoon for determination of pH. The pH was 6.54 for MS09 and 7.31 for MS11. The laboratory Certificate of Analysis for the pH testing is included in Appendix D.

6.0 Discussion of Foundations

Foundation alternatives at this Site include shallow spread footings constructed on sand, driven steel or timber piles, or helical piles. Some construction difficulties should be expected for deep foundations due to the presence of cobbles and boulders, and the relatively high density of sand till.

6.1 Shallow Spread Footings

Generally, spread footings must be constructed below the anticipated depth of freezing, which in this area could be about 3 m. This can be reduced if insulation is incorporated into the design. There is a risk of frost heave associated with ice segregation since groundwater will be close to the freezing front.

6.1.1 Design

Dense sand till possesses relatively high bearing capacity. The estimated net ultimate bearing capacity of sand till at this Site is 450 kPa for a 450 mm wide footing. The ultimate bearing capacity is proportional to the width of the footing. Resistance factors for shallow foundations from NBCC 2010 have been summarized in Table 6.1.

Table 6.1 Resistance Factors for Shallow and Deep Foundations

Case	Resistance Factor
• Shallow Foundations: Vertical resistance by semi-empirical analysis using laboratory and in situ test data	0.5
• Deep Foundation: Bearing resistance to axial load based on semi-empirical analysis using laboratory and in situ test data	0.4
• Deep Foundation: Analysis using dynamic monitoring results	0.5
• Deep Foundation: Analysis using static loading test results	0.6
• Uplift Analysis: By semi-empirical analysis	0.3
• Uplift Analysis: Using load test results	0.4
• Horizontal Load Resistance	0.5

For a spread footing, the geotechnical resistance calculated using the ultimate bearing capacity and appropriate resistance factor is utilized to ensure that a gross failure of the foundation does not occur. Settlement considerations will typically govern the selection of an appropriate bearing pressure. Consideration of serviceability utilizes working or services loads and unfactored geotechnical properties for soil strata.

6.1.2 Settlement

The amount of settlement will be dependent on factors such as the foundation size and applied pressure. The amount of settlement will increase for a larger foundation with no change in the bearing pressure. The estimated settlement for a spread footing with a width of about 450 mm to 1,000 mm will be less than about 25 mm.

6.1.3 Subgrade Preparation

The width of excavations for major foundations should extend a minimum 1.5 m plus the depth of excavation beyond the edge of the foundation to ensure that the subgrade can be prepared and fill can be properly placed and compacted.

Although the base of large excavations can be level, it is desirable to create a cross slope on the subgrade to encourage the flow of water away from structures during construction and after placement of fill.

The subgrade should be prepared by excavating to the design grade and proof rolling with a heavy roller or other equipment to verify uniformity of the subgrade. Soft material should be excavated an additional 600 mm minimum and the area backfilled with compacted pit run gravel. Pit run gravel should be compacted to a minimum 100% of its maximum dry density to minimize the potential for differential settlement.

6.2 Driven Steel or Timber Piles

Driven steel or timber piles are a suitable option for this Site. Driven steel or timber piles may be designed to develop their capacity on the basis of skin friction and end bearing as the end bearing resistance is fully mobilized by the driving process.

6.2.1 Design

Ultimate values for skin friction and end bearing for driven piles have been provided in Table 6.2. Geotechnical resistance factors are provided in Table 6.1.

For H-section piles, the box area calculated as the flange width times the depth may be used in the calculation of end bearing. It is assumed that a plug of soil will form between the flanges as the pile is driven. Closed end pipe piles can be utilized. For open end piles, the creation of a soil plug can be assumed, which allows the use of the plugged end area for calculation of end bearing.

Table 6.2 Summary of Ultimate Pile Design Parameters – Driven Piles

Depth (m)		Soil	Ultimate Skin Friction		Ultimate End Bearing
From	To		Steel (kPa)	Timber (kPa)	(kPa)
0	2.5	Till	0	0	—
2.5	4.5	Till	60	100	
4.5	6.5	Till	85	100	
6.5	9.2	Till	70	100	14,000

* Minimum pile depth is 8 m.

The skin friction contribution of the upper 2.5 m of pile below finished grade or of any fill material should be ignored in the determination of pile capacity. The minimum length of pile is 8.0 m.

As the pile is struck with a hammer with a quantity of kinetic energy, the pile will penetrate the soil a distance referred to as the set. The size of the set for a given quantity of energy is related to the soil resistance; the smaller the set, the greater the soil resistance. Thus, for a fixed energy in a hammer blow, a smaller set implies a greater pile capacity.

The length of a pile required to support the desired load can be estimated using skin friction and end bearing capacity for a specific pile type with a known cross section. A hammer and driving system must then be selected so that the pile can be driven to the design depth.

The tensile and compressive stresses in the pile during driving must then be analyzed to ensure that the pile is capable of being driven with the selected hammer to the required depth without failing the pile. If analyses indicate that compressive or tensile stresses are excessive, the hammer energy can be reduced.

Additionally, if the predicted blow count to achieve the desired penetration is excessive, defined to be more than about 400 blows/m, a more powerful hammer will be required.

If both the blow count and the compressive stresses are excessive, a pile with a larger section should be selected.

An acceptance criterion can be selected to reduce the risk of damage to the pile during driving. However, unless confirmed by dynamic load testing, the pile must be driven to the design depth so that it will possess adequate capacity. 'Refusal' is dependent on the hammer energy. If the hammer selected does not possess adequate energy to drive the pile to the design depth, the pile may be observed to 'refuse'. This will not be an indication that the pile will possess adequate capacity. Practical refusal can be considered to be 400 blows/m, or 2.5 mm/blow.

In general, the hammer energy required to drive a pile will depend on the required pile capacity. As an approximate guide, the hammer-rated energy for driving steel H and pipe piles should be limited to a value of 6×10^6 J times the cross sectional area of the pile to reduce the risk of damage, or about 1.6×10^6 J times the pile head diameter (in metres) for timber.

Piles should be driven continuously once started, since setup, which is generally associated with dissipation of excess pore water pressures with time, may unnecessarily increase the driving effort. In some circumstances, it may be impossible to remobilize a pile that has been left for a few hours. The ratio of the mobilized skin friction while driving to the long term mobilized skin friction of 0.5 will be appropriate for clay soil. No reduction factor is required when considering the end bearing component.

For pile groups, a minimum centre to centre spacing of 2.5 times the pile diameter is recommended. A group efficiency of 1.0 is recommended for the determination of group capacity.

Uplift capacity of a driven steel or timber pile can be calculated on the basis of the ultimate skin friction values provided in Table 6.2 and the geotechnical resistance factors in Table 6.1. The weight of the pile can be included in the calculation. The end bearing component should not be included in the calculation of uplift capacity. The uplift capacity of a pile group will be the lesser of the sum of the uplift resistance of the piles in the group or the sum of the resistance mobilized on the surface perimeter of the group using the ultimate skin friction values provided in Table 6.2 and the geotechnical resistance factors in Table 6.1, plus the effective weight of the soil and piles enclosed within this perimeter.

6.2.2 Settlement

Settlement of a driven steel or timber pile is expected to be less than 5 mm to 10 mm.

6.2.3 Quality Assurance Testing

Load testing of piles is the most positive method to determine load carrying capacity and can form a fundamental part of the pile design process. Load testing can be conducted as part of the design process, during construction as proof tests, or as part of the quality assurance program for construction of the foundation.

The results of a pile load test can be used to evaluate the ultimate load carrying capacity of a pile and its load-settlement behaviour. It also provides a means to verify design assumptions.

Pile load tests may be conducted on production or prototype piles. The design pile capacity may influence the selection of the type of pile tested. If the design capacity of the production pile is high, it may be more economical to test a lower capacity prototype pile to confirm design parameters since it is desired to fail the pile during testing to assess ultimate design parameters.

If dynamic load testing is incorporated into the quality assurance testing program, the design pile capacity can be confirmed for the design pile length or depth of installation. Piles that cannot be driven to the design depth considering a practical refusal criteria of about 2.5 mm/blow should not be accepted unless it can be demonstrated by analysis that the pile has adequate capacity considering the hammer energy and pile set.

The number of pile load tests conducted will depend on the number of piles being driven and the variability of results obtained during construction. Additional pile load tests are suggested if test results indicate variable driving conditions due to the equipment used or subsurface conditions. Piles should be restruck to assess set. In general, the acceptance criterion can be an average capacity of no less than 85% of the estimated ultimate capacity for the tested piles.

6.3 Helical Piles

Helical piles may be a suitable foundation for this structure. The lateral load carrying capacity of the helical pile should be assessed by a structural consultant.

6.3.1 Design

The basis for design of helical piles considers a component of end bearing and skin friction for the shaft of the pile for a single helix pile or skin friction for a cylinder of soil between helixes for a multiple helix pile. The bottom of the pile should be installed below the depth of freezing, and preferably at least 6 m below ground surface to resist potential frost heave. The minimum depth of penetration is reduced when compared to a driven pile due to the presence of the helix that will provide resistance in uplift. The skin friction component of capacity is typically ignored for a pile shaft diameter less than 100 mm.

The installation torque will be dependent on soil conditions, the ultimate capacity of the pile and its shaft diameter. The installation torque can be estimated using the equation:

$$T = Q_{all} / K_T$$

where: Q_{all} = allowable capacity of the pile in N or lb,
 T = torque in N-m or ft-lb, and
 K_T = empirical factor.

Values for K_T will likely range from 3/ft to 20/ft for capacity in lb and torque in ft-lb, or 10/m to 33/m for T in N-m. For shafts of about 90 mm diameter, the value for K_T will be about 7/ft (23/m), with K_T decreasing to about 3/ft (10/m) for shaft diameters approaching 200 mm.

For a single helix pile installed into the sand stratum, the ultimate pile capacity, Q_{ult} (kN) can be estimated using the following equation:

$$Q_{ult} = q_{end,ult} A + \pi d q_{skin,ult} (H - 2)$$

where:

- $q_{end,ult}$ = ultimate bearing capacity as shown in Table 6.2,
- $q_{skin,ult}$ = ultimate skin friction as shown in Table 6.2,
- A = area of helix (m²),
- d = shaft diameter (m), and
- H = depth from ground surface to helix (m).

6.3.2 Settlement

Settlement of a properly designed and installed helical pile is expected to be less than about 20 mm to 30 mm.

6.3.3 Lateral Loads on Piles

The lateral load carrying capacity and deflection of a pile subjected to a lateral load is dependent on the stiffness of the pile and soil strength. The stiffness of a pile can be calculated using well defined properties of steel or concrete, or both; however, the response of soil under loading is subject to some variability. The best method to evaluate the performance of a pile subjected to a lateral load is a well-designed and executed lateral load test based on ASTM D3966-07, Standard Test Methods for Deep Foundations Under Lateral Loads.

The performance of laterally loaded augered cast-in-place concrete piles may be analyzed using the software application LPILE. This program computes deflection, shear, bending moment and soil response with respect to depth in a nonlinear soil. Soil behaviour is modelled with p - y curves that are generated by the software following published recommendations for various types of soils. These relationships consider the relationship between undrained shear strength and soil modulus, as well as strain at 50% of the maximum stress.

The lateral load carrying capacity of pile groups will depend on the pile spacing and orientation of the piles. In general, pile spacing should be at least 2.5 pile diameters. For preliminary analyses, an efficiency of 0.70 may be used for a group loaded parallel to the piles. This can be increased to 0.90 for loading perpendicular to the piles. Specific configurations with specific lateral, vertical or moments can be analyzed using software applications such as GROUP. If required, analyses can be undertaken once the magnitude of applied pile loads has been assessed.

Pile behaviour may be approximated using analysis that incorporates a coefficient of horizontal subgrade reaction, k_s . The coefficient of horizontal subgrade reaction is a rough approximation at best and includes a high degree of uncertainty due to the influence of stress level, pile geometry and empirical nature of expressions used to derive these values. Values for k_s are summarized in Table 6.3.

Table 6.3 Coefficient of Horizontal Subgrade Reaction, k_s

Soil	Depth (m)	k_s (kN/m ³)
Till	0 to 1	0
Till	1 to 6	3,000z/B to 4,000z/B
Till	6 +	4,000z/B to 5,000z/B

z = depth (m)

B = pile diameter (m)

7.0 General Foundation Recommendations

7.1 Shallow Spread Footing

The following recommendations are made for a shallow spread footing:

- Footings constructed above a depth of about 3 m may be prone to frost heave. Insulation may be incorporated into footing design to minimize frost related issues. In general, the bearing surface for a footing should be prepared by removing any pockets of soft soil or soft fill to a uniform bearing surface. The surface must be maintained in an undisturbed state. The excavated surface can be protected with a mudslab placed within 24 hours of completion of excavation.
- Significant seepage is not expected in excavations above about 6m; however, groundwater conditions may fluctuate seasonally and with precipitation. Some sloughing should be expected in footing excavations. Flat cutback angles or shoring may be required.
- Spread footings founded below a depth of 3 m below existing grade should be below the depth of frost penetration.
- Over excavated areas may be filled with a lean concrete mix or with a well graded pit run gravel that conforms to the Recommended Specifications for Granular Materials appended to this report (Appendix C). The material must be compacted to 100% of its maximum dry density determined in accordance with ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft lbf/ft³ (600 kN m/m³)].
- The foundation must be adequately reinforced to distribute the applied loads and also have sufficient stiffness to distribute local over stresses.
- The minimum footing width is 450 mm.
- A shallow spread footing constructed as specified above may be designed on the basis of an ultimate bearing capacity of 450 kPa, using the geotechnical resistance factors shown in Table 6.1. For serviceability criteria, bearing capacity can be selected on the basis of settlement or differential settlement as described in previous sections.

7.2 Driven Steel or Timber Piles

Driven piles consisting of steel or timber may be considered to support the proposed structure. For preliminary purposes, our specific design recommendations for a driven pile foundation system are as follows:

- If practical, we recommend that test piles be driven and tested prior to the ordering of construction piles. The test should at least consist of driving the piles, allowing it to sit overnight, and then redriving it the following day. Piles should also be restruck at least two weeks after installation. The pile should not have any further penetration. Group action must be considered when evaluating the results of the test.
- The capacity of the piles may be estimated on the basis of skin friction and end bearing.
- For preliminary design, ultimate values for skin friction and end bearing are summarized in Table 6.2. Geotechnical resistance factors have been provided in Table 6.1. The skin friction contribution of the upper 2.5 m of pile below finished grade and any fill material should be ignored in the determination of pile capacity.
- Required pile lengths may vary greatly, particularly in pile groups; therefore, the need for qualified inspection, testing of piles and suitable specifications is paramount. The minimum recommended pile spacing for pile groups is 2.5 times the nominal pile width.
- Piles should be driven continuously, once started, to ensure that setup associated with dissipation of excess pore water pressure does not unnecessarily increase the driving effort.
- As an approximate guide, the hammer-rated energy for driving steel H and pipe piles should be limited to a value of 6×10^6 J times the cross sectional area of the pile for steel, or 1.6×10^6 J times the cross sectional area of the pile for timber. Practical refusal can be considered to be 400 blows/m, or 2.5 mm/blow.

7.3 Underground Walls

It is recommended that the underground walls should be designed to withstand the lateral earth pressure (p) at any depth (H) as estimated by the following expression:

$$p = K (\gamma H + q)$$

where: γ = unit weight of the wall backfill as shown in Table 5.2,
 q = the vertical pressure of any surcharge acting at ground surface near the wall,
 K = at rest earth pressure coefficient as shown in Table 5.2.

This expression assumes that the wall will be backfilled with a free draining granular backfill and will not be subject to build up of water pressure behind the wall. If effective wall drainage cannot be guaranteed, full hydrostatic pressure which may act on the wall must be considered in the design.

Free draining backfill materials should be placed adjacent to the exterior underground walls. Free draining means that the granular material should be well graded and have less than 3% passing the 75 μ m sieve. The upper 0.5 m of backfill should consist of compacted clay rich soil or the surface must be covered with some other suitable impermeable material. The ground surface should be contoured away from the building to further discourage the entry of surface runoff into the backfill.

Regardless of the type of backfill used behind the wall, it is recommended that the wall be effectively dampproofed to prevent migration of moisture through the concrete. Dampproofing also aids in reducing the rate of deterioration of the concrete due to chemical attack and weathering.

8.0 Floor Considerations

The following procedures are recommended for the construction of a structurally supported floor:

- The subgrade surface should be positively graded to a sump to remove water, which may inadvertently pond beneath the floor. Infiltration rates are expected to be high; however, the possibility of ponding water should be considered.
- Migration of moisture from the soil should be prevented by installing 150 µm (minimum) thick polyethylene vapour barrier covered with 50 mm of sand.
- Floors designed as a structurally supported system with a crawl space between the floor and the subgrade should have some provision to ventilate the crawl space, particularly during the summer months.
- As an alternative to a crawl space, the floor may be cast upon waxed cardboard carton 'void form' that is designed to degrade, following the placement of the concrete. The cardboard cartons must have strength sufficient to support the fresh concrete until it has sufficient strength to be self-supporting. Great care is required during construction of such floor systems to ensure that the collapse of the cartons does not take place, resulting in a grade supported slab. Careful inspection of these floors during construction is required to ensure that the void does not collapse during the placement of the floor. Further care must be taken during selection of 'void form' used. Materials which depend upon biologic degradation should be avoided.

9.0 Excavation Considerations

The stability of cut slopes and the stability of any adjacent structure must be considered for any excavations on the Site. The anticipated sideslopes for the excavation will depend on the soil texture, water content, and length of time that the excavation is left open.

Although groundwater was encountered around 6m, some seepage and sloughing should be expected in excavations. Shoring or relatively flat cutback angles may be required. Although infiltration rates are expected to be high in sand, the potential requirement for pumping of water from excavations should be considered.

Excavations should be performed in compliance with provincial safety regulations. If construction personnel will be in the excavation, then sideslopes for the excavation should not be steeper than 1:1 for safety, as stated in provincial safety guidelines. Sideslopes may have to be adjusted in the field as excavation progresses, depending upon conditions encountered. Seepage

could contribute to ravelling or sloughing of the sand, and slopes should be monitored and cut back as required during construction. Continuous inspection is recommended since slope failure could be sudden.

All loose material on the sides of the excavation should be trimmed. The excavation should be left open for the minimum amount of time required for construction. Some loss of strength in the soil can be expected with the passing of time, resulting in sloughing and local slope failures.

As described in Occupational Health and Safety Regulations, a competent worker should be stationed on the surface to alert any worker in the excavation about the development of any potentially unsafe conditions. Machinery and heavy equipment should not be allowed closer to the excavation than one half of the depth of the excavation, unless precautions are implemented to ensure that workers in the excavation are safe. Spoil material should not be piled closer than 3 m from the edge of the excavation and with sideslopes no steeper than 1:1.

Infiltration of water into the soil around the excavation can result in loss of strength and collapse of the excavation walls. It is recommended that workers not be in the excavation during rainfall and that excavation walls be carefully inspected for cracking, sloughing, and potential failures after rainfall before work continues in the excavation.

10.0 Closure

This report was prepared by Clifton Associates Ltd. for the use of the RCMP and their agents for specific application to the proposed RCMP Detachment in Stony Rapids, Saskatchewan. The material in it reflects Clifton Associates Ltd. best judgment available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Clifton Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report has been prepared with generally accepted engineering practices common to the local area. No other warranty, expressed or implied, is made.

Our conclusions and recommendations are preliminary and based upon the information obtained from the referenced subsurface exploration. The borings and associated laboratory testing indicate subsurface and groundwater conditions only at the specific locations and times investigated, only to the depth penetrated, and only for the soil properties tested. The subsurface and groundwater conditions may vary between the boreholes and with time. The subsurface interpretation provided is a professional opinion of conditions and not a certification of the Site conditions. The nature and extent of subsurface variation may not become evident until construction or further investigation. If variations or other latent conditions do become evident, Clifton Associates Ltd. should be notified immediately so that we may re-evaluate our conclusions and recommendations.

The enclosed report contains the results of our investigation as well as certain recommendations arising out of such investigations. Our recommendations do not constitute a design, in whole or in part, of any elements of the proposed work. Incorporation of any or all of our recommendations into the design of any such element does not constitute us as designers or co-designers of such elements, nor does it mean that the design is appropriate in geotechnical terms. The designers of such elements must consider the appropriateness of our recommendations in light of all design criteria known to them, many of which may not be known to us. Our mandate has been to investigate and recommend which we have completed by means of this report. We have had no mandate to design, or review the design, of any elements of the proposed work and accept no responsibility for such design or design review.

Clifton Associates Ltd.

Jon Osback PEng

Richard T. Yoshida Peng
Senior Geotechnical Engineer

Appendix A

Clifton Associates Figures

Clifton Associates



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LEGEND

SITE LOCATION

NOTES

1. LOCATION AND SITE PLAN IMAGES PROVIDED BY GOOGLE EARTH PRO, 2007.
2. KEY PLAN IMAGE PROVIDED BY GOVERNMENT OF CANADA; NATURAL RESOURCES CANADA; EARTH SCIENCES SECTOR; THE ATLAS OF CANADA, 2001.
3. LEGAL DESCRIPTION: NE 02-118-23 W2M, STONY RAPIDS, SASKATCHEWAN.

[illegible]

KEY PLAN
SCALE 1" = 7,500.000'

ENGINEER

Clifton Associates

client

RCMP

PROJECT _____ NEW DETACHMENT _____

NEW DETACHMENT
GEO TECHNICAL INVESTIGATION

NEW DETACHMENT
GEOTECHNICAL INVESTIGATION

1998

SITE LOCATION PLAN

DATE	2015-04-14	SHEET NO.	52106-01
AS NOTED			
PROJECT NO.	52106	FILE NO.	52106-01
DATE	2015-04-14	SHEET NO.	52106-01

[illegible]



LEGEND

- SITE LOCATION
- PIEZOMETER
- BOREHOLE



NOTES:
1. IMAGE PROVIDED BY GOOGLE EARTH PRO, 2007.
2. LEGAL DESCRIPTION:
NE 02-118-23 W04
STONY RAPIDS, SASKATCHEWAN.

REVISIONS		
NO.	DESCRIPTION	DATE



ENGINEER	CLIENT
PROJECT	RCMP
NEW DETACHMENT GEO-TECHNICAL INVESTIGATION	
TITLE	
BOREHOLE LOCATION PLAN	
DESIGNED	11/20/2014
DRAWN	11/20/2014
CHECKED	11/20/2014
APPROVED	11/20/2014
DATE	11/20/2014
BY	11/20/2014
FOR	11/20/2014
BY	11/20/2014
FOR	11/20/2014

Appendix B

Clifton Associates

Borehole Logs and Laboratory Test Data

Clifton Associates



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Soil Descriptive Terms

A soil description for geotechnical applications includes a description of the following properties:

- texture
- color, oxidation
- consistency and condition
- primary and secondary structure

Texture

The soil texture refers to the size, size distribution and shape of the individual soil particles which comprise the soil. The Unified Soil Classification System (ASTM D2487-00) is a quantitative method of describing the soil texture. The basis of this system is presented on the following page. The following terms are commonly used to describe the soil texture.

Particle Size (ASTM D2487-00)	
Boulder	300 mm plus
Cobble	75 – 300 mm
Gravel	4.75 – 75 mm
Coarse	19 – 75 mm
Fine	4.75 – 19 mm
Sand	0.075 – 4.75 mm
Coarse	2 – 4.75 mm
Medium	0.425 – 2 mm
Fine	0.075 – 0.425 mm
Silt and Clay	Smaller than 0.075 mm

Relative Proportions (CFEM, 4th Ed., 2006)	
Trace	1 – 10 %
Some	10 – 20 %
Gravelly, sandy, silty, clayey, etc.	20 – 35 %
And	>35 %
Gravel, Sand, Silt, Clay, etc.	35% and main fraction

Gradation	
Well Graded	Having a wide range of grain sizes and substantial amount of all intermediate sizes.
Uniform or Poorly Graded	Possessing particles of predominately one size.
Gap Graded	Possessing particles of two distinct sizes.

Particle Shape	
Angular	Sharp edges and relatively plane sides with unpolished face.
Subangular	Similar to 'angular' but have rounded edges.
Subrounded	Well-rounded corners and edges, nearly plane sides.
Rounded	No edges, has smoothly curved sides. Also may be flat, elongated, or both.

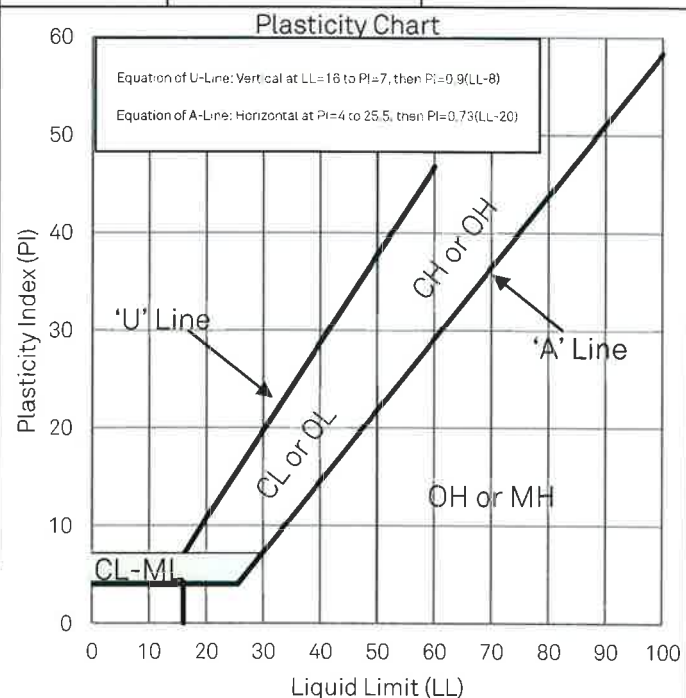
The term "TILL" may be used as a textural term to describe a soil which has been deposited by glaciers and contains an unsorted, wide range of particle sizes.

Colour and Oxidation

The soil color at its natural moisture content is described by common colors and, quantitatively, in terms of the Munsell color notation; (eg. 5Y 3/1). The notation combines three variables, hue, value and chroma to describe the soil color. The hue indicates its relation to red, yellow, green, blue and purple. The value indicates its lightness. The chroma indicates its strength of departure from a neutral of the same lightness. Departure of the soil color from a neutral color indicates the soil has been oxidized. Oxidation of a soil occurs in a oxygen rich environment where most commonly metallic iron, oxidizes and turns a neutral colored soil 'rusty' or reddish brown. Oxidized manganese gives a purplish tinge to the soil. Oxidation may occur throughout the entire soil mass or on fracture/joint/fissure surfaces.

Classification of Soils for Engineering Purposes

ASTM Designation D 2487-00 (Unified Soil Classification System)

Major divisions			Group Symbol	Typical Names	Classification Criteria		
Coarse-grained soils More than 50% retained on No. 200 sieve* (>0.075 mm)	Gravels More than 50% of coarse fraction retained on No. 4 sieve(4.75 mm)	Clean gravels <5% fines	GW	Well-graded gravel	Classification on basis of percentage of fines: Less than 5% pass No. 200 sieve - GW, GP, SW, SP More than 12% pass No. 200 sieve - GM, GC, SM, SC 5 to 12% pass No. 200 sieve - Borderline classifications, use of dual symbols	$C_u = \frac{D_{60}}{D_{10}} \geq 4$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravel		Not meeting either C_u or C_c criteria for GW	
		Gravels with >12% fines	GM	Silty gravel		Atterberg limits below "A" line or PI less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravel		Atterberg limits on or above "A" line and PI > 7	If fines are organic add "with organic fines" to group name
	Sands 50% or more of coarse fraction passes No. 4 sieve(<4.75 mm)	Clean sands <5% fines	SW	Well-graded sand		$C_u = \frac{D_{60}}{D_{10}} \geq 6$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sand		Not meeting either C_u or C_c criteria for SW	
		Sands with >12% fines	SM	Silty sand		Atterberg limits below "A" line or PI less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sand		Atterberg limits on or above "A" line and PI > 7	If fines are organic add "with organic fines" to group name
	Silts and Clays Liquid Limit <50%	Inorganic	ML	Silt	If 15 to 29% coarse-grained, add "with sand" or "with gravel" as appropriate. If >30% coarse-grained, add "sandy" or "gravelly" as appropriate. Class as organic when oven dried liquid limit is < 75% of undried liquid limit.		
			CL	Lean Clay -low plasticity			
		Organic	OL	Organic clay or silt (Clay plots above 'A' Line)			
	Silts and Clays Liquid Limit >50%	Inorganic	MH	Elastic silt			
			CH	Fat Clay -high plasticity			
		Organic	OH	Organic clay or silt (Clay plots above 'A' Line)			
	Highly Organic Soils		PT	Peat, muck and other highly organic soils			

*Based on the material passing the 3 in.(75 mm) sieve, if field samples contain cobbles or boulders, add "with cobbles or boulder's" to group name

Consistency and Condition

The consistency of a cohesive soil is a qualitative description of its resistance to deformation and can be correlated with the undrained shear strength of the soil. The condition of a coarse grained soil qualitatively describes the soil compactness and can be correlated with the standard penetration resistance (ASTM D1586-99).

Consistency of Cohesive Soil (CFEM, 4th Edit., 2006)		
Consistency	Undrained Shear Strength (kPa) (CFEM, 4 th Edit., 2006)	Field Identification (ASTM D2488-00)
Very Soft	<12	Thumb will penetrate soil more than 25 mm.
Soft	12 – 25	Thumb will penetrate soil about 25 mm.
Firm	25 – 50	Thumb will indent soil about 6 mm.
Stiff	50 – 100	Thumb will indent, but penetrate only with great effort (CFEM),
Very stiff	100 – 200	Readily indented by thumbnail (CFEM).
Hard	>200	Thumb will not indent soil but readily indented with thumbnail,
Very Hard	N/A	Thumbnail will not indent soil.

Consistency of Coarse Grained Soil (CFEM, 4th Edit., 2006)	
Compactness Condition	SPT N – Index (Blows/300mm)
Very Loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Over 50

Moisture Conditions (ASTM D2488-00)	
Description	Criteria
Dry	Absence of moisture, dusty, dry to touch.
Moist	Damp but no visible water.
Wet	Visible, free water, usually soil is below water table.

Structure

The soil structure is the manner in which the individual soil particles are assembled to form the soil mass. The primary soil structure is the arrangement of soil particles as originally deposited. The secondary soil structure refers to any rearrangement of the soil such as deformation and cracking which has taken place since deposition.

Primary Soil Structure (Depositional)

Geometry

Stratum	- A single sedimentary 'layer', greater than 10 mm in thickness, visibly separable from other strata by a discrete change in lithology and/or sharp physical break.
Homogeneous	- Same colour and appearance throughout.
Stratified	- Consisting of a sequence of layers which are generally of contrasting texture or colour.
Laminated	- Stratified with layer thickness between 2 – 10 mm.
Thinly Laminated	- Stratified with layer thickness less than 2 mm.
Bedded	- Stratified with layer thickness greater than 10 mm.
Very Thinly Bedded (Flaggy)	- Stratified with layer thickness between 10 – 50 mm.
Thinly Bedded (Slabby)	- Stratified with layer thickness between 50 – 600 mm.
Thickly Bedded (Blocky)	- Stratified with layer thickness between 600 – 1200 mm.
Thick-Bedded (Massive)	- Stratified with layer thickness greater than 1200 mm.
Lensed	- Inclusions of small pockets of different soil, such as small lenses of sand material throughout a mass of clay.

Bedding Structures

Cross-bedding	- Internal 'bedding' inclined to the general bedding plane.
Ripple-bedding	- Internal 'wavy bedding'.
Graded-bedding	- Internal gradation of grain size from coarse at base to finer at top of bed.
Horizontal bedded	- Internal bedding is parallel and flat lying.

Secondary Soil Structure (Post-Depositional)

Accretionary Structures

Includes nodules, concretions, crystal aggregates, veinlets, color banding, and:


















Cementation	- Chemically precipitated material, commonly calcite (CaCO_3), binds the grains of soil, usually sandstone. Described as weak, moderate, or strong (ASTM D2488-00).
Salt Crystals	- Groundwater flowing through the soil/rock often precipitates visible amounts of salts. Calcite (CaCO_3), glauber salts ($\text{Na}_2\text{Ca}(\text{SO}_4)_2$), and gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) are common.

Fracture Structures










Fracture	- A break or discontinuity in the soil or rock mass caused by stress exceeding the material's strength.
Joint	- A fracture along which no displacement has occurred.
Fissure	- A gapped fracture, which may open and close seasonally. Usually an extensive network of closely spaced fractures, giving the soil a 'nuggetty' structure.
Slickensides	- Fractures in clay that are slick and glossy in appearance, caused by shear movements.
Brecciated	- Contains randomly orientated angular fragments of a finer mass, usually associated with shear displacement in soils.
Fault	- A fracture or fracture zone along with displacement has occurred.
Blocky	- A cohesive soil that can be broken down into small angular lumps which resist further break down.

Symbols Used on Borehole Logs






Lithology Type

	Clay		Till - oxidized		Coal		Clay Shale
	Silt		Till - unoxidized		Topsoil or Organic Soil		Sandstone
	Sand		Peat		Concrete		Mudstone
	Gravel		Fill (undifferentiated)		Asphalt		Bedrock (undifferentiated)
	Cobbles						



Borehole Completion and Backfill Materials

	Bentonite		Cuttings		Slough
	Concrete		Grout		Solid Pipe
	Cover		Sand		Slotted Pipe

Soil Sample Type

	Thin Walled Tube		Disturbed		No Recovery
	Driven Spoon		Core (any type)		

Groundwater Symbols

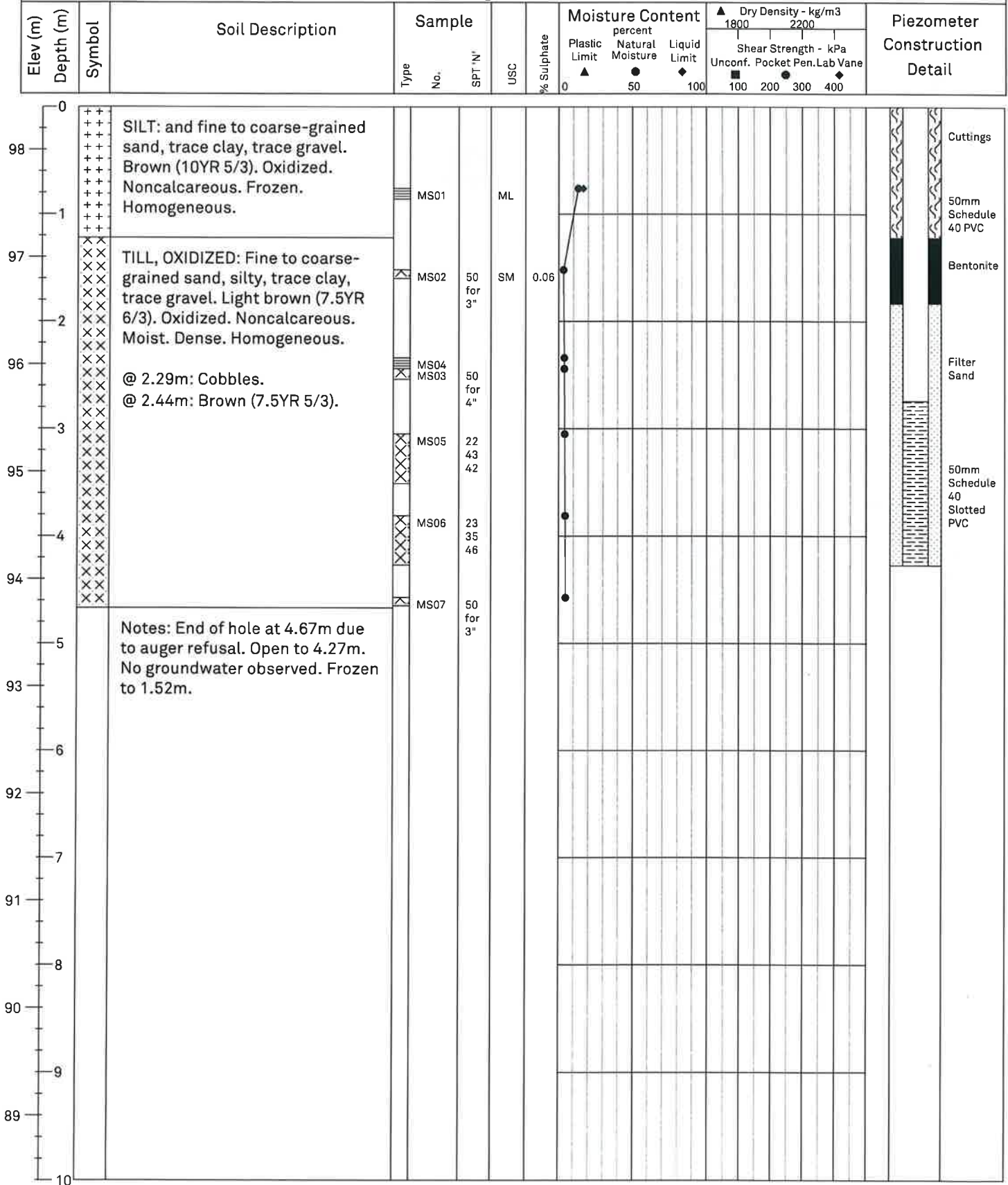
	Piezometric elevation as determined by a piezometer installation.
	Water levels measured in borings at time and under the conditions noted.



Client: RCMP
Project: Geotechnical Investigation
Location: Stony Rapids, SK
Project No.: S2106

Northing: 6569235.8
 Easting: 452612.8
 Ground Elev.: 98.4
 Top Casing Elev.:

Date Drilled: 7 April 2015
Drill: CME-75
Drilling Method: Solid Stem Auger
Logged by: MS



Summary of Sampling and Laboratory Test Data

[illegible]

Remarks

Approved by _____



Clifton Associates

Project No. S2106
Client RCMP
Project Geotechnical Investigation
Location Stony Rapids, SK



BOREHOLE LOG

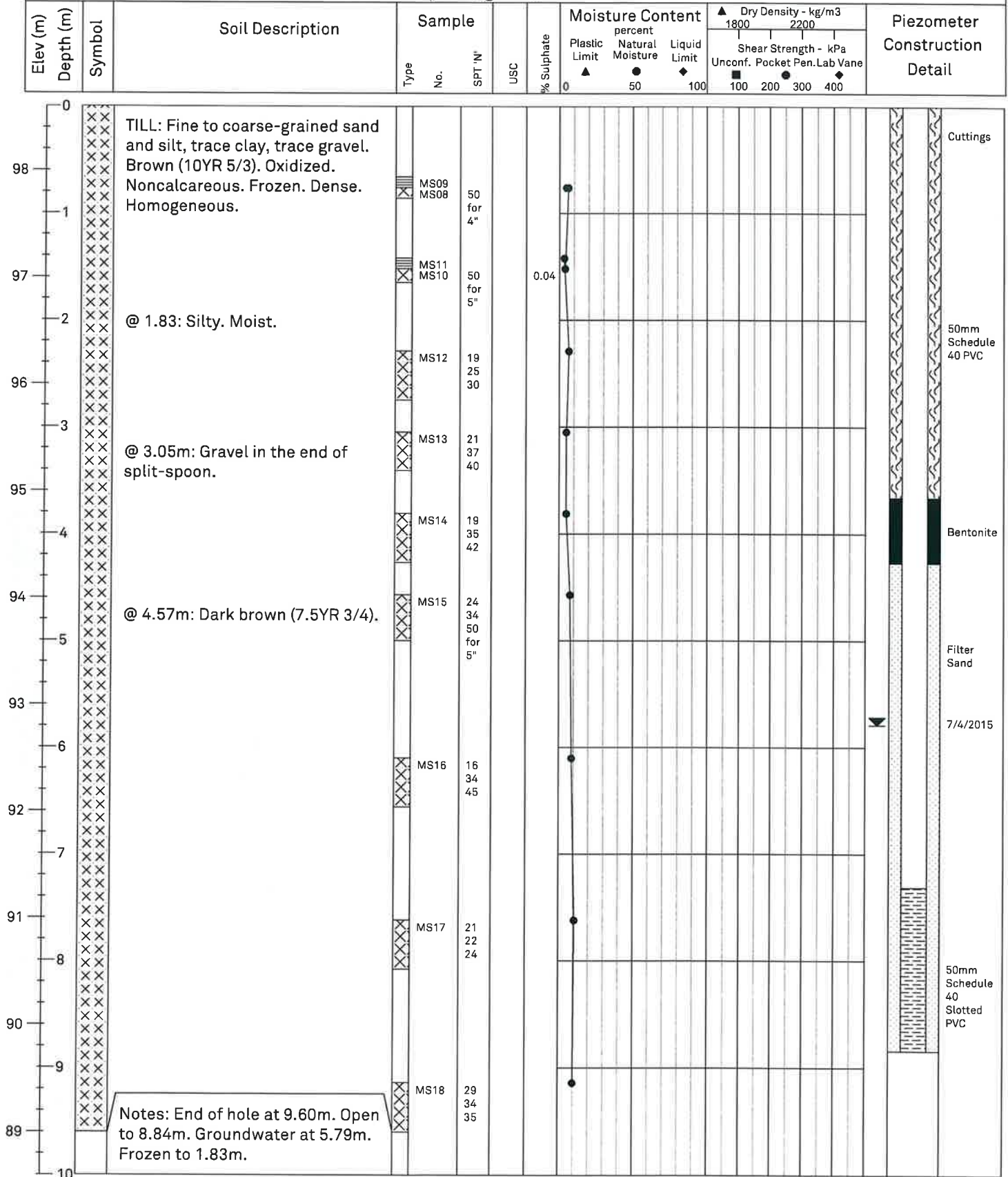
Borehole: 102

Page: 1 of 1

Client: RCMP
 Project: Geotechnical Investigation
 Location: Stony Rapids, SK
 Project No.: S2106

Northing: 6569256.8
 Easting: 452592.3
 Ground Elev.: 98.6
 Top Casing Elev.:

Date Drilled: 7 April 2015
 Drill: CME-75
 Drilling Method: Solid Stem Auger
 Logged by: MS



Summary of Sampling and Laboratory Test Data

[illegible]

Remarks

Approved by



Clifton Associates

Project No. S2106

Client RCMP

Project Geotechnical Investigation

Location Stony Rapids, SK



BOREHOLE LOG

Borehole: 103

Page: 1 of 1

Client: RCMP
Project: Geotechnical Investigation
Location: Stony Rapids, SK
Project No.: S2106

Northing:	6569253.1
Easting:	452628.2
Ground Elev.:	99.3
Top Casing Elev.:	

Date Drilled: 7 April 2015
Drill: CME-75
Drilling Method: Solid Stem Auger
Logged by: MS

Elev (m)	Depth (m)	Symbol	Soil Description	Sample		USC	% Sulphate	Moisture Content percent			Dry Density - kg/m3			Piezometer Construction Detail			
				Type	No.			SPT 'N'	Plastic Limit	Natural Moisture	Liquid Limit	1800	2200		Shear Strength - kPa		
								0	50	100	100	200	300	400			
								▲	●	◆	▲	■	●	◆			
								Unconf.	Pocket Pen.	Lab Vane							
99	0	XXXXXX	TILL, OXIDIZED: Fine to coarse-grained sand, silty, trace clay, trace gravel. Brown (7.5YR 5/3). Oxidized. Noncalcareous. Frozen. Dense. Homogeneous.	MS19													
98	1			MS20													
97	2			MS21	50 for 2"												
96	3			MS22													
95	4			MS24 MS23	50 for 3"												
94	5			MS25	32 40 50 for 5"												
93	6			MS26	25 38 23												
92	7																
91	8			MS27	42 50 for 4"												
90	9			MS28	11 19 23												
NOTES: End of hole at 9.60m. Open to 6.71m. Groundwater at 6.10m. Frozen to 2.44m.																	

Summary of Sampling and Laboratory Test Data

[illegible]

Remarks

Approved by

Clifton Associates

Project No. S2106

Client RCMP

Project Geotechnical Investigation

Location Stony Rapids, SK

Clifton Associates

Recommended Specifications for Granular Materials

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Recommended Specifications for Granular Materials

- Granular materials shall be composed of fragments of durable rock free from undesirable quantities of soft or flaky particles, topsoil, organic matter, clay or silt lumps, lumps of frozen granular soil, ice, snow or construction rubble.
- The Pit Run Fill shall have a plasticity index less than 10 percent. The Crushed Base Course shall have a plasticity index less than 6 percent.
- For Pit Run Sand, $\frac{D_{60}}{D_{10}} > 6$, and $1 < \frac{(D_{30})^2}{D_{10} \times D_{60}} < 3$. For Pit Run Gravel, $\frac{D_{60}}{D_{10}} > 4$, and $1 < \frac{(D_{30})^2}{D_{10} \times D_{60}} < 3$.
- Granular materials shall be excavated, loaded, hauled, placed and levelled in such a manner to prevent contamination with undesirable materials described in Point 1 above and to prevent excessive segregation of coarse and fine particles.
- Granular material shall conform to the following gradation specifications:

Percent by Weight Passing U.S. Standard Sieve Series							
Sieve	Pit Run Gravel Fill	Pit Run Sand Fill	Crushed Base Course				
			32	33	34	35	36
50.0 mm	100						
25.0 mm	85 – 100		100				
18.0 mm	80 – 100		87 – 100	100	100	100	100
12.5 mm	70 – 100	100	79 – 93	81 – 100	91 – 100	81 – 100	91 – 100
5.0 mm	50 – 85	75 – 100	47 – 77	50 – 80	70 – 85	50 – 85	70 – 85
2.0 mm	35 – 75	50 – 90	29 – 56	32 – 52	45 – 65	32 – 65	45 – 70
900 µm	25 – 50	30 – 75	18 – 39	20 – 35	28 – 43	20 – 43	28 – 51
400 µm	15 – 35	15 – 50	13 – 26	15 – 25	20 – 30	15 – 30	20 – 35
160 µm	8 – 22	5 – 30	7 – 16	8 – 15	11 – 18	8 – 18	11 – 21
75 µm	0 – 13	0 – 15	6 – 11	7 – 10	8 – 12	7 – 12	8 – 13

Appendix D

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Certificate of Analysis

pH Testing Results

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ATTN: Geoff Haanen
4 - 1925 1st Ave N
Saskatoon SK S7K 6W1

Date Received: 10-APR-15
Report Date: 14-APR-15 16:40 (MT)
Version: FINAL

Client Phone: 306-975-0401

Certificate of Analysis

Lab Work Order #: L1597584
Project P.O. #: NOT SUBMITTED
Job Reference: S2106
C of C Numbers:
Legal Site Desc:

Brian Morgan
Account Manager

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ADDRESS: #819-58th St E., Saskatoon, SK S7K 6X5 Canada | Phone: +1 306 668 8370 | Fax: +1 306 668 8383
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1597584-1 BH102 MS09								
Sampled By: CLIENT on 10-APR-15								
Matrix: SOIL								
SAR and Cations in saturated soil								
Calcium (Ca)		12.3		2.0	mg/L	14-APR-15	14-APR-15	R3173651
Potassium (K)		3.0		1.0	mg/L	14-APR-15	14-APR-15	R3173651
Magnesium (Mg)		6.8		2.0	mg/L	14-APR-15	14-APR-15	R3173651
Sodium (Na)		19.5		4.0	mg/L	14-APR-15	14-APR-15	R3173651
SAR		1.11		0.10	SAR	14-APR-15	14-APR-15	R3173651
pH and EC (Saturated Paste)								
% Saturation		18.7		1.0	%	13-APR-15	14-APR-15	R3173533
pH in Saturated Paste		6.54		0.10	pH	13-APR-15	14-APR-15	R3173533
Conductivity Sat. Paste		0.22		0.10	dS m-1	13-APR-15	14-APR-15	R3173533
L1597584-2 BG102 MS11								
Sampled By: CLIENT on 10-APR-15								
Matrix: SOIL								
SAR and Cations in saturated soil								
Calcium (Ca)		15.1		2.0	mg/L	14-APR-15	14-APR-15	R3173651
Potassium (K)		4.2		1.0	mg/L	14-APR-15	14-APR-15	R3173651
Magnesium (Mg)		6.7		2.0	mg/L	14-APR-15	14-APR-15	R3173651
Sodium (Na)		13.9		4.0	mg/L	14-APR-15	14-APR-15	R3173651
SAR		0.75		0.10	SAR	14-APR-15	14-APR-15	R3173651
pH and EC (Saturated Paste)								
% Saturation		18.5		1.0	%	13-APR-15	14-APR-15	R3173533
pH in Saturated Paste		7.31		0.10	pH	13-APR-15	14-APR-15	R3173533
Conductivity Sat. Paste		0.21		0.10	dS m-1	13-APR-15	14-APR-15	R3173533

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
SAR-CALC-SK	Soil	SAR and Cations in saturated soil	CSSS 18.4-Calculation
Ca, Mg, Na and K in a saturated soil extract are determined by ICP-OES.			
SAT/PH/EC-SK	Soil	pH and EC (Saturated Paste)	CSSS 18.2.2/CSSC 3.14/CSSS 18.3.1
pH of a saturated soil paste is measured using a pH meter. After equilibration, an extract is obtained by vacuum filtration with conductivity of the extract measured by a conductivity meter.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg ww - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1597584

Report Date: 14-APR-15

Page 1 of 2

Client: Clifton Associates Ltd.
4 - 1925 1st Ave N
Saskatoon SK S7K 6W1
Contact: Geoff Haanen

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SAR-CALC-SK	Soil							
Batch	R3173651							
WG2068371-3	IRM	SAL814						
Calcium (Ca)			108.2		%		70-130	14-APR-15
Potassium (K)			104.0		%		70-130	14-APR-15
Magnesium (Mg)			112.2		%		70-130	14-APR-15
Sodium (Na)			101.9		%		70-130	14-APR-15
WG2068371-2	MB							
Calcium (Ca)			<2.0		mg/L		2	14-APR-15
Potassium (K)			<1.0		mg/L		1	14-APR-15
Magnesium (Mg)			<2.0		mg/L		2	14-APR-15
Sodium (Na)			<4.0		mg/L		4	14-APR-15
SAT/PH/EC-SK	Soil							
Batch	R3173533							
WG2068371-3	IRM	SAL814						
% Saturation			45.2		%		37-47	14-APR-15
pH in Saturated Paste			7.77		pH		7.4-8	14-APR-15
Conductivity Sat. Paste			109.6		%		80-120	14-APR-15
WG2068371-2	MB							
Conductivity Sat. Paste			<0.10		dS m-1		0.1	14-APR-15

Quality Control Report

Workorder: L1597584

Report Date: 14-APR-15

Page 2 of 2

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
J	Duplicate results and limits are expressed in terms of absolute difference.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



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(lab use only)

Canada Toll Free: 1 800 668 9878

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[illegible]

REFER TO BACK PAGE FOR ALL LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

MA 551-0278- v1.0 Excerpt October 2013



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Geotechnical Report
Proposed RCMP Detachment
Black Lake, Saskatchewan

RCMP

File S1981 05 December 2013



Clifton Associates Ltd.
engineering science technology

05 December 2013
File S1981

RCMP
National Project Delivery Office
PO Box 6500
Regina, Saskatchewan
S4P 3J7

Attention: Mr. Corey Schneider

Dear Corey:

Subject: Geotechnical Report
New RCMP Detachment
Black Lake, Saskatchewan

We are pleased to present to you our final geotechnical report regarding the above subject.

If you have any questions regarding this report, please contact me.

Yours truly,

Clifton Associates Ltd.

Jon Osback, P.Eng.

Distribution: RCMP

Clifton Associates Ltd.

1 electronic (PDF) copy
2 bound copies
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Table 5.1 Earth Pressure Coefficients

1.0 Introduction

This report presents results of a geotechnical investigation conducted for the new RCMP Detachment Facility and employee housing to be constructed in Black Lake, Saskatchewan. The site has an area of approximately 2.8 acres and is located along Boneleye Drive, as shown on Drawing No. S1981-01. Authorization to proceed was provided by RCMP Contract No. 7190203, which was provided by email to Jon Osback of Clifton Associates Ltd. (Clifton) on 04 September 2013 by Bonny Manz, Senior Contracting Officer, RCMP.

In general, the objectives of this work were:

- To define the subsurface soil strata and groundwater conditions in the area of the proposed development.
- To provide recommendations for suitable methods of foundation support for proposed structures.
- To provide roadway surfacing structure recommendations.
- To provide recommendations for excavations, backfill and drainage.
- To provide general site development criteria.
- To provide commentary on pertinent geotechnical issues identified during the subsurface investigation.

2.0 Description of the Site and Proposed Structures

It is our understanding that the new detachment facility will consist of a modular structure with a footprint of about 803 m², along with three separate modular structures with footprints of approximately 100 m², which will be used for employee housing. The detachment and employee housing will be single storey structures on a heated crawlspace. Approximate locations of the proposed structures, as indicated in the sketches provided to us, are shown on Drawing No. S1981-02.

The area investigated was generally level and is currently forested, with trees of varying size and spacing. Tree clearing was required in order to access the borehole locations with the drilling rig. The site is bordered by Boneleye Drive on the west, and Father Porte Memorial Dene School on the east. The north and south of the site is forested, with a cut line running approximately east-west along the north border.

General foundation recommendations contained herein are provided for the proposed structures. These recommendations can be revised for specific loadings or configurations, if required, once additional details are known. This office must be advised of any changes so that the applicability of these recommendations can be assessed.

3.0 Field and Laboratory Investigation

Subsurface conditions were investigated by six boreholes drilled at the site as shown on Drawing No. S1981-02. Boreholes were drilled on 02 and 03 October 2013 using a track mounted Acker MP5 drilling rig equipped with 125 mm diameter solid stem auger. All boreholes were drilled to refusal on bedrock. The maximum depth of exploration was 2.25 m. Core samples of sandstone bedrock were recovered from Borehole BH106 using a diamond core barrel.

Representative disturbed samples were recovered for laboratory analysis. Sampling was started at a depth of 0.75 m and continued at a 0.75 m interval to the maximum depth explored. Standard penetration testing (SPT) was conducted in three boreholes to estimate the in-situ density of the local soils. Disturbed cutting samples were collected in the remaining three boreholes.

No groundwater was encountered; piezometers were not installed.

The natural water content of each sample was determined. Other testing included determination of grain size distribution and water soluble sulphate content of selected representative samples. SPT data was used along with empirical correlations in order to estimate the soil undrained shear strength. Bedrock core samples were tested for compressive strength.

Observations made during the field investigation, visual descriptions and the results of laboratory tests are recorded in the Borehole Logs, and the Summary of Sampling and Laboratory Test Data which are appended to this report. An explanation of the symbols and terms used in the borehole logs is included in the Symbols and Terms section of this report.

Laboratory testing was conducted in accordance with procedures and methodologies described in ASTM standards.

4.0 Analysis

4.1 Stratigraphy

Stratigraphy consisted of sand overlying bedrock sandstone. Approximately 80 mm of organic topsoil was encountered. Sand was light brown in colour and fine grained and extended to a depth of 1.0 m to 2.25 m below ground surface. Sand had from 21% to 50% silt and clay sized particles with a trace of gravel. SPT N-values in the sand ranged from about 6 to 18 blows for 300 mm penetration, corresponding to loose to compact density. It should be noted that some higher SPT-N values were observed; however, these higher numbers were interpreted to be due to the SPT sampler hitting gravel, cobbles, or bedrock. The maximum dry density and optimum water content of the sand determined in accordance with the standard Proctor test were 2008 kg/m³ and 7.9%, respectively. The estimated CBR for surficial sand is 12.0 based on its grain size distribution and calculated Group Index.

Bedrock, composed of sandstones belonging to the Manitou Falls Formation of the Athabasca Group, was encountered below the sand. The sandstone was comprised of an assemblage well sorted, well rounded, generally medium grained quartz arenites. The sandstones were generally well cemented displaying a variable degree of faulting and jointing. The uniaxial compressive strength of two samples tested was 75 MPa and 111 MPa.

4.2 Groundwater Regime

No seepage was encountered in the investigation. However, groundwater levels are expected to fluctuate with the level of development in the area, as well as seasonal changes in precipitation, infiltration and evaporation.

5.0 General Discussion

The major geotechnical issues associated with this project are:

- Frost penetration;
- Foundations to support the proposed structures;
- Excavations;
- Roadway surfacing; and,

- Site development criteria.

5.1 Frost

Sand with little silt and clay sized particles will be frost susceptible. The depth of freezing in this area will vary depending on air temperature, ground cover, the type of any fill material utilized during development and other factors. The depth of freezing will be greatest for sand with low water content. Where groundwater is not present or is present at great depth, the risk of ice segregation and associated heave is reduced. Frost heave can be an issue for unheated structures. In general, frost heave will be a potential issue for foundations constructed less than about 3 m from surface. At this site, this risk can be minimized by constructing footings directly on bedrock or below the depth of freezing.

The depth of the foundation can be reduced if the foundation is insulated. This will only apply to a structure without a crawlspace, or a heated crawlspace. Insulation can be incorporated into an unheated structure, although the amount of insulation required can be substantial.

5.2 Foundation Alternatives

Issues related to foundation construction will include:

- Potential for frost heave in sand;
- Depth of frost;
- Cobbles and boulders within the sand; and,
- Potential settlement of shallow spread footings.

Spread footings are a suitable foundation for the proposed structures. Footings may be constructed on sand or bedrock.

Spread Footings

The estimated net allowable bearing capacity of sand at this Site is 120 kPa. The amount of differential and total settlement will depend on the size of the footing and applied bearing pressure. A minimum footing size of 410 mm is recommended. The amount of settlement can be minimized by constructing footings directly on bedrock. The estimated bearing capacity of the sandstone bedrock is 7.5 MPa.

Some settlement of shallow spread footings constructed on sand is expected. The estimated total settlement for the allowable bearing capacity provided will be 25 mm. The magnitude of settlement can be controlled by adjusting footing dimensions to limit settlement and by ensuring good subgrade preparation. The amount of settlement will increase as the size of the footing increases for a constant bearing pressure. The bearing pressure utilized will be controlled by settlement rather than bearing failure. Additional discussion follows in subsequent sections.

5.3 Coefficient of Earth Pressure

Active and passive earth pressure can be calculated using active earth pressure coefficients. Table 5.1 provides a summary of these properties.

Table 5.1
Earth Pressure Coefficients

Material	Angle of Internal Friction (°)	Total Unit Weight (kN/m ³)	Earth Pressure Coefficients		
			Active	At-Rest	Passive
Sand	30	18.0	0.33	0.5	3.0

5.4 Coefficient of Friction for Sliding

The friction angle between concrete and soil for concrete poured directly on soil can be assumed to be equal to the angle of internal friction for soil provided in Table 5.1. This assumes a rough contact surface between soil and concrete. For smooth concrete against soil, the tangent of the angle of internal friction should be reduced by 20 percent.

5.5 Modulus of Subgrade Reaction

The modulus of subgrade reaction, k_s (MPa), was estimated on the basis of correlation with the CBR value of 12.0. On this basis, a value of 50 MN/m³ may be assumed. The value for the modulus of subgrade reaction should be varied over a range of about $\pm 50\%$ to assess the sensitivity of performance to the assumed value.

5.6 Permeability

The permeability or hydraulic conductivity of sand has been estimated to be about 10^{-2} m/s to 10^{-3} m/s, based on the measured grain size distribution.

5.7 Potential for Liquefaction

Factors influencing liquefaction include soil type, relative density, confining pressure, soil drainage conditions, and seismic conditions. Sand can be susceptible to liquefaction if it is loose and has poor drainage, and if ground accelerations associated with an earthquake or other event is sufficient.

An assessment of liquefaction compares the cyclic shear stress developed by the design earthquake (cyclic stress ratio, CSR) and the resistance to liquefaction possessed by the soil due to its density (cyclic resistance ratio, CRR). The factor of safety against liquefaction is assumed to be the ratio, CRR/CSR.

In simplified terms, the cyclic shear stress caused by an earthquake is assumed to be proportional to the peak ground surface acceleration, which is 0.036 for Black Lake. For this site, CSR is calculated to be less than 0.005. As a comparison, the CSR for Richmond, British Columbia would be at least about 15 times higher, or about 0.075, depending on factors such as depth and effective stress.

For the Black Lake site, sand is loose to compact, with an estimated SPT N blow count of about 12. This suggests a CRR of about 0.1 to 0.2. As a comparison, the estimated CRR for loose Fraser River sand is about 0.085.

On this basis, the estimated factor of safety against liquefaction for the site is about 20 or higher. This suggests that even though soil may be considered to be susceptible to liquefaction, it is unlikely that sufficient seismic activity is present that would result in liquefaction.

5.8 Floors

It is our understanding that the proposed structures will have heated crawlspaces. Structurally supported floors are addressed in section 8.0 of this report.

5.9 Excavations

Significant dewatering is not expected for excavations. This may change seasonally, or as a result of precipitation and infiltration.

Soil in this area will be a type 3 soil as defined by Occupational Health and Safety regulations. In general, excavations should be no steeper than about 1 horizontal to 1 vertical (1:1). Although excavations through these materials may stand in the short term at steeper angles, oversteepened slopes will slough and collapse if they are left open for long periods of time or if water is allowed to infiltrate. Failure may be sudden and may endanger personnel and equipment working in the vicinity.

5.10 Roadway Surfacing Structures

The subgrade soil available at this site is loose to compact sand. A design CBR value of 12.0 for this subgrade soil has been assumed because of the presence of as much as 50% of fines.

The existing sand subgrade at this site will perform similarly to a roadway sub base material. For a gravel surface, 100 mm to 150 mm thickness of crushed base course or traffic gravel can be placed on the existing subgrade in order to prepare driving surfaces in the area of the detachment and housing. This type of structure will require periodic maintenance, including blading and reapplication of a gravel surface.

5.11 General Site Development

Construction Equipment

Standard excavation equipment may be used for site development; no unusual excavation conditions are anticipated.

Large vibratory smooth steel drum compacting equipment should be used to compact sand and granular soil.

Topsoil, Cobbles and Boulders

Organic topsoil should be removed prior to placement of any fill to minimize the potential for settlement. The average topsoil thickness was estimated to be about 80 mm.

Cobbles were occasionally encountered during drilling. Cobbles and boulders can be expected in excavations.

Groundwater

Groundwater is not expected in excavations, although some seepage may occur as water infiltrates the ground surface and flows vertically and horizontally through the sand, or along the surface of bedrock. Groundwater levels are expected to fluctuate seasonally and with precipitation.

Suitability of On-Site Soil for Compacted Fill

Sand at this site should be an acceptable material for construction of embankments or fills, although it may be sensitive to small changes in water content when compacting.

Shrinkage Factors

For estimates of earthwork volumes, a shrinkage factor of 15% to 20% may be used for sand.

Engineered Fill

If required, engineered fills supporting important structures should utilize local sand or pit run gravel. Specifications for pit run gravel and sand, and crushed base course material are appended to this report.

Cut or Fill Slopes

Cut or fill slopes in sand will possess long term stability at slopes of 2 horizontal to 1 vertical (2:1), but may be subject to increased rates of erosion. Flatter slopes are preferred for landscaping purposes. Vegetation can be used to maintain slopes. Where vegetation is not desirable, a gravel surface with a minimum thickness of 150 mm is recommended on these slopes to reduce the potential for erosion.

Drainage swales and ditches should be constructed with gentle slopes, if possible, as the soil will be easily eroded, particularly if water velocities are greater than 2 m/s.

It is desirable to have road subgrades at least 1.0 m above natural ground on fill sections or to have at least a 1.0 m ditch in cut-fill sections. The surface of the subgrade should have enough cross-slope to ensure positive surface drainage prior to surfacing, nominally 5%.

Site Grading

The site should be graded to ensure positive drainage throughout the construction phase. Grades should be created to direct water away from excavations and trenches. Within

excavations, the subgrade should be graded with a cross slope so that any accumulated water can be removed by pumping. Similarly, if the base of excavations meets bedrock, the bedrock surface should be roughly graded or channeled to allow pumping of excess water.

Proper site grading design is critical to ensure good long term performance of shallow footings. Grades should ensure that water from precipitation or snowmelt does not accumulate near structures. A positive slope away from structures of at least 5% for about 3 m is recommended. Infiltration rate into the sand is expected to be high. Consideration should be given to the potential of water running along the bedrock surface towards site structures. If possible, the bedrock surface should be prepared in order to direct water away from buildings. Otherwise, interceptor drainage channels can be constructed along the bedrock surface, with excess water being removed by pumping.

5.12 Compaction Specifications

Compaction specifications must consider the desired properties of the fill. Specifications will typically require compaction to a percentage of the maximum dry density determined in accordance with the standard Proctor test and may include a range of water contents that are desirable. Depending on the desired properties for the compacted soil, the water content is often provided as a guide to the contractor, since the compactive effort will usually be minimized if the soil is compacted close to the optimum water content determined in accordance with the standard Proctor test. If the soil is wet of optimum, it will be possible to attain a specified density if greater compactive effort or more work is applied to the soil.

The compaction water content will have an impact on the properties of the compacted soil. Soil strength and compressibility is better if the water content is lower than optimum. Soil compacted wet of optimum to the necessary density may be more compressible under low pressure and may have reduced strength. The swelling potential and permeability of a soil will generally be reduced; however, if the soil is compacted wet of optimum.

The following recommendations are provided for compaction.

- The excavated subgrade should be uniformly compacted to 95% of its maximum dry density determined in accordance with ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)]. The water content of the subgrade should be close to optimum water content.

- Soft areas in the subgrade should be subcut and backfilled with local sand or well graded pit run gravel that is uniformly compacted to at least 100% of its maximum dry density determined in accordance with ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)].
- If considered, granular pads for shallow spread footings should be constructed with local sand or a well graded pit run gravel that conforms to the recommended gradations for granular materials appended to this report. The material should be compacted to a minimum average 98% of maximum dry density for four (4) consecutive tests, with no single test less than 96%, determined in accordance with the standard Proctor test. Lift thickness should not exceed 200 mm.
- Crushed base course that will be under a floor slab, spread footing or paved area should be compacted to a minimum 98% of its maximum dry density determined in accordance with the standard Proctor test.
- Fill material that will be under a parking area or roadway should be compacted to a minimum 98% of maximum dry density determined in accordance with the standard Proctor test in lifts no thicker than 150 mm in compacted thickness. Fill under landscaped areas does not generally require high density, although some compaction is required to reduce the amount of settlement. A suggested level of compaction is a minimum 90% of maximum dry density determined in accordance with the standard Proctor test.
- Backfill of trenches in areas that already have been compacted should be with new subbase material as specified previously and compacted to a minimum 98% of maximum dry density determined in accordance with the standard Proctor test.
- Backfill and compact simultaneously each side of walls in layers of 300 mm to ensure that excessive pressure is not applied to one side of the wall.

5.13 Potential for Sulphate Attack

Water soluble sulphate content was measured to be 0.01% in Boreholes BH101 and BH102. According to CSA A23.1, the potential for sulphate attack is low. Therefore, General Use (Type GU) cement may be used for concrete.

5.14 Corrosion Potential

Sample numbers MN01 and MN11, from boreholes BH101 and BH104, respectively, were submitted to ALS Laboratory Group in Saskatoon for determination of pH. The pH was 5.73 for MN01 and 5.83 for MN11. Corrosive conditions are considered to be present if the pH is less than 5.5; therefore, corrosive conditions are not expected. The laboratory Certificate of Analysis for the pH testing is included in Appendix B.

6.0 Discussion of Foundations

Foundation alternatives at this site include shallow spread footings constructed on sand or sandstone bedrock.

6.1 General

The sand at this site is loose to compact and possesses an allowable bearing capacity of 120 kPa. The bearing capacity of bedrock sandstone is high, and is estimated to be 7.5 MPa.

Shallow foundations are typically constructed below the depth of frost. The depth of freezing around heated buildings will be reduced as a result of heat loss from the structure. The foundation for a structure with a grade supported floor can be constructed at a shallower depth if insulation is incorporated in the design, or if the building has a heated crawlspace.

Insulation can be incorporated into an unheated structure, although the amount of insulation required can be substantial.

6.2 Settlement

For a spread footing, the allowable bearing pressure provided ensures that a gross failure of the foundation does not occur. Settlement considerations will typically govern the selection of an appropriate bearing pressure. As the size of a footing increases, the volume of soil stressed increases, resulting in an increase in settlement at a constant bearing pressure. The performance of existing foundations should be considered in the design of new foundations.

Settlement of foundations designed with the allowable bearing pressure values provided is expected to be less than about 25 mm when placed on a well prepared subgrade, with a differential settlement of about one third to one half of the total settlement. Settlement can be minimized by constructing footings directly on bedrock.

6.3 Subgrade Preparation

The subgrade should be prepared by removing topsoil and any soft soil. The subgrade should be proof rolled with a heavy roller or other equipment to verify uniformity of the subgrade. Any failed or soft areas should be excavated an additional 600 mm, minimum and the area backfilled with compacted local sand or pit run gravel. Pit run gravel should be compacted to a minimum 100% of its maximum dry density to minimize the potential for differential settlement. Sand should be compacted in place using a heavy, vibratory compactor.

The width of any large excavations for major foundations should extend a minimum 1.5 m plus the depth of excavation beyond the edge of the foundation to ensure that the subgrade can be prepared and fill can be properly placed and compacted.

7.0 General Foundation Recommendations

The following recommendations are made for a shallow spread footing:

1. Sand or sandstone bedrock will be the load bearing stratum. The surface of an excavation in sand should be prepared by removing any pockets of soft soil or soft fill to a uniform bearing surface. The surface must be maintained in an undisturbed state. The excavated surface can be protected with a mudslab placed within 24 hours of completion of excavation.
2. Overexcavated areas may be filled with a lean concrete mix or with a well graded pit run gravel that conforms to the Recommended Specifications for Granular Materials appended to this report. The material must be compacted to 100% of its maximum dry density determined in accordance with ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft lbf/ft³ (600 kN m/m³)].
3. The foundation must be adequately reinforced to distribute the applied loads and also have sufficient stiffness to distribute local overstresses.

4. A shallow spread footing constructed as specified above may be designed on the basis of an allowable bearing capacity of 120 kPa on sand. This can be increased to 7.5 MPa for foundations constructed on sandstone bedrock.
5. Foundations may also be constructed on a granular pad constructed with local sand or a well graded pit run gravel that conforms to the recommended gradations for granular materials appended to this report. The material should be compacted to 100% of its maximum dry density in accordance with ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft lbf/ft³ (600 kN m/m³)] in lifts not exceeding 200 mm (8 in) in thickness.
6. Footings should have a minimum width of 410 mm.
7. Bedrock should be excavated/prepared as a flat and level surface prior to footing construction.

8.0 Floor Considerations

The following procedures are recommended for the construction of a structurally supported floor:

1. The subgrade or bedrock surface should be positively graded to a sump to remove water, which may inadvertently pond beneath the floor.
2. Migration of moisture from the soil should be prevented by installing 150 μ m (minimum) thick polyethylene vapour barrier covered with 50 mm of sand.
3. Floors designed as a structurally supported system with a crawl space between the floor and the subgrade should have some provision to ventilate the crawl space, particularly during the summer months.
4. As an alternative to a crawl space, the floor may be cast upon waxed cardboard carton 'void form' that is designed to degrade following the placement of the concrete. The cardboard cartons must have a strength sufficient to support the fresh concrete until it has sufficient strength to be self-supporting. Great care is required during construction of such floor systems to ensure that the collapse of the cartons does not take place, resulting in a grade supported slab. Careful inspection of these

floors during construction is required to ensure that the void does not collapse during the placement of the floor. Further, care must be taken during selection of 'void form' used. Materials which depend upon biologic degradation should be avoided.

9.0 Excavation Considerations

The stability of cut slopes and the stability of any adjacent structure must be considered for any excavations on the site. The anticipated sideslopes for the excavation will depend on the soil texture, water content and length of time that the excavation is left open.

Some seepage originating from surface infiltration associated with precipitation or irrigation may be expected. Seepage can likely be collected in open sumps and pumped away from the excavation.

Excavations should be performed in compliance with provincial safety regulations. If construction personnel will be in the excavation, then sideslopes for the excavation should not be steeper than 1:1 for safety as stated in provincial safety guidelines. Sideslopes may have to be adjusted in the field as excavation progresses, depending upon conditions encountered. Continuous inspection is recommended since slope failure could be sudden.

All loose material on the sides of the excavation should be trimmed. The excavation should be left open for the minimum amount of time required for construction. Some loss of strength in the soil can be expected with the passing of time, resulting in sloughing and local slope failures.

As described in Occupational Health and Safety Regulations, a competent worker should be stationed on the surface to alert any worker in the excavation about the development of any potentially unsafe conditions. Machinery and heavy equipment should not be allowed closer to the excavation than one half of the depth of the excavation, unless precautions are implemented to ensure that workers in the excavation are safe. Spoil material should not be piled closer than 3 m from the edge of the excavation and with sideslopes no steeper than 1:1.

Infiltration of water into the soil around the excavation can result in loss of strength and collapse of the excavation walls. It is recommended that workers not be in the excavation during rainfall and that excavation walls be carefully inspected for cracking, sloughing and potential failures after rainfall before work continues in the excavation.

10.0 Closure

This report was prepared by Clifton Associates Ltd. for the use of the RCMP and their agents for specific application to the proposed RCMP Detachment and employee housing in Black Lake, Saskatchewan. The material in it reflects Clifton Associates Ltd. best judgment available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Clifton Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report has been prepared with generally accepted engineering practices common to the local area. No other warranty, expressed or implied, is made.

Our conclusions and recommendations are preliminary and based upon the information obtained from the referenced subsurface exploration. The borings and associated laboratory testing indicate subsurface and groundwater conditions only at the specific locations and times investigated, only to the depth penetrated and only for the soil properties tested. The subsurface and groundwater conditions may vary between the boreholes and with time. The subsurface interpretation provided is a professional opinion of conditions and not a certification of the site conditions. The nature and extent of subsurface variation may not become evident until construction or further investigation. If variations or other latent conditions do become evident, Clifton Associates Ltd. should be notified immediately so that we may re-evaluate our conclusions and recommendations. Although subsurface conditions have been explored, we have not conducted analytical laboratory testing on samples obtained nor evaluated the site with respect to the potential presence of contaminated soil or groundwater.

The enclosed report contains the results of our investigation as well as certain recommendations arising out of such investigations. Our recommendations do not constitute a design, in whole or in part, of any elements of the proposed work. Incorporation of any or all of our recommendations into the design of any such element does not constitute us as designers or co-designers of such elements, nor does it mean that the design is appropriate in geotechnical terms. The designers of such elements must consider the appropriateness of our recommendations in light of all design criteria known to them, many of which may not be known to us. Our mandate has been to investigate and recommend which we have completed by means of this report. We have had no mandate to design, or review the design, of any elements of the proposed work and accept no responsibility for such design or design review.

Clifton Associates Ltd.



Jon Osback, P.Eng.



Richard T. Yoshida, P.Eng.

Association of Professional
Engineers and Geoscientists of Saskatchewan
Certificate of Authorization No. 238



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Symbols and Terms

Soil Descriptive Terms

A soil description for geotechnical applications includes a description of the following properties:

- texture
- color, oxidation
- consistency and condition
- primary and secondary structure

Texture

The soil texture refers to the size, size distribution and shape of the individual soil particles which comprise the soil. The Unified Soil Classification System (ASTM D2487-00) is a quantitative method of describing the soil texture. The basis of this system is presented overleaf. The following terms are commonly used to describe the soil texture.

Particle Size (ASTM D2487-00)		Relative Proportions (CFEM, 3rd Ed., 1992)	
Boulder	300 mm plus	Trace	1 - 10 %
Cobble	75 - 300 mm	Some	10 - 20 %
Gravel	4.75 - 75 mm	Gravelly, sandy, silty, clayey, etc.	20 - 35 %
Coarse	19 - 75 mm		
Fine	4.75 - 19 mm		
Sand	0.075 - 4.75 mm	And	>35 %
Coarse	2 - 4.75 mm		
Medium	0.425 - 2 mm		
Fine	0.075 - 0.425 mm	Gravel, Sand, Silt, Clay	>35 % and main fraction
Silt and Clay	Smaller than 0.075 mm		

Gradation		Particle Shape	
Well Graded	Having a wide range of grain sizes and substantial amount of all intermediate sizes.	Angular	Sharp edges and relatively plane sides with unpolished surfaces.
Uniform or Poorly Graded	Possessing particles of predominantly one size.	Subangular	Similar to 'angular' but have rounded edges.
Gap Graded	Possessing particles of two distinct sizes.	Subrounded	Well-rounded corners and edges, nearly plane sides.
		Rounded	No edges and smoothly curved sides.
		Also may be flat, elongated or both.	

The term "TILL" may be used as a textural term to describe a soil which has been deposited by glaciers and contains an unsorted, wide range of particle sizes.

Color And Oxidation

The soil color at its natural moisture content is described by common colors and, quantitatively, in terms of the Munsell color notation; (eg. 5Y 3/1). The notation combines three variables, hue, value and chroma to describe the soil color. The hue indicates its relation to red, yellow, green, blue and purple. The value indicates its lightness. The chroma indicates its strength of departure from a neutral of the same lightness.

Departure of the soil color from a neutral color indicates the soil has been oxidized. Oxidation of a soil occurs in a oxygen rich environment where most commonly metallic iron, oxidizes and turns a neutral colored soil 'rusty' or reddish brown. Oxidized manganese gives a purplish tinge to the soil. Oxidation may occur throughout the entire soil mass or on fracture/joint/fissure surfaces.

Classification of Soils for Engineering Purposes

ASTM Designation D 2487-00 (Unified Soil Classification System)

Major divisions		Group Symbols	Typical names	Classification criteria		
Coarse-grained soils More than 50% retained on No. 200 sieve* (>0.075 mm)	Gravels More than 50% of coarse fraction retained on No. 4 sieve(>4.75 mm)	Clean gravels <5% fines	GW	Well-graded gravel	$C_u = \frac{D_{60}}{D_{10}} \geq 4$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 Not meeting either C_u or C_c criteria for GW Atterberg limits below "A" line or PI less than 4 Atterberg limits on or above "A" line and PI > 7 Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols If fines are organic add "with organic fines" to group name	
			GP	Poorly graded gravel		
		Gravels with fines >12% fines	GM	Silty gravel		
			GC	Clayey gravel		
	Sands 50% or more of coarse fraction passes No. 4 sieve(<4.75 mm)	Clean sands <5% fines	SW	Well-graded sand	$C_u = \frac{D_{60}}{D_{10}} \geq 6$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 Not meeting either C_u or C_c criteria for SW Atterberg limits below "A" line or PI less than 4 Atterberg limits on or above "A" line and PI > 7 Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols If fines are organic add "with organic fines" to group name	
			SP	Poorly graded sand		
		Sands with fines >12% fines	SM	Silty sand		
			SC	Clayey sand		
		If $\geq 15\%$ sand add "with sand" to group name If $\geq 15\%$ gravel add "with gravel" to group name Classification on basis of percentage of fines Less than 5% pass No. 200 sieve..... GW, GP, SW, SP More than 12% pass No. 200 sieve..... GM, GC, SM, SC 5 to 12% pass No. 200 sieve..... Borderline classifications requiring use of dual symbols				
Fine-grained soils 50% or more passes No. 200 sieve* (<0.075 mm)		Silts and Clays Liquid limit <50%	Inorganic	ML	Silt	If 15 to 29% coarse-grained, add "with sand" or "with gravel" as appropriate If > 30% coarse-grained, add "sandy" or "gravelly" as appropriate Class as organic when oven dried liquid limit is < 75% of undried liquid limit
Silts and Clays Liquid limit <50%	Organic			CL	Lean Clay -low plasticity	
		Inorganic	OL	Organic clay or silt (Clay plots above 'A' Line)		
Inorganic	MH		Elastic silt			
	Organic	CH	Fat Clay -high plasticity			
Organic		OH	Organic clay or silt (Clay plots above 'A' Line)			
	Highly organic soils	PT	Peat, muck and other highly organic soils			

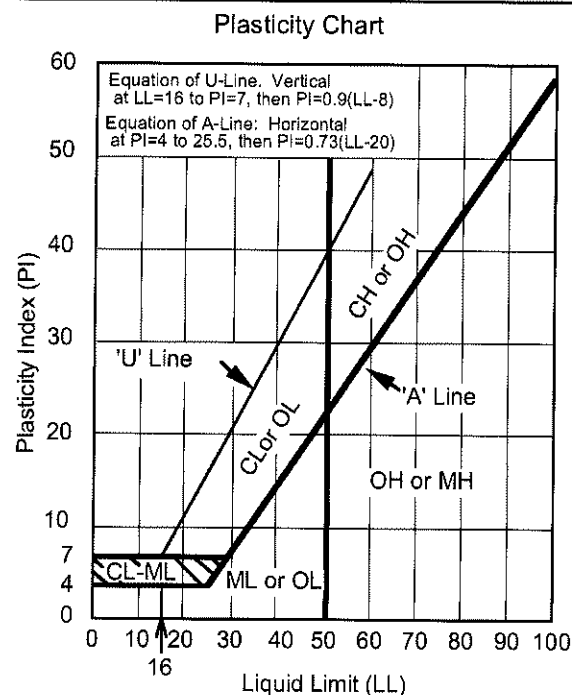
Plasticity Chart

Equation of U-Line: Vertical at $LL=16$ to $PI=7$, then $PI=0.9(LL-8)$
Equation of A-Line: Horizontal at $PI=4$ to 25.5 , then $PI=0.73(LL-20)$

Regions: CL-ML, ML or OL, CH or OH, OH or MH

Lines: 'U' Line, 'A' Line

Y-axis: Plasticity Index (PI) from 0 to 60
X-axis: Liquid Limit (LL) from 0 to 100



*Based on the material passing the 3 in. (75 mm) sieve, if field samples contain cobbles or boulders, add "with cobbles or boulders" to group name

Consistency And Condition

The consistency of a cohesive soil is a qualitative description of its resistance to deformation and can be correlated with the undrained shear strength of the soil. The condition of a coarse grained soil qualitatively describes the soil compactness and can be correlated with the standard penetration resistance (ASTM D1586-99).

Consistency Of Cohesive Soil (CFEM, 3rd Edit., 1992)

Consistency	Undrained Shear Strength (kPa) (CFEM, 3rd Edit., 1992)	Field Identification (ASTM D 2488-00)
Very Soft	<12	Thumb will penetrate soil more than 25 mm.
Soft	12-25	Thumb will penetrate soil about 25 mm.
Firm	25-50	Thumb will indent soil about 6 mm.
Stiff	50-100	Thumb will indent, but penetrate only with great effort (CFEM).
Very Stiff	100-200	Readily indented by thumbnail (CFEM).
Hard	>200	Thumb will not indent soil but readily indented with thumbnail.
Very Hard	N/A	Thumbnail will not indent soil.

Condition Of Coarse Grained Soil (CFEM, 3rd Edit., 1992)

Compactness Condition	SPT N - Index (Blows/300mm)
Very Loose	0 - 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	over 50

Moisture Conditions (ASTM D2488-00)

Description	Criteria
Dry	Absence of moisture, dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible, free water, usually soil is below water table

Structure

The soil structure is the manner in which the individual soil particles are assembled to form the soil mass. The primary soil structure is the arrangement of soil particles as originally deposited. The secondary soil structure refers to any rearrangement of the soil such as deformation and cracking which has taken place since deposition.

Primary Soil Structure (Depositional)

A. Geometry

- | | |
|-----------------------------|---|
| Stratum | - A single sedimentary 'layer', greater than 10 mm in thickness, visibly separable from other strata by a discrete change in lithology and/or sharp physical break. |
| Homogeneous | - Same color and appearance throughout. |
| Stratified | - Consisting of a sequence of layers which are generally of contrasting texture or color. |
| Laminated | - Stratified with layer thicknesses between 2 mm and 10 mm. |
| Thinly laminated | - Stratified with layer thickness less than 2 mm. |
| Bedded | - Stratified with layer thicknesses greater than 10 mm. |
| Very Thinly Bedded (Flaggy) | - Stratified with layer thicknesses between 10 and 50 mm. |
| Thinly Bedded (Slabby) | - Stratified with layer thicknesses between 50 and 600 mm. |
| Thickly Bedded (Blocky) | - Stratified with layer thicknesses between 600 and 1200 mm. |
| Thick-Bedded (Massive) | - Stratified with layer thicknesses greater than 1200 mm. |
| Lensed | - Inclusions of small pockets of different soils, such as small lenses of sand material throughout a mass of clay. |

B. Bedding Structures

- | | |
|-------------------|--|
| Cross-bedding | - Internal 'bedding' inclined to the general bedding plane. |
| Ripple-bedding | - Internal 'wavy bedding'. |
| Graded-bedding | - Internal gradation of grain size from coarse at base to finer at top of bed. |
| Horizontal bedded | - Internal bedding is parallel and flat lying |

Secondary Soil Structure (Post-Depositional)

A. Accretionary Structures

Includes nodules, concretions, crystal aggregates, veinlets, color banding and


















- | | |
|---------------|---|
| Cementation | - Chemically precipitated material, commonly calcite (CaCO_3), binds the grains of soil, usually sandstone. Described as weak, moderate, strong (ASTM D2488-00). |
| Salt Crystals | - Groundwater flowing through the soil/rock often precipitates visible amounts of salts. Calcite (CaCO_3), glauber salts ($\text{Na}_2\text{Ca}(\text{SO}_4)_2$), and gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) are common. |

B. Fracture Structures










- | | |
|--------------|---|
| Fracture | - A break or discontinuity in the soil or rock mass caused by stress exceeding the materials strength. |
| Joint | - A fracture along which no displacement has occurred. |
| Fissure | - A gapped fracture, which may open and close seasonally. Usually an extensive network of closely spaced fractures, giving the soil a 'nuggetty' structure. |
| Slickensides | - Fractures in a clay that are slick and glossy in appearance, caused by shear movements. |
| Brecciated | - Contains randomly oriented angular fragments in a finer mass, usually associated with shear displacements in soils. |
| Fault | - A fracture or fracture zone along which there has been displacement. |
| Blocky | - A cohesive soil that can be broken down into small angular lumps which resist further breakdown. |

Symbols Used on Bore Hole Logs






Lithology Type

 CLAY	 TILL-oxidized	 COAL	 CLAY SHALE
 SILT	 TILL-unoxidized	 FILL (Undifferentiated)	 SANDSTONE
 SAND	 PEAT	 CONCRETE	 MUDSTONE
 GRAVEL	 TOPSOIL or ORGANIC SOIL	 ASPHALT	 BEDROCK (Undifferentiated)
 COBBLES			



Borehole Completion and Backfill Materials

 Bentonite	 Cuttings	 Slough
 Concrete	 Grout	 Solid Pipe
 Cover	 Sand	 Slotted Pipe

Soil Sample Type

 Thin Walled Tube	 Disturbed	 No Recovery
 Driven Spoon	 Core (any type)	

Groundwater Symbols

	Piezometric elevation as determined by a piezometer installation
	Water levels measured in borings at the time and under the conditions noted

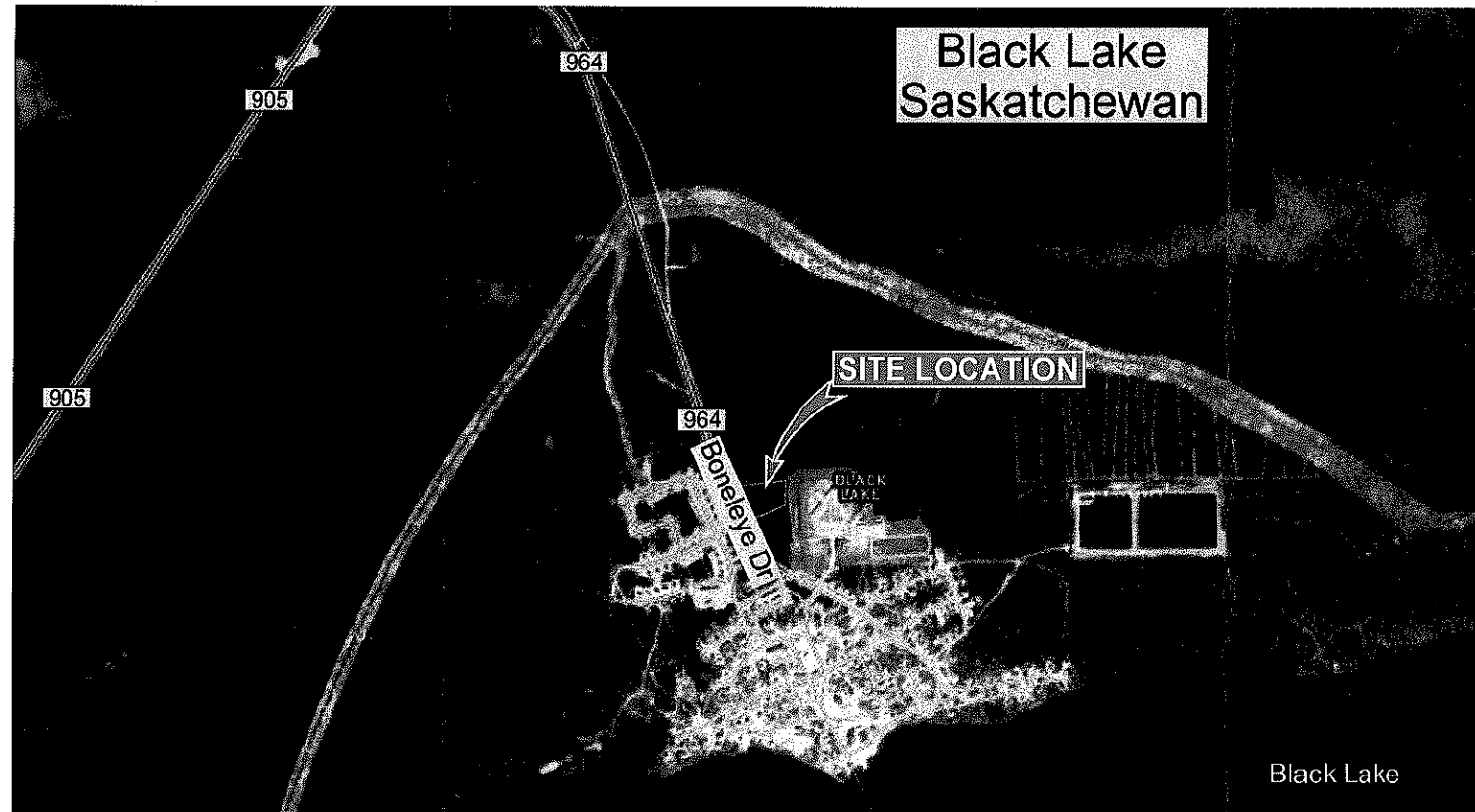


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Drawings



KEY PLAN
SCALE 1:750,000



LOCATION PLAN
SCALE 1:20,000 APPROX.



SITE PLAN
SCALE 1:5,000 APPROX.

LEGEND :

SITE BOUNDARY

NOTES :

1. SITE PLAN IMAGE DOWNLOADED FROM GOOGLE MAP
<http://maps.google.ca/>
Imagery ©2013 Cnes/Spot Image.
DigitalGlobe. Map data ©2013 Google

DRAWING REVISIONS			
NO.	DD/MM/YY	DESCRIPTION	BY
6			
5			
4			
3			
2			
1			

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CLIENT
ROYAL CANADIAN MOUNTED POLICE

PROJECT TITLE
GEOTECHNICAL INVESTIGATION
NEW RCMP DETACHMENT FACILITY
AND EMPLOYEE HOUSING
BLACK LAKE, SASKATCHEWAN

DRAWING TITLE
SITE LOCATION PLAN

PROJECT NO.		FILE NO.	
S1981		S1981.dwg	
DATE	NOV. 2013	SCALE	AS SHOWN
DRAWN	MNG	CHECKED	CDJG
		DWG. NO.	REV.
		S1981-01	

P:\Saskatoon Projects\S1981 - R.C.M.P. - Black Lake - Geotechnical Investigation\S1981.dwg



BORE HOLE LOCATION
SCALE 1:1,000 APPROX.

LEGEND :

SITE BOUNDARY

BORE HOLE LOCATION

NOTES :

1. SITE PLAN IMAGE DOWNLOADED FROM GOOGLE MAP
<http://maps.google.ca/>
Imagery ©2013 Cnes/Spot Image, DigitalGlobe. Map data ©2013 Google
2. ALL DIMENSIONS ARE IN METER.

DRAWING REVISIONS			
8			
5			
4			
3			
2			
1			
NO.	DDMMYY	DESCRIPTION	BY



CLIENT
ROYAL CANADIAN MOUNTED POLICE

PROJECT TITLE
GEOTECHNICAL INVESTIGATION
NEW RCMP DETACHMENT FACILITY
AND EMPLOYEE HOUSING
BLACK LAKE, SASKATCHEWAN

DRAWING TITLE
BORE HOLE LOCATION PLAN

PROJECT NO. S1981	FILE NO. S1981.dwg		
DATE NOV., 2013	SCALE 1:1000	DWG. NO.	REV.
DRAWN MNG	CHECKED CD/JG	S1981-02	



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**Bore Hole Logs
and
Laboratory Test Data**



BOREHOLE: 101

Page: 1 of 1

Date Drilled: 10/02/2013
Drill:Acker MP5
Drilling Method: Solid Stem Auger
Logged by: MN

[illegible]

Summary of Sampling and Laboratory Test Data

[illegible]

Remarks:

Approved by:



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**Project
Location
Project No.**

Black Lake RCMP
Black Lake, SK
S1981

Borehole No.

101

BOREHOLE LOG

BOREHOLE: 102

Page: 1 of 1

Client: Royal Canadian Mounted Police
Project: Detachment Geotechnical Investigation
Location: Black Lake, Saskatchewan
Project No.: S1981

Northing: 6555081
 Easting: 465250
 Ground Elev.:
 Top Casing Elevation:

Date Drilled: 10/02/2013
Drill:Acker MP5
Drilling Method: Solid Stem Auger
Logged by: MN

[illegible]

[illegible]

Approved by:

Borehole No.



BOREHOLE: 103

Page: 1 of 1

Client: Royal Canadian Mounted Police
Project: Detachment Geotechnical Investigation
Location: Black Lake, Saskatchewan
Project No.: S1981

Northing: 6555105
 Easting: 465325
 Ground Elev.:
 Top Casing Elevation:

Date Drilled: 10/02/2013
Drill: Acker MP5
Drilling Method: Solid Stem Auger
Logged by: MN

[illegible]

[illegible]

Approved by:

Borehole No.



BOREHOLE: 104

Page: 1 of 1

Client: Royal Canadian Mounted Police
Project: Detachment Geotechnical Investigation
Location: Black Lake, Saskatchewan
Project No.: S1981

Northing: 6555065
 Easting: 465367
 Ground Elev.:
 Top Casing Elevation:

Date Drilled: 10/03/2013
Drill:Acker MP5
Drilling Method: Solid Stem Auger
Logged by: MN

[illegible]

[illegible]

Approved by:

Borehole No.

BOREHOLE LOG

BOREHOLE: 105

Page: 1 of 1

Client: Royal Canadian Mounted Police
Project: Detachment Geotechnical Investigation
Location: Black Lake, Saskatchewan
Project No.: S1981

Northing: 6555087

Easting: 465305

Ground Elev.:

Top Casing Elevation:

Date Drilled: 10/03/2013

Drill:Acker MP5

Drilling Method: Solid Stem Auger

Logged by: MN

[illegible]

[illegible]

Approved by:



Project	Location	Project No.
---------	----------	-------------

Black Lake RCMP
Black Lake, SK
S1981

Borehole No.
105

Client: Royal Canadian Mounted Police
Project: Detachment Geotechnical Investigation
Location: Black Lake, Saskatchewan
Project No.: S1981

Northing: 6555104
 Easting: 465308
 Ground Elev.:
 Top Casing Elevation:

Date Drilled: 10/03/2013
Drill:Acker MP5
Drilling Method: Diamond
Logged by: MN

[illegible]

[illegible]

Remarks:	Proctor results for composite sample: 2008 kg/m ³ at 7.8%.
----------	---



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Project	Location	Project No.
---------	----------	-------------

Black Lake RCMP
Black Lake, SK
S1981

Borehole No.



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Appendix A

Recommended Specifications For Granular Materials

1. Granular materials shall be composed of fragments of durable rock free from undesirable quantities of soft or flaky particles, topsoil, organic matter, clay or silt lumps, lumps of frozen granular soil, ice, snow or construction rubble.
2. The Pit Run Fill shall have a plasticity index less than 10 percent. The Crushed Base Course shall have a plasticity index less than 6 percent.
3. For Pit Run Sand, $\frac{D_{60}}{D_{10}} > 6$, and $1 < \frac{(D_{30})^2}{D_{10} \times D_{60}} < 3$. For Pit Run Gravel, $\frac{D_{60}}{D_{10}} > 4$, and $1 < \frac{(D_{30})^2}{D_{10} \times D_{60}} < 3$.
4. Granular materials shall be excavated, loaded, hauled, placed and levelled in such a manner to prevent contamination with undesirable materials described in Point 1 above and to prevent excessive segregation of coarse and fine particles.
5. Granular material shall conform to the following gradation specifications:

Percent by Weight Passing U.S. Standard Sieve Series							
Sieve	Pit Run Gravel Fill	Pit Run Sand Fill	32	33	34	35	36
50.0 mm	100						
25.0 mm	85 - 100		100				
18.0 mm	80 - 100		87 - 100	100	100	100	100
12.5 mm	70 - 100	100	79 - 93	81 - 100	91 - 100	81 - 100	91 - 100
5.0 mm	50 - 85	75 - 100	47 - 77	50 - 80	70 - 85	50 - 85	70 - 85
2.0 mm	35 - 75	50 - 90	29 - 56	32 - 52	45 - 65	32 - 65	45 - 70
900 µm	25 - 50	30 - 75	18 - 39	20 - 35	28 - 43	20 - 43	28 - 51
400 µm	15 - 35	15 - 50	13 - 26	15 - 25	20 - 30	15 - 30	20 - 35
160 µm	8 - 22	5 - 30	7 - 16	8 - 15	11 - 18	8 - 18	11 - 21
75 µm	0 - 13	0 - 15	6 - 11	7 - 10	8 - 12	7 - 12	8 - 13



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Appendix B



CLIFTON ASSOCIATES LTD
ATTN: CATLAN DALLAIRE
4 - 1925 1ST AVE. NORTH
SASKATOON SK S7L 6M6

Date Received: 07-NOV-13
Report Date: 15-NOV-13 11:04 (MT)
Version: FINAL

Client Phone: 306-975-0401

Certificate of Analysis

Lab Work Order #: L1389187
Project P.O. #: NOT SUBMITTED
Job Reference: 51981
C of C Numbers: 10-351111
Legal Site Desc:

Brian Morgan
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: #819-58th St E., Saskatoon, SK S7K 6X5 Canada | Phone: +1 306 668 8370 | Fax: +1 306 668 8383
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Environmental

www.alsglobal.com

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[illegible]

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
PH-SAR-SK	Soil	pH (Saturated Paste)	CSSS 18.2.2/CSSC 3.14
pH of a saturated soil paste is measured using a pH meter. After equilibration, an extract is obtained by vacuum filtration with conductivity of the extract measured by a conductivity meter.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

10-351111

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg ww - milligrams per kilogram based on wet weight of sample

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alglobal.com

10-351111

Page { of

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENE 18.01 Eroot

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises:
 - .1 The installation of new water holding tanks, and exterior crawlspace access door, at an existing police building in Black Lake, Saskatchewan.
 - .2 The construction of two (2) new single storey wood-framed modular housing units on an existing site currently housing a police building and two housing units in Black Lake, Saskatchewan. The housing units must be modular in nature, with the ability to be removed from the foundations and transported to another site in the future, but they need not be constructed in a controlled environment and shipped to site. Refer to Section 13 42 00. Site construction will be permitted as long as the units are certified as modular buildings in compliance with CSA A-277-01 as outlined in that Section. Units must be able to pass unimpeded through the Otter Rapids bridge. Each modular housing unit has two bedrooms and is approximately 93 s.m. in area.
 - .3 The salvage of the existing emergency generator, associated transfer switch and other related components, and existing furnaces, currently serving the existing police building in Stony Rapids, SK, for turn-over to the owner.
 - .4 The demolition of one (1) existing police building in Stony Rapids, Saskatchewan, complete with removal of foundations, capping of services, site clean-up, disposal, back fill and compaction and site preparation for new construction.
 - .5 The demolition of one (1) existing double car garage in Stony Rapids, Saskatchewan complete with site clean-up, disposal, back fill and compaction and site preparation for new construction.
 - .6 The construction of two (2) new single storey wood-framed modular housing units on the site of the deconstructed police building in Stony Rapids, Saskatchewan. The housing units must be modular in nature, with the ability to be removed from the foundations and transported to another site in the future, but they need not be constructed in a controlled environment and shipped to site. Refer to Section 13 42 00. Site construction will be permitted as long as the units are certified as modular buildings in compliance with CSA A-277-01 as outlined in that Section. Units must be able to pass unimpeded through the Otter Rapids bridge. Each modular housing unit has two bedrooms and is approximately 93 s.m. in area.
 - .7 The construction of a new double car garage, washroom and mechanical room of approximately 120 s.m. on the site of the deconstructed police building in Stony Rapids, Saskatchewan.
 - .8 All associated site work, including site servicing and connection to existing services, as described on the drawings, for a total of four (4) modular housing units and one (1) new garage on two separate sites is included.

1.2 WORK SEQUENCE

- .1 The General Contractor will be responsible for the coordination of all work.
- .2 It is the owner's desire for work to be sequenced in the following order:
 - .1 Installation of new water tanks at Black Lake Police Building.

- .2 Simultaneously to 1.2.2.1, construction and completion of modular housing units at Black Lake.
- .3 Demolition of existing Stony Rapids Police building and existing garage.
- .4 Completion of all necessary underground services at Stony Rapids.
- .5 Construction and completion of Stony Rapids modular housing units and garage.
- .6 All other work to occur concurrently as coordinated by the General Contractor.

1.3 CONTRACTOR USE OF PREMISES

- .1 Coordinate use of premises under direction of Departmental Representative.
- .2 Make arrangements with Departmental Representative for use of completed housing units as contractor housing during completion of the project. Prior to turn over of housing units in use by Contractor, coordinate review with Departmental Representative. Repair any and all deficiencies to the satisfaction of the Departmental Representative prior to turn over. Refer to mechanical and electrical sections for additional requirements. Warranty period for products and systems within the housing units utilized by Contractor begins at substantial completion of the overall project, or at turn over of housing units utilized by Contractor in a condition satisfactory to the Departmental Representative, whichever is later.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Cooperate with other contractors employed by the Departmental Representative for other work on site.

1.4 EXISTING SERVICES

- .1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services carry out work at times as directed by governing authorities with minimum disturbance to pedestrian and vehicular traffic.
- .3 Establish location and extent of service lines in area of work before starting Work. Locations of utilities shown on drawings are approximate. Notify Departmental Representative of findings.
- .4 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .5 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .7 Record locations of maintained, re-routed, and abandoned service lines.

- .8 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.5 PERMITS AND FEES

- .1 The Contractor shall obtain and pay for all building permits. Obtain and pay for all other permits, licences, certificates, fees and governmental inspections or notices required for the performance of the work. Note: Permit drawings are the property of the owner. Contractor to forward “approved” permit drawings and a copy of the building permit to the Departmental Representative prior to the submission of the first request for progress payment.

END OF SECTION

Part 1 General

1.1 SPECIAL REQUIREMENTS

- .1 Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .2 Keep within limits of work and avenues of ingress and egress.

1.2 RCMP SECURITY CLEARANCE REQUIREMENTS (LAW ENFORCEMENT CHECKS)

- .1 Security forms and documents are appended at the end of this Section.
- .2 After interim completion of the project, all personnel engaged in the execution of the work on the interior of an RCMP occupied and/or unoccupied building shall have at a minimum, the requisite RCMP Reliability (RRS) clearance.
- .3 A minimum of four months prior to interim completion of the project, the Contractor shall prepare and submit the following attached requisite forms and documents for an RRS clearance, for each Contractor employee and sub-contractor employee to be engaged in the work on the interior of an occupied and/or unoccupied building after interim completion of the project:
 - .1 RCMP Contractor/Consultant Information Sheet
 - .2 TBS 330-23e – Personnel Screening, Consent and Authorization Form
 - .3 TBS 330-60e – Security Clearance Form
 - .4 Security/Reliability Interview Pre-Interview Questionnaire
- .4 Also, contractor's employees and sub-contractor employees must include with their completed requisite forms, the following documents:
 - .1 Valid government issued photo identification: photocopy of front and back of document (photo must be clear), certified to be a true copy by their supervisor or colleague. Examples of government issued photo identification include Driver's License, Passport or Treaty card.
 - .2 Birth certificate: photocopy of front and back of document, certified to be a true copy by their supervisor or colleague.
 - .3 Two sets of roll and ink fingerprints on Form C-216 (Contractor cost): Fingerprints must be taken/obtained from a Corp of Commissionaires office.
 - .4 Two current Passport Style Photographs (Contractor cost).
- .5 In addition to the requirements noted in .3 above, Contractor employees and sub-contractor employees must undertake the following additional clearance requirements to obtain the RCMP Reliability Status clearance:
 - .1 Undertaking of a Reliability interview as scheduled by the RCMP.
- .6 To eliminate delays in the clearance process, all clearance forms/documents completed by the Contractor's employees and sub-contractor employees **MUST** be reviewed by the Contractor to ensure that all requested information has been provided, prior to submitting documents to the RCMP. The RCMP will not accept/cannot process documents with

ANY requested information missing as per instruction sheets provided – NO EXCEPTIONS (ie. no abbreviations on documents anywhere ie. “AB”, “CA”). *All incomplete forms will be returned to the Contractor (ensure instructions for completion of documents noted in .2 above are read and followed by each applicant, prior to submitting to the RCMP).*

- .7 The Contractor should batch the fully completed submissions, based on priority work on site and allow for a minimum eighty (80) working days processing time in the project schedule for the review to occur (from the date the “fully completed” documents are received by the RCMP). The inability to submit the fully completed requisite forms and documents will not be reason for an extension to the project schedule or additional compensation.
- .8 After interim completion of the project, the Contractor’s employees and sub-contractor employees shall only mobilize in the interior of an occupied and/or unoccupied building, once the requisite RCMP RRS clearance has been granted.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. No smoking will be allowed in or around the building. Smoking is allowed only in areas indicated by Departmental Representative.

END OF SECTION

Properly completed packages will ensure clearances are issued in a timely manner.

Form TBS-330-23 (customized version): ensure section B is properly completed and all 5 boxes in section C (consent and verification) are initialed by applicant

NOTE: *Line 5 of the consent and verification section must read "Other Law Enforcement Records Checks". As the document is a Treasury Board form, we cannot post a modified version on the Infoweb. You can handwrite the information PRIOR to the applicant initialing/signing the document. You can also contact us and we will provide you with the modified version.*

Form TBS 330-60 (2006/02) Common Errors:

Section D: Marital Status:

- applicant's spouse or common law partner (no time limit is set by the RCMP in regards to a common law relationship); if the applicant is in a relationship with someone and they are living together, then the individual needs to be included on the forms
- if the individual has been in a past relationship which ended in the past 5 years, our unit will require the applicant's ex-spouse, ex-common law partner's name to be included on the forms

Section E: Immediate Family members (individuals to be included in this area):

- applicant's parents, step parents
- in-laws (parents) if the individual is married or in a common law relationship; this also includes ex-in laws (if relationship ended in the past 5 years)
- siblings includes the following: step siblings, half siblings, brother and sisters
- any children 18+ years old
- even deceased immediate family members need to be listed on the forms

Section H: Residence:

- last 10 years of residential information (no time gaps)

Section I: Employment:

- last 10 years of employment information (no time gaps)
- employment information can include the following: periods of unemployment, travel, leave, casual, and education

Section M: Character references:

- the 3 character references should not be family members, or relatives
- should have known the applicant for 3 + years, and they should be individuals whom the applicant spends time with in a social setting (friends or colleagues)
- should be over the age of 18
- should not be listed as an employment contact in Section I

General information:

- missing maiden names
- missing dates of birth
- missing phone numbers

If any of the above mentioned information is not provided, the forms will be returned for follow up. Note that our Personnel Security Unit will not begin processing an incomplete security clearance package.



**PERSONNEL SCREENING,
CONSENT AND AUTHORIZATION FORM**

OFFICE USE ONLY		
Reference number	Department/Organization number	File number

NOTE: For Privacy Act Statement refer to Section C of this form and for completion instructions refer to attached instructions.
Please typewrite or print in block letters.

A ADMINISTRATIVE INFORMATION (To be completed by the Authorized Departmental/Agency/Organizational Official)

☐ New ☐ Update ☐ Upgrade ☐ Transfer ☐ Supplemental ☐ Re-activation

The requested level of reliability/security check(s)

☐ Reliability Status ☐ Level I (CONFIDENTIAL) ☐ Level II (SECRET) ☐ Level III (TOP SECRET)
☐ Other _____

PARTICULARS OF APPOINTMENT/ASSIGNMENT/CONTRACT

☐ Indeterminate ☐ Term ☐ Contract ☐ Industry ☐ Other (specify secondment, assignment, etc.) _____

Justification for security screening requirement

Contractor

Position/Competition/Contract number	Title	Group/Level (Rank if applicable)	
Employee ID number/PRI/Rank and Service number (if applicable)	If term or contract, indicate duration period ▶	From	To
Name and address of department / organization / agency	Name of official	Telephone number ()	Facsimile number ()

B BIOGRAPHICAL INFORMATION (To be completed by the applicant)

Surname (Last name)	Full given names (no initials) underline or circle usual name used		Family name at birth	
All other names used (i.e. Nickname)	Sex <input type="checkbox"/> Male <input type="checkbox"/> Female	Date of birth Y M D	Country of birth	Date of entry into Canada if born outside Canada Y M D

RESIDENCE (provide addresses for the last five years, starting with the most current)
Home address

1	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To present
	City	Province or state	Postal code	Country	Telephone number ()	
2	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To Y M
	City	Province or state	Postal code	Country	Telephone number ()	

Have you previously completed a Government of Canada security screening form? ☐ Yes ☐ No If yes, give name of employer, level and year of screening. Y

CRIMINAL CONVICTIONS IN AND OUTSIDE OF CANADA (see instructions)

Have you ever been convicted of a criminal offence for which you have not been granted a pardon? ☐ Yes ☐ No If yes, give details. (charge(s), name of police force, city, province/state, country and date of conviction) ▼

Charge(s)	Name of police force	City
Province/State	Country	Date of conviction ▶ Y M D



Government
of Canada

Gouvernement
du Canada

**PERSONNEL SCREENING,
CONSENT AND AUTHORIZATION FORM**

PROTECTED (when completed)

Surname and full given names	Date of birth Y M D
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C CONSENT AND VERIFICATION (To be completed by the applicant and authorized Departmental/Agency/Organizational Official)

Checks Required (See Instructions)	Applicant's initials	Name of official (print)	Official's initials	Official's Telephone number
1. <input checked="" type="checkbox"/> Date of birth, address, education, professional qualifications, employment history, personal character references				()
2. <input checked="" type="checkbox"/> Criminal record check				()
3. <input checked="" type="checkbox"/> Credit check (financial assessment, including credit records check)				()
4. <input checked="" type="checkbox"/> Loyalty (security assessment only)				
5. <input checked="" type="checkbox"/> Other (specify, see instructions) Law Enforcement Records Checks				()

The Privacy Act Statement

The information on this form is required for the purpose of providing a security screening assessment. It is collected under the authority of subsection 7(1) of the *Financial Administration Act* and the *Government Security Policy (GSP)* of the Government of Canada, and is protected by the provisions of the *Privacy Act* in institutions that are covered by the *Privacy Act*. Its collection is mandatory. A refusal to provide information will lead to a review of whether the person is eligible to hold the position or perform the contract that is associated with this Personnel Screening Request. Depending on the level of security screening required, the information collected by the government institution may be disclosed to the Royal Canadian Mounted Police (RCMP) and the Canadian Security Intelligence Service (CSIS), which conduct the requisite checks and/or investigation in accordance with the GSP and to entities outside the federal government (e.g. credit bureaus). It is used to support decisions on individuals working or applying to work through appointment, assignment or contract, transfers or promotions. It may also be used in the context of updating, or reviewing for cause, the reliability status, security clearance or site access, all of which may lead to a re-assessment of the applicable type of security screening. Information collected by the government institution, and information gathered from the requisite checks and/or investigation, may be used to support decisions, which may lead to discipline and/or termination of employment or contractual agreements. The personal information collected is described in Standard PIB PSU 917 (Personnel Security Screening) which is used by all government agencies, except the Department of National Defence PIB DND/PPE 834 (Personnel Security Investigation File), RCMP PIB CMP PPU 065 (Security/Reliability Screening Records), CSIS PIB SIS PPE 815 (Employee Security), and PWGSC PIB PWGSC PPU 015 (Personnel Clearance and Reliability Records) used for Canadian Industry Personnel. Personal information related to security assessments is also described in the CSIS PIB SIS PPU 005 (Security Assessments/Advice).

I, the undersigned, do consent to the disclosure of the preceding information including my photograph for its subsequent verification and/or use in an investigation for the purpose of providing a security screening assessment. By consenting to the above, I acknowledge that the verification and/or use in an investigation of the preceding information may also occur when the reliability status, security clearance or site access are updated or otherwise reviewed for cause under the Government Security Policy. My consent will remain valid until I no longer require a reliability status, a security clearance or a site access clearance, my employment or contract is terminated, or until I otherwise revoke my consent, in writing, to the authorized security official.

Signature

Date (Y/M/D)

D REVIEW (To be completed by the authorized Departmental/Agency/Organizational Official responsible for ensuring the completion of sections A, B and C)

Name and title	Telephone number
Address	Facsimile number

E APPROVAL (To be completed by authorized Departmental/Agency/Organizational Security Official only)

I, the undersigned, as the authorized security official, do hereby approve the following level of screening.

Reliability Status

☐ Approved Reliability Status ☐ Not approved

Name and title

Signature

Date (Y/M/D)

Security Clearance (if applicable)

☐ Level I ☐ Level II ☐ Level III ☐ Not recommended

Name and title

Signature

Date (Y/M/D)

Comments

PHOTO
(for Level III T.S.,
and/or upon request
- see instructions)



INSTRUCTIONS FOR PERSONNEL SCREENING CONSENT AND AUTHORIZATION FORM TBS/SCT 330-23E (Rev. 2002/02)

Once completed, this form shall be safeguarded and handled at the level of Protected A.

General:

If space allotted in any portion is insufficient please use separate sheet using same format.

1. Section A (Administrative Information) Authorized Departmental/Agency/Organizational Official

The Official, based on instructions issued by the Departmental Security Officer, may be responsible for determining, based on five year background history, what constitutes sufficient verification of personal data, educational and professional qualifications, and employment history. References are to be limited to those provided on the application for employment or equivalent forms.

SUPPLEMENTAL INFORMATION REQUIREMENTS

Persons who presently hold a SECURITY CLEARANCE and subsequently marry, remarry or commence a common-law partnership, in addition to having to update sections of the *Security Clearance Form (TBS/SCT 330-60)*, are required to submit an original *Personnel Screening, Consent and Authorization Form*, with the following parts completed:

Part A - As set forth in each question

Part B - As set forth in each question, excluding CRIMINAL CONVICTIONS IN AND OUTSIDE OF CANADA.

Part C - Applicant's signature and date only are required

"Other". This should be used to identify if the security screening is for Site Access, NATO, SIGINT etc.

2. Section B (Biographical Information)

To be completed by the **applicant**. If more space is required use a separate sheet of paper. Each sheet must be signed.

Country of Birth - For "NEW" requests, if born abroad of Canadian parents, please provide a copy of your Certificate of Registration of Birth Abroad. If you arrived in Canada less than five years ago, provide a copy of the Immigration Visa, Record of Landing document or a copy of passport.

- List only criminal convictions for which a pardon has NOT been granted. Include on a separate attached sheet of paper, if more than one conviction. Applicant must include those convictions outside Canada.
- Offences under the *National Defence Act* are to be included as well as convictions by courts-martial are to be recorded.

3. Section C (Consent and Verification)

A copy of Section "C" may be released to institutions to provide acknowledgement of consent.

Criminal record checks (fingerprints may be required) and credit checks are to be arranged through the Departmental Security Office or the delegated Officer.

Consent: may be given only by an applicant who has reached the age of majority, otherwise, the signature of a parent or guardian is mandatory.

The age of majority is:

19 years in Nfld., N.S., N.B., B.C., Yukon, Northwest Territories and Nunavut;

18 years in P.E.I., Que., Ont., Man., Sask. and Alta.

The applicant will provide initials in the "applicant's initials box".

The official who carried out the verification of the information will print their name, insert their initials and telephone number in the required space.

- Reliability Screening (for all types of screening identified within Section A): complete numbers 1 and 2 and 3 if applicable.
- Security Clearance (for all types of screening identified within Section A): complete numbers 1 to 4 and 5 where applicable.
- Other: number 5 is used only where prior Treasury Board of Canada Secretariat approval has been obtained.

4. Section D (Review)

To be completed by authorized Departmental/Agency/Organizational Official who is responsible for ensuring the completion of sections A to C as requested.

5. Section E (Approval)

Authorized Departmental/Agency/Organizational Security Official refers to the individuals as determined by departments, agencies, and organizations that may verify reliability information and/or approve/not approve reliability status and/or security clearances. Approved Reliability Status and Level I, II and III, as well as the signature of the authorized security official or manager are added for Government of Canada use only. Applicants are to be briefed, acknowledge, and be provided with a copy of the "Security Screening Certificate and Briefing Form (TBS/SCT 330-47)".

Note: Private sector organizations do not have the authority to approve any level of security screening.

Photographs: Departments/Agencies/Organizations are responsible for ensuring that three colour photographs of passport size are attached to the form for the investigating agency. Maximum dimensions are 50mm x 70mm and minimum are 43mm x 54mm. The face length from chin to crown of head must be between 25mm x 35mm. The photographs must be signed by the applicant and an authorized security official. The photographs must have been taken within the last six months. It is required for new or upgrade Level III security clearances for identification of the applicant during the security screening investigation by the investigating agency. The investigating agency may in specific incidents request a photograph for a Level I or II clearances when an investigation is required.



SECURITY CLEARANCE FORM

OFFICE USE ONLY		
Reference number	Department number	File number

The Privacy Act Statement

The information on this form is required for the purpose of providing a security assessment. It is collected under the authority of subsection 7(1) of the *Financial Administration Act* and the Government Security Policy (GSP) of the Government of Canada and is protected by the provisions of the *Privacy Act* in institutions that are covered by the *Privacy Act*. Its collection is mandatory. A refusal to provide information will lead to a review of whether the person is eligible to hold the position or perform the contract that is associated with this Personnel Screening Request. The information collected by the government institution may be disclosed to the Royal Canadian Mounted Police (RCMP) and the Canadian Security Intelligence Service (CSIS), which conduct the requisite checks and/or investigation in accordance with the GSP and to entities outside the federal government (e.g. credit bureaus). It is used to support decisions on individuals working or applying to work through appointment, assignment or contract, transfers or promotions. It may also be used in the context of updating, or reviewing for cause, the reliability status, security clearance or site access, all of which may lead to a re-assessment of the applicable type of security screening. Information collected by the government institution, and information gathered from the requisite checks and/or investigation, may be used to support decisions, which may lead to discipline and/or termination of employment or contractual agreements. The personal information collected is described in Standard PIB PSU 917 (Personnel Security Screening) which is used by all government agencies, except the Department of National Defence PIB DND/PPE 834 (Personnel Security Investigation File), RCMP PIB CMP PPU 065 (Security/Reliability Screening Records), CSIS PIB SIS PPE 815 (Employee Security), and PWGSC PIB PWGSC PPU 015 (Personnel Clearance and Reliability Records) used for Canadian Industry Personnel. Personal information related to security assessments is also described in the CSIS PIB SIS PPU 005 (Security Assessments/Advice).

Please typewrite or print in block letters.

NOTE: Level I and II must complete sections A to J inclusive and P.
Level III must complete all sections.

A ADMINISTRATIVE INFORMATION (To be completed by Department/Agency/Organization)		
<input type="checkbox"/> New <input type="checkbox"/> Update	<input type="checkbox"/> Upgrade <input type="checkbox"/> Transfer	<input type="checkbox"/> Supplemental <input type="checkbox"/> Re-activation
Level <input type="checkbox"/> I (CONFIDENTIAL) <input type="checkbox"/> II (SECRET)		<input type="checkbox"/> III (TOP SECRET) <input type="checkbox"/> other _____
Department/Agency/Organization	Employee ID number/PRI/Rank and Service number (if applicable)	Organization number

B BIOGRAPHICAL INFORMATION (To be completed by the applicant)		
1. Surname (Last name)	2. Full given names (no initials) underline or circle usual name used	3. Family name at birth
4. All other names used (i.e. Nickname)	5. Sex <input type="checkbox"/> Male <input type="checkbox"/> Female	6. Date of birth Y M D
7. Place of birth (city)	Province/State	Country
8. Name change (other than marriage)	From	To
9. Place of change (city, province or state, and country)		10. Method (authority)

C SECURITY SCREENING	
1. Have you previously completed a Government of Canada security screening form? <input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, give name of department/agency/organization, and the year and level of clearance. Y

D MARITAL STATUS/COMMON-LAW PARTNERSHIP	
Current status <input type="checkbox"/> Married <input type="checkbox"/> Common-Law Partnership <input type="checkbox"/> Separated <input type="checkbox"/> Widowed <input type="checkbox"/> Divorced <input type="checkbox"/> Single	
1 A) CURRENT SPOUSE/COMMON-LAW PARTNER: Surname, given names B) Maiden Name (if applicable) C) Present citizenship of current spouse/common-law partner	
D) Date of marriage/common-law partnership Y M D E) City, province or state, and country of marriage/common-law partnership	
F) City, province or state, and country of birth G) Date of birth Y M D	
H) Present address (apartment number, street number, street name, civic number (if applicable), city, province or state and country) I) If separated, widowed or divorced, specify date Y M D	
J) Name and address of employer (job title)	
2 A) PREVIOUS SPOUSE/COMMON-LAW PARTNER: Surname, given names (cover only the past five years) B) Present citizenship of former spouse/common-law partner	
C) Date of marriage/common-law partnership Y M D D) City, province or state, and country of marriage/common-law partnership	
E) Date of divorce/separation/deceased Y M D F) City, province or state, and country of divorce	
G) Country of Birth (if known) H) Date of birth Y M D	

E IMMEDIATE RELATIVES (including those living outside Canada) (see instructions)	
NOTE: Do not use initials	
1 A) Full name (surname and all given names, including maiden name) B) Relationship	
C) City, province or state, and country of birth D) Date of birth Y M D	
E) Present address (apartment number, street number, street name, civic number (if applicable), city, province or state and country) F) Date of death (if applicable) Y M D	
G) Name and address of employer H) Job title	

Surname and full given names		Date of birth			Y			M			D		
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PROTECTED (When completed)

E IMMEDIATE RELATIVES (continued)

NOTE: Do not use initials

2	A) Full name (surname and all given names, including maiden name)	B) Relationship
	C) City, province or state, and country of birth	D) Date of birth
	E) Present address (apartment number, street number, street name, civic number (if applicable), city, province or state and country)	F) Date of death (if applicable)
	G) Name and address of employer	H) Job title
3	A) Full name (surname and all given names, including maiden name)	B) Relationship
	C) City, province or state, and country of birth	D) Date of birth
	E) Present address (apartment number, street number, street name, civic number (if applicable), city, province or state and country)	F) Date of death (if applicable)
	G) Name and address of employer	H) Job title
4	A) Full name (surname and all given names, including maiden name)	B) Relationship
	C) City, province or state, and country of birth	D) Date of birth
	E) Present address (apartment number, street number, street name, civic number (if applicable), city, province or state and country)	F) Date of death (if applicable)
	G) Name and address of employer	H) Job title
5	A) Full name (surname and all given names, including maiden name)	B) Relationship
	C) City, province or state, and country of birth	D) Date of birth
	E) Present address (apartment number, street number, street name, civic number (if applicable), city, province or state and country)	F) Date of death (if applicable)
	G) Name and address of employer	H) Job title
6	A) Full name (surname and all given names, including maiden name)	B) Relationship
	C) City, province or state, and country of birth	D) Date of birth
	E) Present address (apartment number, street number, street name, civic number (if applicable), city, province or state and country)	F) Date of death (if applicable)
	G) Name and address of employer	H) Job title
7	A) Full name (surname and all given names, including maiden name)	B) Relationship
	C) City, province or state, and country of birth	D) Date of birth
	E) Present address (apartment number, street number, street name, civic number (if applicable), city, province or state and country)	F) Date of death (if applicable)
	G) Name and address of employer	H) Job title

F CRIMINAL CONVICTIONS IN AND OUTSIDE OF CANADA (see instructions)

Have you ever been convicted of a criminal offence for which you have not been granted a pardon?		If yes, give details. (charge(s), name of police force, city, province/state, country and date of conviction)	
<input type="checkbox"/> Yes <input type="checkbox"/> No			
Charge(s)	Name of police force	City	
Province/State	Country	Date of conviction	
		Y M D	

G FOR COMPLETION BY PERSONS BORN OUTSIDE CANADA OR BORN IN CANADA HOLDING DUAL CITIZENSHIP (see instructions)

1. Date of entry into Canada		2. Present citizenship	
Y M D			
3. If you are a naturalized Canadian, give the certificate number and date of issue		4. If you are not naturalized, have you applied for Canadian citizenship? Please provide copy of Immigrant Visa or Record of Landing documentation	
Certificate No. Y M D		<input type="checkbox"/> Yes <input type="checkbox"/> No Date of application	
5. Do you maintain citizenship of a country other than Canada? If yes, please provide the name of the country and explain why.		6. Have you used a passport other than a Canadian one? If yes, explain why.	
<input type="checkbox"/> Yes <input type="checkbox"/> No (If yes) Name of Country: Explain:		<input type="checkbox"/> Yes <input type="checkbox"/> No (If yes) Explain:	

Surname and full given names	Date of birth
	<div style="display: flex; justify-content: space-around;"> YMD </div> <div style="display: flex; justify-content: space-around;"> <div style="border-bottom: 1px solid black; width: 10px;"></div> <div style="border-bottom: 1px solid black; width: 10px;"></div> <div style="border-bottom: 1px solid black; width: 10px;"></div> <div style="border-bottom: 1px solid black; width: 10px;"></div> <div style="border-bottom: 1px solid black; width: 10px;"></div> <div style="border-bottom: 1px solid black; width: 10px;"></div> </div>

H RESIDENCE (there should be no gaps)**List addresses where you have lived during the last 10 years, starting with the most current. (Rural address to include lot and civic number.)**

1	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To present
	City		Province or state	Postal code	Country	
Telephone number ()						
2	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To Y M
	City		Province or state	Postal code	Country	
Telephone number ()						
3	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To Y M
	City		Province or state	Postal code	Country	
Telephone number ()						
4	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To Y M
	City		Province or state	Postal code	Country	
Telephone number ()						
5	Apartment number	Street number	Street name	Civic number (if applicable)	From Y M	To Y M
	City		Province or state	Postal code	Country	
Telephone number ()						

I EMPLOYMENT (last 10 years) (see instructions for self-employed and consultants) (there should be no gaps)

Would your employment be jeopardized if your current supervisor, below, is contacted? <input type="checkbox"/> Yes <input type="checkbox"/> No							
If yes, provide the name of an alternate employment contact and telephone number.							
Were you dismissed or asked to resign from any position(s) as listed below? <input type="checkbox"/> Yes <input type="checkbox"/> No							
If yes, give name of employer, supervisor, and date.							
Name of employer		Supervisor		Position title	Date Y M		
1	A) Name of employer - do not use initials (department/organization/agency, if applicable)			B) From Y M	To present		
	C) Job-site address (street number, street name, city, province or state and country)						
	D) Job title/Description			E) Rank and service number (if applicable)			
	F) Supervisor's name in full			G) Supervisor's telephone number ()			
2	A) Name of employer - do not use initials (department/organization/agency, if applicable)			B) From Y M	To Y M		
	C) Job-site address (street number, street name, city, province or state and country)						
	D) Job title/Description			E) Rank and service number (if applicable)			
	F) Supervisor's name in full			G) Supervisor's telephone number ()			
3	A) Name of employer - do not use initials (department/organization/agency, if applicable)			B) From Y M	To Y M		
	C) Job-site address (street number, street name, city, province or state and country)						
	D) Job title/Description			E) Rank and service number (if applicable)			
	F) Supervisor's name in full			G) Supervisor's telephone number ()			
4	A) Name of employer - do not use initials (department/organization/agency, if applicable)			B) From Y M	To Y M		
	C) Job-site address (street number, street name, city, province or state and country)						
	D) Job title/Description			E) Rank and service number (if applicable)			
	F) Supervisor's name in full			G) Supervisor's telephone number ()			

Surname and full given names	Date of birth	Y	M	D
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J FOREIGN EMPLOYMENT

1. Are you now or have you <u>ever</u> been employed by or acted as a consultant for a foreign government, firm, or agency?	If yes, give details (country, organization, nature of work and dates) Include military (cadets), law enforcement and security intelligence employment
<input type="checkbox"/> Yes <input type="checkbox"/> No	

SECTIONS "K" TO "O" MUST ALSO BE COMPLETED FOR LEVEL III ONLY

K TRAVEL

List countries visited within the last five years for personal travel and/or non-Government business, other than Canada, the USA and Mexico.

Country	Purpose	From		To	
		Y	M	Y	M

L FOREIGN ASSETS

Do you have any business, financial or personal assets outside Canada?	If yes, list the relevant countries (exclude stocks and mutual funds purchased in Canada)
<input type="checkbox"/> Yes <input type="checkbox"/> No	

M CHARACTER REFERENCES IN CANADA (see instructions)

List three character references (non-family members) and one neighbourhood reference

1	Name in full (no initials)	Relationship	Period known
	Complete home address		Telephone Number ()
	Complete title and business address		Business Telephone Number ()
2	Name in full (no initials)	Relationship	Period known
	Complete home address		Telephone Number ()
	Complete title and business address		Business Telephone Number ()
3	Name in full (no initials)	Relationship	Period known
	Complete home address		Telephone Number ()
	Complete title and business address		Business Telephone Number ()
Neighbourhood reference (see instructions)			
Name in full (no initials)			Telephone Number ()
Complete home address			Business Telephone Number ()

N EDUCATION

1. Name of the last school or university you attended full time	2. Student ID number (if known)	3. Location of institution	4. Period of attendance
			From Y M To Y M
5. Field of study (Diploma or degree obtained)			

O MILITARY SERVICE

Military service in the Canadian Armed Forces: Regular, Reserves and Sea, Army and Air Cadets (from the period since your 16th birthday).

1. Name and last location	2. Rank and Service no	3. Period of service
		From Y M To Y M

P CERTIFICATION

I hereby certify that the information set out by me in this document is true and correct to the best of my knowledge and belief.

1. Signature	2. Date	3. Telephone (Home)	3. Telephone (Business)
	Y M D	()	()

ALL INFORMATION SUPPLIED IS SUBJECT TO VERIFICATION BY INVESTIGATION



INSTRUCTIONS FOR COMPLETION OF SECURITY CLEARANCE FORM TBS/SCT 330-60E (Rev. 2006-02)

General:

- Once completed this form shall be safeguarded and handled at the level of PROTECTED A.
- If clarification of information is required, a Canadian Government Official may contact the applicant to obtain additional information in order to complete the security screening investigation and an interview of the applicant may be requested.
- This form is to be completed using an automated system or if not available using a typewriter or printing in block letter format in black ink.
- Please read and follow these instructions carefully.
- The original signed copy must be submitted.
- It is important that a copy of the completed questionnaire be retained by the applicant for future reference.
- Incomplete or illegible forms will NOT be considered.
- All names are to be in full (no initials) (Maternal and Paternal or other names used).
- Addresses are to include, where applicable civic or township name and the lot and concession numbers.
- If information is not known or is unavailable please indicate this on the form and on a separate sheet of paper explain the cause of circumstance.
- All dates are to be entered in order of YEAR, MONTH, and DAY as applicable.
- If space allotted in any portion is insufficient please use separate sheet using same format.

Detailed Instructions:

SECTION A

- To be completed by the department, agency or organization.
- "Other" This should be used to identify if the security screening is for Site Access, NATO, SIGINT etc.

SECTION B (Remainder of the form is to be completed by the applicant)

- Complete as requested.

SECTION C

- Complete as requested.

SECTION D

"common-law partner" - in relation to an applicant, means a person who is cohabiting with the individual in a conjugal relationship, having so cohabited for a period of at least one year. This includes persons of the same sex.

- 1. includes current spouse and common-law partner as applicable.
- If any person is deceased, date of death and last address while living are to be shown.
- 2. includes previous spouse and common-law partner as applicable during the last five years.
- If a person is deceased, date of death is to be shown in 2e.
- All other questions to be answered as set forth.

SECTION E

- Questions 1 to 8 - experience has shown that incomplete answers to these questions are the most common cause of delay. Please follow the instructions carefully.
- For all security clearance requests all Immediate Relative(s) information must be provided.
- Immediate family includes the following:
 - All children 18 years and over that you or your spouse or common-law partner have a parental relationship.
 - Your father, mother, brothers, sisters. Include "half" or "step" relatives in this category.
 - Your current spouse's or common-law partner's father and mother. Include "half" or "step" relatives in this category.

If any person is deceased, date of death and last address while living are to be shown.

SECTION F

- List only criminal convictions for which a pardon has NOT been granted. Include on a separate attached sheet of paper, if more than one conviction. Applicant must include those convictions outside Canada.
- Offences under the *National Defence Act* are to be included as well as convictions by courts-martial are to be recorded.

SECTION G

- If a naturalized Canadian, it is important to show the certificate number, date of issue. Attach a photocopy of the certificate.
- If born abroad of Canadian parents, please provide a copy of your Certificate of Registration of Birth Abroad.
- If not a Canadian Citizen indicate if application has been made for Citizenship. In this case, passport or identity card number and particulars should be recorded in box "6". Please provide copy of Immigrant Visa or Record of Landing documentation.
- Questions 5 and 6 - Attach a separate sheet of paper if more space is required. Each sheet must be signed.

SECTION H

- As set forth, ensuring current address is recorded first.
- The Postal code is mandatory for the current address, and if known, for previous addresses.
- For rural area, include civic number or lot, concession and township number.

SECTION I

- Record your present employment first.
- Please note that it may be necessary to contact your present employer.
- Time at school and periods of unemployment are also to be shown; (as well as, secondments, educational leave, and courses of over six months' duration; include supervisor or colleague's name).
- Job-site address is the address where your work is performed and may be different from your employer's address.

NOTE: If you are self-employed or a consultant, or have been self-employed or a consultant, provide the following:

- a) Name of employer - give your business name; if not applicable, give your name;
- b) No change;
- c) Job-site address - give your permanent business address; if not applicable, give your residence address;
- d) No change;
- e) No change;
- f) Supervisor's name - give a name of a person who can verify your employment;
- g) No change.

SECTION J

- Is related to determining past employment of security concern. A security official may ask for further details.

SECTION K

- Travel record is for less than six months, if more than this period it is to be recorded as residence in part "H".
- One day visits to countries, such as cruise stopover, do not have to be recorded.
- A security official may ask for details of travel.
- An employee or contractor on Canadian Government business is not required to record details of travel in this section.

SECTION L

- A security official may ask for details in terms of the type of assets and estimated value.

SECTION M

- Character references must be colleagues, peers, and friends who have known you well for over three years and should be able to cover your non-work environment and activities.
- Character references are NOT to include relatives and MUST be residing in Canada.
- Faster processing is facilitated if references listed are in your geographic area.
- Neighbourhood reference is an individual who has known you for over six months preferably at your current address. If not, the individual has been a neighbour during the past five years.

SECTION N

- Complete as requested.

SECTION O

- Question to be answered if not covered in employment section. List last or current unit and dates of total service in the Canadian Armed Forces.
- If more space is required use a separate sheet of paper. Each sheet must be signed.

SECTION P

- Complete as requested.

SUPPLEMENTAL INFORMATION REQUIREMENTS

Persons who have previously completed a SECURITY CLEARANCE and subsequently marry, remarry or commence a common-law partnership are required to submit an original Security Clearance Form with the following parts completed:

For all Security Clearances

- Part A - As set forth in each question
- Part B - As set forth in each question
- Part C - As set forth in each question
- Part D - As set forth in each question
- Part E - Provide details on parents of new spouse/common-law partner and any children (over the age of 18 years) of the new spouse/common-law partner
- Part P - To be signed by person submitting the form

Note: In addition to the above, in those cases where an individual marries or commences a common-law partnership with a Non-Canadian National or Landed Immigrant who has not yet arrived in Canada, the following information is required:

- Parts A-D As set forth in each question
- Part E - Parents of new spouse/common-law partner, brothers, sisters (include "half and "step" relatives) and any children (over the age of 18 years) of the new spouse/common-law partner
- Part H - For new spouse/common-law partnership
- Part I - For new spouse/common-law partnership
- Part P - To be signed by person submitting the form

CYCLICAL UPDATE REQUIREMENTS

- Levels I+II (10 year update). Complete all portions of the form as per instructions above.
- Level III (5 year update cycle)

With the exceptions of Parts H and I, where the information required is that which covers the period of time since the last submission of a questionnaire, **ALL OTHER** parts of the questionnaire must be completed **IN FULL**.



Security / Reliability Interview Pre-Interview Questionnaire

- The Pre-Interview Security / Reliability Questionnaire and the Security / Reliability Interview are both integral parts of the RCMP recruiting and security process. They, and the subsequent field investigation, are used to assist in determining suitability and reliability and contribute to the security screening assessment of individuals who seek employment as a member, employee or volunteer of the RCMP or under a contract awarded to, or administered by, the RCMP. Verifications to issue security clearances are carried out to assess an individual's loyalty and reliability as it relates to loyalty. Reliability checks are done to assess an individual's reliability. This is being done in accordance to the Policy on Government Security (PGS) which became effective July 1, 2009.
- You are required to fill the Pre-Interview Questionnaire and return it to the RCMP Human Resources Section when completed. You will soon be contacted to meet with an interviewer to complete the Security / Reliability Interview.
- Please carefully read and follow the instructions below.

Instruction for the Applicant

- The Pre-Interview Questionnaire (Form 1020-1) is available in both official languages. You may complete the Pre-Interview Questionnaire in the language of your choice.
- Your decision to complete the Pre-Interview Questionnaire and the subsequent Security / Reliability Interview must be voluntary and be based on your desire to pursue employment with, or at, the RCMP.
- You should answer the questions contained in the Pre-Interview Questionnaire accurately, completely, thoroughly and honestly to the best of your knowledge and belief. You should answer the questions contained in the Pre-Interview Questionnaire on your own without the assistance of third parties (e.g. family or friends), considering the personal and sensitive nature of the information provided. You may withdraw from the process at any time or refuse to provide answers to any or all of the questions contained in the Pre-Interview Questionnaire. You should, however, be advised that an incomplete Pre-Interview Questionnaire may result in your disqualification from the employment process.
- You are not required to provide any information in the Pre-Interview Questionnaire that relates to a conviction for which a pardon has been received, or a matter that was processed pursuant to the *Young Offenders Act* (R.S.C. 1985, c. Y-1, now repealed) or the *Youth Criminal Justice Act* (S.C. 2002, c. 1).
- You are under no obligation to provide information about third parties, (e.g. individuals other than yourself), in the Pre-Interview Questionnaire.
- You are under no obligation to disclose any information regarding a crime where you were a victim or complainant.
- You should be aware that, in the event of significant discrepancy between the information you provide in this Pre-Interview Questionnaire and in the context of the Security / Reliability Interview, and the information that surfaces from the RCMP's background investigation, you may be asked to undergo a second interview to explain adverse information.

Security / Reliability Interview Pre-Interview Questionnaire

PROTECTED B
when completed
PIB CMP PPU 065

- Deceit, dishonesty or non-disclosure in answer to questions contained in the Pre-Interview Questionnaire are likely to result in your disqualification from the employment process.
- Should you apply for any other employment with, or at, the RCMP within the next five (5) years, the information provided in this Pre-Interview Questionnaire may be used to reassess your suitability and reliability and for security screening purposes. This may result in your disqualification from the employment process.
- If you are currently employed by, or working at, the RCMP, you should be advised that the information provided in this Pre-Interview Questionnaire may be used in reassessing your suitability and reliability, and in carrying out the security screening process. This may result in your disqualification from the employment process in question. This may also lead, where applicable, to a review for cause and possible revocation of an existing clearance or reliability status, and consequently the dismissal from your current employment with the RCMP.

Notices regarding prior serious criminal offences and serious risk to yourself or the safety of others.

- The information you provide on the Questionnaire and during the Security / Reliability Interview process is collected and used by the RCMP for the purposes of an employment application and security screening. However, if you admit to having committed a serious undetected criminal offence, or are deemed to pose a serious risk to yourself or to the safety of others, the RCMP may disclose information to entities with lawful authority to collect such information (e.g. police of jurisdiction or child protection agencies) for a law enforcement or public safety purpose. While cases of such disclosure are rare and exceptional, the RCMP strongly discourages you from completing the Pre-Interview Questionnaire or attending the Security/Reliability Interview if you believe this Notice applies to you.

Examples of serious criminal offences include, but are not limited to:

- murder;
- sexual assault;
- child pornography: accessing, possession, distribution, or the making of;
- any crime involving children;
- arson resulting in loss of life or substantial damage;
- forcible confinement;
- robbery;
- crime committed with a facial covering and/or a weapon.

Should you be uncertain if this applies to you, you should consult a lawyer to obtain independent legal advice.

- If you nonetheless chose to pursue the process and admit, on the Pre-Interview Questionnaire or in the context of the Security / Reliability Interview, to having committed one or a number of serious criminal offence(s), be advised that the information may be disclosed to entities with lawful authority to collect such information (e.g. police of jurisdiction or child protection agencies).
- If, in light of the information provided on the Pre-Interview Questionnaire or in the context of the Security / Reliability Interview, you are deemed to pose a serious threat to yourself or to the safety of others, be advised that the information may be disclosed to the entities with lawful authority to collect such information (police of jurisdiction or child protection agencies).
- You are also advised that such disclosures could lead to incident reports being entered into police databases, which could impact future employment or volunteering opportunities, or other activities that require security screening (e.g. employment with schools, banks, etc.).
- You are further advised that such disclosures could also lead to an investigation, arrest, charge(s), criminal prosecution, conviction, and, ultimately, the imposition of a sentence.

**Security / Reliability Interview
Pre-Interview Questionnaire**

PROTECTED B
when completed
PIB CMP PPU 065

Notice regarding the collection and use of personal information by the RCMP

- The RCMP is collecting, on a voluntary basis, the personal information you provide on the Pre-Interview Questionnaire and in the context of the Security / Reliability Interview to assist in determining your suitability and reliability and for security screening purposes. The information requested is essential for making these determinations and, should it not be provided, may result in your disqualification and/or our inability to proceed with the employment process.
- The information is collected under the authority of the *Royal Canadian Mounted Police Act, R.S.C. 1985, c. R-10* and the *Financial Administration Act, R.S.C. 1985, c. F-11*. It is protected and managed in conformity with the provisions of the *Privacy Act, R.S.C. 1985, c. P-21* and the *Privacy Regulations, SOR/83-508*.
- The information collected will be stored by the RCMP in Personal Information Bank CMP PPU 065 and be disclosed in conformity with the *Privacy Act*. Under this Act, you have the right to the protection of, access to and correction of your personal information. More details regarding the collection and use of personal information can be found at www.infosource.gc.ca.



Security / Reliability Interview Pre-Interview Questionnaire

Declaration, Acknowledgement, and Consent

Name of applicant

Telephone number

Mailing address

In which Official Language would you prefer your interview to be conducted?

☐

English

☐

French

	Applicant's initials
I, the undersigned, have read and understand the previous pages of instruction and notices.	
I am completing this Pre-Interview Questionnaire voluntarily, based on my desire to volunteer, pursue work as a member or employee of the RCMP or under a contract awarded to, or administered by, the RCMP.	
I declare that the information provided in this Pre-Interview Questionnaire is up-to-date, accurate, complete and honest to the best of my knowledge and belief.	
I understand that the consequences of my not being completely honest and forthright in this Pre-Interview Questionnaire could result in me no longer being considered for employment with, or at, the RCMP.	
I understand that I do not have to include any information in this Pre-Interview Questionnaire that relates to a conviction for which a pardon has been received, or a matter that was processed pursuant to the <i>Young Offenders Act</i> or the <i>Youth Criminal Justice Act</i> .	
I understand that the information provided in this Pre-Interview Questionnaire may affect my opportunities for any other employment with, or at, the RCMP within the next five (5) years, or, where applicable, may affect my current security clearance and employment with, or at, the RCMP.	
I understand that, if I admit to having committed one or more serious undetected criminal offence(s) in this Pre-Interview Questionnaire, actions could be taken, which could lead, ultimately to the imposition of a sentence.	
I understand that, if in light of the answers provided in the Pre-Interview Questionnaire, I am deemed to pose a serious risk to myself or to the safety of others, actions could be taken, which could lead, ultimately to the imposition of a sentence.	
I understand that, in the event of significant discrepancy between the information I provide in this Pre-Interview Questionnaire and in the context of the Security / Reliability Interview and information that surfaces from the RCMP's background investigation, I may be asked to undergo a second interview to explain adverse information for verification and confirmation purposes.	
I declare that I will not divulge the contents and format of this Pre-Interview Questionnaire and of the Security / Reliability Interview to anyone.	
I consent to my personal information being collected, used and disclosed for the purposes identified above.	
I consent to my personal information being used for security screening purposes pursuant to the Treasury Board's Policy on <i>Government Security</i> .	
<div>Signature of applicant</div> <div>Date</div>	

Security / Reliability Interview
Pre-Interview Questionnaire

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Please complete the following information and return. This questionnaire will form part of your Security / Reliability Interview that will be completed.

Office use only	
HRMIS number	File number
Name of applicant	
Telephone number	

1. List the names of everyone of 18 years old or more you have lived with at each of your addresses over the past ten years?
(except people who were just visiting for a few days)

2. Do you have any family* or friends** living outside Canada?
- ☐ No ☐ Yes: If yes, list their names and dates of birth below

* Family refers to spouse/cohabitant, parents and/or guardians, spouse's/cohabitant's parents and/or guardians, children, brothers and sisters (including step and half relative).

** Friend refers to persons with whom the interviewee have associated (e.g., person seen frequently) over the last five years, excluding relatives, former employers, supervisors.

**Security / Reliability Interview
Pre-Interview Questionnaire**

**PROTECTED B when completed
PIB CMP PPU 065**

Office use only	
HRMIS number	File number

Name of applicant

Telephone number

3. List the names of your closest friends and associates* and describe your relationship with them (include name, address, relationship and date of birth).

4. List all clubs, organizations, or associations that you belong to or have belonged to or that you have contributed financially or otherwise supported.

* Associate refers to a person who joins with others in some activity and / or keep company with, hang out with.

Security / Reliability Interview
Pre-Interview Questionnaire

PROTECTED B when completed
PIB CMP PPU 065

Office use only	
HRMIS number	File number

Name of applicant	Telephone number
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5. Have you in the past five years traveled outside of Canada, including USA?

☐ No ☐ Yes, complete this section

Bring your passport(s) to the interview for verification and confirmation purposes.

Countries visited	Approx. date (yyyy-mm)	Duration	Reasons	Contact with government officials or police? Difficulties or unusual incidents? (If yes, please specify)

Security / Reliability Interview
Pre-Interview Questionnaire

PROTECTED B when completed
PIB CMP PPU 065

Office use only	
HRMIS number	File number

Name of applicant

Telephone number

6. Financial assessment

Your relationship with money may have an impact in obtaining either, a reliability status, a security clearance and/or site/facilities access. Please answer the following questions and be prepared to explain them to the interviewer.

A - Does your financial situation cause you any stress? If so, what level of stress do you feel: low, medium or high and why?

B - What is your ratio of debt versus income?

C - How has this changed over the past five years, if at all?

D - How do you expect your financial situation to evolve over the next 5 years?

E - If you are not satisfied with your finances, what are you doing to improve your situation?

Security / Reliability Interview Pre-Interview Questionnaire

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PIB CMP PPU 065

Office use only	
HRMIS number	File number

Name of applicant	Telephone number
-------------------	------------------

7. Have any members of your immediate family, close friends or associates been involved (to your knowledge) in criminal activity, meaning been suspected, charged or convicted of any criminal offences? This involvement should not be limited to the following offences (assault, domestic violence, theft, fraud, shoplifting, drug offenses, hack into a computer, drinking and driving, hunting without a permit.)

☐ No ☐ Yes, complete this section.

i)	Name of individual	Date of birth (yyyy-mm-dd)
	Home address	Involvement/Activity
ii)	Name of individual	Date of birth (yyyy-mm-dd)
	Home address	Involvement/Activity
iii)	Name of individual	Date of birth (yyyy-mm-dd)
	Home address	Involvement/Activity
iv)	Name of individual	Date of birth (yyyy-mm-dd)
	Home address	Involvement/Activity
v)	Name of individual	Date of birth (yyyy-mm-dd)
	Home address	Involvement/Activity

**Analyst/Interviewer/Risk manager comments/notes
(For office use only)**

Security / Reliability Interview
Pre-Interview Questionnaire

PROTECTED B when completed
PIB CMP PPU 065

Office use only	
HRMIS number	File number

Name of applicant	Telephone number
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8. Have you ever used or experimented with any illegal drugs and/or have you abused any pharmaceutical (prescription) drugs?

- ☐ No
- ☐ Yes, please provide the requested information for each drug and/or prescription drugs and explain circumstances of use below.

Drug	Method and frequency of use	Approximate dates of use (first time, last time)	Circumstances/ Motives for use	Means to obtain drugs	Financial outlay (How much do/did you spend on drugs on a monthly basis?)

Analyst/Interviewer/Risk manager comments/notes
(For office use only)

<div></div>

Security / Reliability Interview Pre-Interview Questionnaire

PROTECTED B when completed
PIB CMP PPU 065

Office use only	
HRMIS number	File number

Name of applicant

Telephone number

9. Please provide all your email addresses and describe your online activities (most visited sites, discussion forums, social media, etc.)

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper appears to be a standard notebook page.

- ## 10. Declaration

I, undersigned, hereby declare that the information I have provided in this Security / Reliability Interview - Pre-Interview Questionnaire is up to date, accurate, complete and honest, to the best of my knowledge and belief.

Signature of applicant

Date _____

Part 1 General

1.1 ADMINISTRATIVE

- .1 Project meetings will be scheduled throughout the progress of the work and at the call of Departmental Representative.
- .2 Provide physical space and make arrangements for meetings.
- .3 The Consultant shall chair meetings.
- .4 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 10 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Delivery schedule of specified equipment.
 - .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .8 Owner provided products and work.
 - .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
 - .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
 - .12 Monthly progress claims, administrative procedures, photographs, hold backs.
 - .13 Appointment of inspection and testing agencies or firms.
 - .14 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work, progress meetings will be held on a regular basis. Schedule to be determined.
- .2 Contractor, major Subcontractors involved in Work, Departmental Representative, Consultant and Owner's representatives are to be in attendance.
- .3 Minutes of meetings will be recorded by the Consultant. Minutes will be distributed within 72 hours.
- .4 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Other business.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

- .1 Ensure Project Schedule and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative within 7 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

1.4 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule.
 - .1 Project milestone will be identified through discussion with the Contractor and Departmental Representative at the outset of the project.

1.5 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.6 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

END OF SECTION

1.1 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit where required in the specifications, shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 7 days for Departmental Representative's review of each submission.

- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After Departmental Representative's review, distribute copies.
- .10 Submit 6 copies of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .11 Submit 6 copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

- .12 Submit 6 copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .13 Submit 6 copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit 6 copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit 6 copies of manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit 6 copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .20 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that

pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

- .21 Electronic submission of Shop Drawings
 - .1 Electronic Shop Drawings (PDF format) shall not exceed 11x17 actual size. Electronic transfer of shop drawings relies on Architect and Engineering Consultants to print a record copy for their files - this can be done providing shop drawings do not exceed 11x17. Larger shop drawings would require hard copies for review.
 - .2 General Contractor to review shop drawing and place their electronic stamp signifying review.
 - .3 General Contractor to email all shop drawings to Architect with copy to Engineering Consultant as applicable.
 - .4 Engineering Consultant to review and place their electronic stamp / marks up, then email to Architect only (Engineering Consultant will not copy anyone else).
 - .5 Architect to check for coordination and transmit reviewed shop drawings by email to General Contractor.

1.3 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's business address.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

- .1 Erect mock-ups in accordance with 01 45 00 - Quality Control and as specified in each applicable Section.

END OF SECTION

Part 1 General

1.1 SITE PROTECTION

- .1 Prevent damage to all existing items which are to remain (e.g. fencing, signs, trees, shrubs, turf, natural features, buildings, asphalt, surface or underground utility lines). Make good any damage.
- .2 Preserve and protect existing benchmarks and survey monuments. Inform Consultant immediately if benchmarks or survey monuments are encountered during construction. Make good any damage.

1.2 FINES AND PENALTIES

- .1 Abuse to any plant material or unauthorized pruning or removal, in whole or in part, of plant material is not permitted.
- .2 Be responsible to monitor all sub-trades for plant material abuse. Restitution for all damages found will be solely upon the Contractor.
- .3 A fine for not less than plant material repair or replacement costs plus for loss of aesthetic or intrinsic value per individual plant, will be levied. The decision of the Consultant in determination of damage will be final.

1.3 FIRES

- .1 Fires and burning of rubbish on site is not permitted.

1.4 DISPOSAL OF WASTES

- .1 Burying of rubbish and waste materials on site is not permitted.
- .2 Disposal of waste, or volatile materials such as mineral, spirits, oil or paint thinner, into waterways, storm or sanitary sewers prohibited.
- .3 Remove rubbish, waste products and debris in accordance with regulations of authorities having jurisdiction.

1.5 CARE OF EXISTING PLANT MATERIAL

- .1 Use all means necessary to protect plant materials before start up and during construction.
- .2 Do not disturb the existing grade or store heavy equipment within the drip line of existing trees. If access is required within the drip line of existing trees, then protect the access route with a moveable timber bridge to cushion/spread weight of vehicles over a greater surface area. Consultant to approve access route and timber bridge construction before work begins.
- .3 Protection of branches that are interfering with construction: All branches that pose temporary interference to the process of construction, are to be tied up or back under the supervision of the Consultant. Bindings thus provided will be removed as soon as feasible by the completion of construction (or phase of construction) to reduce possible water sprouting or structural damage.

- .4 Pruning trees that are interfering with construction: Remove interfering branches, without injury to trunks only when directed by the Consultant. The Consultant will determine all trees which require pruning, the extent of pruning allowed, and will identify the amount of compensatory pruning required for loss of roots or tops. The Contractor will adhere to limitations of on-site construction movement around identified trees.
- .5 Monitor condition of trees, in particular, possible wind damage or snow load damage to branches that are tied up.
- .6 Wash foliage should excessive construction dust build up on plant material.

1.6 TRAFFIC PROVISIONS AND STORAGE

- .1 Determine interference of trees and their root zones before moving equipment or supplies on site to avoid any damage to trees.
- .2 Traffic provisions:
 - .1 Use only approved access routes for vehicular and heavy pedestrian movement.
- .3 Parking areas shall be pre-designated at each construction site.
 - .1 Contractor responsible to provide soil aeration of compacted tree root areas through holes bored into the soil at the direction of the Consultant.
- .4 Storage:
 - .1 Store construction materials, fuels, chemicals, etc., in approved areas only.
 - .2 Store equipment, soil, building materials and debris beyond the drip-line of trees.

1.7 EXCAVATING ADJACENT TO EXISTING TREES

- .1 Locate and stake locations of electric service utility lines, and other underground construction.
- .2 Excavations within 2.0 metres of trees will be permitted only with prior approval of the Consultant. Prior to excavating, all tree roots along the side to be exposed must be severed with a trencher to a depth of 500mm along the line of excavation. Prune all exposed roots with a sharp pruning tool, in order to provide a clean severance of roots.
- .3 Excavations beyond two (2) metres from trees do not require trenching. Immediately after excavation, prune all exposed roots with a sharp pruning tool, in order to provide a clean severance of roots. Place a tarp over excavation wall to prevent exposed roots from drying out. Backfill around tree roots as soon as possible.

1.8 HERBICIDES / PESTICIDES

- .1 Use only with approval of Consultant and Owner and in strict accordance with applicable regulations and manufacturer's instructions.

1.9 DRAINAGE

- .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

- .2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Saskatchewan
 - .1 Occupational Health and Safety Act, 1993, S.S. 2005.

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit 1 copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Requirements.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.
- .8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.4 SAFETY ASSESSMENT

- .1 Perform site specific safety hazard assessment related to project.

1.5 MEETINGS

- .1 Schedule and administer Health and Safety Meeting with Departmental Representative prior to commencement of Work.

1.6 REGULATORY REQUIREMENTS

- .1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.7 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.8 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.9 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Regulations, 1996.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.10 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.11 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

- .1 Have site-related working experience specific to activities associated with overhead work.
- .2 Have working knowledge of occupational safety and health regulations.
- .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
- .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
- .5 Be on site during execution of Work .

1.12 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

1.13 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 BLASTING

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Departmental Representative.
- .2 Do blasting operations in accordance with Section 31 23 16 Utility Trench Excavation and Backfill.

1.15 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 26 – Environmental Protection.

1.2 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
- .2 Reference Standards:
 - .1 Canadian Environmental Assessment Act, 2012
 - .2 Canadian Environmental Protection Act, 1999
 - .1 Federal Halocarbon Regulations, 2003 (SOR/2003-289)
 - .2 Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations, 2008 (SOR/2008-197)
 - .3 Canadian Council of Ministers of the Environment, Environmental Code for Above Ground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products, 2003.
 - .3 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008 Stipulated Price Contract.
 - .4 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.
 - .2 EPA General Construction Permit (GCP) 2012.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit WHMIS MSDS in accordance with Section 01 33 00 – Submittal Requirements.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.
- .4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.

- .5 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .6 Include in Environmental Protection Plan:
 - .1 Name of person responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Name and qualifications of person responsible for manifesting hazardous waste to be removed from site.
 - .3 Name and qualifications of person responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
 - .6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
 - .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
 - .1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
 - .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
 - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
 - .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
 - .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
 - .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
 - .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
 - .13 Waste Water Management Plan identifying methods and procedures for management and discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
 - .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
 - .15 Pesticide treatment plan to be included and updated, as required.

1.4 FIRES

- .1 Fires and burning of rubbish on site is not permitted.

1.5 DRAINAGE

- .1 Develop and submit erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.
- .3 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.6 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated in related Sections.
- .2 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .3 Minimize stripping of topsoil and vegetation.
- .4 Restrict tree removal to areas indicated.

1.7 WORK ADJACENT TO WATERWAYS

- .1 Construction equipment to be operated on land only.
- .2 Use waterway beds for borrow material only after written receipt of approval from Departmental Representative..
- .3 Waterways to be kept free of excavated fill, waste material and debris.
- .4 Design and construct temporary crossings to minimize erosion to waterways.
- .5 Do not skid logs or construction materials across waterways.
- .6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

1.8 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.

- .1 Provide temporary enclosures where directed by Departmental Representative.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.9 HISTORICAL/ARCHAEOLOGICAL CONTROL

- .1 Provide historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.
- .2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.

1.10 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
 - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Burying rubbish and waste materials is not permitted.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.2 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.
- .2 Smoking on site is restricted to within personal vehicles or designated smoking locations.

END OF SECTION

Part 1 General

1.1 INSPECTION

- .1 Allow Departmental Representative and Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative or Consultant, instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.2 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.3 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.4 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.

- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.5 REPORTS

- .1 Submit two (2) copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to subcontractor of work being inspected or tested.

1.6 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

1.7 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative and as specified in specific Section.
- .3 Prepare mock-ups for Departmental Representative and Consultant's review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 Mock-ups may remain as part of Work.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.2 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.3 TEMPORARY HEATING AND VENTILATION

- .1 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .2 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .3 Permanent heating system of building may be used when available. Obtain written approval from Departmental Representative prior to using equipment. Be responsible for damage to heating system if use is permitted.
- .4 Refer to Mechanical and Electrical sections for specific requirements regarding temporary use of utilities.
- .5 On completion of Work for which permanent heating system is used, provide service maintenance to system at discretion of the Departmental Representative.
- .6 Pay costs for maintaining temporary heat, when not using permanent heating system.
- .7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .8 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.4 TEMPORARY POWER AND LIGHT

- .1 Provide and maintain temporary lighting throughout project. Existing lighting and power systems may be utilized.

1.5 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary telephone, fax, data hook up, lines and equipment necessary for own use and use of Departmental Representative.

1.6 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by Authorities Having Jurisdiction and governing codes, regulations and bylaws.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.3 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, and temporary stairs.

1.5 HOISTING

- .1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists and cranes to be operated by qualified operator.
- .3 Provide protective coverings for finish surfaces of cars and entrances.

1.6 SITE STORAGE/LOADING

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.7 CONSTRUCTION PARKING

- .1 Limited parking will be permitted on site.
- .2 Provide and maintain adequate access to project site and all existing facilities and buildings on site.

1.8 OFFICES

- .1 Provide and maintain, during the entire progress of the Work, a suitable office on the site, for own use, with suitable tables or benches for the examination of drawings, specifications, etc., and where all notices and instructions from the Consultant may be received and acknowledged. Provide suitable meeting space for site meetings. Provide adequate heating, ventilating and lighting. Location of these offices to be coordinated with the Departmental Representative.
- .2 Provide marked and fully stocked first-aid case in a readily available location.

1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.10 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 Contractor shall be responsible for cleaning and maintenance of designated facilities.

1.11 CONSTRUCTION SIGNAGE

- .1 No signs or advertisements, other than warning signs, are permitted on site.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC AND PEDESTRIANS

- .1 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .2 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .3 Protect travelling public from damage to person and property.

- .4 Do not block roads without obtaining approval to do so from the Departmental Representative.
- .5 Contractor's traffic on roads selected for hauling material shall not interfere with on-going training on site.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .8 Dust control: adequate to ensure safe operation at all times.
- .9 Provide snow removal during period of Work.

1.13 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways on an on-going basis.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

1.2 GUARD RAILS, BARRICADES, AND SIGNAGE

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Provide Construction Zone warning and access control signage.

1.3 HOARDING

- .1 Erect temporary site enclosure using 1.8 m high chainlink fence with steel posts spaced at maximum 2.4 m on centre. Maintain fence in good repair.
- .2 Provide lockable truck entrance gates and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.
- .3 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

1.4 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.5 DUST TIGHT SCREENS

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers and finished areas of Work.
- .2 Maintain and relocate protection until such work is complete.
- .3 Maintain negative pressure in area of dust generating work. Exhaust directly to the exterior.

1.6 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.7 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.8 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.10 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Be responsible for damage incurred due to lack of or improper protection.

1.11 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Protection and care of existing trees to be retained.

1.2 RELATED WORK

- .1 Site Preparation Section 02 41 13
- .2 Topsoil Stripping and Stockpiling Section 31 14 13

1.3 CARE OF EXISTING PLANT MATERIAL

- .1 Use all means necessary to protect plant materials before start up and during construction. Review working conditions on-site, prior to start of construction, with Consultant.
- .2 Do not disturb the existing grade or store heavy equipment within the drip line of existing trees. If access is required within the drip line of existing trees, then protect the access route with a moveable timber bridge to cushion/spread weight of vehicles over a greater surface area. Consultant to approve access route and timber bridge construction before work begins.
- .3 Provide drainage where, as a result of construction, water is ponding over existing root zones.
- .4 Protection of branches that are interfering with construction: Branches that pose temporary interference to the process of construction, are to be tied up or back under the supervision of the Consultant. Bindings thus provided will be removed as soon as feasible after the completion of construction (or phase of construction) to reduce possible water sprouting or structural damage.
- .5 Pruning trees that are interfering with construction: Work to be undertaken by a Certified Arborist. Remove interfering branches, without injury to trunks. The Consultant, in consultation with the Arborist, will determine all trees which require pruning, the extent of pruning allowed, and will identify the amount of compensatory pruning required for loss of roots or tops. The Contractor will adhere to limitations of on-site construction movement around identified trees.
- .6 Monitor condition of trees, in particular, possible wind damage or snow load damage to branches that are tied up.
- .7 Wash foliage should excessive construction dust build up on plant material.

1.4 TRAFFIC PROVISIONS AND STORAGE

- .1 Determine interference of trees and their root zones, before moving equipment or supplies on site, to avoid any damage to trees.
- .2 Traffic provisions:
 - .1 Use only approved access routes for vehicular and heavy pedestrian movement. Parking areas shall be pre-designated at each construction site.
 - .2 Contractor responsible to provide soil aeration of compacted tree root areas through holes bored into the soil at the direction of the Consultant.
- .3 Storage:
 - .1 Store construction materials, fuels, chemicals, etc., in approved areas only.
 - .2 Store equipment, soil, building materials and debris beyond the dripline of trees.

1.5 EXCAVATING ADJACENT TO EXISTING TREES

- .1 Locate and stake locations of electrical service, utility lines, and other underground construction.
- .2 Place all underground lines in utility "corridors" to reduce root zone disturbance on site.
- .3 Underground service/utility line installations within two (2) metres of trees are to be tunnelled at a minimum depth of 600mm. Review the location of the utility line with the Consultant, for approval before tunnelling.
- .4 Excavations within 1.5 - 2.0 metres of trees will be permitted only on one side of any tree. Prior to excavating, all tree roots along the side to be exposed must be severed with a trencher to a depth of 500mm along the line of excavation. Prune all exposed roots with a sharp pruning tool, in order to provide a clean severance of roots.
- .5 Excavations beyond two (2) metres from trees do not require trenching. Immediately after excavation, prune all exposed roots with a sharp pruning tool, in order to provide a clean severance of roots. Place a tarp over excavation wall to prevent exposed roots from drying out. Backfill around tree roots as soon as possible.

1.6 HOARDING REQUIREMENTS TO PROTECT TREES

- .1 Contractor to erect hoardings in compliance with the standards outlined below:
 - .1 Trees within 3 to 5 metres of construction: standard snow fence at farthest possible distance from trees.
 - .2 Trees within 1 to 3 metres of construction: plywood 12mm thick, 1220mm height, enclosing trees at farthest possible distance from trees.
 - .3 Trees within 1 metre of construction: 39 x 89 x 2400mm boards secured vertically at 300mm intervals around tree trunk with strapping or equivalent.
 - .2 Contractor is responsible for costs of erecting, maintaining and removing hoardings, and for regular watering and maintenance of trees while so enclosed.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber, steel members, doors and frames on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.

- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.8 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.10 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

1.12 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.

- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.14 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

1.15 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location and depth of capped service.

END OF SECTION

Part 1 General

1.1 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practice in Place of Work, acceptable to Departmental Representative.

1.2 SURVEY REFERENCE POINTS

- .1 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .2 Make no changes or relocations without prior written notice to Departmental Representative.
- .3 Report to Departmental Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .4 Require surveyor to replace control points in accordance with original survey control.

1.3 SURVEY REQUIREMENTS

- .1 Existing base horizontal and vertical control points are designated on drawings.
- .2 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .3 Establish lines and levels, locate and lay out, by instrumentation.
- .4 Stake for grading, fill and top soil placement and landscaping features.
- .5 Stake slopes and berms.
- .6 Establish pipe invert elevations.
- .7 Stake batter boards for foundations.
- .8 Establish foundation column locations and floor elevations.
- .9 Establish lines and levels for mechanical and electrical work.

1.4 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Remove abandoned service lines within 2m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.
- .3 Remove existing piezometer at Stony Rapids as indicated. Refer to geotechnical report and drawings.
 - .1 Remove water from existing piezometer if water is present.
 - .2 Slowly pour bentonite chips down pipe so as not to bridge the chips in the pipe during filling.

- .3 After each 1m of pipe backfilled with chips, add approximately 1 litre to 1.5 litres of water to the pipe to hydrate the bentonite chips.
- .4 Continue backfilling the pipe with bentonite chips and hydrating in 1 metre stages until 0.3m below ground surface.
- .5 Excavate around the pipe to 0.3m below ground surface and cut pipe off.
- .6 Place a 0.1m thick layer of bentonite chips in the excavation above the pipe and hydrate with sufficient water to activate the bentonite chips.
- .7 Backfill the remaining 0.2m excavation to surface with local surficial material.

1.5 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.6 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit name and address of Surveyor to Departmental Representative.
- .2 On request of Departmental Representative submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of elements of project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of operational elements.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Owner or separate contractor.
- .3 Include in request:
 - .1 Identification of project.
 - .2 Location and description of affected Work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed Work, and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on Work of Owner or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.2 FORMS

- .1 Special forms may be required during the course of this Work. Forms will be supplied by the Departmental Representative.

1.3 MATERIALS

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.4 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.5 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.
- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping or firestopping sealant material using UL or ULC rated assembly in accordance with manufacturer's instructions.
- .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise. Coordinate Work with mechanical and electrical divisions.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times. Do not burn waste materials on site.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Dispose of waste materials and debris off site.
- .6 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy. Remove debris and surplus materials from accessible concealed spaces.
- .3 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .4 Vacuum carpet in renovated areas and where construction traffic occurs. If heavily soiled, carpeting shall be commercially steam cleaned. This will be at the discretion of the Departmental Representative.
- .5 Clean and wax areas of resilient sheet and tile flooring in renovated areas, where required by specification section.

- .6 Dust all horizontal surfaces, clean all glass and wipe down walls in renovated areas.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 74 21.01 – Appendix: Existing Generator Shop Drawing.

1.2 WASTE MATERIAL STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal do not become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from required list of salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect salvaged materials from movement or damage.
- .6 Provide on-site facilities for collection, handling, and storage of anticipated quantities of waste materials.
- .7 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

1.3 DIVERSION OF MATERIALS

- .1 Separate materials and equipment required to be salvaged from general waste stream and stockpile in appropriate storage area, as reviewed by Departmental Representative and consistent with applicable fire regulations.
 - .1 Mark containers or stockpile areas.
 - .2 Provide instruction on disposal practices.
- .2 On-site sale of salvaged materials is not permitted.

1.4 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, and paint thinner into waterways, storm, or sanitary sewers.

1.5 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility and where required provide temporary security measures approved by Departmental Representative.
- .3 Burning of waste on site is not permitted.

1.6 SCHEDULING

- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.Execution

1.7 APPLICATION

- .1 Handle waste materials in accordance with appropriate regulations and codes.

1.8 CLEANING

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.

1.9 SCHEDULE

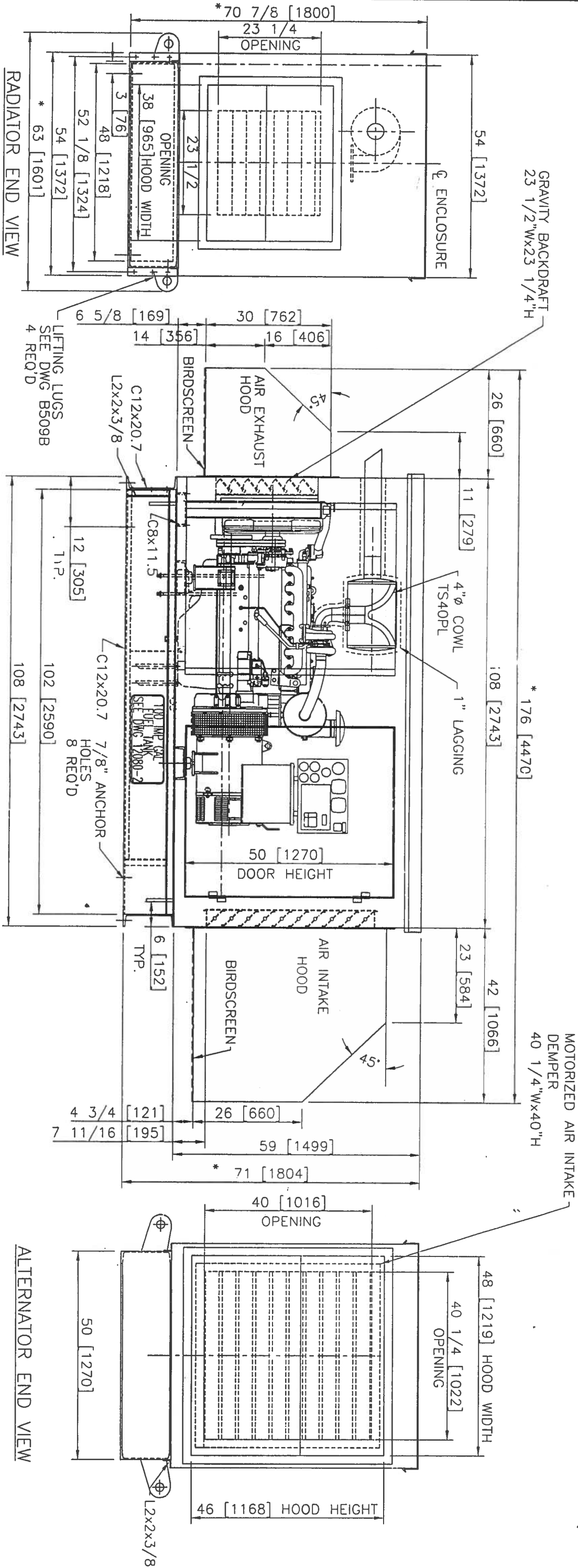
- .1 Salvage the following equipment/materials for owner and/or re-use as indicated:
 - .1 Existing generator, transfer switch and related components currently serving the existing police building in Stony Rapids. Refer to electrical. Package and place on pallet appropriately and move to temporary storage area on same site as directed by Departmental Representative. Refer to Appendix 01 74 21.01 generator shop drawing by Simpson Power Products Ltd., drawing number 12080-3.
 - .2 Existing furnaces within the Stony Rapids Police Building. Refer to mechanical and electrical.
 - .3 Existing condensers at the Stony Rapids Police Building. Refer to mechanical and electrical.

END OF SECTION

DRAWING SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE. THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF SIMPSON POWER PRODUCTS LTD. IT IS NOT TO BE USED DETRIMENTALLY TO OUR INTERESTS.

NOTES

- 1 ALL DIMENSIONS ARE IN inches
- 2 OVERALL SHIPPING DIMENSION MARKED WITH Φ (*)
- 3 NO ROOF CHANNELS OR SEAMS TO INTERFERE WITH EXHAUST FLEX PENETRATING ENCLOSURE ROOF
- 4 APPROX. UNIT WEIGHT IN lbs [kg] : 5000[2267]
- 5 MATERIAL : 14 GAUGE SHEET METAL WITH 2" INSULATION APPLIED TO INTERIOR WALLS DOOR/ROOF FOR SOUND ATTENUATION



SCALE 1:24		TITLE SHEET METAL ENCLOSURE	
DRAWN BY C.T.		DATE 01MAR99	
CHKD BY		DATE	
BY		DATE	
REVISIONS		NO.	
12080/81		2HORD	
12080-3		A	

SIMPSON POWER PRODUCTS LTD.
11545 Kingston St., Maple Ridge (Vancouver), B.C., Canada V2X 0Z5
Tel: (604) 460-3611, Fax: (604) 460-1974, Paris Direct: (604) 460-3301

Part 1 General

1.1 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Contractor and Subcontractors: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Departmental Representative Inspection.
- .2 Departmental Representative Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Certificates required by Fire Commissioner and Utility companies have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Commissioning of systems is complete and commissioning forms have been completed.
 - .7 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative, Consultants and Contractor. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.
- .5 Where re-inspection is required due to uncompleted deficiencies, the time required by the Departmental Representative and Consultants will be recorded and reimbursement of this time may be charges back to the Contractor by deducting from amounts retained.

1.2 CLEANING

- .1 In accordance with Section 01 74 11 - Cleaning.
- .2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Refer to Mechanical and Electrical Divisions for information specific to the mechanical and electrical close-out submittals.
- .3 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .4 Copy will be returned after final inspection, with Departmental Representative's comments.
- .5 Revise content of documents as required prior to final submittal.
- .6 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.
- .7 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .8 Furnish evidence, if requested, for type, source and quality of products provided.
- .9 Defective products will be rejected, regardless of previous inspections. Replace products at Contractor's own expense.
- .10 Pay costs of transportation.

1.2 FORMAT

- .1 Organize data as instructional manual.
- .2 Provide four (4) bound copies including 1 PDF copy on DVD or CD in each of the manuals.
- .3 Provide two (2) additional PDF copies on DVD or CD.
- .4 Binders: cloth, hard covered, expandable, loose leaf paper size 219 x 279 mm. Colour "black." Provide four (4) copies.
- .5 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
- .6 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents. Lettering to be "gold" colour.
- .7 Provide printed title on DVD/CD version to coincide with title on bound version.
- .8 Arrange content by systems, under Section numbers and sequence of Table of Contents.

- .9 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .10 Text: manufacturer's printed data, or typewritten data.
- .11 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.3 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Shop Drawings: illustrating details of a portion of work.
- .4 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .5 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .6 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.4 AS-BUILTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.

1.5 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of opaque drawings, provided by Departmental Representative.
- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, and field test records, required by individual specifications sections.
- .7 Refer to Mechanical and Electrical Divisions for information specific to the mechanical and electrical close-out submittals.

1.6 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control.
- .15 Additional requirements: as specified in individual specification sections.

1.7 MATERIALS AND FINISHES

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

1.8 SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.
- .6 Additional Requirements: as specified in individual specifications sections.

1.9 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.10 SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.11 STORAGE, HANDLING AND PROTECTION

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

1.12 WARRANTIES AND BONDS

- .1 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .2 Assemble approved information in binder and submit upon acceptance of work. Organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .3 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .4 Respond in a timely manner to oral or written notification of required construction warranty repair work.
- .5 Written verification will follow oral instructions. Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.13 PRE-WARRANTY CONFERENCE

- .1 Meet with Departmental Representative, to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Departmental Representative.
- .2 Departmental Representative will establish communication procedures for:
 - .1 Notification of construction warranty defects.
 - .2 Determine priorities for type of defect.
 - .3 Determine reasonable time for response.
- .3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue construction warranty work action.
- .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Refer to all project Specification Sections for detailed description of commissioning requirements.
- .3 Acronyms:
 - .1 Cx - Commissioning.
 - .2 Cx Authority – Commissioning Authority.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 O&M - Operation and Maintenance.
 - .5 PI - Product Information.
 - .6 PV - Performance Verification.
 - .7 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the O&M manual.
 - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 Commissioning (Cx) Plan. The Contractor will be responsible for developing the Commissioning (Cx) Plan.

- .2 The parties responsible for Cx activities shall be identified in the Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the installed systems are proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities include transfer of critical knowledge to facility operational personnel.
- .6 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Cx Authority.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Consultant and Cx Authority, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to Departmental Representative:
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Have Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.

- .5 Understand completely design criteria and intent and special features.
- .6 Submit complete start-up documentation to Departmental Representative.
- .7 Have Cx schedules up-to-date.
- .8 Ensure systems have been cleaned thoroughly.
- .9 Complete TAB procedures on systems; submit TAB reports to Departmental Representative for review and approval.
- .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Refer to individual equipment Specification Sections for (Cx) forms: Installation Check Lists, Product Information (PI) and Performance Verification (PV) forms for requirements.
- .2 Consultant and Cx Authority to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16 - Construction Progress Schedules.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

- .1 Approval of Cx reports.
- .2 Verification of reported results.
- .3 Repairs, retesting, re-commissioning, re-verification.
- .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Cx meetings will be held following project meetings and as specifically requested.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Cx meetings will be held on a regular basis until commissioning deliverables have been addressed.
- .4 At approximately 50% completion stage a separate Cx scope meeting will be held to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Contractor, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 50% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days notice prior to commencement.
- .2 Departmental Representative may witness start-up.
- .3 Consultant and Cx Authority will witness testing for PV.
- .4 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.

- .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .2 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .3 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation, and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Consultant and Cx Authority after distinct phases have been completed and before commencing next phase.
- .4 Documents require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
 - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

- .1 Notify Departmental Representative at least 14 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

- .1 Submit to Departmental Representative for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date, and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.

- .3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

- .1 Consultant and Cx Authority to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Departmental Representative within 10 days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

- .1 Commissioning will be undertaken on new equipment and modified equipment provided under this contract. Where these are tied into existing building systems the Cx will need to be coordinated with the building operator.

1.24 EXTRAPOLATION OF RESULTS

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.25 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify up to 100% of reported results.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Consultant and Cx Authority.

1.26 REPEAT VERIFICATIONS

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive Consultant's or Cx Authority approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 Departmental Representative deems Contractor's request for second verification was premature.

1.27 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.28 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from Departmental Representative.

1.29 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Cx Authority.

1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.31 TRAINING

- .1 Provide training in accordance with Section 01 91 41 - Commissioning (Cx) - Training and requirements of Contract Specification Sections.

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.33 OCCUPANCY

- .1 Cooperate fully with Departmental Representative during stages of acceptance; facility will remain fully occupied.

1.34 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.35 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Unless noted otherwise in this contract Specifications, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless noted otherwise in this contract Specifications actual values to be within +/- 2 % of recorded values.

1.36 OWNER'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

Part 2 Schedules

2.1 SCHEDULE OF ARCHITECTURAL SYSTEMS

- .1 All door hardware and controls: door hardware and electronic controls function.

2.2 CX SCHEDULE FOR MECHANICAL SYSTEMS

- .1 Produce schedule of Cx activities in bar chart format to a scale that will ensure legibility. Bar chart to indicate:
- .2 Sequences of testing equipment and systems, interrelationship between tests, duration of tests and training periods.

- .3 Cx resources which will be committed to this project to ensure completion by prescribed dates.
 - .1 Training Plan.
 - .2 Cx Documentation Plan.
 - .3 Water/fire mains and related site fire hydrants:
- .4 Commission as soon as installation is complete, using procedures described in NFPA reference standards to provide protection for exterior envelope of new building during construction.
- .5 Plumbing systems:
 - .1 To be filled, then proceed with flushing, cleaning and disinfection processes.
 - .2 Test plumbing and piping systems installed under this project.
- .6 HVAC systems:
 - .1 Ductwork, piping and conduit systems that will be concealed to be tested and certified to specified standards before being concealed. This work is specified in relevant technical sections of Division 23.
 - .2 HVAC systems to be initially started up, "bumped" in a stand-alone mode and pre-start-up inspections completed.
 - .3 Start after dust-producing construction procedures have been completed and areas are dust-free.
 - .4 Start HVAC to replace temporary heating systems after Consultant's written approval.
 - .5 Operate HVAC to permit TAB and ensure full compliance with contract documents when weatherstripping, caulking and sealing of exterior envelope has been completed, and interior partitions and doors are installed and ceiling return plenums are in place.
- .7 HVAC and related hydronic systems:
 - .1 Test in conjunction with controls, and fire and smoke detection systems.
- .8 Items which have a detrimental effect on operation and maintenance. To receive preliminary attention at this point. To be fully commissioned at same time as relevant equipment and systems.
- .9 Vibration isolation and seismic control measures:
 - .1 Test these measures at same time as connected system.
- .10 Equipment and systems subject to specified codes and standards or subject to approval of an authority having jurisdiction:
 - .1 Commission equipment and systems in accordance with those requirements.
 - .2 Where testing is required as part of a regulatory process, and where Cx procedures are fully developed, are appropriate to project, ensure tests as required by such codes are performed. Departmental Representative to witness tests as part of Quality Assurance role.
- .11 Controls:

- .1 Testing and Cx to be specified in relevant sections under Division 23, which defines conditions for acceptance.
- .2 Point-by-point and end-to-end testing to be carried out by installation Contractor, monitored by Departmental Representative and verified as part of system verification.
- .3 Demonstration of operation of systems under operating conditions and over full operating range to take place prior to 30-day test period and to be witnessed by Departmental Representative. Includes simulated opposite-season tests. Controls programming and operation to be verified after HVAC systems have been TAB'd.
- .12 To reduce VOC concentrations to acceptable levels:
 - .1 Flow rates of outside air into HVAC systems to be adjusted as required during Cx, after occupancy and as necessary after occupancy.
- .13 Commission mechanical systems and associated equipment as follows:
 - .1 Plumbing systems:
 - .1 Installation and Operation of all plumbing fixtures installed under this project.
 - .2 Installation and Operation of hot water generating equipment (all point of use heaters and common heaters).
 - .3 Installation and Operation of Domestic Recirc pump
 - .4 All piping installed to serve fixtures.
 - .2 HVAC and exhaust systems:
 - .1 HVAC systems (Furnaces, HRVs)
 - .2 Exhaust systems (All exhaust fan systems and controls)
 - .3 Terminal Heating Units (All unit heaters, cabinet unit heaters, duct electric heating coils and perimeter radiation with associated controls for each device)
 - .3 Fire and life safety systems:
 - .1 Fire extinguishers.
- .14 Product Information forms shall be completed and submitted with Shop Drawings. A sample of each type of form is provided with the specifications.
- .15 Performance Verification forms (samples provided as noted) shall be finalized with contractor and completed by the contractor prior to performance review with Departmental Representative for the following mechanical systems:
 - .1 Furnaces (Each housing unit, PV sample provided for Furnace) – 100% to be reviewed with Cx Agent after commissioning is complete.
 - .2 HRVs (Each housing unit and Garage, PV sample provided for HRV) – 100% to be reviewed with Cx Agent after commissioning is complete.
 - .3 Exhaust fan EF-15 (PV sample provided) – 100% to be reviewed with Cx Agent after commissioning is complete.
 - .4 All Unit Heater and Cabinet Unit Heaters: 100% to be reviewed with Cx Agent after commissioning is complete.

- .5 All Duct Heating Coils: 100% to be reviewed with Cx Agent after commissioning is complete.
- .6 Testing and Air Balancing Report: 30% to be reviewed with Cx Agent after commissioning is complete.
- .7 Domestic water Heaters: 100% to be reviewed with Cx Agent after commissioning is complete.

2.3 SCHEDULE OF ELECTRICAL SYSTEMS

- .1 The following is a listing of the building electrical systems to be commissioned:
 - .1 Low Voltage Lighting Control Devices (includes potential relocation for optimizing effectiveness of sensing zones)
 - .2 Panelboards Breaker Type (includes proper operation of emergency transfer panel, verification of panel directories)
 - .3 Motor Starters
 - .4 Grounding (includes ground resistance test results)
 - .5 Lighting Operation
 - .6 Emergency Lighting (includes aiming of lamps to optimize illumination onto egress paths).
 - .7 Fire Alarm System (includes integrated life safety testing and monitoring of alarm call outs)
 - .8 Communication Cable Inside Building (includes review of all testing printouts)
 - .9 Standby Power Meter Socket (includes all switch modes including bypass, alarm testing, trouble testing)
 - .10 Security System and Door Access (by Owner's own forces)

2.4 INTEGRATED LIFE SAFETY SYSTEMS

- .1 Upon completion of individual system tests, test for integration of life safety systems upon
 - .1 Loss of Utility power / Return of Utility power
 - .2 Occurrence of standby power online
 - .3 Fire alarm signal upon loss / return of power feed
 - .4 Failure of standby power during utility outage
- .2 Electronic Hardware and Detention Hardware Systems: Test integration with fire alarm event.
- .3 Fire Protection Systems: test integrated systems to verify that components work together as designed.
- .4 Fire alarm call out, horn strobes.
- .5 Emergency lighting, exit signage during standby power operation.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Commissioning forms to be completed for equipment, system and integrated system.
 - .2 Product Information (PI) forms are appended to this Section.
 - .3 Example Performance Verification (PV) forms are appended to this Section.

1.2 INSTALLATION/START-UP CHECK LISTS

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists may be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in O&M Manual at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the Cx Manual at completion of work.
- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Consultant and Cx Authority approvals.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

- .2 PV report forms include those developed by Contractor, and records the measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete the PV forms of related systems and obtain Consultant's and Cx Authority approval.

1.5 COMMISSIONING FORMS

- .1 Refer to sample commissioning forms appended to this Section.
- .2 Revise items on sample commissioning forms to suit project-specific requirements.

1.6 COMMISSIONING VERIFICATION PROCESS

- .1 Use Commissioning forms to verify installation and record performance of equipment and systems.
- .2 Strategy for Use:
 - .1 Consultant provides Contractor project-specific Commissioning forms with Specification data included.
 - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .3 Confirm operation as per design criteria and intent.
 - .4 Identify variances between design and operation and reasons for variances.
 - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .6 Record analytical and substantiating data.
 - .7 Reported results will be verified by the Consultant and Cx Authority.
 - .8 Form to bear signatures of recording technician and reviewed and signed off by Consultant and Cx Authority.
 - .9 Submit immediately after tests are performed.
 - .10 Reported results in true measured SI unit values.
 - .11 Originals of completed forms are to be retained on site during start-up, testing and commissioning period. Maintain in Commissioning Manual binder.
 - .12 Forms to be hard copy with type written results in Commissioning Manual Binder.

END OF SECTION

Mechanical Component Form Index		
Section 1: Existing Police Building Equipment		
Form	Equipment	Building
CFM1.1	Domestic Water Booster Pump DBP-1	Existing Police Building
Section 2: Housing Unit Equipment		
Form	Equipment	Building
CFM2.1	Dom. Water Heater WH-4	Housing Unit
CFM2.2	Fan Forced Heater FF-1	Housing Unit
CFM2.3	Furnace F-1	Housing Unit
CFM2.4	Heat Recovery Ventilator HRV-1	Housing Unit
Section 3: Garage Equipment		
Form	Equipment	Building
CFM3.1	Oil Interceptor	Garage
CFM3.2	Domestic Hot Water Heater WH-3	Garage
CFM3.3	Domestic Hot Water Expansion Tank	Garage
CFM3.4	Electric Unit Heater UH-7	Garage
CFM3.5	Electric Fan Forced Heater FF-3	Modular Police Building
CFM3.6	Electric Heating Coil HC-2	Modular Police Building
CFM3.7	Electric Heating Coil HC-3	Modular Police Building
CFM3.8	Heat Recovery Ventilator HRV-2	Modular Police Building
CFM3.9	Exhaust Fan EF-15	Modular Police Building

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM1.1	
<i>Component Verification Form</i>			<i>Section:</i>
<i>System:</i> Existing Police Building Equipment		<i>Equipment:</i> BOOSTER PUMP PACKAGE	
		<i>Tag:</i> DBP-1	
INSTALLED EQUIPMENT DATA:		LOCATION DATA:	
Manufacturer		Building	Existing Police Building
Type		Area Served	Domestic Water System
Model Number			
Serial Number		Located	Crawlspace
PERFORMANCE DATA:			
	Specified	Shop Drawings	Required Modification
Pump:	Installed		
Pump Style	Vertical Multi Stage		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Flow	4.42 L/s (70.0 US gpm)		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Fluid	Potable Water		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Head	34.60 kPa (139.00 ft.w.c.)		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Motor Size	11.19 kW (15.00 hp)		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Motor Efficiency	Premium		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Voltage / Phase	575 / 3 phase		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Construction	Stainless Steel		
Options:			
Comments			
SIGN-OFFS:			
Contractor:		Date:	
Engineer:		Date:	
CxA:		Date:	
Prepared By: HDA Engineering Ltd.		Regina, Sk, (306) 525-9815	

Prepared By: **HDA Engineering Ltd.** Regina, Sk, (306) 525-9815

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM2.2	
Component Verification Form			Section:
System: Housing Unit Equipment	Equipment: Fan Forced Heater	Tag: FF-1	
INSTALLED EQUIPMENT DATA:		LOCATION DATA:	
Manufacturer		Building	Housing Unit
Type		Area Served	Room H100
Model Number			
Serial Number		Room	Room H100
PERFORMANCE DATA:			
Supply Fan:	Specified	Shop Drawings	Required Modification
Cabinet	20 gauge steel		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Air Flow	76 L/s (160 CFM)		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Voltage / Phase	240/1 phase		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Control	Remote Thermostat		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Control Transformer	Yes		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Transf. Factory Wired and Mounted	Yes		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Energy Exchanged	4.00 kW (14 MBH)		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Comments			
SIGN-OFFS:			
Contractor:		Date:	
Engineer:		Date:	
CxA:		Date:	
Prepared By: HDA Engineering Ltd.			

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM2.3																																
Component Verification Form			Section:																															
System: Housing Unit Equipment	Equipment: Fan Forced Heater	Tag: FF-2																																
INSTALLED EQUIPMENT DATA:		LOCATION DATA:																																
Manufacturer		Building	Housing Unit																															
Type		Area Served	Room H106																															
Model Number		Room	Room H106																															
Serial Number																																		
PERFORMANCE DATA:																																		
Supply Fan:	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Specified</th> <th style="width: 30%;">Shop Drawings</th> <th style="width: 30%;">Required Modification</th> <th style="width: 10%;">Installed</th> </tr> </thead> <tbody> <tr> <td>Cabinet 20 gauge steel</td> <td></td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Air Flow 76 L/s (160 CFM)</td> <td></td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Voltage / Phase 240/1 phase</td> <td></td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Control Remote Thermostat</td> <td></td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Control Transformer Yes</td> <td></td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Transf. Factory Wired and Mounted Yes</td> <td></td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Energy Exchanged 4.00 kW (14 MBH)</td> <td></td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> </tbody> </table>	Specified	Shop Drawings	Required Modification	Installed	Cabinet 20 gauge steel			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Air Flow 76 L/s (160 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Voltage / Phase 240/1 phase			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Control Remote Thermostat			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Control Transformer Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Transf. Factory Wired and Mounted Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Energy Exchanged 4.00 kW (14 MBH)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	
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Comments																																		
SIGN-OFFS:																																		
Contractor:		Date:																																
Engineer:		Date:																																
CxA:		Date:																																

Prepared By:

HDA Engineering Ltd.

Regina, Sk, (306) 525-9815

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM2.4	
Component Verification Form			
<i>System:</i> Housing Unit Equipment		<i>Equipment:</i> Heat Recovery Ventilator	
		<i>Section:</i> HRV-1	

INSTALLED EQUIPMENT DATA: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 50%;">Manufacturer</td><td style="width: 50%;"></td></tr> <tr><td>Type</td><td></td></tr> <tr><td>Model Number</td><td></td></tr> <tr><td>Serial Number</td><td></td></tr> </table>	Manufacturer		Type		Model Number		Serial Number		LOCATION DATA: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 50%;">Building</td><td style="width: 50%;">Housing Unit</td></tr> <tr><td>Area Served</td><td>Entire Housing Unit</td></tr> <tr><td>Located</td><td>Room H106</td></tr> </table>	Building	Housing Unit	Area Served	Entire Housing Unit	Located	Room H106
Manufacturer															
Type															
Model Number															
Serial Number															
Building	Housing Unit														
Area Served	Entire Housing Unit														
Located	Room H106														

	Specified	Shop Drawings	Required Modification	Installed
Supply Fan:				
Style	Cross Flow			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Air Flow	59 L/s (125 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
S.P.	100 Pa (0.40 in.w.c.)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Return Fan:				
Style	Cross Flow			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Air Flow	59 L/s (125 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
S.P.	100 Pa (0.40 in.w.c.)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Energy Recovery				
Air Flow	59 L/s (125 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Sensible Effectiveness (at 0 Deg.C)	65.0%			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Defrost Control	Recirculating Damper			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Electrical & Controls:				
Wiring	Single Point			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Voltage	120 / 1 phase			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Watts at high Speed	110 W			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Watts at low Speed	48 W			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Amp Rating	1.25 amps			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Controls	Factory digital			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Remote Timers	2			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Accessories				
Balancing Ports	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Duct Connections	4 collars			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Balancing Dampers	On collars			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
S/A Filters	Washable			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
E/A Filters	Washable			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Cabinet	Insulated			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A	
		Component Form #: CFM2.4	

Component Verification Form		<i>Section:</i>
<i>System:</i> Housing Unit Equipment	<i>Equipment:</i> Heat Recovery Ventilator	<i>Tag:</i> HRV-1

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	Housing Unit
Area Served	Entire Housing Unit
Located	Room H106

PERFORMANCE DATA:

Specified	Shop Drawings	Required Modification	Installed
-----------	---------------	-----------------------	-----------

Comments

SIGN-OFFS:

Contractor: _____	Date: _____
Engineer: _____	Date: _____
CxA: _____	Date: _____

Prepared By: **HDA Engineering Ltd.**

Regina, Sk, (306) 525-9815

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM3.2	
Component Verification Form			<i>Section:</i>
<i>System:</i> <div style="text-align: center; font-weight: bold; padding: 5px;">Garage Equipment</div>	<i>Equipment:</i> <div style="text-align: center; font-weight: bold; padding: 5px;">Water Heater</div>		<i>Tag:</i> <div style="text-align: center; font-weight: bold; padding: 5px;">WH-3</div>

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	Garage
Area Served	Room G102
Located	Room G105

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed
Supply Fan:				
Style	Tank			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
T&P Relief Valve	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Tank Size	151.00 L (40.0 US gpm)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Voltage / Phase	208 / 1 phase			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Basis of Recovery	55.50 C (100.00 F)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Recovery Vol. (1st hr)	68.00 L (18.0 US gpm)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Diameter	508 mm (20.0 in.)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Height	1,191 mm (46.9 in.)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
# of Elements	1			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Element Size	4.50 kW (15 MBH)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>

Comments

SIGN-OFFS:

Contractor: _____	Date: _____
Engineer: _____	Date: _____
CxA: _____	Date: _____

Prepared By: HDA Engineering Ltd.

Regina, Sk, (306) 525-9815

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A																									
		Component Form #: CFM3.3																									
Component Verification Form			<i>Section:</i>																								
<i>System:</i> Garage Equipment	<i>Equipment:</i> Expansion Tank	<i>Tag:</i> ET-1																									
INSTALLED EQUIPMENT DATA:		LOCATION DATA:																									
Manufacturer		Building	Garage																								
Type		Area Served	Room G102																								
Model Number		Located	Room G104																								
Serial Number																											
PERFORMANCE DATA:																											
Supply Fan:	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Specified</th> <th style="width: 30%;">Shop Drawings</th> <th style="width: 30%;">Required Modification</th> <th style="width: 10%;">Installed</th> </tr> </thead> <tbody> <tr> <td>Fluid Type</td> <td>Domestic Hot Water</td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Diameter</td> <td>356 mm 14"</td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Height</td> <td>648 mm 25-1/2"</td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Total Volume</td> <td>30 liter 8.0 gallon</td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> <tr> <td>Acceptance Volume</td> <td>19 liter 5.0 gallon</td> <td></td> <td>Eng: <input type="checkbox"/> Con: <input type="checkbox"/></td> </tr> </tbody> </table>	Specified	Shop Drawings	Required Modification	Installed	Fluid Type	Domestic Hot Water		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Diameter	356 mm 14"		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Height	648 mm 25-1/2"		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Total Volume	30 liter 8.0 gallon		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>	Acceptance Volume	19 liter 5.0 gallon		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>		
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Comments																											
SIGN-OFFS:																											
Contractor:		Date:																									
Engineer:		Date:																									
CxA:		Date:																									
<i>Prepared By:</i> HDA Engineering Ltd.		Regina, Sk, (306) 525-9815																									

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM3.4	
Component Verification Form			Section:
System: <div style="text-align: center; font-weight: bold;">Garage Equipment</div>	Equipment: <div style="text-align: center; font-weight: bold;">Electric Unit Heater</div>	Tag: <div style="text-align: center; font-weight: bold;">UH-7</div>	
INSTALLED EQUIPMENT DATA:		LOCATION DATA:	
Manufacturer		Building	Garage
Type		Area Served	Garage G100
Model Number		Location	
Serial Number			Garage G100
PERFORMANCE DATA:			
Supply Fan:	Specified	Shop Drawings	Required Modification
	Installed		
Cabinet	18 gauge steel		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Air Flow	283 L/s (600 CFM)		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Voltage / Phase	208 / 3 phase		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Control	Remote Thermostat		
Control Transformer	Yes		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Transf. Factory Wired and Mounted	Yes		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Energy Exchanged	10.00 kW (34 MBH)		Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Comments			
SIGN-OFFS:			
Contractor:		Date:	
Engineer:		Date:	
CxA:		Date:	

Prepared By:

HDA Engineering Ltd.

Regina, Sk, (306) 525-9815

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM3.5	
Component Verification Form			Section:
System: <div style="text-align: center; font-weight: bold;">Garage Equipment</div>	Equipment: <div style="text-align: center; font-weight: bold;">Fan Forced Heater</div>	Tag: <div style="text-align: center; font-weight: bold;">FF-7</div>	
INSTALLED EQUIPMENT DATA:		LOCATION DATA:	
Manufacturer		Building	Garage
Type		Area Served	Room G102
Model Number			
Serial Number		Room	Room G102
PERFORMANCE DATA:			
Supply Fan:	Specified	Shop Drawings	Required Modification
	Installed		
Cabinet	20 gauge steel		
Air Flow	76 L/s (160 CFM)		
Voltage / Phase	208 / 1 phase		
Control	Remote Thermostat		
Control Transformer	Yes		
Transf. Factory Wired and Mounted	Yes		
Energy Exchanged	2.25 kW (8 MBH)		
Comments			
SIGN-OFFS:			
Contractor:		Date:	
Engineer:		Date:	
CxA:		Date:	
Prepared By: HDA Engineering Ltd.			

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A	
		Component Form #: CFM3.6	

<i>Component Verification Form</i>		<i>Section:</i>
<i>System:</i> Garage Equipment	<i>Equipment:</i> Electric Heating Coil	<i>Tag:</i> HC-2

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	Garage
Area Served	Room G100
Location	Room G100

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed
Supply Fan:				
Type	Duct mounted			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Air Flow	142 L/s (300 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Voltage / Phase	208 / 3 phase			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Contactor	Magnetic			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Auto-cut-out	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Manual Cut-out	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Disconnect Switch	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Controls	SCR Modulating			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Control Mounting	Factory Mounted			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Sensor	Field Installed Duct Sensor			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Discharge Air Stat	Field Installed Thermostat			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Energy Exchanged	9.00 kW (31 MBH)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Electrical:				
Min. Circuit Ampacity	25 amps			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Comments				

SIGN-OFFS:

Contractor: _____	Date: _____
Engineer: _____	Date: _____
CxA: _____	Date: _____

Prepared By: **HDA Engineering Ltd.**

Regina, Sk, (306) 525-9815

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A	
		Component Form #: CFM3.7	

Component Verification Form			<i>Section:</i>
<i>System:</i> Garage Equipment	<i>Equipment:</i> Electric Heating Coil	<i>Tag:</i> HC-3	

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	Garage
Area Served	Room G100
Location	Room G100

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed
Supply Fan:				
Type	Duct mounted			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Air Flow	354 L/s (750 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Voltage / Phase	208 / 3 phase			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Contactor	Magnetic			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Auto-cut-out	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Manual Cut-out	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Disconnect Switch	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Controls	SCR Modulating			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Control Mounting	Factory Mounted			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Sensor	Field Installed Duct Sensor			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Discharge Air Stat	Field Installed Thermostat			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Energy Exchanged	22.50 kW (77 MBH)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Electrical:				
Min. Circuit Ampacity	63 amps			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Comments				

SIGN-OFFS:

Contractor: _____	Date: _____
Engineer: _____	Date: _____
CxA: _____	Date: _____

<i>Prepared By:</i>	HDA Engineering Ltd.	Regina, Sk, (306) 525-9815
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Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM3.8	
--	--	---	--

Component Verification Form		<i>Section:</i>
<i>System:</i> <div style="text-align: center; font-weight: bold; margin-top: 10px;">Garage Equipment</div>	<i>Equipment:</i> <div style="text-align: center; font-weight: bold; margin-top: 10px;">Heat Recovery Ventilator</div>	<i>Tag:</i> <div style="text-align: center; font-weight: bold; margin-top: 10px;">HRV-2</div>

INSTALLED EQUIPMENT DATA:

Manufacturer	
Type	
Model Number	
Serial Number	

LOCATION DATA:

Building	Garage
Area Served	Rooms G102 and G104
Located	Room G100

PERFORMANCE DATA:

	Specified	Shop Drawings	Required Modification	Installed
Supply Fan:				
Style	Cross Flow			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Air Flow	250 L/s (530 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
S.P.	100 Pa (0.40 in.w.c.)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Return Fan:				
Style	Cross Flow			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Air Flow	250 L/s (530 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
S.P.	100 Pa (0.40 in.w.c.)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Energy Recovery				
Air Flow	141 L/s (300 CFM)			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Sensible Effectiveness (at 0 Deg.C)	65.0%			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Defrost Control	Recirculating Damper			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Electrical & Controls:				
Wiring	Single Point			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Voltage	120 / 1 phase			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Watts at high Speed	610 W			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Watts at low Speed	187 W			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Amp Rating	6.30 amps			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Controls	Factory digital			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Remote Timers	2			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Accessories				
Balancing Ports	Yes			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Duct Connections	4 collars			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Balancing Dampers	On collars			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
S/A Filters	Washable			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
E/A Filters	Washable			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>
Cabinet	Insulated			Eng: <input type="checkbox"/> Con: <input type="checkbox"/>

Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A	
		Component Form #: CFM3.8	

Component Verification Form		<i>Section:</i>
<i>System:</i> Garage Equipment	<i>Equipment:</i> Heat Recovery Ventilator	<i>Tag:</i> HRV-2

INSTALLED EQUIPMENT DATA: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="padding: 2px;">Manufacturer</td><td style="height: 20px;"></td></tr> <tr><td style="padding: 2px;">Type</td><td style="height: 20px;"></td></tr> <tr><td style="padding: 2px;">Model Number</td><td style="height: 20px;"></td></tr> <tr><td style="padding: 2px;">Serial Number</td><td style="height: 20px;"></td></tr> </table>	Manufacturer		Type		Model Number		Serial Number		LOCATION DATA: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td style="padding: 2px;">Building</td><td style="padding: 2px;">Garage</td></tr> <tr><td style="padding: 2px;">Area Served</td><td style="padding: 2px;">Rooms G102 and G104</td></tr> <tr><td style="padding: 2px;">Located</td><td style="padding: 2px;">Room G100</td></tr> </table>	Building	Garage	Area Served	Rooms G102 and G104	Located	Room G100
Manufacturer															
Type															
Model Number															
Serial Number															
Building	Garage														
Area Served	Rooms G102 and G104														
Located	Room G100														

PERFORMANCE DATA:			
	Specified	Shop Drawings	Required Modification
Comments			Installed

SIGN-OFFS:	
Contractor: _____	Date: _____
Engineer: _____	Date: _____
CxA: _____	Date: _____

<i>Prepared By:</i>	HDA Engineering Ltd.	Regina, Sk, (306) 525-9815
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Project Name: New Employee Housing & Garage at Black Lake and Stony Rapids		Project #: S-03-2014A Component Form #: CFM3.9																																																								
<i>Component Verification Form</i>																																																										
<i>System:</i> Garage Equipment		<i>Equipment:</i> EXHAUST FAN																																																								
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**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Section:

Item: **BREAKER PANELBOARD**

LOCATION DATA:

Floor _____ Room _____ Panel ID _____

EQUIPMENT DATA:

Manufacturer	_____	Bus Amperage/Bracing	_____
Model Number	_____	c/w TVSS Unit	___ Yes ___ No
Volt/Phase/Wire	_____		
No. of Circuits	_____	Match Installed	___ Yes ___ No

STATIC CHECKS:

DATE / CHECKED BY: _____

Enclosure Details

Mounting _____
EEMAC Enclosure Type _____
Door Type _____
Drip Hood _____
___ Yes ___ No

Door Lock _____
___ Yes ___ No

Feeder Details

Wire Size _____
Ground Wire Type & Size _____

Wire Insulation _____
Conduit Size _____

Branch Breaker

Mounting _____ Bolt In ___ Plug In ___
Branch Wires Labelled _____
___ Yes ___ No
GFCI Breakers Labelled _____
___ Yes ___ No

Branch Lugs Torqued _____
___ Yes ___ No
Neutral Wires Labelled _____
___ Yes ___ No
GFCI Breakers Tested _____
___ Yes ___ No

Auxiliary Components

Main Breaker _____ A
Main Lugs Torqued _____
___ Yes ___ No
Bus Type _____
___ Copper ___ Aluminum

Interrupting Capacity _____ KA
Isolated Ground Bar _____
___ Yes ___ No

Miscellaneous

Conduit Skirting _____
___ Yes ___ No
Spare Conduits _____
___ Yes ___ No
Exterior Clean _____
___ Yes ___ No
Interior Clean _____
___ Yes ___ No

Lamecoid Accurate _____
___ Yes ___ No
Breaker Filler Pieces Installed _____
___ Yes ___ No
Circuit Directory Installed _____
___ Yes ___ No
Top Connectors Sealed _____
___ Yes ___ No

OPERATION CHECKS:

DATE / MEASURED BY: _____

Measured Values

Amperage

Line A _____ Amps
Line B _____ Amps
Line C _____ Amps

Voltage

AB _____ Volts
BC _____ Volts
CA _____ Volts

SIGN-OFFS:

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Item: **DISCONNECT SWITCHES**

LOCATION DATA:

Floor _____ Room _____ Equipment: _____

EQUIPMENT DATA:

Manufacturer _____
Model Number _____
Volt/Phase/Amperage _____
Horsepower _____ Match Installed _____ Yes _____ No

STATIC CHECKS:

DATE / CHECKED BY: _____

Elevator Main Disconnect Switch

Fusible Switch _____ Yes _____ No
Volt/Phase _____
Pole/Wire _____
Switch Amperage - 60A _____ Yes _____ No
Fuse Amperage - 35A _____ Yes _____ No

Enclosure Details

Mounting _____ Flush _____ Surface
EEMAC Enclosure Type _____
Padlockable _____ Yes _____ No
Label _____ Yes _____ No

Elevator Cab Light Main Disconnect Switch

Breaker Switch _____ Yes _____ No
Volt/Phase _____
Pole/Wire _____
Switch Amperage - 15A _____ Yes _____ No

Enclosure Details

Mounting _____ Flush _____ Surface
EEMAC Enclosure Type _____
Padlockable _____ Yes _____ No
Label _____ Yes _____ No

SIGN-OFFS:

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Ritenburg &
Associates Ltd.
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Product Information
Section:

Item: EMERGENCY METER
SOCKET

LOCATION DATA:

Floor _____ Room _____ Equipment: _____

EQUIPMENT DATA:

Manufacturer _____
Model Number _____
Volt/Phase/Amperage _____

STATIC CHECKS:

DATE / CHECKED

BY: _____

Socket Style _____

Withstand Current Amps _____ Volts _____

Generator Input kW _____

Generator Input Volts _____

Generator Input Connection QuickConnect Cord ____ Yes ____ No

Transfer Type _____

Transfer Delay _____ Seconds

Utility Input Voltage _____

Load Protection ____ Yes ____ No

Status Indication ____ Yes ____ No

SIGN-OFFS:

Contractor: Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Item:

EXIT LIGHT

FIXTURE TYPE: _____ **Number Installed:** _____

EQUIPMENT DATA: _____ **DATE / CHECKED BY:** _____

Manufacturer _____

Catalogue Number _____

Fixture Type _____

Housing _____

Voltage _____

Lamp Wattage _____

Lamp Type _____

Lettering Type _____

Number of Faces _____

Circuit _____

Mounting _____

Nexus Compatible _____

Options _____

Match Installed _____ Yes _____ No

SIGN-OFFS:

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Section:

Item: **F/A COMPONENTS**

EQUIPMENT DATA:

Manufacturer _____ Match Installed ____ Yes ____ No
System _____

STATIC CHECKS:

DATE / CHECKED BY: _____

System Devices	Model Number	Match installed
Manual Pull Stations		____ Yes ____ No
Smoke Detectors		____ Yes ____ No
Monitor Modules		____ Yes ____ No
Control Modules		____ Yes ____ No
Relay Modules		____ Yes ____ No
Fault Isolator Modules		____ Yes ____ No
Power Supply		____ Yes ____ No
Annunciator Panel		____ Yes ____ No
Wall Speakers & Speaker Strobes		____ Yes ____ No

SIGN-OFFS:

Contractor: _____ Signature: _____ Date: _____
Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Section:
Item:

GROUNDING

STATIC CHECKS:

DATE / CHECKED BY: _____

Grounded Systems

Communications	___ Yes	___ No
Switchboard	___ Yes	___ No
Transformers	___ Yes	___ No
Lay-in Trays	___ Yes	___ No
Feeder Conduits	___ Yes	___ No
Green Insul. on Branch Conduits	___ Yes	___ No

Miscellaneous

Riser	_____
Ground Bus	_____

SIGN-OFFS:

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Ritenburg &
Associates Ltd.
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Product Information
Section:

Item: HOUSING UNIT MISC

LOCATION DATA:

Floor _____ Room _____ Equipment: _____

STATIC CHECKS:

**DATE / CHECKED
BY:** _____

Smoke Alarms Type	Battery ____ Hard wired ____	Manufacturer _____
Heat Trace Beacon Installed	____ Yes ____ No	Manufacturer _____
Heat Trace Audible Device Installed	____ Yes ____ No	Manufacturer _____
Generator Meter Socket Installed	____ Yes ____ No	Manufacturer _____
Arc Fault Protection Device Type	_____	Manufacturer _____
Emergency Lighting	_____	Manufacturer _____

SIGN-OFFS:

Contractor:	Signature: _____	Date: _____
Consultant: Ritenburg & Associates Ltd.	Signature: _____	Date: _____



**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Item:

LIGHTING

FIXTURE TYPE: _____ **Number Installed:** _____

EQUIPMENT DATA: _____ **DATE / CHECKED BY:** _____

Manufacturer _____

Catalogue Number _____

Voltage _____

Lamp Type _____

Lamp Wattage _____

Number of Lamps _____

Ballast Type _____

Size _____

Mounting _____

Diffuser _____

Options _____

Match Installed _____ Yes _____ No

SIGN-OFFS:

Contractor: _____ Signature: _____ Date: _____

Cx Rep: _____ Signature: _____ Date: _____



**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

Owner:
Project Name:
RAL File No:
Owner File No:

Item: **MOTOR STARTER**

LOCATION DATA:

Floor _____ Room _____ ID _____

EQUIPMENT DATA:

Manufacturer	_____	Thermal Protection	___ Yes ___ No
Model Number	_____	Panel/Cct Fed From	_____
Starter Volt/Phase/Wire	_____	Starter Size	_____
Starter Type	_____	Match Installed	___ Yes ___ No

STATIC CHECKS:

DATE / CHECKED BY: _____

Motor Protection Switch

Type _____ Fuse _____ Breaker _____ Pilot Lights Checked _____ Yes ___ No

Overload Elements

Overload Correctly Sized _____ Yes ___ No Amperage Range _____ Amps

Motor Data

Service Factor	_____	Full Load Current	_____ Amps
Motor Volt/Phase/Wire	_____	Motor Horsepower	_____ HP
Motor Design Type	_____	Motor Code	_____
Motor Insulation	_____	Motor Locked Rotor Current	_____ Amps
Cable Distance to Drive	_____	Motor RPM	_____ RPM

Enclosure Details

Mounting _____ Flush ___ Surface ___
EEMAC Enclosure Type _____
Door Type _____
Drip Hood _____ Yes ___ No Door Lock _____ Yes ___ No

Miscellaneous

Exterior Clean	___ Yes ___ No	Top Connectors Water Tight	___ Yes ___ No
Interior Clean	___ Yes ___ No	Conduit Connectors Sealed	___ Yes ___ No
Indicating Lights Operate	___ Yes ___ No	Ground Wire Type & Size	___ Type ___ AWG
Hand/Off/Auto Switch	___ Yes ___ No	Phase Rotation Confirmed	___ Yes ___ No
Air Filters Present	___ Yes ___ No	Operation Manual Included	___ Yes ___ No
Air Filters Changed Pre-Startup	___ Yes ___ No	Record of VFD Settings	___ Yes ___ No

OPERATION CHECKS:

DATE / MEASURED BY: _____

Starter Operation

Manual Operation Checked	___ Yes ___ No	Auto Operation Checked	___ Yes ___ No
Disconnect Function Checked	___ Yes ___ No	Fire Alarm Shutdown Checked	___ Yes ___ No
VFD Display Calibrated	___ Yes ___ No	Auto Restart Checked	___ Yes ___ No
Motor RPM Verified	___ Yes ___ No	Owner Training Completed	___ Yes ___ No

Measured Values

Amperage

Line A _____ Amps
Line B _____ Amps
Line C _____ Amps

Voltage

AB _____ Volts
BC _____ Volts
CA _____ Volts

Voltage

AN _____ Volts
BN _____ Volts
CN _____ Volts

Motor Terminal Waveforms Taken _____ Yes ___ No

Acceleration Time _____

Deceleration Time _____

Output Pulse Risetime _____

Speed Control ☐ -10VDC ☐ 4-20mA ☐ +/-10VDC

Skip Frequencies _____

Carries Frequency _____

Maximum Speed _____

Minimum Speed _____

Speed Display ☐ % ☐ Hz

SIGN-OFFS:

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

Owner:
Project Name:
Location:
Owner File No:

Item: **Wiring Devices**

STATIC CHECKS:

DATE / CHECKED BY: _____

Receptacles location and operation confirmation

Duplex Receptacles (5-15R)	_____ Yes	_____ No
Single Receptacles (5-15R)	_____ Yes	_____ No
T-Slot Receptacles (5-20R)	_____ Yes	_____ No
Tamper resistant safety Receptacles (5-15R)	_____ Yes	_____ No
GFCI (Safe-Lock - 5mA Ground Fault)	_____ Yes	_____ No

Switches location and operation confirmation

120V Switches (SPST, 15A)	_____ Yes	_____ No
120V Pilot Light Switches (SPST - 15A)	_____ Yes	_____ No
Fractional HP/KW Manual Starters	_____ Yes	_____ No
120V Illuminated Switches	_____ Yes	_____ No
120V Fluorescent Dimmer Switches	_____ Yes	_____ No

Comments:

SIGN-OFFS:

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Verify the products used meet the requirements of the electrical specifications and complies with the shop drawings.
- ☐ Perform the installation and performance tests according to the Canadian Electrical Code, manufacturer's recommendations and Specifications.
- ☐ Confirm that the disconnect switches has been securely fastened.
- ☐ Confirm that all feeder and branch circuit conductors are properly sized, terminated with the proper torque, identified as required by the Specifications.
- ☐ Mark all lugs and terminals that have been torqued with red lacquer or marker.
- ☐ Ensure that the branch circuits and their fuses are correctly matched.
- ☐ Ensure that the disconnect switches lamecoid tags conforms to the drawings & Specification.
- ☐ Ensure that all sections of the Contractor Start-up and Testing Sheet(s) are signed or initialed and dated.
- ☐ Complete record drawings.
- ☐ Conduct Owner training on the operation and maintenance of the panelboards.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.

Notes: _____

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Ensure that all sections of the Contractor Start-up and Testing Sheet(s) are signed or initialed and dated.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.
- ☐ Generator meter socket power transfer operation occurs using alternate power source.

Notes: _____

Contractor:	Signature: _____	Date: _____
Consultant: Ritenburg & Associates Ltd.	Signature: _____	Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Verify the products used meet the requirements of the electrical specifications and complies with the shop drawings (if provided).
- ☐ The installation is completed in accordance with the Canadian Electrical Code, specifications and manufacturer's recommendations.
- ☐ Confirm that all conductors for supply and control are properly sized, terminated with proper torque.
- ☐ Confirm exit lighting clearly indicate the means of egress and are visible in all public areas.
- ☐ Confirm exit light fixtures are connected to a dedicated emergency circuit as indicated on the floor plans.
- ☐ Ensure that exit light circuit breaker is locked in on position.
- ☐ Confirm complete illumination of the EXIT signs.
- ☐ Perform functional & other tests (as applicable) required by the Specifications, the Manufacturer or the Design Consultant.
- ☐ Conduct Owner training in regards to the operation and maintenance of the emergency exit lighting.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.

Notes: _____

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Verify the products used meet the requirements of the electrical specifications and complies with the shop drawings.
- ☐ Complete installation and wiring of all components of the fire alarm system in accordance with the manufacturer's recommendations, specifications, and in accordance with the National Standard of Canada/Underwriters' Laboratory of Canada Standards CAN/ULC-S524-M06 "Standard for the Installation of Fire Alarm Systems".
- ☐ Complete the inspection and testing of the fire alarm system in accordance with the National Standard of Canada/Underwriters' Laboratory of Canada Standards CAN/ULC-S536-04 "Standard for the Inspection and Testing of Fire Alarm Systems".
- ☐ Complete the verification of the fire alarm system in accordance with the National Standard of Canada/Underwriters' Laboratory of Canada Standards CAN/ULC-S537-04 "Standard for the Verification of Fire Alarm System Installations".
- ☐ Confirm fire alarm system connected to a dedicated circuit with breaker lock-on device on branch breaker.
- ☐ Fire alarm control panel is fed with mineral insulated cable, or is provided with 1-hour rating on feeder to the fire alarm panel.
- ☐ Initiate alarm from each breakglass station.
- ☐ Initiate an alarm from each smoke detector and heat detector by initiating an alarm using a magnet, artificial smoke, or by jumping out device in case of fixed temperature heat detectors. The method to activate a detector shall be confirmed by the manufacturer's verification agent.
- ☐ Initiate an alarm from the sprinkler system by testing flow within a floor control zone valve.
- ☐ Conduct an open circuit tests at various points on the Class B tolerant loops. Initiate an alarm from various points on the open circuit.
- ☐ Initiate an alarm to check supervisory and control functions at the fire alarm control and annunciator panel.
- ☐ Check correctness of identification of annunciator zones and device mapping at the annunciator.
- ☐ Initiate one test alarm to central supervisory station after notice of test is given.
- ☐ Check operation of all auxiliary contacts and devices, and verify that auxiliary control door holders, fan shut-down, elevator homing, etc, is fully operational.
- ☐ Perform functional and other tests (as applicable) as required by the Specifications, the Manufacturer or the Consultant.
- ☐ Check operation of fire alarm audible and visual signal appliances in public areas.
- ☐ Record sound levels for fire alarm signal devices within public areas.
- ☐ Confirm signal to the municipal fire department in accordance with the requirements of the 2010 National Building Code.
- ☐ Submit manufacturer's fire alarm certificate of verification and fire alarm test report.
- ☐ Confirm spared devices are provided to the owner as required by the Specifications.
- ☐ Complete record drawings.

FIRE ALARM

- ☐ Conduct Owner training on the operation and maintenance of the fire alarm system.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into notes areas of any unfinished areas or problems encountered during installation or commissioning.

Notes: _____

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Verify the products used meet the requirements of the electrical specifications and complies with the shop drawings (if provided).
- ☐ Perform tests that are required by the Canadian Electrical Code, ANSI/NETA standard's, manufacturer's recommendations and Specifications.
- ☐ All electrical equipment and wiring grounded in accordance with the Canadian Electrical Code, and local inspection authority's rules and regulations.
- ☐ The ground bus in each switchboard, transformer, motor control centre, etc., connected to the grounding network by two AWG #3/0 bare copper conductors.
- ☐ All motors with flexible connections have separate insulated ground wire run bridging the flexible connections with the ground wire run back to the nearest junction box or motor control centre.
- ☐ Exposed copper cleaned to a bright surface, and finished with two coats of clean, insulating varnish.
- ☐ Where bonds are covered with soil, the conductors are to be coated with anti-corrosion compound "Kopr-Shield" (Thomas & Betts Co.) before compression connector is applied. All bonding done with 'C' tap and lug compression connectors.
- ☐ All grounding connectors, conductor and terminations checked and approved by the Consultant prior to concealment by fill or architectural finishes.
- ☐ The main grounding electrode or system shall have a fall-of-potential test. Refer to IEEE Standard 81. Five ohms is the maximum allowable resistance between the main grounding electrode and ground.
- ☐ Determine resistance between main grounding system and all major electrical equipment frames, system neutral and any floating neutrals. Any resistance values greater than 0.5 ohm shall be examined.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.

Notes: _____

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner: RCMP
Project Name:
RAL File No: 50573
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Ensure that all sections of the Contractor Start-up and Testing Sheet(s) are signed or initialed and dated.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.
- ☐ Smoke alarms operate in test mode on DC and AC power.
- ☐ Heat trace beacon operates in simulated heat trace power failure.
- ☐ Heat trace audible device operates in simulated heat trace power failure.
- ☐ Arc Fault protection completed with manufacturer's testing method.
- ☐ Emergency lighting operates during simulated power failure.

Notes: _____

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Verify the products used meet the requirements of the electrical specifications and complies with the shop drawings.
- ☐ Perform the installation and performance tests according to the Canadian Electrical Code, specifications, and manufacturer's recommendations.
- ☐ Confirm that all circuit conductors for supply and control are properly sized, terminated with proper torque, identified as required by the Specifications.
- ☐ Confirm proper ballast and voltage ratings are installed within the fixtures.
- ☐ Confirm correct lamps are provided for the fixture in accordance with the specifications and manufacturer's requirements. Ensure lamp colour temperatures and colour rendering index (CRI) are in accordance with the requirements of the specifications.
- ☐ Confirm fixtures are clean, proper fit of lenses and fixture trims.
- ☐ Confirm installation of switches, occupancy sensors and photocells.
- ☐ Adjust coverage and time delay-off to all wall and ceiling occupancy sensors.
- ☐ Complete record drawings for layout of lighting, circuit identification and control.
- ☐ Conduct Owner training in regards to the operating and maintenance of lighting fixtures, including the type of lamps installed, lamp and ballast replacement, ballast warranties, and general maintenance of the fixtures.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.

Notes: _____

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Verify the products used meet the requirements of the electrical Specification and complies with the shop drawings.
- ☐ Perform the installation and performance tests according to the Canadian Electrical Code, ANSI/NETA standards, manufacturer's recommendations and Specification.
- ☐ Confirm that all line voltage and class II wiring for supply and control are properly sized, terminated, identified as required by the specifications.
- ☐ Day-light sensors installed for interior perimeter lighting.
- ☐ Exterior photo-sensors installed for exterior lighting.
- ☐ Low voltage power packs are installed and locations marked on as-built drawings.
- ☐ Verify and adjust photo control sensitivity for interior and exterior lighting.
- ☐ Occupancy sensors interconnected to switches as shown on drawings.
- ☐ Provide record of occupancy sensor and photocell programming.
- ☐ Aim and adjust photo controls to optimize function.
- ☐ Conduct Owner training in regards to the operation, programming and maintenance of the lighting control system.
- ☐ Complete record drawings.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.

Notes: _____

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Verify the products used meet the requirements of the electrical specifications and complies with the shop drawings.
- ☐ Perform the installation and performance tests according to the Canadian Electrical Code, manufacturer's recommendations and Specifications.
- ☐ Confirm that the panelboard has been securely fastened and mounted on unistrut and / or plywood backboards (where required by the specifications).
- ☐ Ensure panel interior is at the correct depth from the tub or wall face. Confirm that the nuts securing the interior to the tub bolts / tub are properly tightened.
- ☐ Confirm that all feeder and branch circuit conductors are properly sized, terminated with the proper torque, identified as required by the Specifications. Ensure that the panelboard, panelboard feeders & branch wiring have been Megger tested. Panel phase and branch wiring colour & circuit number must correspond.
- ☐ Mark all lugs and terminals that have been torqued with red lacquer or marker.
- ☐ Ensure that the branch circuits and their breakers are correctly matched.
- ☐ Ensure that the panelboards lamecoid tag conforms to the drawings & Specification.
- ☐ Insert final typewritten panel directory and provide breaker lock-on devices as per Specification.
- ☐ Operate the PTT test feature if GFCI breakers are in the panelboard.
- ☐ Ensure that all sections of the Contractor Start-up and Testing Sheet(s) are signed or initialed and dated.
- ☐ Complete record drawings.
- ☐ Conduct Owner training on the operation and maintenance of the panelboards.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.

Notes: _____

Contractor: _____ Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd. Signature: _____ Date: _____



Owner:
Project Name:
RAL File No:
Owner File No:

Activities, Checks and Tests by the Electrical Contractor

- ☐ Verify the products used meet the requirements of the electrical specifications and complies with the shop drawings.
- ☐ Perform the installation and performance tests according to the Canadian Electrical Code, manufacturer's recommendations and Specifications.
- ☐ Test receptacles for polarity.
- ☐ Test GFCI Receptacles with an appropriate ground fault tester.
- ☐ Verify panel directories and circuit identification indicated on the record drawings are consistent and correct.
- ☐ Record drawings are completed, indicating actual location of devices and circuit identification.
- ☐ Ensure that all parts of this commissioning form and performance checks have been completed. Enter into the notes areas of any unfinished work or problems encountered during installation or commissioning.

Notes:

Contractor:

Signature: _____ Date: _____

Consultant: Ritenburg & Associates Ltd.

Signature: _____ Date: _____

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 This Section specifies roles and responsibilities of Training.

1.2 TRAINEES

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training for purposes of familiarization with systems.

1.3 INSTRUCTORS

.1 Consultant will provide:

- .1 Descriptions of systems.
- .2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:

- .1 Start-Up, operation, shut-down of equipment, components and systems.
- .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
- .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

- .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:

- .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
- .2 Effective on-going inspection, measurements of system performance.
- .3 Proper preventive maintenance, diagnosis and trouble-shooting.
- .4 Ability to update documentation.
- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.

- .2 Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating & Maintenance Manual.
 - .3 TAB and PV Reports.
- .3 Departmental Representative will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
 - .1 Transparencies for overhead projectors.
 - .2 Multimedia presentations.
 - .3 Manufacturer's training videos.
 - .4 Equipment models.

1.6 SCHEDULING

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be for duration specified in relevant Specification Sections.
- .3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

- .1 Be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,
 - .3 Quality of training, training materials,
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, with complete list of attendees, and witnessed by Consultant and Cx Authority.
- .4 Coordination with Departmental Representative.

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components and controls.

- .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
 - .7 Maintenance and servicing.
 - .8 Trouble-shooting diagnosis.
 - .9 Interaction among systems during integrated operation.
 - .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Sections of the Specifications.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Removal of existing sitework in preparation for new construction.

1.2 RELATED WORK

- | | | |
|----|-----------------------------------|------------------|
| .1 | Tree Protection | Section 01 56 39 |
| .2 | Topsoil Stripping and Stockpiling | Section 31 14 13 |
| .3 | Grading | Section 31 22 00 |

1.3 MATERIAL OWNERSHIP

- .1 All useable lumber, bricks, and miscellaneous materials shall become the property of the Owner.

1.4 SAFETY

- .1 Take all precautions for the safety and the protection of the employees, public vehicle and pedestrian traffic by adequate fencing, hoarding, flagmen and barricades as may be required in the interest of safety and in accordance with provincial and municipal requirements.

1.5 DAMAGE TO MUNICIPAL STRUCTURES

- .1 Care shall be taken to avoid damage to sidewalks, pavement and any and all municipal works. Be responsible for repair or replacement of any damaged public property or utility to the satisfaction of the property owner.

1.6 DAMAGE TO ADJACENT PROPERTIES

- .1 Take all precautions necessary for the protection of fences, trees, structures, pavement and excavations on adjoining properties. Be responsible for any damages resulting from whatever causes; make good any such damages to the satisfaction of adjacent property owners, and settle any claims which may arise.

1.7 DISCONNECTION OF SERVICES

- .1 Arrange, and pay the cost of, disconnection of any services by the appropriate utility company. No claims shall be made for delays which may result in such disconnections. Should municipal authority elect to shut off the water supply by closing the service valve only, mark and protect the valve during the course of construction. If a water leak develops, immediately bring the matter to the municipal authority's attention and pay for the cost of repair if due to Contractor negligence.

1.8 TREES

- .1 Trees, designated to be retained, shall be protected in accordance with Section 01 56 39 - Tree Protection.

- .2 **Do not remove trees in contravention of current *Migratory Birds Convention Act*.**
Trees designated for removal shall be cleared, without damage to adjacent trees or structures. Thoroughly grub out roots and stumps to minimum 500 mm below grade. Take particular care to avoid damage to root systems of trees to be retained. **Remove elm trees in accordance with provincial and municipal regulations.**
- .3 Dispose of cleared vegetation, stumps and roots off-site at approved municipal location.

1.9 BACKFILL

- .1 Where necessary to provide backfill, provide in accordance with Section 31 22 00 - Site Grading.

1.10 DEMOLITION

- .1 Be responsible for the demolition of existing structures, as shown on drawings. Pay costs required by Stony Rapids, SaskPower, SaskTel, SaskEnergy, and any other party or agency involved. Remove all abandoned and terminated water, gas, sewer, telephone and electrical lines. Co-ordinate the termination and removal of all services involved. Be responsible for the removal or relocation of any services adjacent to the property necessary for the completion of the work.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Methods and procedures for demolition of structures.

1.2 RELATED SECTIONS

- .1 Section 01 56 00 - Temporary Barriers and Enclosures.
- .2 Section 01 35 26 - Environmental Protection.
- .3 Section 01 35 29.06 - Health and Safety Requirements.
- .4 Section 01 74 21 – Waste Management and Disposal.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA S350-M1980(R1998), Code of Practice for Safety in Demolition of Structures.
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Assessment Act (CEAA), 1992, c. 37.
 - .2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.4 SUBMITTALS

- .1 Where required by authorities having jurisdiction, submit for approval drawings, diagrams or details showing sequence of demolition work .

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Ensure Work is performed in compliance with applicable Provincial and Municipal regulations.
- .2 Meetings:
 - .1 Prior to start of Work arrange for site visit and start-up meeting with Consultant and Departmental Representative to examine existing site conditions related to demolition work.
 - .2 Ensure key personnel attend.

1.6 ENVIRONMENTAL PROTECTION

- .1 Ensure Work is done in accordance with Section 01 35 26 - Environmental Protection.
- .2 Ensure that demolition work does not adversely affect adjacent groundwater, or contribute to excess air and noise pollution.
- .3 Fires and burning of waste or materials is not permitted on site.

- .4 Do not bury rubbish waste materials.
- .5 Do not dispose of waste or volatile materials including but not limited to: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
 - .1 Ensure proper disposal procedures are maintained throughout project.
- .6 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
- .7 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction.
- .8 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.
- .9 Protect trees, plants and foliage on site and adjacent properties where indicated.

1.7 EXISTING CONDITIONS

- .1 Some of the paint in the buildings may have a lead content.
- .2 Some of the fluorescent light ballasts may contain PCBs. The ballasts should be inspected for containment of PCBs and disposed of appropriately.
- .3 Some of the floor and ceiling finishes may contain asbestos. The ceiling tiles and resilient floor finishes should be inspected for containment of asbestos and disposed of appropriately.
- .4 Should material resembling spray or trowel applied asbestos or other designated substance listed as hazardous be encountered in course of demolition, stop work, take preventative measures, and notify Consultant immediately. Do not proceed until written instructions have been received.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 PROTECTION

- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, and landscaping.
- .2 Repair damage caused by demolition as directed by Departmental Representative at no additional cost.

- .3 Protect existing pavement not designated for removal from damage. In the event of damage, immediately replace or make repairs to approval of consultant at no additional cost.
- .4 If safety of adjacent structures or services appears to be endangered, take preventative measures, stop Work and immediately notify Departmental Representative.
- .5 Prevent debris from blocking surface drainage system.

3.2 PREPARATION

- .1 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements.
 - .1 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.
- .2 Protect equipment owned by utility companies during demolition.
- .3 Disconnect and cap designated mechanical services.
 - .1 Natural gas supply lines: remove in accordance with gas company requirements.
 - .2 Sewer and water lines: disconnected and capped in accordance with authority having jurisdiction.
- .4 Do not disrupt active or energized utilities .
- .5 Disconnect electrical and telephone service lines entering buildings to be demolished.
- .6 Remove rodent and vermin in accordance with authority having jurisdiction.
- .7 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.
- .8 Protection of in-place conditions:
 - .4 Work in accordance with Section 01 35 26 - Environmental Protection.
 - .5 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades, properties..
 - .1 Provide bracing, shoring and underpinning as required.
 - .2 Repair damage caused by demolition as directed by Departmental Representative.
 - .6 Support affected structures and, if safety of structure being demolished, adjacent structures, or services appears to be endangered, take preventative measures, stop Work and immediately notify Departmental Representative.
 - .7 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.

- .9 Underground storage tanks and piping: remove and dispose in accordance as directed.

3.3 SAFETY CODE

- .1 Do demolition work in accordance with Section 01 56 00 - Temporary Barriers and Enclosures .
- .2 Blasting operations not permitted during structure demolition.

3.4 DEMOLITION

- .1 Demolish structures and surrounding parking areas as identified on drawings.
- .2 Remove existing piezometer as indicated. Refer to drawings, geotechnical report and Section 01 71 00 Examination and Preparation.
- .3 Remove contaminated or dangerous materials as defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.
- .4 Demolish and remove basement walls and footings, piles and concrete floors below or on grade.
- .5 Backfill open excavations with clean fill. See Section 03 30 00 Cast in Place Concrete and 31 22 00 Site Grading. Remove from open excavations all pieces of concrete and masonry from demolition work.
 - .1 Do not backfill basement areas until inspected by Departmental Representative.
- .6 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.
- .7 Demolish to minimize dusting.
- .8 Demolish masonry and concrete walls.
- .9 Remove structural framing.
- .10 Contain fibrous materials to minimize release of airborne fibres while being transported within facility.
- .11 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.
- .12 Remove following materials and equipment and store in location designated by Departmental Representative:
 - .1 Existing emergency generator and transfer switch (Stony Rapids). Refer to Section 01 74 21 Waste Management and Disposal.
 - .2 Existing furnaces in Police Building (Stony Rapids). Refer to Section 01 74 21 Waste Management and Disposal.
 - .3 Existing condensers in Police Building (Stony Rapids). Refer to Section 01 74 21 Waste Management and Disposal.

- .13 At end of each day's work, leave Work in safe and stable condition.

3.5 REMOVAL FROM SITE

- .1 Dispose of materials in accordance with applicable regulations.

3.6 SWEEPING/CLEANING

- .1 Clean debris resulting from demolition and removal operations from surrounding sidewalks, lanes and property.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

1.2 WORK INCLUDED

- .1 Form for all cast-in-place concrete indicated on drawings and subsequently remove all such forms.

1.3 DESIGN AND CODE REQUIREMENTS

- .1 Formwork and supporting falsework shall be designed and constructed in accordance with the requirements of CAN/CSA S269.3-M92 (R2008) and CAN/CSA -A23.1-09 as applicable to the work.
- .2 Assume full responsibility for the design and for the adequacy and safety of all formwork and falsework.
- .3 Retain a professional engineer to design falsework which consists of shoring more than one tier in height or which is a framed structure.
- .4 The design and erection of formwork and related supporting works shall comply with construction safety legislation and regulations.

1.4 HANDLING AND STORAGE

- .1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.
- .2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

Part 2 Products

2.1 QUALITY AND STRENGTH

- .1 The quality and strength of formwork material shall comply with the requirements set forth in this Specification and CAN/CSA A23.1-09.

2.2 FINISHES

- .1 Form materials for concrete surfaces which will be exposed to view, or which require smooth and uniform surfaces for applied finishes or other purposes, shall consist of square

edges, smooth panels of plywood, metal or plastic to approval of the Departmental Representative. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.

- .2 Square edged, tongue and groove or shiplap lumber may be used to form concrete which will not be exposed to view or which does not require smooth uniform surface for other purposes.

2.3 MATERIALS

- .1 Form plywood: exterior grade, Douglas Fir conforming to CSA Standard O121-08. Plywood shall be resin coated one side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make up or patching strips between panels shall be kept to a minimum.
- .2 Lumber for forms, falsework, shoring and bracing: conform to CAN/CSA O141-05 (R2009) for Softwood Lumber, and the applicable authorized grading authority. All lumber shall be a grade to which allowable unit stresses may be assigned in accordance with the National Building Code. All lumber shall be grade marked by the authorized grading authority.
- .3 Form Ties: Fabricated units having a minimum working strength when assembled of 21 MPa and shall be adjustable in lengths to permit tightening and alignment of forms. Ties shall be made with breakback ends or other means of removing the tie end to a depth of at least 25 mm from the concrete surface, after the forms are removed. Flat tie for Architectural exposed concrete to include plastic cones leaving no metal within 20 mm of surface.
- .4 Form release agent: Proprietary material which will not stain the concrete or impair the natural bonding or colour characteristics of coating intended for use on the concrete.
- .5 Waterstops: Purpose made polyvinyl chloride; 12 MPa minimum tensile strength, -46⁰ C. to +70⁰ C working temperature range, conforming to CGSB 41 GP 35M, Type 2.
- .6 Tubular column forms: round spirally wound laminated fibre forms, internally treated with release material.
- .7 Dovetail anchor slots: minimum 0.6 mm galvanized steel with insulation filled slots.
- .8 Pre-moulded joint fillers:
 - .1 Bituminous impregnated fibreboard: ASTM D1751-73.
 - .2 Vinyl Foam: to ASTM D1752-67 (1973) Type I, flexible grade.
 - .3 Standard Cork: to ASTM D1752-67 (1973) Type II.

Part 3 Execution

3.1 CONDITION OF SURFACES

- .1 Examine the excavations and foundations for adequate working room and support for the work of this section.
- .2 Verify lines, levels and centre lines before proceeding with the work and ensure that dimensions agree with drawings.
- .3 Report to the Departmental Representative discrepancies in other work which affect the work of this section.

3.2 PREPARATION

- .1 Coat the inside surfaces of forms with a form release agent, used in accordance with the manufacturer's instructions.
- .2 Apply the agent prior to placing reinforcing steel, anchoring devices and embedded parts.

3.3 ASSEMBLY AND ERECTION

- .1 Construct the formwork and shoring and bracing to meet the design and code requirements, accurately so that the resultant finished concrete shall conform to the shapes, lines and dimensions shown on the drawings, within the specified tolerances.
- .2 Formwork shall be so arranged and assembled as to permit easy dismantling and stripping so that the concrete will not be damaged during its removal.
- .3 Review locations of ties and form panels for exposed concrete work with the Departmental Representative.
- .4 Check and correct formwork as required, both horizontally and vertically, during the placing of the concrete.
- .5 Construct formwork to maintain the following maximum tolerances:
 - .1 Deviation from horizontal and vertical lines:
 6 mm in 3000 mm
 20 mm in 12000 mm.
 - .2 Deviation of building dimensions indicated on Drawings and position of columns, walls and partitions:
 6 mm.
 - .3 Deviation in cross sectional dimensions of columns or beams or in thickness of slabs and walls:
 ± 6 mm.
 - .4 Camber slabs and beams:
 10 mm per 3000 mm of span unless indicated on drawings.

- .6 Obtain Departmental Representative's approval for use of earth forms.

3.4 JOINTS IN FORMS

- .1 Make form joints tight in order to prevent leakage of mortar.
- .2 Clean all edges and contact surfaces before erection.
- .3 Where required, install pvc waterstop to manufacturer's instructions and without displacing reinforcement. Do not distort or pierce waterstop.

3.5 SHORING AND BRACING

- .1 Provide bracing to ensure the stability of the formwork as a whole.
- .2 Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.
- .3 Arrange forms to allow stripping without removal of the principal shores, where these are required to remain in place.

3.6 EMBEDDED PARTS AND OPENINGS

- .1 Provide formed openings where required for pipes, conduit, sleeves and other work to be embedded in and passing through concrete members. Accurately locate and set in place items which are to be cast directly into the concrete. Co-ordinate the work of other sections and co-operate with the trade involved in the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. No such forming or setting of openings, slots, recesses, chases, sleeves, or parts shall be done unless specifically shown on the drawings or approved prior to installation.
- .2 Obtain Departmental Representative's approval before framing openings in concrete beams or columns not specifically detailed on structural drawings.
- .3 Provide temporary ports or openings where required to facilitate cleaning and inspection. Openings at the bottom of forms shall be located so that flushing water will drain from the forms.
- .4 Close the temporary ports or openings with tight fitting panels, flush with the inside face of the forms, neatly fitted so that the joints will not be apparent in exposed concrete surfaces.
- .5 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval in writing or all modifications from the Departmental Representative before placing concrete.
- .6 Install continuous vertical anchor slots where concrete walls or columns are masonry faced. Co-ordinate extent and locations of anchor slots with spacing of masonry ties as specified in Division 4.

3.7 FIELD QUALITY CONTROL

- .1 Inspect and check the completed formwork, shoring and bracing to ensure that the work is in accordance with the formwork design, and that the supports, fastenings, wedges, ties and parts are secure. The Departmental Representative responsible for the design of the formwork shall assist in this inspection.
- .2 Inform the Departmental Representative when the formwork is complete and has been cleaned. Obtain the approval of the Departmental Representative responsible for the design of the formwork and the general approval of the Departmental Representative before placing concrete.

3.8 CLEANING

- .1 Clean the forms as erection proceeds to remove foreign matter.
- .2 Remove cuttings, shavings and debris from within the forms.
- .3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the clean-out ports.

3.9 WINTER CONSTRUCTION

- .1 Remove ice and snow from within the forms.
- .2 The use of de-icing salts will not be permitted.
- .3 Unless formwork and concrete construction proceed within a heated enclosure, do not use water to clean out completed forms. Use compressed air or other means to remove foreign matter.

3.10 REMOVAL OF FORMWORK

- .1 Notify the Departmental Representative before removing formwork.
- .2 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.
- .3 Do not remove forms and shoring before concrete has attained sufficient strength to ensure safety of structure. If evidence to verify concrete strength is not available, the forms and shores shall not be removed before the following minimum intervals after concrete is placed.
 - .1 Footings, walls and grade beams - 4 days.
 - .2 Columns - 7 days.
 - .3 Beams, soffits and slabs - 21 days.
- .4 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.

- .5 Leave forms loosely in place, against vertical surfaces, for protection until complete removal is approved by Departmental Representative.
- .6 Store removed forms, for exposed architectural concrete, in a manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
- .7 Re-shore structural members where required due to design requirements or construction conditions and as required to permit progressive construction.
- .8 Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.
- .9 Re-use of formwork and falsework is subject to the requirements of CAN/CSA A23.1-09.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made a part of this section.

1.2 WORK INCLUDED

- .1 Furnish and install all bonded reinforcement and associated items required and/or indicated on the Drawings for all cast-in-place concrete and reinforced masonry work.

1.3 INSPECTION AND TESTING

- .1 Upon request, provide certified copy of mill test report of steel supplied, showing physical and chemical analysis.

1.4 REFERENCE STANDARDS

- .1 Do reinforcing work in accordance with CAN/CSA A23.1-09 and welding of reinforcement with CSA W186-M1990 (R2007).

1.5 SUBMITTALS

- .1 Prepare, check and submit reinforcing steel and mesh placing drawings and bar bending and cutting schedules for all steel reinforcement shown or specified in accordance with General Conditions.
- .2 All drawings and schedules shall be prepared and checked under the direct supervision of a qualified professional engineer who is experienced in this work.
- .3 Clearly indicate bar sizes, spacing, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to ACI - 315 Manual of Standard Practice and Metric Supplement 1977 by Reinforcing Steel Institute of Ontario.
- .4 Design and detail lap lengths and bar development lengths to CAN3 A23.3-04, unless specified on drawings.
- .5 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

1.6 DELIVERY AND STORAGE

- .1 Reinforcing steel, welded wire fabric and accessories shall be delivered, handled and stored in a manner which prevents contamination from bond reducing or foreign matter and damage to its fabricated form.

Part 2 Products

2.1 MATERIALS

- .1 *All reinforcing steel:* unless noted otherwise on the drawings or herein shall be deformed bars of new billet steel conforming to the current CAN/CSA G.30.18-09 Grade 400, plain finish for all bars. Minimum splice for 10 M bars to be 450 mm. Minimum lap splice for all other bars to be 36 bar diameters or 675 mm, whichever is greater.
- .2 *Weldable reinforcing bars:* high strength ductile, deformed bars to CSA G30.18-09, Grade 400.
- .3 *Column ties and beam stirrups:* shall conform to the current CAN/CSA G30.18-09, Grade 300.
- .4 *Welded wire fabric:* to CSA G30.5-M1983. Provide in the flat sheets only.
- .5 *Tie wires:* shall be 1.29 mm or heavier annealed wire or a patented system approved by the Departmental Representative.
- .6 *Reinforcing steel supports:* shall conform to ACI Standard 315 unless otherwise approved by the Departmental Representative.
- .7 *Mechanical splices:* subject to the approval of the Departmental Representative.

2.2 FABRICATION

- .1 Fabricate bends, splices and ties and supply bar supports and accessories in accordance with the requirements of CAN-A23.3-04. Spacing and arrangements of supports in accordance with ACI 315.
- .2 All intermediate grade reinforcing bars shall be bent cold without hickeying. All high strength steel shall be preheated.
- .3 Reinforcing bars shall not be straightened or rebent.
- .4 Location of reinforcement splices not shown on the drawings subject to approval by the Departmental Representative and shall, for beams and slabs be away from points of maximum stress in the steel.
- .5 *Welding of reinforcing bars:* use only weldable bars, preheat and weld to CSA W186-1990 (R2007).

Part 3 Execution

3.1 EXAMINATION

- .1 Examine the work upon which this section depends and report any discrepancies to the Departmental Representative.

- .2 Commencement of the work shall imply acceptance of conditions.

3.2 PLACING

- .1 Reinforcement of the size and shapes shown on the drawings shall be accurately placed in accordance with the approved shop drawings, the structural drawings and the requirements of the current National Building Code.
- .2 Clear distances between parallel bars, except for columns, shall be not less than 1.4 times the diameter of the bar, or 30 mm or 1.4 times the maximum size of the coarse aggregate. Bars placed in two or more layers shall be placed directly above and below each other.
- .3 Clear distance between bars in columns shall be not less than 1½ the nominal diameter of the bar or 40 mm or 1½ times the maximum size of the coarse aggregate.
- .4 Reinforcing steel shall, where not otherwise shown on the structural drawings, be protected by the clear cover of concrete over the reinforcement as follows:
- .1 Where concrete is formed against earth, not less than 75 mm.
- .2 Where concrete placed against forms is to be exposed to the weather or be in contact with the ground, not less than 50 mm for bars larger than 15 M, and not less than 40 mm for bars 15 M and smaller.
- .3 In slabs and walls not exposed to the ground or weather, not less than 20 mm.
- .4 In beams, girders and columns not exposed to the ground or weather, not less than 40 mm to principal reinforcement, ties and stirrups.

The foregoing clear covers shall be maintained within 5 mm.

- .5 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with the latest ACI Standard 315.
- .6 For slabs on grade, footings or similar construction, concrete blocks may be used in place of metal chairs.
- .7 Unless specifically detailed otherwise, supply and install additional 10 M bars by 2400 long at 300 mm centres above all steel floor beams supporting open web steel floor joists. Bars to be centred above beam and placed with 25 mm cover to top of slab. Provide 1 - 15 M carrier bar below for chairing.
- .8 Unless detailed otherwise, all exterior slabs, walks and pads abutting building foundations to be dowelled with 15 M at 400 on centre, extending minimum 750 into slab.
- .9 Review with the Departmental Representative, placement of reinforcement prior to concreting.

- .10 Notify the Departmental Representative twenty-four (24) hours prior to placing concrete.

3.3 CLEANING

- .1 All materials shall be clean and free of all form oil or deleterious materials.
- .2 All deleterious material shall be removed from the surface of the reinforcing steel in a manner acceptable to the Departmental Representative.

3.4 WELDING

- .1 Do welding to meet requirements of CSA W186-M1990 (R2007). Have welding performed by workmen qualified under CSA W47.1-09. Welding only by written authority of the Departmental Representative.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

1.2 QUALITY ASSURANCE

- .1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this Section.
- .2 For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.
- .3 Perform cast-in-place concrete work to requirements of CAN/CSA-A23.1-09 - "Concrete Materials and Methods of Concrete Construction".

1.3 PRODUCT HANDLING

- .1 Use all means necessary to protect cast-in-place concrete materials before, during and after installation and to protect the installed work and materials of all other trades.
- .2 In the event of damage, immediately make all repairs and replacements necessary to approval of the Departmental Representative and at no additional cost to the Departmental Representative.

1.4 INSPECTION AND TESTING

- .1 Inspection and testing will be performed by a firm approved by the Departmental Representative and paid for by the Contractor. Unless approved otherwise, the testing agency must perform all aspects of testing including cylinder preparation.
- .2 Provide free access to all portions of work and co-operate with appointed firm.
- .3 Submit proposed mix design for each class of concrete to Departmental Representative for approval two (2) weeks prior to commencement of work.
- .4 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.
- .5 One concrete test, consisting of three test cylinders, will be taken for every 50 cubic meters or less of each class of concrete placed. One cylinder to be tested at seven (7) days, the remaining two cylinders to be tested at twenty-eight (28) days.
- .6 One (1) additional test cylinder will be taken during cold weather concreting, and be cured on job site under same conditions of concrete it represents.
- .7 One (1) slump test and one (1) air content test will be taken for each set of test cylinders taken.

- .8 Testing of concrete will be performed in accordance with CAN/CSA-A23.2-09 "Method of Test for Concrete".
- .9 Test results will be issued to the Contractor, and Departmental Representative. Test reports are to be numbered consecutively beginning with number one.
- .10 Required retesting will be paid for by the Contractor.
- .11 The Departmental Representative may order additional testing any time even though the required tests indicate the strength requirements have been met. In this instance, the Departmental Representative will pay for those tests that meet the specified requirements and the Contractor will pay for those that do not.
- .12 Non-destructive methods for testing concrete shall be according to CAN/CSA A23.2-09.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Prepare and submit to the Departmental Representative for review, shop drawings showing detailed layout of form dimensions, form joint fitting, form sealing and placement, location of openings and placement of form ties. Submit a detailed description of the exact construction method to be used, for all area designated as sand blasted finish, exposed aggregate finish and architectural exposed concrete

Part 2 Products

2.1 CONCRETE MATERIALS

- .1 *Cement:* Normal - N and Sulphate Resistant - HS Portland Type, to CSA A3000-08 - "Portland Cements".
- .2 *Fine and Coarse Aggregates:* conforming to CAN/CSA-A23.1-09 - "Concrete Material and Methods of Concrete Construction".
- .3 *Fine and Coarse Aggregates:* conforming to CAN/CSA-A23.1-09 - "Concrete Materials and Methods of Concrete Construction". The fine and coarse aggregate for concrete floor slabs and finish toppings shall contain a maximum of 0.4% low density particles as determined by CSA Test A23.2-09 "Low Density Material in Aggregate". Test results shall be submitted to Departmental Representative for review.
- .4 *Water:* clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.

2.2 ADMIXTURES

- .1 *Air Entrainment:* to ASTM C260-06 - "Air-Entraining Admixtures for Concrete".
- .2 *Chemical:* to ASTM C494-08a - "Chemical Admixtures for Concrete"; water reducing, strength increasing type WN - normal setting.

- .3 *Pozzolanitic Mineral:* to CSA A3000-08 "Supplementary Cementing Materials and Their Use in Concrete Construction", fly ash permitted only as approved by Departmental Representative.

2.3 ACCESSORIES

- .1 *Vapour Barrier:* 6 mil polyethylene film, to CGSB 70-GP-1a, Type 1 - low permeance heavy duty.
- .2 *Curing Compounds:* shall conform to the requirements of the latest issue of ASTM Standard C309.
- .3 *Non-shrink Grout:* premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 20 MPa at 3 days and 50 MPa at 28 days. CPD Non Shrink Grout by CPD Construction Products or approved equivalents.
- .4 *Void Form:* **to comply with either of the following:**
- .1 Biodegradable Void Form: biodegradable, 150 mm deep, structurally sufficient to support weight of wet concrete and other superimposed loads without collapsing until concrete has gained sufficient strength to support these loads after which time the form must promptly degrade. Do not wrap void form. Do not place void form on poly ground sheet. The onus is entirely on the Contractor and Supplier to ensure that the void form is installed to perform as intended.
- .2 Compressible Void Form: Compressible void form designed for 150 mm soil heave, installed to supplier's specifications.
- .5 *Joint Filler:* pre moulded bituminous impregnated cane fibre board.
- .6 *Vertical Joint Sealant:* non-sag polyurethane sealant designed for use on vertical surfaces. Install strictly in accordance with manufacturer's recommendations.
- .7 *Horizontal Joint Sealant:* three component chemically curing, self-levelling, polyurethane joint sealant. Colour selection by Departmental Representative. Install strictly in accordance with manufacturer's recommendations.
- .8 *Concrete Expansion Anchors:* Sized as per drawings. Minimum embedment length of all expansion anchors to be 150 mm unless noted otherwise.
- .9 *Concrete Inserts with Bolt Extension:* Concrete inserts to be sized as detailed on drawings. Bolt extensions to be mild steel threaded extensions sized as detailed on drawings.
- .10 *Concrete Patching Material:* pre-packaged, polymer modified, cementitious product containing graded natural aggregate,
- .11 *Bonding Agent:* Approved high polymer polyvinyl acetate emulsion applied in strict accordance with manufacturer's recommendations for proposed application. Mix bonding agent with Portland cement, sand and water to manufacturer's recommendation to achieve

a uniform slurry and scrubbed into the surface. Ensure surface is free from all laitance, dirt, dust, debris, grease or other substances. Clean surface with acid etching and hosing down. Neutralize acid if necessary.

- .12 *Epoxy Bonding Agent:* Approved mineral filled polymer/epoxy adhesive formulated to bond new concrete to cured concrete. Apply in strict conformance with manufacturer's written recommendations for proposed application.
- .13 *Cement Grout Capsules:* reinforcing steel detailed to be installed in pre-placed concrete to be anchored using Cement Grout Capsules.

2.4 CONCRETE MIXES

- .1 Mechanical mix concrete in accordance with the requirements of CAN/CSA A23.1-09.
- .2 All concrete shall have the following minimum properties.

Based on 2010 National Building Code

Location	Exposure Class	Comp. Strength (MPa) and Age	Aggregate	Air Entrainment	Slump
1. Footings/Pedestals	S-3	30 @ 56 d	20	4 – 7	80 ± 30
2. Interior Slab on Metal Deck **	N	25 @ 28 d	20	0	80 ± 30
3. Exterior Grade Supported Sidewalks/Landing Pads, Slabs	C-2	32 @ 28 d	20	5 – 8	80 ± 30
4. Miscellaneous Concrete	N	25 @ 28 d	20	Specify	80 ± 30

Minimum cement content for Type 50 cement to be 280 kg/m³.

Maximum free water/cement ratio for Type 50 cement to be 0.5.

Semi-lightweight concrete to have unit weight of 2075 ± 75kg/m³.

Lightweight concrete to have unit weight of 1850 ± 75 kg/m³.

*****Interior slabs on metal deck to include powder pigment additive to achieve colour selection by Departmental Representative. Basis of design: Interstar Colour Additive, procedures and requirements as per manufacturer's requirements. Provide mock-up samples of concrete colour selection for approval by Departmental Representative.***

All slabs finished with dry shake hardener to contain no artificially entrained air.

- .3 Submit proposed mix design to Inspection and Testing Firm and to Departmental Representative two (2) weeks prior to commencement of work. Provide certification that mix proportions selected will produce concrete of specified quality and that strength will comply with CAN/CSA A23.1-09.
- .4 Each load of ready-mixed or transit-mixed concrete delivered to the project site shall be accompanied by duplicate delivery slips providing the following information:

- .1 Name of ready-mix batch plant
 - .2 Serial number of ticket
 - .3 Date and truck number
 - .4 Name of contractor
 - .5 Specific designation of project
 - .6 Specific class of concrete
 - .7 Amount of concrete in cubic metres
 - .8 Time of loading or first mixing of aggregate, cement and water.
-
- .5 Use accelerating admixtures in cold weather only when approved by Departmental Representative. If approved, the use of admixture will not relax cold weather placement requirements. Use calcium chloride only as approved by the Departmental Representative.
 - .6 Use set-retarding admixtures during hot weather only when approved by the Departmental Representative.
 - .7 Use of plasticizers only when approved by Departmental Representative.
 - .8 Concrete mix for exposed aggregate finish and sandblasted finish shall be designed as a low slump, gap-graded mix with a maximum amount of screened and washed crushed coarse aggregate.

Part 3 Execution

3.1 INSPECTION

- .1 Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- .2 Verify that all items to be embedded in concrete are in place.
- .3 Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.

3.2 DISCREPANCIES

- .1 In the event of discrepancy, immediately notify the Departmental Representative.
- .2 Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.3 PREPARATION

- .1 Remove all wood scraps and debris from the formed areas in which concrete will be placed.
- .2 Thoroughly clean the forms to ensure proper placement and bonding of concrete.
- .3 Thoroughly wet the forms, except in freezing weather, or oil them; remove all standing water.

- .4 Thoroughly clean all transporting and handling equipment.
- .5 Construct slabs on grade on prepared subgrade as follows unless noted otherwise.
 - .1 Strip native soil minimum 400 mm (16") and proof roll, replacing soft areas with Type 8 granular.
 - .2 Build base above native soil with Type 8 granular compacted to 96% proctor, placed in maximum 150 mm (6") lifts.
 - .3 Top 150 mm (6") below slab to be Type 32 compacted to 98% proctor.

3.4 PLACING CONCRETE

- .1 Place concrete in accordance with requirements of CAN/CSA A23.1-09 and as indicated on Drawings.
- .2 Notify Departmental Representative and Inspection and Testing Firm a minimum of forty-eight (48) hours prior to commencement of concreting operations.
- .3 Ensure all anchors, seats, plates and other items to be cast into concrete are placed, held securely and will not cause undue hardship in placing concrete.
- .4 Maintain accurate records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- .5 Ensure reinforcement, inserts, embedded parts, formed joints and fitments are not disturbed during concrete placement.
- .6 Prepare previously placed concrete by cleaning with steel brush.
- .7 Pour concrete continuously between predetermined construction and control joints. All construction joints subject to approval of the Departmental Representative.
- .8 Approval to place concrete shall be contingent on the formwork and reinforcing steel placement and evidence that the Contractor can place the planned casting without stopping.
- .9 Pour slabs on grade in checkerboard pattern or saw cut, as indicated on Drawings. Saw cut control joints within twenty-four (24) hours after finishing. Use 6 mm thick blades, cutting 20 mm into depth of slab thickness. Vacuum clean saw cut prior to installation of sealant.
- .10 Excessive honeycomb or embedded debris in concrete is not acceptable. Remove and replace defective concrete. Excessive honeycomb is when eraser end of a pencil fits into cavity.

3.5 COLD WEATHER REQUIREMENTS

- .1 When the air temperature is at or below 5⁰ C. or when there is a probability of it falling to this limit during the placing or curing period, cold weather requirements shall be applicable.
- .2 Provide heating equipment or heating plant on the job ready for use when concrete is being placed during cold weather. Such equipment shall be adequate for the purpose of maintaining the required temperature during the placing and curing of the concrete. The methods used for heating shall be approved by the Departmental Representative. Equipment inducing carbon monoxide gas in the building shall not be accepted.
- .3 Concrete shall not be placed on or against reinforcement, formwork, ground or any surface that is at a temperature less than 5⁰ C.
- .4 The temperature of the concrete at all surfaces shall be maintained at not less than 15⁰ C for three (3) days, or at not less than 10⁰ C for five days after placing. Means shall be provided to humidify the air within enclosures and to keep the concrete and formwork continuously moist if dry heat is used. The concrete shall be kept above freezing temperature for a period of seven (7) days, and shall be kept from alternate freezing and thawing for at least fourteen (14) days after placement.
- .5 At the end of the specified protection period the temperature of the concrete shall be reduced gradually at a rate not exceeding that shown in CAN/CSA A23.1-09.
- .6 Accelerator or so-called anti-freeze compounds shall **not** be permitted unless otherwise approved in writing by the Departmental Representative.
- .7 All protective coverings shall be kept clear of the concrete and form surfaces to permit free circulation of air and shall be maintained intact for at least twenty-four (24) hours after artificial heat is discontinued.

3.6 HOT WEATHER REQUIREMENTS

- .1 When the air temperature exceeds 27⁰, hot weather requirements shall be applicable.
- .2 Time of initial mixing to complete discharge shall not exceed 1 hour and 15 minutes and concrete placed shall not exceed 27⁰.
- .3 Concrete forming surfaces and reinforcing steel shall be sprinkled with cool water just prior to placing concrete. Standing water or puddles shall be removed prior to concrete placement.
- .4 Special wind protection will be required as directed by the Departmental Representative.
- .5 Columns, walls, beams and slabs shall be kept continuously damp for twenty-four (24) hours by normal curing procedures as outlined by this Specification. Slabs cured by the applications of sealing, shall have curing compound applied immediately after finishing of the slab but before evaporation of surface moisture.
- .6 The use of water reducing agents shall be subject to the approval of the Departmental Representative when hot weather conditions prevail.

3.7 CONSTRUCTION JOINTS AND WATERSTOPS

- .1 The location and detail of all construction joints not detailed on the structural drawings shall be approved by the Departmental Representative.
- .2 Where fresh concrete is to be placed against concrete which has set or has partially set, the surface of the set or partially set concrete shall be roughened, cleaned of all laitance, and thoroughly soaked with water prior to the placement of fresh concrete.
- .3 In general the construction joints in floor and roof systems shall be located in the middle of the spans of slabs, beams and girders. Proper key and dowels or extensions of reinforcing shall be provided at all construction joints.
- .4 Concrete placed in wall and column forms shall be struck off flush with the underside of the floor and roof systems.
- .5 Vertical construction joints in foundation walls shall be properly keyed and dowelled and constructed with an approved water stop, properly anchored against displacement during the placement of the concrete and properly sealed at all of the intersections. Splices and intersections of water stop shall be jointed by heat fusion in accordance with approved manufacturer's instructions.
- .6 Where new below grade concrete foundation walls abut existing foundation walls, unless specifically detailed otherwise, install new pvc vertical waterstop at the joint by sawcutting and grouting the waterstop into the existing wall and casting into the new wall. Install full height vertical reglet each side of the joint and seal with approved vertical joint sealant over Ethafoam back up rod. Installation shall be in accordance with manufacturer's recommendations.

3.8 DEFECTIVE CONCRETE

- .1 Concrete not meeting the requirements of the Specifications and drawings shall be considered defective concrete.
- .2 Concrete not conforming to the lines, details and grade specified herein or as shown on the drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Departmental Representative. Finished lines, dimensions and surfaces shall be correct and true within tolerances specified in the Formwork Section of these Specifications.
- .3 Concrete not properly placed resulting in excessive honeycombing and all honeycombing and other defects in critical areas of stress, shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Departmental Representative.
- .4 Concrete of insufficient strength or improper consistency shall be, as required by the Departmental Representative, subject to one or more of the following:
 - .1 Changes in mix proportions for the remainder of the work.

- .2 Cores drilled and tested from the areas in question as directed by the Departmental Representative and in accordance with CAN/CSA A23.2-09. The test results shall be indicative of the in-place concrete.
- .3 Load testing of the structural elements in accordance with CAN3 A23.3-04.
- .4 The changes in the mix proportions and the testing shall be at the Contractor's expense.
- .5 Concrete failing to meet the strength requirements of this Specification shall be strengthened or replaced at the Contractor's expense and to the satisfaction of the Departmental Representative.

3.9 PATCHING CONCRETE

- .1 After the removal of the forms concrete surfaces may be subject to inspection by the Departmental Representative.
- .2 All exposed metal form ties, nails, wires, shall be removed, fins broken off and all loose concrete removed.
- .3 Form tie pockets shall be thoroughly wetted and patched with patching concrete followed by proper curing.
- .4 Honeycombed and other defective surfaces shall be chipped away to a depth of not less than 25 mm with the edges perpendicular to the surface, thoroughly wetted and patched with patching concrete followed by proper curing.
- .5 Patching concrete shall be thoroughly compacted into place and finished in such a manner as to match the adjoining concrete. The design mix of the patching concrete shall be approved by the Departmental Representative.

3.10 FINISHING OF FORMED SURFACES

- .1 All formed surfaces noted in Architect's Room Finish Schedule as receiving a paint, vinyl or other applied finish shall be final finished to remove all protrusions, ridges and other irregularities. All voids and pinholes are to be filled. Finished surface is to be smooth, straight and true, ready to receive architectural finish as noted.
- .2 On all other exposed formed concrete surfaces, except at unfinished areas: remove blemishes, formwork joint marks by rubbing with carborundum block and water. Leave finished surfaces smooth, unmarred. Complete rubbing within twenty-four (24) hours for stripping formwork.

3.11 ANCHOR BOLTS AND WELDMENTS

- .1 Set anchor bolts and weldments to the following tolerances:
 - .1 Alignment: ± 3 mm of location, plumb and true.
 - .2 Projection: ± 6 mm of elevations called for.

3.12 BASE PLATES GROUTING

- .1 Mix and place as per Manufacturer's specifications. Pack grout tightly under plates and leave no voids. Neatly finish edges.

3.13 EQUIPMENT PADS

- .1 Provide concrete pads for equipment where and as indicated on Drawings.
- .2 Insert bolts and sleeves and pack solidly with non-shrink grout, in accordance with setting details and templates.
- .3 Steel trowel top surfaces smooth. Tool edges.

3.14 CONCRETE TOPPING

- .1 All concrete toppings indicated on drawings are to be bonded toppings.
- .2 Concrete toppings are to be bonded by either of the following methods unless specifically directed:
 - .1 Application of cement/bonding agent/sand grout to prepared base course in accordance with CAN/CSA A23.1-09, Clause 7.6.4.2.2 (b).
 - .2 Application of approved bonding agent to prepared base course.
- .3 The following toppings are to be bonded specifically by application of approved bonding agent:
 - .1 All toppings cast over existing slabs.
 - .2 All interior toppings.
- .4 New concrete slabs which are to receive toppings are to be prepared in accordance with CAN/CSA A23.1-09, Clause 23 and Section 03 35 00.
- .5 Existing concrete slabs which are to receive toppings are to be prepared in accordance with Specification Section 03 35 00 and as detailed on the Drawings.

3.15 FOOTINGS

- .1 All footings to be placed on undisturbed material. Any disturbed bearing material to be compacted to in situ density.
- .2 Adequate precautions shall be taken by the Contractor to prevent the soil at foundation level from drying to becoming wet from surface water prior to placement of concrete.
- .3 The Contractor shall ensure that the soil below the foundation is not allowed to freeze, either before or after construction. Under no circumstances should concrete be placed on frozen soil.

3.16 UNDERFLOOR DUCTS

- .1 Where underfloor ducts are indicated pour 10 MPa concrete around duct work being careful to avoid damaging or displacing ducts or allowing ducts to float. Concrete to be in two pours with ducts securely anchored into first pour.

3.17 DOVETAIL ANCHOR SLOTS

- .1 Cast in continuous dovetail anchor slots to receive dovetail anchors and masonry ties for lateral support of masonry.
- .2 Refer to Specifications Division 4 for extent and spacing of masonry ties. Anchor slots to be located to coincide with spacing of masonry ties as specified in Division 4.

3.18 SIDEWALKS

- .1 Unless specifically detailed otherwise on drawings or in specifications, sidewalks shall be constructed to the following details.
- .2 Use forms for edges of concrete walls to provide straight lines and smooth curves.
- .3 Locate asphalt impregnated fibreboard joint filler at 4.5 metre centres and where walks abut walls and other vertical surfaces. Joint filler to be full area of concrete section.
- .4 Slabs to be 125 thick cast over 6 mil poly and 200 compacted granular fill. Reinforce with 10 M at 300 mm on centre each way at mid-depth of slab.
- .5 Install tooled joints at 1.5 metres on centre.
- .6 Round all edges, including edges of control joints and tooled joints, with 12 mm radius edging tool.
- .7 Provide exposed surfaces of all sidewalks with medium broomed finish.
- .8 Slope walks and slabs as detailed on drawings.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

1.2 WORK INCLUDED

- .1 Finish separate floor toppings, slabs on fill and monolithic floor slabs.
- .2 Apply concrete hardener, sealer.
- .3 Cure finished surfaces.

Part 2 Products

2.1 COMPOUNDS/HARDENERS/SEALERS

- .1 *Curing Compound:* chlorinated liquid rubber to CGSB 90-GP-1a, Type 1.
- .2 *Non-metallic Surface Sealer:* premixed natural mineral type.
- .3 *Penetrating Epoxy Sealer:*
- .4 *Coloured Dry Shake Hardener and Sealer:* Hardener to be prepackaged, factory-mixed product containing crushed, washed and graded non-metallic aggregate, Portland cement, colouring pigments and other proprietary components. Sealer to be liquid curing and sealing compound recommended for use on color hardened floors. Sealer to be supplied in colour that is recommended for, and compatible with, colour or dry shake hardener.
- .5 *Horizontal Joint Sealer:* three component, chemically curing, self-levelling polyurethane joint sealant. Color selection by Departmental Representative. Install strictly in accordance with manufacturer's recommendations.
- .6 *Bonding Agent:* Approved high polymere polyvinyl acetate emulsion applied in strict accordance with manufacturer's recommendations for proposed application.
- .7 *Epoxy Bonding Agent:* Approved mineral filled polymer/epoxy adhesive formulated to bond new concrete to cured concrete. Apply in strict conformance with manufacturer's written recommendations for proposed application.

Part 3 Execution

3.1 FLOOR FINISHING

- .1 Finish concrete floor surfaces in accordance with CAN/CSA A23.1-09.

- .2 Uniformly spread, screed and float concrete. Do not use grate tampers or mesh rollers. Do not spread concrete by vibration. Bring surfaces to levels indicated on Drawings.
- .3 Apply Plain or Coloured Dry Shake Hardener and Sealer to concrete floors noted in Architect's Room Finish Schedule as receiving hardener. Colour selecting by Departmental Representative. Apply dry shake in two passes at the rate of 5.0 kg/m² (100 lb/100 Ft²) or as recommended by manufacturer for Normal Traffic Conditions. After application of shake hardener is complete, apply minimum one coat of sealer. Application of both the dry shake hardener and sealer is to be strictly in accordance with manufacturer's recommendations.
- .4 Unless otherwise noted, all concrete floors which are noted in Architect's Room Finish Schedule as exposed concrete, or as receiving carpeting, resilient flooring or hardener are to be final finished to a hard, smooth dense trowelled surface free from blemishes. Final finish to achieve a "flat" floor in accordance with CAN3 A23.1-09, Table 22 Class A straight edge method to produce floor surface of pleasing characteristics.
- .5 All concrete slabs noted in Architect's Room Finish Schedule as receiving thin-set quarry tile finish are to be final finished with a swirl trowel finish plus fine hair brooming to give a surface finish to achieve a "flat" floor in accordance with CAN/CSA A23.1-09, Clause 7.5.6.1 maintaining surface flatness with maximum variation of 5 mm in 3 M and absolute maximum of ± 6 mm.
- .6 All concrete slabs noted in Architect's Room Finish Schedule as receiving application of Penetrating Epoxy Sealer are to be final finished with a swirl trowel finish suitable for the application of penetrating type epoxy sealer. Slab is to be finished to a hard, smooth surface free from blemishes. Final finish to achieve a "flat" floor in accordance with CAN/CSA A23.1, Clause 7.5.6.1 to produce floor surface of pleasing appearance, easily cleaned and maintained with high wear-resistance qualities. Maintain surface flatness with maximum variation of 5 mm in 3 M and absolute maximum of ± 6 mm. Co-ordinate suitable curing method for slabs where penetrating type of sealer is used. Supplier's representative must be on site prior to application to advise on finishing procedures and application rate. Apply sealer at rate recommended for medium traffic in a minimum of two passes.
- .7 Apply concrete Surface Sealer on floor surfaces noted in Architect's Room Finish Schedule as exposed concrete. Apply strictly in accordance with manufacturer's recommendations.
- .8 In areas with floor drains, maintain floor level at walls and pitch surfaces uniformly to drain at 5 mm/M nominal unless indicated otherwise on Drawings.

3.2 TOPPINGS

- .1 All new concrete slabs which are to receive topping or thick set tile finish are to be screeded and mechanically floated to achieve surface flatness with maximum variation of 8 mm in 3 M. Depress slabs to accommodate finish where required. Provide a scratch finish in accordance with CAN/CSA A23.1-09, Clause 7.5.6.2 to all concrete slabs receiving topping or thickset tile finish.

- .2 All concrete slabs which are to receive a concrete topping shall be cleaned free of oil and loose material.
- .3 Place dividers, edge strips, reinforcing, expansion joint assemblies and other cast-in items shown.
- .4 Just prior to placing topping, apply cement bonding agent slurry coat in accordance with CAN/CSA A23.1-09, Clause 7.6.4.2.2 (b) or approved bonding agent to base slab.
- .5 Apply bonded concrete topping over prepared concrete base slab to CAN/CSA A23.1-09.
- .6 All concrete toppings to receive insulation or roofing system shall be final finished by hand or mechanical floating to within a tolerance of 8 mm in 3 M.
- .7 All concrete toppings to serve as floor surfaces are to be final finished in accordance with Item 3.1 Floor Finishing.

3.3 CURING AND PROTECTION

- .1 All equipment needed for the curing and protection of the concrete shall be on hand and ready for use before actual placing is started.
- .2 All exposed non-formed surfaces shall be kept continuously moist for a minimum of seven consecutive days after placement of the concrete. The water for curing shall be clean and free from any materials that will cause staining or discolouration of the concrete. A liquid, membrane forming, curing compound shall be used under circumstances where the application of moisture is impracticable and where such compounds will not jeopardize the appearance of the concrete nor the bonding of future floor finishes.
- .3 Special curing techniques shall be employed when the concrete is subject to drying conditions such as high temperatures, low relative humidity and high winds. Concrete wall and column forms shall be kept continuously moist.
- .4 Freshly placed concrete shall be protected from the effects of direct sunshine, drying winds, cold, excessive heat and running water by the use of adequate tarpaulins or other suitable material to cover completely or enclose all freshly finished surfaces until the end of the curing period specified.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this Section.

1.2 WORK INCLUDED

- .1 Structural steel framing members, structural steel support members, struts, complete with required bracing, welds, washers, nuts, shims, anchor plates and bolts.
- .2 Baseplates, connectors and bearing plates.
- .3 Field and shop welded composite beam studs shall be supplied and installed under this section.
- .4 Erection.

1.3 QUALITY ASSURANCE

- .1 Structural steel fabricator to be certified as minimum Division 2 Company under CSA W47.1-09 - "Certification of Companies for Fusion Welding of Steel Structures" or CSA Standard W55.3-08 "Resistance Welding Qualification Code for Fabricators of Structural Members" or both, as applicable.
- .2 Design to strictly adhere to all codes and standards as enumerated under Section 1.5 Reference Standards.
- .3 In the event of conflict between pertinent codes, standards and/or regulations, most stringent shall govern.
- .4 Composite steel studs attached to structural steel beams or girders and installed in either the fabricator's plant or in the field shall be supplied and installed by the Structural Steel Subcontractor who shall be a company certified as a Division 2 fabricator by the Canadian Welding Bureau under CSA Standard W47.1 "Certification of Companies for Fusion Welding of Steel Structures". This certification to be in effect prior to date of tender closing. This condition is a mandatory condition of the Contract Documents and shall not be waived regardless of Saskatchewan Bid Depository Rules or practices.

1.4 REFERENCE STANDARDS

- .1 CSA Standard CAN/CSA-S16-01 - "Limit States Design of Structural Steel Buildings".
- .2 CSA G40.21-04 (R2009) - "Structural Quality Steel".
- .3 ASTM Standard A325M - "High Strength Bolts for Structural Steel Joints including Suitable Nuts and Plane Hardened Washers".
- .4 CSA Standard W59-03 (R2008) - "Welded Steel Construction".

.5 CSA Standard W47.1-09 - "Certification of Companies for Fusion Welding of Steel Structures".

.6 ASTM Standard A53 - "Welded and Seamless Steel Pipe".

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with General Conditions.

.2 Clearly indicate sizes, spacing and locations of structural members, connections, attachments, anchorages, framed openings and size and type of fasteners and welds.

.3 Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds.

.4 Show all welds, both shop and field, by the currently recommended symbols of the Canadian Welding Bureau.

.5 Provide drawings stamped and signed by a Professional Engineer registered in the Province of Saskatchewan.

.6 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

1.6 INSPECTION AND TESTING

.1 Materials and workmanship subject to inspection on behalf of Departmental Representative.

.2 Report failure of material to fit together properly to Departmental Representative. No corrective measures permitted unless approved by Departmental Representative in writing.

Part 2 Products

2.1 MATERIALS/COMPONENTS

.1 *Standard Rolled Sections:* new material conforming to CSA G40.21-04 (R2009), Grade 350W.

.2 *Hollow Structural Sections:* new material conforming to CSA G40.21-04 (R2009), Grade 350W, Class C.

.3 *Steel Pipe Sections:* new material conforming to ASTM Standard A53, Grade 241.

.4 *Base and Cap Plates:* new material conforming to CSA G40.21-04 (R2009), Grade 300W.

.5 *Beam End Plates, Ledger Angles and Miscellaneous Steel:* new material conforming to CSA G40.21-04 (R2009), Grade 300W.

.6 *Anchor Bolts:* new material conforming to CSA G40.21-04 (R2009), Grade 260W.

- .7 *Bolts, Nuts and Washers:* high strength type recommended for structural steel joints, conforming to requirements of ASTM A325M-83c.
- .8 *Paint for Primer:* shall be grey (unless approved otherwise) and meet requirements of one of the following:
 - .1 CGSB 1-GP-40d, Primer, Structural Steel, oil alkyd type.
 - .2 CISC/CPMA Standard 1-73a, quick drying one-coat paint for use on structural steel.
- .9 *Shop and Field Studs:* shall be Nelson headed anchors to ASTM A108 - 58T or approved equivalent. Sizes as detailed on drawings.

2.2 FABRICATION

- .1 Fabricate structural steel members in accordance with building design drawings and all requirements of CAN/CSA S16-01. Welding to conform to CSA W59-03 (R2008) "Welded Steel Construction". Verify all dimensions prior to fabrication.
- .2 No cutting of openings in structural members except as shown on structural drawings. Reinforce openings to maintain required design strength.
- .3 Accurately cut and mill column ends to assure full contact of bearing surfaces.
- .4 Camber horizontal members as specified on drawings. Mill camber up where not specifically detailed.
- .5 All bolted connections to be "bearing" type connections except where subject to stress reversal which are to be "slip resistant" type connections.
- .6 All connections showing combined axial load (tension or compression) across the joint to be designed for loads shown. Such connection to be bolted through columns only.
- .7 All beams to be connected for the greater of the following conditions.
 - .1 Loads shown on drawings.
 - .2 50% of the total uniformly distributed load resistance of the member.
 - .3 Half depth of the connected member using M20 bolts (minimum two bolts) in double shear.
- .8 Shop installed shear studs to be installed in strict conformance with requirements of CSA Standard W59. Refer to Part 3 Execution for additional requirements.
- .9 Fabricate all glued-laminated timber brackets supported directly from structural steel. Coordinate design and details of connections with glulam supplier.
- .10 Masonry Ledgers
 - .1 All masonry ledgers supplied by structural steel shall be fabricated with connections to provide for full site adjustment.

.11 Tolerances

- .1 All masonry ledgers exposed to view are to be fabricated straight with no discernible kinks, bends or sweep. Maintain straightness to within tolerance of 1 in 500 with maximum deviation of ± 3 mm.
- .2 Tolerances of all other structural steel shall be maintained strictly in accordance with CAN/CSA S16-01.

- .12 All exposed steel and all related bridging and bracing shall be fabricated with clean, neat fitting welded connections.

2.3 PAINTING

- .1 All steel in contact with concrete and all faying surfaces of high strength bolted slip-resistant connections shall not be primed.
- .2 All exposed steel ledgers, lintels and glulam connections shall be prepared and painted as follows:
 - (I) Blast clean steel to SSPC Standard SP6 "Commercial Blast Cleaning". Apply one coat of General Paint 06-134 Q.D. Shop Primer.
 - (II) Apply one coat of General Paint 17-Line Q.D. Industrial Enamel. Color section by Departmental Representative.
- .3 All other structural steel shall be prepared in accordance with SSPC Standard SP2 "Hand Tool Cleaning" and have one coat of specified shop applied primer.
- .4 Hot dipped galvanizing zinc coating. 600 grams/m² to CAN/CSA G164-M92.

Part 3 Execution

3.1 ERECTION

- .1 Erect structural steel in accordance with building design drawings and all requirements on CAN/CSA S16-01.
- .2 Make adequate provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection. Leave such bracing in place as long as required for safety and integrity of the structure.
- .3 As erection progresses, securely bolt work to take care of full design loads and to provide structural integrity as required.
- .4 Use high tensile bolts for field connections unless otherwise noted on building design drawings.
- .5 Set all baseplates which are shop welded to columns to proper elevation on steel shims. Maximum tolerance from stated elevations to be ± 2 mm.

.6 Masonry Ledgers

- .1 All masonry ledgers shall be erected with provision for full site adjustment. Position ledgers accurately to correct elevations and plan location and field weld in place prior to laying up masonry.

7. Tolerances

- .1 All masonry ledgers are to be erected straight, level and plumb with no discernible kinks, bends or sweep. All masonry support members are to be erected such that the masonry can be laid up in its correct location, fully supported, straight and plumb.
- .2 All masonry support members exposed to view are to be erected to comply with the following tolerances:
 - .1 Straight to within tolerance of 1 in 500 with maximum deviation of ± 3 mm from established location.
 - .2 Level to within tolerance of 1 in 1000 with maximum deviation of ± 3 mm from established location.
 - .3 Plumb to within tolerance of 1 in 500 with maximum deviation of ± 3 mm .
 - .4 Adjoining ends of these members shall be aligned vertically within 2 mm.
 - .5 The location of these members vertically and horizontally shall be within 10 mm of the location established on the drawings.
 - .6 Splices between ledgers shall have the toe of the exposed flanges flush. The ledgers are to be fully welded together at all splice locations and all exposed portions are to be continuous with all welds ground smooth and flush.
 - .7 Exposed portions of all ledgers are to be finished smooth ready for finish painting. All irregularities and surface defects are to be removed.
- .3 Tolerance of all other structural steel shall be maintained strictly in accordance with CAN/CSA S16-01.
- .8 After erection, prime all welds, abrasions, bolted connections and all other surfaces not shop primed, except surfaces to be in contact with concrete.
- .9 Obtain written permission of Departmental Representative prior to altering or field welding of structural members.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A276-13a, Standard Specification for Stainless Steel Bars and Shapes.
 - .3 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB-1.181-99, Ready-Mixed, Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CAN/CSA-S16.1-01, Limit States Design of Steel Structures.
 - .4 CSA W48-06(R2011), Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's:
 - .1 For finishes, coatings, primers and paints.
- .2 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors and locations, supports, reinforcement, details, and accessories.

1.3 QUALITY ASSURANCE

- .1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

- .2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Protection:
 - .1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.
 - .2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

Part 2 Products

2.1 MATERIALS

- .1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 300W or 350W.
- .2 Steel pipe: to ASTM A53/A53M extra strong, galvanized finish.
- .3 Welding materials: to CSA W59.
- .4 Welding electrodes: to CSA W48 Series.
- .5 Bolts and anchor bolts: to ASTM A307.
- .6 Stainless steel: to ASTM A276, Type 304.
- .7 Steel Mesh: rolled flattened steel mesh, galvanized finish.
- .8 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper, 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.
- .3 Shop coat primer: to CAN/CGSB-1.40.
- .4 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

2.4 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of bituminous paint:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

2.5 SHOP PAINTING

- .1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .3 Clean surfaces to be field welded; do not paint.

2.6 MISCELLANEOUS STEEL ANGLES

- .1 Steel angles: see drawings.
- .2 Pre-drill anchor holes in angles.
- .3 Finish: shop primed or galvanized as indicated on drawings.

2.7 STEEL MESH

- .1 Locations: Refer to drawings.
- .2 Material: 19mm #9/10 rolled flattened steel mesh, galvanized.

2.8 SHEET STEEL

- .1 2mm (14ga) hot rolled sheet steel, galvanized.
- .2 Refer to drawings for locations and details.

2.9 BOLLARDS

- .1 Material: 200mm diameter x 8mm thick steel pipe.
- .2 Refer to drawings for detailing.
- .3 Finish: Galvanize after fabrication.

Part 3 Execution

3.1 ERECTION

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Provide components for building by other sections in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CAN/CSA-S16.1, or weld.
- .7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .9 Touch-up galvanized surfaces with zinc rich primer and zinc finish coating where burned by field welding.

3.2 MISCELLANEOUS STEEL ANGLES

- .1 Install angles as indicated in drawings.

3.3 STEEL MESH

- .1 Refer to Wall Types and details in drawings.

3.4 SHEET STEEL

- .1 Refer to drawings.

3.5 BOLLARDS

- .1 Refer to drawings.

3.6 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 20 00 – Finish Carpentry
- .2 Section 06 40 00 – Architectural Woodwork
- .3 Section 08 71 00 – Door Hardware
- .4 Section 09 21 16 – Gypsum Board Assemblies
- .5 Section 09 91 13 – Exterior Painting
- .6 Section 10 28 10 – Toilet and Bath Accessories

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C36/C36M-03e1, Standard Specification for Gypsum Wallboard.
 - .2 ASTM E-84/UL 723, Test for Surface Burning Characteristics of Building Materials and Flammability Ratings
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
 - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .3 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA O112 Series-M1977(R2006), CSA Standards for Wood Adhesives.
 - .4 CSA O141-05(R2009), Softwood Lumber.
 - .5 CSA O151-09, Canadian Softwood Plywood.
 - .6 CAN/CSA-O325.0-92(R2003), Construction Sheathing.
- .4 Underwriters Laboratories of Canada (ULC)
 - .7 CAN/ULC-S102.2-10 Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies
- .5 National Lumber Grades Authority (NLGA)
 - .8 Standard Grading Rules for Canadian Lumber 2010.

1.3 SUBMITTALS

- .1 Submit Submittal submissions: in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 FRAMING AND STRUCTURAL MATERIALS

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Structural Composite Lumber (SCL) in accordance with ASTM D5456.
- .3 Framing and board lumber: in accordance with NBC.
- .4 Furring, blocking, nailing strips, grounds, rough bucks:
 - .1 Board sizes: "Standard" or better grade.
 - .2 Dimension sizes: "Standard" light framing or better grade.
 - .3 Post and timbers sizes: "Standard" or better grade.
- .5 Skirting: pressure (preservative) treated, exterior grade lumber material meeting CAN/CSA S406.
- .6 Decks, stairs and miscellaneous exterior wood framing noted to be pressure treated: pressure (preservative) treated, exterior grade lumber material, meeting CAN/CSA S406.

2.2 PANEL MATERIALS

- .1 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.0.
- .2 Canadian softwood plywood (CSP): to CSA O151, standard construction.

- .3 Skirting: Pressure (preservative) treated, exterior grade douglas fir plywood sheathing, meeting CAN/CSA S406.

2.3 ACCESSORIES

- .1 Sealants: in accordance with Section 07 92 10 - Joint Sealing.
 - .1 Maximum allowable VOC limit 250 g/L.
- .2 Subflooring adhesive: to CGSB-71.26, cartridge loaded.
 - .1 Maximum allowable VOC limit 30 g/L.
- .3 General purpose adhesive: to CSA O112 Series.
 - .1 Maximum allowable VOC limit 140 g/L.
- .4 Nails, spikes and staples: to CSA B111.
- .5 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .6 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

2.4 FASTENER FINISHES

- .1 Galvanizing: to CAN/CSA-G164, use galvanized fasteners for exterior work, interior highly humid areas, pressure-preservative, fire-retardant, and treated lumber.

Part 3 Execution

3.1 PREPARATION

- .1 Store wood products in a dry location, off the ground.

3.2 INSTALLATION

- .1 Comply with requirements of NBC 2010 Part 3 and Part 9 supplemented by following paragraphs.
- .2 Install members true to line, levels and elevations, square and plumb.
- .3 Construct continuous members from pieces of longest practical length.
- .4 Install spanning members with "crown-edge" up.
- .5 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .6 Install wall sheathing in accordance with manufacturer's printed instructions.
- .7 Install preservative treated plywood skirt with good side facing out.
- .8 Install furring and blocking as required to space-out and support architectural woodwork, residential casework, toilet partitions, toilet and bath accessories, detention furnishings,

tack boards and whiteboards, storage assemblies, miscellaneous specialties, wall and ceiling finishes, facings, electrical equipment mounting boards, and other work as required. Refer to relevant Sections.

- .9 Install solid wood blocking 38mm x 152 mm in joist cavities at locations where wall mounted door stop is attached to stud wall assemblies.
- .10 Install solid wood blocking 38mm x 184 mm at 400 o.c. in floor at locations where interior partitions are required to be secured to floor between floor joists.
- .11 Install solid wood blocking 38mm x 184 mm between joists beneath fastening points for detention furniture. See Section 12 50 00 and drawings for locations.
- .12 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .13 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.

3.3 ERECTION

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.
- .3 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.4 SCHEDULES

- .1 Refer to drawings for various items requiring furring, blocking, nailing strips, grounds and rough bucks.
- .2 Refer to drawings for specialized fastening and joint layouts of panel materials.
- .3 Provide backing in walls for all millwork, shelving and wall mounted items requiring solid blocking.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

1.2 WORK INCLUDED

- .1 Supply and erect wood roof decking where shown on drawings.

1.3 REFERENCE STANDARDS

- .1 CSA Standard O86-09 - Engineering Design in Wood.
- .2 CSA Standard B111-1974 - Wire Nails, Spikes and Staples.
- .3 CSA Standard O80 Series 08 (R2012)- Wood Preservation and Supplements.
- .4 CSA Standard O141-05 (R2009) - Softwood Lumber.

1.4 PROTECTION

- .1 Where decking to be exposed as a finish, handle with care during shipping and installation to maintain undamaged and unmarked exposed face. Damaged members will be rejected.

1.5 DELIVERY AND HANDLING

- .1 Store wood decking well blocked off ground and separated with strippings, so air may circulate around sides of members. Cover top and sides with opaque moisture resistant membrane.

Part 2 Products

2.1 MATERIALS

- .1 *Wood decking:* to be Cedar of Species Group E, select grade in accordance with the National Lumber Grades Authority - "Standard Grading Rules". Nominally 150 wide x 89 thick, double tongue and grooved with pre-drilled lateral holes 6 mm diameter at 760 mm on centre for lateral anchorage, maximum moisture content 15%.
- .2 *Nails and Spikes:* conforming to requirements to CSA B111; size and type to suit application. Plain finish for interior application, galvanized for exterior use.

Part 3 Execution

3.1 PLACEMENT

- .1 Placement of wood decking not to proceed until work upon which this is dependent has been inspected and approved. Advise Department Representative of proposed schedule for placing deck such that wood decking and prior work may be inspected before erection commences.

- .2 Place wood decking where indicated on drawings, perpendicular to support members. Lay decking with tongues in an upward position in controlled random pattern in accordance with CSA Standard O86.
- .3 Secure each plank to each support with one 125 toe nail and one 150 face nail. Laterally spike planks together using one 250 spike in each pre-drilled hole.
- .4 Where planks are unable to be laterally spiked due to perimeter parapet wall, connect planks together by 100 mm wide x 18 ga. galvanized metal straps face nailed to the top face of the decking at 750 mm on centre. Extend straps back to include at least the last plank which as been laterally spiked.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this Section.

1.2 WORK INCLUDED

- .1 This work includes the complete furnishings and installation of all laminated veneer lumber as shown on the drawings herein specified and necessary to complete the work.

1.3 QUALITY ASSURANCE

- .1 Unless detailed otherwise, all beams to be designed to support all applicable dead loads, partition loads and all live loads for designated occupancies in accordance with current NBC.
- .2 All design in accordance with Part 4 of the National Building Code 1995 and CSA O86 "Engineering Design in Wood".
- .3 Complete design calculations showing layout, forces and stress control points to be provided to Departmental Representative for review, if requested.
- .4 Design of beams to be under the direct supervision of a Professional Engineer registered in the Province of Saskatchewan.

Part 2 Products

2.1 MATERIALS

- .1 Materials shall comply with CCMC Report No. 08675-R.
- .2 Laminated veneer lumber shall be manufactured in a continuous process with all grain oriented parallel to the length of the member. All members are to be free of finger or scarf joints or mechanical connections in full length members.
- .3 Adhesives shall be of the waterproof type conforming to the requirements of CSA O112.6-M.

2.2 FABRICATION

- .1 Laminated veneer lumber shall be manufactured in a plant listed in the reports referred to above and under the supervision of an approved third-party inspection agency. It shall be manufactured in a continuous process with all grain parallel with the length of the members.

2.3 TOLERANCES

- .1 Manufacture all parallel strand lumber to the following tolerances:
- | | |
|---------------------------------|----------------------|
| Finished Length (as specified): | $\pm 6.5 \text{ mm}$ |
| Depth: | $\pm 1.5 \text{ mm}$ |
| Width: | $\pm 1.5 \text{ mm}$ |

2.4 IDENTIFICATION

- .1 Each of the beams shall be identified by a stamp indicating the product type and grade, CCMC report number, manufacturer's name, plant number and the independent inspection agency's logo.

2.5 HARDWARE

- .1 All hardware is to be fabricated by others according to details contained in the contract drawings.

Part 3 Execution

3.1 ERECTION AND INSTALLATION

- .1 Beams shall be erected and installed in accordance with the plans, drawings and installations that may be provided.
- .2 Temporary construction loads that cause stresses beyond design limits are not permitted.
- .3 Holes, cuts or notches not previously approved shall not be permitted.
- .4 Connections: lateral nail holding and withdrawal are as provided in the Code for Douglas Fir sawn timber (SG=0.50). Nails installed parallel to the glue lines on the narrow face shall not be spaced closer than 100 mm for 76 mm (10d) common nails and 75 mm for 63.5 mm (8d) common nails. Nails installed perpendicular to the glue lines on the wide face shall be installed in accordance with the code. These nailing specifications are based on at least a 19 mm-thick and 89 mm-wide member. The resistance of bolts installed perpendicular to the glue lines in as provided in the Code for Douglas Fir.

3.2 INSTALLATION REVIEW

- .1 The Contractor shall give notification to the manufacturer, prior to enclosing the beams, to provide opportunity for review of the installation.

3.3 PERFORMANCE STANDARDS

- .1 Products shall be proven by testing and evaluation in accordance with the provisions of ASTM D-5456.

3.4 WARRANTY

- .1 The products delivered shall be free from manufacturing errors or defects in workmanship and material. The products, when correctly installed, shall perform to specifications for the normal and expected life of the building.

3.5 EXPOSED FINISH

- .1 Laminated veneer lumber: Sand to a smooth finish ensuring identifying labeling has been removed and apply two coats semi-transparent stain. Colour by Departmental Representative.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

1.2 WORK INCLUDED

- .1 Supply, fabricate and erect dimensional lumber trusses shown on drawings.
- .2 Examine the work upon which the work is this division depends and report any defects to the Consultant. The work of this division shall not commence until all defects have been corrected.
- .3 Commencement of the work shall imply acceptance of conditions.

1.3 QUALITY ASSURANCE

- .1 Unless detailed otherwise, all roof trusses to be designed to support all applicable dead loads and snow loads, including drift conditions, in accordance with current NBC.
- .2 Unless detailed otherwise, all floor joists to be designed to support all applicable dead loads, partition loads, and all live loads for designated occupancies in accordance with current NBC.
- .3 All design in accordance with Part 4 of the National Building Code 2010 and CAN3-086 "Engineering Design in Wood".
- .4 Complete design calculations showing layout, forces and stress control points to be provided to Consultant for review prior to fabrication.
- .5 Design of roof trusses to be under the direct supervision of a Registered Professional Engineer licensed for practice in Saskatchewan.
- .6 Unless noted otherwise, all trusses and joists to be designed for maximum liveload deflection of L/360.

1.4 SHOP DRAWINGS

- .1 Prepare and check shop drawings including anchorage and erection drawings. Clearly indicate dimensioned profiles, member sizes, connection details, spacing, material grades and other information pertinent to design. Submit shop drawings in accordance with General Conditions.
- .2 Roof truss shop drawings must be reviewed by General Contractor and Mechanical Contractor to ensure that the size and locations of all duct penetrations are identified and

co-ordinated. Final roof truss shop drawings must reflect framing to accommodate all such conditions.

- .3 Review of drawings to be for size and arrangement of principal and auxiliary members only. Review will not relieve Contractor of responsibility for general and detailed dimensions and fit or any errors or omissions.

Part 2 Products

2.1 MATERIALS

- .1 Structural wood members to CSA Standard 0141-05 "Softwood Lumber" graded in accordance with NLGA Grading Rules, or machine stress-rated material, kiln dried to maximum 19% moisture content. All joints to be full strength of section.
- .2 Connection may be proprietary systems of steel to minimum ASTM A307. Material and size to requirements of design. Submit data to satisfaction of the Consultant to substantiate connection design.
- .3 Pre-manufactured double-grip framing anchors, galvanized, shall be used to tie down trusses at all bearing locations.
- .4 Bridging to be horizontal wood members at top and bottom chord as required by design and indicated on shop drawings. Cross-brace as required.

Part 3 Execution

3.1 STORAGE

- .1 Store in vertical position and completely protected from weather. Handle in such a manner that no damage will be done to materials or structure.

3.2 FABRICATION

- .1 Wood trusses to be custom design Warren, Pratt or Howe Truss with tapered and pitched profiles as detailed.
- .2 Wood trusses to be manufactured in a plant subject to the approval of the Departmental Representative.
- .3 All connections as detailed on approved shop drawings.
- .4 Camber wood trusses for full dead load plus three-eighths ($\frac{3}{8}$) live load.
- .5 Supply for erection all pre-cut blocking, bridging and double-grip framing anchors.

3.3 ERECTION

- .1 Erect plumb and true; use temporary bracing where required to take care of all loads to which structure may be subjected, including erection equipment, and operation of same.
- .2 Wind forces on building permanently carried out by walls and decks. Provide temporary stability struts if required as work progresses and maintain in place until stability is provided by permanent structure.
- .3 As erection progresses, securely fasten work by means of double-grip framing anchors to take care of all dead, wind and erection stresses.
- .4 Make proper provision for safety carrying piles of material, erection equipment of other loads during erection.
- .5 Manufacturer to provide fully qualified representative to ensure conformance with design intent. Manufacturer's representative to inspect completed installation and certify acceptance of work. All shop drawings to be sealed by a professional engineer registered in the Province of Saskatchewan.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Describes workbenches in garage and casing at housing units. For residential casework see Section 12 35 00 – Residential Casework.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 09 91 23 – Interior Painting

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/HPVA HP-1-2009, Standard for Hardwood and Decorative Plywood.
 - .2 ANSI/NPA A208.1-2009, Particleboard.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
 - .1 Architectural Woodwork Quality Standards Illustrated, 2nd edition, 2014.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O112.4 Series-M1977(R2006), Standards for Wood Adhesives.
 - .3 CSA O121-08(R2013), Douglas Fir Plywood.
 - .4 CSA O141-05(R2009), Softwood Lumber.
- .5 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-2005, High-Pressure Decorative Laminates (HPDL).
- .6 National Hardwood Lumber Association (NHLA)
 - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 2011.
- .7 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2010.

1.4 PERFORMANCE REQUIREMENTS

- .1 Perform architectural casework work in accordance with the recommendations of the "Architectural Woodwork Quality Standards Illustrated" of the Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada (AWMAC), 2014 Edition, together with authorized additions and amendments, Custom Grade.

- .2 Where modifications to the AWMAC Quality Standards are included in this project specification, then such modifications shall govern in case of conflict.
- .3 Materials and installation shall be in metric measurement as specified.

1.5 SUBMITTALS

- .1 Provide Submittal submissions: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .1 Scales: profiles full size, details half full size.
 - .2 Indicate materials, thicknesses, finishes and hardware.
 - .3 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide duplicate samples: sample size 300 x 300 mm or 600 mm long unless specified otherwise.
 - .2 Provide two (2) samples of each wood species for review.
 - .3 Provide duplicate colour samples of laminated plastic for colour selection.
 - .4 Provide duplicate samples of laminated plastic joints, edging, cutouts and postformed profiles.
- .4 Quality assurance submittals:
 - .1 Manufacturer's Instructions: manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.
- .3 Delivery, Storage, and Handling:
 - .1 Deliver, handle, store and protect materials of this section in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Protect millwork against dampness and damage during and after delivery.
 - .2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.
- .4 Waste Management and Disposal:

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Softwood lumber: unless specified otherwise, S4S, moisture content 19% or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
 - .3 AWMAC custom grade, moisture content as specified.
- .2 Hardwood lumber: moisture content 6% or less in accordance with following standards:
 - .1 National Hardwood Lumber Association (NHLA).
 - .2 AWMAC custom grade, moisture content as specified.
- .3 Douglas fir plywood (DFP): to CSA O121, standard construction.
 - .1 Urea-formaldehyde free.
- .4 Hardwood plywood: to ANSI/HPVA HP-1.
 - .1 Urea-formaldehyde free.
- .5 Engineered Combination core – 5 ply veneer: to ANSI A208-1
 - .1 Urea-formaldehyde free.
- .6 MDF (medium density fibreboard) core: to ANSI A208.2.
 - .1 Medium density fibreboard performance requirements to: ANSI A208.2.
 - .2 MDF resin to contain no added urea-formaldehyde.
- .7 Nails and staples: to CSA B111.
- .8 Wood screws: plain, type and size to suit application.
- .9 Splines: wood and metal.
- .10 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .11 Stainless steel: to ASTM A276, Type 304.
- .12 Prefinished Hardboard/Pegboard: Wood fibre hardboard, tempered, 6 mm thick with one side prefinished.

2.2 CASINGS, BASE AND TRIMS

- .1 Size: refer to drawings. Medium density fibreboard, paint (PT4). Refer to section 09 91 23 – Interior Painting. Radius top of baseboards and double radius at casings for doors and windows.

2.3 WORKBENCHES

- .1 Workbenches:
 - .1 Fabricate to AWMAC custom quality grade.
 - .2 Framing, furring, blocking, nailing strips, grounds and rough bucks:
 - .1 S2S is acceptable for concealed products.
 - .2 Board sizes: "standard" or better grade.
 - .3 Dimension sizes: "standard" light framing or better grade.
 - .4 Urea-formaldehyde free.
 - .3 Shelving:
 - .1 MDF, square edge, 19mm thick. Paint.
 - .4 Countertops: Continuous, seamless, stainless steel. Refer to drawings.
 - .5 Pegboard: Refer to drawings.

2.4 FABRICATION

- .1 Set nails and countersink screws apply plain wood filler to indentations, sand smooth and leave ready to receive finish.
- .2 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .3 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .4 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

2.5 HARDWARE

- .1 Not used.

Part 3 Execution

3.1 INSTALLATION

- .1 Do architectural woodwork to Quality Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC), except where specified otherwise.
- .2 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.

- .3 Fasten and anchor millwork securely. Provide heavy duty fixture attachments for wall mounted cabinets.
- .4 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .5 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .6 Install wood window sills as noted in drawings.
- .7 Coordinate installation of in-wall continuous wood blocking behind workbenches and tool storage pegboard.

3.2 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Clean all surfaces.

3.3 PROTECTION

- .1 Protect from damage until final inspection.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Division 03
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 07 27 00 - Air and Vapour Barriers
- .4 Section 07 46 46 – Cementitious Siding

1.2 REFERENCES

- .1 Underwriters Laboratories of Canada (ULC)
 - .1 ASTM C612-04, Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
 - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
 - .3 CAN/ULC-S702- 97, Thermal Insulation, Mineral Fibre, for Buildings.
 - .4 CAN/ULC-S704-03, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01300 Submittals. Indicate VOC's insulation products and adhesives.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.4 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

- .1 Mineral fibre insulation must be formaldehyde free.

Part 2 Products

2.1 INSULATION

- .1 High Density Extruded polystyrene (XPS): to CAN/ULC-S701.
 - .1 Type: 4.
 - .2 RSI (R-Value) and Thickness: as indicated in drawings.
 - .3 Edges: shiplapped.
- .2 Mineral Fibre Board Insulation: to CAN/ULC-S702- 97.
 - .1 Purpose made, dual density fibre board for use in cavity and rainscreen applications.
 - .2 R-Value: RSI 0.70/ 25.4mm (R4.0/inch)
 - .3 Exterior wall as noted on drawings.
 - .1 Type 1.
 - .2 Density: 128 kg/m³.
 - .3 Thickness as indicated.
 - .4 Approved product:
 - .1 Rockwool “Comfortboard 80”
 - .2 Approved equivalent.

2.2 ADHESIVE

- .1 Adhesive (for polystyrene): to CGSB 71-GP-24.
- .2 Compatible with board insulation.

2.3 ACCESSORIES

- .1 Strapping: Refer to drawings and Section 06 10 00 Rough Carpentry.
- .2 Fasteners: length, number, spacing and embedded depth to suit installation, as recommended by manufacturer.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 WORKMANSHIP

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN4-S604 type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by Departmental Representative.

3.3 EXAMINATION

- .1 Examine substrates and immediately inform Departmental Representative in writing of defects.
- .2 Prior to commencement of work ensure:
 - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.4 RIGID POLYSTYRENE INSTALLATION

- .1 Refer to drawings. Install as per manufacturer's written instructions to suit application.

3.5 UNDER SLAB INSTALLATION

- .1 Install in accordance with manufacturer's written instructions to suit application.

3.6 MINERAL FIBRE BOARD INSTALLATION

- .1 Install mineral fibre board in accordance with manufacturer's written instructions to suit application

3.7 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 27 00 – Air Barriers

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C553-02, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S702-1997, Standard for Mineral Fibre Insulation.
 - .2 CAN/ULC S102 – Surface Burning Characteristics

Part 2 Products

2.1 INSULATION

- .1 Stud Cavities: Mineral Fibre Batt Insulation
 - .1 Mineral Fibre batt: to CAN/ULC S702.
 - .1 Type: 1
 - .2 Interior Partition Stud Cavity Applications: Density 40kg/m3.
 - .3 Exterior Wall Stud Cavity Applications: Density 32kg/m3.
 - .4 Thickness and RSI values: as indicated.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSULATION INSTALLATION

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C1320.
- .2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .3 Do not compress insulation to fit into spaces.

- .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 Type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B vents.

3.3 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 06 10 00 – Rough Carpentry.
- .2 Section 07 27 00 – Air and Vapour Barriers.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S702-2012 , Standard for Mineral Fibre Insulation for Buildings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for loose fill insulation and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Test Reports:
 - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

- .1 Provide 2 copies of Certification of Coverage and Application Chart in accordance with CAN/ULC-S702 to Departmental Representative, certified by Applicator's signature that the information is correct.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials in accordance with manufacturer's recommendations.

- .3 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

- .1 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
- .2 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of insulation materials.
- .3 Ventilation:
 - .1 Ventilate area of work in accordance with manufacturer's written instructions by use of approved portable supply and exhaust fans.
- .4 Protection:
 - .1 Provide temporary enclosures to prevent dust from contaminating air beyond application area.
 - .2 Protect adjacent surfaces and equipment from damage by fall-out, and dust.

Part 2 Products

2.1 MATERIALS

- .1 Mineral fibre insulation: to CAN/ULC-S702, asbestos-free mineral fibre.
 - .1 Type 5 - blowing wool, suitable for application by means of pneumatic equipment.
 - .2 Refer to drawings for RSI values.
- .2 Vapour retarder: in accordance with Section 07 27 00 Air and Vapour Barriers.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for loose fill insulation application in accordance with manufacturer's written instructions.

3.2 LOOSE FIBRE INSTALLATION

- .1 Pneumatically place loose fibre insulation above ceiling between and over joists to provide minimum thermal resistance value RSI as indicated.
- .2 Ensure ceiling areas exposed to outside air are insulated.
- .3 Ensure unobstructed air circulation to eave vents.
- .4 Install plywood baffles to prevent insulation from spilling over top of exterior wall and causing blockage of soffit vents, and to prevent displacement of insulation by wind entering vents.

- .5 Keep insulation minimum 75 mm from heat emitting devices and recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 chimneys and CSA B149.2 type B and L and CSA B149.1 vents.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.
- .3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

- .1 Section 01 00 05 - General Requirements
- .2 Section 06 10 00 – Rough Carpentry

1.2 REFERENCES

- .1 American Society for Testing and Materials
 - .1 ASTM E 96/E 96 M, Water Vapor Transmission of Materials, desiccant method.
- .2 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S705.1-01, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Material Specification.
 - .2 CAN/ULC-S705.2-02, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Installer's Responsibilities-Specification.

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for including product characteristics, performance criteria and limitations.
 - .2 Submit proof of License of the Contractor by CUFCA (Canadian Urethane Foam Contractors Association Inc.) prior to commencing the work. Licensing is required by CAN/ULC S705.2-05 Installation Standard.
 - .3 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Maintenance Manuals:
 - .1 Conform to Section 01 78 00 – Closeout Submittals.

1.2 MOCK-UP

- .1 Construct on site a mock-up in accordance with Section 01 45 00.
- .2 The mock-up area shall be minimum 5 m² and include components of the work such as attachments, penetrations and corners.
- .3 The mock-up shall be reviewed by the Departmental Representative to verify conformance with the specification, workmanship and appearance. Recommended changes to installation methods and procedures may be agreed to at this time.
- .4 The mock-up may be part of the finished work.

- .5 This mock-up shall constitute a standard of acceptance for the remaining work.

1.3 QUALITY ASSURANCE

- .1 Applicators to conform to Canadian Urethane Foam Contractors Association Quality Assurance Program.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with with manufacturer's written instructions.
- .2 Materials are to be delivered in original containers and packaged with appropriate MSDS and labels.

1.5 SAFETY REQUIREMENTS

- .1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations.

1.6 PROTECTION

- .1 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and 24 hour after application to maintain non-toxic, unpolluted, safe working conditions.
- .2 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.
- .3 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.

1.7 ENVIRONMENTAL CONDITIONS

- .1 Apply spray polyurethane foam when chemical, atmospheric and cavity/surface temperatures are within the limitations required by the CAN/ULC S705.2-05 Installation Standard and as recommended by the manufacturer.

PART 2 Products

2.1 MATERIALS

- .1 Insulation: 2 component spray polyurethane to CAN/ULC-S705.1.
- .2 Composition: Medium-density closed cell foam. Minimum in-place core density 32.0 kilograms per cubic meter (2 lb/ft³)
- .3 Primers: in accordance with manufacturer's recommendations for surface conditions.
- .4 Low expansion foam: closed cell, one-component moisture cure polyurethane. Must not contain urea formaldehyde or formaldehyde. Core density not less than 23kg/m³ (1.44 lbs/ft³).

- .5 Refer to drawings for RSI values.

PART 3 Execution

3.1 EXAMINATION

- .1 Verify that surfaces and conditions are suitable to accept work as outlined in this section.
- .2 Prior to commencement of work report in writing to the consultant any defects in surfaces or conditions that may adversely affect the performance of products installed under this section.

3.2 PREPARATION

- .1 Mask and cover adjacent areas to protect from over spray.
- .2 Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
- .3 Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
- .4 Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

3.3 APPLICATION

- .1 Do not install product after expiry date on the container.
- .2 Manufacture of material on site by qualified installer trained to spray urethane foam insulation in accordance with CAN/ULC-S705.2
- .3 Apply insulation to clean surfaces in accordance with CAN/ULC-S705.2 and manufacturer's printed instructions. Use primer where recommended by manufacturer.
- .4 Apply spray foam in accordance with ASTM E 96/E 96 M if the spray foam is to act as a vapour barrier.
- .5 Apply sprayed foam insulation in thickness and in locations as indicated in drawings.
- .6 Apply in consecutive lifts as recommended by manufacturer to thickness indicated on drawings. Lifts shall be not less than 15mm and not greater than 50mm. Allow to cure between lifts.
- .7 Maintain minimum 75mm clearance from heat-emitting devices.
- .8 Finished surface of foam insulation to be free of voids and imbedded foreign objects.
- .9 Trim, as required, any excess thickness that would interfere with the application of cladding/covering system by other trades.

3.4 LOW EXPANSION FOAM

- .1 Install low expansion foam appropriate to the installation between door and window frames and the adjacent structure to avoid causing pressure on the frame due to the expansion of the foam.

3.5 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.6 TOLERANCES

- .1 Maximum variation from indicated thickness: minus (-) 6mm; plus (+) 12mm.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove insulation material spilled during installation, clean affected surfaces.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 46 13 – Preformed Metal Panels
- .3 Section 07 46 46 – Cementitious Siding
- .4 Section 07 92 00 - Joint Sealants
- .5 Section 08 54 13 – Fiberglass Windows
- .6 Section 087 90 10 – Door, Frame & Hardware Schedule

1.2 REFERENCES-

- .1 ASTM International
 - .1 ASTM C920; Standard Specification for Elastomeric Joint Sealants
 - .2 ASTM C1193; Standard Guide for Use of Joint Sealants
 - .3 ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting
 - .4 ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics
 - .5 ASTM E84; Test Method for Surface Burning Characteristics of Building Materials
 - .6 ASTM E96; Test Method for Water Vapor Transmission of Materials
 - .7 ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
 - .8 ASTM E2178; Test Method for Air Permeance of Building Materials
 - .9 ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
 - .10 ASTM E154-99 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls or as Ground Cover
 - .11 ASTM E96-05 Standard Test Methods for Water Vapor Transmission of Materials
 - .12 ASTM F1249-06 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
 - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
- .3 AATCC – American Association of Textile Chemists and Colorists
 - .1 Test Method 127 Water Resistance: Hydrostatic Pressure Test
- .4 TAPPI

- .2 Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
- .3 Test Method T-460; Air Resistance (Gurley Hill Method)

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheets.
 - .2 Submit summary of test results as per paragraph 8.3 of ASTM E 1745.

1.4 QUALITY ASSURANCE

- .1 Mock-Ups:
 - .1 Submit mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Convene pre-installation meeting prior to construction of mock-up, include major sub-trades..
 - .3 Install mock-up using approved air barrier assemblies including seaming, fasteners, flashing, tape and related accessories per manufacturer's current printed instructions and recommendations.
 - .1 Mock-up size: approximately 4 meters by 4 meters including wall opening.
 - .4 Mock-up will be used to judge workmanship, substrate preparation, and material application.
 - .5 Installation shall be in accordance with manufacturer's installation guidelines and recommendations.
 - .6 Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.
- .2 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.
- .3 Allow 48 h for inspection of mock-up by Consultant before proceeding with air/vapour barrier Work.

1.5 SEQUENCING

- .1 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .2 Store weather barrier materials as recommended by system manufacturer

Part 2 Products

2.1 POLYETHYLENE VAPOUR BARRIER

- .1 Polyethylene film: to CAN/CGSB-51.34, 0.15 mm thick.

2.2 AIR AND MOISTURE BARRIER (HOUSING UNITS and GARAGE)

- .1 Spunbonded polyolefin, non-woven, non-perforated.
- .2 Performance Characteristics:
 - 1. Air Penetration: <.004 cfm/ft² at 1.57 psf, when tested in accordance with ASTM E2178. Type I per ASTM E1677.
 - 2. Water Vapor Transmission: 56 perms, when tested in accordance with ASTM E96-05, Method A.
 - 3. Water Penetration Resistance: 250 cm when tested in accordance with AATCC Test Method 127.
 - 4. Basis Weight: 1.8 oz/yd², when tested in accordance with TAPPI Test Method T-410.
 - 5. Air Resistance: 1200 seconds, when tested in accordance with TAPPI Test Method T-460.
 - 6. Tensile Strength: 30/30 lbs/in., when tested in accordance with ASTM D882.
 - 7. Tear Resistance: 8/6 lbs, when tested in accordance with ASTM D1117.
 - 8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 15, Smoke Developed: 15
- .3 Acceptable products:
 - .1 Basis of Design: Dupont Tyvek HomeWrap, by Dupont, www.construction.tyvek.com
 - .2 Approved equivalent.

2.3 CRAWLSPACE VAPOUR RETARDER

- .1 Multi-layer plastic extrusion, continuously sealed, sheet-style vapour retarder for use as crawlspace ground cover.
- .2 Vapour retarder must have all of the following qualities:
 - .1 Permeance of less than 0.01 Perms [grains/(s.f.*hr*inHg)] as tested in accordance with ASTM E 1745 Section 7.1.
 - .2 Strength: ASTM E 1745 Class A.
 - .3 Compatible and available tapes, sealants, vapour-proofing mastic, pipe boots for continuous seal.
- .3 Acceptable products:
 - .1 Basis of Design: Stego Industries: Stego Wrap Vapour Barrier (15 mil) by Stego Industries LLC, www.stegoindustries.com
 - .2 Approved equivalent

2.4 ACCESSORIES – POLYETHYLENE VAPOUR BARRIER

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
- .2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer. To Section 07 92 00 - Joint Sealing .
- .3 Staples: minimum 6 mm leg.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

2.5 ACCESSORIES – AIR AND MOISTURE BARRIER (HOUSING UNITS and GARAGE)

- .1 Seaming Tape: as recommended by manufacturer.
- .2 Fasteners: as recommended by manufacturer.
- .3 Sealants: Refer to Section 07 92 00 Joint Sealants. Sealants are to be compatible and as recommended by manufacturer.
- .4 Adhesives: as recommended by manufacturer.
- .5 Primers: as recommended by manufacturer.
- .6 Flashings and Peel and Stick Membranes: At perimeter of openings and as recommended by manufacturer to suit type of opening and to ensure weather-tight seal.

2.6 ACCESSORIES- CRAWLSPACE VAPOUR RETARDER

- .1 Sealant: compatible with vapour retarder materials, recommended by manufacturer. Refer to Section 07 92 00 - Joint Sealing.
- .2 Vapour-proof mastic: compatible with vapour retarder materials, recommended by manufacturer.
- .3 Seaming tape: compatible with vapour retarder materials, recommended by manufacturer.
- .4 Pipe boots: compatible with vapour retarder materials, recommended by manufacturer.
- .5 Foam Seal: Spray-applied medium density spray polyurethane foam insulation/air/vapour barrier compatible with vapour retarder materials and as recommended by manufacturer.
- .6 Sheet steel: Galvanized steel, Z275 zinc coating; 0.8 mm thick core steel.
- .7 Attachments: Galvanized steel bars and anchors.
- .7 Primer: Appropriate to application.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify substrate and surface conditions are in accordance with manufacturer recommended tolerances prior to installation of barrier and accessories.

3.2 INSTALLATION - POLY VAPOUR BARRIER

- .1 Refer to Wall Types and details on drawings for location and assembly.
- .2 Ensure services are installed and inspected prior to installation of retarder.
- .3 Install sheet vapour retarder on warm side of exterior wall and ceiling assemblies prior to installation of gypsum board to form continuous retarder.
- .4 Use sheets of largest practical size to minimize joints.
- .5 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.
- .6 Exterior Surface Openings
 - .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame using sealant recommended by manufacturer.
- .7 Perimeter Seals
 - .1 Seal perimeter of sheet vapour barrier as follows:
 - .1 Apply continuous bead of sealant, minimum 6mm wide and high, to substrate at perimeter of sheets.
 - .2 Lap sheet over sealant and press into sealant bead.
 - .3 Install staples through lapped sheets at sealant bead into wood substrate.
 - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .8 Lap Joint Seals
 - .1 Seal lap joints of sheet vapour barrier as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
 - .4 Install staples through lapped sheets at sealant bead into wood substrate.
 - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .9 Electrical Boxes
 - .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
 - .1 Install moulded box vapour barrier Wrap boxes with film sheet providing minimum 300 mm perimeter lap flange.

- .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

3.3 **INSTALLATION – AIR AND MOISTURE BARRIER (HOUSING UNITS and GARAGE)**

.1 Air and Moisture Barrier:

- .1 Install over exterior face of exterior wall substrate in accordance with manufacturer recommendations.
- .2 Start installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
- .3 Install weather barrier in a horizontal manner starting at the lower portion of the wall surface. Maintain weather barrier plumb and level.
- .4 Extend bottom roll edge over sill plate interface 2” to 3” minimum. Seal weather barrier with sealant or tape. Shingle weather barrier over back edge of thru-wall flashings and seal weather barrier with sealant or tape. Ensure weeps are not blocked.
- .5 Subsequent layers shall overlap lower layers a minimum of 6 inches horizontally in a shingling manner.
- .6 Window and Door Openings: Extend weather barrier completely over openings.
- .7 Weather Barrier Attachment:
 - .1 Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommended fasteners, spaced 12 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.
- .8 Apply manufacturer's recommended flashing membrane to weather barrier membrane prior to the installation cladding anchors.

.2 Seaming

- .1 Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- .2 Seal any tears or cuts as recommended by weather barrier manufacturer.

.3 Opening Preparation

- .1 Cut weather barrier in an “**I**ut” pattern. A modified **I**-cut is also acceptable.
 - .1 Cut weather barrier horizontally along the bottom and top of the window opening.
 - .2 From the top center of the window opening, cut weather barrier vertically down to the sill
 - .3 Fold side and bottom weather barrier flaps into window opening and fasten.
- .2 Cut a head flap at 45-degree angle in the weather barrier membrane at window head to expose 8 inches of sheathing. Temporarily secure weather barrier membrane flap away from sheathing with tape.

.4 Flashing

- .1 Cut manufacturer's recommended flashing a minimum of 12 inches longer than width of sill rough opening. Apply primer as recommended by the manufacturer.

- .2 Cover horizontal sill by aligning edge of manufacturer's recommended flashing with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
 - .3 Fan flashing at bottom corners onto face of wall. Firmly press in place. Follow manufacturer's recommended method of fastening fanned edges.
 - .4 On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
 - .5 Install window according to manufacturer's instructions.
 - .6 Apply 4-inch wide strips of manufacturer's recommended flashing at jambs overlapping entire mounting flange. Extend jamb flashing 1-inch above top of rough opening and below bottom edge of sill flashing.
 - .7 Apply 4-inch wide strip of manufacturer's recommended flashing as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
 - .8 Position weather barrier head flap across head flashing. Adhere using 4-inch wide manufacturer's recommended flashing over the 45-degree seams.
 - .9 Tape head flap in accordance with manufacturer recommendations.
 - .10 On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.
- .5 Thru-wall Flashing Installation
- .1 Apply primer per manufacturer's written instructions.
 - .2 Install preformed corners and end dams bedded in sealant in appropriate locations along wall.
 - .3 Starting at a corner, remove release sheet and apply membrane to primed surfaces in lengths of 8 to 10 feet.
 - .4 Extend membrane through wall and leave ¼ inch minimum exposed to form drip edge.
 - .5 Roll flashing into place. Ensure continuous and direct contact with substrate.
 - .6 Lap ends and overlap preformed corners 4 inches minimum. Seal all laps with sealant.
 - .7 Trim exterior edge of membrane 1-inch and secure metal drip edge per manufacturer's written instructions.
 - .8 Terminate membrane on vertical wall. [Terminate into reglet, counterflashing or with termination bar.]
 - .9 Apply sealant bead at each termination.
- .6 Thru-Wall Flashing / Weather Barrier Interface At Base Of Wall
- .1 Overlap thru-wall flashing with weather barrier by 6-inches.
 - .2 Mechanically fasten bottom of weather barrier through top of thru-wall flashing.
 - .3 Seal vertical and horizontal seams with tape or sealing membrane.

- .7 Thru-Wall Flashing / Weather Barrier Interface At Window Head
 - .1 Cut flap in weather barrier at window head.
 - .2 Prime exposed sheathing.
 - .3 Install lintel as required. Verify end dams extend 4 inches minimum beyond opening.
 - .4 Install end dams bedded in sealant.
 - .5 Adhere 2 inches minimum thru-wall flashing to wall sheathing. Overlap lintel with thru-wall flashing and extend ¼ inch minimum beyond outside edge of lintel to form drip edge.
 - .6 Apply sealant along thru-wall flashing edges.
 - .7 Fold weather barrier flap back into place and tape bottom edge to thru-wall flashing.
 - .8 Tape diagonal cuts of weather barrier.
 - .9 Secure weather barrier flap with fasteners.

3.4 INSTALLATION - CRAWLSPACE VAPOUR RETARDER

- .1 Preparation
 - .1 Ensure that base material is approved by Departmental Representative or Geotechnical Engineer.
 - .2 Level and compact base material
- .2 Installation
 - .1 Install vapour retarder in accordance with manufacturer's written instructions and ASTM E 1643.
 - .2 Unroll vapour retarder with the longest dimension parallel with the longest direction of the crawlspace.
 - .3 Lap vapour retarder over footings and/or seal to foundation walls. See drawings.
 - .4 Overlap joints 150mm (6 inches) and seal with manufacturer's seaming tape.
 - .5 Seal all penetrations (including pipes) per manufacturer's written instructions.
 - .6 No penetration of the vapour retarder is allowed except for permanent utilities and radon exhaust pipes.
 - .7 Repair damaged areas by cutting patches of vapour retarder, overlapping damaged area 150 mm (6 inches) and taping all sides with manufacturers' seaming tape.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Cementitious lap siding, accent siding and trim, sealants associated with installation of panels and lap siding.
- .2 Cementitious skirting panels.
- .3 Refer to Section 07 61 00 Sheet Metal roofing for side wall vents.

1.2 RELATED SECTIONS

- .1 Section 01 00 05 - General Requirements
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 07 27 00 – Air and Vapour Barriers (joint flashing behind lap siding)
- .4 Section 07 61 00 – Sheet Metal Roofing
- .5 Section 07 92 00 - Joint Sealants
- .6 Section 09 91 13 - Exterior Painting

1.3 REFERENCES

- .1 James Hardie Siding Products
 - .1 Best Practices – Installation Guide - Siding, Trim and Interior Products, Version 4.0
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 1186-08 (2012) Standard Specification for Flat Fibre-Cement Sheets
 - .2 ASTM C 1325-14 Standard Specification for Non-Asbestos Fibre-Mat Reinforced Cementitious Backer Units
 - .3 ASTM D 226: Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 - .4 ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .5 ASTM E119: Test Method for Fire Tests of Building Construction and Materials.
 - .6 ASTM C 954: Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.110 inch in Thickness.
 - .7 ASTM C 1002: Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .8 ASTM C 1280: Standard Specification for Application of Gypsum Sheathing.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 00 05 General Requirements.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature and specifications.
 - .2 Submit manufacturer's printed Material Safety Data Sheet.
- .3 Shop Drawings:
 - .1 Provide detailed shop drawings of cementitious siding materials application including trim around openings, panel joints, butting to different material and flashing details.
- .4 Samples
 - .1 For each finish product specified, provide two samples, minimum size 100 by 150 mm, representing actual product, colour, and patterns.

1.5 QUALITY ASSURANCE

- .1 Installer Qualifications: Company experienced in installation of cementitious siding with minimum five years documented experience.
- .2 Mock-Ups:
 - .1 Submit mock-ups in accordance with Section 01 00 05 General Requirements
 - .2 Mock-up will be used to judge workmanship, substrate preparation, and material application and detailing.
 - .1 Mock-up size: 4 meters by 4 meters including window opening.
 - .2 Locate where directed by Consultant.
- .3 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Store products in manufacturer's unopened packaging until ready for installation.
- .2 Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

1.7 PROJECT CONDITIONS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

- .1 Product Warranty: Standard manufacturer's product warranty against manufacturing defects.

Part 2 Products

2.1 MANUFACTURER

- .1 Lap Siding, Accent Siding, Trim Boards: James Hardie Building Products, Inc. NO SUBSTITUTIONS.
- .2 Cementitious Panels: FINEX. NO SUBSTITUTIONS.

2.2 PRODUCTS

- .1 Cementitious Panels (Skirt Cladding)
 - .1 Non-combustible, glass-fibre reinforced, non-asbestos, cementitious board suitable for unfinished weather-exposed exterior applications. No labels showing on exterior exposed face.
 - .2 Type: Type A suitable for exterior application.
 - .3 Thickness: 13 mm (1/2") with reinforced edge.
 - .4 Sheet Size: 1219 mm (4') wide x 2440 mm (8'). Refer to drawings. Cut to suit.
 - .5 Finish: None.
 - .6 Joints: Butt joints. No flashing or caulking.
 - .7 Color: selected by Departmental Representative from manufacturer's standard range.
- .2 Fibre Cement Lap Siding
 - .1 Cementitious siding:
 - .1 James Hardie Building Products, Inc - "HardiePlank Select Cedarmill Color Plus", Climactic zone: HZ5
 - .2 Thickness: 7.9mm (5/16").
 - .3 Length: 3658 mm (12').
 - .4 Width: 184mm (7.25") with 152 mm (6") exposure.
 - .5 Finish:
 - .1 Factory applied finish; James Hardie "ColorPlus" Technology
 - .1 Colour 1 : JH70-30 "Evening Blue"
 - .2 Texture: Wood grain.

2.3 ACCESSORIES

- .1 Trim Boards
 - .1 James Hardie Building Products, Inc - "4/4 HardieTrim NT3 Boards" Climactic zone: HZ5
 - .2 Thickness: 19.0 mm (3/4").
 - .3 Length: 3658 mm (12').
 - .4 Finish: Factory applied finish; James Hardie "ColorPlus" Technology
 - .1 Colour 2: JH10-20 Arctic White.
 - .2 Texture: Smooth.

- .2 Accent Siding
 - .1 James Hardie Building Products, Inc - "HardieShingle Straight Edge Panel Siding" Climactic zone: HZ5
 - .2 Thickness: 6.3 mm (1/4").
 - .3 Sheet Size: 1219 mm (4') wide x 406 mm (16") high (178 mm/7" exposure).
 - .4 Finish: Factory applied finish; James Hardie "ColorPlus" Technology
 - .1 Colour 3: JH30-20 Sandstone Beige.
 - .2 Texture: Wood grain.
- .3 Side Wall Vents
 - .1 Refer to Section 07 61 00 – Sheet Metal Roofing.

2.4 FASTENERS

- .1 Skirt Cladding
 - .1 Exposed stainless steel screws complete with washers.
- .2 Cementitious Lap and Accent Siding
 - .1 Fasteners shall be blind nailed wherever possible. Where blind nailing is not possible fasteners shall be treated to accept paint adhesion. Fasteners shall be painted to match cementitious siding colour using manufacturer approved product.
 - .1 Fasteners as recommended by manufacturer.
- .3 Trim Boards
 - .1 Exposed nail heads set flush. Nails shall be treated to accept paint adhesion. Fasteners shall be painted to match cementitious siding colour using manufacturer approved product.

2.5 JOINT FLASHING

- .1 Air barrier membrane, refer to Section 07 27 00 Air Barrier.

2.6 CAULKING

- .1 Refer to Section 07 92 10 – Joint Sealing.

2.7 FINISHING

- .1 Repair nicks, scrapes and nail holes with manufacturer approved matching paint colour products
- .2 Paint or seal all field cut edges during the installation process using an approved paint or sealer compatible with the final paint finish and colour.

Part 3 Execution

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.

- .2 If framing preparation is the responsibility of another installer, notify Consultant of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

- .1 Follow all safety procedures recommended by the manufacturer
- .2 Install materials in strict accordance with manufacturer's installation instructions.
- .3 Do not install cementitious panels or planks directly against concrete or brick. Isolate panels or planks with metal flashing as indicated on drawings.
- .4 Caulk, prime and paint all field cut edges.
- .5 Skirt Cladding
 - .1 Install 1200 mm wide panels. Length varies.
 - .2 Place fasteners no closer than 9.5 mm (3/4") from panel edges and 50 mm (2") from panel corners.
 - .3 Joint treatment: None. Butt joints. Refer to drawings for layout.
- .6 Fibre Cement Lap Siding
 - .1 Install siding utilizing blind nailing procedure.
 - .2 Stagger butt joints
 - .3 Joint treatment: Provide joint flashing at each butt joint between planks. Joint flashing shall be peel and stick membrane.
 - .4 Leave gaps between plank ends and planks and trim pieces as recommended by the manufacturer.
 - .5 Apply colour matched edge coater to end cuts.
 - .6 Remove laminate protective sheet immediately after installation of each course.
- .7 Fibre Cement Panels
 - .1 Install panels in largest size possible. Butt joining of field-cut panels to create panels less than 2426 x 1206 shall not be permitted.
 - .2 Place fasteners no closer than 9.5 mm (3/4") from panel edges and 50 mm (2") from panel corners.
 - .3 Install panel using 13 mm (1/2") spacers at horizontal joints. Leave bottom edge of panel above all horizontal trims exposed, no caulking shall be placed at this overlap of Horizontal Reveal trim. Factory primed edges shall always be used.
 - .4 Joint treatment: purpose made aluminum trim pieces.

3.3 FIELD PAINTING

- .1 Refer to Section 09 91 13 Exterior Painting.

3.4 JOINT SEALANT

- .1 Refer to Section 07 92 00 Joint Sealants.
- .2 Schedule of joint sealant locations:
 - .1 Butt joints of horizontal planks (colour to match planks)
 - .2 As recommended by mineral fibre plank and paneling manufacturer.

3.5 CLEANING

- .1 Wash down surfaces to remove any surface dirt.

3.6 PROTECTION

- .1 Protect finished Work from damage.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Latex modified concrete facing, bonded to rigid polystyrene foam insulation backing, for exterior application to perimeter of garage foundations, with related flashings.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-In-Place Concrete

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM International):
 - .1 ASTM A123/A123M-09, Zinc (Hot Dip Galvanized) Coatings on Iron or Steel Products
 - .2 ASTM C518-04, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .3 ASTM D1621-04a, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
 - .4 ASTM D2842-06, Standard Test Method for Water Absorption of Rigid Cellular Plastics
 - .5 ASTM D696-08, Standard Test Method for Determining Coefficient of Linear Thermal Expansion of Plastics between -30C and +30C

1.4 SYSTEM DESCRIPTION

- .1 Assembly of components includes purpose supplied, preformed panel mounting clips capable of securing factory bonded concrete faced insulated wall panels to structural supporting wall.

1.5 SUBMITTALS

- .1 Submission procedures as specified in Section 01 33 00 - Submittal Procedures.
- .2 Installation Data: Manufacturer's special installation requirements.
- .3 Shop Drawings: Indicate dimensions, layout, construction and expansion joints, construction details, methods of anchorage.
- .4 Samples: Submit two (2) samples of full size wall siding, 200 x 200 mm (8 x 8 inch) in size illustrating manner of fitment devices with adjacent panels, with specified finishes and surface texture.

1.6 DELIVERY, STORAGE, AND PROTECTION

- .1 Transport, handle, store, and protect delivered products as specified in Section 01 61 00 - Common Product Requirements.
- .2 Store concrete faced insulated wall panels under cover, and in original packaging until ready to install. Store opened packages under cover until installed. Schedule installation to minimize open package time
- .3 Store prefinished material off ground protected from weather, to prevent twisting, bending, or abrasion, and to provide ventilation.
- .4 Prevent contact with materials which may cause electrolysis, discolouration or staining.

1.7 WARRANTY

- .1 Provide manufacturers five (5) year limited warranty to include panel replacement for delamination of concrete facing.

Part 2 Products

2.1 MANUFACTURERS

- .1 Tech-Crete Processors Ltd: "Concrete Faced Insulated Panels" or approved equivalent.

2.2 WALL PANEL ATTACHMENT

- .1 Galvanized Steel: ASTM A123/A123M-08 - Zinc-Coated (Galvanized), Z275 to G90 coating designation

2.3 INSULATION

- .1 Extruded polystyrene, flame/smoke classification to code requirements in accordance with CAN/ULC S-102.2-03
- .2 Thermal resistance per 25.4mm: $RSI \geq 0.88$ (R-Value ≥ 5.0 inch)
- .3 Foam Compressive Strength: 240 kPa (35 PSI) in accordance with ASTM D1621
- .4 Water Absorption, ASTM D2842: $<0.7\%$ by volume, to ASTM D2842-06.
- .5 Water Vapour Permeance, ASTM E96: 1.0 perms.
- .6 Insulation Thickness: 76 mm. (RSI 2.64)

2.4 CONCRETE FACED INSULATED WALL PANELS

- .1 Concrete: Latex modified concrete mix, 8 mm (5/16") thick, with control joint score at mid-length.

- .2 Edge Treatment: Tongue and groove along longitudinal foam edges, butt joints on lateral edges.
- .3 Surface Finish: Textured Broom finish; Grey colour.

2.5 ACCESSORIES

- .1 Gaskets to Adjacent Substrates: Standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant; colour to match adjacent colour.
- .2 Sealants to Adjacent Substrates: Standard type suitable for use with installation of system; non-staining, non-skinning, non-shrinking and non-sagging; ultraviolet and ozone resistant; colour as selected.
- .3 Clips and Fasteners: Manufacturer's standard type to suit application; as supplied.
- .4 Field Repair and Touch-up: As recommended by panel manufacturer.

2.6 COMPONENTS

- .1 Exterior concrete faced insulated wall panel sizes:
 - .1 Width: 610 mm (24 inches).
 - .2 Length: 1220 mm (48 inches).
- .2 Internal and External Corners:
 - .1 Trim, Closure Pieces, Caps, Flashings, Facias, and Infills: Brake formed to required profiles.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions and substrates before starting work as specified in Section 01 71 00 - Examination and Preparation.
- .2 Verify that building support is ready to receive panel assembly.
- .3 Remove substrate surface irregularities before installing wall panels. Sweep and clear debris clear of surfaces to receive panels.

3.2 COMPONENT FABRICATION

- .1 Form sections and fastening clips true to shape, accurate in size, square, and free from distortion or defects.
- .2 Form custom pieces in longest practicable lengths.
- .3 Fabricate corners in one continuous piece.

3.3 INSTALLATION

- .1 Ensure snug fit between panel tongue and grooves, and lateral butt joints.
- .2 Fasten concrete faced insulated panels to structural support; aligned level and plumb.
- .3 Install panels with vertical joints and panel control joints in alignment.
- .4 Cut back insulation on back of panels, where they meet at an outside corners, to allow concrete face of panels to meet each other.
- .5 Use manufacturer's recommended concealed fasteners. Maintain neat appearance.

3.4 CLEANING

- .1 Clean installed work as specified in Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for sheet metal roofing and associated air barrier for conventional installation on sloped wood deck on housing units and garage. Side wall vents are included in this section.

1.2 RELATED SECTIONS

- .1 Section 07 46 46 – Cementitious Siding
- .2 Section 07 62 00 – Sheet Metal Flashing and Trim.
- .3 Section 07 72 53 – Snow Guards
- .4 Section 07 92 00 - Joint Sealants.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.
 - .3 ASTM D523-89(2008), Standard Test Method for Specular Gloss.
 - .4 ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .5 ASTM D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- .2 Canadian Sheet Steel Building Institute Standards
 - .1 CSSBI S8-2001, Quality & Performance Specification for Prefinished Sheet Steel Used for Building Products
 - .2 CSSBI 10M and 20M.

1.4 ROOF DESCRIPTION

- .1 Roof Type HR1 and R1 as noted on drawings.

1.5 DESIGN CRITERIA

- .1 Roofing Panels manufactured, fabricated and installed to withstand structural and thermal movement, wind load, snow build-up and weather exposure without defects, damage, and infiltration of water.
- .2 Design roof system in accordance with:
 - .1 CAN/CSA Standard S136 latest edition for the Design of Cold Formed Steel Structural Members.

- .2 Canadian Sheet Steel Building Institute Standards 10M and 20M.
- .3 National Building Code of Canada (latest edition).
- .3 Design fastener systems to withstand wind uplift on the roof and sliding forces induced by environmental loads.
- .4 Select ridge ventilation products in coordination with Section 07 62 00 to ensure soffit and roof ventilation products provide an unobstructed vent area not less than 1/300 of the insulated ceiling area as per the National Building Code. Vents are to be distributed uniformly on opposite sides of the building with not less than 25% of the required openings located at the top and 25% at the bottom of the space. Vents shall comply with CAN3-A93-M, "Natural Airflow Ventilators for Buildings."
- .5 This section is responsible to provide a snow guard designed specifically for this roof by a professional engineer registered in the province of Saskatchewan.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sheet metal roofing and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate arrangement of prefinished roof sheets including joints, types and locations of supports, fasteners, sealants and all metal components related to the roof installation.
 - .3 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .4 Samples:
 - .1 Submit duplicate 300 x 300 mm samples of each sheet metal material.

1.7 QUALITY ASSURANCE

- .1 Manufacturer and installer of the metal roof system must have a minimum of 5 years' experience in fabrication and installation of architectural metal roofing projects similar in scope.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect sheet metal roofing from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install roofing materials or adhesives when temperature is below manufacturer's recommendations.
- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.10 QUALIFICATIONS

- .1 Applicator: Company specializing in performing work of this section with minimum 5 years documented experience in installation of roof systems. roofing contractor will supply and install materials to acceptance of manufacturer in order to qualify for manufacturer's warranty.

1.11 WARRANTY

- .1 Contractor shall warrant that the sheet metal roofing and companion flashing and snow guard will stay in place and remain leakproof in accordance with the General Conditions, but for two years.

Part 2 Products

2.1 COMPATIBILITY

- .1 Compatibility between components of system and adjacent materials is essential. Provide a written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement and are eligible for system warranty.

2.2 SHEET METAL MATERIALS

- .1 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, Grade 230, with AZ150 coating (Galvalume), regular spangle surface, uncoiled, thermally cured clear organic resin passivation coating for unpainted finish.

2.3 PROFILE

- .1 Profile equivalent to Vicwest, "Prestige 16" or approved equivalent.
- .2 Single skin system on rigid decking.
 - .1 Snap-In/Interlocking Progressive System; thermal clip; standing seam-style seam, 32mm high, 406mm (16") wide panels.
 - .2 No exposed fasteners.
- .3 Finish: Weather XL.
- .4 Colour: 16154 Metro Brown

2.4 UNDERLAYMENT MEMBRANE

- .1 Self-adhered water resistive, high heat resistant, air and moisture barrier membrane to ASTM E 2178. Consisting of butyl rubber based adhesive with protective plastic release liner backed with a layer of high density cross laminated polyethylene, suitable for roof underlayment. Min. 0.76mm thickness (30 mils). Permeable self-adhesive layer with release film. Refer to details on drawings for locations and assembly.
 - .1 Grace Company: Grace Ultra
 - .2 Approved equivalent

2.5 ACCESSORIES

- .1 Roof Panel Support System: Hidden fastener, purpose-made, thermally responsive full height clip system, designed to accommodate full thermal expansion and contraction of the exterior roof sheet. Clips to be fabricated from a minimum of 0.61mm steel, with minimum Z275 galvanized coating.
- .2 Roof fasteners as specified by manufacturer to resist wind uplift and sliding snow forces.
- .3 Flashing: in accordance with Section 07 62 00 and manufacturer recommendations. Color: To match Metal Roofing Sheet. Formed from same materials (thickness and finish) as the Metal Roofing Sheet. Flashings to be custom fabricated to suit architectural details, as required.
- .4 Snow guard: Refer to Section 07 72 53 – Snow Guards.
- .5 Closures: Foam and metal closures to suit profiles selected, to manufacturer's recommendations.
- .6 Sealants: In accordance with manufacturer's recommendation and Section 07 92 00.
- .7 Isolation coating: alkali resistant bituminous paint.
- .8 Touch-up paint: as recommended by sheet metal roofing manufacturer.
- .9 Ridge vents: VicWest Field Notched Ridge Cap. Color to match roofing panels. Quantity and Net Free Area: to suit National Building Code ventilation requirements. Refer to drawings.
- .10 Roof vents: Prefinished roof vents to supplement ventilation capacity of ridge vent as necessary. Color to match roofing panels. Quantity and Net Free Area: to suit National Building Code ventilation requirements. Refer to drawings.
- .11 Side wall attic vents with integrated insect screens: Prefinished side wall vents to supplement ventilation capacity of ridge vent as necessary. Colour to be white. Quantity and Net Free Area: to suit National Building Code ventilation requirements. Refer to drawings.

2.6 FABRICATION

- .1 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .2 Fabricate Metal Roofing System components to comply with dimensions, profiles, gauges and details as shown on the approved shop drawings, including all companion flashings.

- .3 Fabricate all components of the system in the factory, ready for field installation.
- .4 Provide roof sheet and all accessories in longest practicable length to minimize field lapping.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sheet metal roofing installation in accordance with manufacturer's written instructions.
 - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 UNDERLAYMENT MEMBRANE

- .1 Install as per manufacturer's written instructions.

3.3 INSTALLATION – ROOF PANEL SYSTEM

- .1 Provide metal roofing sheets in longest standard length available from manufacturer.
- .2 Install exterior prefinished roof panels on panel support clips, using manufacturer's proper construction procedure. Ensure metal roofing sheet side-lap is positively retained by clips, and proper sheet coverage is maintained.
- .3 Install the seam-cap at all side laps as shown on the approved shop drawings. Add sealant as required. Mitre snap-cap as required to resist water entry.
- .4 Where indicated on approved shop drawings, secure the end-lap of metal roofing sheets in accordance with the manufacturers specifications and details to provide a weather-tight seal. Exposed fasteners to match colour of the roof sheet.
- .5 Provide notched and formed closures, sealed against weather penetration, at changes in pitch, at ridges and eaves and vertical walls where required.
- .6 Install all companion flashing as shown on the shop drawings. Use concealed fasteners when possible. Exposed fasteners to match colour of roof sheet.

3.4 SNOW GUARDS

- .1 Install snow guards in accordance with approved engineered shop drawings.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.6

PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by sheet metal roofing installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 05 50 00 – Metal Fabrications
- .2 Section 07 46 13 – Preformed Metal Siding
- .3 Section 07 46 46 – Cementitious Siding
- .4 Section 07 61 00 – Sheet Metal Roofing.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM A653/A653M-01a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual 1997.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B111-1974 (R1998), Wire, Nails, Spikes and Staples

1.3 SAMPLES

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit duplicate 100 x 100 mm samples of each type of sheet metal material, colour and finish.

1.4 DESIGN CRITERIA

- .1 Select soffit ventilation products in coordination with Section 07 61 00 to ensure soffit and roof ventilation products provide an unobstructed vent area not less than 1/300 of the insulated ceiling area as per the National Building Code. Vents are to be distributed uniformly on opposite sides of the building with not less than 25% of the required openings located at the top and 25% at the bottom of the space. Vents shall comply with CAN3-A93-M, “Natural Airflow Ventilators for Buildings.”

1.5 WARRANTY

- .1 Contractor shall warrant that sheet metal flashings will stay in place and remain leakproof in accordance with General Conditions (GC) - CCDC GC 12.3 , but for two years.

Part 2 Products

2.1 SHEET METAL MATERIALS

- .1 Zinc coated steel sheet: 0.8 mm thickness, commercial quality to ASTM A653/A653M, with Z275 designation coating.

2.2 PREFINISHED STEEL SHEET

- .1 Prefinished steel with factory applied silicone modified polyester finish.
 - .1 Stelco / Dofasco 8000 Series
 - .2 Colours : varies see below.

2.3 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Plastic cement: to CAN/CGSB 37.5.
- .3 Sealants: two component polyurethane, colour to match adjacent materials.
- .4 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .5 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .7 Solder: to ASTM B32, alloy composition.
- .8 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 METAL FLASHINGS, CAP FLASHINGS AND FASCIAS

- .1 Form flashings, copings and fascias to profiles indicated of 0.8mm thick prefinished steel.
- .2 Housing Units: Colour of miscellaneous prefinished metal flashings at walls : White. Colour of miscellaneous prefinished metal flashings at roof: Selected by Consultant from manufacturers standard range of colours. Color of fascia: White.
- .3 Garage: Colour of miscellaneous prefinished metal flashings at walls : White. Colour of miscellaneous prefinished metal flashings at roof: Selected by Consultant from manufacturers standard range of colours. Colour of fascia: White. Color of prefinished metal flashing at perimeter of garage door openings: White.

2.5 EAVES TROUGHS AND DOWNPIPES

- .1 Form eaves troughs and downpipes from prefinished steel, 28 gauge.
- .2 Clip hanger: galvanized metal hanger and stainless steel screws as recommended by eave trough manufacturer.

- .3 Sizes and profiles as indicated. Color: White.
- .4 Provide goosenecks, outlets, strainer baskets and necessary fastenings.

2.6 VENTILATED SOFFIT

- .1 Colour: Bright White.
- .2 Size: 407 mm (16") x 3700 mm (12'-1 5/16")
- .3 Style: 2 Panel Heavy Gauge Aluminum.
- .1 Acceptable products: Gentek 1607 Vented or approved alternate. Coordinate with Section 07 61 00 to ensure soffit and roof ventilation products provide the required net free ventilated area to suit National Building Code requirements.

Part 3 Execution

3.1 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.
- .2 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- .6 Coordinate with Section 07 61 00 to ensure soffit and roof ventilation products provide the required net free ventilated area to suit National Building Code requirements.

3.2 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details, FL Aluminum Sheet Metal Work in Building Construction and as detailed.
- .2 Use concealed fastenings except where approved before installation.
- .3 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips, as detailed.
- .4 "S-Lock" end joints and caulk with sealant.
- .5 Install metal flashing under cap flashing to form weather tight junction.

3.3 EAVES TROUGHS AND DOWNPIPES

- .1 Install eaves troughs and secure to building at 750 mm on centre with strap anchors.

- .1 Slope eaves troughs to downpipes as indicated.
- .2 Match exposed screw heads to colour of eave trough.
- .3 Seal joints watertight.
- .2 Install downpipes and provide goosenecks back to wall.
 - .1 Secure downpipes to wall with straps at 1800 mm on centre; minimum two straps per downpipe. Color: White.
- .3 Install splash pans as indicated.

3.4 VENTILATED SOFFIT

- .1 Install as indicated on drawings as per manufacturer's written instructions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 07 61 00 - Sheet Metal Roofing

1.2 REFERENCES

- .1 Conform to the current edition of the following codes and standards:
 - .1 Aluminum Association (AA) - Aluminum Standards and Data, 2003 Edition.
 - .2 ASTM International (ASTM):
 - .1 B85-03 - Standard Specification for Aluminum-Alloy Die Castings.
 - .2 B221-04a - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.4 SYSTEM DESCRIPTION

- .1 Snow fence designed by a professional engineer registered in the province of Saskatchewan. Refer to Section 07 61 00 – Sheet Metal Roofing.
- .2 Loading: Supplier to Design the ‘Snow Guard System’ to meet all applicable codes and loading requirements.
- .3 Factor of safety: Utilize a factor of safety 2 to determine allowable loads from ultimate tested clamp tensile load values.
- .4 Attachment system to provide attachment to standing seam metal roof:
 - .1 With only minor dimpling of panel seams.
 - .2 Without penetrations through roof seams or panels.
 - .3 Without use of sealers or adhesives.
 - .4 Without voiding roof warranty.

1.5 SUBMITTALS

- .1 Submittals for Review:
 - .1 Shop Drawings: Show locations of snow guards on roof and attachment spacing.
 - .2 Product Data: Include product description and installation instructions.
 - .3 Samples:
 - .1 Clamp samples.
 - .2 24 inch long cross member samples including coupler and other hardware.
- .2 Quality Control Submittals:
 - .1 Test results: Results of product load testing, issued by a recognized independent testing laboratory, showing load-to-failure value of attachment.
- .3 Closeout Submittals:

- .1 Certification: Installer's certification that snow guard system was installed in accordance with manufacturer's instructions and approved Shop Drawings.

Part 2 Products

2.1 COMPONENTS

- .1 Clamps:
 - .1 Manufactured from 6061-T6 aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.
 - .2 Clamp model: clamp suitable for the standing seam metal roofing. Non-penetrating.
 - .3 Set screws: 300 Series stainless steel, 18-8 alloy, 3/8 inch diameter, with round nose point.
 - .4 Attachment bolts: 300 Series stainless steel, 18-8 alloy, 10 mm diameter, with flat washers.
- .2 Brackets:
 1. Manufactured from 6061-T6 alloy and temper aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data or cast aluminum.
 2. Screws for attachment of brackets to roof: Stainless steel of type best suited to application.
- .3 Cross Members:
 - .1 Manufactured from 6061-T6 alloy and temper aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data.
 - .2 Receptacle in face to receive color-matched metal strips.
 - .3 Provide splice connectors ensuring alignment and structural continuity at end joints.
- .4 Colour Strips: Same material and finish as roof panels; obtained from the roof panel manufacturer.
- .5 Snow and Ice Clips: Aluminum, with rubber foot, minimum 3 inches wide. The number of clips to be as per manufacturers recommendations.

2.2 ACCEPTABLE MANUFACTURERS

- .1 Metal Roof Innovations, Ltd.- S-5! ColorGard complete with S-5! Clamps compatible with roof panel system
- .2 Approved equivalent

Part 3 Execution

3.1 EXAMINATION

- .1 Prior to beginning installation, verify that:
 - .1 Panel seaming is complete.

- .2 Panel attachment is sufficient to withstand loads applied by snow guard system.
- 3. Installation will not impede roof drainage.

3.2 PREPARATION

- .1 Clean areas to receive attachments; remove loose and foreign matter that could interfere with installation or performance

3.3 INSTALLATION

- .1 Install system in accordance with manufacturer's instructions and approved Shop Drawings.
- .2 Place clamps as required by design engineer.
- .3 Place clamps in straight, aligned rows.
- .4 Place both set screws on same side of clamp.
- .5 Tighten set screws to manufacturer's recommended torque. Randomly test set screw torque using calibrated torque wrench.
- .6 Insert color-matched metal strips into cross members, staggering strips to cover cross member joints.
- .7 Attach cross members to clamps; tighten bolts to manufacturer's recommended torque.
- .8 Install couplers at cross member end joints.
- .9 Do not cantilever cross members more than 4 inches beyond last clamp at ends.
- .11 Install SnoClips at spacings indicated on shop drawings.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 06 10 00 – Rough Carpentry.
- .2 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115-05, Fire Tests of Fire stop Systems.

1.3 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .3 Shop Drawings:
 - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

- .2 Construction details should accurately reflect actual job conditions.
- .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire stopping installations with 5 documented years experience.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended.
 - .2 Fire stop system rating: as indicated in drawings.
- .2 Re-penetrable fire rated cable pathway system for power and communication cables.
 - .1 Square profile, heavy gauge galvanized steel with intumescent material for rapid expansion.

- .2 Wall and floor applications.
- .3 Accessories including manufactured multi-gang plates, brackets, extensions and multi-slot frames.
- .4 Minimum fire rating of 4 hours.
- .5 Approved systems:
 - .1 ETI EZ Path 44+ fire rated pathway system complete with all accessories
- .3 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .4 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .5 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .6 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .7 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .8 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .9 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .10 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .11 Sealants for vertical joints: non-sagging.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by Consultant.
- .2 Mechanical pipe insulation: certified fire stop system component.
 - .1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

- .1 Inspections: notify Consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Top of fire-resistance rated masonry and gypsum board partitions.
 - .3 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .4 Control joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .5 Penetrations through fire-resistance rated floor slabs.
 - .6 Openings and sleeves installed for future use through fire separations.
 - .7 Around mechanical and electrical assemblies penetrating fire separations.
 - .8 Rigid ducts: greater than 129 cm² : fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials, preparation and application for caulking and sealants.

1.2 RELATED SECTIONS

- .1 Section 06 40 00 - Architectural Woodwork.
- .2 Section 07 27 00 – Air and Vapour Barriers
- .3 Section 07 62 00 – Sheet Metal Flashing and Trim
- .4 Section 08 54 13 – Fiberglass Windows

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
 - .2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
 - .4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
 - .5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data
 - .1 Manufacturer's product to describe.
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
 - .2 Submit manufacturer's instructions in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Instructions to include installation instructions for each product used.

- .3 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit duplicate samples of each type of material and colour.
 - .3 Submit cured samples of exposed sealants for each color where required to match adjacent material.
- .4 Maintenance Manuals:
 - .1 Conform to Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

1.6 PROJECT CONDITIONS

- .1 Environmental Limitations:
 - .1 Do not proceed with installation of joint sealants under following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 5 degrees C.
 - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
 - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

Part 2 Products

2.1 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.
- .3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT TYPES

- .1 Type 1 -Urethanes Three Part.
 - .1 Non-Sag to CAN/CGSB-19.24, Type 2, Class B, colour as selected by Consultant from standard range of manufacturer's colours.
 - .1 Acceptable material: Tremco "Dymeric 240",
 - .2 Or equivalent.
- .2 Type 2 -Urethanes One Part.
 - .1 Non-Sag to CAN/CGSB-19.13, Type 2, colour as selected by Consultant from standard range of manufacturer's colours.
 - .1 Acceptable material: BASF "Sonolastic NP 1".
 - .2 Or equivalent.
- .3 Type 3 -Silicones One Part.
 - .1 To CAN/CGSB-19.13. Colour as selected by Consultant from standard range of manufacturer's colours.
 - .1 Acceptable material: Dow Corning "Tub, Tile & Ceramic Silicone Sealant".
 - .2 Or equivalent.
- .4 Type 4 -Acrylic Latex One Part.
 - .1 To CAN/CGSB-19.17.
- .5 Type 5 -Acoustical Sealant.
 - .1 To ASTM C919.
- .6 Type 6 –Single Component Silicone Rubber sealant
 - .1 Self-leveling elastomeric polyurethane to ASTM C 920 Type S, Grade P. Colour as selected by Consultant from standard range of manufacturer's colours.
 - .1 Acceptable material: BASF "Silcoferm S".
 - .2 Or equivalent.
- .7 Type 7 –Epoxy Adhesive – Security Sealant

- .1 Acceptable material: "Dynapoxy EP-430 Fast"
- .2 No substitutions permitted.
- .3 Location: Room 001, Black Lake Police Building. Install only where instructed by Departmental Representative.

2.3 PREFORMED COMPRESSIBLE AND NON-COMPRESSIBLE BACK-UP MATERIALS.

- .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded open closed cell foam backer rod.
 - .2 Size: oversize 30 to 50 %.
- .2 Neoprene or Butyl Rubber.
 - .1 Round solid rod, Shore A hardness 70.
- .3 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
- .4 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.

2.4 SEALANT SELECTION

- .1 Exterior sealant: Sealant type: 1 or 2 (colour to be selected by consultant).
- .2 Perimeters of exterior openings where door and window frames meet exterior facade of building : Sealant type: 1 or 2.
- .3 Seal interior perimeters of exterior openings: Sealant type: 3.
- .4 Poly Vapour Barrier: Sealant type: 5.
- .5 Perimeters of interior window and door frames, base of interior door frames between frame and floor finish: Sealant type: 4.
- .6 Tops and bottoms of acoustic walls. Sealant type: 5.
- .7 Perimeters of countertop edges, Sealant type: 4.
- .8 Perimeter of fixtures (e.g. sinks, urinals, waterclosets, basins, vanities): Sealant type: 3.
- .9 In additional locations as noted on the drawings: confirm with Consultant.

2.5 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
- .2 Primer: as recommended by manufacturer.

Part 3 Execution

3.1 PROTECTION

- .1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter that may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

- .1 Refer to referenced Sections for specific installation instructions.
- .2 General Installation.
 - .1 Apply sealant in accordance with manufacturer's written instructions.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
 - .3 Apply sealant in continuous beads.
 - .4 Apply sealant using gun with proper size nozzle.
 - .5 Apply sufficient pressure to fill voids and joints solid.
 - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
 - .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
 - .8 Remove excess compound promptly as work progresses and upon completion.
- .3 Curing.
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.
- .4 Cleanup.
 - .1 Clean adjacent surfaces immediately and leave Work neat and clean.
 - .2 Remove excess and droppings, using recommended cleaners as work progresses.
 - .3 Remove masking tape after initial set of sealant.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 08 71 00 - Door Hardware.
- .2 Section 08 90 10 - Door, Frame, and Hardware Schedule.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-11, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM C591-13, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
 - .3 ASTM C1289-13e1, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
 - .3 CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/1.S.2/A440, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
 - .4 CSA-A440.4-07(R2012), Window, Door, and Skylight Installation
 - .5 CSA-A440.2/A440.3, Fenestration Energy Performance/User Guide to CSA A440.2-14, Fenestration Energy Performance.
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 2009.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80-2013, Standard for Fire Doors and Fire Windows.
 - .2 NFPA 252-2013, Standard Methods of Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S104-10, Standard Method for Fire Tests of Door Assemblies.
- .7 NFRC

- .1 NFRC 100 Determining Product U-Factors

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
 - .2 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC S104 for ratings specified or indicated.
 - .3 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC S104, ASTM E152 or NFPA 252 and listed by nationally recognized agency having factory inspection services.
 - .4 Maximum overall thermal transmittance of insulated exterior doors and frames shall not be more than $2.2 \text{ W}/(\text{m}^2 \times \text{K})$ calculated in accordance with CSA A440.2/A440.3, "Fenestration Energy Performance/User Guide to CSA A440.2-14, Fenestration Energy Performance or NFRC 100, "Determining Fenestration Product U-Factors".
 - .5 Doors and frames that act as environmental separators shall have an air leakage rate not greater than $0.50 \text{ L}/(\text{s} \times \text{m}^2)$ when tested in accordance with ASTM E283, "Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen" at pressure differential of 75 Pa.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
 - .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, louvred, arrangement of hardware and fire rating and finishes.
 - .3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing, fire rating, and finishes.
 - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
 - .5 Indicate compliance with design requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.

2.2 DOOR CORE MATERIALS

- .1 Honeycomb construction:
 - .1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.
- .2 Insulated core:
 - .1 Polyisocyanurate: Rigid, modified polyisocyanurate, closed cell board. Density; 32 kg/m³ (2.0 pcf) minimum, thermal values; RSI 1.9 (R 11.0) minimum, in accordance with ASTM C591 (un-faced) or C 1289 (faced).
 - .2 Satisfy overall maximum thermal transmittance values noted in design requirements.
- .3 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door. Core to be tested as part of a complete door assembly, in accordance with CAN/ULC S104, ASTM E152 or NFPA 252, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
 - .1 Adhesive: maximum VOC content 50 g/L.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.4 PRIMER

- .1 Touch-up prime CAN/CGSB-1.181.
 - .1 Maximum VOC limit 50 g/L.

2.5 PAINT

- .1 Field paint steel doors and frames in accordance with Sections 09 91 13 - Exterior Painting and 09 91 23 - Interior Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Exterior and interior top and bottom caps: steel.
- .3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .4 Metallic paste filler: to manufacturer's standard.
- .5 Fire labels: metal rivited.
- .6 Sealant: in accordance with Section 07 92 00 – Joint Sealants.
 - .1 Maximum VOC limit 250 g/L.
- .7 Glazing: in accordance with Section 08 80 50 - Glazing.
- .8 Make provisions for glazing as indicated and provide necessary glazing stops.
 - .1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screw.
 - .2 Design exterior glazing stops to be tamperproof.
- .9 Foam insulation: for space between door frame and wall at exterior door frames: Low expanding polyurethane foam insulation compatible with frame insulation.

2.7 FRAMES FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Exterior frames: 1.6 mm welded, thermally broken type construction using rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.
- .4 Interior frames: 1.6 mm welded type construction.
- .5 Strike bucket: accept a 25 mm throw dead bolt. Grout or wedge in the area of the strike bucket to prevent spreading.
- .6 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

- .7 Protect mortised cutouts with steel guard boxes.
- .8 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .9 Manufacturer's nameplates on frames and screens are not permitted.
- .10 Conceal fastenings except where exposed fastenings are indicated.
- .11 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .12 Insulate exterior frame components with polyurethane insulation.
- .13 Prepare frames to receive electronic monitoring and security devices. Refer to Section 08 71 10 - Door Hardware and Section 08 90 10 - Door, Frame and Hardware Schedule. Coordinate frame preparation with Electrical Divisions 26 and 28.

2.8 FRAME ANCHORAGE

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.9 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

- .1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

- .2 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .3 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
- .4 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .5 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
- .6 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .7 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC S104, ASTM E152, or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
- .8 Manufacturer's nameplates on doors are not permitted.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

- .1 Form face sheets for interior doors from 1.6 mm sheet steel with honeycomb core laminated under pressure to face sheets.

2.12 THERMALLY BROKEN DOORS AND FRAMES

- .1 Form each face sheet for exterior doors from 1.6 mm sheet steel.
- .2 Fabricate thermally broken doors by using polyisocyanurate insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.
- .3 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.
- .4 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.
- .5 Apply insulation.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material.
- .6 Maintain continuity of air barrier and vapour retarder.

3.4 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
 - .1 Hinge side: 1.0 mm.
 - .2 Latchside and head: 1.5 mm.
 - .3 Finished floor, top of carpet, and thresholds: 13 mm.
- .3 Adjust operable parts for correct function.
- .4 Install louvres.

3.5 FINISH REPAIRS

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

- .1 Install glazing for doors and frames in accordance with Section 08 80 50 - Glazing.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Molded panel interior doors for the housing units.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 08 71 00 - Door Hardware.
- .3 Section 08 90 10 – Door, Frame and Hardware Schedule.
- .4 Section 09 91 23 - Interior Painting.

1.3 REFERENCES

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC).
 - .1 Quality Standards for Architectural Woodwork, 2nd edition, 2014.
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA O132.2 Series-90(R1998), Wood Flush Doors.
 - .2 CAN/CSA-O132.5-M1992(R1998), Stile and Rail Wood Doors.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's:
 - .1 For caulking materials during application and curing.
 - .2 For door materials and adhesives.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate door types and cutouts for hardware, edge bevel locations and size, door sizes, core construction, swing.

1.5 QUALITY ASSURANCE

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Protection:
 - .1 Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
 - .2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.
 - .3 Protect doors from scratches, handling marks and other damage. Wrap doors.
 - .4 Store doors away from direct sunlight.

Part 2 Products

2.1 MOLDED PANEL SIDE HINGED DOORS

- .1 See Room Finish Schedule for sizes and locations.
- .2 Grade: AWMAC "Custom" grade unless otherwise noted.
- .3 Performance Duty Level: AWMAC "Standard Duty" level unless otherwise noted
 - .1 Construction:
 - .1 Hollow core: honeycomb grid. Grade LD-1 or LD-2, stile and rail frame bonded to core with wood lock blocks, 3-ply construction, 45 mm thickness. Door core and all materials shall contain no urea formaldehyde.
 - .2 Face Panels:
 - .1 Finish: Molded factory-finished hardboard. Sealed 6 sides. Textured wood grain finish.
 - .2 Style: 6-panel style to match exterior fibreglass doors and interior bifold doors.
 - .3 Color: Prefinished White.
 - .3 Adhesive: Type II (water resistant) for interior doors.
 - .4 Frame: Composite wood.
 - .5 Hardware: 3 butt hinges.
 - .1 Basis of Design: Stanley FBB179 114 x 101mm 26D
 - .2 Approved equivalent.
- .4 Acceptable pre-manufactured wood flush doors.
 - .1 Meet specified AWMAC Grade and Performance Level.
 - .2 Acceptable pre-manufactured door unit:
 - .1 Masonite
 - .2 Lynden
 - .3 Approved equivalent.

2.2 ACCESSORIES

- .1 Refer to Section 08 71 00 for additional side hinged door hardware.

2.3 FABRICATION

- .1 Loose layup assembly includes hardboard facing, composite stiles, composite rails and core. Composite bottom rail. Composite top rail with edge band. Vertical edge strips of composite wood with edge band lock stile.
- .2 Door facings to be bonded to stiles, rails and core forming 3-ply structural attachment.
- .3 Prepare doors for required hardware. See Section 08 71 00.
- .4 Bevel vertical edges of single acting doors 3 mm in 50 mm on lock side and 1.5 mm in 50 mm on hinge side.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

- .1 Unwrap and protect doors in accordance with CAN/CSA-O132.2 Series, Appendix A and manufacturer's printed instructions.
- .2 Install doors and hardware in accordance with manufacturer's printed instructions.
- .3 Adjust hardware for correct function.

3.3 ADJUSTMENT

- .1 Re-adjust doors and hardware just prior to completion of building to function freely and properly.

3.4 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 On completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 – General

1.1 SECTION INCLUDES

- .1 Fiberglass exterior door with integral storm door for the housing units.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 08 71 00 – Door Hardware
- .3 Section 08 90 10 – Door, Frame and Hardware Schedule

1.4 REFERENCE STANDARDS

- .1 ASTM International (ASTM):
 - 1. ASTM D1666 - Test Methods for Conducting Machining Tests of Wood and Wood-Base Materials.
 - 2. ASTM D1761 - Test Methods for Mechanical Fasteners in Wood.
 - 3. ASTM E283 - Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - 4. ASTM E330 - Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - 5. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
 - 6. ASTM E413 - Classification for Rating Sound Insulation.
 - 7. ASTM E547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
 - 8. ASTM E1332 - Standard Classification for Determination of Outdoor-Indoor Transmission Class.
 - 9. ASTM E1886 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 - 10. ASTM E1996 - Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
 - 11. ASTM F1450 - Test Methods for Hollow Metal Swinging Door Assemblies for Detention Facilities.
- .2 National Fire Protection Association (NFPA):
 - 1. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- .3 National Fenestration Rating Council (NFRC):
 - .1 NFRC 100 - Procedure for Determining Fenestration Product U-Factors.
 - .2 NFRC 200 - Procedure for Determining Fenestration Product Solar Gain Heat Coefficient and Visible Transmittance at Normal Incidence.

- .3 NFRC 500 - Procedure for Determining Fenestration Product Condensation Resistance Values.
- .4 Underwriters Laboratories (UL):
 - .1 UL 10C - Positive Pressure Fire Tests of Door Assemblies.
- .5 AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights (harmonized standard).

1.5 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Maximum overall thermal transmittance of insulated exterior doors shall not be more than $1.4 \text{ W}/(\text{m}^2 \times \text{K})$ calculated in accordance with CSA A440.2/A440.3, “Fenestration Energy Performance/User Guide to CSA A440.2-14, Fenestration Energy Performance or NFRC 100, “Determining Fenestration Product U-Factors” and NFRC 200, “Determining Fenestration Product Solar Heat Gain Coefficient and Visible Light Transmittance at Normal Incidence”.
 - .2 Doors and their components shall comply with the minimum air leakage requirements stated in AAMA/WDMA/CSA 101/I.S.2/A440, “NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights (harmonized standard) and CSA A440S1, “Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, “NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights”.

1.6 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00.
- .2 Shop Drawings: Submit for each type of door specified including details of core and edge construction and trim for openings.
 - .1 Include factory finishing information.
 - .2 Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in product data; and other pertinent data.
 - .3 Indicate compliance with referenced standards.
- .3 Operation and Maintenance Data as per Section 01 78 00 Closeout Submittals.

1.7 QUALITY ASSURANCE

- .1 Manufacturers: Firms regularly engaged in manufacture of fiberglass doors of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years.
- .2 Source Limitations: Obtain fiberglass doors through one (1) source from a single manufacturer.

1.8 DELIVERY, STORAGE AND HANDLING

- .1. Comply with requirements of manufacturer's written instructions.
- .2. Package doors on pallets and protect with cardboard top and bottom, corner protectors, banding, and shrink wrap.
- .3. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- .4. Protect from damage due to weather, excessive temperature, and construction operations.

1.9 WARRANTY

- .1. Warranty: Manufacturer's standard form, in which manufacturer warrants doors to be free of manufacturing defects in materials or workmanship.
 1. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Twenty-five (25) year limited warranty on main and storm door slabs; five (5) years on frame, twenty (20) years on glass assembly.
 - .2. Factory Stained Finish and Components: Five (5) year warranty.

Part 2 - Products

2.2 FIBERGLASS DOORS

- .1. Basis of design: Madero (www.madero.ca): "Workhorse Combo Plus" or approved equivalent.
- .2. Construction:
 - .1. Door: Min. 44 mm (1.75") thick. Skins of high impact compression molded fiberglass reinforced material. Factory finished. Maintenance free. Color: Prefinished: White. Style: 6 panel. Texture: Smooth. Coordinate pre-drill for door hardware with Section 08 71 00. Complete with pre-mounted 35 mm thick storm door with half-venting glazed insert.
 - .2. Stiles and rails: Composite material; full-length of door.
 - .3. Lockblock: full length steel reinforced wood.
 - .4. Core: 100 percent CFC-free polyurethane insulation. Min. RSI 2.4 (R14).
 - .5. Water resistance: Construction protecting doors against water infiltration on all six (6) sides to prevent warping, delamination, corrosion, rotting, and build up of mold and mildew.
 - .6. Brickmould: 50mm (2") composite.
 - .7. Frame: Double rabbeted. Smooth white composite. Maintenance free. Factory finished. Color: white. Width to suit construction see drawings.
 - .8. Threshold: Subsill of rot and insect-proof composite material. Pultruded fiberglass top sill.
 - .9. Accessories:
 - .1. Check chain.
 - .2. Dust pad.
 - .2. Steel ball-bearing hinges and adjustable strike plate at latch and deadbolt.

- .1 Basis of design: Stanley FBB179 114x101mm 26D or approved equivalent.
- .3 Door viewer.
 - .1 Basis of design: Rockwood 622 26D or approved equivalent.
- .4 White compression foam weatherstrip at jambs and head with second fin-type weatherstrip.
- .5 Fixed vinyl Kerf-in sweep at bottom of door slab supplied by door manufacturer. Size to suit.
 - .1 Basis of design: Pemko 216APK or approved equivalent.
- .6 Sill: Extruded aluminum premium sill system.

PART 3 - Execution

3.1 EXAMINATION

- .1 Examine frames and substrates, for suitable conditions where fiberglass doors [=and composite frames will be installed.
- .2 Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
- .3 Reject doors and composite frames with defects.
- .4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Install composite door frames level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
- .2 Hardware: Refer to Section 08 71 00 for installation.
- .3 Install fiberglass doors in compliance with manufacturer's written instructions.

3.3 ADJUSTING

- .1 Operation: Rehang or replace doors that do not swing or operate freely.
- .2 Factory Finished Doors: Replace doors that are damaged or do not comply with requirements. Repair or refinish doors if work complies with requirements and shows no evidence of repair or refinishing.

3.4 SCHEDULE

- .1 Refer to drawings and Section 08 90 10 Door, Frame & Hardware Schedule.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Mechanical Contractor to provide access doors for mechanical components for installation by contractor under section erecting associated walls or ceilings.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for cleaning and maintenance of stainless steel finishes for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 Products

2.1 ACCESS DOORS

- .1 Sizes: Except as indicated otherwise, to be minimum sizes as follows:
 - .1 For service entry: 600 x 600 mm.
 - .2 For visual inspection: 300 x 300 mm.
- .2 Construction: Rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180 degrees.
- .3 Materials
 - .1 Tiled or marble surfaces and other special areas: Stainless steel with brushed satin or polished finish as directed by Departmental Representative.
 - .2 Other areas: Prime coated steel.
- .4 Access doors in ductwork, refer to 23 33 00 Ductwork Accessories.

3 Execution

3.1 LOCATION

- .1 Location: Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.
- .2 Provide adequately sized access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, humidifiers, at fire dampers, and elsewhere as indicated. Review locations prior to fabrication.
- .3 Provide 100 x 100 mm (4"x 4") quick opening access doors for inspection of balancing dampers.

3.2 LOCATION

- .1 Location: Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry.
- .2 Section 05 50 00 - Metal Fabrications
- .3 Section 08 90 10 – Door, Frame and Hardware Schedule
- .4 Division 26 - Electrical

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A1008/A1008M-[06a], Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - .2 ASTM A653/A653M-[06a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA G164-M92 (R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .2 CAN/CSA-A440.4-07(R2012), Window, Door, and Skylight Installation
 - .3 CAN/CSA-A440.2/A440.3-14, Fenestration energy performance/User guide to CSA A440.2, Fenestration energy performance.
- .3 NFRC
 - .1 NFRC 100 Determining Product U-Factors

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements.
 - .1 Design exterior door assembly to withstand windload of 1 kPa with a maximum horizontal deflection of 1/240 of opening width.
 - .2 Design door panel assemblies with minimum thermal insulation factor 3.0 RSI (R17).
 - .3 Design door assembly to withstand minimum 75,000 cycles.
 - .4 Standard lift doors.
 - .5 Maximum overall thermal transmittance shall not be more than 2.2 W/(m²xK) calculated in accordance with CSA A440.2/A440.3, “Fenestration Energy Performance/User Guide to CSA A440.2-14, Fenestration Energy Performance or NFRC 100, “Determining Fenestration Product U-Factors”.
 - .6 Overhead doors that act as environmental separators shall have an air leakage rate not greater than 5.0 L/(s x m²) when tested as a complete assembly in accordance with ASTM E283, “Determining Rate of Air Leakage Through

Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen” at pressure differential of 75 Pa.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Indicate sizes, service rating, types, materials, operating mechanisms, hardware and accessories and required clearances.
 - .2 Indicate electrical requirements including motor size, voltage, amperage. and electrical connections Include low voltage wiring diagram.
 - .3 Provide written verification that door is designed to withstand designated minimum required cycles.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for overhead door hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 WARRANTY

- .1 Provide five-year manufacturer’s warranty for doors and all components and ten year for delamination.

Part 2 Products

2.1 MATERIALS

- .1 Galvanized steel sheet: commercial quality to ASTM A653/A653M with Z275 zinc coating.
- .2 Steel sheet: commercial quality to ASTM A1008/A1008M,.
 - .1 Exterior face sheet thickness 1.6 mm (16 gauge).
 - .2 Interior face sheet thickness 1.2 mm (18 gauge).
- .3 Prefinished steel with factory applied, two coat baked on polyester, primer and finish coat.
 - .1 Coating thickness: recommended by manufacturer.
 - .2 Resistance to accelerated weathering for chalk rating of 8, colour fade 5units or less and erosion rate less than 20 % to ASTM D822 as follows:
 - .1 Outdoor exposure period 2500 hours.
 - .2 Humidity resistance exposure period 5000hours.

- .4 Insulation: Non-CFC foamed in place, polyurethane to meet design requirements.

2.2 DOORS

- .1 Door Lift Type:
 - .1 Garage: Standard lift.
- .2 Fabricate 50 mm thick insulated, textured panel doors of interlocking, roll formed steel sections, with thermal break between skins.
- .3 Extend doors 100 mm minimum past both sides of door opening.
- .4 Assemble components by means of spot or arc welding or coated rivet system or adhesive and self tapping screws to manufacturer's recommendations.
- .5 Finish shall be factory applied, two-coat baked on polyester. Colour:
 - .1 Interiors: White.
 - .2 Exteriors: White.
- .6 Acceptable Manufacturer: Sentinel Thermostop by ASSA ABLOY or approved equivalent.

2.3 HEAVY DUTY INDUSTRIAL HARDWARE

- .1 Track: standard hardware with 75 mm size 2.75 mm core thickness galvanized steel track. Track to suit specified door movements.
- .2 Track Supports: 3.1 mm core thickness continuous galvanized steel angle track supports.
- .3 Spring counter balance: heavy duty oil tempered torsion spring with manufacturers standard brackets.
- .4 Top roller carrier: galvanized Steel 3.04mm thick adjustable.
- .5 Rollers: full floating grease packed hardened steel, ball bearing 75mm diameter solid steel tire.
- .6 Roller brackets: adjustable, minimum 3.1mm galvanized steel.
- .7 Hinges: heavy duty, galvanized as recommended by manufacturer.
- .8 Cable: 6 mm diameter galvanized steel aircraft cable.

2.4 ACCESSORIES

- .1 Overhead horizontal track and operator supports: galvanized steel, type and size to suit installation.
- .2 Track guards: 5 mm thick formed sheet 1500 mm high track guards.
- .3 Pusher springs.

- .4 Door Handles.
 - .1 No exterior handles.
 - .2 Handle interior side only.
 - .3 Interior latch: flat bar door latch with hole in flat bar at overhead door track for installation of padlock for manual locking of door.
- .5 Weather stripping.
 - .1 Sills: bulb type full width extruded neoprene weatherstrip.
 - .2 Jambs and head: extruded aluminum and arctic grade vinyl weatherstrip to manufacturer's standard.
 - .3 Two dual finned seals between sections.
- .6 Finish ferrous hardware items with minimum zinc coating of 300 g/m² to CSA G164.

2.5 ELECTRICAL OPERATOR

- .1 Electrical jack shaft operator to suit door size.
- .2 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA approval.
- .3 Electric Motor: 120/208 V
 - .1 Size motor to suit type and weight of door. Electrical division will provide 120/208 wiring to motor locations.
 - .1 Electrical division to provide final connection to motor and local disconnect.
 - .2 Door provider to provide any additional wiring and connections required for operation of door. All wiring to be installed in suitable sized steel conduit.
- .4 Controller units with integral motor reversing starter, solenoid operated brake, heater elements for overload protection, including pushbuttons and control relays as applicable.
- .5 Operation:
 - .1 Garage:
 - .1 "OPEN-STOP-CLOSE" designations on pushbuttons in English.
 - .2 Provide one (1) wired interior wall mounted pushbutton station for each door. Locate station adjacent each door unless otherwise indicated.
 - .3 Remote controllers are not required. Operator must incorporate capability for adding 4-button, 4-channel, automatic dual frequency cycling overhead door transmitters in future. Operator must permit door transmitters to be programmable to permit operation of both doors from a single remote.
- .6 Location:
 - .1 Interior pushbutton stations to be located as noted in drawings. Refer to architectural and electrical drawings.
- .7 Wiring and Conduit

- .1 Section Metal Door section is responsible to provide all low voltage wiring and connections for operation of doors.
- .2 Provide conduit and wiring for each door control location. All wiring will be installed in conduit.
- .3 Door provider is responsible for connection of each wall station.
- .4 Door provider is responsible for final connection of safety equipment to low voltage wiring.
- .5 Provide underground conduit for connection between overhead door operator pedestal and overhead door.
- .8 Safety switch: combination roll rubber with limit switches for full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.
 - .1 Sensing edge cord to be self retracting.
- .9 Emergency Release
 - .1 Attach operator to door with quick release device to disconnect door from operator in event of power failure. Provide chain for manual operation.
 - .2 Provide steel bracket on wall to allow chain to be bolted to the wall.
- .10 Mounting brackets: galvanized steel, size and gauge to suit conditions.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

- .1 Install doors and hardware in accordance with manufacturer's instructions.
- .2 Rigidly support rail and operator and secure to supporting structure.
- .3 Touch-up steel doors with primer where galvanized finish damaged during fabrication.
- .4 Install operator including electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.
- .5 Lubricate and adjust door operating components to ensure smooth opening and closing of doors.
- .6 Adjust weatherstripping to form a weather tight seal.
- .7 Adjust doors for smooth operation.
- .8 Install metal conduit as required for installation of low voltage wiring.

- .9 Coordinate installation of conduit to be buried and cast in concrete for exterior pedestal with General Contractor.
- .10 Install and make final connections of low voltage wiring.

3.3 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 Clean glass and glazing materials with approved non-abrasive cleaner.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Underwriters Laboratories
 - .1 UL325 - Door, Drapery, Gate, Louver, and Window Operators and Systems
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.
 - .3 CAN/CGSB-79.1-M91, Insect Screens.
- .3 Canadian Standards Association (CSA) International
 - .1 CSA A440.2/A440.3, Fenestration Energy Performance/User Guide to CSA A440.2-14, Fenestration Energy Performance
 - .2 CSA A440-11, NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights.
 - .3 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4 CAN/CSA-C22.2 NO. 0-10 - General requirements - Canadian electrical code, part II.
- .4 National Fenestration Rating Council (NFRC)
 - .1 NFRC 100, Procedure for Determining Fenestration Product U-factors.
 - .2 NFRC 200, Determining Fenestration Product Solar Heat Gain Co-efficient and Visible Transmittance at Normal Incidence.

1.2 PERFORMANCE REQUIREMENTS

- .1 Design and size components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of system as calculated in accordance with NBC to a design pressure windload per 30 year occurrence.
- .2 Fixed windows shall have a minimum air leakage rate not greater than the most restrictive of the following:
 - .1 0.20 L/(sm²) when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights at a pressure differential of 75 Pa., or;
 - .2 AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights (harmonized standard) and CSA A440S1, "Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights".
- .3 Operable windows shall have a minimum air leakage rate not greater than the most restrictive of the following:
 - .1 0.50 L/(sm²) when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS – North American Fenestration

- Standard/Specification for Windows, Doors, and Skylights at a pressure differential of 75 Pa., or;
- .2 AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights (harmonized standard) and CSA A440S1, "Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights".
 - .2 Limit mullion deflection to $L/175$; with full recovery of glazing materials.
 - .3 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.
 - .4 Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.
 - .5 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
 - .6 Overall Thermal Resistance of:
 - .1 Total system maximum U-value: $1.40 \text{ W/m}^2\text{K}$.

1.3 SUBMITTALS

- .1 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim junction between combination units elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes fasteners, and caulking. Indicate location of manufacturer's nameplates.
- .2 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit samples from manufacture's standard range of colours.
 - .3 Submit one representative cross-section of each type window frame (operable and fixed).
 - .4 Include frame, sash, sill, glazing and weatherproofing method, insect screens, surface finish and hardware. Show location of manufacturer's nameplates.

1.4 QUALITY ASSURANCE

- .1 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Construct mock-up to including window frame, glass glazing, and perimeter air barrier and vapour retarder.
 - .3 Mock-up will be used:

- .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .2 For testing to determine compliance with performance requirements (testing will be at the discretion of the Departmental Representative).
- .4 Locate where directed.
- .5 Allow 48 hours for inspection of mock-up before proceeding with work.
- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.
- .2 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for windows for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 MANUFACTURER'S WARRANTY

- .1 Provide manufacturer's written warranty that frame will not warp, shrink, dent, twist, bow or rot under normal conditions and use for a period of 25 years and against aging and maintenance of window finish for a period of 10 years from date of acceptance of installation.
- .2 Sealed glazing units shall be warranted against failure of the air seal due to defects in material or workmanship for a period of 10 years from date of acceptance of installation.

Part 2 Products

2.1 MATERIALS

- .1 Materials: to CSA A440 supplemented as follows:
- .2 All windows by same manufacturer.
- .3 Fibreglass frame and sash shall be made from 60 to 85% glass fibres and 15 to 35% resin.
 - .1 Main frame: pultruded fiberglass thermally broken and insulated with expanded polystyrene (Type 1) insulation. To sizes indicated on drawings. Finish shall be non-chalking and non-yellowing, U/V resistant.
 - .1 Colour: white. Provide samples for selection.
 - .2 Sash: pultruded fiberglass thermally broken and insulated with expanded polystyrene (Type 1) insulation. To sizes indicated on drawings. Finish shall be non-chalking and non-yellowing, U/V resistant. Colour to match window frame.
- .4 Glazing: Refer to Section 08 80 50 Glazing.
- .5 Screens: to CAN/CGSB-79.1.
 - .1 Insect screening mesh: count 18 x 16, glassfibre mesh. (black)
 - .2 Fasteners: tamper proof.

- .3 Screen frames: aluminum colour to match window frames.
- .4 Mount screen frames for interior replacement.
- .6 Interior jambs/sills: provide jamb/sill extension on interior as indicated and to suit conditions. Colour to match window frames.
- .7 Interior trim: Refer to Section 06 40 00 Architectural Woodwork for window sills.
- .8 Brickmould and brickmould extensions: by window manufacturer, profile and sizes as indicated. Minimum 50mm depth and minimum 1 mm wall thickness.
 - .1 Colour to match window frame.
- .9 Isolation coating: alkali resistant bituminous paint.
- .10 Fasteners: all fasteners are to be stainless steel and are to be concealed.

2.2 WINDOW TYPE AND CLASSIFICATION

- .1 Types:
 - .2 Type 1: Location: Housing Units. See drawings for locations.
 - .1 Opening sash: bottom projected (awning) with triple glazing insulating glass.
 - .1 Manual crank operation.
 - .2 Fixed sash: with triple glazing insulating glass.
 - .3 Screens: on ventilating portion of windows.
 - .3 Type 2: Location: Housing Units. See drawings for locations.
 - .1 Opening sash: side projected (casement) with triple glazing insulating glass.
 - .1 Manual crank operation.
 - .2 Fixed sash: with triple glazing insulating glass.
 - .3 Screens: on ventilating portion of windows.
- .2 Classification rating: to CSA A440.
 - .1 Air tightness: A3.
 - .2 Water tightness: B6.
 - .3 Wind load resistance: C3.
 - .4 Condensation resistance: Temperature Index, I 55.
 - .5 Forced Entry: F1
 - .6 Insect Screens: S1 (Heavy Duty)

2.3 FABRICATION

- .1 Fabricate in accordance with CSA A440 supplemented as follows:

- .2 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.
- .3 Face dimensions detailed are maximum permissible sizes.
- .4 Brace frames to maintain squareness and rigidity during shipment and installation.
- .5 Finish steel clips and reinforcement with shop coat primer to CAN/CGSB-1.40; 380 g/m² zinc coating to CAN/CSA G164.

2.4 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of isolation coating:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

2.5 GLAZING

- .1 Refer to Section 08 80 50 - Glazing

2.6 HARDWARE

- .1 Hardware: stainless steel or bronze sash locks and aluminum handles to provide security and permit easy operation of units. Colour to match window frames.
- .2 Locks: provide operating sash with spring loading locking device, to provide automatic locking in closed position.
- .3 Provide special keyed opening device for windows normally locked.
- .4 Equip projected units with roto operators with locking handle.

2.7 AIR BARRIER AND VAPOUR RETARDER

- .1 Equip window frames with factory installed air barrier and vapour retarder material for sealing to building air barrier and vapour retarder as follows:
 - .1 Material width: adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder from interior.
 - .2 Ensure continuity of air barrier and vapour retarder with adjacent construction.
 - .3 Refer to drawings for arrangement of air barrier.

2.8 LOW EXPANSION FOAM

- .1 Low pressure polyurethane expanding foam, closed cell structure.
- .2 Foam remains flexible after curing.
- .3 Insulation value: R-5 per inch of cured foam.

Part 3 Execution

3.1 WINDOW INSTALLATION

- .1 Install in accordance with CSA A440.
- .2 Attach to structure to permit sufficient adjustment to accommodate existing building conditions and other irregularities.
- .3 Install products specified square, plumb and level. Center window unit in opening and secure window unit as indicated in manufacturer's written instructions. Provide alignment attachments and shims to permanently fasten system to building structure.
- .4 Arrange components to prevent abrupt variation in colour.
- .5 All fasteners are to be stainless steel and are to be concealed. Exposed heads will not be permitted.
- .6 Verify proper operation of all opening windows.
- .7 Allow for deflection of structure at head of window so structure will not impact window.

3.2 SILL INSTALLATION

- .1 Provide profile of sill as indicated on drawings for each condition.
- .2 Fabricate sills to suit opening sizes.
- .3 Secure sills in place with concealed anchoring clips located at ends and mid-point; space no more than 600 mm on centre in between.

3.3 CAULKING

- .1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Provide backer rod in gap and install sealant to thickness recommended by manufacturer for proper performing joint. Generally 1:3 thickness to width.
- .2 Seal perimeter joints of window to adjoining finish material.
- .3 Seal ends of sills at finish material.

3.4 LOW EXPANSION FOAM

- .1 Ensure compatibility between foam and adjacent materials.
- .2 Fill gap between window frame and adjacent rough opening with low expansion foam.
- .3 Do not overfill cavity.

3.5 ADJUSTING

- .1 Adjust units for smooth operation without binding or racking.

- .2 Adjust operating hardware and screens for correct operation.

3.6 CLEANING

- 1. Clean interior and exterior surfaces free of labels, mortar, plaster, paint, joint sealers and other foreign mater to prevent damage to weatherstripping and to prevent interference with operation or hardware.
- 2. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- 3. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.7 PROTECTION

- .1 Protect window unit from damage. Protect ventilators and operating parts from dirt and damage caused by subsequent construction activities. Repair or replace damages units.
- .2 Protect finished Work from damage.

3.8 SCHEDULE

- 1. Refer to drawings for window locations and sizes.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
 - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-69.18-M90/ANSI/BHMA A156.1-1981, Butts and Hinges.
 - .2 CAN/CGSB-69.19-93/ANSI/BHMA A156.3-1989, Exit Devices.
 - .3 CAN/CGSB-69.20-M90/ANSI/BHMA A156.4-1986, Door Controls (Closers).
 - .4 CAN/CGSB-69.21-M90/ANSI/BHMA A156.5-1984, Auxiliary Locks and Associated Products.
 - .5 CAN/CGSB-69.22-M90/ANSI/BHMA A156.6-1986, Architectural Door Trim.
 - .6 CAN/CGSB-69.24-M90/ANSI/BHMA A156.8-1982, Door Controls - Overhead Holders.
 - .7 CAN/CGSB-69.26-96/ANSI/BHMA A156.10-1991, Power-operated Pedestrian Doors.
 - .8 CAN/CGSB-69.28-M90/ANSI/BHMA A156.12-1986, Interconnected Locks and Latches.
 - .9 CAN/CGSB-69.29-93/ANSI/BHMA A156.13-1987, Mortise Locks and Latches.
 - .10 CAN/CGSB-69.32-M90/ANSI/BHMA A156.16-1981, Auxiliary Hardware.
 - .11 CAN/CGSB-69.35-M89/ANSI/BHMA A156.19-1984, Power Assist and Low Energy Power Operated Doors.

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Hardware List:
 - .1 Submit contract hardware list in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .4 Closeout Submittals
 - .1 Provide operation and maintenance data for door closers, locksets, door holders electrified hardware and fire exit hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .2 Storage and Protection:
 - .1 Store finishing hardware in locked, clean and dry area.

1.5 WASTE DISPOSAL AND MANAGEMENT

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Dispose of corrugated cardboard, polystyrene, plastic, and packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Supply two sets of wrenches for door closers, locksets, and fire exit hardware.

Part 2 Products

2.1 HARDWARE ITEMS

- .1 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE – Black Lake Police Building and Stony Rapids Garage Building

- .1 Locks and latches:

- .1 Interconnected locks and latches: to CAN/CGSB-69.28, series 5000 interconnected lock, grade 1, designed for function and keyed as stated in Hardware Schedule.
- .2 Mortise locks and latches: to CAN/CGSB-69.29, series 1000 mortise lock, grade 1, designed for function as stated in Hardware Schedule.
- .3 Knobs: Corbin Russwin "Global" design.
- .4 Lever handles: Corbin Russwin "Lustra" design.
- .5 Escutcheons: Solid stainless steel
- .6 Normal strikes: box type, lip projection not beyond jamb.
- .7 Cylinders: Corbin-Russwin, 0 bitted.
- .8 Finish: BHMA 626 Satin Chrome.
- .9 Acceptable manufacturer: Corbin Russwin.
- .2 Padlocks
 - .1 Refer to Section 08 36 13 – Sectional Metal Doors.
 - .2 Keyed heavy duty brass padlocks with hardened steel shackle, with six-pin key.
 - .3 Core cylinders to match locksets and keying system specified.
 - .4 Provide two (2) padlocks per overhead door.
- .3 Storage Lockers
 - .1 Refer to Section 10 51 13 – Metal Lockers
- .4 Butts and hinges:
 - .1 Butts and hinges: to CAN/CGSB-69.18, listed in Hardware Schedule.
 - .2 Hinges on selected doors to be "NRP" Type (non-removable-pin) as scheduled.
 - .3 List of hinges:
 - a) FBB 168 114 x 114.
 - b) FBB 168 114 x 144 NRP.
 - .4 Acceptable manufacturers: Stanley, Hager, Monthard, McKimmey or approved alternate.
- .5 Door Closers and Accessories:
 - .1 Door controls (closers): to CAN/CGSB-69.20, size in accordance with CAN/CGSB-69.20, table A1, finished to 630.
 - .1 Grade 1, heavy duty, adjustable hydraulic back check, separate regulation of closing speed and latching speed, rack and pinion action.
 - .2 List of closers:
 - .1 LCN 4040 extra duty parallel with delayed action function.
 - .2 LCN 4040H extra duty parallel arm with integral hold-open function
 - .3 Acceptable manufacturers: LCN, Sargent, Norton, Rixson or approved alternate.
- .6 Auxiliary locks and associated products: to CAN/CGSB-69.21, as listed in Hardware Schedule, finished to 26D.

- .7 Architectural door trim: to CAN/CGSB-69.22, as listed in Hardware Schedule, finish as noted
 - .1 Door protection plates: kick plate type, 1.27 mm thick stainless steel, bevelled edges, 300 mm high by 25 mm less than door width, 32D finish.
 - .2 Push plates: 1.27 mm thick stainless steel, bevelled edges, 125 mm wide by 400 mm high, finished to 32D.
 - .3 Pulls: 19 mm diameter "D" style, projecting 35 mm from door, height 300 mm, without rose.
- .8 Latch guard: Heavy gauge formed steel plate cover to protect lock strike area, 300 mm high, through bolt mounting formed to suit mortised locksets with standard strikes.
- .9 Auxiliary hardware: to CAN/CGSB-69.32, as listed in Hardware Schedule and as listed below.
 - .1 Door check chain: heavy duty compression springs, heavy duty welded steel chain, vinyl cover. 650 mm long, 26D finish.
 - .2 Wall stop: concave wall stop with concealed mounting, 62 mm diameter, 30 mm projection, cast brass with rubber bumper, 26D finish.
 - .1 Acceptable products: Hager 234 or Richelieu 2205.
 - .3 Floor stop: to ANSI A156.16, low dome stop, 45 mm diameter, 3.2 mm thick base, cast brass, 26D finish.
 - .1 Acceptable products: Hager 241, or Richelieu 218.
- .10 Thresholds:
 - a) Interior doors: 127 mm wide x full width of door opening, 12.7mm height, 3.8 mm wall. stainless steel mill finish, plain surface.
 - b) Exterior doors: 127 mm wide x full width of door opening, 12.7 mm height, extruded stainless steel, mill finish, serrated surface, with thermal break of rigid PVC.
- .11 Weatherstripping:
 - .1 Head and jamb seal:
 - .1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.
 - .2 Door bottom seal:
 - .1 Heavy duty, extruded aluminum frame and closed cell neoprene weather seal, surface mounted, closed ends, adjustable, clear anodized finish.
 - .3 Door 131 EPDM bulb bottom seal:
 - .1 Heavy duty, extruded aluminum frame and EPDM bulb-style weather seal, surface mounted to door bottom, closed ends, clear anodized finish.
- .12 Door Viewer
 - .1 Mount 1.57m above floor level.
 - .2 Pre-cut holes by door manufacturer to maintain listing of fire rated doors.
 - .3 Acceptable manufacturer:
 - .1 For use in non-rated door assemblies: ASD Doorscope DS238.

- .2 For use in rated door assemblies: Leigh Metal Products Ltd. Ives by
Schlage No. 698B3

2.3 DOOR HARDWARE – Housing Units

- .1 Exterior Lever Lockset:
 - .1 Style: Lever
 - .2 Finish: 26D
 - .3 Keying: master keyed. Weiser KKY.
 - .4 Basis of design:
 - .1 Taymor 32-C5553 C26D
 - .2 Approved equivalent.
- .2 Deadlocks:
 - .1 Finish: 26D
 - .3 Keying: master keyed. Weiser KKY.
 - .4 Basis of design:
 - .1 Taymor 30-D01SC602SC C26D
 - .2 Approved equivalent.
- .3 Wall Stops:
 - .1 Finish: 26D
 - .2 Basis of design:
 - .1 Gallery GSH-250 C26D
 - .2 Approved equivalent.
- .4 Floor Stops:
 - .1 Finish: 26D
 - .2 Basis of design:
 - .1 Gallery GSH-200 C26D
 - .2 Approved equivalent.
- .5 Weatherstripping:
 - .1 By frame manufacturer. See Section 08 16 13.
- .6 Threshold:
 - .1 By frame manufacturer. See Section 08 16 13.
- .7 Door sweep:
 - .1 By door manufacturer. See Section 08 16 13.
- .8 Door viewer:

- .1 By door manufacturer. See Section 08 16 13.
- .9 Butt Hinges:
 - .1 By door manufacturer. See Section 08 16 13.
- .10 Roller Latches:
 - .1 Finish: 26D
 - .2 Basis of design:
 - .1 Gallery 404H 26D
 - .2 Approved equivalent.
- .11 Interior Lever Dummy Set:
 - .1 Style: Lever
 - .2 Finish: 26D
 - .3 Keying: None
 - .4 Basis of design:
 - .1 Taymor 32-5593 C26D
 - .2 Approved equivalent.
- .12 Interior Lever Passage Set:
 - .1 Style: Lever
 - .2 Finish: 26D
 - .3 Keying: none.
 - .4 Basis of design:
 - .1 Taymor 32-C5510 C26D
 - .2 Approved equivalent.
- .13 Interior Lever Privacy Set:
 - .1 Style: Lever
 - .2 Finish: 26D
 - .3 Keying: privacy lock.
 - .4 Basis of design:
 - .1 Taymor 32-C5540 C26D
 - .2 Approved equivalent.
- .14 Robe Hook:
 - .1 Basis of design:
 - .1 Rockwood Manufacturing RM803 C26D
 - .2 Approved equivalent.
- .15 Hinge Pin Stop:
 - .1 Basis of design:
 - .1 Rockwood Manufacturing RM528 C26D
 - .2 Approved equivalent.

2.4 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.5 KEYING – Black Lake Police Building and Stony Rapids Garage Building

- .1 Construction keying:
 - .1 Provide construction cores. Contractor to install construction cores and perform operation verification for all locks. Construction cylinders to be “0” bitted Corbin-Russwin L4 cylinders. Perimeter doors may have random bitting.
- .2 Permanent keying:
 - .1 Provide 000000 bitted for keying by Owner.
 - .2 Provide two blank keys, in duplicate, for every lock in this Contract.

2.6 KEYING – Housing Units

- .1 Permanent keying:
 - .1 By contractor. Owner will not be re-keying.
 - .2 Provide keys, in triplicate, for every lock in each unit.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Furnish manufacturers' instructions for proper installation of each hardware component.

3.2 INSTALLATION

- .1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association and as specified.
- .2 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .3 Use only manufacturer's supplied fasteners. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .4 Coordinate door and frame preparation with Section 08 11 00 Metal Doors and Frames to ensure the proper installation and operation of hardware.
- .5 Door manufacturer to precut holes for door viewers to maintain listing of fire rated doors.
- .6 Remove construction cores and locks when directed by Departmental Representative; install permanent cores and check operation of locks.

3.3 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to provide tight fit at contact points with frames.

3.4 TESTING

- .1 All locks must be tested by the Contractor with the installed permanent cores for proper installation. All doors and locks not installed and operating correctly will be rejected.

3.5 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
- .3 Remove protective material from hardware items where present.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.6 DEMONSTRATION

- .1 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning, and general maintenance of projects complete hardware.

- .2 Description, use, handling, and storage of keys.
- .3 Use, application and storage of wrenches for door closers, locksets, and fire exit hardware.
- .2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.7 SCHEDULE

<u>Door 005</u>	<u>Door G100a</u>
1 lockset: <ul style="list-style-type: none"> • Full Mortise • Model: ML2029-LWR-626 • "0" Bitted L4 Cylinder • ANSI No.: F15 3 butts (non-removable pins) 1 weatherstripping 1 closer 1 door viewer (interior to exterior) 1 latch guard	1 lockset: <ul style="list-style-type: none"> • Full Mortise • Model: ML2029-LWR-626 • "0" Bitted L4 Cylinder • ANSI No.: F15 3 butts (non-removable pins) 1 weatherstripping 1 door sweep 1 door viewer 1 threshold 1 kickplate 1 door check chain 1 latch guard
<u>Door G100b</u>	<u>Door G100c</u>
Sliding latch bolt from interior by overhead door manufacturer. SEE SECTIONAL METAL DOORS 08 36 13	Sliding latch bolt from interior by overhead door manufacturer. SEE SECTIONAL METAL DOORS 08 36 13
<u>Door G102</u>	<u>Door G103</u>
1 lockset: <ul style="list-style-type: none"> • Full Mortise • Model: ML2060-LWR-626 • ANSI No.: F22 3 butts 1 wall stop 1 kickplate	1 lockset: <ul style="list-style-type: none"> • Full Mortise • Model: ML2051-LWR-626 • "0" Bitted L4 Cylinder • ANSI No.: F04 3 butts 1 wall stop 1 kickplate

<u>Door G104</u>	
1 lockset: <ul style="list-style-type: none"> • Full Mortise • Model: ML2051-LWR-626 • “0” Bitted L4 Cylinder • ANSI No.: F04 3 butts 1 wall stop 1 kickplate	
Housing Unit Door Hardware	
<u>Door H100</u>	<u>Door H101</u>
6 butt hinges – See Section 08 16 13 2 exterior lever locksets (master keyed) 1 deadlock (interior door) 1 wall stop 1 threshold – See Section 08 16 13 1 set weatherstripping – See Section 08 16 13 1 sweep – See Section 08 16 13 1 door viewer (interior door) – See section 08 16 13 Note : See Section 08 16 13 for additional requirements	3 butt hinges – See Section 08 16 13 1 lever passage set 1 hinge pin stop
<u>Door H102</u>	<u>Door H103</u>
6 butt hinges – See Section 08 16 13 2 interior lever dummy sets – Provide solid backing in hollow core doors. 2 roller latches 2 hinge pin stops	3 butt hinges – See Section 08 16 13 1 lever privacy set 1 hinge pin stop
<u>Door H104A</u>	<u>Door H104B</u>
3 butt hinges – See Section 08 16 13 1 lever passage set 1 hinge pin stop	3 butt hinges – See Section 08 16 13 1 lever passage set 1 hinge pin stop
<u>Door H105</u>	<u>Door H106A</u>
3 butt hinges – See Section 08 16 13 1 lever privacy set 1 wall stop 1 robe hook	3 butt hinges – See Section 08 16 13 1 lever passage set 1 hinge pin stop
<u>Door H106B</u>	<u>Door H107</u>

6 butt hinges – See Section 08 16 13 2 exterior lever locksets (master keyed) 1 deadlock (interior door) 1 wall stop 1 threshold – See Section 08 16 13 1 set weatherstripping – See Section 08 16 13 1 sweep – See Section 08 16 13 1 door viewer (interior door) – See section 08 16 13 Note : See Section 08 16 13 for additional requirements	3 butt hinges – See Section 08 16 13 1 lever passage set 1 hinge pin stop
<u>Door H110</u>	<u>Door H111</u>
3 butt hinges – See Section 08 16 13 1 lever privacy set 1 wall stop 1 robe hook	3 butt hinges – See Section 08 16 13 1 lever privacy set 1 wall stop
<u>Door H112</u>	<u>Door H113</u>
3 butt hinges – See Section 08 16 13 1 lever passage set 1 hinge pin stop	6 butt hinges – See Section 08 16 13 2 interior lever dummy sets – Provide solid backing in hollow core doors. 2 roller latches 2 hinge pin stops
<u>Door H001 Crawlspace Access Door</u>	
1 exterior lever lockset (master keyed) 3 butts (non-removable pins) 1 weatherstripping 1 closer	

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

- .1 Section 07 92 00 – Joint Sealing.
- .2 Section 08 11 00 - Metal Doors and Frames.
- .3 Section 08 16 13 – Fibreglass Doors.
- .4 Section 08 54 13 – Fibreglass Windows.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
 - .3 CAN/CGSB-12.4-M91 Heat Absorbing Glass
 - .4 CAN/CGSB-12.11-M90, Wired Safety Glass.
- .2 Canadian Standards Association (CSA)
 - .1 CSA A440.2/A440.3, Fenestration Energy Performance/User Guide to CSA A440.2-14, Fenestration Energy Performance.
- .3 Flat Glass Manufacturers Association (FGMA).
 - .1 FGMA Glazing Manual – current edition.
- .4 International Window Film Association (IWFA)
 - .1 IWFA Visual Quality Standard for Applied Window Film 1999.

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Provide continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
 - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit test data substantiating triple glazed sealed units meets specified maximum centre-of-glazing U-factor.

- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Sealed Units: Submit duplicate 300 x 300 mm size samples of sealed units.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .5 Closeout Submittals:
 - .1 Provide maintenance data including cleaning instructions for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 WARRANTY

- .1 Contractor's Warranty –Contractor shall warrant the work in accordance with the General Conditions.
- .2 Product Warranty – Provide a TEN (10) year manufacturer's warranty for sealed glazing units. Include coverage for sealed glass units from seal failure, interpane dusting or misting and replacement of same.

PART 2 Products

2.1 MATERIALS: FLAT GLASS

- .1 Float glass: to CAN/CGSB-12.3, Glazing quality.
- .2 Safety (tempered) glass: to CAN/CGSB-12.1, transparent.
 - .1 Type 2-tempered.
 - .2 Class B-float.
- .3 Heat absorbing glass: to CAN/CGSB-12.4.
 - .1 Type: Insulating glass unit.
 - .2 Class: Heat strengthened.
- .4 Silvered mirror glass: thickness to suit mirror dimensions.
 - .1 Type 3A-tempered or
 - .2 Heat strengthened glass with safety film applied to the backside.

2.2 MATERIALS: EXTERIOR SEALED INSULATING TRIPLE UNITS

- .1 Refer to Section 08 54 13 Fiberglass Windows and drawings.
- .2 Refer to Section 08 90 10 Door, Frame and Hardware Schedule and drawings.

- .3 Performance: Maximum centre-of-glazing U-factor:
 - .1 0.68 W/m²K (0.12 Btu/hour ft²F)
- .4 Insulating glass units: to CAN/CGSB 12.8, triple glazed unit; 44 mm overall thickness.
 - .1 Glass: to CAN/CGSB 12.1 and 12.3.
 - .2 Glass thickness: sized to in CAN/CGSB-12.20 and National Building Code to 1 in 50 hourly wind pressure level of 0.75 kPa – Open Terrain.
 - .1 Minimum lite thickness 6mm
 - .3 Exterior lite:
 - .1 Heat strengthened.
 - .2 Colour clear.
 - .4 Inter cavity space thickness: 12.5 mm
 - .5 Interior Lites:
 - .1 Heat strengthened.
 - .2 Low-E Glass coating: PPG “Solar Ban 60” soft coat low ‘e’
 - .3 Colour: clear.
 - .4 Coating surface #2 and surface #5.
 - .6 Inert gas fill: argon.
 - .7 Spacer: warm edge spacer PPG “Intercept” Black colour.
 - .8 U-value of sealed unit: 0.12 Btu/hour ft²F
 - .9 Solar Heat Gain Coefficient: 0.33
 - .10 Visible Transmittance: 0.56

2.3 SAFETY (TEMPERED) GLASS:

- .1 Safety glass: to CAN/CGSB-12.1, transparent, thickness as indicated.
 - .1 Type 2-tempered.
 - .2 Class B-float.
 - .3 Category 1 and 2 as applicable.
 - .4 Square edge.

2.4 ACCESSORIES

- .1 Sealant – refer to Section 07 92 00 – Joint Sealing
- .2 Setting blocks: Neoprene, 80-90 Shore durometer hardness to ASTM D2240, to suit glazing method, glass light, weight and area.
- .3 Spacer shims: Neoprene, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.
- .4 Glazing tape: Preformed butyl compound, 10-15 Shore durometer hardness to ASTM D2240; coiled on release paper; black colour.
- .5 Mirror attachment accessories:

- .1 As recommended by manufacturer to suit dimensions and weight of mirror.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 EXAMINATION

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.3 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.4 INSTALLATION: EXTERIOR SEALED UNITS

- .1 Install to window frame manufacturer's instructions.

3.5 INSTALLATION: SAFETY (TEMPERED) GLASS:

- .1 Refer to Section 08 90 10 Door Frame and Hardware Schedule and as noted in drawings.
- .2 Perform work in accordance with FGMA Glazing Manual for glazing installation methods.

3.6 INSTALLATION: MIRRORS

- .1 Anchor rigidly to wall construction.
- .2 Place plumb and level.
- .3 Refer to drawings for locations.

3.7 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking.

- .3 Remove glazing materials from finish surfaces.
- .4 Remove labels after work is complete.
- .5 Clean glass using approved non-abrasive cleaner in accordance with manufacture's instructions.

3.8 PROTECTION OF FINISHED WORK

- .1 After installation, mark light with an "X" by using removable plastic tape or paste.

3.9 SCHEDULE

- .1 Refer to Specifications and Drawings.

END OF SECTION

General notes:

- .1 This schedule is to be read in conjunction with the Drawings and applicable Specification Sections.
- .2 Refer to Section 08 71 10, Door Hardware for hardware groups.
- .3 Refer to Drawings for door and frame types
- .4 Refer to Electrical for Card reader rough-ins, door contacts, power operators and associated power. Hardware manufacturer/installer shall be responsible for making all low voltage connections.
- .5 Verify all door and frame sizes prior to ordering.

Door No.	Door				Frame			Rating (Min.)	Glass	Additional Requirements
	Size	Type	Mat'l	Fin.	Type	Mat'l	Fin.			
Typical Housing Unit (Typical of 4) – Refer to Drawing A2.1 and A2.2.										
H001	900 x 800ht	H	HM	PT1	F13	PS	PT1	-	-	Site confirm available height for door with grade prior to order.
H100	2 - 900 x 2030	I & J	FI	PRE	F15	PRE	PRE	-	-	Door viewer on interior door, type I.
H101	550 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H102	2 - 600 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H103	800 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H104A	550 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H104B	550 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H105	750 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H106A	900 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H106B	2 - 900 x 2030	I & J	FI	PRE	F15	PRE	PRE	-	-	Door viewer on interior door, type I.
H107	600 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H110	750 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H111	800 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H112	800 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
H113	2 - 600 x 2030	I	HCW	PRE	F14	WD	PT4	-	-	
Black Lake Police Building – Refer to Drawing A3.1										
005	1200 x 1200	H	IMD	PT2	F12	PS	PT2	-	-	Door viewer. Site confirm available height for door to suit existing condition and prior to order.
Stony Rapids Garage Building – Refer to Drawing A4.1										
G100a	900 x 2150	K	IMD	PT1	F17	PS	PT1	-	-	Door viewer.

Door No.	Door				Frame			Rating (Min.)	Glass	Additional Requirements
	Size	Type	Mat'l	Fin.	Type	Mat'l	Fin.			
G100b	3048 x 2440	L	-	PRE	F18	-	PRE	-	-	Sectional Metal Door.
G100c	3048 x 2440	L	-	PRE	F18	-	PRE	-	-	Sectional Metal Door.
G102	900 x 2150	K	HM	PT1	F16	PS	PT1	-	-	
G103	900 x 2150	K	HM	PT1	F16	PS	PT1	-	-	
G104	900 x 2150	K	HM	PT1	F16	PS	PT1	-	-	

Abbreviations:

EL – Elastomeric Coating (09 96 53)

HM – Hollow Metal Door (08 11 00)

ASD – Acoustic Steel Door (08 34 74)

IMD – Insulated Metal Door (08 11 00)

LX – Lexan (08 34 63)

PT# – Paint (# Denotes Colour) (09 91 13 & 09 91 23)

PS – Pressed Steel Frame (welded) (08 11 00 & 08 34 74)

LG – Laminated Glass (08 80 50)

WFD – Wood Flush Door (08 14 16)

TG – Tempered Glass (08 80 50)

STL – Steel (08 34 63)

S/V – Stain and Varnish (09 91 23)

FI –Fibreglass Insulated Door (08 16 13)

HCW –Hollow Core Molded Panel Interior Doors (08 14 18)

SCW –Solid Core Molded Panel Interior Doors (08 14 18)

PRE – Prefinished

WD - Wood

Notes:

F# * denotes a frame with special security requirements, refer to electrical drawings and specifications.

This schedule is to be read in conjunction with the Drawings and Specification Sections.

Room No.	Floor	Base	Walls				Ceiling	Notes:
			N	S	E	W		
H100	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H101	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H102	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H103	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H104	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H104A	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H104B	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H105	RPF	MDF	PT3	PT3	PT3	PT3	PT4	
H106	RPF	MDF	PT3	PT3	PT3	PT3	PT4	
H107	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H108	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H109	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H110	RPF	MDF	PT3	PT3	PT3	PT3	PT4	
H111	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H112	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
H113	RPF	MDF	PT3	PT3	PT3	PT3	KD PT4	
G100	CONC S&H	-	PT3	PT3	PT3	PT3	PT3	
G101	CONC S&H	-	PT3	PT3	PT3	PT3	PT3	
G102	CONC S&H	MDF	PT3	PT3	PT3	PT3	PT3	
G103	CONC S&H	-	PT3	PT3	PT3	PT3	PT3	
G104	CONC S&H	-	PT3	PT3	PT3	PT3	PT3	
G105	CONC S&H	-	PT3	PT3	PT3	PT3	PT3	

List of Abbreviations:

APT	ACOUSTIC PANEL TYPE 1 (09 84 00)
ATC	ACOUSTIC TILE CEILING (09 51 13 & 09 53 01)

CONC S&H	CONCRETE WITH HARDENER AND SEALER (03 35 00/09 91 23)
COV	COVED FLOORING BASE (09 67 00)
RFF	RUBBER FLOCKED FLOORING (09 65 18)
EL	ELASTOMERIC COATING (09 96 53)
EXP	EXPOSED – No finish
GB	GYPSUM BOARD – PAINTED (09 91 23)
MDF	MDF BASE (06 40 00)
PT#	PAINT (# DENOTES COLOUR – SEE 09 91 23)
RB	RUBBER BASE (09 68 00)
RSSF	RESILIENT SHEET SAFETY FLOORING (09 65 16)
RHF	RESILIENT HYDRO FLOORING (09 65 16)
RWC	RESILIENT WALL CLADDING (10 26 00)
RSF	RUBBER SPORT FLOORING (09 65 20)
SS	STAINLESS STEEL (05 50 00)
RPF	RESILIENT PLANK FLOORING (09 65 20)
KD	KNOCK-DOWN TEXTURED CEILING FINISH – PAINTED (09 21 16)

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry.
- .2 Section 07 27 00 – Air and Vapour Barriers.
- .3 Section 09 06 01 – Room Finish Schedule.
- .4 Section 09 51 13 – Acoustical Panel Ceilings.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C36/C36M-03e1, Specification for Gypsum Wallboard.
 - .2 ASTM C475-12, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .3 ASTM C840-11, Specification for Application and Finishing of Gypsum Board.
 - .4 ASTM C841-03(2008), Standard Specification for Installation of Interior Lathing and Furring.
 - .5 ASTM C1002-07, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .6 ASTM C1047-10a, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .7 ASTM C1178/C1178M-11, Specification for Glass Mat Water-Resistant Gypsum Backing Board.
 - .8 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.
 - .9 ASTM C1629/C1629M-06(2011), Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
- .2 Association of the Wall and Ceilings Industries International (AWEI)
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-2007, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

- .1 Samples:
 - .1 Submit duplicate 300 x 300 mm samples of textured ceiling finishes for Housing Unit ceilings, in selected colour, to consultant for approval prior to installation.

1.4 MOCK-UP

- .1 Provide mock-up in accordance with Section 01 45 00 – Quality Control.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.
- .2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.
- .3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 SITE ENVIRONMENTAL REQUIREMENTS

- .1 Maintain temperature minimum 10 degrees C, maximum 21 degrees C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.
- .3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 Products

2.1 MATERIALS

- .1 Standard board: to ASTM C36/C36M, Type X, 16 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.
- .2 Mold and mildew resistant gypsum board: to ASTM C1396/C1396M, Type X, thickness as indicated in drawings, 1200 mm wide x maximum practical length.
- .3 Metal Access doors: frameless, welded construction, push latching door, removable door, accepts 12.7 mm or 15.9 mm gypsum board, exposed frames paintable.
- .4 Metal furring runners, hangers, tie wires, inserts, and anchors required for installation to ASTM C841.

- .5 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .6 Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .7 Metal channel stiffener: 19 x 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .8 Steel drill screws: to ASTM C1002.
- .9 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by electrolytic process, 0.5 mm base thickness, perforated flanges, one piece length per location.
- .10 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .11 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .12 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .13 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.
- .14 Joint compound: to ASTM C475, asbestos-free.
- .15 Texturing plaster: mill mixed finishing plaster prepared for texture ceiling application. Colour: See Section 09 06 01.

Part 3 Execution

3.1 ERECTION

- .1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.
- .2 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.
- .3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .4 Install work level to tolerance of 1:1200.
- .5 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, and grilles.
- .6 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .7 Install gypsum board fire and sound stops and to form plenum areas to underside of wood roof deck above suspended ceilings as indicated.

- .8 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.
- .9 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .10 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .11 Erect drywall resilient furring transversely across studs, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.

3.2 APPLICATION

- .1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.
- .2 Apply single and double layer gypsum board (as indicated on drawings) to metal furring or framing using screw. Maximum spacing of screws, 300 mm on centre.
 - .1 Single-Layer Application:
 - .1 Apply gypsum board on ceilings prior to application of walls in accordance with ASTM C840.
 - .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.
 - .2 Double-Layer Application:
 - .1 Install gypsum board for base layer and exposed gypsum board for face layer.
 - .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.
 - .3 Apply base layers at right angles to supports unless otherwise indicated.
 - .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.
- .3 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .4 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
- .5 Install gypsum board with face side out.
- .6 Do not install damaged or damp boards.
- .7 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.
- .8 Apply mold and mildew resistant panels, where indicated, at Rooms G100, G101, G102, H105, H106, H108, H110, and in locations where gypsum board is to be painted.

Location, thickness and fire resistance rating to match gypsum board specified in Wall Type.

- .9 Textured Finishing Plaster:
 - .1 Mix, in proportion by dry weight, in accordance with applicable bag mixing instructions.
 - .2 Machine-Applied Spray Finishes:
 - .1 Apply plaster in uniform spray pattern to produce texture approved by Departmental Representative.

3.3 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated.
- .4 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.
- .5 Provide continuous polyethylene dust barrier behind and across control joints.
- .6 Apply 12 mm diameter bead of acoustic sealant continuously around perimeter of first layer of multiple layers of gypsum board to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, and penetrations, in partitions where perimeter sealed with acoustic sealant.
- .7 Install access doors to electrical and mechanical fixtures specified in respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .8 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .9 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with Association of the Wall and Ceiling Industries (AWCI) International Recommended Specification on Levels of Gypsum Board Finish:
 - .1 Levels of finish:
 - .1 Level 0: No tapping, finishing or accessories required.
 - .2 Level 1: Embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable.
 - .3 Level 2: Embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener

- heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.
- .4 Level 3: Embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
 - .5 Level 4: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
 - .6 Level 5: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.
- .10 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
 - .11 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
 - .12 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
 - .13 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
 - .14 Mix joint compound slightly thinner than for joint taping.
 - .15 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.
 - .16 Allow skim coat to dry completely.
 - .17 Remove ridges by light sanding or wiping with damp cloth.
 - .18 Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of substantial completion.
 - .19 Install textured knock-down finish to housing unit ceilings in locations indicated in Section 09 06 01 and as per manufacturer's written instructions. See Room Finish Schedule for locations and colors.

3.4 CONTROL JOINTS

- .1 Provide control joints at not greater than 9 m spacing on continuous gypsum board walls in a single plane and at not greater than 9 m spacing on ceilings and bulkheads except where indicated otherwise in the drawings.
 - .1 Confirm location of control joints with the Consultant prior to installation of gypsum board
- .2 Provide control joints of preformed units set in gypsum board facing and supported independently on both sides of joint. Interrupt top and bottom tracks at location of control joint.

- .3 Install control joints straight and true. Finish control joints as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

3.5 ACCESS PANELS

- .1 Coordinate installation with Mechanical.
- .2 Secure frames rigidly in place, plumb and level in opening, with plane of door and panel face aligned with adjacent finished surfaces.
- .3 Set concealed frame type units flush with adjacent finished surfaces.
- .4 Position unit to provide convenient access to concealed work requiring access.

3.6 FINISH SCHEDULES

- .1 Levels of finish: Interior partitions;
 - .1 Level 1:
 - .1 Plenums above suspended ceilings, inside of duct shafts and other gypsum board wall areas not exposed to view.
 - .2 Level 4:
 - .1 Vertical surfaces (walls) exposed to view.
 - .2 Ceilings and underside of bulkheads exposed to view.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Luxury vinyl plank floor at residential building. Refer to Section 06 40 00 Architectural Woodwork for base.

1.2 RELATED REQUIREMENTS

- .1 Section 01 00 05 General Requirements

1.3 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM F1066-04(2010)e1, Standard Specification for Vinyl Composition Floor Tile.
 - .2 ASTM F1700-18, Standard Specification for Solid Vinyl Tile
 - .3 ASTM F1344-12e1, Standard Specification for Rubber Floor Tile.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
 - .2 CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 00 05 General Requirements.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for resilient tile flooring and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit duplicate tile in size specified.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials of resilient tile flooring, base and adhesive in accordance with Section 01 00 05 General Requirements.
 - .2 Provide equivalent of 2% of each installed product as maintenance material.
 - .3 Extra materials from same production run as installed materials.
 - .4 Identify each container of floor tile and each container of adhesive.
 - .5 Deliver to Owner upon completion of the work of this section.
 - .6 Store where directed by Owner.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 05 General Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect specified materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Maintain air temperature and structural base temperature at flooring installation area above 20degrees C for 48 hours before, during and for 48 hours after installation.

1.8 DISPOSAL OF WASTES

- .1 Dispose of waste in accordance with Construction Waste Management Plan provided in Section 01 00 05 General Requirements.

1.9 WARRANTY

- .1 Lifelong limited residential warranty.

Part 2 Products

2.1 MATERIALS

- .1 Fire ratings, meet requirements of :
 - .1 ASTM D 648 – Class 1.
 - .2 ASTM E 84 – 75 or less.

2.2 LUXURY VINYL PLANK TYPE - LVP

- .1 Vinyl plank: to ASTM F1066, Composition 1 - non asbestos.
- .2 Slip resistance: minimum ADA requirements for wet floor conditions.
- .3 Dimensions: 184.2mm x 1219.2 mm
- .4 Edge: microbevel.
- .5 Thickness: 3.0 mm.
- .6 Factory prefinished.
- .7 Wear layer: 0.50mm (20 Mil) high-performance urethane fortified with aluminum oxide.
- .8 Base: Vinyl composition.

- .9 Approved Manufacturer:
 - .1 Congoleum Luxury Vinyl Plank: Timeless, Structure, Pioneer Collection, Color: Rustic Honey UR102.
 - .2 Or approved equivalent.
- .2 Primers and adhesives: waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
 - .1 Flooring adhesives:
 - .1 Adhesive: maximum VOC limit 50g/L .
- .3 Sub-floor filler and leveller: as recommended by flooring manufacturer for use with their product.
- .4 Metal edge strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
- .5 Stair nosings: Vinyl. Color to match LVP. Textured top face for extra traction, size to suit application.
- .6 Sealer: type recommended by flooring manufacturer to CAN/CGSB-25.20, Type 2-water based.
 - .1 Sealant:
 - .1 Sealant: maximum VOC limit 50g/L
- .7 Wax: type recommended by flooring manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for resilient plank flooring installation in accordance with manufacturer's written instructions.
- .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSPECTION

- .1 Ensure floors are dry, by using test methods recommended by tile manufacturer.

3.3 SUB-FLOOR TREATMENT

- .1 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .2 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .3 Seal sub-floor to flooring manufacturer's printed instructions.

3.4 APPLICATION

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.
- .2 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .3 Lay flooring with joints parallel to building lines.
- .4 Install flooring to ashlar/staggered pattern with continuous joints flowing with direction of mottle to square grid pattern with joints aligned with pattern grain alternating to produce basket weave pattern with pattern grain parallel for units and parallel to width length of room. Confirm layout with Consultant.
- .5 As installation progresses, and after installation, roll flooring in 2 directions including resilient tile with 45kg minimum roller to ensure full adhesion.
- .6 Cut tile and fit neatly around fixed objects.
- .7 Install feature strips and floor markings where indicated. Fit joints tightly.
- .8 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
- .9 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .10 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 STAIR APPLICATION

- .1 Install stair treads and risers as one piece for full width of stair. Adhere over entire surface and fit accurately.

3.6 BASE APPLICATION

- .1 Lay out base to keep number of joints at minimum. Base joints at maximum length available or at internal or premoulded corners.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles, minimum 300mm each leg. Wrap around toeless base at external corners.
- .8 Install toeless type base before installation of carpet on floors.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 05 General Requirements.
 - .1 Clean flooring surfaces to flooring manufacturer's printed instructions.
- .3 Remove excess adhesive from floor, base and wall surfaces without damage.
- .4 Clean, seal and wax floor and base surface to flooring manufacturer's instructions.

3.8 PROTECTION

- .1 Protect new floors until final inspection.
- .2 Prohibit traffic on floor for 48hours after installation.

3.9 SCHEDULE

- .1 Refer to Section 09 06 01 – Room Finish Schedule.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 05 50 00 - Metal Fabrications.
- .2 Section 06 10 00 – Rough Carpentry.
- .3 Section 08 90 10 – Door, Frame and Hardware Schedule.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual – latest edition.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Conform to latest MPI requirements for exterior painting work including preparation and priming.
 - .2 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.
 - .3 paint materials such as linseed oil, shellac, and turpentine to be highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and to be compatible with other coating materials as required.
 - .4 Standard of Acceptance:
 - .1 Walls: No defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Soffits: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
- .3 Upon completion, submit records of products used. List products in relation to finish system and include the following:

- .1 Product name, type and use.
- .2 Manufacturer's product number.
- .3 Colour numbers.
- .4 MPI Environmentally Friendly classification system rating.
- .5 Manufacturer's Material Safety Data Sheets (MSDS).
- .4 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit one four litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, supplemented as follows:
 - .1 Deliver and store materials in original containers, sealed, with labels intact.
 - .2 Labels: to indicate:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
 - .3 Remove damaged, opened and rejected materials from site.
 - .4 Provide and maintain dry, temperature controlled, secure storage.
 - .5 Observe manufacturer's recommendations for storage and handling.
 - .6 Store materials and supplies away from heat generating devices.
 - .7 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
 - .8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
 - .9 Remove paint materials from storage only in quantities required for same day use.
 - .10 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
 - .11 Fire Safety Requirements:

- .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.
- .2 Waste Management and Disposal:
 - .1 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
 - .2 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground the following procedures shall be strictly adhered to:
 - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
 - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
 - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
 - .4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
 - .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
 - .3 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.
 - .4 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

1.7 AMBIENT CONDITIONS

- .1 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless specifically pre-approved by specifying body, Paint Inspection Agency and, applied product manufacturer, perform no painting work when:
 - .1 Ambient air and substrate temperatures are below 10 degrees C.
 - .2 Substrate temperature is over 32 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.
 - .4 Relative humidity is above 85 % or when dew point is less than 3 degrees C variance between air/surface temperature.
 - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
 - .2 Perform no painting work when maximum moisture content of substrate exceeds:

- .1 12% for concrete and masonry (clay and concrete brick/block).
 - .2 15% for wood.
 - .3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
 - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .2 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits noted herein.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.
 - .4 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.
 - .5 Do not apply paint when:
 - .1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.
 - .2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.
 - .3 Surface to be painted is wet, damp or frosted.
 - .6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.
 - .7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.
 - .8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

Part 2 Products

2.1 MATERIALS

- .1 Paint materials listed in latest edition of MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Paint materials for paint systems: to be products of single manufacturer.
- .3 Use only MPI listed L rated materials.
- .4 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).

- .5 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .6 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.

2.2 COLOURS

- .1 PT1: white to match James Hardie JH210-20 Arctic White.
- .2 PT2: to match blue prefinished metal siding at Police Building.
- .3 Selection of exterior paint or stain colours not noted above will be from manufacturer's full range of colours. Confirm with consultant.
- .4 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Add thinner to paint manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based paints.
- .4 Thin paint for spraying according in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss: defined as sheen rating of applied paint, in accordance with following values:

Gloss Level Category/	Units @ 60 Degrees/	Units @ 85 Degrees/
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	85	

- .2 Gloss level ratings of painted surfaces as specified and as noted on Finish Schedule.

2.5 EXTERIOR PAINTING SYSTEMS

- .1 Structural Steel and Metal Fabrications: (only as noted)

- .1 EXT 5.1M - Waterborne light industrial Gloss level 5 semi-gloss coating (over waterborne primer). Premium grade.
- .2 Galvanized Metal: not chromate passivated (Exterior doors)
 - .2 EXT 5.3L - Pigmented polyurethane over Epoxy Primer
 - .1 Grade: Premium; Gloss Level: G6
- .3 Dimension Lumber: wood beams and columns exposed to the exterior elements
 - .1 EXT 6.2G – Fire retardant penetrating wood preservative, clear.
 - .1 Grade: Premium; Gloss Level: G4

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

- .1 Perform preparation and operations for exterior painting in accordance with MPI Maintenance Repainting Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.
- .3 Clean and prepare exterior surfaces to be painted in accordance with MPI requirements.
- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before priming and between applications of remaining coats. Touch-up, spot prime, and apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .5 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

3.3 EXISTING CONDITIONS

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

3.4 PROTECTION

- .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces.
- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.

- .4 Protect passing pedestrians, and general public in and about building.
- .5 Remove light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Store items and re-install after painting is completed.
- .6 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas.

3.5 APPLICATION

- .1 Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray Application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
 - .4 Brush out immediately runs and sags.
 - .5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers when no other method is practical in places of difficult access.
- .5 Apply coats of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Unless otherwise specified, paint exterior exposed conduits, piping, hangers, duct work, grilles and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.
- .2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .3 Do not paint over nameplates.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

3.8 RESTORATION

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 05 50 00 - Metal Fabrications.
- .2 Section 06 10 00 – Rough Carpentry.
- .3 Section 06 40 00 – Architectural Woodwork.
- .4 Section 08 06 01 - Door, Frame and Hardware Schedule.
- .5 Section 09 06 01 – Room Finish Schedule.
- .6 Section 09 21 16 – Gypsum Board Assemblies.

1.2 REFERENCES

- .1 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33
- .2 Environmental Protection Agency (EPA)
 - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual, 2004.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit product data and instructions for each paint and coating product to be used.
 - .2 Submit product data for the use and application of paint thinner.
 - .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.
- .3 Samples:

- .1 Submit full range colour sample chips to indicate where colour availability is restricted.
- .2 Submit three 200 x 300 mm sample panels of each paint, stain and clear coating with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards.
- .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
 - .1 Submit manufacturer's installation application instructions.
- .4 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.
 - .2 Quantity: provide one four litre can of each type and colour of primer, stain and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.
 - .3 Delivery, storage and protection: comply with Owner requirements for delivery and storage of extra materials.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
 - .1 Identify products and materials with labels indicating:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.

- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Fire Safety Requirements:
 - .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.
- .9 Waste Management and Disposal:
 - .1 Handle and dispose of hazardous materials in accordance with Regional and Municipal, regulations.
 - .2 Ensure emptied containers are sealed and stored safely.
 - .3 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Dispose of according to Authorities with Jurisdiction.
 - .4 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
 - .5 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

1.7 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Provide continuous ventilation for seven days after completion of application of paint.
 - .4 Coordinate use of existing ventilation system with Consultant and ensure its operation during and after application of paint as required.
 - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
 - .6 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Perform no painting when:

- .1 Ambient air and substrate temperatures are below 10 degrees C.
 - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
 - .5 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
- .2 Perform painting work when maximum moisture content of the substrate is below:
 - .1 Allow new concrete and masonry to cure minimum of 28 days.
 - .2 15% for wood.
 - .3 12% for plaster and gypsum board.
- .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
- .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.

Part 2 Products

2.1 MATERIALS

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Only qualified products with E2 or E3 "Environmentally Friendly" rating are acceptable for use on this project.
- .4 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .5 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

- .6 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .7 Provide paint products meeting MPI "Environmentally Friendly" minimum E2 ratings based on VOC (EPA Method 24) content levels.
- .8 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .9 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.
- .10 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.

2.2 COLOURS

- .1 PT3: to match General Paint 8210W 'Whispering Birch'
- .2 PT4: to match General Paint CLW 1037W 'Stoney Plain'
- .3 S1: No stain. Clear varnish, satin finish.
- .4 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from Departmental Representative DCC Representative Consultant for tinting of painting materials.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35

Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated as noted on Finish Schedule.

2.5 INTERIOR PAINTING SYSTEMS

- .1 Structural steel: refer to Section 05 12 23.
- .2 Miscellaneous metal fabrications:
- .1 INT 5.1Q – Latex (over q.d. alkyd primer), Gloss Level 5 – Semi-Gloss finish. Premium grade, 1 coat primer, two top coats.
- .3 Galvanized metal: (doors, frames, railings, misc. steel, pipes, ducts and as indicated on drawings).
- .1 INT 5.3M - High performance architectural latex (over w.b. galvanized primer). Gloss Level 5 – Semi-Gloss finish. Premium grade, 1 coat primer, two top coats.
- .4 Dressed lumber: (including door and window frames, window sills, casings, mouldings and as indicated on drawings):
- .1 INT 6.3A – High performance architectural latex (over latex primer). Gloss Level 5 – Semi-Gloss finish. Premium grade, 1 coat primer, two top coats.
- .5 Wood paneling and casework (paint): plywood protection panels, shelving, millwork:
- .1 INT 6.4S - High performance architectural latex (over latex primer). Gloss Level 5 – Semi-Gloss finish. Premium grade, 1 coat primer, two top coats.
- .6 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:
- .1 INT 9.2B - High performance architectural latex (over latex primer sealer). Gloss Level 3–egg shell finish. Premium grade, 1 coat primer, two top coats.
- .7 Wood Paneling and Casework (clear varnish) : residential casework:
- .1 INT 6.4M – water borne varnish, clear. Gloss Level 4 –satin finish. Premium grade.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Correct damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Proceeding with work is acceptance of substrate.
- .3 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .4 Maximum moisture content as follows:
 - .1 Stucco, plaster and gypsum board: 12%.
 - .2 Concrete: 12%.
 - .3 Clay and Concrete Block/Brick: 12%.
 - .4 Wood: 15%.

3.4 PREPARATION

- .1 Protection:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
 - .4 Protect passing pedestrians, building occupants and general public in and about the building.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris.

- .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
- .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
- .4 Allow surfaces to drain completely and allow to dry thoroughly.
- .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
- .6 Use trigger operated spray nozzles for water hoses.
- .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
- .6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted.
- .8 Touch up of shop primers with primer as specified.

3.5

APPLICATION

- .1 Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray application:

- .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
- .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
- .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
- .4 Brush out immediately all runs and sags.
- .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .9 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .10 Finish closets and alcoves as specified for adjoining rooms.
- .11 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint fire protection piping red.
- .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

- .10 Paint natural gas piping yellow.
- .11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .12 Do not paint interior transformers and substation equipment.
- .13 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.7 FIELD QUALITY CONTROL

- .1 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 RESTORATION

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition.
- .5 Touch up scratches, abrasions, voids and other defects in painted surfaces.

3.9 CLEANING

- .1 Proceed in accordance with Section 01 74 11 – Cleaning Procedures

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
 - .2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
 - .3 CGSB 31-GP-107Ma-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA-B651-07(2012), Barrier-Free Design.
 - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples to be returned for inclusion into work.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 EXTRA MATERIALS

- .1 Provide special tools required for accessing, assembly/disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.
- .2 Deliver special tools to Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A167, Type 302, with satin finish.
- .3 Stainless steel tubing: Type 302, commercial grade, seamless welded, 1.2 mm wall thickness.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 COMPONENTS

- .1 All washroom components shall be supplied by the same manufacturer, from the same design series wherever possible.
- .2 Garage:
 - .1 Toilet tissue dispenser (TPD2): double roll type, surface mounted, heavy-duty cast aluminum with satin finish, capacity of two standard-core toilet tissue rolls up to 152mm diameter (2000 sheets). Theft-resistant spindles shall be molded high-impact ABS with retractable pins and concealed locking mechanism.
 - .1 Bobrick B-2740
 - .2 Approved alternate.
 - .2 Soap dispenser (HSD): liquid push-in valve spout, self-contained, 340 mL translucent polyethylene, tamper proof filler lock, surface mounted.
 - .3 Paper Towel Dispenser (TD): for roll paper towels, stainless steel cabinet, hinged front panel with full length piano hinge, lock and key, surface mounted, touch free pull dispensing mechanism dispenses one 305mm (12") towel per pull (pull force 1.8 pounds (8.0N), minimum capacity 205mm (8") wide x 205mm (8") diameter non-perforated paper towel rolls.
 - .1 Acceptable material: Bobrick B-2860
 - .2 Approved alternate.
 - .4 Waste receptacle (TC): 320mm x 320 mm x 560 mm high, stainless steel, open top, no cover.
 - .1 Acceptable material: Bobrick B-2260 or approved alternate.

- .5 Mirror (MI): Frame: heavy-gauge, one piece, roll-formed stainless steel with bright polished stainless steel finish. Channel shall be a minimum 13mm x13mm x 9.5mm with 90 degree mitred corners. Continuous integral stiffeners on all sides. Back of unit to be galvanized steel.
 - .1 Mirror: 6 mm tempered glass set on neoprene tubing in frame.
 - .2 Attachment clips: Vandal resistant stainless steel clips with concealed fasteners. Mirror support brackets sized to suit mirror size.
 - .3 Size: 450mm x 900mm, or equivalent, in configurations shown on drawings.
 - .4 Acceptable material: Bobrick B-165 Series or approved alternate.
- .6 Clothes Hook (CH & BFCH)
 - .1 Type 304, 2.8mm stainless steel, all welded construction with no sharp corners. Satin finish.
 - .2 Acceptable material: Bobrick B-6827 or equivalent.
- .7 Stainless Steel Shelf (SLF): Surface Mounted Shelf is 18-8 stainless steel, type 304. All exposed surfaces are N°4 satin finish. Exposed finishes to be protected during shipment by PVC film which is easily removed after installation. Shelf and brackets to be welded construction.
 - .1 Shelf: 18 gauge. 13mm lip on all four (4) sides, with front lip hemmed under.
 - .2 Brackets: 16 gauge. Two (2) brackets.
 - .3 Attachment: N°10 (M5) self-tapping screws through holes provided in support brackets. Adequate blocking in wall required so as to meet intended load weight (times 3) and to support shelf.
 - .4 Size: Shelf is 150mm deep by 410mm long with 152mm high brackets.
 - .5 Acceptable material: ASi Model N° 0692-616 or approved equivalent.
- .3 Housing Units (H Series Rooms):
 - .1 Toilet tissue dispenser (HTPD): single roll type, surface mounted, concealed fastener, brushed nickel plated steel frame, spring-loaded roller' lifetime limited warranty.
 - .1 Acceptable manufacturers:
 - .1 Moen EVA Series
 - .2 Approved alternate.
 - .2 Mirror (HMI): Frameless.
 - .1 Mirror: 6 mm tempered glass.
 - .2 Attachment: Stainless steel clips with concealed fasteners. Mirror support brackets sized to suit mirror size. Supplemental adhesive as recommended by manufacturer.
 - .3 Size: Configurations shown on drawings.
 - .3 Towel bars (HTB1): Brushed nickel plated steel, concealed screw attachment, lifetime limited warranty.
 - .1 Acceptable manufacturers:

- .1 Moen EVA Series
- .2 Approved alternate.
- .4 Towel ring (HTR): brushed nickel plated steel, concealed screw attachment, lifetime limited warranty..
 - .1 Acceptable manufacturers:
 - .1 Moen EVA Series
 - .2 Approved alternate.
- .5 Shower rod and curtain (HSR): 20 ga., brushed nickel, curved, fits standard 1.5m x 1.8m (60" x 72") shower complete with heavy duty white vinyl shower curtain and hooks.
 - .1 Acceptable manufacturers:
 - .1 To match Moen EVA Series
 - .2 Approved alternate.

2.3 FABRICATION

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CSA G164.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

2.4 FINISHES

- .1 Chrome and nickel plating: to ASTM B456, satin finish.
- .2 Manufacturer's or brand names on face of units not acceptable.

Part 3 Execution

3.1 INSTALLATION

- .1 Install and secure accessories rigidly in place as follows:
 - .1 Stud walls: install steel back-plate to stud prior to plaster, drywall or plywood finish. Provide plate with threaded studs or plugs.
 - .2 Toilet/shower compartments: use male/female through bolts.
- .2 Install grab bars on built-in anchors provided by bar manufacturer.
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.
- .5 Install mirrors in accordance with Section 08 80 50 - Glazing.

3.2 SCHEDULE

- .1 Locate accessories where indicated. Exact locations determined by Departmental Representative.
- .2 Room G102
 - .1 1 mirror at sink
 - .2 1 toilet tissue dispenser
 - .3 1 soap dispenser
 - .4 1 paper towel dispenser
 - .5 1 waste disposal
 - .6 3 clothes hooks
 - .7 1 Stainless Steel Shelf
- .3 Room H105 (quantities noted are per housing unit)
 - .8 1 toilet tissue dispenser
 - .9 1 towel ring
 - .10 1 – 900mm long towel bar
 - .11 1- soap dish integrated into tub surround (see Section 22 42 20)
 - .12 1 mirror
 - .13 1 shower rod with hooks and curtain
- .4 Room H110 (quantities noted are per housing unit)
 - .14 1 toilet tissue dispenser
 - .15 1 towel ring
 - .16 1 – 900mm long towel bar
 - .17 1- soap dish integrated into shower surround (see Section 22 42 20)
 - .18 1 mirror
 - .19 1 shower rod with hooks and curtain

END OF SECTION

1 General

1.1 REFERENCES

- .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 10-2006, Standard for Portable Fire Extinguishers.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with specifications.
- .3 Provide shop drawings.
- .4 Quality control submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 Products

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

- .1 Cartridge operated type with hose and shut-off nozzle, ULC labelled for A, B and C class protection.
 - .1 Sizes: Refer to equipment schedule.

2.2 CARBON DIOXIDE

- .1 Extinguishers Insulated handle, hose and horn discharge assembly, self-closing lever or squeeze-grip operation, fully charged, ULC labelled for B and C class protection.
 - .1 Sizes: Refer to equipment schedule.

2.3 EXTINGUISHER BRACKETS

- .1 Type recommended by extinguisher manufacturer.

2.4 CABINETS

- .1 Semi-recessed, as indicated, constructed of 1.6 mm thick steel, 180 degrees opening door of 2.5 mm thick steel with latching device.
- .2 Cabinet to maintain fire resistive rating of construction in which they occur.
- .3 Cabinet door: with 5 mm full glass panel.
- .4 Finish:
 - .1 Tub: prime coated.
 - .2 Door and frame: No.4 satin finish stainless steel.

2.5 IDENTIFICATION

- .1 Identify extinguishers in accordance with recommendations of ANSI/NFPA 10.
- .2 Attach bilingual label to extinguishers, indicating month and year of installation. Provide space for service dates.

2.6 FIRE SAFETY BLANKETS

- .1 1800 x 1800 mm of silicone coated fibre glass in metal container.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install or mount extinguishers in cabinets or on brackets as indicated on drawings and / or required by authority having jurisdiction.
- .2 Install fire safety blankets as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Section includes clothing lockers.

1.2 REFERENCES

- .1 CAN/CGSB-44.40-2001, Steel Clothing Locker.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, hooks, shelves, bases, trim, numbering, filler panels, end/back panels, doors, handles, locking method, ventilation method, and finishes.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit duplicate 50 x 50 mm samples of colour and finish on actual base metal.

Part 2 Products

2.1 SINGLE TIER CLOTHING LOCKER (LK1)

- .1 Lockers: to CAN/CGSB-44.40.
- .2 Steel: cold rolled to ASTM #A653.
- .3 Acceptable product:
 - .1 Shanahan's – "SML Deluxe 16"
 - .2 Approved equivalent.
- .4 Single tier locker.
 - .1 Size: 381 mm wide x 583 mm deep x 1829 mm high.
 - .2 Side and back panels: 0.56 mm (24 Ga) cold rolled steel.
 - .3 Vent holes: vent openings in top and bottom of doors plus additional vent holes in body top of locker. Vent holes in body top to be equal in area to vent holes in top of doors.
 - .4 Assembly: factory assembled welded construction.
 - .5 Doors:
 - .1 Single door.
 - .2 Double pan construction. Outer panel shall be no less than 1.52mm (16 Ga) cold rolled steel to ASTM A366. Inner panel 0.90 mm (20 Ga) cold

- rolled steel. Sandwich panel construction welded and complete with honeycomb core. Vent slots in top and bottom of door.
- .3 Full length astragal welded to active door (right hand).
- .4 Rubber bumpers.
- .6 Door hinges: Frame to be equipped with 3 – 64mm long, 5 knuckle hinges, 2 mm (14 Ga).
- .7 Door handle: recessed handle stainless steel box and pull.
- .8 Shelves:
 - .1 Notched into frame, thickness .90mm (20 Ga).
 - .1 Top shelf, full width of locker.
- .9 Accessories
 - .1 Coat hooks – 6 mm diameter zinc plated steel, 3 per locker.
- .10 Locking system: padlocks provided by Departmental Representative.
- .11 Options: to CAN/CGSB-44.40,
 - .1 Base: 100 high steel base, colour to match locker frames.
 - .2 Finished end panel where exposed to Room G100: minimum 0.9 mm steel thickness, colour to match locker frames.
 - .3 Steel trim including corner angles and jamb trim: minimum 0.9 mm steel thickness, colour to match locker frames.
 - .4 Corner and Filler Panels: minimum 0.9 mm steel thickness, colour to match locker frames. See drawings for locations.
 - .5 Number plates: to manufacturer's recommendations.
- .12 Finish
 - .1 Metal finish: Steel surfaces shall be thoroughly cleaned and undercoated with an iron phosphate treatment utilizing a wash and etching process. The paint finish shall be 2 coats of high quality alkyd baking enamel to 40% - 45% gloss, electro-statically applied to a minimum thickness of 1mm.
 - .2 Color to be selected from manufacturers standard color selector.
- .13 Quantity: Refer to drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Lockers
 - .1 Assemble and install lockers in accordance with manufacturer's written instructions.
 - .2 Securely fasten lockers to floor assembly and blocking in walls.
 - .3 Install locker bases and level as required.
 - .4 Install filler panels (false fronts) where indicated and where obstructions occur.
 - .5 Install finished end panels to exposed ends of locker banks.
 - .6 Install sloped false tops and gable ends.

- .7 Install locker numbers.

3.2 CLEANING

- .1 Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.3 SCHEDULE

- .1 Quantities and configuration as indicated on drawings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Section includes prefinished metal shelving units at G104.

1.2 RELATED REQUIREMENTS

- .1 Section 06 10 00 – Rough Carpentry.

1.3 REFERENCES

- .1 CAN/CGSB-44.40-2001, Steel Clothing Locker.
- .2 American Society for Testing and Materials (ASTM): ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- .3 ASTM A1011 - Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- .4 ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

1.4 DESIGN REQUIREMENTS

- .1 Layout: Refer to Drawings for configuration and quantities.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Schedule of shelving units indicating configuration, types, materials, quantities, sizes, and finishes.
- .3 Design data to determining loads, gear ratio, and anti-tip restraints.
- .4 Shop drawings showing layout plans, elevations, dimensions, required tolerances, clearances, and details for fabrication, installation, connections, anchors, accessories, and interface with other elements and systems.

1.6 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Minimum 75 mm square sample of each colour and texture to be exposed after installation.
- .3 Finish color samples for selection by Departmental Representative.

1.7 QUALITY ASSURANCE

- .1 Installer qualifications: Experienced in installation of storage systems and employee of manufacturer or certified by manufacturer for installation of specified system.

1.8 WARRANTY

- .1 Provide under provisions of Section 01780 - Closeout Submittals the following warranties:
 - .1 5 years warranty to cover parts and materials against defects.
 - .2 2 years warranty to cover workmanship.

Part 2 Products

2.1 MATERIALS

- .1 Steel sheet:
 - .1 Cold rolled steel sheet complying with ASTM A1008.
 - .2 Hot rolled, pickled steel sheet complying with ASTM A1011.
- .2 Steel rail: SAE 1045.
- .3 Extruded aluminum: ASTM B221, alloy 6063 Temper T-5.

2.2 METAL SHELVING (STG1, STG2)

- .1 Size:
 - .1 STG1: nominal 900mm long x 400mm deep x 1830mm high.
 - .2 STG2: nominal 900mm long x 600mm deep x 1830mm high.
 - .3 Shelf: Cold-rolled furniture-grade steel, 1.27 mm (18 ga.) . Double formed on all four sides. Corners are closed with double thickness steel forming a no-slip notch for the shelf clip.
 - .4 Clip: 12-gauge compression type; cadmium plated.
 - .5 Reinforcement: 25 mm x 12 GA. bent angle of steel, installed in the front and rear flange of the shelf to provide additional shelf capacity.
 - .6 Number of shelves per unit: Refer to schedule on drawings.
- .2 T-Posts
 - .1 38 mm x 50 mm x 3.17 mm double-formed steel in a "T" style with a smooth, unperforated face.
- .3 Closed End Panel Assembly
 - .1 Two "T" posts welded to a cold-rolled steel side panel to form a single unit providing greater strength and easier handling.
 - .2 Provide closed end panel between adjacent shelving units.
- .4 Back Panel
 - .1 Cold-rolled steel panel attached to uprights with cadmium-plated back clips.

- .5 Base Plates
 - .1 Formed top and bottom to provide support for the bottom shelf in addition to closing the space under the shelf.
- .6 Finish
 - .1 Prepared components for painting by being cleaned, iron phosphatized and rinsed. Electrostatically apply high-grade alkyd enamel. Bake to provide a hard, long lasting, furniture-grade finish.
- .7 Minimum Shelf Capacity
 - .1 STG1 and STG2 minimum load capacity per shelf : 630 pounds.

Part 3 Execution

3.1 PREPARATION

- .1 Verify dimensions and Project conditions prior to fabrication.
- .2 Verify floor substrate is level and ready to receive storage system.

3.2 INSTALLATION METAL SHELVING

- .1 Assemble and install cabinets in accordance with manufacturer's written instructions.
- .2 Install storage cabinets in numbers and configurations shown in drawings.
- .3 Ensure shelving units are installed square and plumb.
- .4 Align shelving units adjacent to each other when they are installed end to end.
- .5 Install shelving units parallel and perpendicular to walls according to the layout.

3.3 CLEANING

- .1 Remove protective wrappings.
- .2 Clean metal surfaces using clean water and mild detergent. Do not use abrasive agent, steel wool, or harsh chemicals. Rinse with clean water.

3.4 DEMONSTRATION

- .1 Demonstrate to Owner's designated representatives, complete operation and required maintenance for mobile storage system.

3.5 SCHEDULE

- .1 Refer to drawings for quantity and location.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

- .1 Ventilated metal shelves with integral closet rod.
- .2 Ventilated metal shelving on matching adjustable metal shelving standards.
- .3 Prefinished aluminum guardrails.
- .4 Small parts bin in Room G100.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 06 40 00 – Architectural Woodwork
- .3 Section 09 21 16 – Gypsum Board Assemblies
- .4 Section 09 91 23 – Interior Painting

1.3 REFERENCE STANDARDS

- .1 National Building Code of Canada 2015 edition.

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures. Provide overall layouts, colors, dimensions, product and accessory information, support and anchorage details.

PART 2 Products

2.1 VENTILATED METAL SHELVES

- .1 Type 1: Indicated R+S on Drawings. Prefinished Ventilated Metal Wire Shelf with Integrated Closet Rod: 400 mm (16” depth). Length to suit - see drawings. Matching supporting brackets, anchors and accessories as per manufacturer’s written instructions to suit application. Color: White.
 - .1 Basis of design: ClosetMaid or approved alternate.
- .2 Type 2: Indicated as #S on Drawings where # represents number of shelves required. Prefinished Ventilated Metal Wire Shelving on matching metal adjustable shelf standards: 400mm (16” depth). Length to suit - see drawings. Matching corner shelving, supporting brackets, anchors, shelf standards and accessories as per manufacturer’s written instructions to suit application. Color: White.
 - .1 Basis of design: ClosetMaid or approved alternate.

- .3 Shelves, standards, brackets and all accessories are to be from a single manufacturer.

2.2 PREFINISHED ALUMINUM GUARDRAILS

- .1 Base Rail: Powder-coated aluminum. White. Compatible with pickets and spacers.
- .2 Hand Rail: Powder-coated aluminum. White.
- .3 Regular Pickets: Powder-coated aluminum. Space pickets to meet National Building Code of Canada requirements. White.
- .4 Spacers: Powder-coated aluminum. Compatible with pickets, stair pickets and base rail components. White.
- .5 Stair Kit with Regular Stair Pickets: Powder-coated aluminum. White.
- .6 End Posts/Mid-posts: 1800 mm max spacing. Complete with Post Attachment kit from manufacturer.
- .7 Layout and Dimensions: See drawings.
- .8 Accessories, Fasteners and Connectors: By manufacturer to suit layout. See drawings. Powder-coated aluminum. White.
- .9 All components are to be supplied from a single manufacturer.
- .10 All components must meet requirements of National Building Code of Canada.
- .11 Basis of design: RailBlazers by Peak Products (1-877-883-7325) or approved alternate.

2.3 PREFINISHED SMALL PARTS BIN

- .1 857 wide x 305 dp x 1067 ht (33.75" w x 12" dp x 42" ht), prefinished metal wall-mounted parts bin. 44 bins. Mounting holes at top and bottom. Gray powder coated finish. Bin sizes: 40 bins at 102 w x 302 dp x 114 ht (4" w x 11-7/8" dp x 4.5" ht) and 4 bins at 413 w x 302 dp x 178 ht (16.25" w x 11-7/8" dp x 7" ht). Weight: 26.3 kg (58 lb.)
- .1 Acceptable product: Model 398-95, supplied by L.K. Goodwin Co., Material Handling Equipment, 20 Technology Way, West Greenwich, RI, USA, 1-800-343-2478, email: contact@lkgoodwin.com, www.lkgoodwin.com or approved equivalent.
2. Quantity: 1.

PART 3 Execution

3.1 INSTALLATION – VENTILATED METAL SHELVING

- .1 Comply with manufacturer's installation requirements and instructions.
- .2 Length to suit locations. See drawings.

.3 Coordinate installation of continuous wood blocking behind all adjustable shelf standards. Attach standards to studs at a maximum spacing of 400mm on centre.

.4 Ensure support and anchorage is adequate to meet intended use.

3.2 INSTALLATION – PREFINISHED ALUMINUM GUARDRAILS

.1 Comply with manufacturer's installation requirements and instructions.

.2 Length to suit locations. See drawings for details.

.3 Ensure support and anchorage is adequate to meet intended use and to comply with National Building of Canada requirements.

3.3 INSTALLATION – PREFINISHED SMALL PARTS BIN

.1 Comply with manufacturer's installation requirements and instructions.

.2 Coordinate installation of in-wall blocking to suit.

3.4 CLEANING

.1 Clean surfaces after installation using manufacturer's recommended cleaning procedures.

3.5 SCHEDULE

.1 Ventilated Metal Shelves:

.1 Type 1: Rooms H101, H102, H104A, H104B, H112, H113.

.2 Type 2: Rooms H106, H107.

.2 Prefinished Aluminum Guardrails:

.1 See drawings for locations.

.3 Small Parts Bin:

.1 See drawings for location.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Appliances for Housing Units.

1.2 REFERENCES

- .1 CAN/CSA C300-08: Energy Performance and Capacity of Household Refrigerators, Refrigerator-Freezers, Freezers, and Wine Chillers.
- .2 CAN/CSA-C22.2 NO. 150-M89 (R2014): Microwave ovens.
- .3 CAN/CSA-E60335-2-43:13 – Household and Similar Electrical Appliances – Safety – Part 2-11
- .4 CAN/CSA-C361-12 – Test Method for Measuring Energy Consumption and Drum Volume of Electrically Operated Household Tumble-Type Clothes Dryers
- .5 CAN/CSA-C62301:11 – Household Electrical Appliances – Measurement of Standby Power
- .6 CAN/CSA-E60335-2-6:13-Safety of Household and Similar Electrical Appliances – Safety – Part 2-6
- .7 CAN/CSA-C360-03 (2009) – Energy Performance, Water Consumption and Capacity of Household Clothes Washers
- .8 CAN/CSA-F325-M91 (R2010) – Residential Mechanical Ventilation Systems

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for furniture and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry and well-ventilated area.
- .2 Store and protect furniture from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

1.6 WARRANTY

- .1 Provide 1 year parts and labour warranty.

Part 2 Products

2.1 REFRIGERATORS

- .1 Refrigerators are to be from same manufacturer.
- .2 Type FR-FRZ – bottom freezer
 - .1 Width: maximum 30 inches.
 - .2 Capacity:
 - .1 Refrigerators: minimum 14 cubic feet.
 - .2 Freezer: minimum 6 cubic feet.
 - .3 Temperature controls: electronic.
 - .4 Shelving: adjustable in refrigerator with storage in refrigerator door.
 - .1 Refrigerator: minimum 3. Glass.
 - .5 Refrigerator Drawers: Min. 2.
 - .6 Door: reversible.
 - .7 Light: refrigerator and freezer compartments.
 - .8 Defrost system: frost free.
 - .9 Energy Star qualified: No.
 - .10 Legs/Wheels: adjustable.
 - .11 Finish: white.
 - .12 Acceptable Manufacturers
 - .2 KitchenAid, Whirlpool, Frigidaire, LG or approved alternate.

2.2 RANGES

- .1 Ranges are to be from same manufacturer.
- .2 Type RNG – residential range
 - .1 Width: maximum 30 inches.
 - .2 Cooktop: 5 elements min.
 - .1 2- 150mm (6”) radiant 1200W min.
 - .2 1 - 6/9” Expandable 3000W min.
 - .3 1- 9/12” Expandable 3000W min.
 - .4 1-100W warming zone.
 - .5 Black Glass surface.

- .6 Hot surface warning light.
- .3 Cabinet: White.
- .4 Storage Drawer: Yes.
- .5 Control Panel: White aluminum. Rear location. Small appliance outlet: 1 min. Timer: Erc. Clock: digital.
- .6 Controls: electronic.
- .7 Oven:
 - 1. Capacity: 5.3 cu. Ft. min.
 - 2. Bake Element Pass: 8
 - 3. Bake Element Power (W) – 3500 min.
 - 4. Broil Element Pass: 8
 - 5. Broil Element Power (W) – 4000 min.
 - 6. Voltage: 220/240V
 - 7. Cavity Material: Porcelain on Steel
 - 8. Convection function.
 - 9. Hidden Bake Element.
 - 10. Oven Light.
 - 11. Self Clean function.
 - 12. Auto Shut off function.
 - 13. 2 adjustable wire racks. 6 rack positions.
- .8 Door: large vision lite.
- .9 Energy Star qualified: No.
- .10 Legs: adjustable.
- .11 Acceptable Manufacturers
 - .1 KitchenAid, Whirlpool, Frigidaire, LG or approved alternate.

2.3 RANGE HOODS

- .1 Range hoods are to be from same manufacturer.
- .2 Type RHD – residential range hood. See mechanical specification.

2.4 CHEST FREEZERS

- .1 Freezers are to be from same manufacturer.
- .2 Type DFRZ –chest-style freezer
 - .1 Dimensions: maximum 857 high x 953 wide x 527 mm deep (33.75” high x 37.5” wide x 20.75” deep)
 - .2 Capacity:
 - .1 Freezer: 7 cu. Ft.
 - .3 Temperature controls: adjustable mechanical.
 - .4 Defrost system: manual.
 - .5 Defrost Water Drain: yes.

- .6 Freezer Interior Light: no.
- .7 Number of Storage Baskets: one.
- .8 Power Light Indicator: yes.
- .9 Compressor Noise Level (dB): 0.
- .10 Energy Star qualified: no.
- .11 Finish: white.
- .12 Acceptable Manufacturers
 - .1 KitchenAid, Whirlpool, Frigidaire, LG or approved alternate.

2.5 ELECTRIC WASHING MACHINES

- .1 Washing machines and Dryers are to be matching pair, from same manufacturer.
- .2 Type WASH: top load washing machine.
 - .1 Cabinet Height: maximum 37 inches. With lid open: max. 52 inches.
 - .2 Cabinet Depth: maximum 28 inches.
 - .3 Cabinet Width: maximum 28 inches.
 - .4 Washer Interior Capacity: minimum 4.0-4.5 cubic feet.
 - .5 Circuit rating/Voltage: 15 amps/ 110/120 V
 - .6 Top and Lid: powder coated white.
 - .7 Cabinet: white. Insulated for noise reduction.
 - .8 Wash basket material: stainless steel.
 - .9 High efficiency: No.
 - .10 Max spin speed: min. 770
 - .11 Wash agitator motion: Wash plate.
 - .12 Dispenser: Bleach.
 - .13 Number of Water Temperatures: Min. 5.
 - .14 Wash Cycles: Min. 7 with end of cycle signal.
 - .15 Energy Star compliant: No.
 - .16 Acceptable Manufacturers
 - .1 Panasonic, Bosch, Samsung, Whirlpool LG, GE or approved alternate.

2.6 ELECTRIC CLOTHES DRYERS

- .1 Washing machines and Dryers are to be matching pair, from same manufacturer.
- .2 Type DRY– front load
 - .1 Cabinet Height: maximum 37 inches. To top of control panel: 43 inches.
 - .2 Cabinet Depth: maximum 29 inches with door closed.
 - .3 Cabinet Width: maximum 29 inches.
 - .4 Dryer Interior Capacity: minimum 7.0 cubic feet.
 - .5 Drum Material: Powder coated.

- .6 Power Source: 220/240V
- .7 Min. Circuit Rating: 30 amps
- .8 Venting: back (standard).
- .9 Control type: Electromechanical.
- .10 Top and Lid: powder coated white.
- .11 Cabinet: white. Insulated for noise reduction.
- .12 Sensor dry: yes.
- .13 Dry cycles: Min. 3.
- .14 High efficiency: No.
- .15 Energy Star compliant: No.
- .16 End of cycle signal: yes.
- .17 Timed dry: yes.
- .18 Wrinkle reduction: yes.
- .19 Acceptable Manufacturers:
 - .1 Panasonic, Bosch, Samsung, Whirlpool LG, GE or approved alternate.

2.7 MICROWAVES

- .1 Microwaves are to be from same manufacturer.
- .2 Type MIC
 - .1 Width: maximum 22 inches.
 - .2 Height: maximum 13 inches.
 - .3 Depth: maximum 16 inches.
 - .4 Capacity: minimum 1.6 cubic feet.
 - .5 Power: minimum 1100 watts.
 - .6 Options:
 - .1 Turntable, auto defrost, auto reheat, auto cook, timer, minimum 10 programmable power levels.
 - .7 Oven liner: painted steel.
 - .8 Finish: white.
 - .9 Acceptable Manufacturers
 - .1 Panasonic, Bosch, Samsung, Whirlpool LG, GE or approved alternate.

Part 3 Execution

3.1 INSTALLATION

- .1 Install according to manufacturer's written instructions.
- .2 Install in locations as indicated on drawings.
- .3 Set digital clocks to display correct time.

3.2 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Remove masking or protection after installation.
- .3 Clean finished surfaces as recommended by panel manufacturer.

3.3 SCHEDULE

- .1 Refer to drawings for quantities and locations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for residential casework in Housing Units. For architectural woodwork in garage and base, trims and casings at Housing Units see Section 06 40 00 Architectural Woodwork. For wire shelving see Section 10 90 00 Miscellaneous Specialties.

1.2 RELATED SECTIONS

- .1 Section 06 40 00 – Architectural Woodwork
- .2 Section 10 90 00 – Miscellaneous Specialties

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/HPVA HP-1-2009, Standard for Hardwood and Decorative Plywood.
 - .2 ANSI/NPA A208.1-2009, Particleboard.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O112.4 Series-M1977(R2006), Standards for Wood Adhesives.
 - .3 CSA O121-08(R2013), Douglas Fir Plywood.
 - .4 CSA O141-05(R2009), Softwood Lumber.
- .4 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-2005, High-Pressure Decorative Laminates (HPDL).
- .5 National Hardwood Lumber Association (NHLA)
 - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 2011.
- .6 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2010.

1.4 PERFORMANCE REQUIREMENTS

- .1 Materials and installation shall be in metric measurement as specified.

1.5 SUBMITTALS

- .1 Provide Submittal submissions: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

- .1 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .1 Scales: profiles full size, details half full size.
- .2 Indicate materials, thicknesses, finishes and hardware.
- .3 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide duplicate samples: sample size 300 x 300 mm or 600 mm long unless specified otherwise.
 - .2 Provide two (2) samples of each wood species for review.
 - .3 Provide duplicate colour samples of laminated plastic for colour selection.
 - .4 Provide duplicate samples of laminated plastic joints, edging, cutouts and postformed profiles.
- .4 Quality assurance submittals:
 - .1 Manufacturer's Instructions: manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.
- .3 Delivery, Storage, and Handling:
 - .1 Deliver, handle, store and protect materials of this section in accordance with Section 01 61 00 - Common Product Requirements.
 - .1 Protect millwork against dampness and damage during and after delivery.
 - .2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Softwood lumber: unless specified otherwise, S4S, moisture content 19% or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.

- .2 Hardwood lumber: moisture content 6% or less in accordance with following standards:
 - .1 National Hardwood Lumber Association (NHLA).
- .3 Douglas fir plywood (DFP): to CSA O121, standard construction.
 - .1 Urea-formaldehyde free.
- .4 Hardwood plywood: to ANSI/HPVA HP-1.
 - .1 Urea-formaldehyde free.
- .5 Engineered Combination core – 5 ply veneer: to ANSI A208-1
 - .1 Urea-formaldehyde free.
- .6 Laminated plastic for flatwork: to NEMA LD3, Grade VGL, Type HD, 1.6 mm thick; based on solid, woodgrain, printed pattern, and metallic, colour range with satin, matt, textured, and embossed finish.
- .7 Laminated plastic backing sheet: Grade BK, Type HD not less than 0.5 mm thick or same thickness and colour as face laminate.
- .8 Thermofused Melamine: to NEMA LD3 Grade VGL.
 - .1 High wear resistant thermofused melamine: equal or exceed 400 cycles (Minimum standard for HPL abrasion test).
- .9 Nails and staples: to CSA B111.
- .10 Wood screws: plain, type and size to suit application.
- .11 Splines and dowels: wood and metal.
- .12 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .13 Laminated plastic adhesive:
 - .1 Adhesive: contact adhesive to CAN/CGSB-71.20.
 - .1 Maximum VOC limit 250 g/l.
 - .2 Adhesives urea-formaldehyde free.

2.2 MANUFACTURED UNITS

- .1 Cabinets:
 - .1 Construction: frameless.
 - .2 Furring, blocking, nailing strips, grounds and rough bucks
 - .1 S2S is acceptable for concealed products.
 - .2 Board sizes: "standard" or better grade.
 - .3 Dimension sizes: "standard" light framing or better grade.
 - .4 Urea-formaldehyde free.
 - .3 Case bodies (sides, tops, floors, dividers).

- .1 Construction: **ALL** construction to be maple veneer plywood, square edge, min.16.0 mm thick. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
- .2 Edge banding: 3.0 mm PVC to matching maple veneer.
- .3 Exposed Exterior and Exposed Interior Surfaces: maple veneer plywood. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
- .4 Semi Exposed and Concealed Surfaces colour: maple veneer plywood. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
- .5 Shelf support: Precision drilled 5.0mm diameter holes at 32mm spacing.
- .6 Feet: provide min. four (4) 100mm high height-adjustable feet per base cabinet complete with clips for attachment of toe kick.
- .4 Rails:
 - .1 Construction: **ALL** construction to be maple veneer plywood, square edge, min.16.0 mm thick. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
 - .2 Exposed Surfaces: maple veneer plywood. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
 - .3 Semi Exposed and Concealed Surfaces colour: maple veneer plywood. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
- .5 Backs:
 - .1 Construction: **ALL** construction to be maple veneer plywood, square edge, min.16.0 mm thick. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
 - .2 Colour: Clear satin finish S1.
- .6 Shelving:
 - .1 Construction: **ALL** construction to be maple veneer plywood, square edge, min. 16.0 thick. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
 - .2 Edge banding: provide 3.0 mm PVC to match maple veneer.
 - .3 Quantity: See drawings.
- .7 Toe Kick:
 - .1 Construction: **ALL** construction to be maple veneer plywood, square edge, min. 16.0 thick. Clear satin finish S1. Refer to 09 91 23 Interior Painting
 - .2 Exposed Exterior Surface: maple veneer plywood. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
 - .3 Accessories: Screw-on plate for clip attachment to base cabinet feet.
 - .4 Location: at base of all base cabinets and at all returns on end runs of casework.
- .2 Drawers:
 - .1 Sides, Back and Bottom:
 - .1 **ALL** construction to be maple veneer plywood, square edge, min. 16.0 thick. Clear satin finish S1. Refer to 09 91 23 Interior Painting.
 - .2 Fronts:

- .1 Construction: Five piece flat panel, shaker style. See drawings.
 - .1 Drawer fronts less than 184 mm high: 38 mm wide solid maple stiles and rails min. 19.0 mm thick, with min. 6.3 mm thick composite core insert with horizontal grain maple veneer.
 - .2 Drawer fronts greater than 184 mm high: 57 mm wide sold maple stiles and rails min. 19.0 mm thick with min. 6.3 mm thick composite core insert with horizontal grain maple veneer.
- .2 Exposed Surface Color: Clear satin finish S1. Refer to 09 91 23 Interior Painting.
- .3 Doors:
 - .1 Construction: Five piece shaker door (square flat panel door). See drawings.
 - .1 57 mm wide solid maple stiles and rails min. 19.0 mm thick, with min. 6.3 mm thick composite core insert with vertical grain maple veneer.
 - .2 Color: Clear satin finish S1. Refer to 09 91 23 Interior Painting.
- .4 Countertops:
 - .1 High-pressure plastic laminate: fully formed w/coved splash, waterfall edge at countertop edge, top of back and side splash. Backsplash and sidesplash finish to match countertop unless indicated otherwise on drawings.
 - .2 Color: to match Pionite MT340 Rock Around the Clock. Suede finish.

2.3 FABRICATION

- .1 Assemble cabinets in flush overlay style.
- .2 Set nails and countersink screws apply plain wood filler to indentations, sand smooth and leave ready to receive finish.
- .3 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.
- .4 Shelving to cabinetwork to be adjustable unless otherwise noted.
- .5 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .6 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .7 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .8 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .9 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support

and bond over entire surface. Use continuous lengths up to 2400 mm. Keep joints 600 mm from sink cutouts.

- .10 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.
- .11 Apply laminate backing sheet to reverse side of core of plastic laminate work.

2.4 **HARDWARE**

- .1 Hinges: European concealed hinges, 110 degree opening. Only screw fastened hardware will be accepted, no friction fit hardware will be accepted. Use plastic insertion dowels to receive screws of hinge baseplates.
 - .1 Acceptable manufacturers: Hettich, Blum, Hafele or Richelieu.
- .2 Drawer slides: full extension, bearing type, double wall, secured to sides of drawers and to gable, 25kg static load capacity, integral stop, silent-closing.
 - .1 Acceptable product: Hettich Summit System
 - .2 Approved equivalent.
- .3 Shelf standards: Locking clip support pin for 5mm diameter holes, steel pin with moulded on clear plastic.
- .4 Pulls: Metal handle pull.
 - .1 Acceptable products: Richelieu BP458128195 or Hettich Anzio 116 0018
 - .2 Approved equivalent.
- .5 Clear plastic silencers to be installed on all cabinet doors.

Part 3 **Execution**

3.1 **INSTALLATION**

- .1 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.
- .2 Fasten and anchor millwork securely. Provide heavy duty fixture attachments for wall mounted cabinets.
- .3 Use draw bolts in countertop joints.
- .4 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .5 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant.

- .6 Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.
- .7 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .8 Site apply laminated plastic to units as indicated. Adhere laminated plastic over entire surface. Make corners with hairline joints. Use full sized laminate sheets. Make joints only where indicated or approved. Slightly bevel arises.
- .9 For site application, offset joints in plastic laminate facing from joints in core.
- .10 Coordinate installation of continuous wood blocking behind all cabinets.

3.2 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Clean millwork and cabinet work, inside cupboards and drawers and outside surfaces.
- .3 Remove excess glue from surfaces.

3.3 PROTECTION

- .1 Protect millwork and cabinet work from damage until final inspection.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 08 54 13 - Fiberglass Windows

1.2 DESIGN REQUIREMENTS

- .1 Design roller shades to following requirements:
 - .1 Be designed in a manner that allows wear susceptible parts to be replaceable by either the user or the manufacturer.
 - .2 A guarantee of at least five years of available replacement parts following discontinue of the products manufacture.
 - .3 Be accompanied by instructions for replacing or repairing worn parts, including inventory numbers for parts and procedures for ordering replacement parts.
 - .4 A program that allows for the refurbishing or return of used roller shades.
 - .5 Be designed in a manner that permits effective disassembly of components in order to permit recycling of materials for which recycling markets exist.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate dimensions in relation to window jambs, operator details, head and sill anchorage details, hardware and accessories details.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit duplicate samples of manufacturer's standard colours for selection by Consultant.
- .3 After approval, samples will be returned for incorporation into the Work.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS / PRODUCTS

- .1 Housing Units (H Series Rooms):
 - .1 Basis of Design: Hunter Douglas Designer Dual Roller Shade FR. Double bracket assembly with offset roller shades. Two shades in one cassette. Independent shade operation. Independent concealed clutches and metal beaded cord loop with cord tensioner. White anodized aluminum cassette with matching end caps. Front shade (nearest room): Shearweave 2410 openness of 3%. Rear shade (nearest glazing): Shearweave 7000 openness to be 0%.
 - .1 Width Range for Single Shade: 305-3660 mm (12-144").

- .2 Height Range for Single Shade: 305-3048 mm (12-120").
- .3 Mounting: Inside window opening. Refer to drawings.
- .4 Fabric Color: Consultant to select fabric colours from manufacturer's standard range. Submit samples as per Section 01 33 00.
- .2 Acceptable manufacturers:
 - .1 Hunter Douglas.
 - .2 Approved equivalent.

2.2 MATERIALS AND FABRICATION

- .1 To manufacturer's standard.

Part 3 Execution

3.1 INSTALLATION

- .1 Include centre brackets where necessary to prevent deflection of headrail.
- .2 Adjust to provide for operation without binding.
- .3 Use non-corrosive metal fasteners for installation, concealed in final assembly.
- .4 Install blinds mounted to inside of jambs.
- .5 Provide white aluminum cassette typical at all locations.

3.2 SCHEDULE

- .1 Housing Units

Room Number	Number Of Shades per Room	Window Type
H100	1	G
H103	1	L
H108	1	K
H109	2	J
H109	2	H
H111	1	L

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Housing units must be constructed to be modular and relocatable, meeting the modular building codes, standards and requirements outlined in this Section, however, construction within an “off-site” controlled environment, and transportation to site, is optional. Housing units may be site constructed outside a controlled environment on site provided the resultant construction results in a relocatable unit, governed by the restrictions and codes outlined in this Section. Provide for third party inspection guaranteeing compliance with CSA A-277-01 in all instances.
- .2 Should housing units be constructed “off-site” in a controlled environment:
 - .1 a substantial portion of the work is to be completed at the modular builder’s facility (plant).
 - .2 All housing unit modules for this project must be constructed at a single plant in a single location.
- .3 Building modules shall include:
 - .1 All specified interior and exterior finishes, specialties and accessories.
 - .2 Mechanical systems as noted.
 - .3 Electrical systems as noted.
- .3 Section includes preparation and protection of building modules for shipment to site.
- .4 Section includes shipment of building modules to site.
- .5 Section includes erection of building modules on prepared foundation.
- .6 Section includes site repairs to modules after transportation.

1.2 RELATED REQUIREMENTS

- .1 Section 01 11 00 – Summary of Work.
- .2 Section 13 42 00.01 – Appendix, Otter Rapids Bridge from Ministry of Highways

1.3 REFERENCES

- .1 CSA Group
 - .1 CAN/CSA A277-01 (R2005), Procedure for Certification of Factory-Built Houses.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Co-ordination: co-ordinate work of this Section with all requirements of technical specifications.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Required submittals:

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 As referenced in other Sections of technical specifications.
- .2 Shop Drawings (Building Modules):
 - .1 If alternate structural methods or layouts are proposed for the modular components:
 - .1 Verify that the structural design meets the design intent and assume all costs associated with this verification.
 - .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
 - .2 Indicate on drawings related provisions required for mechanical, electrical and other work.
 - .3 Indicate weight of each Building Module on permanent plaque. Install permanent plaque on each unit's underside. Refer to 1.8.2 - Transportation Requirements and 2.1 - Designed Requirements.

1.6 QUALITY ASSURANCE / QUALITY CONTROL

- .1 Modular builder shall have a QA/QC program in place for the design, fabrication, delivery and installation of building modules. The QA/QC program is subject to review and approval by the Departmental Representative prior to award of contract.
- .2 Construct all modules in a single location in compliance with CAN/CSA A277. Provide and pay for any and all third party inspections required to ensure this standard is maintained. Provide copies of all third party inspections to Departmental Representative.
- .3 Modular builder shall be responsible to have the building modules and systems inspected and tested at the facility and/or site as required by the requirements of the technical specifications and as may be required by the Owner, Province, or any other Authority Having Jurisdiction in addition their QA/QC program and CAN/CSA A277.
- .4 Provide Inspection and Test Plan (ITP) to include:
 - .1 Schedule of in-plant or on-site reviews of selected modules by all required parties. Confirm list of required parties at pre-construction meeting.
 - .2 The condition of selected building module will be reviewed by all required parties for condition prior to its preparation for shipment.
 - .3 Test all mechanical and electrical systems and connections installed in factory prior to shipping in accordance with specifications including but not limited to Sections 23 08 01 and 23 05 94. Document test results and provide copies for Operations and Maintenance manuals. Systems shall be retested on site once final connections are completed.
- .5 Comply with all applicable Provincial, National and Municipal Building Codes.
- .6 Mock-ups:
 - .1 Refer to individual specification sections for required mock-ups.
 - .2 To expedite construction, mock-ups may be pre-qualified or constructed for review and approval by Departmental Representative prior to construction of modules. Confirm requirements at pre-construction meeting.
 - .3 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Building module transportation requirements:
 - .1 Arrange for all costs associated with transportation permits, and conduct a road survey of any and all maximum vehicular loading regulations and obstructions prior to transportation. Height, width and loading restrictions apply.
 - .2 Prepare building modules for shipment to site wrapped and protected in accordance with industry best practices to prevent damage from weather, dirt or debris during transport.
 - .3 Ensure openings between modules are temporarily framed and protected prior to being wrapped for shipment.
 - .4 Ship loose items shall be catalogued and marked for proper placement and use in each section. Ship loose items shall be installed by General Contractor at the site.
 - .5 Provide additional bracing to units as required by means of cable bracing or other means in order to prevent damage during building relocation.
 - .6 Include appropriate insurance for modules during transportation.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Designed weight of each building module is to ensure transportation Gross Vehicle Weight (GVW) does not exceed 41,500 kg.

2.2 MATERIALS

- .1 Use only materials specified in other Sections of technical specifications.

2.3 FABRICATION

- .1 Refer to the drawings and technical specifications.
- .2 Floor Construction:
 - .1 Floor finishes, as scheduled, are to be installed prior to shipping.
- .3 Wall Construction:
 - .1 All gypsum board shall be mechanically fastened.
 - .2 All walls are to receive at minimum tape, and prime coat of paint at the plant. Shipping module units with unfinished gypsum partitions is not permitted.
 - .3 Walls receiving finishes other than paint are to be completely finished prior to shipping.
- .4 Roof Construction:

- .1 Design roof structure to support the specified minimum live loads plus all dead loads for structure, finishes, ground snow loads, imposed snow loads, and building equipment.
- .2 Roofing system shall be as specified in Division 7 of the technical specifications. Comply with all specified warranty requirements.

2.4 MECHANICAL SYSTEMS

- .1 Schedule of work to be completed on site (not in plant):
 - .1 Final cleaning, testing and commissioning.
 - .2 Plumbing lines and all associated fittings, valves and accessories running in the crawlspace including connections to pipe terminations in modules.
 - .3 Installation of floor sink and associated interceptor.
 - .4 Ductwork and all associated fittings and accessories running in space below modules including connections to ductwork terminations in modules.
 - .5 Installation and connection of equipment located in the space below modules (booster pump, etc.)
 - .6 Final placement and connection of all equipment (includes placement of equipment, connection of equipment and all ductwork and piping).
 - .7 Installation of water meter.
 - .8 Service connections in space below modules.
 - .9 Testing and certification of fire protection system and all other mechanical systems as required by individual specification sections.

2.5 ELECTRICAL SYSTEMS

- .1 Schedule of work to be completed on site (not in plant):
 - .1 Commissioning.
 - .2 Connection of cross over connections from module to ventilated space (looped, tagged, and identified in plant).
 - .3 Final connection to heat trace cabling.
 - .4 Service trench for incoming power cables.
 - .5 Service trench and conduit for incoming SaskTel service cables.
 - .6 Home run wiring.
 - .7 Standby Power Generator installation including meter socket, power and control cabling.
 - .8 Power cabling to Fuel Storage tank system (Stony Rapids).
 - .9 Fire alarm cabling (Police Building, Black Lake).
 - .10 Site testing and verifications.

Part 3 Execution

3.1 VERIFICATION OF CONDITIONS

- .1 Verify areas to receive components of this Section are free of impediments interfering with access and installation.

3.2 ERECTION

- .1 Set building modules on prepared foundations in accordance with reviewed Shop Drawings.
- .2 A qualified supervisor from the building module manufacturer shall be on site during time of delivery and set.
- .3 Provide skilled workers trained and approved by the building manufacturer to place the modular units in accordance with the building manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- .1 Maintain all requirements of QA/QC program and specified tolerances between building modules.

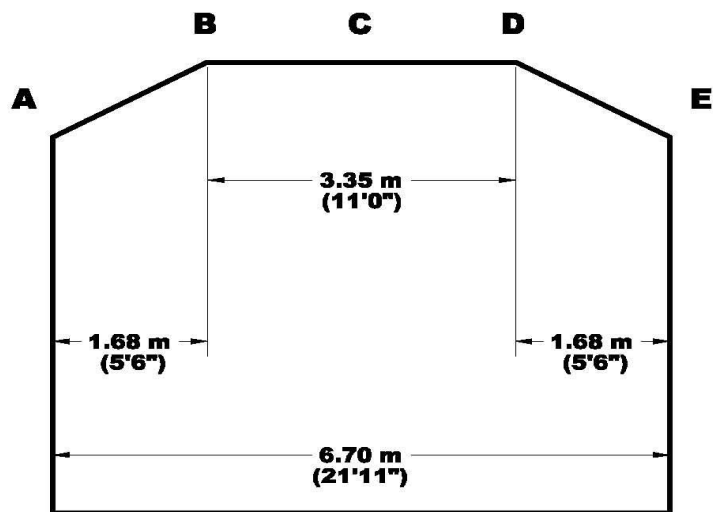
3.1 WARRANTY

- .1 Submit manufacturer's standard warranty form for each product as required in the technical specifications.
- .2 Extended warranties: Where extended warranties are listed in other specification Sections they shall be passed through from the building module manufacturer to the General Contractor.

END OF SECTION

Appendix

Highway 102 - Churchill River at Otter Rapids



Maximum vertical clearances at:

A = 4.57 m (15'0")

B = 5.48 m (18'0")

C = 5.48 m (18'0")

D = 5.48 m (18'0")

E = 4.57 m (15'0")

Steel Truss Bridge with steel grate deck

Part 1 - General

1.1 RELATED WORK

.1	Access Doors	Division 08
.2	Fire Extinguishers	Division 10
.3	Fire Suppression	Division 21
.4	Plumbing	Division 22
.5	Heating, Ventilating and Air Conditioning	Division 23
.6	Integrated Automation	Division 25

1.2 INTENT

- .1 Provide a complete and fully operational mechanical system with facilities and services to meet requirements described herein and in complete accord with applicable codes and ordinances.
- .2 Contract documents for mechanical scope are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .3 Should any discrepancies occur on drawings or in specifications which leaves doubt as to the intent and meaning of the drawings and specifications, obtain a ruling from the designer before submitting tender. If this is not done, it will be assumed that the most expensive alternate has been allowed for in the bid.
- .4 Follow manufacturer's recommended installation details and procedures for equipment supplemented by details given herein and on plans subject to approval of the Departmental Representative.
- .5 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Departmental Representative at no extra cost.
- .6 Provide labour and materials required to install, test and place into operation complete mechanical system. Provide additional material for modifications required to correct minor job conflicts.
- .7 Connect to equipment furnished in other Sections and by Departmental Representative, including uncrating equipment, moving in place and installing complete, start-up and test.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Store and manage hazardous materials in accordance with cepa, tdga AND Regional and Municipal Regulations.
- .2 Waste Management and Disposal:
 - .1 Due to location, recycling is not required. Remove from site and dispose of packaging materials at appropriate disposal facilities.

- .3 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.4 MATERIALS

- .1 Replace materials or workmanship below specified quality and relocate work wrongly placed to satisfaction of the Departmental Representative.
- .2 Materials and equipment installed shall be new, full weight and of the best quality specified. Use same brand or manufacturer for each specific application. Statically and dynamically balance rotating equipment for minimum vibration and low operating noise level.
- .3 Each major component of equipment shall have manufacturer's name, address, catalog and serial number in a conspicuous place.
- .4 Install materials and equipment in a neat and workmanlike manner by competent specialists.

1.5 CUTTING AND PATCHING

- .1 Locate and provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves at no extra cost.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Do no cutting or burning of structural members of building frame without obtaining prior written approval from the Departmental Representative.
- .4 Provide openings and holes required in precast members for mechanical work. Cast holes larger than 100 mm (4") in diameter. Field-cut smaller than 100 mm (4").
- .5 All patching of finished construction of building shall be performed under the sections of specifications covering these materials.

1.6 SEMI-FINAL AND FINAL INSPECTIONS

- .1 Perform the following items prior to semi-final inspection.
 - .1 Heating and air conditioning systems capable of operation with alarm controls functional and automatic controls in operation generally, but not necessarily finally calibrated.
 - .2 Necessary tests on equipment made including those required by authorities and certificates of approval obtained.
 - .3 Rough balance of air and water systems completed.
 - .4 Valve tagging completed and equipment identified. Equipment and piping painted and escutcheons installed.
 - .5 Equipment lubricated as per manufacturer's data.
 - .6 Warranty forms have been mailed to manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.

- .7 Systems chemically cleaned, flushed and water treatment initiated. Provide report from manufacturer's representative to confirm status of treatment.
- .8 Submit sample of Operating/Maintenance Manuals. Arrange Operating and Maintenance Instructions and submit schedule for approval.
- .9 Review and ensure access doors are suitably located and equipment easily accessible including plumbing cleanouts.
- .10 Have noise and vibration control devices and flexible connections inspected by manufacturer's representative and submit written report.
- .11 Equipment alignment carried out by qualified millwright and certified report submitted.
- .12 Check operations of plumbing systems and fixtures and ensure fixtures are solidly supported.
- .13 Fan plenums cleaned, temporary filters removed and permanent filters installed.
- .2 Provide declaration in writing that semi-final deficiencies and the following items have been completed prior to the final inspection:
 - .1 Equipment cleaned inside, outside and lubricated. Plumbing fixtures and brass cleaned.
 - .2 Final balancing completed and rough data of balance reports submitted.
 - .3 Final calibration of controls completed including point-to-point verification and confirmation that sequences are fully operational.

1.7 SHOP DRAWINGS

- .1 Submittal procedures in accordance with Division 1.
- .2 Submit materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalog material. Do not assume applicable catalogues are available in the Departmental Representative's office. Maintenance and operating manuals are not suitable submittal material.
- .3 Clearly mark each sheet of printed submittal material (using arrows, underlining or circling) to show particular sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pump seals, materials or painting.
- .4 Include dimensional data for roughing in and installation, technical data sufficient to check that equipment meets requirements of drawings and specifications, wiring, piping, and service connection data, motor sizes complete with voltage ratings and schedules as applicable.
- .5 Shop drawings to show all information identified under individual product specifications and in general shall show the following:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Detailed drawings of bases, supports, and anchor bolts.
 - .4 Acoustical sound power data, where applicable.
 - .5 Points of operation on performance curves.
 - .6 Manufacturer to certify current model production.
 - .7 Certification of compliance to applicable codes.
- .6 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.8 OPERATING AND MAINTENANCE MANUALS

- .1 Provide services of qualified and experienced personnel to prepare proper documentation and to instruct the Operating Staff in the operation and preventative maintenance of each piece of equipment and system supplied and installed. Complete and turn over documentation prior to final inspection.
- .2 Provide 215 mm x 280 mm (8-1/2" x 11") capacity extension type catalogue binders bound with heavy fabric, hot stamped in gold lettering front and spine. Refer to Division 1 for colour and quantity.
- .3 Each binder shall be indexed according to the following indexing system:
- .4 Tab-1.0 Mechanical Systems: Title page with clear plastic protection cover.
- .5 Tab-1.1 List of Mechanical Drawings.
- .6 Tab-1.2 Description of Systems: Provide complete description of each system. Include detailed system description and components comprising that system, explanation of how each component interfaces with others to complete the system, location of each thermostat, controller or operating setpoints. Refer to 21 05 01, 1.1.5 for additional required information.
- .7 Tab-1.3 Operation Division: Provide complete and detailed operation of each major component. Include how to energize and exact location of switches and controls, how the component interfaces with other components, operation of controls, including the operational sequence, operational characteristic changes for summer or winter operation, and how to accomplish the changeover, complete troubleshooting sequence, setpoints cannot be maintained, and safeguards to check if equipment goes off line. Refer to 21 05 01, 1.1.5 for additional required information.
- .8 Tab-1.4 Maintenance and Lubrication Division: Provide detailed preventative maintenance and lubrication schedule for each of the major components to include daily, weekly, monthly, semi-annual and yearly checks and tasks. Explain how to proceed with each task required for each piece of typical equipment such as bearings, drives, motors and filters. Compile this information for each typical piece of equipment separate from the shop drawings section. Refer to 21 0-5 01, 1.1.5 for additional required information.
- .9 Tab-1.5 List of Equipment Suppliers and Contractors: Provide complete list of equipment suppliers and contractors, including address and telephone number. Outline procedures for purchasing parts and equipment. Include steps to take in order to purchase new parts.
- .10 Tab-Certification (2.0, 2.1, etc.): Include copy of test data degreasing and flushing of heating system analysis of system water taken at time system was put into operation, hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of balancing data for air and water systems, copy of valve tag identification and pipe colour code, inspection approval certificates for plumbing system, hot air heating and ventilation systems and fire damper schedule.
- .11 Tab-Shop Drawings and Maintenance Bulletins (3.0, 3.1, etc.): Provide materials as received in compliance with clause "Shop Drawings".

- .12 The divider tabs shall be laminated mylar plastic, and coloured according to section. The colouring is as follows: Mechanical Systems - 1.0 - 1.5 - Orange, Certification - 2.0 - 2.4 - Green, Shop Drawings and Maintenance - 3.0 - 3.17 - Yellow. Plastic tabs with typed insertions will not be accepted.
- .13 Submit documents to the Departmental Representative for approval prior to being turned over to the Departmental Representative. At completion of project, hold a Seminar to instruct the Operating Staff in operation and preventative maintenance of each piece of equipment and system supplied and installed.
- .14 Provide one digital copy on compact disk of the final operation and maintenance manual in each of the manuals (six in total).

1.9 RECORD DRAWINGS

- .1 Refer to Division 1.
- .2 Keep on site, an extra set of white prints and specifications recording changes and deviations daily. Allow for the work required to transfer site changes to Departmental Representative's original tracings and for providing the Departmental Representative with set of sepias marked "Record Drawings". Co-ordinate through Departmental Representative's office. Addenda corrections and Departmental Representative initiated construction changes to original tracings will be the responsibility of the Departmental Representative.
- .3 Contractor shall utilize a different colour water proof ink for each service.
- .4 Contractor shall ensure that white prints are available on site for reference purposes and inspection.
- .5 Record drawings shall identify location of fire dampers, major control lines, access doors, tagged valves and actual room names or numbers.
- .6 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows:
- "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
- .7 Submit to Departmental Representative for approval and make corrections as directed.

1.10 IDENTIFICATION

- .1 Refer to Section 23 05 54, Mechanical Identification.

1.11 TEMPORARY FACILITIES

- .1 Refer to General Requirements - Division 01.

1.12 SUPERVISION

- .1 Refer to General Requirements - Division 01.

1.13 TEMPORARY HEAT AND/OR VENTILATION

- .1 Refer to General Requirements - Division 01.

- .2 Do not use the permanent system for temporary heating or ventilation purposes, without written permission from the Departmental Representative.
- .3 Thoroughly clean and overhaul permanent equipment used during the construction period, replacing worn or damaged parts. Exchange equipment or components operating improperly at final inspection with new equipment or components.
- .4 Use of permanent systems for temporary heat shall not modify the terms of warranty.
- .5 Operate heating systems under conditions which ensure no temporary or permanent damage. Operate fans at proper resistance with filters installed. Change filters at regular intervals. Operate with proper safety devices and controls installed and fully operational. Operate water systems with proper water treatment.
- .6 Where air systems are used during temporary heating, provide filter media on return and exhaust air outlets. Clean duct systems which have become dirty.
- .7 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company system.
- .8 Replace mechanical seals in pumps used for temporary heating purposes with new mechanical seals, regardless of condition.
- .9 Provide one year warranty from date of Substantial Completion.

1.14 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Protect equipment and materials in storage on site, during and after installation until final acceptance. Leave factory covers in place and take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.
- .4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

1.15 TEMPORARY OR TRIAL USAGE

- .1 Temporary or trial usage by the Departmental Representative of mechanical equipment supplied under contract and claimed complete before final acceptance shall not represent acceptance.
- .2 Repair or replace permanent equipment used temporarily.
- .3 Take responsibility for damage caused by defective materials or workmanship during temporary or trial usage.

1.16 ELECTRICAL MOTORS

- .1 Supply mechanical equipment complete with electrical motors.

- .2 Provide NEMA premium efficiency motors to CEMA and CSA standards for hard, continuous service, designed to limit temperature rise to 40 deg.C (100 deg.F) for open housing and 50 deg.C (125 deg.F) for drip proof housing, and operate at 1800 RPM unless otherwise specified.
- .3 Motors shall have ball or roller type bearings with grease lubrication fittings.
- .4 Motors used in conjunction with variable frequency drives shall be suitable for inverter duty, as specified by NEMA MG1-1993, Part 31. Refer to electrical specifications for inverters.
- .5 Refer to mechanical equipment schedule and electrical specification for voltage, phase and cycle.

1.17 ACCESS DOORS

- .1 Supply access doors for furred ceilings, ducts or spaces for servicing equipment and accessories or for inspection of safety, operating and fire devices for installation under section erecting the walls or ceilings.
- .2 Provide access doors in ductwork in accordance with Section 23 33 00 - Air Duct Accessories
- .3 Provide service access door in accordance with Section 08 31 00.01 - Access Doors - Mechanical.

1.18 COMMISSIONING

- .1 Mechanical Contractor is responsible to ensure all mechanical systems are fully commissioned and detailed commissioning forms are completed and reviewed with Departmental Representative. Refer to Sections 01 91 13 General Commissioning (Cx) Requirements, 01 91 33 Commissioning Forms, 01 91 41 Commissioning Training for details on Mechanical Contractors responsibilities in addition to all commissioning activities identified under Division 21, 22, 23 and 25. As part of the commissioning process, the contractor is required to complete the Site Standard Equipment Labelling and Tracking sheets for the equipment they supplied, the sheets will be provided by the owner.

1.19 INSTRUCTION OF OPERATING STAFF

- .1 Provide trained personnel to instruct operating staff on maintenance, adjustment and operation of mechanical equipment. Instruct staff on changes or modification in equipment made under terms of guarantee.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Where specified elsewhere in Mechanical manufacturers to provide demonstrations and instructions.
- .4 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn one manual over to chief operating personnel, the balance to Departmental Representative.
- .5 Record every instruction and training session on digital video.

.6	Time allocated for Instruction:	
	Plumbing Fixtures	One-half (1/2) hour instruction per fixture type.
	Fire Protection	One (1) hour instruction
	Tanks	One-half (1/2) hour instruction
	Fans	One (1) hours instruction
	Electric Heaters	One (1) hours instruction
	Domestic Water Heater	Two (2) hours instruction
	Split AC Units	One (1) hour instruction
	Furnace and Controls	Two (2) hour instruction
	Stand Alone Controls	One (1) hour instruction per controller type

1.20 SUBSTANTIAL COMPLETION

- .1 The mechanical portion of the project shall be deemed substantially complete when ALL mechanical systems are operational as designed. In addition, the air and/or water balance must be completed with the report submitted and approved by the Departmental Representative and the temperature control system must be complete, as designed, operational, with all control components calibrated and the maintenance manuals in final form must be submitted. The date will be established by the Departmental Representative and will set the date for the start of the one (1) year warranty on all mechanical systems.

1.21 EXCESSIVE ADMINISTRATION

- .1 Following the "Substantial Completion" Inspection a "Final" Inspection will be conducted and a follow up inspection will be conducted to "check off" all outstanding mechanical deficiencies.
- .2 If the mechanical portion of the project is not 100 percent complete at the time of the deficiency "checkoff" inspection, the cost of the failed deficiency "check-off" inspection and any and all additional inspections will be back charged directly to the Mechanical Contractor.
- .3 The cost of each excessive inspection will be \$2,000.00 plus travel, and will be deducted directly from the total Mechanical Contract amount.
- .4 If the contractor fails the deficiency "checkoff" inspection, no additional money will be released and a subsequent inspection will be scheduled when the Contractor re-verifies that they are 100% complete.
- .5 This process will repeat until the contractor can demonstrate that the project is 100% complete with all deficiencies rectified.

1.22 ALTERNATE AND SEPARATE PRICES

- .1 Referenced specification sections and drawings contain pertinent requirements for materials and methods to achieve work described herein.
- .2 Coordinate pertinent related work and modify surrounding work as required to complete project under each alternate designated.
- .3 Alternate products may vary in operation or construction, but shall meet or exceed the requirements of the specifications, drawings and the specified equipment for performance capacities, controllability and equipment options.

- .4 Revisions required to adapt equipment other than that specified shall be made without extra charge to the Departmental Representative.

1.23 ALTERNATE MATERIALS & EQUIPMENT

- .1 The design is based on the materials and equipment as specified. Any alternate materials or equipment that meet or exceed the performance, quality and design intent of that specified will be accepted unless specifically noted otherwise under this article.
- .2 If alternate material or equipment will alter the design intent, make proposals to supply said materials or equipment in writing to the Departmental Representative at least ten working days prior to closing date of tender for Mechanical Trade. Any material or equipment that alters the design intent must be formally approved to be accepted.
- .3 All proposed equipment is subject to the requirements of the drawings and specifications. Revisions required to adapt equipment other than that specified shall be made without extra charge to the contract. All suppliers, except those specified, shall guarantee in writing that their individual proposed products meet or exceed the performance and quality of specified products. If the departmental representative determines at any time that the equipment or material being supplied does not meet or exceed the performance, quality or design intent of that being specified, the contractor shall replace the article in question with a suitable product at the contractors expense.
- .4 The following products shall be supplied as specified, there is no other products/manufacturers that will be accepted:
 - .1 Any other products specifically noted to be supplied as specified.

Part 2 - Materials

2.1 NOT USED

- .1 Not Used

Part 3 - Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

- .1 Materials and installation for domestic water service used in the following:
 - .1 Incoming domestic water service, up to NPS 2 1/2.
 - .2 Hard domestic hot and cold water services inside building.
 - .3 Soft tubing inside building.
 - .4 Soft buried tubing outside building, as in between potable water source and meter inside building.
- .2 Sustainable requirements for construction, verification and operation.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-06, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-01, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-01, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 ASTM International Inc.
 - .1 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/ (AWWA)
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
 - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-Addendum 2007.
 - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .6 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-02a, Butterfly Valves.
 - .2 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-05, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .9 National Research Council (NRC)/Institute for Research in Construction
 - .1 NRCC 38728, National Plumbing Code of Canada (NPC) - 1995.
- .10 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 Products

2.1 WATER PIPING, BURIED

- .1 Copper tubing type K annealed; wrought copper fittings 95/5 solder or silver braze joints. Copper tubing to be in long lengths and with no buried joints.
- .2 Plastic "BLUE BRUTE" pipe and fittings; solvent weld joints.
- .3 All piping and fitting shall be rated to a minimum of 1034 kPa (150 PSI)

2.2 WATER PIPING, UNBURIED

- .1 Type L hard copper; with cast brass or wrought copper fittings; 95/5 solder joints.
- .2 Stainless steel pipe, Schedule 10; grooved fittings.
- .3 Cross Linked Polyethylene (PEX) pipe with mechanical joints.
- .4 Polypropylene: Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. All pipe shall be made in an extrusion process. Hot water piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. Fittings: Fittings shall be manufactured

from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. All pipe and fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11. The pipe and fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe system shall be plenum-rated with pipe wrapped and/or insulated with standard pipe insulation, field installed. The pipe wrap or insulation shall meet the requirements of CAN/ULC-S102.2-03 or ASTM E84. The system shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50. It is assumed pipe will be exposed to direct UV light and shall be provided with a Factory applied, UV-resistant coating or alternative UV protection.

2.3 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1 1/2 and smaller: wrought copper to ANSI/ASME B16.22; with 301stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.4 JOINTS

- .1 Rubber gaskets, latex-free mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.5 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.

- .3 NPS 2 1/2 and over, in mechanical rooms, flanged:
 - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23.02 - Valves - Cast Iron.
- .4 NPS 2 1/2 and over, other than mechanical rooms, flanged:
 - .1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

2.6 GLOBE VALVES

- .1 NPS2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Lockshield handles: as indicated.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Lockshield handles: as indicated.

2.7 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 1/2 and over, flanged:
 - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrind seat, bronze disc, bolted cap specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

2.8 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.

2.9 BUTTERFLY VALVES

- .1 NPS 2-1/2 and over, wafer:
 - .1 To MSS-SP-67, Class 200.

- .2 Cast iron body, ductile iron chrome plated disc, stainless steel stem, EPT liner.
- .3 Lever operated, NPS8 and over, gear operated.
- .2 NPS 2-1/2 and over, grooved ends:
 - .1 Class 300 psig CWP, bubble tight shut-off, bronze body EPDM coated ductile iron disc with integrally cast stem.
 - .2 Operator:
 - .1 NPS 4 and under: lever handle.
 - .2 NPS 6 and over: gear operated.

3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with NPC.
- .2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install cold piping below and away from all other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

3.3 ROUTES AND GRADES

- .1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furrings to a minimum.
- .2 Slope water piping 25 mm in 12 m (1" in 40') and arrange to drain at low points.
- .3 On closed systems, equip low points with 20 mm (3/4") drain valves and hose nipples. Provide, at high points, collecting chambers and high capacity float operated automatic air vents.
- .4 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.
- .5 Grade horizontal drainage and vent piping 22 mm per meter (1/4" per foot) minimum unless otherwise indicated on drawings.

3.4 VALVES

- .1 Isolate equipment, fixtures and branches with gate valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.
- .3 Install valves with stems upright or horizontal, not inverted.
- .4 Install gate, ball and butterfly valves for isolating service, to isolate equipment, part of systems or vertical risers.
- .5 Install globe, ball or angle valves for throttling service and control device or meter bypass.
- .6 Use plug cocks in water systems for throttling service. Use non-lubricated plug cocks only when shut-off or isolation valves are also provided.
- .7 Provide drain valves at main shut-off valves, low points of piping and apparatus.

3.5 PRESSURE TESTS

- .1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1.25 times maximum system operating pressure or 860 kPa.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- .1 Prior to starting work, verify system is complete, flushed and clean. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric). Provide copies of pH tests in O&M manual.
- .2 Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/l residual.
- .3 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets. Maintain disinfectant in system for 24 hours. If final disinfectant residual tests less than 25 mg/L, repeat treatment. Record levels obtained in system and provide copy of record for O&M manual.
- .4 Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze. Provide copies of test results for O&M manual.

3.7 FINAL FLUSHING/TESTING OF DOMESTIC WATER PIPING SYSTEM

- .1 Once the entire plumbing system is complete, disinfected and particle producing work has ceased within facility the potable plumbing systems shall be flushed. Flushing must be performed complete with testing prior to substantial completion complete with test results proving system is clean.

- .2 Flush entire system for a minimum of 8 hours ensure that each and every outlet is flushed for a minimum of 2 hours. Let stand for 24 hours. Draw a test sample from the longest run on each floor or each distribution wing in conjunction with a sample from the supply water at the building source. Submit to testing laboratory to verify that system is clean and drinkable. Let system flush for additional 2 hours, then draw off a second sample from each previous location for testing. Flushing and testing shall be carried out for each supply distribution system.
- .3 Submit samples for drinking water quality testing by an accredited agency and prove that the building water supply quality matches the incoming water supply source. Testing shall include Water Quality Analysis (bicarbonate, calcium, carbonate, chloride, conductivity, fluoride, iron, magnesium, nitrate, pH, potassium, sodium, sulfate, total alkalinity, total hardness and total dissolved solids) and Water Potability (total coliforms and E. coli bacteria and nitrate). Test for systems where copper lines are installed shall include copper content.
- .4 Upon completion, provide laboratory test reports on water quality for review. Include one copy of final reviewed test reports in Operation and Maintenance Manual.

3.8 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.9 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
 - .4 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.10 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Verify performance of temperature controls.
 - .3 Verify compliance with safety and health requirements.
 - .4 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .5 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
 - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.11 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The installation of drainage waste and vent piping. Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B32-03, Specification for Solder Metal.
 - .2 ASTM B306-02, Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564-03a, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67-1972 (R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70-02, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125-01, Plumbing Fittings.

1.3 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary, storm and vent Type DWV to: ASTM B306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.
 - .2 Wrought copper: to CAN/CSA-B125.
 - .2 Solder: 95:5, type TA, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary, storm and vent: to CAN/CSA-B70.
 - .1 Joints.
 - .1 Hub and spigot.
 - .1 Caulking lead: to CSA B67.
 - .2 Mechanical joints.
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

3 Execution

3.1 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

3.2 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The installation of drainage waste and venting piping - plastic.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM D2564-02, Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-Series B1800-02, Plastic Nonpressure Pipe Compendium.
 - .2 CSA-B181.2-02, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
 - .3 CSA-B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.

2 Products

2.1 PIPING AND FITTINGS

- .1 For buried and or above ground DWV piping to:
 - .1 CSA-B181.1.
 - .2 CSA-B181.2.
 - .3 CSA-B182.1.

2.2 JOINTS

- .1 Solvent weld for PVC: to ASTM D2564.

3 Execution

3.1 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .3 Refer to 23 05 05 Installation of Pipework for fire stopping requirements.

3.2 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)
 - .1 ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
 - .2 ANSI Z21.10.1A-2006/CSA 4.1A-2006, Addenda 1 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
 - .3 ANSI Z21.10.1b-2006/CSA 4.1b-2006, Addenda 2 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
 - .4 ANSI Z21.10.3A-2007/CSA 4.3-2007, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
 - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-Addendum 2007.
 - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B51-03(R2007), Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA-B139-04, Installation Code for Oil Burning Equipment.
 - .3 CAN/CSA-B140.0-03, Oil Burning Equipment: General Requirements.
 - .4 CAN/CSA-B149.1-05, Natural Gas and Propane Installation Code.
 - .5 CAN/CSA-B149.2-05, Propane Storage and Handling Code.
 - .6 CSA B140.12-03, Oil-Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools.
 - .7 CAN/CSA C22.2 No.110-94(R2004), Construction and Test of Electric Storage Tank Water Heaters.
 - .8 CAN/CSA-C191-04, Performance of Electric Storage Tank Water Heaters for Household Service.
 - .9 CAN/CSA-C309-M90(R2003), Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 WARRANTY

- .1 For the Work of this Section 22 30 05 - Domestic Water Heaters, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.
- .2 Contractor hereby warrants domestic water heaters in accordance with CCDC2, but for number of years specified for each product.

2 Products

2.1 UPRIGHT ELECTRIC WATER HEATER

- .1 Upright electric water heater and integral tank.
- .2 Fully Automatic Controls - Fast acting surface-mount thermostat for automatic temperature control. Factory installed sensitive manual reset energy cut-off for safety to prevent overheating (Maximum setting 160 Deg.F.).
- .3 Direct Heat Transfer With a Single Immersed Element - Screw-in style element copper or incoloy.
- .4 Steel Tank - Heavy gauge steel automatically formed, rolled, and welded.
- .5 Tank Lining - enamel lined to provide superior tank protection from the highly corrosive effects of hot water. Enamel to be fused to the steel surface by firing at a temperature of over 1600°F (871°C).
- .6 Tank to be insulated with 2" Non-CFC Foam Insulation. Insulation to cover the sides and top of tank, reducing the amount of heat loss.
- .7 Unit to have factory installed cold water inlet sediment reducing device to help prevent sediment build up in tank.
- .8 Water Connections - 3/4" NPT factory installed true dielectric fittings to extend water heater life and ease installation.
- .9 Unit to be complete with protective Magnesium Anode Rod, T&P Relief Valve and Low Restriction Brass Drain Valve
- .10 Unit to be ETL listed and certified to 300 psi (2068 kPa) test pressure and 150 PSI (10.4 kPa) working pressure.
- .11 Warranty - 5-Year Limited Tank Warranties / 1-Year Limited Warranty on Component Parts)
- .12 Refer to equipment schedule for capacity and performance.

2.2 TRIM AND INSTRUMENTATION

- .1 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
- .2 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations.
- .2 Provide structural steel for horizontal mounted tanks.
- .3 Provide insulation between tank and supports.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for plumbing specialties and accessories.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A126-95 (2001), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-B64 Series-01, Backflow Preventers and Vacuum Breakers.
 - .2 CSA-B79-94 (R2000), Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
 - .3 CSA-B356-00, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 Plumbing and Drainage Institute (PDI).
 - .1 PDI-G101-96, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
 - .2 PDI-WH201-92, Water Hammer Arresters Standard.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
 - .2 Indicate dimensions, construction details and materials for specified items.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Provide materials, equipment and labour to install plumbing as required by Provincial and Local Codes and as specified herein.

- .3 Provide water and drainage connections to equipment furnished in other sections of this specification and by the Departmental Representative.
- .4 Fittings of same type shall be product of one manufacturer.

2 Products

2.1 FLOOR DRAINS

- .1 Floor Drains: to CSA B79.
- .2 Provide trap primer tapping on all floor drains where trap primers are required by Code and authority having jurisdiction.
- .3 FD-1 – Regular Floor Drain
 - .1 Type 1 (General Duty): Epoxy coated cast iron body with double drainage flange, reversible clamping collar with primary and secondary weep holes, combined two piece body and adjustable nickel-bronze strainer. Shower and washroom floor drains shall have a removable perforated sediment bucket.
 - .2 Type 2 (Heavy Duty): Epoxy coated cast iron body with double drainage flange, reversible clamping collar with primary and secondary weep holes, combined two piece body and adjustable heavy duty nickel-bronze strainer.
 - .3 Type 3 (Combination Funnel Floor Drain): Epoxy coated cast iron body with double drainage flange, reversible clamping collar with primary and secondary weep holes, combined two piece body and adjustable nickel-bronze strainer with integral 102 mm x 229 mm oval nickel bronze funnel.

2.2 CLEANOUTS

- .1 Cleanout: Adjustable floor cleanout with lacquered cast iron body and anchor flange, secondary O ring test seal, 4" diameter cleanout opening and combined scoriated satin finished nickel bronze cover and plug top assembly with stainless steel vandal-proof allen key screws and primary gasket seal. Provide membrane clamp for all membrane floors. Specification based on Mifab Model C1100.
- .2 Access Covers:
 - .1 Wall Access: face or wall type, polished nickel bronze with chrome plated cap, round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: round, nickel bronze, gasket, vandal-proof screws.
 - .3 Cover for Terrazzo Finish: Polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
 - .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
 - .5 Cover for Carpeted Floors; polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.
 - .3 Provide bolted cover plates on all vertical rainwater leaders.

2.3 WATER HAMMER ARRESTORS

- .1 Stainless steel bellow type or copper piston type to PDIWH201.

- .2 Air chamber same size as supply line or 19 mm minimum, and minimum 450 mm long.

2.4 INTERIOR HOSE BIBBS AND SEDIMENT FAUCETS (HB-2)

- .1 Cast brass anti-contamination faucet; exposed type, mild climate, anti-contamination wall faucet with 19 mm male hose connection and anti-siphon vacuum breaker. Exterior finish to be polished chrome plated, operating handle to be cast iron wheel handle, and inlet connection to be 19 mm F.P.T. unless specifically noted as 12 mm on drawings. Vacuum breaker to be certified to the ASSE Standard 1011 and listed by IAPMO.
- .2 Specification based on Mifab Model MHY-90.

2.5 EXTERIOR HOSE BIBBS AND SEDIMENT FAUCETS (HB-4)

- .1 A.S.S.E. 1019-B certified encased key operated non-freeze self-draining wall hydrant with A.S.S.E. 1011 approved anti-siphon and vandal resistant integral vacuum breaker and 19 mm diameter male hose connection. Length to suit wall thickness. Hydrant assembly complete with neoprene plunger to control both the flow and drain functions, hardened bronze operating stem, drain port under the hexagon nut, heavy duty brass casing, 360 degree swivel inlet connection, heavy duty chrome plated bronze head casting, polished chrome plated face plate and satin finished nickel bronze box with hinged locking cover. Operating key to be furnished with each hydrant.
- .2 Specification based on Mifab Model MHY-20.

2.6 TRAP SEAL PRIMERS (Electronic)

- .1 Group Trap Seal Primer:
 - .1 MIFAB Series MI-100-10 (6-10 outlet ports) enclosed electronic trap seal primer system with timer, ½" F.I.P. plastic ball valve, lead free bronze vacuum breaker, 1/2" solenoid valve and plastic Manifold with distribution ports. Electrical components to include single point power connection at 120VAC, manual override switch, minimum 5 amp breaker, 24 hour timer with relay and adjustable delay. All components to be factory assembled and installed into a 16 gauge satin coated steel box for recessed (standard) or surface mounted installation as indicated on drawings. The entire assembly is tested and certified to the ASSE 1044 Standard. 100 p.s.i. operating pressure.
 - .2 Specification based on Mifab Model MI 100.
- .2 Air Gap Fitting:
 - .1 Copper air gap fitting complete with a 12 mm male NPT fitting at the inlet supply incorporating a stream directing nozzle, a 12 mm NPT female outlet, and a ANSI/ASME A112.1.2 air gap in plumbing systems standard.
 - .2 Specification based on Mifab Model MI-GAP.

2.7 VACUUM BREAKERS

- .1 Breakers: To CSA-B64 Series.

2.8 STRAINERS

- .1 Size 50 mm and under: Screwed brass, Y pattern with 0.7 mm stainless steel perforated screen.
- .2 Size 63 mm to 100 mm: Flanged iron body with bolted cap, Y pattern with 1.2 mm stainless steel perforated screen.

- .3 Size 127 mm and larger: Flanged iron body, basket pattern with 3 mm stainless steel perforated screen.
- .4 Screen free area shall be minimum three times area of inlet pipe. Provide valved drain and hose connection off strainer bottom.

2.9 LAUNDRY SERVICE BOX (Standard LB-2)

- .1 Double outlet reversible drain washing machine outlet box complete with ¼ turn brass ball valves with copper seat connections and 50mm PVC drain opening.
- .2 Box made of 20 gauge steel with two support brackets.
- .3 Faceplate made of 18 gauge steel
- .4 Specification based on Oatey Metal.

2.10 EXPANSION TANKS

- .1 Construction: Welded steel with heavy duty butyl air/water interface, tank style to match equipment schedule. Tank shall be cleaned, prime coated, and supplied with steel support saddles; with tappings for installation of accessories.
 - .1 Pressure rating: 860 kPa.
 - .2 Size: As noted on equipment schedule.
- .2 Tank shall be tested and stamped to ASME SEC 8-D.
- .3 Quick Connect Air Inlet:
 - .1 Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.
- .4 Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved bypass.
- .5 Hot Water Heating System:
 - .1 Select expansion tank pressure relief valve to match heater.
 - .2 Set pressure reducing valve at select 35 kPa.
- .6 Precharge air side to 84 kPa (12 PSI) initial fill pressure of system.

2.11 AUTOMATIC FLOW RESTRICTOR

- .1 Automatic flow control valve complete with isolation and strainer, sized for design flow rate
- .2 Construction: Forged or cast brass or bronze body with union on inlet, temperature and pressure test ports on inlet and outlet. To be rated for potable applications.
- .3 Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 13.7 kPa.
- .4 Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- .5 In-line strainer with 20 mesh stainless steel filter screen and drain valve.
- .6 Isolation Valve: Ball valve with Teflon seats, refer to valve specifications.

2.12 BACK FLOW PREVENTERS

- .1 Reduced Pressure Back flow Preventers: Bronze body with bronze and plastic parts and stainless steel springs; two independent spring loaded check valves; diaphragm type differential pressure relief valve; check valve for diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks; Back siphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel, or directly into the supply pipe via a separate vent. Refer to equipment schedule for size.
- .2 Double Check Valve Assemblies: Bronze body with stainless steel springs; two independent check valves with intermediate atmospheric vent, tight closing resilient seated shut-off valves, and test cocks. Each check module shall have a captured spring and be accessible through a bolted cover plate. Seats shall be replaceable without special tools. Refer to equipment schedule for size.
- .3 Quality Assurance:
 - .1 Reduced pressure backflow preventers shall meet the requirements of ASSE Std. 1013; AWWA Std. C-511-92; and CSA B64.4.
 - .2 Double Check Valve assemblies shall meet the requirements of ASSE No. 1015; AWWA C510-92; CSA B64.5 and UL Classified File No. EX3185

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

- .1 Install in accordance with Provincial Codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required by Code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.
- .4 Lubricate cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover remove cleanout plugs, relubricate and reinstall using only enough force to ensure permanent leak proof joint.

3.4 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures as required to eliminate water hammer.

3.5 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

- .2 Install complete with isolation valve upstream of hose bibbs.

3.6 TRAP SEAL PRIMERS

- .1 Install for floor drains and elsewhere, as required by Code and/or where indicated on drawings. Trap primers shall be electronic.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Departmental Representative.
- .3 Install plastic PEX tubing to floor drain.

3.7 STRAINERS

- .1 Install with sufficient room to remove basket.

3.8 VACUUM BREAKERS

- .1 Install vacuum breakers on plumbing lines where contamination of domestic water may occur; generally make-up lines, hose bibbs, and flush valves.

3.9 START-UP

- .1 Timing: Start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.

3.10 EXPANSION TANKS

- .1 Support tanks inside building from building structure.
- .2 Refer to equipment schedule and drawings for size and configuration.
- .3 Adjust expansion tank pressure to suit actual site conditions.
- .4 Install lockshield type valve at inlet to tank.

3.11 AUTOMATIC FLOW RESTRICTOR

- .1 Install automatic flow control valve complete with additional isolation valve to permit servicing of valve without draining system.

3.12 TESTING AND ADJUSTING

- .1 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .2 Application tolerances:
 - .1 Pressure at fixtures: within tolerance allowable by manufacturer.
 - .2 Flow rate at fixtures: +/- 10%.
- .3 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.

- .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .4 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate and timer to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removeability of strainer.
 - .5 Clean out baskets.
- .5 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O&M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.
- .6 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .7 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .8 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .9 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.
- .10 Hose bibbs, sediment faucets:
 - .1 Verify operation of vacuum breakers.
- .11 Training:
 - .1 In accordance with Section 21 05 01 Common Work Results - Mechanical, Training of Operation and Maintenance Personnel, supplemented as specified.
 - .2 Demonstrate full compliance with Design Criteria.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The supply and installation of Plumbing Fixtures and Trim.
- .2 Products Installed but not Supplied Under this Section:
 - .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
 - .2 Equipment installed by others.
 - .1 Connect with unions.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45 Series-02, Plumbing Fixtures.
 - .2 CAN/CSA-B125-01, Plumbing Fittings.
 - .3 CAN/CSA-B651-95 (R2001), Barrier-Free Design.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity, material, water consumption and details of all items noted under specification..
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 GENERAL REQUIREMENTS

- .1 Provide new fixtures, CSA approved, free from flaws and blemishes with finished surfaces clear, smooth and bright.
- .2 Provide CSA approved plumbing fittings. Visible parts of fixture brass and accessories shall be heavily chrome plated.
- .3 Fixtures shall be product of one manufacturer. Fittings of same type shall be product of one manufacturer.
- .4 Protect fixtures against use and damage during construction.

1.5 JOB CONDITIONS

- .1 Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.

2.2 WATER CLOSET WC-1 (Standard Water Closet)

- .1 Handicapped close coupled floor mounted 300 mm rough-in, tank style with 4.8 LPF (1.1 GPF) siphon jet flushing action. Water closet to be capable of flushing 1000 grams of waste under bulk waste removal protocols conducted by a CSA certified laboratory. Water closet to be complete with 5 year limited warranty.
- .2 Bowl/Tank: 419 mm (16-1/2") high, white, vitreous china, elongated bowl, oversized flush valve, 54 mm (2-1/4") fully glazed trapway, siphon jet, 2 bolt caps, insulated tank complete with fittings.
- .3 Supplies and Riser Tubes: chrome plated angle supplies with lockshield stem, screwdriver stop, 9.5 mm O.D. x 305 mm long flexible braided stainless steel riser and stainless steel escutcheon plate.
- .4 Seat: White, elongated, open front, moulded plastic seat with cover and self-sustaining stainless steel hinges and stainless steel insert post.
- .5 Design based on the following: Bowl/Tank - American Standard Cadet 3 FloWise Right Height Elongated, Seat - Bemis 1950SS, Supplies – Delta 47T2312SD

2.3 WATER CLOSET WC-2 (Housing Water Closet)

- .1 Handicapped close coupled floor mounted 300 mm rough-in, tank style with 4.8 LPF (1.1 GPF) siphon jet flushing action. Water closet to be capable of flushing 1000 grams of waste under bulk waste removal protocols conducted by a CSA certified laboratory. Water closet to be complete with 5 year limited warranty.
- .2 Bowl/Tank: 419 mm (16-1/2") high, white, vitreous china, elongated bowl, oversized flush valve, 54 mm (2-1/4") fully glazed trapway, siphon jet, 2 bolt caps, insulated tank complete with fittings.
- .3 Supplies and Riser Tubes: chrome plated angle supplies with lockshield stem, screwdriver stop, 9.5 mm O.D. x 305 mm long flexible braided stainless steel riser and stainless steel escutcheon plate.
- .4 Seat: White, elongated, closed front, moulded plastic seat with cover and self-sustaining stainless steel hinges and stainless steel insert post.
- .5 Design based on the following: Bowl/Tank - American Standard Cadet 3 FloWise Right Height Elongated, Seat - Bemis 1900SS, Supplies – Delta 47T2312SD

2.4 LAVATORY L-2 (Standard Wall hung Lavatory)

- .1 Bowl: ADA compliant wall hung stainless steel lavatory, 600 mm x 480 mm with 540mm x 340mm x 150mm deep basin, 19 Ga type 304 stainless steel with seamless welded bowl, 100mm center set, with overflow and faucet ledge. Exposed surfaces are #4 Satin Finish. Unit to be complete with wall support, contractor to provide sufficient backing in wall to mount supports.
- .2 Trim: ADA compliant chrome plated single lever manual faucet, 0.5 GPM/1.9 LPM vandal proof spray head, 100mm centerset, cast brass lead free waterway, ceramic drip-free disc valve cartridge, 89 mm lever.
- .3 Supplies and Riser Tubes: chrome plated angle supplies with lockshield stem, screwdriver stop, 9.5 mm O.D. x 305 mm long flexible braided stainless steel riser and stainless steel escutcheon plate.
- .4 Tailpiece and Trap: grid drain assembly with open grid stainless steel strainer. Chrome plated cast brass adjustable P-trap complete with cleanout, plug with chain and escutcheon.
- .5 Design is based on the following: Bowl - Franke WT600C-8, Trim – Delta 22C151, Supplies - Delta 47T2312SD, Tailpiece - Delta 33T290-1, Trap - Delta 33T311.

2.5 LAVATORY L-3 (Counter Top Manual)

- .1 Bowl: ADA compliant self-rimming countertop lavatory, 533 mm x 488 mm, vitreous china, hole drilling to match trim, back overflow with faucet ledge. Color: White.
- .2 Trim: ADA compliant chrome plated single lever manual faucet, 0.5 GPM/1.9 LPM vandal proof spray head, 100mm centerset, cast brass lead free waterway, ceramic drip-free disc valve cartridge, 89 mm lever.
- .3 Supplies and Riser Tubes: chrome plated angle supplies with lockshield stem, screwdriver stop, 9.5 mm O.D. x 305 mm long flexible braided stainless steel riser and stainless steel escutcheon plate.
- .4 Tailpiece and Trap: open grid drain assembly with open grid strainer. Chrome plated cast brass adjustable P-trap complete with cleanout, and escutcheon.
- .5 Provide anti-scald temperature mixing controls: pressure independent thermostatic mixing valve complete with integral check valves, service isolation valves, and vandal resistant temperature setting adjustments.
- .6 Design based on the following: Bowl - American Standard Cadet Oval Countertop, Trim – Delta 22C151, Supplies – Delta 47T2312SD, Tailpiece – Delta 33T290-1, Trap - Delta 33T311.

3. Execution

3.1 INSTALLATION

- .1 Install each fixture that is to be operational with its own trap, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures and equipment.
- .2 Provide chrome plated rigid or stainless steel flexible supplies to fixtures that are to be operational complete with quarter turn stops, reducers and escutcheons.

- .3 Install wall mounted lavatories, urinals and water closets with approved wall carriers, model to suit installation.
- .4 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified by architect.
 - .2 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.
- .5 Install hose and faucets and hose connections with vacuum breakers.

3.2 PLUMBING FIXTURE ROUGH-IN SCHEDULE

- .1 Rough-in fixture piping connections in accordance with the following table of minimum sizes or as required for particular fixtures:

	<u>Hot Water</u>	<u>Cold Water</u>	<u>Waste</u>	<u>Vent</u>
Lavatories	12 mm (½")	12 mm (½")	38 mm (1-1/2")	32 mm (1-1/4")
Water Closet (flush valve)	-----	32 mm (1-1/4")	75 mm (3")	51 mm (2")
Water Closet (tank)	-----	12 mm (1/2")	75 mm (2")	51 mm
Hose Bibbs	19 mm (3/4")	19 mm (3/4")	-----	-----

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2
 - .3 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators or Laminar Flow Control: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The supply and installation of Plumbing Fixtures and Trim.
- .2 Products Installed but not Supplied Under this Section:
 - .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
 - .2 Equipment installed by others.
 - .1 Connect with unions.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45 Series-02, Plumbing Fixtures.
 - .2 CAN/CSA-B125-01, Plumbing Fittings.
 - .3 CAN/CSA-B651-95(R2001), Barrier-Free Design.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity, material, water consumption and details of all items noted under specification.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 GENERAL REQUIREMENTS

- .1 Provide new fixtures, CSA approved, free from flaws and blemishes with finished surfaces clear, smooth and bright.
- .2 Provide CSA approved plumbing fittings. Visible parts of fixture brass and accessories shall be heavily chrome plated.
- .3 Fixtures shall be product of one manufacturer. Fittings of same type shall be product of one manufacturer.
- .4 Protect fixtures against use and damage during construction.

1.5 JOB CONDITIONS

- .1 Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.

2.2 SINK SK-5 (Double Compartment)

- .1 Bowl: double compartment, type 302 18-8 stainless steel, 20 gauge, self-rimming sink 560x840 overall dimensions with 430 mm x 380 mm x 200 mm depth, complete with 89 mm removable drain assembly and 89 mm crumb cup strainer.
- .2 Trim: heavy duty cast brass 200mm (8") center two handle sink faucet complete with 200mm (8") wallform swing spout with 5.7 L/minute standard aerator. Handles to be 102mm (4") blade handles.
- .3 Trap: cast brass adjustable swivel pattern P-trap with cleanout.
- .4 Supplies and Riser Tubes: chrome plated angle supplies with lockshield stem, oval handle stop, 9.5 mm O.D. x 305 mm long flexible braided stainless steel riser and stainless steel escutcheon plate.
- .5 Design based on the following: Bowl - Franke LBD7508P-1, Trim - Delta 26C3234, Supplies – Delta 47T2512, Tailpiece - Delta 33T290-1, Trap - Delta 33T311.

3 Execution

3.1 INSTALLATION

- .1 Install each fixture that is to be operational with its own trap, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures and equipment.
- .2 Provide chrome plated rigid or stainless steel flexible supplies to fixtures that are to be operational complete with screwdriver stops, reducers and escutcheons.
- .3 Install wall mounted lavatories, urinals and water closets with approved wall carriers, model to suit installation.
- .4 Mount fixtures above finished floor as noted on Architectural drawings.
- .5 Install hose and faucets and hose connections with vacuum breakers.
- .6 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified by architect.

- .2 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.

3.2 PLUMBING FIXTURE ROUGH-IN SCHEDULE

- .1 Rough-in fixture piping connections in accordance with the following table of minimum sizes or as required for particular fixtures:

	<u>Hot Water</u>	<u>Cold Water</u>	<u>Waste</u>	<u>Vent</u>
Sink	12 mm (½")	12 mm (½") (1-1/2")	38 mm (1-1/4")	32 mm

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators or laminar flow control: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The supply and installation of Plumbing Fixtures and Trim.
- .2 Products Installed but not Supplied Under this Section:
 - .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
 - .2 Equipment installed by others.
 - .1 Connect with unions.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45 Series-02, Plumbing Fixtures.
 - .2 CAN/CSA-B125-01, Plumbing Fittings.
 - .3 CAN/CSA-B651-95(R2001), Barrier-Free Design.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity, material, water consumption and details of all items noted under specification..
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 GENERAL REQUIREMENTS

- .1 Provide new fixtures, CSA approved, free from flaws and blemishes with finished surfaces clear, smooth and bright.
- .2 Provide CSA approved plumbing fittings. Visible parts of fixture brass and accessories shall be heavily chrome plated.
- .3 Fixtures shall be product of one manufacturer. Fittings of same type shall be product of one manufacturer.
- .4 Protect fixtures against use and damage during construction.

1.5 JOB CONDITIONS

- .1 Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.

2.2 SHOWER SH-4 (Change Room Shower)

- .1 Cabinet: Acrylic finish reinforced fibreglass shower, one piece seamless unit with smooth rounded corners, integrated shelves and without cap. Shape to be neo-angle corner shower complete with door system. Shower shall not exceed 940 mm (37") x 940 mm (37") and a height of 1980mm (78"). Colour - White.
- .2 Door: To be matched to cabinet, neo-angle framed pivot door for corner shower. Door to have full-length aluminium pull and be reversible (left or right opening). Door system to have integral gutter in the inside of the door
- .3 Trim: Concealed in-wall single lever pressure balancing mixing valve control, polished chrome plated metal trim, integral stops and checks, and vandal resistant metal lever handle; combination integral diverter and adjustable stop screw to limit handle turn. Wall-mounted shower head with arm and flange, and polished chrome plated finish. Volume control - 7.6 LPM flow control. Unit to be vandal resistant. Trim to have 5-year warranty in commercial installation.
- .4 Design based on: Cabinet – MAAX Freestyle 37 Neo-Angle, Trim - Symmons - Temptrol C-96-1-X-2.0-CHKS-VP

2.3 TUB/SHOWER T-1 (Housing Tub)

- .1 Cabinet: Acrylic finish reinforced fibreglass combination tub and shower, one piece seamless unit with smooth rounded corners, integrated shelves, soap dish, towel bar and without cap. Unit to have seat opposite shower head. Shower shall not exceed 1524 mm (60") x 787.4 mm (31") and a height of 1905mm (75"). Colour - White.
- .2 Trim: Concealed in-wall single lever pressure balancing mixing valve control, polished chrome plated metal trim, integral stops and checks, and vandal resistant metal lever handle; combination integral diverter and adjustable stop screw to limit handle turn. Wall-mounted shower head with arm and flange, and polished chrome plated finish. Volume control - 7.6 LPM flow control. Unit to be vandal resistant. Trim to have 5-year warranty in commercial installation.
- .3 Design based on: Cabinet – MAAX Allia Model TS-6032, Trim - Symmons - Temptrol C-96-1-X-2.0-CHKS-VP

3. Execution

3.1 INSTALLATION

- .1 Install each fixture that is to be operational with its own trap, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures and equipment.
- .2 Provide chrome plated rigid or stainless steel flexible supplies to fixtures that are to be operational complete with screwdriver stops, reducers and escutcheons.
- .3 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified by architect.

- .2 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.

3.2 PLUMBING FIXTURE ROUGH-IN SCHEDULE

- .1 Rough-in fixture piping connections in accordance with the following table of minimum sizes or as required for particular fixtures:

	<u>Hot Water</u>	<u>Cold Water</u>	<u>Waste</u>	<u>Vent</u>
Tub/Shower	12 mm (½")	12 mm (½") (2")	50 mm (1-1/4")	38 mm

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators or Laminar Flow Control: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION

1 General

1.1 TESTING AND APPROVING AGENCIES

1. Where items of equipment are required to be provided with compliance to U.L., C.S.A., E.T.L., or other testing and approving agencies, the contractor may submit a written certification from any nationally recognized testing agency, adequately equipped and competent to perform such services, that the item of equipment has been tested and conforms to the same method of test as the listed agency would conduct.
2. Variable Frequency Drives (VFD) must be certified and listed by UL, CSA, or ETL.
3. Control Panels must be certified and listed to UL 508A or CSA C22.2 No. 14-13 by either UL, CSA, or ETL

1.2 SUBMITTAL DATA

1. Provide manufacturer's literature for all products specified in this Section, which will be installed under this project.
2. Provide performance curves for all pumps. Plot the specified operating point for each pump on its respective curve.
3. Provide complete literature for all components of packaged systems. These include pump performance, data for all accessories and valves and complete wiring diagrams specific to the exact unit to be supplied. The wiring diagram shall indicate all required field and factory wiring.

2 Products

2.1 SKID MOUNTED PUMPING PACKAGE

1. Basis of design is Franklin Model VR.
2. The pumps shall be vertical inline multi stage design. The capacities and characteristics shall be as called for in the plans/schedules. Hydraulic components shall be 316 Stainless Steel with working pressure to 360 psig (26bar) at 248°F (120°C).
3. Pump shall have type 316 Stainless Steel wetted parts.
4. Each impeller shall be fitted with a Teflon seal ring. The 316L stainless steel shaft shall be fitted with Tungsten Carbide bearings.
5. The mechanical seal shall be suitable for the full pressure and temperature range of the pump and shall be fitted with carbon rotating face and silicon carbide stationary face.
6. The thrust bearing must be connected to the adaptor and shaft coupling in such manner as to eliminate pump axial loads from the motor, allowing NEMA design motors to be used.
7. The base mounted pump shall be assembled in a vertical shaft configuration with the suction and discharge connections being in-line at the bottom.
8. The suction and discharge headers shall be made of 304 Stainless Steel, minimum schedule 20.

9. The system shall include the pump & motor assemblies on a common structural steel base, the Integrated Drive Controller (IDC), suction and discharge piping & headers.
10. The system shall include stainless steel or low-lead bronze suction & discharge ball valves, and stainless steel or low-lead bronze non-slam check valve on the discharge.
11. One single point pressure sensor to be wired by others to properly execute the sequence of operation.
12. The system shall require only suction and discharge connections and a single point power connection.
13. Field connection of remote sensor/transmitters shall be installed by controls contractor as indicated on the plans.
14. All components shall be mounted on a structural steel base suitable for grouting.
15. The discharge of each pump shall be fitted with a check valve. Each pump and discharge valve assembly shall also be equipped with isolation valves so that the pump can be serviced.
16. Pressure gauges shall be installed on the suction and discharge headers.

2.2 INTEGRATED DRIVE CONTROLLER

1. The pump system controller shall be integrated with the variable frequency drive (IDC) as one unit.
2. The controller shall be microprocessor based capable of having software changes and updates via personal computer. The controller shall have a fully graphic, multilingual display with a large, bright, backlit graphic display to provide complete drive information.
 - a. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.
 - b. The controller shall display the following as status readings from a single display on the controller.
 - i. Current value of the control parameter.
 - ii. Most recent existing alarm (if any).
 - iii. System status with current operating mode.
 - iv. Status of each pump with current operating mode and rotational speed as a percentage.
 - c. The controller shall have as a minimum the following hardware inputs and outputs:
 - i. 2 Analog Inputs (4-20mA or 0-5Vdc or 0-10Vdc).
 - ii. 6 Digital Inputs (Programmable and 2 can be used as outputs).
 - 1 Analog Output (Programmable).
 - iii. 2 Standard Form C 240V Relay.
 - iv. Ethernet connection.
 - v. Field Service connection to PC.
 - d. All analog inputs shall be provided with current limit circuitry to provide short circuit protection and safeguard against incorrect wiring of sensors.
 - e. Pump system programming shall include the following protections:
 - i. Ground Fault
 - ii. Motor stall
 - iii. Motor over temperature
 - iv. Motor compensation & overload

- v. Pump no-flow
- vi. Dry Pump
- vii. Fault Tolerant Control
- viii. Pump end of curve
- ix. Short-cycle
- f. The controller shall be capable of receiving a remote analog set point (0-5V, and 0-10V).
- g. No flow shutdown shall not require any external flow meters or flow switches or pressure switches to determine when a NO FLOW condition exists.
- h. The controller shall be compatible with the following communication protocols via the RS-485 port :
 - i. Johnson Controls Metasys (N2)
 - ii. Siemens Building technologies system 600 (FLN)
 - iii. BACnet, FC Protocol
 - iv. Modbus RTU systems

2.3 VARIABLE FREQUENCY DRIVE (VFD)

1. The VFD shall convert incoming fixed frequency single – phase or three phase AC power into a variable frequency and voltage for controlling the speed of the three phases AC induction motors.
2. The VFD shall be a six pulse input design, and the input voltage rectifier shall employ a full wave diode bridge; VFD's utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.
3. The VFD shall be in a NEMA 1, 12 & 4X enclosures. VFD with plastic enclosure shall not be acceptable.
4. The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor.
5. The VFD shall be able to provide its full rated output current continuously at 110% of rated current for 60 seconds.
6. Automatic motor adaptation (AMA) algorithm shall be utilized. This feature shall allow for automatically optimized drive performance and efficiency leading to additional energy savings.
7. The VFD shall provide full torque to the motor given input voltage fluctuations of up to +10% to 15% of the rated input voltage.
8. The VFD shall be suitable for elevations to 3300 feet above sea level without derating. Maximum operating ambient temperature shall not be less than 104 degrees 'F VFD shall be suitable for operation in environments up to 95% non-condensing humidity.
9. The VFD shall be capable of displaying the following information in plain English via a 40- Character alphanumeric display:
 - i. Frequency
 - ii. Voltage
 - iii. Current
 - iv. Actual System Set point
 - v. Actual System Demand

- vi. Kilowatts per hour
- vii. Fault identification
- viii. Percent torque
- ix. Percent power
- x. RPM

2.4 SENSORS/TRANSMITTERS/ALARMS

1. Pressure Transducer:
 - i. Provide field mounted single point pressure sensor transmitter(s) as indicated on the plans. Unit shall transmit an isolated 0-5V or 0-10V DC signal indicative of process variable to the integrated drive controller via standard two wire 24VDC system.
 - ii. Unit shall have stainless steel wetted parts and a ceramic diaphragm with one 1/4" male NPT process connection.
 - iii. A pressure snubber shall be required to protect against any water hammering. Accuracy shall be within 0.25% of full span.
 - iv. A certification of final calibration shall be required for each sensor/transmitter.
2. Low Suction Pressure Switch
 - i. A low suction pressure switch shall be mounted to the suction header. The switch shall have an adjustable set point between 0-150 psi in addition to an adjustable differential. The switch shall be wired to disable the pump in the instance of low suction pressure to prevent the pump from running dry. The status of the switch shall be shown on the panel on the booster control panel.
3. High/Adequate Pressure Switch
 - a. A high suction pressure switch shall be mounted to the suction header. The switch shall have an adjustable set point between 0-150 psi in addition to an adjustable differential. The switch shall be wired to disable the pump in the instance of adequate city suction pressure to prevent water usage from the storage tank when not necessary. The status of the switch shall be shown on the panel on the booster control panel.
4. Domestic water tank float switch
 - a. Two level float switches shall be mounted on the tank and shall have a set of dry contact to be used in order to send signals to the control panel to send alarms and notifications. One float switch shall be located at the top of the storage tank to indicate that the storage tank is full, and the second shall be located at the midrange of tank to indicate when the storage tank needs to be filled. The status of the domestic water tank levels shall be shown on two control panels, one located at the booster package and the second located at the exterior of the building in a NEMA 4 type enclosure.
5. Auto-Dialer Alarm Module
 - a. An Auto-Dialer Alarm Module shall be installed in the booster controls package. The alarm module shall notify the owner, via telephone, of an alarm situation upon detection of a digital input signal.

2.5 SEQUENCE OF OPERATION

1. The IDC shall compare each sensor signal to the determined set points
2. When all set points are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.

3. The IDC shall continuously scan and compare each process variable to its individual set point and control to the least satisfied zone.
4. If the set point cannot be satisfied by the designated lead pump, the IDC shall initiate a timed sequence of operation to stage a lag pump.
5. The lag pump shall accelerate resulting in the lead pump decelerating until they equalize in speed.
6. Further change in process variable shall cause the pumps to change speed together.
7. No-Flow Detection:
 1. In addition to staging a pump off when it is running at minimum frequency, the VFD can also monitor the power provided to the motor by the drive. If this power is low for the operating speed, a no-flow condition is indicated.
 2. The no-flow power level for each drive/pump combination can be easily determined by using an automated macro during system start-up. If a drive's output power for its operating speed indicates a no-flow condition and the No-Flow Delay timer expires, the drive will enter a sleep condition and turn off.
8. End-Of-Curve Detection:
 - i. End-of-curve detection is meant to detect a situation where a broken pipe causes one or more pumps to run at full speed and create excessive flow without reaching the set point pressure, the LEAD drive will issue a warning to indicate this.
9. Dry Pump Protection:
 - i. This feature is used to detect if a pump has run dry, such as improper system fill at start up or when a pump has been out of service and restarted without water. This condition can cause pump damage if not detected and corrected promptly.
10. IDC Duplex operation:
 - i. Both VFD's will be configured to be the LEAD and LAG Pump.
 - ii. The first VFD will act as the LEAD drive, using its PID controller to control the pressure based on sensor readings. The word LEAD PUMP will be displayed on the screen.
 - iii. The second VFD will act as the LAG drive, it will be instructed when to run by the LEAD drive. The word LAG PUMP will be displayed on the screen.
 - iv. The role of LEAD and LAG drive will be alternated between the 2 VFDs based on a predetermined time schedule. The system can also be manually altered by simultaneously pressing the [OK] and [RIGHT] keys on drive 1's keypad.
 - v. In the event that the LEAD pump cannot maintain the load it will bring on the LAG pump and both will run in unison to maintain pressure. Once the VFDs reach a predetermined low speed together the LAG VFD will turn off and the LEAD VFD will maintain the load.
 - vi. In the event that either drive should fail the other will automatically take over regardless of the timer.
 - vii. The feedback signal will be piggybacked to both VFDs.
 - viii. Stall protection will be provided in the event that either of the pumps should experience a stall or locked rotor.
 - ix. A personal menu in the drive will be set to allow the operator to easily access the pressure set point, the LEAD-LAG timer settings, and to access the sensor range.
 - x. In the event that the pressure sensor should fail the VFD will go to a predetermined speed and remain there until the sensor is repaired. The LAG VFD will display the "Live Zero" alarm while the LEAD VFD will continue to run with a warning "Live zero".

11. Run Commands:
 - i. The main run command for the booster shall be interlocked with the high suction pressure switch. When there is adequate supply pressure to the booster, the switch will trigger the external interlock such that the pump cannot run.
 - ii. The main run command for the booster shall be interlocked with the low suction pressure switch. When there is inadequate pressure due to low water levels in the storage tank supplying water to the booster, the switch will trigger the external interlock such that the pump cannot run.
12. Level Switches
 - i. The Domestic water storage tank shall be fitted with two level float switches. The switch at the midrange of the tank shall be wired to an external auto-dialer module. The second switch at the top will indicate on the control panel when the tank is full. This is to ensure that the storage tank is not overfilled.
13. Auto-Dialer Alarm Module
 - i. An automatic auto-dialer shall be installed in the main control package mounted on the booster package. The auto-dialer shall take a digital signal from the lower float level switch in the tank. Upon receipt of the digital signal, the auto-dialer will notify the owner that the water level is low and that the tank needs to be refilled.
14. Control Panel
 - a. The control panel on the domestic booster package shall feature a panel mounted on the booster frame, in addition to an AUXILIARY PANEL external auxiliary indication panel.
 - b. The main indoor panel shall feature indication lamps showing the status of the high pressure switch, low pressure switch, and two tank float level switches. The main panel shall house all relays, terminal blocks, auto-dialer alarm modules, transformer and any other electrical components required to achieve the design intent. The rating of the enclosure shall be NEMA type 1.
 - c. The outdoor auxiliary panel shall be located near the water supply connection that is used to fill the domestic water storage tank. The outdoor electrical enclosure shall contain a terminal block to make the connections to the float level switches mounted on the domestic storage tank. The terminal block shall be used to connect the auxiliary control panel to the main control panel using field installed wiring. The auxiliary control panel shall have indication lamps to display the status of the float level switches on the tank.

3 Execution

3.1 INSTALLATION

1. Install pumps in accordance with manufacturer's requirements.
2. Provide drains for bases and stuffing boxes piped to and discharging into floor drains
3. Support piping adjacent to pump such that no weight is carried on pump casings.
4. Support suction guide and discharge elbow from a floor stand with rubber and shear sandwich pad isolators or from above with hangers and spring isolators
5. Check motor and pump lubrication points, fill oil reservoir on in-inline of pumps
6. Provide vibration isolated pipe hangers (resilient support) next to pumps on piping.

7. Pressure sensor to be mounted immediately downstream of main water softener assembly
8. Field connection to BACnet interface is by controls contractor.

3.2 FIELD QUALITY CONTROL

1. Test pumps and systems to verify capacity, sequence of operation and flow.

3.3 START-UP AND TRAINING

- .1 Manufacturer's representative to review and approve installation.
- .2 Manufacturer's representative to participate in start-up of domestic water booster systems.
- .3 Manufacturer's representative to provide operator training in the operation, maintenance and adjustment of the domestic water booster systems.

3.4 PERFORMANCE

1. Refer to pump schedule.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Use of mechanical systems during construction.

1.2 USE OF SYSTEMS

- .1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions and with the express written permission of Departmental Representative:
 - .1 Entire system is complete, pressure tested, cleaned, flushed out.
 - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
 - .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage.
 - .5 Supply ventilation systems are protected by 80% filters, inspected daily, changed every week or more frequently as required.
 - .6 Return systems have approved filters over openings, inlets, outlets.
 - .7 Systems will be:
 - .1 Operated as per manufacturer's recommendations and instructions.
 - .2 Operated by Contractor.
 - .3 Monitored continuously by Contractor.
 - .8 Warranties and guarantees are not relaxed.
 - .9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative.
 - .10 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.
- .2 Filters specified in this Section are over and above those specified in other Sections of this project.
- .3 Exhaust systems are not included in approvals for temporary heating ventilation.
- .4 Contractor shall not assume at time of bidding that permission will be given to use permanent heating and/or ventilation systems.

2 Products

2.1 NOT USED

3 Execution

3.1 NOT USED

END OF SECTION

1 General

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2 REGULATORY REQUIREMENTS

- .1 Conform to ASME B31.9 - Building Services Piping.
- .2 Contractor to supply shop drawings for all grooved end components. Do piping system work including hangers in accordance with ANSI B31.1. Install all grooved end components as per manufacturer's latest recommendations. All grooved joint couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .3 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.3 WELDING

- .1 Welding materials and labour must conform to ASME Code and the Provincial Board of Labour Regulations.
- .2 Use welders fully qualified and licensed by Provincial Authorities.

1.4 SUBMITTALS

- .1 Submit shop drawings to requirements of Section 01 33 00.
- .2 Submit shop drawings and product data for manufactured products and assemblies required for this project. Include data on pipe material, pipe fittings, valves and accessories.
- .3 Shop drawings shall clearly indicate product description, make, model, dimensions, component sizes, rough-in requirements, location, type, size, service clearances, finishes, and pressure rating.
- .4 Submit copies of valve "ordering schedule" for approval before ordering valves.

1.5 QUALITY ASSURANCE

- .1 Domestic water, drainage and vent piping shall meet the requirements of the National Building Code and the Provincial and Municipal Codes.
- .2 Automatic sprinkler system piping shall conform to the requirements of NFPA No. 13.
- .3 Contractor to supply shop drawings for all grooved end components. Do piping system work including hangers in accordance with ANSI B31.1-1983. Install all grooved end components as per manufacturer's latest recommendations. All grooved joint couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .4 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

2 Products

2.1 PIPE

- .1 Refrigerant Piping
 - .1 Copper Tubing: ASTM B280, Type ACR hard drawn or annealed. Fittings: ASME B16.22 wrought copper. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 640 to 805 degrees (1190 to 1480 degrees F).
- .2 Equipment Drains/Overflow
 - .1 Steel Pipe: ASTM A53 or A120, Schedule 40 galvanized, with galvanized cast iron or malleable iron fittings, screwed joints or grooved mechanical couplings.
 - .2 Plastic Pipe buried or crawlspace may be PVC Pipe: Schedule 40 or SDR 21 or 26, with PVC fittings, solvent weld or grooved mechanical joints.
 - .3 Plastic Pipe in ceiling space shall be fire rated PVC Pipe: Schedule 40 or SDR 21 or 26, with fire rated PVC fittings, solvent weld or grooved mechanical joints. Rating to meet 25/50 flame and smoke spread.
 - .4 Copper Pipe: Type L hard copper, with cast brass or wrought copper fittings, 95/5 solder.
- .3 Sanitary Drainage and Vent (unburied)
 - .1 Cast iron pipe and fittings; hub-and spigot, neoprene gaskets; or hubless with neoprene gaskets and stainless steel clamp-and-shield assemblies.
 - .2 Type "M" or "DWV" copper with cast brass, or bronze or wrought copper fittings; 95/5 solder joints or grooved mechanical.
 - .3 Plastic PVC-XFR-15/50 or CPVC pipe and fittings; solvent weld joints or grooved mechanical.
- .4 Water Piping (buried)
 - .1 Copper tubing type K annealed; wrought copper fittings 95/5 solder or silver braze joints.
 - .2 Plastic "BLUE BRUTE" pipe and fittings; solvent weld joints.
 - .3 All piping and fitting shall be rated to a minimum of 1034 kPa (150 PSI)
- .5 Water Piping (unburied)
 - .1 Type L hard copper; with cast brass or wrought copper fittings; 95/5 solder joints.
 - .2 Stainless steel pipe, Schedule 10; grooved mechanical.
 - .3 Cross Linked Polyethylene (PEX) pipe, mechanical joints.
 - .4 Polypropylene (PP) with heat fused joints.
- .6 Use factory fabricated butt welded fittings for welded steel pipes.
- .7 Use long radius elbows for steel and cast iron water piping.

3 Execution

3.1 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and unions or flanges (as indicated) for isolation and ease of maintenance and assembly.

- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve complete with isolation at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to nearest floor drain where indicated. Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 DIELECTRIC COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: Isolating flanges.

3.5 ROUTE AND GRADES

- .1 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical at common elevations. Install concealed pipes close to the building structure to keep furrings to a minimum.
- .2 Slope water piping 25 mm in 12 m and arrange to drain at low points.
- .3 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.
- .4 Grade horizontal drainage and vent piping 20 mm per meter minimum.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.

- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
 - .2 Do not project branch pipe inside the main pipe.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions. Valves to be complete with valve handle extensions where insulation is thicker than 25mm, extension to suit insulation thickness.
- .11 Group piping wherever possible.
- .12 Ream pipes, remove scale, welding slag and other foreign material, inside and outside before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.
- .15 Use grooved mechanical couplings and mechanical fasteners in accessible locations, risers, pipe chases, and in other locations as approved by Departmental Representative. Use flexible couplings at pumps, coils and all vibration isolated equipment in lieu of flexible connectors, all other couplings to be rigid.
 - .1 Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions.
 - .2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the job site and review Contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or job site visits.)
- .16 Make connections to equipment and branch mains with unions or flanges, as indicated:
 - .1 Unions are not required in installations using grooved mechanical joint couplings (The couplings shall serve as disconnect points.)
- .17 Provide non-conducting type connections wherever jointing dissimilar metals in systems. Brass adaptors and valves are acceptable. Refer to dielectric couplings.

- .18 Pressfit piping and fittings are not permitted.
- .19 Install piping to allow for expansion and contraction without unduly stressing pipe or equipment connected.
 - .1 For mechanical pipe jointing systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the Departmental Representative.) Where expansion loops are required, use Victaulic Style 77 couplings on the loops.
- .20 Install piping material specified as inside the building to 2.4 meters outside of building unless indicated otherwise on Mechanical Drawings.
- .21 Use of PVC or other plastic pipe allowed where approved by the authority having jurisdiction. Plastic pipe run in plenum spaces shall have flame and smoke rating for that purpose. All plastic pipe to be complete with ULC labelled intumescent fire stopping wherever penetrating fire separations. The piping shall be sealed at the penetration by a fire stop that has an F rating not less than the fire resistance rating required for the fire separation when subjected to the fire test method CAN/ULC-S115, "Fire Tests of Firestop Systems," with a pressure differential of 50 Pa between the exposed and unexposed sides, with the higher pressure on the exposed side. Combustible piping shall not be permitted in a vertical service space.
- .22 Valves:
 - .1 Shall be flanged for steam and condensate 38 mm and larger.
 - .2 Install in accessible locations.
 - .3 Remove interior parts before soldering.
 - .4 Install with stems upright or horizontal, not inverted.
 - .5 Valves accessible for maintenance without removing adjacent piping.
 - .6 Install globe valves in bypass around control valves.
 - .7 Use ball valves up to 50 mm or butterfly valves 63 mm and larger at branch take-offs for isolating purposes except where otherwise specified.
 - .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .9 Install ball valves for domestic water.
 - .10 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
 - .11 Install gate, ball and butterfly valves for isolating service, to isolate equipment, part of systems or vertical risers.
 - .12 Install globe, ball or angle valves for throttling service.
 - .13 Use plug cocks in water systems for throttling service. Use non-lubricated plug cocks only when shut-off or isolation valves are also provided.
 - .14 Use butterfly valves in fire protection systems where approved.
 - .15 Provide drain valves at main shut-off valves, low points of piping and apparatus.
 - .16 Valve operators to be complete with extensions on systems with insulation thicker than 25mm, extension to suit insulation thickness.
- .23 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
 - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.
- .24 Provide thermometers, thermometer wells, and sensor wells where thermometers are indicated on drawings and schematics.

- .25 Provide plug cocks at all pressure tapping locations.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems. Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11- Cleaning supplemented as specified in relevant sections of Mechanical.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 PIPework: Test as specified in relevant sections of Mechanical or to 1.5 times maximum operating pressure. All installed piping to be tested unless noted otherwise.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Mechanical.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Electrical motors, drives and guards for mechanical equipment and systems.
 - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22, 23 and 25. Refer to Division 26 for quality of materials and workmanship. Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan.
- .3 Closeout Submittals
 - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 GENERAL

- .1 Motors: premium efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.
- .2 Must be inverter duty for all variable frequency drive applications.
- .3 Must be CSA approved.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors 373 W (1/2 HP) and under: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W (3/4 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.-
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for flexible connections, expansion joints, anchors and guides for building services piping.
- .2 Sustainable requirements for construction, verification and operation.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A105/A105M-03, Standard Specification for Carbon Steel Forgings, for Piping Applications.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and indicate for items as applicable:
 - .1 Manufacturer, model number, line contents, pressure and temperature rating.
 - .2 Movement handled, axial, lateral, angular and the amounts of each.
 - .3 Nominal size and dimensions including details of construction and assembly.
- .3 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Data to include:
 - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

1.4 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 GENERAL REQUIREMENTS

- .1 Verify, prior to installation, required anchors and expansion joints to adequately protect system.
- .2 Base expansion calculations on -10 deg.C installation temperature to 100 deg.C for hot water heating and 60 deg.C for domestic hot water, plus 30% safety factor.

2 Products

2.1 FLEXIBLE LOOP EXPANSION JOINT (Manufactured)

- .1 Construction to be 3 equal length sections of annular corrugated 321 / 304L stainless steel or bronze for models TFLBSW and TFLBHM close-pitch hose with stainless steel or bronze over-braid that will absorb or compensate for pipe movements in all 6 degrees of freedom (3 coordinate axes, plus rotation about those axes) simultaneously.

- .2 The corrugated metal hose, braid(s), and a stainless steel ring-ferrule/band (material gauge not less than .048") must be integrally seal welded using a 100% circumferential, full penetration TIG welds. End fittings shall be selected per application. Fittings must be attached using a 100% circumferential TIG weld.
- .3 Braided stainless steel Loops must be suitable for operating temperatures up to 850 degrees F (455 degrees C). Braided bronze Loops must be suitable for operating temperatures up to 400 degrees F (204 degrees C)
- .4 Loop must be designed for pressure testing to 1.5 times their maximum rated working pressure and a minimum 4:1 (burst to working) safety factor.
- .5 Each braided Loop shall be individually leak tested by the manufacturer using air-under-water and/or hydrostatic pressure.
- .6 Loops shall be prepared for shipment in a method that maintains the manufactured length during shipping. Shipping supports must be removed prior to system start-up.
- .7 Manufacturers approved hanger assembly kit shall be used to support and hang the Loop. The UL Listed Seismic Wire/Cable assemblies conform to the requirements of the ASCE (American Society of Civil Engineers) guidelines for structural applications of wire rope, in that the cable is pre-stretched and the permanent end fittings maintain the break strength of the cable with a safety factor of two.
- .8 The pre-manufactured flexible loop shall be installed and guided following the manufacturer's published installation instructions. Specification is based on a product that does not require pipe guides. Manufactured loops that require pipe alignment guides shall use "Spider" type with outer housing ring affixed to building structure with rigid elements. Units shall be fabricated from carbon steel. Pipe hangers and/or roller supports shall not be considered acceptable for use as guides.
- .9 The pre-manufactured flexible loop design shall be tested by an independent third party to confirm simultaneous movement in X, Y, and Z planes plus rotation about those axes. Third party testing will document and confirm motion capabilities of the device. Device testing to include large and irregular movements similar to movement that may be caused by seismic movement analytically using finite element modeling and computer simulation as well as physical testing of the device. Independent third party testing data and documentation are to be furnished upon the engineers request during pre-qualification process or at the time of submission.
- .10 The pre-manufactured flexible loop shall meet the requirements of the 2009 International Building Code (IBC) and the American Society of Civil Engineers code requirements for Total Maximum Displacement and accidental torsion as directed in IBC Chapter 13 and ASCE 7-05, Chapter 17.1.2.
- .11 When used for potable water (in copper tubing systems) product shall be third party tested and, listed (by a laboratory in compliance with all applicable requirements of ISO/IEC 17025) and marked in accordance with NSF/ANSI 61-2011.
- .12 When used for potable water (in copper tubing systems) product shall be third party tested and, listed (by a laboratory in compliance with all applicable requirements of ISO/IEC 17025) and marked in accordance with Section 1417(d) of the Safe Drinking Water Act. Must meet the lead content requirements of Section 116875 of the California Health & Safety Code, and the criteria of NSF/ANSI 372 for low lead.

- .13 When used for potable water (in steel piping systems) product shall be third party tested and, listed (by a laboratory in compliance with all applicable requirements of ISO/IEC 17025) and marked in accordance with NSF/ANSI 61-2011
- .14 When used for potable water (in steel piping systems) product shall be third party tested and, listed (by a laboratory in compliance with all applicable requirements of ISO/IEC 17025) and marked in accordance with Section 1417(d) of the Safe Drinking Water Act. Must meet the lead content requirements of Section 116875 of the California Health & Safety Code, and the criteria of NSF/ANSI 372 for low lead.
- .15 When used for potable water (in stainless steel piping systems) products shall be third party tested and, listed (by a laboratory in compliance with all applicable requirements of ISO/IEC 17025) and marked in accordance with NSF/ANSI 61-2011
- .16 When used for potable water (in stainless steel piping systems) products shall be third party tested and, listed (by a laboratory in compliance with all applicable requirements of ISO/IEC 17025) and marked in accordance with Section 1417(d) of the Safe Drinking Water Act. Must meet the lead content requirements of Section 116875 of the California Health & Safety Code, and the criteria of NSF/ANSI 372 for low lead.
- .17 Loop material shall reasonably match pipe material.
- .18 Pre-Manufactured Loop must have a 5-year full replacement warranty when installed in accordance with all specifications and installation instructions as described in the Manufacturers Installation and Maintenance Instructions. If it is deemed that installation did not meet Manufacturers Installation and Maintenance requirements, then contractor shall be responsible for 5 year warranty.
- .19 Specifications are based on the Tri-Flex series of product offered by Flex-Hose including models TFLBSW, TFLSMP, TFLSMN, TFLSVG, TFLSSMP6, TFLSSMN6 and TFLSSVG6.

2.2 GROOVED PIPE EXPANSION JOINTS

- .1 Grooved end expansion joints for steel piping:
 - .1 Packless, gasketed, slip expansion joints: 2400 kPa maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with grooved ends. Suitable for axial end movement to 80 mm Victaulic Style 150.
 - .2 Expansion joint consisting of a series of grooved end pipe nipples joined in tandem with Victaulic Style 77 flexible couplings. Total joint movement dependent on the number of couplings and nipples used. Victaulic Series 155.

2.3 FLEXIBLE CONNECTION

- .1 Application: to suit motion as indicated.
- .2 Minimum length in accordance with manufacturer's recommendations to suit offset as indicated.
- .3 Inner hose: bronze corrugated for copper pipe, inner hose stainless steel corrugated for steel pipe.
- .4 Braided wire mesh bronze outer jacket, for copper pipe.
- .5 Braided wire mesh stainless steel after jacket for steel pipe.
- .6 Diameter and type of end connection: as indicated under Section 23 05 01.

- .7 Operating conditions:
 - .1 Working pressure: 1034 kPa minimum.
 - .2 Working temperature: 232 degrees C minimum.
 - .3 To match system requirements.

3 Execution

3.1 INSTALLATION

- .1 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .2 Install pipe anchors and guides as indicated and required. Anchors to withstand 150% of axial thrust.
- .3 Provide flexible pipe connectors on pipes connected to all equipment supported by vibration isolation and where shown on drawings and schematics.
- .4 Provide structural work and equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints and provide corrugated bellows type expansion joints where indicated or required.
- .5 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor at other end.
- .6 Rigidly anchor pipe to building structure at points shown and where required, where necessary provide pipe guides so that movement takes place along axis of pipe.
- .7 Three Victualic Style 77 couplings may be used in lieu of a flexible connector for vibration attenuation and stress relief. The couplings shall be placed in close proximity to the source of the vibration.
- .8 Rigidly anchor pipe to building structure at points shown, and where necessary provide pipe guides so that movement takes place along axis of pipe only.

3.2 CLEANING AND START-UP

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

3.3 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-1998, Power Piping.
 - .2 ANSI/ASME B31.3-2000, Process Piping Addenda A.
 - .3 ANSI/ASME B31.3-2001, Process Piping Addenda B.
 - .4 ANSI/ASME Boiler and Pressure Vessel Code-1998:
 - .1 Section I: Power Boilers.
 - .2 Section V: Nondestructive Examination.
 - .3 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C206-97, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
 - .1 AWS C1.1-2000, Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1-1999, Safety Welding, Cutting and Allied Process.
 - .3 AWS W1-2000, Welding Inspection Handbook..
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-48.2-92, Spot Radiography of Welded Butt Joints in Ferrous Materials.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA W47.2-M1987 (R1998), Certification of Companies for Fusion Welding of Aluminum.
 - .2 CSA W48 series-01, Filler Metals and Allied Materials for Metal Arc Welding.
 - .3 CSA B51-97, Boiler, Pressure Vessel and Pressure Piping Code.
 - .4 CSA-W117.2-01, Safety in Welding, Cutting and Allied Processes.
 - .5 CSA W178.1-02, Certification of Welding Inspection Organizations.
 - .6 CSA W178.2-01, Certification of Welding Inspectors.

1.2 QUALIFICATIONS

- .1 Welders
 - .1 Welding qualifications in accordance with CSA B51.
 - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
 - .3 Furnish welder's qualifications to Departmental Representative.
 - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
 - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors
 - .1 Inspectors qualified to CSA W178.2.

1.3 QUALITY ASSURANCE

- .1 Registration of welding procedures in accordance with CSA B51.
- .2 Copy of welding procedures available for inspection.

- .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

2 Products

2.1 ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

3 Execution

3.1 WORKMANSHIP

- .1 Welding: in accordance with ANSI/ASME B31.1, B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

3.2 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
 - .1 Where used, fit to minimize gaps between ring and pipe bore.
 - .2 Do not install at orifice flanges.
- .3 Fittings:
 - .1 NPS 2 and smaller: install welding type sockets.
 - .2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by Codes and as specified.

3.4 SPECIALIST EXAMINATIONS AND TESTS

- .1 Hydrostatically test welds to requirements of ANSI/ASME B31.1.
- .2 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .3 Failure of visual examinations:
 - .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10% of welds, selected at random by Departmental Representative by radiographic particle tests.

- .4 Full radiographic tests for piping systems.
 - .1 Spot radiography to CAN/CGSB-48.2.
 - .1 Conduct spot radiographic tests of up to 10% of welds, selected at random by Departmental Representative from welds which would be most difficult to repair in event of failure after system is operational.
 - .2 Radiographic film:
 - .1 Identify each radiographic film with date, location, name of welder, and submit to Departmental Representative. Replace film if rejected because of poor quality.
 - .3 Interpretation of radiographic films:
 - .1 By qualified radiographer.
 - .4 Failure of radiographic tests:
 - .1 Extend tests to welds by welder responsible when those welds fails tests.
- .5 Magnetic particle tests for piping systems.

3.5 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
- .2 In addition, chilled water systems:
 - .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.
 - .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.
 - .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.
 - .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.
 - .5 Repair cracks and defects in excess of 0.8 mm in depth.
 - .6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic particle tests.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Bronze - valves.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A276-04, Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B283-99a, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B505/B505M-02, Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-2003, Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Specifications.
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit data for valves specified in this section.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 All products to have CRN registration numbers.
 - .3 Refer to Section 22 11 16.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: Grooved ends to requirements of manufacturer.
 - .2 Copper tube systems: Solder ends to ANSI/ASME B16.18.
 - .3 Provide flanged ends as indicated under 23 05 05, Installation of Pipework.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal. Refer to 23 05 05 - Installation of Pipework.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Valves, gate, globe, and check.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A49-01, Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A126-95 (2001), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .3 ASTM B61-93, Specification for Steam or Valve Bronze Castings.
 - .4 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.
 - .5 ASTM B85-03, Specification for Aluminum-Alloy Die Castings.
 - .6 ASTM B209-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS SP-71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .3 MSS SP-82-1992, Valve Pressure Testing Methods.
 - .4 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Specifications.
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit data for valves specified in this section.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
 - .1 Gate valves: MSS SP-70.
 - .2 Globe valves: MSS SP-85.
 - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
 - .1 Body, bonnet: cast iron to ASTM B209 Class B.
 - .2 Connections: flanged ends with 2 mm raised face with serrated finish to ANSI B16.1.
 - .3 Inspection and pressure testing: to MSS SP-82.
 - .4 Bonnet gasket: non-asbestos.
 - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
 - .7 Gland packing: non-asbestos.
 - .8 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
 - .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

2.2 GATE VALVES

- .1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly. Class 300.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B62.
 - .3 Seat rings: renewable bronze to ASTM B62, screwed into body.
 - .4 Stem: bronze to ASTM B62.
 - .5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
 - .6 Seat: Integral with body.
 - .7 Stem: wrought steel.
 - .8 Operator: Handwheel.
- .2 NPS 2 1/2-8, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 300.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
 - .3 Seat rings: renewable bronze screwed into body.
 - .4 Stem: nickel-plated steel.
 - .5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.

- .6 Seat rings: integral with body.
- .7 Stem: nickel-plated steel.
- .8 Pressure-lubricated operating mechanism.
- .9 Operator: Handwheel.
- .10 Bypass: complete with union and NPS globe valve as Section 23 05 05 - Installation of Pipework.

2.3 UNDERWRITERS APPROVED GATE VALVE

- .1 NPS 2 1/2 - 14, OS&Y:
 - .1 Approvals: UL and FM approved for fire service.
 - .2 UL and FM Label: on valve yoke.
 - .3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC 262 (B).
 - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
 - .5 Packing gland: bronze.
 - .6 Stem: manganese bronze. Diameter to ULC C-262 (B).
 - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
 - .8 Bosses for bypass valve, drain: on NPS 4 and over.
 - .9 Disc: solid taper wedge. Up to NPS 3: bronze. NPS 4 and over: cast iron with bronze disc rings.
 - .10 Disc seat ring: self-aligning, Milwood undercut on NPS 3 - 12.
 - .11 Pressure rating:
 - .1 NPS 2-1/2 - 12: 1.7 Mpa CWP.
 - .12 Operator: handwheel.
 - .13 Bypass: complete with union and NPS globe valve as Section 23 05 23.01 - Valves - Bronze.

2.4 GLOBE VALVES

- .1 NPS 2 1/2 - 10, OSY:
 - .1 Body: with multiple-bolted bonnet, Class 300.
 - .2 WP: 860 kPa steam, 1.4 MPa CWP.
 - .3 Bonnet-yoke gasket: non-asbestos.
 - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
 - .5 Seat ring: renewable, regrindable, screwed into body.
 - .6 Stem: bronze to ASTM B62.
 - .7 Operator: Handwheel.

2.5 BYPASSES FOR GATE AND GLOBE VALVES

- .1 Locations: on valves as indicated.
- .2 Position of bypass valve on main valves.
- .3 Size of bypass valve:
 - .1 Main valve up to NPS 8: NPS 3/4.
- .4 Type of bypass valves:
 - .1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.
 - .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.

2.6 VALVE OPERATORS

- .1 Install valve operators as follows:
 - .1 Handwheel: on valves except as specified.
 - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms and mechanical equipment rooms.

2.7 CHECK VALVES

- .1 Swing check valves, Class 300:
 - .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
 - .2 Flanged ends: 2 mm raised face with serrated finish.
 - .3 Rating: 300 psi steam; 500 psi CWP.
 - .4 Disc: rotating for extended life.
 - .1 Up to NPS 3: bronze to ASTM B61.
 - .2 NPS 4 - 8: Iron faced with ASTM B61 bronze.
 - .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
 - .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
 - .7 Hinge: galvanized malleable iron.
 - .8 Identification tag: fastened to cover.

3 Execution

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance and equipment removal. Refer to Section 23 05 05 Installation of Pipework.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Valves Cast Steel, gate, globe, and check.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B16.5-2003, Pipe Flanges and Flanged Fittings.
 - .2 ANSI/ASME B16.10-1992, Face-to-Face and End-to-End Dimensions Valves.
 - .3 ANSI/ASME B16.25-1997, Buttwelding Ends.
 - .4 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding End.
- .2 American Petroleum Institute (API).
 - .1 API 598-1996, Valve Inspection and Testing.
- .3 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A49-01, Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A193/A193M-04, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - .3 ASTM A194/A194M-03b, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
 - .4 ASTM A216/A216M-1993 (03), Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
 - .5 ASTM B85-03, Specification for Aluminum-Alloy Die Castings.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS SP-61-2003, Pressure Testing of Steel Valves.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Specifications.
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit data for valves specified this section.
 - .3 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
 - .2 Valves to be individually tested.
- .2 Requirements common to valves, unless specified otherwise:
 - .1 Pressure-temperature ratings: to ANSI B16.34.
 - .2 Inspections and tests: to API 598.
 - .3 Pressure Testing: to MSS SP-61.
 - .4 Flanged valves:
 - .1 Face-to-face dimensions: to ANSI B16.10.
 - .2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face.
 - .5 Butt-weld valves:
 - .1 End-to-end dimensions: to ANSI B16.10.
 - .2 End dimensions: to ANSI B16.25 bored for standard pipe schedule.
 - .6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49.
 - .7 Markings: to MSS SP-25.
 - .8 Identification:
 - .1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
 - .2 Body markings: manufacturer, size, primary service rating, material symbol.
 - .9 CRN registration number required for all products.

2.2 GATE VALVES

- .1 NPS 2 1/2 - 12, rising stem, OS&Y, solid flexible wedge disc, flanged or butt-weld ends, Class 300:
 - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB, with full length disc guides designed to ensure correct re-assembly.
 - .2 Body/bonnet joint: Flat face with corrugated metallic gasket.
 - .3 Bonnet studs: to ASTM A193/A193M Type B7.
 - .4 Bonnet nuts: to ASTM A194/A194M Type 2H.
 - .5 Stuffing box: including non-galling two-piece ball jointed packing gland, with swing-type eye bolts and nuts.
 - .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
 - .7 Yoke sleeve: Ni-Resist, minimum melting point above 954 degrees C.
 - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
 - .9 Disc: with disc stem ring to connect to stem, guided throughout its travel.
 - .1 NPS 2 1/2 - 6: Solid corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.

- .2 NPS 8 and larger: Carbon steel faced with corrosion and heat resistant 13 chromium steel with minimum hardness of 350 HB.
- .10 Seat ring: seamless carbon steel with hard-faced cobalt-chromium-tungsten alloy seating surface, slipped in, seal welded, ground to match disc.
- .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut, T-head disc-stem connection.
- .12 Operator: see elsewhere this section.

2.3 GLOBE VALVES

- .1 NPS 2 1/2 - 12, rising stem, OS&Y, flanged or butt-weld ends, Class 300:
 - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB.
 - .2 Body/bonnet joint: Flat face with corrugated metallic gasket.
 - .3 Bonnet studs: to ASTM A193/A193M Type B7.
 - .4 Bonnet nuts: to ASTM A194/A194M Type 2H.
 - .5 Stuffing box: including non-galling two-piece ball-jointed packing gland, with swing-type eye bolts and nuts.
 - .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
 - .7 Yoke bushing: Ni-Resist, minimum melting point above 954 degrees C.
 - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
 - .9 Disc: Plug type with 15 degrees taper seat and bottom guide or ball type with 35 degrees taper seat.
 - .10 Seat rings: with 1.6 mm thick cobalt-chromium-tungsten alloy facings with minimum hardness of 375 HB (cold), slipped in, seal welded, ground to match disc.
 - .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with bonnet bushing, long engagement with yoke bushing for accurate seating, accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
 - .12 Operator: see elsewhere this section.

2.4 VALVE OPERATORS

- .1 Handwheel: on all valves except as specified.
- .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.

2.5 BYPASSES FOR GATE AND GLOBE VALVES

- .1 Locations: on valves as indicated.
- .2 Position of bypass valve on main valves.
- .3 Size of bypass valve:
 - .1 Main valve up to NPS 8: NPS 3/4.
- .4 Type of bypass valves:
 - .1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 22 - Valves - Bronze.

- .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 22 - Valves - Bronze.

2.6 CHECK VALVES

- .1 NPS 2 1/2 and over, flanged or butt-weld ends, Class 300: swing check.
 - .1 Body and multiple-bolted cap: cast steel to ASTM A216/A216M WCB.
 - .2 Cap studs: to ASTM A193/A193M Type B7.
 - .3 Cap nuts: to ASTM A194/A194M Type 2H.
 - .4 Body/cap joint: male-female face with corrugated metallic gasket.
 - .5 Disc: heat treated corrosion and heat resistant 13% chromium steel.
 - .6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.
 - .7 Hinge: cast carbon steel.
 - .8 Hinge pin: stainless steel (410).

2.7 SILENT CHECK VALVES

- .1 Construction:
 - .1 Body: Cast steel to ASTM A216 WCB with integral seat.
 - .2 Pressure rating: Class 300.
 - .3 Connections: Flanged or Wafer ends.
 - .4 Double bronze disc with SS seat and stem. Renewable disc, seat, stem and spring. Spring rating must match system design for silent operation and installation.
 - .5 Stainless steel spring, heavy duty.
 - .6 Seat: regrindable.

3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.
- .2 Install valves with unions or flanges to each piece of equipment arranged to allow servicing, maintenance, and equipment removal. Refer to Section 23 05 05 Installation of PIPES.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Plug Valves - Lubricated plug valves, Eccentric plug valves.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
 - .3 ANSI/ASME B16.11-2001, Forged Fittings, Socket-Welding and Threaded.
 - .4 ANSI/ASME B16.25-1997, Butt Welding Ends.
 - .5 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding End.
 - .6 ANSI/ASME B16.10-2000, Face to Face and End to End Dimensions of Valves.
- .2 American Society for Testing and Materials International (ASTM).
 - .1 ASTM A126-95 (2000), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B209-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry Inc. (MSS).
 - .1 MSS SP-78-1998, Cast Iron Plug Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Specifications.
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .3 Submit data for valves specified this Section.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 MATERIAL

- .1 Valves:
 - .1 Except for specialty valves, to be of single manufacturer.
 - .2 Products to have CRN registration number.

2.2 ECCENTRIC PLUG VALVES

- .1 General:
 - .1 Dead-tight shut-off on liquids and gases at pressure differentials up to 1.2 MPa in forward direction, 520 kPa in reverse direction.
- .2 Up to NPS 2, screwed ends:
 - .1 Body: cast iron to ASTM B209 Class B.
 - .2 Plug:
 - .1 NPS 1/2 and 3/4: bronze to ASTM B62.
 - .2 NPS 1 to NPS 2: bronze to ASTM B62.
 - .3 Bearings: permanently lubricated, bronze to ASTM B62 in upper and lower journals.
 - .4 Seals: double-seal consisting of:
 - .1 Plastic seat coating between plug and body.
 - .2 Resilient seal moulded into groove in plug face.
 - .3 Seal materials: BUNA Stem seals with Neoprene (gas service) plug seals.
 - .4 VITON stem seals with Fluorinated hydrocarbon plug seals (over 149 deg.C).
 - .5 Isobutene Isoprene stem seal with isobutene-isoprene plug seals (up to 121 deg.C)
 - .5 End connections: screwed.
 - .6 Operators: lever with adjustable memory stop.
- .3 NPS 2 1/2 to NPS 4, flanged ends:
 - .1 Body: cast iron to ASTM B209 Class B.
 - .2 Plug: nickel-plated cast iron to ANSI.
 - .3 Bearings: permanently lubricated, bronze to ASTM B62 in upper and lower journals.
 - .4 Seals: double-seal consisting of:
 - .1 Plastic seat coating between plug and body.
 - .2 Resilient seal moulded into groove in plug face.
 - .3 Seal materials: BUNA Stem seals with Neoprene plug seals (gas service)
 - .4 VITON stem seals with Fluorinated hydrocarbon plug seals (over 149 deg.C).
 - .5 Isobutene Isoprene stem seal with isobutene-isoprene plug seals (up to 121 deg.C)
 - .5 End connections: flanged to ANSI B16.1 or roll grooved.
 - .6 Operators: lever.

2.3 LUBRICATED PLUG VALVES

- .1 Principle of operation:
 - .1 Special sealing compound used to effect tight seal. When line pressure applied to valve in closed position, parallel plug forced against downstream side of valve. The metal-to-metal contact and sealing compound ensures leak-tight seal.
- .2 Testing to specifications: MSS SP-78 for non-shock pressure at specified temperature.
- .3 End connections:
 - .1 NPS 1/2 to 2: screwed ends.
 - .2 NPS 2½ to 12: flanged ends.
- .4 Valve:
 - .1 Body: cast iron to ASTM A126 Class B semi-steel.
 - .2 Pressure rating: NPS 1/2 to 12:
 - .1 Screwed end valves: screwed to NPT standards.

- .2 Flanged end valves: flanged to ANSI B16.1 Class 300. Flanged valves NPS 2-8 face dimensions in accordance with ANSI B16.10 short pattern, making them interchangeable with Class 300 flanged cast iron gate valves.
- .3 Hydrostatic tests: body 300 psig. Seat: 100 psig.
- .3 Plug: tapered, with regular pattern port - 90 degrees from full open to fully closed, complete with PFTE thrust ring: 100% full port.
- .4 Number of ports: as required.
- .5 Ends: with ends screwed to ANSI B1.20.1, butt welding to ANSI B16.25, socket-welding to ANSI B16.11.
- .6 Lubrication system, nickel-plated.
- .7 Lubricant: to suit type, temperature and pressure of contained fluid.
- .8 Provide sealing compound injection gun designed for use with pre-packed sealing compound cartridges and valve fitted with button head nipples and combination sealing screws.
- .9 Feeding system: lubricant forced into lubrication grooves between seating surfaces of plug and body to form positive seal, leakproof operation, and corrosion preventing film. Lubricant receptacle to hold additional lubricant. Lubricant screw for lubrication. Check valve to prevent reverse flow of lubricant. O-rings between body and plug.
- .5 Operator:
 - .1 Up to NPS 5: manual lever.
- .6 3 port and 4 port valves:
 - .1 To be supplied transflow pattern, to allow reduced flow through ports during rotation of plug from one position to another.
 - .2 Limit stops: to be provided.
- .7 Accessories: lubricant gun.

3 Execution

3.1 INSTALLATION OF LUBRICATED PLUG VALVES

- .1 Install with line pressure acting to hold plug against body ports which are to be cut-off from higher pressure.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Butterfly Valves.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings.
 - .3 ANSI/ASME B16.5-03, Pipe Flanges and Flanged Fittings.
 - .4 ANSI/ASME B16.11-01, Forged Fittings, Socket-Welding and Threaded.
 - .5 ANSI/ASME B16.25-1997, Butt welding Ends.
 - .6 ANSI/ASME B16.34-1996, Valves - Flanged, Threaded and Welding Ends.
- .2 American National Standards Institute (ANSI)/American Petroleum Institute (API).
 - .1 ANSI/API 609-1997, Lug- and Water-Type Butterfly Valves.
- .3 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A126-95 (01), Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - .2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B209M-04, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS SP-67-02, Butterfly Valves.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Specifications.
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .3 Submit data for valves specified this section.
- .3 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 300 PSIG

- .1 Sizes: Lug type: NPS 2 to 48.
- .2 Pressure rating: 300 psig at 135 degrees C.
- .3 Lug body: 300 ANSI bolt pattern.
- .4 Full lug body (threaded).
- .5 Application: for on-off service.
- .6 Operators:
 - .1 NPS 2 - 6: Handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel.
 - .2 Install parallel or perpendicular to pipeline.
- .7 Designed to comply with MSS SP-67 and API 609.
- .8 Compatible with ANSI B16.1 Class 250 (iron) and ANSI B16.5 Class 300 (steel) flanges.
- .9 Construction:
 - .1 Body: ductile iron.
 - .2 Disc: aluminum bronze.
 - .3 Seat: EPDM.
 - .4 Shaft: NPS 2 - 12: 416 stainless steel.
 - .5 Taper pin: 316 SS.
 - .6 Blowout proof stem.
 - .7 O-Ring: Buna-N.
 - .8 Bushings: teflon.
 - .9 Disc shall not be pinned to shaft.
 - .10 Bubble tight shutoff with downstream flanges removed, class 6 shutoff.

2.2 MOUNTING FLANGES

- .1 Class 300 steel to B16.5 pipe flanges.

2.3 ELECTRIC ACTUATORS

- .1 Operation: designed to provide precise quarter turn electric operation.
 - .1 Torque range: up to 1.130 N-m and speed ranges from 10 seconds to 30 seconds to move from fully open to fully closed.
 - .2 Gear train within actuator to provide smooth continuous rotary power stroke for accurate automatic valve positioning. Factory-set, field adjustable cam-actuated travel limit switches to provide precise control of shaft rotation.
- .2 Construction:
 - .1 Castings: heavy duty industrial grade for rugged use.
 - .2 Actuators: continuous duty with high efficiency single phase reversing capacitor motor with thermal overload protection.
 - .3 Gears and pinions constructed from hardened steel.
 - .4 Gear train to be permanently lubricated.
 - .5 Mechanical brake to ensure that gear is locked in precise position.
- .3 Electrical:
 - .1 Standard voltage: 120 VAC. 60 Hz.
 - .2 Control options: 4-20 Ma DC or 0-10 V DC.

- .3 CSA approved.
- .4 Electrical rating: NEMA IV.

3 Execution

3.1 PREPARATION

- .1 Valve and mating flange preparation.
 - .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
 - .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
 - .3 Install butterfly valves with disc in almost closed position.
 - .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 INSTALLATION OF VALVES

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.
- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

3.3 ACTUATOR INSTALLATION

- .1 Electrical connections to be made by actuator manufacturer.
- .2 Cycle valve operation from fully closed to fully open then back to fully closed.
- .3 At same time, check travel stop settings for proper disc alignment.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 hangers and supports for mechanical piping, ducting and equipment.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-04, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125-1996 (R2001), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-04a, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment and prevent vibration.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

- .6 Pipe supports shall meet the requirements of ASME B31.1 Power Piping and ASME B31.9 Building Services Piping.
- .7 Automatic sprinkler pipe supports shall meet the requirements of NFPA No. 13, Standard for Installation of Sprinkler Systems.
- .8 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- .9 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.
- .10 Fasten hangers and supports to building steel or structural wood in accordance with the requirements of Structural. Equipment, piping and ductwork shall be supported from the top chords of trusses/beams, supporting off bottom is not permitted, except where specifically noted.
- .11 Provide and set sleeves required for equipment, including openings required for placing equipment.
- .12 Obtain approval prior to drilling for inserts and supports for piping systems.
- .13 Obtain approval prior to using percussion type fastenings.
- .14 Use of other piping or equipment for hanger supports is not permitted.
- .15 Use of perforated band iron, wire or chain as hangers is not permitted.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ASME B31.1, ASME B31.9 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 Design hangers so they cannot become disengaged by movements of supported pipe.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: to be UL listed.

- .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies: Steel channels with welded spacers and hanger rods.
 - .2 Steel brackets: Welded and wrought steel clamp.
- .6 Hanger rods: threaded rod material to MSS SP58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Threaded both ends, one end or continuous.
- .7 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.
- .12 Wall Support:
 - .1 Up to 75 mm: Cast iron hook.
 - .2 100 mm and over: Welded steel bracket and wrought steel clamp.

- .13 Floor Support:
 - .1 Pipe sizes up to 100 mm and all cold pipe sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.
- .14 Insulation:
 - .1 Supports shall be coordinated with requirements of insulation. Oversized hangars are required for all pipe systems that require insulation with a vapour barrier to maintain integrity of vapour barrier.
 - .2 Oversized hangars shall also be required for steam pipe systems.
- .15 PEX pipe mains and branches running in service spaces (crawl space, ceiling plenum, etc.) shall be installed in a suitable channel to ensure pipes remain plumb. Channel shall be large enough to house pipe and insulation. Pipe shall be secured to channel.

2.3 WIRE ROPE PIPE AND DUCT HANGERS

- .1 Wire Rope Suspension Systems:
 - .1 Wire rope suspension systems shall be ULC, CSA and SMACNA approved and tested.
 - .2 Wire suspensions systems shall consist of a pre-formed wire rope sling with either a ferruled loop, permanently fixed threaded 1/4" (or 3/8") stud, or permanently fixed nipple end with toggle, at one end or hook or eyelet. The end fixings and the wire must be of the same manufacturer. The system is secured and tensioned with a hanger self-locking grip at the other end. System shall incorporate pipe hangars. Pipe hangars shall not penetrate vapour barrier of chilled water pipe insulation.
 - .3 Only wire and or supports supplied and or approved, shall be used with the system installed.
 - .4 The Contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum Safe Working Load Limit (which incorporates a 5:1 safety factor). The correct specification of wire hanger required is determined using the following formula:

$$\text{Weight per metre of object suspended (kg)} \times \text{Distance between suspension points (m)} = \text{Weight loading per hanger suspension point (kg)}$$

Table 1 Wire Hanger Safe Working Loads

Size	Working Load Limit (kg)	Working Load Limit (lbs)
No. 1	0 - 10 kg	0 - 22 lbs
No. 2	10.5 - 45.5 kg	23 - 100 lbs
No. 3	46 - 91 kg	101 - 200 lbs
No. 4	95.5 - 225 kg	210 - 495 lbs
No. 5	225.5 - 325 kg	496 - 715 lbs

- .5 Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations given in the manufacturer's handbook.
- .6 The Contractor shall select and use the correct length of wire rope required to support the service.
- .7 No in-line joins shall be permitted in the rope.
- .8 Solid trapeze hangars may be used to suspend piping routed together, where wire support can be coordinated with ceiling and still ensure pipes are routed at highest point possible (tight to beams).

2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: black carbon steel to MSS SP58, type 42, UL listed.

- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.6 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 50 00 - Metal Fabrications.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.10 HOUSEKEEPING PADS

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-place Concrete.

2.11 SLEEVES

- .1 Pipes through floors: Form with 18 gauge galvanized steel.
- .2 Pipes through beams, walls, fire proofing, footings, potentially wet floor: Form with steel pipe or 18 gauge galvanized steel.
- .3 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

2.12 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 50 00 - Metal Fabrications.
- .2 Submit structural calculations with shop drawings.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, at all vibration isolated equipment and as indicated.

- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25% of total load.
- .8 Installation of Exposed Pipe and Duct Hangers:
 - .1 Exposed pipe and duct shall be any pipe/duct visible to the occupants. This does not include piping and ductwork routing above dropped ceilings.
 - .2 Exposed Pipe and Duct hangers shall be a Wire Rope Suspension System.

3.3 INSERTS

- .1 Use inserts for suspending hangers for reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- .2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100 mm.
- .3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- .4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

3.4 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code, Provincial Code, authority having jurisdiction.
- .2 Fire protection: to applicable Fire Code.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

- .5 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper	Rod Diameter
up to 32 mm	1.8 m	1.8 m	9.5 mm
38 mm	1.8 m	1.8 m	9.5 mm
50 mm and 63 mm	3.0 m	3.0 m	9.5 mm
75 mm - 100 mm	3.6 m	3.0 m	15.8 mm
150 mm - 200 mm	4.3 m	4.3 m	22.2 mm

- .6 Install hangers to provide a minimum 12 mm clear space between finished covering and adjacent work.

3.5 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Use hangers which are vertically adjustable 38 mm minimum after piping is erected.
- .5 Support horizontal soil pipe near each hub, with 1.5 m maximum spacing between hangers.
- .6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Where practical, support riser piping independently of connected horizontal piping.
- .9 Hangers: Pipe sizes 12 mm to 38 mm: Adjustable wrought steel ring.
- .10 Hangers: Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes: Adjustable wrought steel clevis.

3.6 SLEEVES

- .1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
- .2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.

- .3 Where piping passes through floor, ceiling or wall close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.
- .4 Install chrome plated escutcheons where piping passes through finished surfaces.
- .5 All penetrations through fire rated walls, floors or partition assemblies shall be sealed/fire stopped with fire stop materials that will remain in place and prevent the passage of smoke, toxic gases, flame, etc., when subjected to the standard test method Can 4-S115, "Standard Method of Fire Tests for Firestop Systems" for a period of time equal to fire protection rating required for the grade of fire separation of the penetrated wall or floor.
- .6 Acceptable Product: According to instructions provided, all penetrations in fire rated walls, floors, or partition assemblies shall be sealed/fire stopped with:
 - .1 3M Brand Intumescent, "Fire Barrier" Caulk CP-25, Putty 303, Penetration Sealing Systems 7902 or 7904 Series, Composite Sheet CS-195, or Wrap Strip FS-195.
 - .2 Tremco Firestop Systems: Fyresil, Fyreshield for penetrations and perimeters. Dymeric ULC, THC 900 ULC

3.7 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.8 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Vibration isolation.

1.2 PERFORMANCE REQUIREMENTS

- .1 Provide vibration isolation on all mechanical motor driven equipment plus connected piping and ductwork.
- .2 Supply vibration isolation equipment and materials by one supplier. Consider side loading of equipment and inertia bases when calculating maximum loads on isolators.
- .3 Ensure equipment is sufficiently rigid for isolator point loading.
- .4 Provide and install mechanical equipment so that Average Noise Criteria Curves, as outlined in ASHRAE Guide, are not exceeded.
- .5 Consider upper floor locations critical unless otherwise indicated.
- .6 Use concrete inertia bases where indicated and for fans having static pressure in excess of 0.85 kPa or motors in excess of 30 kW, and on base mounted pumps over 7.5 kW.

1.3 SUBMITTALS

- .1 Section 01 33 00: Procedures for submittals.
- .2 Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.
- .3 Product Data: Provide schedule of vibration isolator type with location and load on each.
- .4 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
- .5 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.4 PROJECT RECORD DOCUMENTS

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Record actual locations of isolation including attachment points.

2 Products

2.1 VIBRATION ISOLATORS

- .1 Open Spring Isolators:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

- .2 Code: Colour code springs for load carrying capacity.
 - .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - .3 Spring Mounts: Provide with levelling devices, minimum 6 mm thick neoprene sound pads, and zinc chromate plated hardware.
 - .4 Sound Pads: Size for minimum deflection of 1.2 mm; meet requirements for neoprene pad isolators.
- .2 Restrained Spring Isolators:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - .2 Code: Colour code springs for load carrying capacity.
 - .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - .3 Spring Mounts: Provide with levelling devices, minimum 6 mm thick neoprene sound pads, and zinc chromate plated hardware.
 - .4 Sound Pads: Size for minimum deflection of 1.2 mm; meet requirements for neoprene pad isolators.
 - .5 Restraint: Provide heavy mounting frame and limit stops.
- .3 Closed Spring Isolators:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - .2 Code: Colour code springs for load carrying capacity.
 - .2 Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - .3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - .4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm clearance.
- .4 Restrained Closed Spring Isolators:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - .2 Code: Colour code springs for load carrying capacity.
 - .2 Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - .3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - .4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm clearance and limit stops.
- .5 Spring Hanger:
 - .1 Spring Isolators:
 - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - .2 Code: Colour code springs for load carrying capacity.
 - .2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

- .3 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
- .4 Misalignment: Capable of 20 degree hanger rod misalignment.
- .6 Neoprene Pad Isolators:
 - .1 Rubber or neoprene waffle pads.
 - .1 30 durometer.
 - .2 Minimum 13 mm thick.
 - .3 Maximum loading 275 kPa.
 - .4 Height of ribs: maximum 0.7 times width.
 - .2 Configuration: Single layer.
- .7 Rubber Mount or Hanger: Moulded rubber designed for 13 mm deflection with threaded insert.
- .8 Glass Fibre Pads: Neoprene jacketed pre-compressed moulded glass fibre.

3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Install isolation for mechanical motor driven equipment throughout, unless specifically noted otherwise
- .3 Install spring hangers without binding.
- .4 On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- .5 Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- .6 Provide pairs of horizontal limit springs on fans with more than 1.5 kPa static pressure, and on hanger supported, horizontally mounted axial fans.
- .7 Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 1.5 mm maximum clearance. Provide other snubbers with clearance between 4 mm and 7 mm.
- .8 Support piping connections to isolated equipment resiliently for scheduled distance.
 - .1 Up to 100 mm Diameter: First three points of support.
 - .2 125 to 200 mm Diameter: First four points of support.
 - .3 250 mm Diameter and Over: First six points of support.
 - .4 Static deflection of first point shall be twice deflection of equipment. The next two hangers closest to vibration source shall have the greater deflection of 25 mm static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 25 mm static deflection or 1/2 static deflection of isolated equipment.
- .9 Connect wiring to isolated equipment with flexible hanging loop.

3.2 MANUFACTURER'S FIELD SERVICES

- .1 Examine systems to Section 01 45 00.
- .2 Inspect isolated equipment after installation and submit report. Include static deflections.

3.3 EQUIPMENT ISOLATION SCHEDULE

	ISOLATED EQUIPMENT	BASE Thickness	ISOLATOR Type	Deflection
.1	Outdoor Condensing Units	On concrete pad	Rubber	
.2	Fans	Suspended	Spring	2"

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems

1.2 REFERENCES

- .1 ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- .1 Section 01 33 00: Procedures for submittals.
- .2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
- .3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- .4 Product Data: Provide manufacturers catalogue literature for each product required.

1.4 PROJECT RECORD DOCUMENTS

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Record actual locations of tagged valves.

2 Products

2.1 LANGUAGE

- .1 Identification in English.

2.2 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification of Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.
- .2 Identification of Sprinkler System: to NFPA 13

2.3 NAMEPLATES

- .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .2 Colours:
 - .1 Hazardous: red letters, white background
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable Codes)

- .3 Sizes: Conform to following table using a maximum of 25 characters per line.
- | Size # mm | Sizes (mm) | No. of Lines | Height of Letters (mm) |
|-----------|------------|--------------|------------------------|
| 1 | 10 x 50 | 1 | 3 |
| 2 | 13 x 75 | 1 | 5 |
| 3 | 13 x 75 | 2 | 3 |
| 4 | 20 x 100 | 1 | 8 |
| 5 | 20 x 100 | 2 | 5 |
| 6 | 20 x 200 | 1 | 8 |
| 7 | 25 x 125 | 1 | 12 |
| 8 | 25 x 125 | 2 | 8 |
| 9 | 35 x 200 | 1 | 20 |

Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour.

2.4 TAGS

- .1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 40 mm diameter.
- .2 Control Tag: Laminated plastic card with black letters on light contrasting background colour in multiple lines. Tag size minimum 85mm x 55mm. Inscriptions to include function and (where appropriate) fail-safe position
- .3 Metal Tags: Brass with stamped letters; tag size minimum 40 mm diameter with smooth edges.
- .4 Chart: Typewritten letter size list in anodized aluminum frame.

2.5 STENCILS

- .1 Stencils: With clean cut symbols and letters of following size:
 - .1 20-30 mm Outside Diameter of Insulation or Pipe: 200 mm long colour field, 15 mm high letters.
 - .2 40-50 mm Outside Diameter of Insulation or Pipe: 200 mm long colour field, 20 mm high letters.
 - .3 65-150 mm Outside Diameter of Insulation or Pipe: 300 mm long colour field, 30 mm high letters.
 - .4 200-250 mm Outside Diameter of Insulation or Pipe: 600 mm long colour field, 65 mm high letters.
 - .5 Over 250 mm Outside Diameter of Insulation or Pipe: 800 mm long colour field, 90 mm high letters.
 - .6 Ductwork and Equipment: 65 mm high letters.
- .2 Stencil Paint: As specified in Section 09 91 23.

2.6 PIPE MARKERS

- .1 Colour: Conform to ASME A13.1.
- .2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

- .3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- .4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 150 mm wide by 0.10 mm thick, manufactured for direct burial service.

2.7 CEILING TACKS

- .1 Description: Steel with 20 mm diameter colour coded head.
- .2 Colour code as follows:
 - .1 Yellow - HVAC equipment
 - .2 Red - Fire dampers/smoke dampers
 - .3 Green - Plumbing valves
 - .4 Blue - Heating/cooling valves

2.8 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms: where required to Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend: Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible
- .5 Extent of background colour marking.
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Extent of background colour marking.
- .7 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C
- .8 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.

- .2 Colours for legends, arrows: to following table:
- | | | |
|------------------------------------|-------|--|
| Background colour: Legend, arrows: | | |
| Yellow | BLACK | |
| Green | WHITE | |
| Red | WHITE | |
- .3 Background colour marking and legends for piping systems:
- | | | |
|---------------------------------|---------------------------|----------------|
| Contents | Background colour marking | Legend |
| City water | Green | CITY WATER |
| Domestic hot hard water | Green | DOM. HHW |
| Dom. Hot water recirculation | Green | DOM. HW CIRC |
| Domestic cold hard water supply | Green | DOM. CHW |
| Sanitary | Green | SAN |
| Plumbing vent | Green | SAN. VENT |
| Fire protection water | Red | FIRE PROT. WTR |
| Sprinklers | Red | SPRINKLERS |

2.9 IDENTIFICATION OF DUCTING SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast

2.10 VALVES AND CONTROLLERS

- .1 Valves to be complete with brass tags with 12 mm stamped identification data filled with black paint coordinated with Valve Tag List.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
- .3 Controllers to be complete with controls laminated identification tag.
- .4 Identify all control systems components including but not limited to equipment, components, controls, sensors with control tags specified in this section.

2.11 FIRE DAMPERS

- .1 All new fire dampers shall be tagged with unique tag (FD-1, FD-2 etc.), 12 mm stamped identification data filled with black paint. Contractor shall compile a Fire Damper Tag List and include in O&M. List to identify fire damper tag and location in building.

2.12 EQUIPMENT WITHIN CEILING SPACE

- .1 Provide identification (equipment labels and colour coded dots) on the ceiling for all equipment concealed within a ceiling space in addition to identification on equipment.
- .2 Equipment Labels:
- .1 Colours: Black lettering on transparent background.
 - .2 Height of letter: 5 mm.

- .3 T-bar ceilings: Label shall be located on the metal ceiling grid beside the ceiling tile that provides service access to the equipment. The label shall include the equipment tag and an arrow indicating the ceiling tile to remove for servicing and access to the equipment.
- .4 Solid ceilings: Label shall be located on the trim of the access panel used for servicing the equipment and include the equipment tag.
- .3 Colour Coded Dots:
 - .1 Confirm site standard colour coding with the Departmental Representative prior to commencing work. Coordinate with all trades.
 - .2 Provide a Legend in the operating and maintenance manual identifying the colour coding utilized on site.
 - .3 T-bar ceilings: Dot shall be located on the metal ceiling grid beside the ceiling tile that provides service access to the equipment.
 - .4 Solid ceilings: Dot shall be located on the trim of the access panel used for servicing the equipment.

3 Execution

3.1 PREPARATION

- .1 Degrease and clean surfaces to receive adhesive for identification materials.
- .2 Prepare surfaces to Section 09 91 23 for stencil painting.

3.2 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- .3 Install tags with corrosion resistant chain.
- .4 Apply stencil painting to Section 09 91 23.
- .5 Install plastic pipe markers to manufacturer's written instructions.
- .6 Install plastic tape pipe markers complete around pipe to manufacturer's written instructions.
- .7 Install underground plastic pipe markers 150 to 200 mm below finished grade, directly above buried pipe.
- .8 Identify equipment including air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as small in-line pumps, may be identified with tags.
- .9 Identify control panels and major control components outside panels with control tags.
- .10 Identify thermostats relating to equipment with nameplates.

- .11 Identify valves in main and branch piping with tags.
- .12 Identify air terminal units with numbered tags.
- .13 Tag automatic controls, instruments, and relays. Key to control schematic.
- .14 Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Location of identification not to exceed 6 m on straight runs including risers and drops, adjacent to each valve and Tee, adjacent to each change in direction, at each side of penetration of structure or enclosure, and at each obstruction. Provide additional identification at point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side
- .15 Identify ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- .16 Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- .17 Identify electric starting switches and remote push button stations with nametags.
- .18 Provide identification on the ceiling for all equipment concealed within a ceiling space in addition to identification on the equipment.
- .19 Tag fire dampers sequentially and record on Fire Damper Tag List. Provide copy of list in O&M Manual.

3.3 VALVE, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Owner. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Testing, adjustment and balance of air systems.
- .2 Testing, adjustment and balance of water systems.

1.2 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.3 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Consultant within 90 days of award of contract.
- .2 Personnel performing TAB shall be qualified to standards of AABC and/or NEBB
- .3 Provide documentation confirming qualifications, successful experience.
- .4 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .5 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .6 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .7 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .8 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .9 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.7 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started confirm in writing to Consultant adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Consultant in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.9 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.10 START OF TAB

- .1 Notify Consultant 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.

- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.11 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5 %, minus 5 %.

1.12 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2 % of actual values.

1.13 INSTRUMENTS

- .1 Use accurate instruments for measurements. Prior to TAB, submit to Consultant list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Consultant.
- .4 Provide calibration histories for each instrument. Re-calibration or use of other instruments may be requested when accuracy of readings is questionable.

1.14 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Submit proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Consultant, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.16 TAB REPORT

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 4 copies of TAB Report to Consultant for verification and approval, in English in D-ring binders, complete with index tabs.

1.17 VERIFICATION

- .1 Reported results subject to verification by Consultant.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results as directed by Consultant.
- .4 Pay costs to repeat TAB as required to satisfaction of Consultant.

1.18 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.19 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Consultant.

1.20 AIR SYSTEMS

- .1 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .2 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .3 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.21 OTHER TAB REQUIREMENTS

- .1 Measurement of noise from equipment specified in Division 23.
 - .1 As specified elsewhere or as required to prove Noise Performance when operating performance is questioned.

1.22 CLOSEOUT SUBMITTALS

- .1 Section 01 33 00: Submission procedures.
- .2 Provide copies of complete final TAB report for Operation and Maintenance manual

1.23 BALANCE REPORTS

- .1 Balance reports to include the following at minimum (data shall always include design and actual measured data):
 - .1 Title Page: Company Name, Address, and Telephone Number; Project Name, Location, Architect, Engineer, and Project Contractor.
 - .2 Include types, serial number and dates of calibration of instruments used.
 - .3 Air Handling Units (including HRV): Location, Local Identification, Manufacturer, Model, Size, Arrangement, discharge and class, Supply Air Flow, Return/Exhaust Air Flow, Outside Air Flow, Static Pressures, Fan RPM, inlet and outlet dry bulb and wet bulb temperatures.
 - .4 Duct air quantities: Mains, Branches, Outside Air and Exhausts (Maximum and Minimum), Duct sizes; Number of pressure readings; Sum of velocity measurements; Average velocity; duct air flow rate.
 - .5 Exhaust Fan Data: Location, Manufacturer, Model, Specified and Actual Air Flow, Static Pressure, and Fan RPM.
 - .6 Electric Motors: Manufacturer, HP/BHP, Phase, Voltage, Amperage (maximum operating and full load), RPM, Service Factor, Starter Heater Elements.
 - .7 V-Belt Drive: Identification/Location, Driven Sheave Diameter and RPM belt Size and Quantity, Motor Sheave Diameter and RPM.
 - .9 Air Inlets and Outlets: Outlet identification location and Designation; Manufacturer's catalogue identification and type; Application factors; air velocities; air flow rates; Deflector vane or diffuser cone settings.
 - .10 Pump Data: Location, Identification/Number, Manufacturer, Size/Model, Drive type, Motor type, Flow Rate, Head, BHP, Discharge and Suction Pressure (full flow and no flow).
 - .11 Coil Data: Location, Identification/Number, Service, Manufacturer, Element type, Air Flow Rate, Entering Air and Leaving Air Temperatures (dry bulb and wet bulb), Electrical Current at coil, energy transfer at load..
 - .12 Terminal Heating/Cooling Equipment with fans (unit heaters, force flows, unit ventilators, fan coils etc.): Location, Identification/Number, Manufacturer, Model, Heat transfer rate, Electrical heating load and air flow.

2 Products

2.1 NOT USED

3 Execution

3.1 PREPARATION

- .1 Before adjusting and balancing, verify that systems are complete and operable. Ensure temperature control systems are complete and operable, thermal overload protection is in place, final filters installed, hydronic systems, flushed, filled, and vented.

- .2 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.
- .3 Recorded data shall represent actually measured, or observed condition.

3.2 GENERAL PROCEDURES

- .1 Balance to maximum measured flow, allowable deviation as specified.
- .2 Permanently mark settings on valves, splitters, dampers, and other adjustment devices.
- .3 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.
- .4 At final inspection, re-check random selections of data recorded in report. Re-check points of areas as selected and witnessed by the Owner.
- .5 Check and adjust systems approximately six (6) months after final acceptance and submit report.
- .6 The Balancing Contractor shall include the cost of sheave changes necessary to achieve specified air flow within limits specified.

3.3 AIR SYSTEM PROCEDURES

- .1 Adjust air handling and distribution systems to provide required or design supply, return and exhaust air quantities. Permanently mark settings of damper and other adjustment devices allowing settings to be restored.
- .2 Make air quantity measurements in ducts by Pitot tube traverse of entire cross-sectional area of duct.
- .3 Measure air quantities at each air inlet and outlet. Use volume control devices to regulate air quantities.
- .4 Vary total system air quantities by adjustment of fan speeds. Where Variable Frequency Drives (VFDs) are installed, utilize VFDs to adjust fan speed. Provide drive changes where required.
- .5 Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating.
- .6 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- .7 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

3.4 WATER SYSTEM PROCEDURE

- .1 Adjust water systems to provide required or design quantities. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops.

- .2 Use calibrated venturi tubes, orifices, or other metered fittings and pressure gauges in conjunction with permanent and portable type flow meters to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- .3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- .4 Effect adjustment of water distribution systems by means of balancing cocks, valves and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- .5 Where pump capacity available is less than total flow requirements or individual system parts, full flow in any part may be simulated by temporary restriction of flow to other parts.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Test Reports: submit test reports indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format to Departmental Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
 - .2 Prepare report of results and submit to Departmental Representative within 7 days of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordination with other building subtrades.

- .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.
- .3 Submit details of test instruments to be used to Departmental Representative at least one month before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.
- .5 Re-calibrated every six months thereafter.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PREPARATION

- .1 Do not conceal or cover ductwork or equipment until inspected by consultant and tested.
- .2 Provide equipment, materials and labour for tests and pay expenses. Use test instruments by approved laboratory or manufacturer and furnish certificate showing degree of accuracy.
- .3 Test instruments shall have been calibrated within one year.
- .4 Install permanent gauges and thermometers just prior to tests to avoid changes in calibration.
- .5 Before adjusting and balancing, verify that systems are complete and operable. Ensure temperature control systems are complete and operable, thermal overload protection is in place, final filters installed, hydronic systems, flushed, filled, and vented.

- .6 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.
- .7 Recorded data shall represent actually measured, or observed condition. And shall be included in O&M Manual

3.3 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins, fire dampers.
- .3 Repeat tests until specified leakage at test pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.4 SITE TOLERANCES

- .1 Allowable system leakage tolerances are to follow SMACNA Leakage standards as specified under ductwork.
- .2 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.5 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals and gaskets.
- .4 Low Pressure Ducts: Test for tightness such that leakage is inaudible and not detectable by feel. Check for audible leaks at 250 Pa above duct design operating pressure.
- .5 Medium and High Pressure Ductwork: Check for audible leaks. Test for tightness as specified by the SMACNA Manuals at a duct leakage classification of 3 with a static pressure equal to 2 times the external static pressure of the associated air system.

3.6 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Departmental Representative to witness tests and to verify reported results.
 - .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C921-(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.4 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.5 QUALITY ASSURANCE

- .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
- .2 Materials: UL listed; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.
- .3 Do work to TIAC standards.
- .4 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.
- .5 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 deg.C mean temperature when tested in accordance with ASTM C335. Maximum "K" factor to be 0.035 W/m. deg.K (0.24 BTU in/hr/sq.ft. Deg.K) to ASTM C553.
- .3 TIAC Class C-1: Rigid mineral fibre board to ASTM C612, unfaced or faced with vapour retarder jacket; ksi value of 0.035 at 24 degrees C.
- .4 TIAC Code C-2: mineral fibre blanket to ASTM C553 with or without factory applied vapour retarder jacket; ksi value of 0.035 at 24 degrees C

- .5 Flexible Duct Liner: Flexible non-combustible mineral fiber blanket to ASTM C 1071 Type 1; ksi value of 0.035 at 24 degrees C, 24 kg/cu m minimum density; coated air side for maximum 20.3 m/s air velocity. Minimum NRC value of 0.65 at 25mm to ASTM 423.
- .6 Rigid Duct Liner: semi-rigid non-combustible mineral fiber to ASTM C 1071 Type 2; ksi value of 0.035 at 24 degrees C, 48 kg/cu m minimum density; coated air side for maximum 20.3 m/s air velocity. Minimum NRC value of 0.7 at 25mm to ASTM 423.

2.3 JACKETS

- .1 Interior Applications:
 - .1 Vapour Barrier Jackets: to CGSB 51-GP-52Ma.
 - .2 PVC Jackets: One piece, high-gloss pre-moulded type, 0.8 mm (30mls) thick. Jackets exposed to outdoor use or fluorescent lighting shall be ultra-violet ray resistant.
 - .3 Canvas Jackets: ULC listed treated cotton fabric, 220 g/sq.m. to ASTM C 921
 - .4 Aluminum Jackets: 0.51 mm thick; stucco embossed.
- .2 Exterior Applications:
 - .1 Aluminum Jackets: 0.51 mm thick; stucco embossed.
 - .2 Stainless Steel Jackets: Type 304 stainless steel; 0.25 mm thick, stucco embossed
 - .3 Outdoor Jacket: Coated glass fibre sheet, 16 kg/sq m.

2.4 ACCESSORIES

- .1 Bands: 20 mm wide; 0.38 mm thick stainless steel.
- .2 Insulating Cement: Hydraulic setting on mineral wool.
- .3 Fibrous Glass Cloth: Untreated; 305 g/sq m weight.
- .4 Adhesives: Compatible with insulation, waterproof, fire-retardant type.
- .5 Impale Anchors: Galvanized steel, 2 mm diameter with 35mm diameter head, length as required for insulation.
- .6 Joint Tape: self adhesive reinforced aluminum, minimum 50mm wide
- .7 Tie Wire: stainless steel, 1.5 mm.
- .8 Outdoor vapour retarder mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation
 - .2 Fibrous glass cloth

3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.

- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.
- .6 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .7 Locate insulation or cover seams in least visible location.
- .8 Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.
- .9 External Duct Insulation:
 - .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
 - .2 Secure insulation without vapour barrier with staples, tape, or wires.
 - .3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners to prevent sagging. Seal vapour barrier penetrations with vapour barrier adhesive. Stop and point insulation around access doors and damper operators.
- .10 Exposed Rectangular: Secure rigid insulation with 50% coverage of adhesive and 12 gauge galvanized impale anchor tabs on 400 mm (16") centres. Seal joints and breaks with 250 mm (10") wide strips of open mesh glass cloth or tape imbedded between 2 coats of vapour barrier sealant. Point up other joints and breaks with hydraulic setting cement.
- .11 Round Duct and Concealed Rectangular Duct: Adhere flexible insulation to ductwork with adhesive applied in 150 mm (6") wide strips on 400 mm (16") centres. Provide 16 gauge annealed tie wire tied, spiral wound or half hitched at 200 mm (8") centres for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks with 50 mm (2") lap of foil adhered over joint.
- .12 Acoustic lining: Apply to interior of ducts where shown.
 - .1 Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners on 375 mm centres maximum on top and side of duct work with dimension exceeding 500 mm. Seal and smooth joints. Seal vapour barrier penetrations with vapour barrier adhesive. Cut off excess fastener length and cover with brush coat of mastic.
 - .2 Use 25 mm (1") thick insulation unless otherwise noted.

- .3 Provide vapour barrier located on the warm side for outside air intakes.
- .4 Ducts with acoustic insulation do not require external thermal insulation
- .5 Ductwork dimensions indicated on drawings include insulation thickness.

3.3 INSTALLATION – JACKETS

- .1 Install in accordance with TIAC standards and manufacturers written requirements.
- .2 Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.

3.4 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: conform to following table:

System	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Supply, return and exhaust ducts exposed in space being served	none, unless indicated otherwise on drawings		
Mixing plenums	C-1	yes	50
Exhaust duct between fan and louvre/discharge	C-1	Yes	50
Ducts outside building	C-1	Yes	special as required to achieve RSI 4.76 (R-20) to match walls in accordance with NECB requirements.
Acoustically lining	none		25
Domestic Kitchen Range Hood Exhaust	C-1	yes	50

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

- .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

- .1 Finishes: conform to following TIAC codes noted in table:

	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Thermal insulation for piping and piping accessories.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.4 QUALITY ASSURANCE

- .1 Applicator: Company specializing in mechanical insulation application with three years minimum experience.
- .2 Materials: UL listed; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.
- .3 Do work to TIAC standards.
- .4 Deliver material to job site in original non-broken factory packaging, labelled with manufacturer's density and thickness.
- .5 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre and rock wool.
 - .1 TIAC Code A-1; rigid pre-moulded mineral fibre to ASTM C 547 with or without factory applied vapour retarder jacket; ksi value of 0.035 at 24 degrees.

- .2 TIAC Code A-2: rigid moulded calcium silicate to ASTM C533 in sections and blocks, and with special shapes to suit project requirements, asbestos free; ksi value of 0.060 at 147 deg.C.
- .3 TIAC Code A-3: rigid pre-moulded mineral fibre to ASTM C 547 with or without factory applied vapour retarder jacket for high temperature applications; ksi value of 0.072 at 260 degrees C
- .4 TIAC Code A-6: flexible unicellular tubular elastomer to ASTM C534; ksi value of 0.04 at 24 degrees C
- .5 TIAC Class C-1: Rigid mineral fibre board to ASTM C612, unfaced or faced with CGSB 51-GP-52Ma vapour retarder jacket; ksi value of 0.035 at 24 deg.C.
- .6 TIAC Code C-2: mineral fibre blanket to ASTM C553 with or without factory applied vapour retarder jacket. Thermal conductivity; ksi value of 0.04 at 24 deg.C

2.3 ACCESSORIES

- .1 Bands: 20 mm wide; 0.38 mm thick stainless steel.
- .2 Insulating Cement: Hydraulic setting on mineral wool.
- .3 Fibrous Glass Cloth: Untreated; 305 g/sq m weight.
- .4 Adhesives: Compatible with insulation, waterproof, fire-retardant type.
- .5 Impale Anchors: Galvanized steel, 2 mm diameter with 35mm diameter head, length as required for insulation.
- .6 Joint Tape: self adhesive reinforced aluminum, minimum 50mm wide
- .7 Tie Wire: stainless steel, 1.5 mm.
- .8 Outdoor vapour retarder mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation
 - .2 Fibrous glass cloth

2.4 JACKETS

- .1 Interior Applications:
 - .1 Vapour Barrier Jackets: to CGSB 51-GP-52Ma.
 - .2 PVC Jackets: One piece, high-gloss pre-moulded type, 0.8 mm (30mls) thick. Jackets exposed to outdoor use or fluorescent lighting shall be ultra-violet ray resistant.
 - .3 Canvas Jackets: ULC listed treated cotton fabric, 220 g/sq.m. to ASTM C 921
 - .4 Aluminum Jackets: 0.51 mm thick; stucco embossed.
- .2 Exterior Applications:
 - .1 Aluminum Jackets: 0.51 mm thick; stucco embossed.
 - .2 Stainless Steel Jackets: Type 304 stainless steel; 0.25 mm thick, stucco embossed
 - .3 Outdoor Jacket: Coated glass fibre sheet, 16 kg/sq m.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION ON PIPING

- .1 Install materials in accordance with manufacturer's instructions and TIAC National standards.
- .2 Continue insulation with vapour barrier through penetrations. pack around pipes with fire proof self-supporting insulation material, properly sealed.
- .3 In exposed piping, locate insulation and cover seams in least visible locations.
- .4 Provide insulation with vapour barrier when medium conveyed may be below ambient temperature and as noted on schedules.
- .5 Insulate fittings and valves on pipe systems.
- .6 On insulated piping with vapour barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints. Cover with open mesh glass cloth sealed with vapour barrier sealant.
- .7 On insulated piping without vapour barrier and piping conveying fluids 60 degrees C or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
- .8 Provide an insert of cork or other heavy density material not less than 150 mm long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 50 mm diameter or larger.
- .9 Neatly finish insulation at supports, protrusions, and interruptions.
- .10 Handicap Plumbing Fixtures: Insulate trap and drain with 25 mm (1") fibreglass insulation complete with high gloss white PVC jacket. Refer to Plumbing specifications.

3.4 INSTALLATION - JACKETS

- .1 Install in accordance with TIAC standards and manufacturers written requirements.

- .2 Indoor, Concealed Pipes: Apply pipe insulation with an integral all-service jacket complete with vapour barrier if specified. Secure jacketing using appropriate fastenings on approximately 100mm centres. Cover longitudinal and circumferential joints with jacket finishing tape neatly applied. Alternately secure jacketing using integral self-sealing lap and self-sealing circumferential joint strips. Fittings, (valves and strainers if specified) not finished with PVC covers shall be covered with a hard coat cement and finish with treated fitting fabric applied with fabric adhesive. Finish jackets as scheduled.
- .3 Indoor, Exposed Applications: Insulate as for concealed applications. Finish jacket to be as indicated in schedule. Where indicated by Architect to be painted, finish insulation with canvas jacket; size for finish painting.
- .4 Exterior Applications: Vapour barrier jacket, covered with aluminum jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Lap joints 75 mm (3") minimum and seal with compatible waterproof lap cement.
- .5 Provide recovering jackets on exposed insulation throughout, including equipment room. Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed. Use pre-sized paper under recovering at uneven insulated surfaces.
- .6 Metal Jackets: Over the pipe insulation apply metal jacketing using necessary fastenings on approximately 150mm centres. Over insulated fittings, (valve bodies, valve bonnets, strainers and flanges etc. as specified) apply metal jacket or preformed metal fitting covers to provide a complete jacket system. Secure with necessary fastenings.
- .7 PVC Jackets: Over the pipe insulation apply PVC jacketing using necessary fastenings on approximately 100mm centres. Cover longitudinal and circumferential joints with finishing tape neatly applied. Over insulated fittings, valve bodies, valve bonnets, strainers and flanges if specified) apply PVC jacket or preformed PVC fitting covers to provide a complete jacket system. Secure with appropriate fastenings and jacket finishing tape.

3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges, fittings and all associated equipment unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .2 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: to TIAC standards.

- .5 TIAC Code: C-2 vapour retarder jacket.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: A-2.
 - .1 Seals: lap seal adhesive, lagging adhesive.
 - .2 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.
 - .3 Chilled water insulation thicknesses are listed such that a minimum of 25mm is maintained over all fittings, valves and accessories.
 - .4 Note that in accordance with the National Energy Code of Canada for Buildings HVAC piping located outside the building envelope shall be insulated to the thickness specified for steam over 175 Deg.C. This requirement does not alter the TIAC Code defining the type of insulation to be used.

Application (mm)	Temp deg.C.	TIAC code		Pipe sizes (NPS) & insulation thickness				
		Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over	
Hot Water	60 - 94	A-1	25	38	38	38	38	38
Hot Water	up to 59	A-1	25	25	25	25	38	38
Cold Water		A-3	25	25	25	25	25	25
Refrigerant	4 - 13	A-6	25	25	25	25	25	25
Refrigerant	below 4	A-6	25	25	38	38	38	38
Cooling Coil cond. drain and pan		C-2	25	25	25	25	25	25

- .8 Finishes:
 - .1 Exposed indoors: canvas or PVC
 - .2 Exposed in mechanical rooms: PVC jacket.
 - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .4 Use vapour retarder jacket on TIAC code A-3, A-6 and C-2 insulation compatible with insulation.
 - .5 Outdoors: water-proof aluminum jacket.
 - .6 Finish attachments: SS screws, at 150 mm on centre. Seals: wing.
 - .7 Installation: to appropriate TIAC code CRF/1 through CPF

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 PREPARATION

- .1 Do not conceal or cover piping, fixtures or equipment until inspected by consultant and tested.
- .2 Provide equipment, materials and labour for tests and pay expenses. Use test instruments by approved laboratory or manufacturer and furnish certificate showing degree of accuracy.
- .3 Test instruments shall have been calibrated within one year
- .4 Install permanent gauges and thermometers just prior to tests to avoid changes in calibration.
- .5 Carry out hydraulic tests for 8 hours and maintain pressure. Where leakage occurs, repair and re-test.
- .6 Before adjusting and balancing, verify that systems are complete and operable. Ensure temperature control systems are complete and operable, thermal overload protection is in place, final filters installed, hydronic systems, flushed, filled, and vented.
- .7 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.
- .8 Recorded data shall represent actually measured, or observed condition.

3.2 PRESSURE TESTS

- .1 Domestic Water Piping: Test to 1-1/2 times maximum working pressure or 1034 kPa (150 psi) water pressure measured at system low point.

- .2 Drainage Systems: Test by filling with water to produce water pressure of 30 kPa (10') minimum and 75 kPa (25') maximum. Check for proper grade and obstruction by ball test.
- .3 Control Air Piping: Test to 345 kPa air pressure. Maintain pressure 1 hour with maximum 7 kPa pressure drop.
- .4 Check system during application of test pressure including visual check for leakage of water test medium, soap bubble test for air or nitrogen test medium and halide torch for refrigerant medium.
- .5 During piping system tests, check linear expansion at elbows, U bends, expansion joints, and offsets for proper clearance.
- .6 When using water as test medium for system not using water or steam, evacuate and dehydrate the piping and certify the lines are dry. Use agency specializing in this type of work.
- .7 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by remaking joints in screwed fittings, cutting out and rewelding welded joints, remaking joints in copper lines. Do not caulk.

3.3 PERFORMANCE TESTS

- .1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required as tests may indicate prior to operating tests.
- .2 Lubricate bearings, adjust and/or replace and set direct and "V" belt drives for proper alignment and tension.
- .3 Calibrate and adjust thermostats, thermometers, gauges, linkage and dampers. Control valves shall operate freely.
- .4 Operate and test motors and speed switches for correct wiring and sequences. Check overload heaters in motor starters.
- .5 Replace disposable filters with new testing filters and remove, clean and reinstall washable filters prior to conducting testing.
- .6 Clean fan wheel and coils prior to conducting tests.
- .7 Remove, clean, and reinstall strainers prior to conducting tests.
- .8 Fasten loose and rattling pieces of equipment. Unit heaters, pumps and other equipment shall operate quietly.
- .9 Make operating tests for minimum of 5 days during heating season and cooling season of first year of operation and at times when directed, for proper setting of controls under peak load conditions.

- .10 Provide services of mechanics and manufacturer's representatives, ladders, tools and associated equipment required to assist the Owner in final tests.
- .11 Conduct final operating tests in presence of the Owner. Vary loads to illustrate start-up and shut-down sequence and simulate emergency Conditions for safety shut-downs, with automatic and manual reset. Repair and test defects until satisfactory. Make final adjustments to suit exact building conditions.
- .12 Provide manufacturer's start-ups and reports as specified under specific equipment. Provide copies reports in the Operation and Maintenance Manuals.
- .13 Subject gas fired appliances rated in excess of 117 kW to an operational test established by the authority having jurisdiction and to pass this test before being approved for operation.

3.4 POTABLE WATER SYSTEMS

- .1 When cleaning is completed and system filled:
 - .1 Verify performance of equipment and systems as specified elsewhere in Division 22, 23 or 25.
 - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
 - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

3.5 SANITARY AND STORM DRAINAGE SYSTEMS

- .1 Ensure that traps are fully and permanently primed.
- .2 Ensure that fixtures are properly anchored, connected to system.
- .3 Operate flush valves and operate each fixture to verify drainage and no leakage.
- .4 Cleanouts: refer to Section 22 42 03 - Commercial Washroom Fixtures.
- .5 Roof drains:
 - .1 Refer to Section 22 42 03 - Commercial Washroom Fixtures.
 - .2 Remove caps as required.

3.6 REPORTS

- .1 Include record of all tests in Operation and Maintenance Manuals.

3.7 TRAINING

- .1 In accordance with Section 21 05 01 - Common Work Results Mechanical.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation procedures for electric heating and cooling controls.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 COORDINATION

- .1 All electrical low-voltage control wiring, including interlock wiring, required for the equipment supplied by Mechanical, except where otherwise noted, shall be supplied and installed by Mechanical or their subtrades.
- .2 All mechanical control wiring 50 volts or more shall be a minimum of #14 gauge wire. All mechanical control wiring less than 50 volts shall be minimum #18 gauge wire.
- .3 All mechanical control wiring installed by mechanical shall conform with the requirements of the local electrical authority and the Division 26 Electrical specifications.
- .4 Electrical Contractor: Electrical shall provide the following:
 - .1 All power wiring to equipment.
 - .2 Wiring of inline control devices on 120 Vac as indicated on drawings (remote solid state speed controllers for fan operation).

2 Products

2.1 THERMOSTAT (LOW VOLTAGE)

- .1 Low voltage wall thermostat:
 - .1 For use on 24 V circuit at 1.5 A capacity.
 - .2 With heat anticipator adjustable 0.1 to 1.2 A.
 - .3 Temperature setting range: 10 degrees C to 25 degrees C.
 - .4 Without sub-base.

2.2 THERMOSTAT GUARDS

- .1 No thermostat guards are required.

2.3 LOW LIMIT TEMPERATURE ALARM

- .1 Low limit temperature alarm with:
 - .1 Rating: 10.2 A at 120 V.
 - .2 Sensing bulb and 1.5 m long capillary tube.
 - .3 Switching action: manual.
 - .4 Temperature setting range: 0 degrees C to 15 degrees C.

2.4 HIGH LIMIT TEMPERATURE ALARM

- .1 High limit temperature alarm with:
 - .1 Rating 10 A at 120 V.
 - .2 Positive lock-out.
 - .3 Manual reset only after 14 degrees C drop-in temperature.
 - .4 Cutout setting: 50 degrees C.

2.5 FURNACE THERMOSTAT

- .1 Programmable low-voltage thermostat/interface to be supplied with furnace, refer to furnace specifications.

2.6 ELECTRIC DUCT COIL CONTROL

- .1 Heating coil controller to be supplied with heating coil complete with matched low voltage duct temperature sensor.

2.7 ELECTRIC HEATER LOW VOLTAGE THERMOSTAT

- .1 Low voltage adjustable thermostat to be supplied with electric heaters (baseboard, unit heaters, convectors etc.)
- .2 Thermostat to be complete with heat anticipator.
- .3 Thermostat to be in Celsius.

2.8 MOTORIZED DAMPER ACTUATOR – OUTDOOR AIR INTAKE, CO SENSORS

- .1 Mechanical to provide line voltage (120V/1ph) actuator matched to damper.
- .2 Actuator to be normally closed.

2.9 HRV CONTROL (Housing)

- .1 Digital HRV controller to be supplied with HRV complete with remote timers to be installed in housing washrooms.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install control devices and wire to equipment.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.
- .3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.
- .4 Install and wire thermostats supplied with mechanical equipment, refer to respective equipment sections.

3.3 FURNACE THERMOSTATS

- .1 Thermostats supplied with furnaces to be installed at locations shown on drawings.
- .2 Wire from thermostat to furnace.
- .3 Commission furnace operation and establish programmed schedule for each furnace.

3.4 ELECTRIC DUCT COIL CONTROL

- .1 Install duct mounted temperature sensor supplied with heating coil and wire to coil controller.
 - .1 Sensor to be installed in accordance with manufacturers requirements
 - .2 Wire from thermostat to controller on coil.
 - .3 Commission coil operation to maintain discharge temperature of 15 Deg.C.
 - .4 Interlock coil to associated fan.

3.5 GARAGE EXHAUST FAN CONTROL

- .1 Line voltage CO Monitor/Controller to be supplied by mechanical and wired by electrical.
- .2 Lead fan to operate from occupant sensor(s), when space is occupied, fan shall be on. Sensor shall be wired to controller.
- .3 Lead fan to operate from CO monitor during unoccupied periods
 - .1 Fan shall initiate when CO is above 5ppm, anytime.
 - .2 Fan shall shut off when CO drops below 5 ppm unless space is occupied.

- .4 Lead fan to operate from CO monitor
 - .1 Fan shall be off unless CO levels require operation.
 - .2 Fan shall initiate when CO reaches 25ppm.
 - .3 Fan shall shut off when CO drops below 5 ppm.

3.6 ELECTRIC HEATER LOW VOLTAGE THERMOSTATS

- .1 Install wall mounted adjustable low voltage thermostat supplied with electric heater in locations shown on drawings.
 - .1 Sensor to be installed in accordance with manufacturers requirements
 - .2 Wire from thermostat to transformer on heater.
 - .3 Commission thermostat and ensure heat anticipator is set to electric heat.

3.7 MOTORIZED DAMPER ACTUATOR – EF-15

- .1 Mechanical to supply and install damper in ductwork complete with actuator.
- .2 Electrical to wire actuator from exhaust circuit (s).
- .3 Damper to open when EF-15 is on.
- .4 Damper to be closed when EF-15 is off.

3.8 MOTORIZED DAMPER ACTUATOR – EF-16

- .1 Mechanical to supply and install damper in ductwork complete with actuator.
- .2 Electrical to wire actuator from exhaust circuit (s).
- .3 Damper to open when EF-16 is on.
- .4 Damper to be closed when EF-16 is off.

3.9 HRV - Housing

- .1 HRV to operate from low voltage digital controller supplied with HRV and mounted with HRV.
- .2 Wire remote timers from locations shown on drawings to HRV controller.
 - .1 Remote timer to be installed in accordance with manufacturers requirements
 - .2 Wire from remote timers to HRV.
 - .3 Commission HRV control and ensure.

3.10 HRV - Garage

- .1 HRV to operate from low voltage digital controller supplied with HRV and mounted in mechanical room.
- .2 Wire remote timers from locations shown on drawings to HRV controller.
 - .1 Remote timer to be installed in accordance with manufacturers requirements
 - .2 Wire from remote timers to HRV.
 - .3 Commission HRV control and ensure.

3.11 DOMESTIC BOOSTER (Black Lake)

- .1 Refer to Domestic Booster Pumps 22 47 01.

- .2 Wire remote sensors in accordance with manufacturers requirements
- .3 Manufacturer representative to commission booster package operation.

3.12 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for copper tubing and fittings for refrigerant.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22-01, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-02, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-01, Refrigeration Piping and Heat Transfer Components.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B280-03, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B52-99, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
 - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Submit WHMIS MSDS in accordance with Specifications. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Comply with Provincial Regulations and Mechanical Refrigeration Codes.

- .2 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16 - Construction Progress Schedules - Bar (GANTT) Charts.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 START-UP AND TESTING

- .1 Supply initial charge of refrigerant and oil for each refrigeration system. Losses of oil or refrigerant prior to acceptance of equipment or due to defects covered under guarantee shall be replaced. Supply to the Owner, one complete charge of lubricating oil in addition to that placed in the system.
- .2 Charge the system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.
- .3 Shut-down system if initial start-up testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.
- .4 Provide cooling season start-up, winter season shut-down for first year of operation.

2 Products

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280, type ACR.
 - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
- .3 Flanged:
 - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
 - .2 Gaskets: suitable for service.
 - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .4 Flared:
 - .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

2.5 LIQUID INDICATORS

- .1 Liquid indicators shall be double port type with copper or brass body, and flared or solder ends.
- .2 Provide removable seal caps on each port to inspect refrigerant condition.

2.6 STRAINERS

- .1 Refrigerant strainers shall be angle replaceable cartridge type with brass shell.
- .2 Cartridge material and screen size shall be suitable for refrigerant and pipe material utilized in the system.

2.7 FILTER DRIERS

- .1 Combination filter driers shall be angle type, with brass shell and incorporate a combined straining and drying material.
- .2 Desiccant material shall be replaceable.

2.8 SOLENOID VALVES

- .1 Solenoid valves shall have copper or brass body with flared or screwed ends.
- .2 Coil assembly shall be replaceable.
- .3 Valves shall incorporate a manually operated stem to serve as a bypass in case of coil failure.

2.9 EXPANSION VALVES

- .1 Provide angle type or straight through expansion valves suitable for the refrigerant utilized in the system.
- .2 Valves shall have brass body, internal or external equalizer, adjustable super-heat setting and be complete with capillary tube and remote sensing bulb.

2.10 CHARGING VALVES

- .1 Provide general purpose type refrigerant charging valves with brass body, flared or solder ends and with removable valve core.

- .2 Provide valve inlet with quick coupling connection for ease of charging.

2.11 FLEXIBLE CONNECTORS

- .1 Flexible connectors shall consist of close pitch corrugated bronze hose with single layer of exterior braiding to provide additional strength and prevent elongation of corrugated section.
- .2 Connectors shall be minimum 9" long and provided with bronze fittings to facilitate connection to equipment.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5, Section 23 05 01 - Installation of Pipework.

3.3 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.

- .3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 DX EQUIPMENT START-UP AND TESTING

- .1 Refrigeration equipment: Prepare system for start-up by having manufacturer's factory trained representative supervise testing, dehydration and charging of machine. Do start-up including co-ordination on start-up of condensers.
- .2 Testing:
 - .1 Provide sufficient refrigerant, dry nitrogen and refrigeration oil for pressure and operational testing under manufacturer's supervision.
 - .2 Prior to testing ensure that system is complete. Protect relief valves during test procedure. After completion of test, reconnect and make good piping connections and leak test entire system.

3.7 AIR COOLED CONDENSING UNIT

- .1 Check unit for damage before and after placement:
 - .1 Protect and cover exposed units to the elements during construction.
 - .2 Conform to installation drawings. Mount units on roof mounting frame.

3.8 LIQUID INDICATORS

- .1 Provide full size liquid indicators in main liquid line leaving condenser. If receiver is used install in liquid line leaving receiver.

3.9 STRAINERS

- .1 Provide full size strainer ahead of each automatic valve. Where multiple expansion valves with integral strainers are used, install single main liquid line strainer.
- .2 On steel piping systems provide adequate strainer in suction line to remove scale and rust inherent in steel pipe.
- .3 Provide shut-off valve on each side of strainer to facilitate maintenance.

3.10 FILTER-DRIERS

- .1 Filter-driers may be used in systems instead of separate strainers and driers.
- .2 Install with three valve bypass assembly to permit isolation for servicing.

3.11 SOLENOID VALVES

- .1 Provide solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
- .2 Provide solenoid valves with manually operated stems.

3.12 EXPANSION VALVES

- .1 Size expansion valves properly to avoid penalty of being undersized at full load and of being excessively oversized at partial load.

- .2 Properly evaluate refrigerant pressure drop through system to determine the available pressure drop across the valve.
- .3 Select valves for maximum load at design operating pressure and minimum 7.2 deg.C of superheat.
- .4 Locate remote expansion valve sensing bulb immediately after evaporator outlet on suction line.

3.13 CHARGING VALVES

- .1 Provide refrigerant charging connections in liquid line between receiver shut-off valve and expansion valve.

3.14 FLEXIBLE CONNECTORS

- .1 In general install suction and hot gas piping connections to compressors with three directional changes for distance of minimum six pipe diameters before reaching point of support.
- .2 Flexible connectors shall only be utilized at or near compressors where it is not physically possible to absorb vibration within piping configuration.

3.15 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Departmental Representative.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.

- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements Departmental Representative.
- .9 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately to Departmental Representative.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Metal duct work.
- .2 Nonmetal duct work.
- .3 Casing and plenums.
- .4 Buried duct work.
- .5 Kitchen hood duct work.
- .6 Duct cleaning.

1.2 REFERENCES

- .1 ASTM A36/A36M - Carbon Structural Steel.
- .2 ASTM A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- .3 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .4 ASTM A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .5 ASTM A568/A568M - General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- .6 ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .7 ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.
- .8 ASTM A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.
- .9 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .10 ASTM C14/C14M - Concrete Sewer, Storm Drain, and Culvert Pipe.
- .11 ASTM C443 - Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- .12 AWS D9.1 - Sheet Metal Welding Code.
- .13 NBS PS 15 - Voluntary Product Standard for Custom Contact-Moulded Reinforced-Polyester Chemical Resistant Process Equipment.
- .14 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- .15 NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.
- .16 NFPA 91 - Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particulate Solids.
- .17 NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .18 SMACNA - HVAC Air Duct Leakage Test Manual.
- .19 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .20 SMACNA - Fibrous Glass Duct Construction Standards.
- .21 UL 181 - Factory-Made Air Ducts and Connectors.

1.3 DEFINITIONS

- .1 Low pressure/low velocity: Static pressure in duct less than 498 Pa (2" w.g.) and velocities less than 10 meters/second (2000 fpm).
- .2 Medium pressure/high velocity: Static pressure in duct less than 996 Pa (4" w.g.) and velocities between 10 meters/second (2000 fpm) and 20 meters/second (4000 fpm).
- .3 High pressure/high velocity: Static pressure in ducts more than 996 Pa (4" w.g.) And velocities greater than 4000 fpm.

- .4 Duct sizes: as shown on drawings are outside dimensions. For acoustically lined or internally insulated ducts, sizes shown are actual duct sizes and the insulation thickness has been accounted for.

1.4 PERFORMANCE REQUIREMENTS

- .1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

1.5 SUBMITTALS

- .1 Section 01 33 00: Procedures for submittals.
- .2 Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for 1000 kPa pressure class and higher systems.
- .3 Product Data: Provide data for duct materials.
- .4 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.6 QUALITY ASSURANCE

- .1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .2 Ductwork shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems, and NFPA No. 96, Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapours from Commercial Cooking Equipment

1.7 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Installer: Company specializing in performing the work of this section with minimum 3 years documented experience.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- .2 Maintain temperatures during and after installation of duct sealants.

2 Products

2.1 DUCT MATERIALS

- .1 Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating to ASTM A90 on both sides.
- .2 Steel Ducts: ASTM A1008.

- .3 Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.
- .4 Stainless Steel Ducts: ASTM A167, Type 304.
- .5 Concrete Ducts: ASTM C14; hub and spigot concrete sewer pipe with ASTM C443 joints, rubber gaskets.
- .6 Fasteners: use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

2.2 SEALANT

- .1 Oil resistant, water based or solvent based, anti-microbial, anti-bacterial, ultra violet resistant, polymer type, flame resistant duct sealant.
- .2 VOC content to be less than VOC limits of the State of California's South Coast Air Quality District Rule #1168. VOC content less than 30 g/L (less water and less exempt compounds) for sealing metal to metal contact.
- .3 Sealant shall be cured for a minimum of 48 hours.
- .4 Flame Spread Rating: 0 (zero).
- .5 Smoke Spread Rating: 0 (zero).

2.3 TAPE

- .1 Polyvinyl treated, open weave fibre glass, 50 mm wide.

2.4 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
up to 500	B
Over 500	A
- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.
 - .3 Class C: transverse joints and connections made air tight with gaskets. Longitudinal seams unsealed.
 - .4 Unsealed seams and joints.

2.5 DUCT WORK FABRICATION

- .1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

- .2 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air foil turning vanes.
- .3 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm, cross break for rigidity. Open corners are not acceptable.
- .4 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.
- .5 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- .6 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 100 mm cemented slip joint, brazed or electric welded. Prime coat welded joints.
- .7 Provide standard 45 degree lateral wye takeoffs unless duct manufacturer can show 90 degree and tap has less static pressure loss.
- .8 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breath, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.
- .9 Provide easements where low pressure ductwork conflicts with piping and structure where easements exceed 10% duct area, split into two ducts maintaining original duct area.
- .10 Exposed ductwork to be fabricated from Aluminum for aesthetics.

2.6 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
 - .1 Rectangular: standard radius with single thickness turning vanes. Centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius. Centreline radius: 1.5 times diameter.
 - .3 Oval: 7 gore 90's, 5 gore 45's.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness Airfoil turning vanes.
 - .2 Over 400 mm: with double thickness Airfoil turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 15 degrees maximum included angle when increasing duct sizes.
 - .2 Converging: 45 degrees maximum included angle downstream of equipment.
 - .3 Diverging: 30 degrees maximum included angle upstream of equipment.

- .6 Offsets:
 - .1 Full radiused elbows, as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.7 MANUFACTURED DUCT WORK AND FITTINGS

- .1 Manufacture to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- .2 Flat Oval Ducts:
 - .1 Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gauges heavier metal than duct.
- .3 Double Wall Insulated Flat Oval Ducts:
 - .1 Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 25 mm thick fibreglass insulation, perforated galvanized steel inner wall; fittings manufactured with solid inner wall.
- .4 PVC Coated Steel Ducts:
 - .1 UL 181, Class 1, galvanized steel duct coated with polyvinyl chloride plastic, 0.1 mm thick on outside and 0.05 mm thick on inside.
- .5 Transverse Duct Connection System:
 - .1 SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.8 CASINGS

- .1 Fabricate casings to SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.
- .2 Mount floor mounted casings on 100 mm high concrete curbs. At floor, rivet panels on 200 mm centres to angles. Where floors are acoustically insulated, provide liner of 1.20 mm galvanized expanded metal mesh supported at 300 mm centres, turned up 300 mm at sides with sheet metal shields.
- .3 Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection. Provide clear wire glass observation ports, minimum 150 X 150 mm size.
- .4 Fabricate acoustic casings with reinforcing turned inward. Provide 1.50 mm back facing and 0.80 mm perforated front facing with 2.4 mm diameter holes on 4 mm centres. Construct panels 75 mm thick packed with 72 kg/cu m minimum glass fibre media, on inverted channels of 1.50 mm.

2.9 FIRESTOPPING

- .1 Retaining angles around duct, on both sides of fire separation
- .2 Fire stopping material and installation must not distort duct.

2.10 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping Equipment.
 - .1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.
 - .2 Trapeze hangers: ducts over 500 mm diameter or longest side, to SMACNA.
 - .3 Hangers: steel angle with black steel rods to following table.

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .1 Mount to top cord.
 - .3 For steel beams: manufactured beam clamps:

2.11 WIRE ROPE SUSPENSION SYSTEMS

- .1 Wire rope suspension systems shall be ULC, CSA and SMACNA approved and tested.
- .2 Wire suspensions systems consist of a pre-formed wire rope sling with either a ferruled loop, permanently fixed threaded 1/4ins (or 3/8ins) stud, or permanently fixed nipple end with toggle, at one end or hook or eyelet. The end fixings and the wire must be of the same manufacturer. The system is secured and tensioned with a hanger self-locking grip at the other end.
- .3 Only wire and or supports supplied and or approved, shall be used with the system.
- .4 The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum Safe Working Load Limit (which incorporates a 5:1 safety factor). The correct specification of wire hanger required is determined using the following formula:

$$\text{Weight per metre of object suspended (kg)} \times \text{Distance between suspension points (m)} = \text{Weight loading per hanger suspension point (kg)}.$$

Table 1 Wire Hanger Safe Working Loads

Size	Working Load Limit (kg)	Working Load Limit (lbs)
No. 1	0 - 10 kg	0 - 22 lbs
No. 2	10.5 - 45.5 kg	23 - 100 lbs

No. 3	46 - 91 kg 101 - 200 lbs
No. 4	95.5 - 225 kg 210 - 495 lbs
No. 5	225.5 - 325 kg 496 - 715 lbs

(i) Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations given in the manufacturer's handbook.

.5 The Contractor shall select and use the correct length of wire rope required to support the service.

.6 No in-line joins shall be permitted in the rope.

3 Execution

3.1 GENERAL REQUIREMENTS

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Ensure diffuser is fully seated.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints and manufactured equipment in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.7 At each point where ducts pass through partitions, the joints around the duct shall be sealed with non-combustible material.

3.2 INSTALLATION

.1 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible according to seal classification specified.

.2 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated duct work, install insulation material inside a metal ring.

.3 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.4 Use double nuts and lock washers on threaded rod supports.

.5 Provide access doors for inspection.

- .6 Tape joints of PVC coated metal duct work with PVC tape.
- .7 Connect terminal units to supply ducts directly or with 300 mm maximum length of flexible duct. Do not use flexible duct to change direction.
- .8 Connect diffusers to low pressure ducts directly. To decouple diffuser from duct system, use 1.5 m maximum length of flexible duct held in place with caulking compound and strap or clamp. Do not use flexible duct to change direction.
- .9 Connect flexible ducts to metal ducts with adhesive and strap or clamp.
- .10 Set plenum doors 150 to 300 mm above floor. Arrange door swings so that fan static pressure holds door in closed position.
- .11 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.
- .12 Provide floor drains in fresh air coil, and humidifier sections with deep seal traps.

3.3 CLEANING

- .1 Clean work to requirements of Division 1 and as detailed herein.
- .2 Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- .3 Provide adequate access into duct work for cleaning purposes.
- .4 Prior to occupancy and during initial occupancy, building shall be flushed at maximum outdoor air volume. Supply a total of 4,300 cu.m of outdoor air per sq.m of floor area or approximately 30,564,400cu.m of outdoor air or approximately 54 days of flushing. Note that a minimum of 3 weeks of flushing will be required prior to occupancy.

3.4 WATER TIGHT DUCTS

- .1 Provide watertight duct for:
 - .1 Fresh air intake.
 - .2 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Solder or weld joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards hoods served.
 - .1 Slope header ducts down toward risers.
- .4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and discharging to open funnel drain.

3.5 WIRE ROPE SUSPENSION SYSTEMS

- .1 The wire hangers shall be fixed to the building structure in accordance with the standard practice and structural limitations.

- .2 Loop end can be wrapped around purlins, beams, roof trusses and other accessible building features.
- .3 Stud end can be fixed with suitable anchors into concrete ceilings and structures, metal decking and pressed metal brackets (using nuts).
- .4 Toggle end can be fixed into profile roof cladding, light fittings and luminaries.
- .5 Other wire rope systems can be fixed to an approved structure, as determined by the Departmental Representative.
- .6 The wire hangers shall not be fixed to any other services, without the approval of the Departmental Representative.
- .7 The free end of the wire rope should be threaded through one channel of the self-locking grip before being either passed around the object being suspended or connected to it, using a suitable fixing. The wire rope is then threaded back through the second channel in the grip until the required level is achieved.
- .8 Adjust duct elevations as required to remain level and plumb, the weight of the suspended object must be independently supported while making adjustments.
- .9 The wire rope must not be damaged, twisted or deformed in any way prior to, or during, installation. Any such ropes must be discarded and replaced.
- .10 When installing wire hangers the angle between the ropes when exiting the grip must never exceed the manufacturer's recommendations and/or 60 degrees.
- .11 Lubricants, paint or any other coating shall not be applied to the wire hanger as it may impair its performance.
- .12 Wire hangers must be installed in accordance with the manufacturer's loading and installation instructions and all the manufacturer's recommendations.

3.6 LEAKAGE TESTS

- .1 Refer to Section 23 05 94.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete tests before performance insulation or concealment Work.

3.7 SEALANT APPLICATION

- .1 Contractor shall apply sealant on exposed ductwork in a 50mm band centered on joint.
- .2 Sealant shall be applied evenly with a clean edge finish perpendicular to duct and plumb.
- .3 Tape shall be utilized to provide clean edge finish to sealant application.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Air turning devices/extractors.
- .2 Backdraft dampers.
- .3 Combination fire and smoke dampers.
- .4 Duct access doors.
- .5 Duct test holes.
- .6 Fire dampers.
- .7 Flexible duct connections.
- .8 Volume control dampers.

1.2 REFERENCES

- .1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- .2 NFPA 92A - Smoke-Control Systems.
- .3 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .4 UL 33 - Heat Responsive Links for Fire-Protection Service.
- .5 UL 555 - Fire Dampers.
- .6 UL 555S - Smoke Dampers.

1.3 SUBMITTALS

- .1 Section 01 33 00: Procedures for submittals.
- .2 Shop Drawings: Provide for shop fabricated assemblies including volume control dampers.
- .3 Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- .4 Manufacturer's Installation Instructions: Indicate for dampers including fire and fire/smoke dampers.

1.4 PROJECT RECORD DOCUMENTS

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Record actual locations of access doors.

1.5 QUALITY ASSURANCE

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems.
- .3 Fabricate in accordance with ASHRAE handbooks and SMACNA duct manuals.

1.6 REGULATORY REQUIREMENTS

- .1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Protect dampers from damage to operating linkages and blades.

1.8 EXTRA MATERIALS

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Provide two of each size and type of fusible link.

2 Products

2.1 TURNING VANES

- .1 Factory or shop fabricated single thickness or double thickness, to recommendations of SMACNA and as indicated.
- .2 Shall be airfoil type.
- .3 Where acoustical lining is provided, provide turning vanes of perforated metal type with fibre glass inside.

2.2 BACKDRAFT DAMPERS.

- .1 Gravity Backdraft Dampers, Size 450 x 450 mm or Smaller Provided with Air Moving Equipment: Air moving equipment manufacturers standard construction.
- .2 Extruded aluminum 6063T5 backdraft damper frame shall not be less than 1.52 mm in thickness. Frame shall be 63.5 mm deep.
- .3 Blades shall be extruded aluminum (6063T5) profiles and shall be less than 1.52 mm in thickness.
- .4 Blade and side seals shall be extruded silicone. Seals are to be secured in integral slots within the aluminum extrusions.
- .5 Bearing system shall be composed of Celcon bearings rotating on zinc-plated 12.7 mm steel pivot points.
- .6 Linkage system shall consist of hard alloy aluminum (6005T6) crank arms fastened to zinc-plated steel pivot rods and shall be doubly secured within channel running along top of blade. Large diameter 8.73 mm hard alloy aluminum (6065-T6C) linkage rod shall connect the crank arms by means of a zinc-plated steel trunnion.
- .7 Cup point trunnion set screw shall create a compression hard spot where it secures to the linkage rod for a slip-proof grip.
- .8 Trunnions shall be zinc-plated to provide a hard, smooth and long-lasting rotating surface.
 - .1 Performance:
 - .2 Temperature range: -40 deg.C to 100 deg.C.
 - .3 Leakage: 101.2 l/s per square meter at 0.25 kPa.
 - .4 Pressure Drop: less than 24.9 Pa.

- .9 Backdraft dampers shall be made to size required. Minimum section size shall be 152 mm wide x 152 mm high. Maximum section size shall be 914 mm wide by 3658 mm high. Mullion breaks shall be used when damper height exceeds 1220 mm.
- .10 Backdraft dampers with dimensions greater than maximum section size shall be manufactured in multiple sections. Multiple sections are not interlinked or connected. To install, each section must be individually fastened to a structural frame prepared on site.
- .11 Fully adjustable device to permit setting for varying differential static pressures less than 2.49 Pa.

2.3 DUCT ACCESS DOORS

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Access doors to be ULC labelled.
- .3 Fabrication for un-insulated ducts: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices.
- .4 Fabrication for insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation with sealing gaskets and quick fastening locking devices.
- .5 Gaskets: neoprene.
- .6 Hardware:
 - .1 Less Than 300 mm Square: Secure with sash locks complete with safety chain.
 - .2 Up to 450 mm Square: Provide two hinges and two sash locks.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 300 x 300 mm glass viewing panels where indicated.
 - .6 Hold open devices.
- .7 Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

- .1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- .2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FLEXIBLE DUCT CONNECTIONS

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Connector:
 - .1 Fabric: cUL listed fire-retardant self extinguishing neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m. Approximately 50mm of fabric clenched by means of double locked seams.

- .2 Frame: 75 mm wide, 0.6 mm thick galvanized sheet metal.
- .3 Attach edging strip to ducting and equipment by screws or bolts at 150 mm (6") intervals
- .3 Leaded Vinyl Sheet: Minimum 14 mm0.55 inch thick, 4.2 kg/sq m0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.6 DRYER VENT

- .1 Provide stainless steel side wall commercial dryer vent complete with backdraft damper, wind guard, and rain cap. Vent to be minimum 26 gauge metal.

3 Execution

3.1 INSTALLATION

- .1 Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- .2 Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

3.2 ACCESS DOORS

- .1 Provide adequately sized duct access doors for inspection and cleaning.
- .2 Sizes:
 - .1 600 x 600 mm for person size entry.
 - .2 900 x 900 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .4 As indicated.
- .3 Locations (before and after):
 - .1 Fire and smoke dampers (install at fire dampers).
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Filters.
 - .7 To facilitate cleaning of ductwork (minimum
 - .8 Elsewhere as indicated.
- .4 Provide 100 mm x 100 mm (4" x 4") quick opening access doors for inspection at balancing dampers, before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 200 x 200 mm size for hand access, 450 x 450 mm size for shoulder access, and as indicated. Provide 100 x 100 mm for balancing dampers only. Review locations prior to fabrication.

3.3 TEST PORTS

- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

- .2 Provide duct test ports where indicated and required for testing and balancing purposes.
- .3 Install insulation port extensions as required.
- .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.

3.4 FLEXIBLE CONNECTORS

- .1 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators, including but not limited to the following:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 ensure slack material in flexible connection.
- .6 For fans developing static pressures of 1250 Pa and over, cover connections with leaded vinyl sheet, held in place with metal straps.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures..
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 MANUAL VOLUME CONTROL DAMPERS.

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

- .2 Splitter Dampers:
 - .1 Fabricate from same material as duct but one sheet metal thickness heavier (minimum 16 gauge), with appropriate stiffening to avoid vibration.
 - .2 Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous piano hinge.
 - .3 Operator: Minimum 6 mm diameter rod in self aligning, universal joint action, flanged bushing with set screw and position indicator.
 - .4 Rod configuration to prevent end from entering duct.
 - .5 Folded leading edge.
 - .6 Size on basis of straight air volume proportioning.
- .3 Single Blade Dampers:
 - .1 Fabricate for duct sizes up to 150 (in depth) x 760 mm.
 - .2 Fabricate from same material as duct, but one sheet metal thickness heavier (minimum 16 gauge). V-groove stiffened.
 - .3 Size and configuration to recommendations of SMACNA
 - .4 Locking quadrant with shaft extension to accommodate insulation thickness.
 - .5 Inside and outside nylon end bearings.
 - .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .4 Multi-Blade Damper:
 - .1 Factory manufactured of material compatible with duct.
 - .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
 - .3 Maximum blade height: 100 mm
 - .4 Bearings: self-lubricating oil impregnated nylon.
 - .5 Linkage: shaft extension with locking quadrant.
 - .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .5 End Bearings: Except in round duct work 300 mm and smaller, provide end bearings.
- .6 Quadrants:
 - .1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - .2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - .3 Where rod lengths exceed 750 mm provide regulator at both ends.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install where specified, where required for balancing and where indicated on drawings.

- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Use splitter dampers only where indicated.
- .4 Provide commercial balancing dampers on all low velocity duct take-offs to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly unless specifically noted otherwise.
- .5 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts. Where indicated on the drawings, a balancing damper is not required for runouts in non-accessible ceiling spaces provided a damper is specified on the register and diffuser.
- .6 Dampers: shall be installed vibration free.
- .7 Ensure damper operators are observable and accessible. Provide access doors in ceilings/ walls where required.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

2 Products

2.1 MULTI-LEAF DAMPERS

- .1 Opposed airfoil blade type as indicated.

- .2 Extruded aluminum (6063T5) damper frame shall not be less than 2.03 mm thickness. Damper frame to be 100 mm deep.
- .3 Blades to be extruded aluminum (6063T5) profiles. Aluminum end caps are to be press fitted to blade ends, in order to seal hollow interior and reduce air leakage rate.
- .4 Blade and frame seals shall be of extruded silicone. Seals are to be secured in an integral slot within the aluminum extrusions.
- .5 Bearings are to be composed of a Celcon inner bearing fixed to a 11.11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
- .6 Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
- .7 Standard air leakage data to be certified under the AMCA Certified Ratings Program.
- .8 Dampers shall be made to size required without blanking off free area.
- .9 Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width.
- .10 Operator: to Division 25.
- .11 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.
- .12 Performance:
 - .1 Temperature Range: -40 deg.C to 100 deg.C.
 - .2 Leakage: 15.2 l/s per sq.meter at 0.25 kPa, 40.5 l/s per sq.meter at 1.0 kPa. Shall meet Class 1A at 0.25 kPa.
 - .3 Pressure Drop: less than 4 Pa at 5.08 m/s.

2.2 DISC TYPE DAMPERS

- .1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
- .2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
- .3 Gasket: extruded neoprene, field replaceable, with 10 year warranty.
- .4 Bearings: roller self lubricated and sealed.
- .5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.

- .6 Performance:
 - .1 Leakage: in closed position less than 0.001 % of rated air flow at .25 kPa pressure differential across damper.
 - .2 Pressure drop: at full open position less than 5 Pa differential across damper at 5.08 m/s.

2.3 BACKDRAFT DAMPERS

- .1 Extruded aluminum 6063T5 backdraft damper frame shall not be less than 1.52 mm in thickness. Frame shall be 63.5 mm deep.
- .2 Blades shall be extruded aluminum (6063T5) profiles and shall be less than 1.52 mm in thickness.
- .3 Blade and side seals shall be extruded silicone. Seals are to be secured in integral slots within the aluminum extrusions.
- .4 Bearing system shall be composed of Celcon bearings rotating on zinc-plated 12.7 mm steel pivot points.
- .5 Linkage system shall consist of hard alloy aluminum (6005T6) crank arms fastened to zinc-plated steel pivot rods and shall be doubly secured within channel running along top of blade. Large diameter 8.73 mm hard alloy aluminum (6065-T6C) linkage rod shall connect the crank arms by means of a zinc-plated steel trunnion.
- .6 Cup point trunnion set screw shall create a compression hard spot where it secures to the linkage rod for a slip-proof grip.
- .7 Trunnions shall be zinc-plated to provide a hard, smooth and long-lasting rotating surface.
- .8 Performance:
 - .1 Temperature range: -40 deg.C to 100 deg.C.
 - .2 Leakage: 101.2 l/s per square meter at 0.25 kPa.
 - .3 Pressure Drop: less than 24.9 Pa.
- .9 Backdraft dampers shall be made to size required. Minimum section size shall be 152 mm wide x 152 mm high. Maximum section size shall be 914 mm wide by 3658 mm high. Mullion breaks shall be used when damper height exceeds 1220 mm.
- .10 Backdraft dampers with dimensions greater than maximum section size shall be manufactured in multiple sections. Multiple sections are not interlinked or connected. To install, each section must be individually fastened to a structural frame prepared on site.
- .11 Fully adjustable device to permit setting for varying differential static pressures less than 2.49 Pa.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.
- .6 Install insulated dampers at interface with outdoors including outdoor air intakes, exhaust ducts, and relief ducts.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Fire and smoke dampers, and fire stop flaps.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Fire stop flaps.
 - .4 Operators.
 - .5 Fusible links.
 - .6 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

- .2 Provide a Fire Damper Schedule identifying the following: damper tag, duct size, location, access door size, location.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide following:
 - .1 Six (6) fusible links of each type.

2 Products

2.1 FIRE DAMPERS

- .1 Fabricate to NFPA 90A and as indicated.
- .2 Fire dampers: arrangement Type A, B and C, listed and bear label of ULC, UL, Warnock Hersey, meet requirements of authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112. Fusible links on fire dampers shall be constructed to ULC Standard S505.
- .3 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation
 - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated or required.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .4 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .5 Ceiling Dampers: Galvanized steel, 0.76 mm frame and 1.5 mm flap, two layers 3.2 mm ceramic fibre on top side, and one layer on bottom side for round flaps, with locking clip
- .6 Horizontal Dampers: Galvanized steel, 0.76 mm frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- .7 Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 250 Pa pressure class ducts up to 300 mm in height.

- .8 Multiple Blade Dampers: 1.5 mm galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 3.2 x 12.7 mm plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- .9 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .10 Fusible Links: separate at 71 degrees C (161 Deg.F.) with adjustable link straps for combination fire/balancing dampers.
- .11 Fire dampers in low pressure ductwork may be multi-blade, offset butterfly or curtain type.
- .12 Fabricate combination fire and balancing dampers with linkage readily adjustable in open position.
- .13 50 x 50 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .14 Equip fire dampers with steel sleeve and frame installed disruption ductwork (breakaway ductwork) to ensure damper operation is not impaired. Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening, except where noted otherwise. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .15 Fire dampers mounted on through the ceiling/floor security grilles shall utilize the security grille frame as the sleeve through the rated structure. Fire damper to be mounted on the service side to the security grille frame.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- .1 Fabricate to NFPA 90A, UL 555, UL 555S, and as indicated.
- .2 Provide factory sleeve and collar for each damper.
- .3 Multiple Blade Dampers: Fabricate with 1.5 mm galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 3.2 x 12.7 mm plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 12.7 mm actuator shaft.
- .4 Smoke Rating: Leakage Class III Smoke Damper in accordance with UL555S. A Class III smoke damper leaks no more than 80 cubic feet per minute (2.27 m³/min) at 4 in. wg. (1 kPa.) differential pressure
- .5 Operators: UL listed and labelled Electric 24V, 60 Hz, two-position, fail close, externally mounted.
- .6 Duct Smoke Detector: Factory mounted duct smoke detector with no minimum velocity requirement and complete with single point low voltage electrical connection. Sensor to be photoelectronic type.

- .7 Normally Open Smoke Responsive Fire Dampers: opposed blades complete with factory mounted actuator, flexible stainless steel blade edge seals to provide constant sealing pressure.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- .2 Install fire dampers and combination smoke and fire dampers to ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .3 Maintain integrity of fire separation.
- .4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .5 Install access door adjacent to each damper.
- .6 Co-ordinate with installer of firestopping.
- .7 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .8 Install break-away joints of approved design on each side of fire separation.
- .9 Contractor to individually tag each and every fire damper and provide a fire damper schedule in the Operation and Maintenance manual showing tag, size, type and location.
- .10 Contractor shall tag fire damper and access door with fire damper tag.
- .11 Demonstrate re-setting of fire dampers to Owner's representative.
- .12 Where required by authority, seal dampers against smoke with non-intumescent (non-expanding) fire rated sealant.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of flexible ductwork, joints and accessories.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-02, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 (Addendum No.1, November 1997).
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.
- .6 Underwriters' Laboratories Inc. (UL).
 - .1 UL 181-96, Standard for Factory-Made Air Ducts and Air Connectors.
- .7 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110-1986 (R2001), Fire Tests for Air Ducts.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials for the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.
- .3 Samples: submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to Codes and Standards.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 FLEXIBLE DUCT MATERIALS

- .1 Two ply vinyl film supported by helically wound spring steel wire.
 - .1 Pressure Rating: 2.50 kPa positive and 250 Pa negative.
 - .2 Maximum Velocity: 20.3 m/sec.
 - .3 Temperature Range: -23 to 71 degrees C.
- .2 ULC Labeled, black polymer film supported by helically wound spring steel wire.
 - .1 Pressure Rating: 1000 Pa positive and 175 Pa negative.
 - .2 Maximum Velocity: 20.3 m/sec.
 - .3 Temperature Range: -28 to 79 degrees C.
- .3 ULC labeled, multiple layers of aluminum laminate supported by helically wound spring steel wire.
 - .1 Pressure Rating: 2.50 kPa positive and 250 Pa negative.
 - .2 Maximum Velocity: 20.3 m/sec.
 - .3 Temperature Range: -28 to 99 degrees C.

2.3 INSULATED FLEXIBLE DUCT MATERIALS

- .1 Two ply vinyl film supported by helically wound spring steel wire; fibreglass insulation; polyethylene vapour barrier film.
 - .1 Pressure Rating: 2.50 kPa positive and 250 Pa negative.
 - .2 Maximum Velocity: 20.3 m/sec.
 - .3 Temperature Range: -23 to 71 degrees C.
- .2 Black polymer film supported by helically wound spring steel wire; fibreglass insulation; polyethylene vapour barrier film.
 - .1 Pressure Rating: 1000 Pa positive and 175 Pa negative.

- .2 Maximum Velocity: 20.3 m/sec.
- .3 Temperature Range: -28 to 79 degrees C.
- .3 Multiple layers of aluminum laminate supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapour barrier film.
 - .1 Pressure Rating: 2.50 kPa positive and 250 Pa negative.
 - .2 Maximum Velocity: 20.3 m/sec.
 - .3 Temperature Range: -28 to 99 degrees C.

3 Execution

3.1 DUCT INSTALLATION

- .1 Install in accordance with: SMACNA.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Centrifugal fans.
- .2 Roof and Wall Exhausters.
- .3 Axial fans.
- .4 Propeller fans.
- .5 Fan accessories.
- .6 Roof curbs.
- .7 Motors and Drives.
- .8 Cabinet Exhaust Fans

1.2 SUBMITTALS

- .1 Section 01 33 00: Procedures for submittals.
- .2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- .3 Product Data:
 - .1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
 - .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
 - .3 Provide fan curves with specified operating point clearly plotted.
 - .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
 - .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

1.3 SOURCE QUALITY CONTROL

- .1 Fans used shall not decrease motor size, increase noise level, increase tip speed by more than 10 percent or increase inlet air velocity by more than 20 percent, from specified criteria; and capable of accommodating static pressure variations of plus or minus 10 percent.

1.4 OPERATION AND MAINTENANCE

- .1 Submit operation and maintenance data to requirements of Section 01 78 00.
- .2 Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

2 Products

2.1 CENTRIFUGAL FANS

- .1 Wheel and Inlet
 - .1 Backward Inclined: Steel construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate, cast hub riveted to back plate and keyed to shaft with set screws.
 - .2 Forward Curved: Steel construction with inlet flange, back plate, shallow blades with inlet and tip curved forward in direction of air flow, mechanically secured to flange and back plate, steel hub swaged to back plate and keyed to shaft with set screw.
 - .3 Airfoil Wheel: Steel construction with smooth curved inlet flange, heavy back plate, die formed hollow airfoil shaped blades continuously welded at tip, flanged and back plate, cast hub riveted to back plate and keyed to shaft with set screws.
- .2 Housing
 - .1 Heavy gage steel, spot welded, designed to minimize turbulence with spun inlet bell and shaped cut-off.
 - .2 Factory finish before assembly in prime coated. For fans handling air downstream of humidifiers, provide two additional coats of paint. Prime coating on aluminum parts is not required.
 - .3 Provide bolted construction with horizontal flanged split housing.
 - .4 Fabricate plug fans without volute housing, with steel cabinet, lined.
 - .5 Shafts: Hot rolled steel, ground and polished, with key-away and protectively coated with lubricating oil.
 - .6 V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed, variable and adjustable pitch sheaves for motors 11.2 kW and under, fixed sheaves for 15 kW and over, matched belts, drive rated minimum 1.5 times nameplate rating of the motor.
 - .7 Belt Guards: Fabricate to SMACNA Low Pressure Duct Construction Standards.
- .3 Accessories
 - .1 Adjustable Inlet Vanes: Steel construction with blades supported at both ends with two permanently lubricated bearings, variable mechanism terminating in single control lever with control shaft for double width fans.
 - .2 Discharge Dampers: Opposed blade heavy duty steel dampers assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever.
 - .3 Inlet/Outlet Screens: Galvanized steel welded grid.
 - .4 Access Doors: Shaped to conform to scroll with quick opening latches and gaskets.
 - .5 Scroll Drain: 15 mm steel pipe coupling welded to low point of fan scroll.

2.2 CABINET EXHAUST FANS

- .1 Cabinet and Ceiling Exhaust Fans
 - .1 Centrifugal Fan: V-belt or direct driven, with galvanized steel housing lined with 15 mm acoustic insulation, resilient mounted motor, gravity back draft damper in discharge.
 - .2 Disconnect Switch: Factory wired non-fusible in housing for thermal overload protected motor and wall mounted.
 - .3 Grille for Ceiling Fan: Moulded white plastic grille or aluminum grille with

- baked white enamel finish.
- .4 V-belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed, variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position, fan shaft with self aligning pre-lubricated ball bearings.
- .5 To be complete with factory mounted solid state speed control for air balancing only. The speed control shall not be utilized as the disconnect switch.

2.3 RANGE HOODS

- .1 Fan: Resiliently mounted, multi-blade direct driven fan and motor, with two-speed plug-in type motor with permanently lubricated bearings.
- .2 Hood: Stainless steel or baked enamel as indicated on equipment schedule, with rocker type switches for light and fan, and washable aluminum mesh type filter.

3 Execution

3.1 PREPARATION

- .1 Verify that electric power is available and of the correct characteristics (voltage and phase) prior to ordering pump.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Assemble high pressure packaged air units by bolting sections together. Isolate fan section with flexible duct connections.
- .3 Install flexible connections between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm flex between ductwork and fan while running.
- .4 Install fan restraining snubbers as indicated. Flexible connectors shall not be in tension while running.
- .5 Pipe scroll drains to nearest floor drain.
- .6 Provide access to adjustable blade axial fan wheels for varying blade angle setting. Adjust blades for varying range of volume and pressure.
- .7 Provide floor mounted axial fans with reinforced legs and ceiling suspended units with support brackets bolted to casing flange.
- .8 When fan inlet or outlet is exposed, provide safety screen.
- .9 Install unit on vibration isolators with static deflection of 50 mm. For smaller fans, vibration isolators to be as recommended by manufacturer.
- .10 Set roof mounted fans on metal, self flashing curbs 200 mm minimum above roof. Provide acoustic insulation on duct to below roof line and one fan inlet plenum and drip pan for collecting condensation.

- .11 Provide exhaust fans with multi-blade, rattle free, back draft damper with felt lined blades edges, bird screen, disconnect switch and curb caps.
- .12 Supply and install sheaves as necessary for final air balancing.
- .13 Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.
 - .2 Sustainable requirements for construction and verification.

1.2 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to Codes and Standards.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Air flow tests and sound level measurement shall be made in accordance with ANSI/ASHRAE Standard 70.
- .2 Manufacturer shall have published performance data.
- .3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

1.5 JOB CONDITIONS

- .1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlet.

- .2 Positions indicated are approximate only. Check location of outlets and make necessary adjustment in position to conform with Architectural features, symmetry, performance, and lighting arrangement.

2 Products

2.1 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Base air outlet application on space noise level, either by Noise Criteria (NC) curves or Room Criteria (RC) curves, as listed below:
 - .1 Other Spaces NC 30
- .3 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames for diffusers, located in plaster surface.
 - .3 Concealed fasteners.
- .4 Concealed manual volume control damper operators.
- .5 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.
- .6 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.
- .7 Refer to equipment schedule for specification of air outlets.
- .8 Colour: as directed by Departmental Representative.

2.2 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 Sidewall and ceiling exhaust grilles shall have streamlined blades, depth of which exceeds 20 mm spacing. Provide spring tension or other device to set blades. Provide units with horizontal face.
- .2 Provide 25 mm narrow margin frame with countersunk screw holes.
- .3 Fabricate of steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or heavy aluminum extrusions.
- .4 Provide exhaust grilles, with integral, gang-operated opposed blade dampers with removable key operator, operable from face, where indicated.
- .5 Finish in factory baked enamel finish, colour by Departmental Representative.

2.4 GRID CORE RETURN AND EXHAUST GRILLES

- .1 Fabricate fixed grilles of 13 mm x 13 mm x 13 mm louvres.

- .2 Provide 32 mm margin frame with lay-in frame for suspended grid ceilings.
- .3 Fabricate of aluminum.
- .4 Provide exhaust grilles, where not individually connected to exhaust fans, with integral, gang-operated opposed blade dampers with removable key operator, operable from face, where indicated.

2.5 LOUVRED SUPPLY GRILLES

- .1 Ceiling supply grilles shall have streamlined and individually adjustable curved blades to discharge air along face of grille. Units shall have two-way deflection.
- .2 Provide 25 mm narrow margin frame with countersunk screw holes.
- .3 Fabricate of heavy aluminum extrusions.
- .4 Provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face, and equalizing grid, where indicated.
- .5 Finish in factory enamel finish, colour as selected by Departmental Representative.

2.6 OUTSIDE LOUVRES

- .1 Refer to Section 23 37 20 - Louvres, Intakes and Vents.

2.7 LINEAR FLOOR SUPPLY REGISTERS/GRILLES

- .1 Type: Streamlined blades with 0 or 15 degree deflection (refer to schedule), 3 x 19 mm on 13 mm centres.
- .2 Frame: heavy duty frame with countersunk screw mounting
- .3 Fabrication: Steel, welded construction with factory baked enamel finish.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with oval head, stainless steel screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, where indicated.
- .4 With security grilles, contractor shall use high yield grout to fill any space between back of the face plate and the mounting surface.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
 - .1 ANSI/NFPA 96-04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .5 Society of Automotive Engineers (SAE)

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Test Reports:

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

2 Products

2.1 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth. Blade and frame fillet welds concealed from view.
- .2 Material: extruded aluminum alloy 6063-T5; blades and frames minimum 2.7 mm thick.
- .3 Blade: stationary with drainable gutters, reinforcing bosses and maximum blade length of 1500 mm or manufacturer's recommendations.
- .4 Frame, head, sill and jamb: 100 or 150 mm deep one piece extruded aluminum, minimum 2 mm thick with approved caulking slot, integral to unit. Depth as indicated. Frames shall be jointed at each corner with full length weld.
- .5 Mullions: at 1500 mm maximum centres, visible vertical mullions.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel. Colour: as selected by Departmental Representative.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.

- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
 - .1 ANSI/NFPA 96- 1994, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.1- 1992, Gravimetric And Dust Spot for Testing Air-cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10- M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.11- M85, Filters, Air, High Efficiency, Disposable, Bag Type (Reaffirmed April 1985).
 - .3 CAN/CGSB-115.12- M85, Filters, Air, Medium Efficiency, Disposable, Bag Type (Reaffirmed April 1985).
 - .4 CAN/CGSB-115.13- 85, Filter Media, Automatic Roll (Reaffirmed April 1985).
 - .5 CAN/CGSB-115.14- M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .6 CAN/CGSB-115.15- M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .7 CAN/CGSB-115.16- M82, Activated Carbon for Odor Removal from Ventilating Systems.
 - .8 CAN/CGSB-115.18- M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
 - .9 CAN/CGSB-115.20- 95, Polarized Media Air Filter.
- .4 Underwriters' Laboratories of Canada
 - .1 ULC -S111- M80, "Fire Tests for Air Filter Units".
 - .2 ULC-S649-1993, Grease Filters for Commercial and Institutional Kitchen Exhaust Systems.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawing and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Filters shall be product of and supplied by one manufacturer. Filter components assembled to form filter banks shall be products of same manufacturer.
- .2 Filter media shall be UL listed, Class I or Class II, as approved by local authority.

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

1.6 ALTERNATIVES

- .1 Size, media face area, Merv rating, initial and final resistance of alternative manufacturer's shall be same as type specified.

1.7 EXTRA MATERIALS

- .1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Departmental Representative , supply one complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals. Total number of filters for each and every filter bank as follows:
 - .1 One set for testing, balancing and commissioning.
 - .2 One set to be installed at acceptance.
 - .3 One spare set to be used by Owner during first year of operation.

2 Products

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50 °C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.
- .4 Fire rated to: ULC S111
- .5 Final filters for all supply air systems shall be MERV 14 to meet LEED requirements.

2.2 ACCESSORIES

- .1 Seals: to ensure leakproof operation.
- .2 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .3 Access and servicing: through doors/panels on each side and/or from upstream or downstream face of filter bank.

2.3 FIBROUS GLASS PANEL FILTERS

- .1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.
- .2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diam hinged wire mesh screen.
- .3 Performance: as indicated, to ASHRAE 52.2.
- .4 Fire rated: to ULC -S111.
- .5 Nominal thickness: as indicated.

2.4 COTTON PANEL FILTERS

- .1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.
- .2 Holding frame: galvanized steel, or slide in channel for side access.
- .3 Performance: as indicated, to ASHRAE 52.2.
- .4 Fire Rated: to ULC -S111.
- .5 Nominal thickness: as indicated.

2.5 FILTER GAUGES - MANOMETER TYPE

- .1 Direct Reading Dial: 90 mm diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0 Pa to two times initial pressure, 2 percent of full scale accuracy.
- .2 Inclined Manometer: One piece moulded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0 Pa to two times initial pressure, 3 percent of full scale accuracy.
- .3 Accessories: Static pressure tips with integral compression fittings, 6 mm aluminum tubing, 2-way or 3-way vent valves.

2.6 RIGID, SUPPORTED BAG TYPE FILTERS

- .1 Media: disposable preformed fibrous glass, cartridge with approximately 4.6 sq.m. (50 sq.ft.) of media per 472 l/s capacity (1000 CFM).
- .2 Holding frame: galvanized steel with bracing. Provision for front mounted panel pre-filter and front or rear removal of filter media.
- .3 Media support: welded wire grid.
- .4 High efficiency: to CAN/CGSB-115.11.
- .5 Medium efficiency: to CAN/CGSB-115.12
- .6 Nominal thickness: as indicated.

2.7 CARTRIDGE FILTERS

- .1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.

2.8 FILTER FRAMES AND HOUSINGS

- .1 General: Fabricate filter frames and supporting structures of 1.50 mm (16 gauge) galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.
- .2 Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.
- .3 Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 1.5 mm galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary and secondary filters with positive sealing gaskets.

3 Execution

3.1 INSTALLATION GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.
- .2 Filter banks shall have removal and access indicated.
- .3 Do not operate fan systems without filtration in place.

3.2 REPLACEMENT MEDIA

- .1 Replace all media with new upon acceptance.
- .2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.3 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and components for electric-resistance furnaces.
- .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.1-92, Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI approved).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Provinces of Saskatchewan, Canada.
 - .2 Include:
 - .1 Physical dimensions.
 - .2 Filter accessibility.
 - .3 Fan configuration.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

- .3 Sustainable Requirements:
 - .1 Construction requirements: in accordance with Section 01 47 15 - Sustainable Requirements: Construction.
 - .2 Verification: contractor's verification in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification.

2 Products

2.1 ELECTRIC FORCED AIR FURNACES

- .1 Cabinet: die-formed, cold-rolled steel,
- .2 Heater elements: nickel chrome, oversized heaters for rapid heat transfer, plug in modules to facilitate servicing.
- .3 Blower: centrifugal type permanently lubricated multi-speed, capacity as indicated. Blower to be complete with vibration isolation and balanced.
- .4 Motor: electronically commutated motor. Motor and fan accessible for service, mounted on steel frame secured with resilient mountings.
- .5 Filters: disposable fibreglass type in removable frame.
- .6 Unit to have integral time delay sequencers to prevent power surges and integral breakers to protect from overcurrent.
- .7 Cabinet finish: baked epoxy powder paint finish.
- .8 Unit shall be CSA certified.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install furnace.
- .2 Locate furnace allowing accessibility for service and filter change.
- .3 Check for free rotation of fan.
- .4 Ensure alignment of fan and motor pulleys.
- .5 Ensure proper belt tension.
- .6 Make connections to line, thermostats, humidistat in accordance with manufacturer's instructions.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Cabinet convector heaters, controls and installation.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.46-M1988(R2001), Electric Air-Heaters.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit product data sheets for cabinet convector heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
 - .9 Wiring diagram.
 - .10 Matched stand alone controls.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .3 Closeout Submittals:
 - .1 Submit operation and maintenance data for cabinet convector heaters in accordance with Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 Products

2.1 ELECTRIC CABINET CONVECTOR HEATERS (BASEBOARD)

- .1 Wall mounted cabinet: to CSA C22.2 No. 46, pre-drilled back for securing to wall, slope top design.
- .2 Elements: Stainless steel sheath encloses a nickel chromium element compacted in a mineral insulation. Aluminum fins to be brazed to the surface. Element to have floating suspension to eliminate expansion noise.
- .3 Voltage – refer to schedule.
- .4 Wattage – refer to schedule.
- .5 Finish: Painted finish to be hybrid polyester epoxy powder coat process, Color - White
- .6 Construction: Front and top constructed of extruded aluminum equivalent in strength to 14 gauge steel, with punched air intake and exhaust vents. Cabinet back and bottom are fabricated from satin coat steel with multiple knockouts for convenient power connection. Endcaps are field removable for continuous heater installation. Unit to have full length wire way for convenient wiring

2.2 CONTROLS

- .1 Wall mounted thermostats: type line voltage to Section 23 09 33 - Electric and Electronic Control System for HVAC.
- .2 Unit to have built-in low voltage transformer, relay and disconnect matched to remote low voltage thermostat.
- .3 Power connection to be possible at either end of the heater

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install cabinet convectors as indicated.
- .2 Install wall mounted thermostats in locations indicated.
- .3 Make power and control connections.

3.3 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Commission system in accordance with requirements of Performance Verification.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.46-M1988, Electric Air-Heaters.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for unit heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
- .3 Submit product data sheets for unit heaters.
 - .1 Include product characteristics, performance criteria, physical size, limitations and finish.
- .4 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures and detailed installation instructions.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 Products

2.1 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.
- .3 Motor and Fan:
 - .1 Fan size and pitch is matched to the power and speed of the unit to optimize CFM, airflow, temperature rise, and quietness
 - .2 Motor is heavy duty, continuous operation, totally enclosed, thermally protected with permanently lubricated ball bearings.
- .4 Hangers: as indicated or required by manufacturers installation instructions..
- .5 Elements: To include metal tubular sheath fused with spiral steel fins and contain a high quality nickel chromium wire, encased in solidly packed magnesium oxide insulation

- .6 Cabinet: Constructed of 18 gauge die formed steel. Units to have individual adjustable 20 gauge convex profile air directing louvers. Louvers shall be friction fastened to a single piece 20 gauge frame to prevent movement, once adjusted to the desired position.
- .7 Finish: Polyester/epoxy powder coat, Colour – almond.
- .8 Refer to schedule for Voltage and Wattage.

2.2 CABINET UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with louvers finished to match cabinet.
- .2 Fan type cabinet unit heaters with built-in high-heat limit protection, fan-delay switches.
- .3 Motor and Fan:
 - .1 The fan motor to be totally enclosed and factory lubricated complete with a black anodized 5 blade mixed flow aluminum fan.
 - .2 Fan delay to be a bi-metallic snap action type
- .4 Hangers: as indicated or required by manufacturer's installation instructions. Unit to be recessed in wall, as indicated in drawings.
- .5 Elements: nickel chromium resistance wire heating element within a steel sheath. Spiral steel fins to be firmly brazed to the surface.
- .6 Cabinet: - Front panel constructed of 20 gauge steel. Recess box to be designed for recessing into either frame or masonry walls or ceilings and shall contain knockouts for wiring connections.
- .7 Finish: Polyester/epoxy powder coat, Colour – white.
- .8 Refer to schedule for Voltage and Wattage.
- .9 Access door to be lockable for tamperproof installation.

2.3 CONTROLS

- .1 Wall mounted thermostats: type line voltage to Section 23 09 33 - Electric and Electronic Control System for HVAC.
- .2 Units to have built-in low voltage transformer, relay and disconnect matched to remote low voltage thermostat.

3 Execution

3.1 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.
- .2 Install thermostats in locations indicated.

- .3 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.
- .6 Commission system in accordance with requirements of Performance Verification.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This Section covers items common to Sections of Electrical Contractor. This section supplements requirements of Division 00 – Procurement and Contracting Requirements, Division 01 – General Requirements, Division 02 – Existing Conditions.
- .2 Provide complete and fully operational electrical systems with facilities and services to meet requirements described herein, as shown on the drawings, and in complete accord with applicable codes and ordinances.
- .3 Only those items that are specifically indicated as not in contract (N.I.C.) will be omitted.
- .4 Contract documents of Divisions 26, 27, and 28 are diagrammatic and approximately to scale, unless detailed otherwise. They establish scope, material and installation quality, and are not detailed installation instructions.
- .5 Follow manufacturers' recommended installation details and procedures for equipment supplemented by details given herein and on plans subject to approval of the Consultant.
- .6 Examine all drawings to ensure that work under this Division can be properly installed without interference.
- .7 Where discrepancies, ambiguities, obvious omissions or errors have been made in drawings and specifications, it shall be the responsibility of the contractor to clarify same prior to tender closing. No allowance will be made after contract award for any expense incurred by him for having to adjust his work to properly conform.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 Audio Engineering Society (AES).
 - .8 Other Applicable CSA and UL approvals.

1.3 CODES AND STANDARDS

- .1 The electrical installation shall comply with all SaskPower requirements and regulations.

- .2 In the event of any inspection authority requesting deviation from the design, notify the Consultant and obtain approval before proceeding with any change.
- .3 In no instance, shall the standard established by the drawings and specification be reduced by any code or ordinance. All references to codes and standards shall be to the latest edition.

1.4 CARE, OPERATION AND START-UP

- .1 Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Connect to equipment furnished in other Divisions and by Owner including start-up and test.
- .3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.5 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235-83
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.6 PERMITS, FEES AND INSPECTION

- .1 Submit to SaskPower necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Consultant.

1.7 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 All goods and materials shall be new and carry CSA approval seal. Equipment and material shall be CSA certified. Where there is no alternative to supplying equipment which is not

CSA certified, obtain special approval from the Consultant and the Electrical Inspection Department.

- .3 All fire alarm equipment shall carry ULC approval seal.
- .4 No deviation from specified materials shall be allowed, except where alternative materials have been specifically accepted in writing.
- .5 Where materials are not directly specified by catalogue number and manufacturer's name, a high industry specification grade product shall be provided. The Consultant shall be the sole judge of whether this standard is being met.
- .6 All references to known standard specifications shall mean and intend the latest edition of such specifications.
- .7 Each major component of equipment shall have manufacturer's name, address, catalogue and serial number in a conspicuous place.
- .8 Upon request, provide a complete list of all materials and their manufacture. The contractor will be required to use the materials indicated. Changes in manufactures at a future date will not be acceptable.
- .9 Factory assemble panels and component assemblies.

1.8 WORKMANSHIP

- .1 All work under this Division shall be executed in a workmanlike and substantial manner, neat in its mechanical appearance and arrangement.
- .2 A competent representative shall constantly supervise the work of this Division from beginning to completion and final acceptance. So far as possible, the same supervisor and workmen shall be employed throughout the project's duration.
- .3 Material and workmanship not meeting the standard intended and required by this specification shall, upon instruction from the Consultant, be properly replaced without further charge or consideration.

1.9 ELECTRICAL DRAWINGS

- .1 They indicate the general location and route of conduit and cable to be installed. Conduit shall be installed in coordination with other services. These include both new and existing services. Prior to excavation anywhere on site, arrange to have all existing services marked. Where space is indicated for future equipment or plant use, leave space clear.
- .2 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to the satisfaction of the Consultant at no extra cost.
- .3 Ceiling and floor outlet symbols are scaled to centre line of symbol; symbol does not indicate the size or shape. Mounting height shall be measured to the lowest point on ceiling mounted equipments, and above finished surface for wall mounted equipment.

- .4 Wall outlets are scaled to the perpendicular centre line of the symbol. Mounting heights for all wall mounted outlets shall be measured to the horizontal centre line.
- .5 Where outlets are mounted in masonry walls, outlets should be mounted to the nearest coursing line.

1.10 WORK PROVIDED FOR OTHER DIVISIONS

- .1 Provide information as to exact size and location of all required, housekeeping pads and roof curbs required for the installation of equipment of Divisions 26, 27, and 28.
- .2 Provide information as to the location and exact size of all openings through floors and walls.
- .3 Provide information as to the location and exact size of all equipment supports required within walls, and roof support structure.
- .4 Provide electrical connections, circuit protection and disconnect devices for all equipment supplied by other Divisions, including the Owners. Provide motor starters, disconnect switches, thermal switches, etc., for motors supplied by mechanical contractor. Special control equipment being supplied by mechanical contractor shall be installed and wired by that contractor.

1.11 WORK PROVIDED BY OTHER DIVISIONS

- .1 All housekeeping pads and curbs required for the installation of equipment of Divisions 26, 27, and 28.
- .2 Installation and framing of all openings in walls or floors larger than 150 mm diameter, or rectangular, with one dimension greater than 150 mm.
- .3 Openings in millwork for electrical outlets and conduits.
- .4 Painting of all panelboard and communication panel trims to match colour scheme where exposed in finished areas.
- .5 Firestopping shall be the responsibility of the General Contractor.

1.12 WORK NOT PROVIDED BY THIS DIVISION

- .1 Control wiring for Mechanical Contractor equipment beyond terminal section of each motor control centre, unless specifically indicated otherwise.
- .2 Other work as noted on drawings or specified herein.

1.13 COORDINATION WITH OTHER DIVISIONS

- .1 Cooperate fully with the Consultant and other trades of electrically operated equipment to ensure proper arrangement of and provision for all electrical equipment.
- .2 Where outlets or equipment may affect architectural or site treatment desired, contact Consultant and for instructions or detailed drawings.

- .3 Refer to other Divisions including mechanical, millwork, kitchen equipment, owner supplied equipment, etc, for electrical work in connection with these drawings and specifications.
- .4 Location of lighting outlets and receptacles in mechanical or equipment rooms and similar areas shall be finalized during construction to give optimum arrangement. The Consultant shall approve final location before installation.
- .5 Supply and install all motor connections, including starters and overload protection and disconnecting devices at motors where required. All motor driven equipment shall be provided with a lockable disconnecting device within line of site of the motor to be disconnected.
- .6 Supply and install complete wiring requirements for full voltage in-line devices on single phase equipment such as thermostats, multi-speed switches for unit heaters, force flows, cabinet heaters, etc.
- .7 Cutting of openings for electrical outlets in millwork and other similar types of custom-made equipment shall be done by the supplier of this equipment.
- .8 Check other Divisions to ensure that suitable provisions have been provided for all motors. It is possible that some motors may vary in size, numbers and characteristics, depending on the equipment manufacturer's specific requirements. Any variations in this regard will not constitute cause for further consideration. The mechanical coordination schedule supplied on the drawings shall be updated with nameplate specifications.
- .9 Assume full responsibility for layout of this work and for any damage caused the Owner or other Divisions by improper location or carrying out of this work.
- .10 Before commencing work, examine the work of other Divisions, and report at once any defects or interference affecting the work under this Division, or the guarantee of same.
- .11 Location of lighting outlets and receptacles in mechanical or equipment rooms and similar areas shall be finalized during construction to give optimum arrangement. The Consultant shall approve final location before installation.
- .12 Allow for all hoisting and setting of material and equipment.

1.14 OWNER SUPPLIED EQUIPMENT

- .1 Connect all electrically operated equipment supplied by the Owner, as designated on the drawings.
- .2 Reconnect all existing electrical services from new and existing electrical sources modified by the work of this contract.

1.15 INSPECTION AND TESTING

- .1 During construction and up to final acceptance, make accessible any equipment or wiring for inspection purposes.

- .2 All electrically operating equipment shall be left as a complete installation in perfect operating condition, and receive final test in the presence of the Consultant.
- .3 Ensure that all power circuitry is properly tested and meets the CSA Ground Resistance Requirements. For any 600 volt systems, a 600 volt megger or hi-pot procedures shall be used for all such tests. Provide documentation for each test within maintenance/commissioning manuals.
- .4 On the request of the Consultant, a staff supervisor shall be made available to assist in this inspection work.
- .5 At the completion of the installation, voltage tests shall be conducted in the presence of the Consultant. Transformer taps shall be adjusted, and any other corrective measures implemented to assure the proper operation of all electrical equipment. Provide documentation for each test within maintenance/commissioning manuals.
- .6 Acceptance tests and commissioning shall be conducted for systems and/or equipment where indicated in the specifications and other standards referenced herein. Acceptance tests shall include, but not be limited to, the following Sections.
 - .1 26 09 24 – Low Voltage Lighting Control Devices
 - .2 26 32 10 – Diesel Generating Unit
 - .3 26 36 23 – Automatic Transfer Switches
 - .4 27 05 14 - Communication Cables Inside Buildings
 - .5 27 05 28 – Pathways for Communication Systems
 - .6 27 11 19 - Communications Termination Blocks and Patch Panels
 - .7 28 31 01 - Fire Alarm System
- .7 Acceptance tests shall meet requirements as required by manufacturer, as outlined in ANSI – NETA 2007 and additional requirements described on drawings and specified herein. All tests shall be documented as per ANSI – NETA 2007 standards and shall include testing results, testing date, testing technician and representative present.
- .8 Acceptance tests shall be made up of the following:
 - .1 Shop Drawing Information Sheets
 - .2 Manufacturer Commissioning and Report
 - .3 Manufacturer Test Reports, Factory and On Site where required
 - .4 Test Results not forming part of the Static Review Checks Sheets
 - .5 Owner / Consultant Demonstration Sheets
 - .6 Training
- .9 Certification of all acceptance tests and commissioning shall be submitted to the Consultant for approval. Tests not conducted to the satisfaction of the Consultant shall be repeated, and no further costs will be considered. Written documentation bearing name and signature of Contractor, Consultant and Owner's personnel present during acceptance tests shall be included in certification reports. Provide for a minimum of six (6) hours across three (3) separate meetings with Consultant and Owner for review of acceptance test sheets.

1.16 SHOP DRAWINGS

- .1 Submit shop drawings, where specifically called for, or as requested. Shop drawings shall show detailed dimensional and technical information, and shall properly describe each piece of equipment. Where applicable, shop drawings shall include complete schematics and wiring diagrams. These shop drawings shall be sufficiently detailed to permit the Owner's technicians to trouble-shoot and repair the equipment. Equipment shall not be ordered and/or fabricated until shop drawings have been reviewed by the Consultant. Shop Drawings shall include, but not be limited to the following Sections on systems and equipment:
 - .1 26 05 36 - Cable Trays
 - .2 26 23 00 – Low Voltage Switchboards
 - .3 26 24 17 - Panelboards Breaker Type
 - .4 26 27 26 - Wiring Devices
 - .5 26 28 14 - Fuses - Low Voltage
 - .6 26 28 21 - Moulded Case Circuit Breakers
 - .7 26 28 23 - Disconnect Switches - Fused and Non-Fused
 - .8 26 29 10 - Motor Starters
 - .1 26 32 10 – Diesel Generating Unit
 - .2 26 36 23 – Automatic Transfer Switches
 - .9 26 50 00 – Lighting
 - .10 26 52 00 - Emergency Lighting
 - .11 26 53 00 - Exit Signs
 - .12 27 00 00 - Communication Requirements
 - .13 27 05 14 - Communications Cables Inside Buildings
 - .14 27 05 28 - Pathways for Communication Systems
 - .15 27 11 19 - Communications Termination Blocks and Patch Panels
 - .16 28 31 01 - Fire Alarm System
- .2 Review of shop drawings shall be for general design, arrangement and appearance only. This Division shall check and correct, if necessary, all manufacturer's drawings before submitting, and shall so indicate on each copy, along with a dated approval stamp. All shop drawings must bear an approval stamp and be signed by the Contractor. This review does not relieve this Division from the responsibility for the final installation being correct in all detail, and fully acceptable to the Consultant. Refer to each section for further shop drawing information.
- .3 Refer to General Conditions of the Contract.
- .4 Provide nine (9) printed copies and one PDF copy for each Section. Each shop drawing shall be complete with a cover page with the following information:
 - .1 Specification Section and name
 - .2 Project name, Owner's name and address
 - .3 Number of pages in submittal
 - .4 Contractor and Supplier's name and contact information
 - .5 Approval stamps with room for Consultant's stamp

- .5 Shop drawings for complementary systems and/or equipment shall be submitted at the same time. Partial submittals of related equipment will be rejected or held until all other related shop drawing information has been submitted (i.e. submit all shop drawings for power equipment at the same time). Submittals of shop drawings that are incomplete will be rejected.

1.17 CHANGES

- .1 Refer to General and Supplemental Conditions.
- .2 Submit complete itemized breakdowns of all extras, deletions, and changes to the Consultant. Breakdown shall include quantities, unit costs and extensions. If requested, support claim by certified copies of supplier's invoices.
- .3 The right is reserved to move equipment 3000 mm from location shown without further charge or consideration, provided that such re-location is requested prior to finish being applied.

1.18 CONSULTANT PRICES

- .1 Electrical progress claims shall be made on Contractor Progress Report #ES110 provided by the Consultant. A copy of this Progress Report is attached for reference. The Electrical contract price shall be broken down into thirteen (13) parts to facilitate assessment of work done and material supplied. This progress claim shall be submitted simultaneously to the General Contractor and the Consultant, the latter case in duplicate. Refer to General Conditions.
- .2 The breakdown shall indicate labour and material to the nearest dollar. Overhead, profit and job expense shall be apportioned to all parts. The breakdown shall be as follows:
 - .1 Main services
 - .2 Distribution/Panels
 - .3 Conduit and boxes
 - .4 Wire and cable
 - .5 Motor control
 - .6 Wiring devices
 - .7 Lighting fixtures and lamps
 - .8 Communications systems
 - .9 Security Systems
 - .10 Fire Alarm System
 - .11 Specials
 - .12 Miscellaneous - 8% maximum
 - .13 Extras and credits. (Extras in excess of \$1,000 shall be broken down into the above points on a separate ES110 sheet)

1.19 OPERATING INSTRUCTIONS AND SERVICE MANUALS

- .1 Upon completion of the installation, provide complete and comprehensive identical sets of operating and maintenance manuals.

- .2 The Consultant shall review the operating and maintenance manuals and approve same prior to the manuals being sent to the Owner.
- .3 The operating and maintenance manuals shall include but not be limited to the following information when applicable in the project:
 - .1 Certification reports.
 - .2 Documentation indicating Owner's receipt of operating instructions.
 - .3 Complete list of all materials turned over to the Owner c/w receipts for same.
 - .4 Shop drawings properly indexed and contained in suitably sized binders.
 - .5 Schematic drawings for all systems indexed and contained in suitably sized envelopes or attached efficiently in the above binders.
 - .6 Catalogue brochures for light fixtures, panelboards, switches, receptacles, fuses, etc.
 - .7 All final settings of equipment that has user adjustable settings.
 - .8 Overcurrent coordination and arc fault study and documentation of associated tests.
 - .9 Phase rotation confirmation by the Contractor.
 - .10 Certificate of Owner's training.
 - .11 Acceptance Testing and Commissioning reports.
 - .12 Listing of any spare devices turned over to Owner

The above information shall be bound in binders as noted in specifications. Incomplete or poorly reproduced manuals will be rejected.

- .4 Maintain, on a daily basis, a complete set of marked-up prints as as-built drawings that show in complete detail the final arrangement and location of all electrical components and the interconnecting wiring.
- .5 All riser conduits (size and routing), panel feeds (size and routing), conduit runs (size and routing) and main communications (size and routing) shall be marked on plans. These are to be maintained in a neat and substantial manner, so as to properly and fully illustrate the way in which the installation has been completed.
- .6 All equipment locations such as fire alarm signal boosters, cable termination boxes, signal amplifiers, network switches, door controllers, etc shall be identified on the drawings as to their location and quantity (if more than one exists at that particular location).
- .7 The Owner's personnel shall be instructed in the operation and maintenance of the following equipment to the satisfaction of the Owner as per the standards referenced herein.

<u>Section No.</u>	<u>Description</u>	<u>Hours</u>
26 09 24	Low Voltage Lighting Control	2
26 29 10	Motor Starters	1
26 50 00	Lighting	1
26 29 10	Motor Starters	1
26 32 10	Diesel Generating Unit	4
26 36 23	Automatic Transfer Switches	1
52 00 00	Emergency Lighting	1
27 00 00	Communication Requirements	1

27 11 19	Communications Termination Blocks and Patch Panels	1
28 31 01	Fire Alarm System	2

- .8 The above instructions shall be given by personnel experienced in the operation of the particular system or equipment. Each item or type of equipment, and all controls, shall be operated in the presence of the Owner's personnel to ensure their understanding of equipment function and individual working parts. The Owner reserves the right to set the period or periods during which the instruction shall be given. The contractor shall submit a program of instruction for approval by the Owner.
- .9 Operating and maintenance manuals shall include written documentation bearing name and signature of Owner's personnel who received the above instructions. Contractor shall allow for all training to be completed in a minimum of two sessions. One session at substantial completion, and one session within three months of turning over the system.
- .10 Operating and maintenance manuals, as well as all Owner instructions, shall be complete before substantial completion (as outlined by the Builders' Lien Act) will be considered. Also, preliminary maintenance manuals must be submitted prior to 70% completion. No further progress payments will be permitted until these preliminary maintenance manuals have been submitted and approved.

1.20 STORAGE AND PROTECTION

- .1 Maintain and protect all work provided under this Division. Store all materials within a protected enclosure to prevent exposure to weather or construction dirt.
- .2 Protect all finished and unfinished work of this and other divisions from damage during the course of construction. Cover floors and other surfaces, if necessary. Any damaged work or finishes shall be repaired or replaced without further charge to the Owner.

1.21 WARRANTY

- .1 All materials and workmanship shall be guaranteed for a period of one year from date of substantial completion.
- .2 Properly repair and replace all defective work and other work which becomes defective during the term of warranty.
- .3 Service on equipment or systems critical to the Owner's operation shall be provided on an emergency basis which may necessitate overtime and service outside of normal working hours. The contractor shall ensure that all suppliers comply with this requirement.

1.22 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is provided by the Electrical Contractor except for conduit, wiring and connections below 50 V which are related to control systems specified in Mechanical Division and shown on mechanical drawings.

1.23 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor switchboards and distribution enclosures light grey ASA 61.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.24 ABBREVIATIONS

- .1 Abbreviations used in this specification are common to and in general use within the related trades.

1.25 EQUIPMENT IDENTIFICATION

- .1 Nameplates shall be provided on each new piece of electrical equipment, including, power panels, distribution panels, lighting panels, transformers, disconnect switches, contactors, telephone panels, miscellaneous systems and panels.
- .2 Nameplates for each new electrical panel shall indicate panel designation, mains voltage and panel and circuit number from which this panel is fed.
- .3 Nameplates for new disconnects and contactors shall indicate equipment being controlled, and voltage.
- .4 Nameplates for new terminal cabinets shall indicate system and voltage and load of area served.
- .5 Nameplates for Normal Power Equipment shall be made from black-white-black Lamecoid with bevelled edges and white engraved letters. Nameplates shall be fastened with self tapping metal screws to equipment in a conspicuous location. Flush mounted panels shall have nameplate located on front of panel behind hinged door.
- .6 Typical identification standards shall be used for new equipment throughout the project as follows:
 - .1 Lighting, receptacle and power panels shall each be identified with an engraved Lamecoid plate secured to top interior trim as:

Panel 202	10 mm high lettering
120/208 volts	6 mm high lettering
Fed from	6 mm high lettering
 - .2 Each panel shall be supplied with a directory card holder welded to inside of door, complete with a neatly typewritten list showing information as follows:

Panelboard name	202
Panel voltage	120/208 volts

<u>Circuit Number</u>	<u>Description</u>	<u>Load</u>
1	Lighting Room 200 (Main Area)	1200W
2	Receptacles Room 200 (Main Area)	6-15A
3	Room 220	1/3 H.P. Fan

Spaces and spares shall be left blank so as to facilitate future description. Also, existing panels where adjustments have been made in the circuitry shall be field checked in their entirety and new directory cards shall be provided.

- .3 List shall be covered with a 1 mm thick clear plastic sheet to protect it.
- .4 Other cabinets and plywood back boards for low voltage systems, such as signals and communications, shall be identified as panelboards with a directory showing circuit numbers and room locations, plus a blank for "Remarks", as well as a Lamecoid plate designation panel name.
EXAMPLE: if cabinet is for telephone
.....TP - 2nd floor
- .5 Equipment not listed above, such as incoming service cables, communicating cables, switchgear, transformers, disconnects, motors, instruments, fire alarm and control panels, shall be identified in a similar manner, showing name and number of the equipment, voltage and load information.
- .7 Feeder pull boxes and junction boxes shall be identified with waterproof ink, showing feeder or system concerned. Conduit entering junction boxes for communications systems shall be identified with the room number that each conduit serves.
- .8 A small dab of paint shall be applied to inside of each outlet box, pull box and panel as it is installed, using colour code as follows:

Red	- Fire Alarm System
Yellow	- Security, Alarm Systems, Card Access
Green	- Telephone/IT Computer Systems

The outside of the box shall also be identified in this way so as to readily determine the system within the conduit system. The cover of each junction box for branch circuits shall describe the voltage being used by means of a waterproof ink.
- .9 No colour code is required for regular lighting and power circuits, but voltage class shall be displayed on all pull boxes and panels.
- .10 Junction boxes in furred ceilings shall be colour identified on both inside and outside.
- .11 Connections in equipment shall be made Phase 'A', 'B', 'C', from left to right when viewing wiring from front or accessible direction.
- .12 Colour coding shall be carried through from incoming utility supply down to and including panels, and shall be as follows:

- .1 Incoming utility service lines shall be identified by Red - Phase 'A'; Black - Phase 'B'; Blue - Phase 'C'; with colour coded PVC tape.
- .2 Switchgear buswork in each switchboard and unit substation cubicle shall be banded with 3M tape identified in accordance with service lines colour coding. In addition, where neutral bus is introduced, it shall be banded white. Ground bus shall be banded green.
- .3 Feeder and sub-feeder bus or conductors shall be banded as above.
- .4 Lighting and power panels shall conform to the Canadian Electrical Code, and shall have main bus banded with tape as follows:

Red	-	Phase 'A'
Black	-	Phase 'B'
Blue	-	Phase 'C'
White	-	Neutral
Green	-	Ground

- .13 Each cover plate shall have an engraved label or riveted Lamecoid approximately 8 mm x 30 mm, and contain the panel and circuit number in 4 mm high lettering. The cover plates for all receptacles designated on the drawings for housekeeping purposes shall also contain the wording "Housekeeping". The cover plates for all receptacles fed from the ground fault interrupters shall also contain the wording "G.F.I."
- .14 The circuits controlled by all light switches shall be neatly printed with waterproof ink on the side of the switch outlet box so that the panel and circuit number are clearly legible when the coverplate is removed. It shall not be necessary to remove the switch from the outlet box in order to read the panel or circuit number.

1.26 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 All data cables and data jumper cables (minimum 23 gauge), jacks and connector boots installed as part of this project used for Security Systems, whether CAT 6A or fibre optic, shall be BRIGHT GREEN in colour.
- .6 All patch cables are to be stranded cable with RJ45 connectors. RJ45 connectors shall not be attached to solid conductor cable.
- .7 All installed runs of CAT 6A cable are to be solid conductor cable and terminated into patch panels in equipment racks or faceplates in other locations.
- .8 An installed cable is any cable that is run through a conduit, run from one area in a building to another area or any cable that travels farther than the adjacent equipment cabinet in a series of

cabinets. Note: Equipment cabinets must be abutting without side panels to open connection to be considered adjacent.

1.27 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.

1.28 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.29 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible, after equipment is installed.

1.30 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department and Owner.
- .2 Decal signs, minimum size 175 x 250 mm.

1.31 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with drawings and specifications.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and electrical on latch side of door.

1.32 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise or as noted on drawings.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 450 mm.
 - .2 Above top of counters or counter splash backs: 150 mm.
 - .3 In mechanical rooms: 1400 mm.

- .3 Fire alarm stations: 1200 mm.
- .4 Fire alarm horn/strobe: 2100 mm.

1.33 LOAD BALANCE

- .1 All lighting panels, distribution centres, motor control centres and main switchboards shall be load balanced such that the maximum variation between the two worst phases does not exceed 5%.
- .2 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .4 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.34 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .4 All conduit and tray sealing shall be the responsibility of the Electrical Contractor.

1.35 TEMPORARY AND TRIAL USAGE

- .1 Temporary and trial usage by the Owner, or the Contractor, of any of the electrical apparatus or equipment, or any work or materials supplied under this Division before final completion and written acceptance, is not to be construed as evidence of acceptance of same by the Owner.
- .2 Temporary and trial usage may be made as soon as this Division deems the work sufficiently advanced for making a complete and thorough test of same, and that no claim may be made for the injury to or the breaking of any part of such work which may be so used, whether caused by weakness or inaccuracy of structural parts, or by defective material or workmanship of any kind.
- .3 Lighting shall not be used for temporary or trial usage without prior approval of the owner and consultant sign off. If temporary lighting is required for the duration of the project, only construction lamps marked with a permanent ink on the lamp may be used. Evidence of marking will be requested by the consultant. Any fixtures used for temporary or trail usage shall be relamped and cleaned. Evidence of cleaning and relamping will be required by the consultant.

1.36 EXCAVATION AND BACKFILL

- .1 Any excavation and backfilling work that is necessary to accommodate the work under this Division shall be the responsibility of Divisions 26, 27, and 28, in accordance with the requirements of Division 31.
- .2 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.
 - .2 Departmental Representative has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
- .3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .4 Do not use backfill material which is frozen or contains ice, snow or debris.

1.37 TEMPORARY LIGHT AND POWER

- .1 The General Contractor shall be responsible for all temporary light and power provisions. Refer to General Conditions.

1.38 MATERIAL TO BE TURNED OVER TO THE OWNER

- .1 All equipment that is being removed or replaced shall be stockpiled as per Owner's request. The owner may deem that the equipment shall be disposed. All disposal and removal is the responsibility of the contractor.
- .2 Materials as indicated in various sections of this specification shall be turned over to the Owner. These materials shall include, but not be limited to the following:
 - .1 Obtain a signed receipt for each item turned over to the Owner. Include receipts in the operating and maintenance manuals.
 - .2 One set of three fuses for each fuse type and size for each switchboard distribution centre and motor control centre.
 - .3 One set of contacts and one holding coil for each size and type of FVNR motor starter.
 - .4 Spare lighting fixtures.
 - .5 Spare Fire Alarm Devices.
 - .6 Data patch cables.

1.39 SITE EXAMINATION AND REVIEW OF WORK

- .1 It is recommended that the contractor visit the existing site during the tendering period to familiarize himself with the construction conditions and electrical work provided to date. The contractor shall thoroughly satisfy himself that the work contained in these drawings and specifications can be carried out and that all costs have been included in the tender submitted.
- .2 The Contractor shall review all sets of tender documents associated with the project to ensure that they have an idea as to the scope of work involved in the other trades and to assist with their coordination of required interface procedures and inter-connection requirements.

1.40 SITE WORK

- .1 The electrical contractor shall be responsible for all necessary trenching and backfilling for all exterior work in connection with underground feeders. All trenches shall be a minimum 900 mm deep or to top of bedrock. Care must be exercised to ensure a proper grade line is used, and that suitable drainage has been provided.
- .2 All excavated material shall be removed from the site.
- .3 Trenches shall be filled with granular fill and compacted to 95% proctor. Prior to backfilling, all trenches must be inspected by the Consultant.
- .4 Supply and install all cable and conduit in trenches, as described herein or detailed on the drawings.
- .5 Electrical contractor shall be responsible for all concrete and reinforcing in connection with site lighting and car parking pedestals. All concrete and reinforcing on the project shall be in accordance with the quality required for reinforced concrete and reinforcing as specified under Division 3, and as detailed on the drawings.

1.41 CUTTING AND PATCHING

- .1 Should any cutting or repairing of either unfinished or finished work be required, the contractor shall employ the particular trade whose work is involved, to do such cutting and patching, and shall pay for any resulting costs.
- .2 All holes within buildings shall be fire stopped when penetrating a fire rated structure.
- .3 Provide re-usable fire stopping sleeves for all locations where data/voice cables penetrate a fire rated structure.

1.42 PAINTING

- .1 All iron or steel structures fabricated and installed by Divisions 26, 27, and 28 for supporting panels, starters, conduit or other equipment, shall be wire brushed and given one coat of lead chromate paint primer before being set into place. After all equipment is installed and piping complete, this iron work shall be given two coats of ASA #61 enamel to match the panel or structure being supported or in the colour specified for the product.
- .2 All pull boxes, wireways, gutters, etc., fabricated for Divisions 26, 27, and 28, shall be given a coat of lead chromate primer and two coats of ASA #61 enamel before installation to match equipment finish.
- .3 All panels and pull boxes that are set in finished walls or ceilings shall have approved flush covers that shall be prime coated with lead chromate paint, and left for the painting division to paint in with the surrounding wall or ceiling finishes. Panel trims and pull box covers to be painted with the cover removed from the wall so that it can be easily installed or removed without damaging the surrounding paint finish.
- .4 All electrical equipment shall be finished with an ASA #61 enamel, the colour of which shall be grey, unless otherwise specified.

- .5 When installation is complete, all scratches and defects to the paint finishes shall be properly touched up, and where necessary, entire paint surfaces shall be re-done.

1.43 MATERIAL SAFETY DATA AND HAZARDOUS MATERIALS

- .1 The Contractor shall provide material safety data sheets on all materials prior to shipping materials to site. These data sheets shall be submitted in triplicate to the Owner.
- .2 The Contractor shall coordinate and provide necessary information for the Owner's "Work Place Hazardous Material Information System".

1.44 SCHEDULING OF WORK AND DEMOLITION

- .1 Refer to Division 1 specifications.
- .2 Refer to the overall project schedule for further scheduling requirements.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

CONTRACTOR PROGRESS REPORT ES110



**Ritenburg &
Associates Ltd.**
Consulting Electrical Engineers

#200-2222 ALBERT STREET — REGINA, SASK. S4P 2V2
Phone: (306) 569-1303 Fax: (306) 569-1307

ELECTRICAL PROGRESS CLAIM No. _____

DATE _____ 20 _____

PROJECT _____

ELECTRICAL CONTRACTOR _____

GENERAL CONTRACTOR _____

PRIME CONSULTANT _____

SUBMITTED BY _____

REVIEWED BY: _____

DATE: _____ 20 _____

RECOMMENDED PAYMENT AS SHOWN ☐

AS CORRECTED ☐

REJECTED ☐

* Cross out if not applicable	TOTAL CONTRACT		COMPLETE TO DATE		THIS PROGRESS	
	MATERIAL	LABOR	MATERIAL	LABOR	MATERIAL	LABOR
A. MAIN SERVICE *HV, Duct Bank, Trans- formers, Switchboards						
B. DISTRIBUTION / PANELS *Distribution Centres, Dry Type Transformers, Fuses						
C. CONDUIT AND BOXES *Tray						
D. WIRE AND CABLE *Bus Duct						
E. MOTOR CONTROL						
F. WIRING DEVICES *Dimmers, Pac Poles, Low Voltage Switching, Cover- plates						
G. LIGHTING FIXTURES & LAMPS						
H. ALARM SYSTEMS *Fire, Security, Signal, Medical						
I. COMMUNICATIONS SYSTEMS *Intercom, Nurses' Call, Data/Telephones						
J. SPECIALS *Emergency Generator, Lightning Protection CCTV, UPS, Trench Duct						
K. MISCELLANEOUS — 8% Maximum						
L. EXTRAS & CREDITS (List price changes separately, use separate sheet if necessary)						
TOTAL						
SUMMARY TOTAL	Contract \$		To Date \$		This Progress	
	Contract GST \$		To Date GST \$		This Prog GST \$	
	Total Amount		Less Holdback		Less Holdback	
	Net Amount		Net Amount		Net Amount	

% COMPLETE _____

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 Audio Engineering Society (AES).
 - .8 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 26 05 01 – Common Work Results
- .2 Shop drawings shall include but not be limited to device types, cable types, and special mounting details.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors #10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

- .1 Connector body and stud clamp for round copper conductors.
- .2 Clamp for round copper conductors.
- .3 Stud clamp bolts.
- .4 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
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 - .7 Audio Engineering Society (AES).
 - .8 Other Applicable CSA and UL approvals.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 26 05 01 – Common Work Results
- .2 Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

1.3 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 BUILDING WIRES

- .1 All conductors shall be copper, minimum No. 12 gauge, unless specifically noted otherwise.
- .2 All non-housing building conductors #12 AWG to #8 AWG shall be rated for minimum 600V RW-90 XLPE. Conductors #6 AWG and larger shall be rated for minimum 600V RW-90 XLPE. All conductor for motor feeds from variable frequency drives, shall be rated for minimum 1000V RW-90 XLPE. Wiring in channel back of fluorescent fixtures shall be 600 volt Type GTF or TEW. Size, grade of insulation, voltage and manufacturer's name shall be marked at regular intervals.
- .3 All wiring shall be rated at 75 Deg C when connected to equipment rated 75 Deg C.
- .4 All cabling for housing units shall be NMD-90 cabling except where noted or specified as otherwise.
- .5 Wiring for major feeders may be NUAL aluminum and shall be installed only where specifically noted on the drawings.
- .6 Conductor utilized in conduit run under slab on grade or in conduit underground shall be Type 'RWU-90'.
- .7 Wire shall be as manufactured by Nexans, Alcan, Pirelli, BICC General Wire or Superior Essex.
- .8 NMD90 cables meet or exceed the requirements of all applicable ASTM specifications, CSA C22.2 No. 48 (non-metallic sheathed cable).
- .9 The construction is manufactured using annealed (soft) copper conductors—compressed stranding for the stranded conductors; a 90°C rated thermoplastic polyvinyl chloride (PVC) insulation and a nylon jacket for the individual conductors; and a PVC jacket surrounding the overall construction.

2.2 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
- .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V to 1000V as noted above.

- .4 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .5 Connectors:
 - .1 Watertight approved for TECK cable.
- .6 Gasoline Dispensing Station:
 - .1 Watertight and Hazardous Location Rated (HL) approved for TECK cable.
 - .2 All Teck90 Cable shall be HL rated.
 - .3 Provide adequate protection and strain relief for cables between stub-up and devices.
 - .4 All cables shall include grounding conductor.

Part 3 Execution

3.1 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information for the Intercom system for incorporation into manual specified in:
 - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
 - .1 Manufacture description sheet on each cable type

3.2 INSTALLATION OF BUILDING WIRES

- .1 Termination for #8 AWG and larger shall be by means of approved solderless connector lug. For parallel conductors, a common lug with separate termination for each conductor shall be employed.
- .2 Conductor splices shall be made in accordance with specifications. Provide sufficient length for joint remake, and no less than 200 mm spare length. On through wiring, leave 300 mm loop.
- .3 Wiring in cabinets, pull boxes, panels and junction boxes shall be neatly trained and held with nylon cable ties.
- .4 Conductors shall be tag identified where passing through junction boxes.
- .5 All housing unit wiring shall be installed as per residential wiring methods that comply with applicable Canadian Electrical Code and the local authority having jurisdiction.
- .6 The use of BX cabling is required for connections to such equipment as furnace, water heater, etc.

- .7 The maximum allowable conductor temperature for NMD-90 is 90°C. The minimum recommended installation temperature for NMD-90 is minus 25°C for two-conductor cables, and minus 10°C for three-conductor cables (with suitable handling procedures)
- .8 NMD-90 cable should be properly stored above 0°C for 24 hours prior to installation.
- .9 The maximum voltage rating for all intended applications is 300 volts.
- .10 After installation of all cable, wrap connectors having exposed conductive surfaces with plastic electrical tape, applying enough servings to provide uniform covering not thinner than the insulation of the largest conductor connected and overlapping the insulation of each connected conductor by not less than 12mm.

3.3 INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0-1000V.
- .3 All cables shall be terminated and spliced with suitable compression type connectors, as recommended by the cable manufacturer. The connectors shall satisfy the bonding and grounding requirements at the supply end.
- .4 All cables shall be single conductor and copper, unless otherwise specified.
- .5 All cable shall be rated for 600 volts (except for VFD output cable), insulated with cross-linked polyethylene and rated for operation at 90 degrees C. Cable shall have a FT4 rated outer jacket.
- .6 All cable shall meet the CSA requirements for cold bend and impact testing at minus 40 degrees C.
- .7 All cable shall be protected by a corrugated aluminum sheath or by interlocked aluminum armour. PVC jackets shall be required on all metallic sheathed cables.
- .8 The jackets shall meet the FT6 flame spread requirements and be identified on the P.V.C. jacket.
- .9 All cables shall be installed in accordance with the manufacturers recommendations, in suitable cable tray as specified within the specifications.
- .10 The cables shall be terminated at the supply end on a non-ferrous metallic plate and at the load end on a non-metallic rigid fibre board plate. The cable sheaths shall be bonded at the supply end only.
- .11 All cable installed in cable tray shall be installed at one diameter spacing.
- .12 When single conductor cables are direct earth buried they shall be spaced 150 mm apart.
- .13 Cables shall be manufactured by Nexans, Alcan, Superior Essex, General Wire or Pirelli.

3.4 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors 0-1000 V.
- .3 Conductors: insulated, copper, size as indicated.
- .4 Type: AC90 - Armour: interlocking type fabricated from aluminum strip.
- .5 Type: ACWU90 - jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .6 Connectors: as required.
- .7 Multi conductor cables shall be color coded during manufacture. Single conductor cables shall be color coded with adhesive colour coding tape. The tape shall be applied for a minimum of 75 mm at all terminations. Cables shall not be painted under any condition. Color coding shall be as follows:

Phase 'A' - Red

Neutral - White

Phase 'B' - Black

Ground - Green or Bare

Phase 'C' – Blue

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
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- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
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 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 Audio Engineering Society (AES).
 - .8 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Shop drawings shall include but not be limited to connectors used, specialty ground bars, etc.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 All ground rods shall be 20 mm diameter by 3000 mm long, copper clad.
- .3 Plate electrodes: galvanized steel surface area 0.2 m2, minimum 6 mm thick.
- .4 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .5 Insulated grounding conductors: green
- .6 Ground bus: copper, complete with insulated supports, fastenings, connectors.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
- .8 All ground conductors shall be bare or insulated, stranded, medium hard drawn copper wire. All insulated ground wires shall be green.
- .9 Exposed copper shall be cleaned to a bright surface, and shall be finished with two coats of clean, insulating varnish.
- .10 Connect ground conductor to copper water pipe at least twice (minimum 40 mm diameter), utilizing a Burndy Type GAR pipe clamp. Provide jumper across water meter.
- .11 All connections to the ground bus or risers shall be thermowelded, or shall utilize the Burndy Hy-Ground compression connections. Clamp type connections shall only be allowed to individual pieces of equipment.
- .12 Where bonds are covered with soil, the conductors are to be coated with anti-corrosion compound "Kopr-Shield" (Thomas & Betts Co.) before compression connector is applied. All bonding shall be done with 'C' tap and lug compression connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Electrical equipment and wiring shall be grounded in accordance with the Canadian Electrical Code, and local inspection authority's rules and regulations.

- .2 All metallic raceways and conduits for communications, cable and conductors shall be grounded.
- .3 All motors with flexible connections shall have separate ground wire run bridging the flexible connections. This ground wire shall be run from the motor back to the nearest junction box or motor control centre where the termination can be readily inspected. Insulation for this wire shall be green.
- .4 Lay-in trays and feeder conduits shall be connected to the ground bus.
- .5 All panel feeds (208 volt and 600 Volt) shall include a building network ground conductor.
- .6 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .7 Install connectors in accordance with manufacturer's instructions.
- .8 Protect exposed grounding conductors from mechanical injury.
- .9 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .10 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .11 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .12 Structural steel and metal siding to ground by welding copper to steel.
- .13 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections unless indicated otherwise.
- .14 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .15 Soldered joints not permitted.
- .16 Install separate ground conductor to outdoor lighting standards.
- .17 Make grounding connections in radial configuration only. Avoid loop connections.
- .18 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .19 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary systems.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, duct systems, frames of motors, starters, control panels, structure steel work, and distribution panels.

3.4 MAINTENANCE HOLES

- .1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each manhole.
- .2 Install ground rod in each manhole so that top projects through bottom of manhole.
- .3 Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

3.5 COMMUNICATION SYSTEMS

- .1 Install grounding connections for all communication and security systems as per manufacturer's recommendations

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform tests before energizing electrical system.
- .3 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .4 Connections to equipment shall be made with, bronze or copper bolts and connectors.
- .5 Equipment grounds shall be connected to the building grounding network. All non-current carrying metallic parts of equipment shall be connected to the ground network.
- .6 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
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- .2 Submit shop drawings in accordance with:
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- .3 Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

1.3 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended or set in poured concrete walls and ceilings.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to poured concrete with expandable inserts.
- .2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits, use channels spaced as required by C22.1.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.2 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information for the Intercom system for incorporation into manual specified in:
 - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
 - .1 Operation instructions
 - .2 Description of system operation
 - .3 Description of each subsystem operation
 - .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - .5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

3.3 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 Audio Engineering Society (AES).
 - .8 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
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- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters.

2.2 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

2.3 CABINETS

- .1 Sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

Part 3 Execution

3.1 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information for incorporation into manual specified in:
 - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
 - .1 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - .2 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

3.2 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.3 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal / bix block where indicated in cabinets.

- .4 Only main junction and pull boxes are indicated. Provide others as required by code. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

3.4 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase, Emergency, or Normal power.

3.5 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
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Part 1 General

1.1 GENERAL REQUIREMENTS

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 - .8 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
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- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Provide blank cover plates for boxes without wiring devices.
- .5 Provide combination boxes with barriers where outlets for more than one system are grouped.
- .6 Each outlet box installed in steel stud and gyproc walls shall be mounted on Caddy #BHA, series SGB or TSGB screw gun brackets. Wood strapping with steel studs shall not be utilized for supporting outlet boxes
- .7 Use condulets where 90° turn required on wall mounted conduit. They shall be of the type where cover screws do not enter the wire chamber and covers are left accessible.
- .8 Each outlet box installed in acoustic tile ceilings shall be mounted on double Caddy "Tee Bar Hanger" #512 in such a manner that the outlet box will not twist in any direction.
- .9 Where boxes are surface mounted in unfinished areas, such as furnace or boiler rooms, stamped galvanized steel 100 mm square box to accept #8300 series raised covers shall be used.
- .10 Where surface wiring methods are allowed and approved in finished areas, use Hubbell or Wiremold boxes as per drawings c/w suitable adapter for wireway entrance.
- .11 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.
- .12 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.
- .13 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .14 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.
- .15 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.
- .16 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.
- .17 Where required, provide voltage separation barriers.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.4 CONDUIT BOXES

- .1 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.
- .2 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.
- .3 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .4 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.
- .5 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.
- .6 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.
- .7 Where required, provide voltage separation barriers.

2.5 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Outlet boxes shall be supported independently of conduit capable of supporting weight of fixture or other device. Conduit entering the back of a box shall not enter the centre knockout.
- .6 For recessed fixtures in suspended ceilings, outlet box shall be accessible when fixture is removed.
- .7 Flexible conduit to fixture shall be minimum 12 mm diameter, and shall not emanate from outlet box cover. Maximum length of flexible conduit from outlet box to fixture shall be 3000 mm. Outlet box for fixture shall not be located above ducts, pipes, etc. Outlet box shall be within 750 mm (vertically) of the fixture.
- .8 Provide and set all special communications type back boxes associated with systems specified under Electrical Divisions.
- .9 In placing outlets, allow for overhead pipes, ducts, etc., and for variation in wall and ceiling finishes, door and window trim, panelling, etc.
- .10 Location of receptacle outlets in equipment rooms shall be finalized during construction to give optimum arrangement. Consultant to approve locations before installation.
- .11 Multigang boxes shall have each gang fully barriered from the next, or multiple single gang boxes may be used, provided they are installed in a neat, orderly fashion. Barriers shall be steel and shall be firmly held in place.

Attention is directed to special outlet box locations for switches requiring wider mount spacing rejection feature.

3.2 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information for incorporation into manual specified in:
 - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
 - .1 Operation instructions

- .2 Description of system operation
- .3 Description of each subsystem operation
- .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
- .5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

3.3 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
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END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
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 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 Audio Engineering Society (AES).
 - .8 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
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- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .4 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3
- .5 Conduit for use in corrosive atmospheres shall be rigid PVC or rigid steel with extruded PVC jacketed. Refer to drawings for areas requiring PVC.
- .6 Condulets shall be of a type wherein cover screws do not enter the wire chamber.
- .7 Flexible conduit connections to all mechanical equipment shall be of 'Sealtite' manufacture.
- .8 Flexible conduit connectors shall be of the insulated throat type.
- .9 Condulets with suitable covers shall be used where condulets are exposed. Each conduit fitting shall be of a type suitable to its particular use, and of a type which will allow installation of future conduits without blocking covers of existing condulets.
- .10 Expansion joints shall be installed with ground jumper.
- .11 All conduits shall be terminated with a suitable bushing.
- .12 Flexible conduit and Rigid conduit entering boxes or enclosures shall be terminated with nylon insulated steel threaded bushings, grounded type.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit / raceway specified. Coating: same as conduit / raceway.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits / raceways.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conduits and cables shall be supported, at regular intervals, with corrosion resisting clamps. Lead anchors or expansion bolts shall be used to attach clamps to masonry walls.
- .3 Conduit and cables shall be installed to avoid proximity to water and heating pipes. They shall not run within 150 mm of such pipes, except where crossings are unavoidable, in which case they shall be kept at least 25 mm from covering of pipe crossed.
- .4 Cap ends of all conduits to prevent entrance of foreign matter during construction. Manufactured caps shall be employed.
- .5 Conduit shall be installed as close to building structure as possible so that where concealed, necessary furring can be kept to a minimum.
- .6 Empty conduits, installed under this Division but in which wiring will be installed by others, shall be swabbed out with "Jet Line" foam packs, and be c/w Polypropylene pull wire or polytwine.
- .7 Conduits shall be installed at right angles or parallel to building lines, accurate in line and level.
- .8 Conduit shall not be bent over sharp objects. Improperly formed bends and running threads will not be accepted. Bends and fittings shall not be used together. Proper supports of manufactured channels shall be provided where exposed conduits and cable runs are grouped.
- .9 Under no condition will EMT be allowed exposed within 1200 mm of floor, outdoors, or in areas where explosive, corrosive or moist atmosphere exists.
- .10 Not more than four (4) 90 degree bends or equivalent offsets will be permitted between pull boxes. When maximum number of bends are used, the total run between pull boxes shall not exceed 18000 mm.

- .11 PVC conduit shall not pass through a fire partition or floor separation. Where it is necessary for PVC conduits to pass through a fire barrier, a transition to rigid steel conduit shall be provided for 2000 mm on either side of the fire barrier.
- .12 Surface mount conduits except where noted otherwise.
- .13 Use rigid PVC conduit in corrosive areas or as indicated on plans.
- .14 Use flexible metal conduit or Teck90 for connection to motors.
- .15 Use liquid tight flexible metal conduit or Teck90 for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .16 Use explosion proof flexible connection for connection to explosion proof motors.
- .17 Minimum conduit size for lighting and power circuits: 19 mm.
- .18 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Mechanically bend steel conduit over 19 mm dia.
- .19 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .20 Install pulltwine in all empty conduits / raceways and conduits / raceways that are less than 40% filled.
- .21 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .22 Dry conduits out before installing wire.
- .23 Conduits/Cabling/raceways are not to be run within concrete floors/ceilings. Any conduits/cabling/raceways required to be run along the concrete slabs shall be surface run and not recessed into the concrete. Any instances where cabling is required to be run vertically within concrete poured walls, coreline may be used as the raceway but it shall be transitioned to EMT or Rigid Steel (where required) with interfacing connectors or junction boxes being provided as required. This specification contains references to cast in place conduits. This is only applicable where specifically called for in certain locations within the documents.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information for incorporation into manual specified in:
 - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
 - .1 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - .2 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

3.6 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.

Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts.

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Part 1 General

1.1 GENERAL REQUIREMENTS

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- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 CSAC22.2No.26, Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.
 - .3 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .4 National Electrical Manufacturers Association (NEMA).
 - .5 National Building Code 2010 (NBC 2010)
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Part 2 Products

2.1 WIREWAYS

- .1 Wireways and fittings: to CSA C22No.26.
- .2 Sheet steel with hinged cover to give uninterrupted access with baked grey enamel finish
- .3 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

Part 3 Execution

3.1 INSTALLATION

- .1 Install wireways and auxiliary gutters.
- .2 Keep number of elbows, offsets, connections to minimum.
- .3 Install supports, elbows, tees, connectors, fittings.
- .4 Install barriers where required.
- .5 Install gutter to full length of equipment.

3.2 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information for incorporation into manual specified in:
 - .1 Section 01 78 00 - Closeout Submittals
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 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 CSA C22.2No.29-M1989(R2000), Panelboards and enclosed Panelboards.
 - .8 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .3 Include time-current characteristic curves for breakers with ampacity of 50 A and over or with interrupting capacity of 18,000 A symmetrical (rms) or greater.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.

- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 PANELBOARDS

- .1 All panels shall be of the dead front, molded case circuit breaker type, as shown, sized and located on the drawings.
- .2 Panel trim shall be furnished for flush or surface mounting as indicated on the drawings. Panel trim shall be removed for painting, and allowed to dry before final placement.
- .3 Surface mounted panels shall have manufacturer's standard trim, and shall be finished with two coats of grey ASA #61.
- .4 Panels shall be equipped with a flush type combination lock-latch. Two keys shall be provided for each panel, and all locks shall be keyed alike.
- .5 Panels shall have mains of voltage and capacity and shall be complete with branch breakers, spares and spaces, as shown on the drawings. "Spaces" shall be understood to include necessary bus work such that Owners, at a later date, need buy only breakers.
- .6 Panelboards: to CSA C22.2No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .7 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .8 Each panel shall be complete with a typed directory, which shall be mounted inside the door in a metal frame with clear plastic cover.
- .9 Flush panels shall have concealed hinges and flush type combination lock-latch. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed.
- .10 Cabinets shall be fabricated of code gauge steel, with ample wiring gutters for all wiring connections.
- .11 All panels shall have main bus bar equipped with solderless lug and be capable of accepting any arrangement of single, two or three pole breakers.
- .12 Branch circuit breaker shall have quick-make, quick-break toggle mechanism with single, two or three pole common trip thermal magnetic units in ampere ratings as designated on the

drawings. Breaker handles shall have three positions: 'on', 'off' and 'tripped'. All circuit breakers and panel bus shall have an interrupting capacity of 10,000 amps symmetrical.

- .13 Panels for 120/208 volt, 3 phase, 4 wire systems, shall be complete with bolt-in type breakers, with a minimum nominal width of 20 mm per pole, and a bus of sufficient capacity to feed the number of branch circuit breakers indicated.
- .14 All panels shall be specification grade and of the same manufacture. Load centres are not acceptable.
- .15 All branch circuit spaces shall be fitted with filler plates.
- .16 All panels serving bedrooms shall be equipped with arc fault circuit interrupters where shown on the drawings.
- .17 Each panel shall be equipped with a ground bus suitable for terminating one ground conductor per load circuit.
- .18 Panels shall be General Electric, Siemens, Eaton or Schneider Electric.
- .19 Refer to attached breaker panel schematic detail sheets attached at the end of this specification section.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Lock-on devices for fire alarm circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results – Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on painted plywood backboards. Where practical, group panelboards on common backboard.
- .3 Electrical panels shall, where possible, be mounted with top of trim at uniform height of

2000 mm.

- .4 Panels, shown adjacent to other panels, shall have adjacent edges of different panels mounted parallel to each other with a gap of 75 mm.
- .5 For panels recessed in a finished wall, provide for every six branch circuit spaces and spares, or fractions thereof, one 20 mm empty conduit up to furred ceiling space, and one (1) 20 mm empty conduit down to ceiling space of floor below, and cap for future wiring.
- .6 Connect neutral conductors to common neutral bus.

3.2 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .8 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .9 CSA-C22.2 No.55, Special Use Switches.
 - .10 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval,

as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 SWITCHES

- .1 15 A, 120 V, single pole, three-way switches where required on drawings.
- .2 Manually-operated general purpose ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine molding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps.
- .4 All wiring devices specified shall be of the same manufacture throughout the project.
- .5 Switches controlling motors shall be K.W. (H.P.) rated and approved for motor control service.
- .6 Set switches flush in all finished areas, or in surface box where conduit or wireway is exposed.
- .7 Refer to drawing symbol schedule for further requirements.
- .8 Switches and receptacles shall comply with requirements of CSA and NEMA Standards.
- .9 Switches shall be specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
 - .1 White high impact chemical resistant molded nylon or polycarbonate face.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

- .1 White high impact chemical resistant molded nylon or polycarbonate face.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Four back wired entrances, 2 side wiring screws.
- .4 Specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Set receptacles flush in all finished areas, or in surface box where conduit or wireway is exposed
- .6 Provide ten (10) 20 amp and ten (10) 15 amp specification grade receptacles c/w installation, 10 meters of wire and required raceway, etc for each of these receptacles so that they may be installed where required during the construction and commissioning stages of this project. .

2.3 SPECIAL WIRING DEVICES

- .1 **Ground Fault Circuit Interrupter** - shall have a nylon face and a thermoplastic backbody. They must have a feed-through capability for protecting receptacles downstream on the same circuit. They must be Class A rated with a 5 milliampere ground fault trip level and a 20 ampere feed through rating. GFCI receptacles shall have 'Safe Lock' protection such if critical components are damaged and ground fault protection is lost, power to the receptacle is disconnected. GFCI receptacles shall be equipped with LED trip indicator light, NEMA configuration 5-15R, side wired and one of the following manufacturers: Cooper #XGF15-V, Leviton #8599-I or Pass & Seymour #1594-I, Hubbell 'Autoguard' GFR Series
- .2 **Pilot Light Switches** - shall be quiet specification grade and rated 15A, 120 volts, back and side wiring with toggle lit red in the "ON" position, accepting up to #10 copper conductor and of one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.
- .3 **Fractional HP/KW Manual Starters** - to be non-reversing, toggle operated, suitable for mounting in a surface or flush box, single or two pole to suit 120 or 208 volt application, c/w pilot light and thermal overload to adequately protect motor. Flush mount to have stainless steel or ivory cover plates to match other flush mount wiring devices. To be of one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.
- .4 **Illuminated Switches** - shall be quiet specification grade, 120 volts, back and side wiring with toggle lit in the "OFF" position, accepting up to #10 copper conductor and of one of the following: Cooper, Leviton, Hubbell or Pass & Seymour.
- .5 **Wall Occupancy / Vacancy Sensors, 120-Volt:** Wall occupancy / vacancy sensors shall be specification grade passive infrared (PIR) or dual technology (PIR/Microphonics) wall sensor switch, white finish. Manual ON/OFF switch with automatic time delay off operation (adjustable from 30 seconds to 30 minutes) after momentary occupancy and user adjustable switch to convert unit to Vacancy mode. Adjustable PIR unit sensitivity from 20% to 100%. Coverage limited to 180° field of view, 900 square feet, rated for minimum 800 watt for ballast load at 120-volt. Wall occupancy / vacancy sensor switch shall be compatible with all electronic fluorescent non-dimming ballasts and LED fixtures and shall mount in a standard

single 120-volt single gang switch box. Set delay off to 5 minutes after momentary occupancy. Wall occupancy / vacancy sensors shall be of one of the following manufacturers:

Hubbell, Leviton, Sensorswitch, Wattstopper, Cooper

- .6 **Ceiling Occupancy / Vacancy Sensors, 120-Volt:** Designated as 'OC1' on drawings - Ceiling occupancy / vacancy sensors for controlling the room lighting shall be multi-technology occupancy / vacancy sensor switch, passive infrared (PIR/Microphonics) and ultrasonic sensor (40kHz ultrasonic frequency), 360° coverage within a 92.9 square meter area. Automatic ON/OFF control, Occupancy / Vacancy mode switch, with delay off set at 5 minutes after momentary occupancy.

Hubbell, Leviton, Sensorswitch, Wattstopper, Cooper

2.4 COVER PLATES

- .1 Cover plates for wiring devices.
- .2 Cover plates from one manufacturer throughout project.
- .3 Wall plates shall be designed and manufactured in accordance with performance and dimensional requirements of the following industry standards:

CSA Standard C22-2 No. 42

U.S. Federal Specification WP455

NEMA Standard WD-1

- .4 Wall plates shall be manufactured by one of the following:
Cooper, Arrow Hart, Eagle, Hubbell, Leviton or Pass & Seymour.
- .5 Blank cover plates in finished ceiling areas shall be Columbia Electric #9002 baked white enamel for white ceilings, or painted to match colored finishes.
- .6 Stainless Steel wall plates shall be provided for all switches, receptacles, blanks, telephone and special purpose outlets. The wall plates shall be of suitable configuration for the device for which it is to cover with colour matched mounting screws. Use ganged plate where more than one device occurs at one location. Any specific locations calling for Metal wall plates shall be stainless steel.
- .7 Where surface wiring methods need to be employed in a high finish area because of renovations to existing structure, wall plates shall be used in conjunction with Wiremold surface box to suit the device.
- .8 Where outlets occur in an unfinished area such as boiler or furnace room and surface conduit and boxes are specified, stamped galvanized steel wall plates shall be used to suit configuration.
- .9 Wall plates for HOUSING UNITS shall be "white".

- .10 Exterior outlets shall be fitted with weatherproof die cast aluminum cover plates to suit wiring device, c/w rubber gasket to provide positive seal. Duplex cover plates shall have two independent flaps. Weatherproof covers shall provide protection in wet and damp locations.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Switches shall be as located on the drawings, mounted up 1200 mm, and ganged where more than one occurs in the same location.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Convenience outlets shall be as located on the drawings, and mounted up 450 mm, unless otherwise noted.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Outlets over counter tops shall be mounted 150 mm above counter, or immediately above backsplash. Coordinate with architectural drawings for location of all counter tops, millwork and feature walls, to ensure proper location and mounting height.
 - .5 Coordinate with the location of all mechanical convectors and mount convenience outlets up 100 mm above heating convectors.
 - .6 All convenience outlets shall meet tension tests as per CSA requirements, and will be subjected to 'on site' tests during final inspection.
- .3 All plug-in type receptacles shall be identified by means of a Lamecoid label fixed with self tapping screws on the cover plate or engraved stainless steel cover plates. Each cover plate shall contain the panel and circuit number. Those receptacles fed from ground fault inter-rupters shall have 'GFI' labeled adjacent to the panel and circuit number. Those receptacles designated for housekeeping purposes shall have 'HOUSEKEEPING' labeled adjacent to the panel and circuit number.
- .4 The circuits controlled by all switches on all levels, shall be neatly printed with waterproof ink on the side of the switch outlet box so that the panel and circuit number are clearly legible when the cover plate is removed. It shall not be necessary to remove the switch from the outlet box in order to read the panel or circuit number.
- .5 Cover plates:
 - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.

- .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.2 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).
 - .8 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Include time-current characteristic curves for breakers with ampacity of 50 A and over or with interrupting capacity of 18,000 A symmetrical (rms) and over at system voltage.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval,

as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 deg C ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Circuit breakers to have minimum of 10,000 A symmetrical rms interrupting capacity rating in breaker panelboards.
- .6 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .1 Trip settings on breakers to have adjustable trips.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP BREAKERS

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous, tripping for ground fault short circuit protection.
- .2 The main service breaker for the building main service shall have solid state trip unit. All other breakers shown shall be thermal magnetic breakers unless otherwise noted.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

3.2 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
 - .8 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.
 - .9 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Shop drawings shall include but not be limited to speakers, riser diagram, cable types, and special mounting details.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval,

as one complete listing. Provide complete product specification sheets with request for approval.

- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible and non-fusible disconnect switch in CSA Enclosure , size as indicated.
- .2 Mechanically interlocked door to prevent opening when handle in ON position.
- .3 Fuses: size as indicated, in accordance with Section 26 28 14 - Fuses - Low Voltage. Switch fuse units shall be available in 30 through 1200 amp standard industry sizes. They shall be readily removable and interchangeable without modification to bus work or mounting rails
- .4 Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .5 Quick-make, quick-break action.
- .6 Fusible switches shall be quick-make, quick-break, visible blades, integral handle mechanism, deionizing arc quenchers, front operation, high pressure fuse clips and recessed live parts.
- .7 Operating handles to have provision for padlocking in either 'on' or 'off' position.
- .8 Handle to be marked to clearly indicate switch contact positions.
- .9 Switch fuse units shall be available in 30 through 1200 amp standard industry sizes.
- .10 Shall be readily removable and interchangeable without modification to bus work or mounting rails.
- .11 All switches shall be manufactured by General Electric, Eaton, Siemens, or Schneider Electric.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Lamecoid nameplates, approximately 75 mm x 25 mm, shall be provided on front doors of each switch for identification, showing the name and rating.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

3.2 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.
- .3 Coordinate all control requirements prior to ordering equipment.
- .4 All motor control and ancillary components shall be supplied by one manufacturer in order to assure an integrated system and one point of contact for service with the exception of the VFD requirements. Each manufacturer shall still have a local Saskatchewan service capability. All motor control equipment shall be manufactured by one of the following:

Eaton, Schneider Electric, General Electric, Toshiba

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.

- .5 Wiring diagram for each type of starter.
- .6 Interconnection diagrams.
- .7 All Fuse types for all starters

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

1.5 GENERAL REQUIREMENTS EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide listed spare parts for each different size and type of starter:
 - .1 2 contacts, auxiliary.
 - .2 1 operating coil.
 - .3 2 fuses.

Part 2 Products

2.1 MATERIALS

- .1 For all motors, provide circuit and thermal protection on all lines except neutral.
- .2 For all pumps not controlled by VFD's, provide hour meters for each visible on the motor control centre doors. All magnetic starters located outside of motor control centres shall contain hour meters.
- .3 All contactors shall be NEMA rated contactors.

2.2 MANUAL MOTOR STARTERS

- .1 Single or Three phase manual motor starters as shown of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 Overload heater(s) for each phase, manual reset, trip indicating handle.
 - .3 Thermal switches for small fractional KW motors shall be single or 2 pole as required.
 - .4 In all cases, locate within 9000 mm and in sight of motor

- .2 Accessories:
 - .1 Toggle switch: industrial standard type labelled as indicated.
 - .2 Indicating light: standard neon type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.
 - .4 thermal relay

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .5 All starters shall be combination starters c/w quick-make, quick-break, switch, fuse and magnetic starter c/w red and green indicator lights
 - .6 H.O.A. switch operator controls
 - .7 Provide primary fuse for control transformer.
 - .8 Starters shall not be equipped with an automatic thermal overload reset.
 - .9 Tin plated stab on connectors are acceptable.
- .2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
 - .4 Fusing shall be Form I, NEMA "J", HRC, 200,000 amps current limiting type.
- .3 Accessories:
 - .1 Pushbuttons and Selector switches: standard labelled as indicated.
 - .2 Indicating lights: standard type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.
 - .4 The overload relays shall be the ambient temperature compensated type, and the trip rating of a specific heater element shall be field adjustable over a range of approximately 85% + 115% of its respective rating.

2.4 FULL VOLTAGE REVERSING MAGNETIC STARTERS

- .1 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.

- .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .5 All combination starters shall be quick-make, quick-break, switch, fuse and magnetic starter c/w red and green indicator lights
 - .6 H.O.A. switch operator controls
 - .7 Provide primary fuse for control transformer.
 - .8 Starters shall not be equipped with an automatic thermal overload reset.
- .2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
- .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
 - .4 Fusing shall be Form I, NEMA "J", HRC, 200,000 amps current limiting type.
- .3 Accessories:
- .1 Pushbuttons and Selector switches: standard labelled as indicated.
 - .2 Indicating lights: standard type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.
 - .4 The overload relays shall be the ambient temperature compensated type, and the trip rating of a specific heater element shall be field adjustable over a range of approximately 85% + 115% of its respective rating.

2.5 VARIABLE FREQUENCY DRIVES

- .1 All VFDs shall be remotely mounted outside of motor control centres and shall be located as close as possible to the motor unit being controlled. Unistrut supports shall be provided for mounting the VFD units. All remote controllable parameters shall be wired within the VFD assembly. The VFD assembly shall be rated for Nema 12.
- .2 All VFDs shall be provided with a connected bypass mounted to the VFD unit. Space is limited so the bypass may be provided as a separate attached unit or integral to a larger VFD assembly in a common cabinet.
- .3 Provide variable frequency drives (VFD) where designated by the motor control schedule and drawings. These drives shall have the following features:
 - .1 The drives shall be capable of continuously operating any standard squirrel cage induction motor, NEMA design A, B, or C self-ventilated or force ventilated and inverter duty motors without derating within ambient temperatures up to 40°C. Coordinate final type with Mechanical Contractor.

- .4 It is required that the variable speed drive models for the fans be the HVAC applicable type drives that have accessories and functions typical for requirements of motors used in HVAC applications.
- .5 It is required that the variable speed drive models for the pumps be the Pump applicable type drives that have accessories and functions typical for requirements of motors used in Pumping applications.
- .6 The variable speed drive shall be the pulse width modulated (PWM sinusoidal) output type with adjustable carrier frequencies.
- .7 Unless otherwise noted, all horsepower/Kilowatt drive ratings are to be based on a variable torque load and FLA of motor being controlled.
- .8 The drive shall maintain a minimum line side power factor of 0.95 throughout the entire speed range and the drive shall be capable of an overload of 115% for 1 minute.
- .9 Provide surge arrestors (internal or external) with a minimum 250 Joule (line-ground) rating shall be used to protect the drive from AC line transients. Surge arrestors shall not be part of the bridge circuit.
- .10 Provide separate Input line reactors in separate enclosure rated a minimum impedance of 3%. Ensure adequate ventilation is provided for proper heat dissipation.
- .11 Ensure drives have EMI and RFI filtering (internal or external). Equipment shall be designed that use of communication equipment adjacent to VFD units is permissible. The VFD shall not be susceptible to interference from communications equipment operated adjacent to it.
- .12 The output inverter section shall utilize insulated gate bipolar transistors and diodes to provide a sine coded pulse width modulated output to the motor. The carrier frequency of the pulse width modulation shall be asynchronous to control harmonic distortion in the 3rd to 7th bandwidths to less than 1%. Total voltage harmonic distortion on the input shall be less than 3%.
- .13 Control power input terminals shall be separate from the input power terminals to facilitate start-up, trouble-shooting, and diagnostics without power to the DC bus.
- .14 The VFD shall not be sensitive to incoming power feeder phase sequence.
 - .1 Operator controls shall consist of:
 - .1 “Hand / Off / Auto” selector switch
 - .1 “Hand” for local control of VFD. VFD is operated by panel mounted keypad pushbuttons, speed controlled by the keypad. LCD Keypad Display. LCD Display to be full English Word.
 - .2 Motor cannot be started or remain running in Off position through Power Removal Function.
 - .3 in “AUTO” position, the VFD operates by remote start/stop command, the speed is controlled by a programmable analogue input selectable isolated input signal 0 to 10 Vdc from the BMS.

- .2 Input disconnect switches and fuses shall be mounted in the existing motor control centres. In the event that the motor protection such as the overloads or thermistor tripping unit senses a motor fault, the starter shall lock out and the motor shall be de-energized.
- .15 Each VFD shall be provided with an integral disconnect switch to minimize area consumed.
- .16 All control wiring shall be run in separate raceway away from any line voltage or motor feeder power wiring. Motor cables shall be separated from the supply cables at a minimum distance of 600mm and from signal / control cables at a minimum distance of 400mm. The signal / control cables shall be separated from the motor cables at a minimum distance of 900mm. Where signal / control cables must cross power or motor cables, the crossover angle shall be 90 degrees.
- .17 The drive shall be designed and constructed to operate at a maximum altitude of 1000 m without derating and an ambient temperature between 0o C and 40o C. The drive shall operate in an environment with a relative humidity up to 90% with no condensation.
- .18 The drives shall operate at 208 Volts or 600 Volts (as noted on mechanical schedule) as applicable plus 10% 60Hz, 3ph. Drives which require isolation transformers or are rated at 200 Volt or 575 Volt are not acceptable.
- .19 The drive shall accept an analog signal of 0-10Vdc for use as a fan motor speed reset.
- .20 All VFD set-up operations and adjustments shall be digital and stored in nonvolatile memory (EEPROM).
- .21 The drive shall also have a fault log that stores several last occurring fault conditions within its internal memory.
- .22 The VFD shall have a “momentary Power Loss” ride through capability.
- .23 The VFD shall be capable of operating with the VFD output open circuited (no motor connected) with no fault or damage to any part of the drive.
- .24 The drive shall have the capability to energize and control a currently ‘spinning’ load regardless of the direction of rotation of the load.
- .25 Provide a bump-less speed transfer from remote control to local control or local control to remote control without setting the motor to zero.
- .26 Provide a display that shall show, when the drive is running the motor, electronic setspeed, motor current and motor thermal state (if RTD’s or thermistors are installed in motor).
- .27 The setting controls shall be accessible from the front of the control board, from a commissioning terminal. The drive shall contain the required communications card to communicate with the BMS.
- .1 The following functions shall be independently field adjustable:
 - .1 Acceleration rate
 - .2 De-acceleration rate

- .3 Adjustable minimum speed of 0 to maximum speed.
- .4 Adjustable maximum speed of minimum speed to max. frequency.
- .5 Automatic restart.
- .6 Catching a spinning load in either direction.
- .2 The following conditions shall result in a drive fault and orderly shutdown. The mode of the fault shall be displayed on the electronic display on the front of the drive.
 - .1 Phase failure on the input line
 - .2 Drive over temperature
 - .3 Motor phase failure
 - .4 Over current for short-circuit or grounding of the drive output or excessive transient operation.
- .3 The drive shall include a self-diagnostic system to test all main functions and identify any failed elements.
- .4 Provide an Operations and Maintenance manual with the following:
 - .1 Preliminary checks and start up check sheet with list with outline
 - .2 Design and Operation
 - .3 Technical characteristics
 - .4 Installation
 - .5 Connections
 - .6 Troubleshooting charts for all device faults.
 - .7 An instruction manual for programming and hardware provided with the equipment at time of shipment.
 - .8 A listing of authorized service depots, spare parts lists and recommended spare parts
 - .9 Final settings of all parameters
 - .10 Input and output filter type and size
 - .11 Specified environmental conditions
 - .12 Voltage and current wave form printout taken from the motor terminals
- .5 Provide a trouble shooting guide with the following features:
 - .1 Observation, fault code
 - .2 Possible causes
 - .3 Checks to be made
 - .4 Result
 - .5 Remedial action
 - .6 Comments
- .6 The starter shall be equipped with an automatic start mode that shall restart the motor after a power failure without operator intervention. This option shall be controlled by the internal parameter settings. Drives that lock out in a fault condition due to power

outage or transfer from and to emergency power shall not be accepted. The drive shall resume to the last known frequency.

- .7 The starter shall be equipped with a programmable automatic reset/restart after any individual trip condition resulting from either overcurrent, over voltage, under voltage, or an over temperature. This parameter shall initially be set to disabled.
- .8 The drives are to be set for two (2) only restarts, set for a 30 second delay following the return of essential power to the drive. Failure of the drive to restart the motor following these two (2) restarts will necessitate a manual acknowledgement of the fault at the actual drive control panel.
- .9 Prior to any motor control equipment ordering, the Electrical contractor shall coordinate with successful controls contractor and determine the required control, i.e. '2 wire' or '3 wire' control. Equipment shall be ordered as such upon written confirmation from the controls contractor.
- .10 Coordinate all control requirements prior to ordering equipment.
- .11 Each VFD shall be provided with a minimum of 2 dry contacts assignable to alarm conditions such as a VFD fault. Both contacts shall be wired to the nearest BMS control panel.
- .28 The Contractor shall coordinate with the VFD manufacturer regarding all motor sizes, motor types and motor feeder lengths. Provide Load dv/dt filters for all motors equipped with VFD's where the feeder distance exceeds the limits for the pulse rise times shown in the following table:

Pulse Rise Time (Microseconds)	Critical Lead Length (Meters)
1 or greater	45
0.5	20
0.1 and less	Always

Coordinate with manufacturer to ensure proper mounting of all output filters (when required). Filters shall be connected to the drive via bus bars. If bus bar connection not available with drive manufacturer, connect filter to drive with 105°C RW90 rated cable. All filters shall be placed in their own enclosure mounted beneath the drive. Ensure enclosure is adequately vented as per manufacturer recommendations. Ensure clearances are made within filter enclosure as per filter manufacturer recommendations. Ensure filters and enclosures are bonded to ground connections of drive.

- .29 The manufacturer in coordination with the Contractor shall have voltage and current waveforms taken at the time of final commissioning from the motor terminals of each motor controlled to ensure that the waveforms are within the tolerance limit of the motor and drives. The settings of the waveform capture shall be such that the pulse rise time of the waveform shall be visible and easily evaluated for voltage reflection amplification. Any documentation not meeting this requirement shall be rejected and resubmitted until it is satisfactory to the Consultant.
- .30 Coordinate with the motors supplied to site and ensure the proper filter protection is provided for all motors served by the VFD's. The electrical contractor shall assume full responsibility

for ensuring a complete and fully operational system in regards to output and input filtering for the motors and VFD's supplied.

- .31 The manufacturer shall provide all necessary assistance, including on-site support, to both mechanical and electrical contractors to determine final drive parameter settings. The VFD manufacturer shall adjust the drive parameter settings to suit on-site conditions prior to commissioning.
- .32 Setting of all drive parameters, commissioning, testing and certification of all VFD's shall be completed by the VFD Manufacturer Certified VFD Service Technicians. Third party commissioning agents will not be accepted.
- .33 Coordinate all control requirements prior to ordering equipment.
- .34 All VFDs and ancillary components shall be supplied by one manufacturer in order to assure an integrated system and one point of contact for service. Each manufacturer shall have a local Saskatchewan service capability. All motor control equipment shall be of the same manufacture, and shall be manufactured by one of the following:

Schneider Electric, Eaton, General Electric, Toshiba, Siemens

2.6 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated.

2.7 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.8 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 The plates shall be attached with two self-tapping metal screws.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.
- .3 Each manufacturer shall have a local Saskatchewan service capability.
- .4 All motor control equipment shall be of the same manufacture.

- .5 Install starters, connect power and control as indicated.
- .6 Ensure correct fuses and overload devices elements installed.
- .7 The motor starters shall be cleared of all ambient construction dust prior to commissioning or the energizing of the starters.
- .8 Provide a disconnect for each motor within the room or area that the motor is located. All disconnects shall be sized in accordance with kilowatt ratings of the motor being isolated and shall be quick-make, quick-break type, equipped with lock-off feature.
- .9 Within 900 mm of each motor, provide flexible Sealtite conduit. Provide a separate ground wire bridging the flexible connections.
- .10 All conduit / cabling entering top of motor starter shall be c/w water tight connectors with silicone based caulking.
- .11 Use shielded twisted pair (STP) wiring for control and signal wiring that connects externally to the VFD.
- .12 Provide separate conduits for VFD control wiring from input and output power wiring.
- .13 Provide #6 bare copper ground from each VFD grounding point to the building ground grid. DO NOT loop or series connect multiple VFD ground cables.
- .14 Control wiring shall be stranded TEW 105°C (220°F) rise.
- .15 Terminal blocks for remote interface shall be Weidmueller SAK6N or approved equal.
- .16 Provide wire markers at both ends of all control wires, Electrovert Type Z or approved equal

3.2 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information for incorporation into manual specified in:
 - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
 - .1 Operation instructions
 - .2 Description of system operation
 - .3 Description of each subsystem operation
 - .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - .5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.
 - .6 Include operation and maintenance data for each type and style of starter.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical and manufacturer's instructions.
- .2 Provide factory certified copies of production test results to the Consultant prior to shipment of the equipment.
- .3 Operate switches, contactors to verify correct functioning.
- .4 Perform starting and stopping sequences of contactors and relays.
- .5 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .6 Calibrate VFD display values with Building Management System display output. Verify motor RPM values.
- .7 Ensure that voltage waveforms are taken at the motor terminals at a time span that shows the relative rise times of output waveform from drive and that the waveforms are within the tolerance limit of the motor and drives.

3.4 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

3.5 VERIFICATION

- .1 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:
 - .1 That the system is complete in accordance with this specification
 - .2 That the system is installed in accordance with the manufacturer's best recommendations
- .2 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to

assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

3.6 TRAINING

- .1 Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
- .2 American National Standards Institute (ANSI)
 - .1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.
 - .3 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .4 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.
 - .5 American Society for Testing and Materials (ASTM)
 - .6 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
 - .7 United States of America, Federal Communications Commission (FCC)
 - .8 FCC (CFR47) EM and RF Interference Suppression.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results

- .2 Shop drawings for each fixture shall include but not be limited to, lamps, ballasts, fixture cuts, custom colors, and special mounting details. All pertinent information for each fixture shall be stapled separately from other fixtures.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 10 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide detailed lighting calculation drawings for fixtures that are submitted for approval for closed office areas, open office areas, training rooms or as requested by the consultant. These shall be submitted no later than 10 working days before tender close.
- .4 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 LAMPS

- .1 Provide in wattages and types to properly suit the specified fixtures.

2.2 BALLASTS

- .1 Ballasts for fluorescent fixtures shall be supplied with the fixtures, pre-wired for operation with the compatible lamps and quantity of lamps specified for the fixture. Provide ballasts in the voltage noted with the fixture specification.
- .2 Fluorescent ballast systems shall include:
 - .1 Operate lamps for maximum efficacy, high lumen output operation and operate for full lamp life
 - .2 Eliminate lamp flicker
 - .3 UL Listed Class P, Type 1 Outdoor
 - .4 CSA Certified
 - .5 70°C Maximum Case Temperature
 - .6 FCC 47CFR Part 18 Non-Consumer for EMI and RFI filtering
 - .7 Class A Sound Rating
 - .8 ANSI C62.41 Category A Transient Protection
 - .9 CFCI Compatible
- .3 Fluorescent ballasts shall have inrush current limiting capability to assure compatibility with all lighting systems controls.

- .4 Ballast Warranty: All fluorescent ballasts shall include a written manufacturer's warranty against defects in materials and workmanship for 60 months from date of substantial completion and include a nominal replacement labour allowance.

2.3 LED LIGHTING – LAMP MODULES AND DRIVERS

- .1 Solid-State Lighting (LED luminaires) shall comply with ENERGY STAR® SSL test standards for the following qualification requirements:
 - .1 Testing: SSL testing standards including IES LM-79-2008 and LM-80-2008 as performed by an independent test lab.
 - .2 Efficacy: The luminaire test data and submitted report shall demonstrate a minimum of 35 lumens per watt and 575 lumens for the least efficient LED for apertures $\geq 4.5''$ (345 lumens for apertures $\leq 4.5''$), lowest efficient optic, and hottest luminaire configuration for the product group submitted for qualification.
 - .3 Colour: LED luminaire shall demonstrate colour uniformity across the aperture.
 - .4 Power: The driver/power supply must have a power factor of > 0.90 for all non-residential products, meet FCC requirements, sound rating of A and provide transient protection.
 - .5 Reliability: The LED luminaire shall demonstrate 70% lumen maintenance at 35,000 hours for non-residential products, as calculated using the DOE's linear extrapolation model.
- .2 Tight chromaticity specification and LED colour binning process shall ensure LED colour uniformity, sustainable Colour Rendering Index (CRI) and Correlated Colour Temperature (CCT) consistency over the useful life of the LED. Consistent colour uniformity and tight colour control shall be maintained even during dimming.
- .3 LED modules shall be InGaN (Indium Gallium Nitride) semiconductor material, absent of UV and minimal IR wavelengths. The conglomeration of diodes covered with remote phosphor technology shall provide consistent colour uniformity and tight colour control.
- .4 LED Light Engine (Driver)
 - .1 Over-voltage, over-current and short-circuit protected
 - .2 Thermal management of the LED system shall be designed to yield 70% lumen maintenance after 50,000 hours of operation
 - .3 Total Harmonic Distortion: $< 20\%$ THD
- .5 LED fixtures where specified as dimmable, shall have a dimming range of 100% to 10% unless otherwise noted.
- .6 Warranty: The light engine and power components of LED luminaires installed for indoor applications shall be free from defects in material and workmanship for a minimum period of three (3) years from date of original purchase. Warranty shall cover only product failure due to defective material or workmanship, and does not include labour to remove or install

fixtures. Defective LED's shall be considered if a minimum of 5% of LEDs per luminaire are non-operative in the fixture or module.

2.4 LUMINAIRES

- .1 Contractor is responsible for all required mounting details for all lighting fixtures. If mounting of fixture is uncertain, contractor shall confirm prior to finalising pricing.
- .2 Lighting fixtures shall be of the makes indicated. Similar types of fixtures shall be by one manufacturer.
- .3 Only clean luminaires and lamps will be accepted at time of final inspection.
- .4 Recessed fixtures shall generally be supplied complete with trim, plaster frame or ring and mounting brackets where installed in plaster, or without plaster frame in acoustic ceilings.
- .5 Fixtures shall bear appropriate CSA labels.
- .6 Cooperate with all other trades for the proper installation of all lighting fixtures.
- .7 Verify the quantity of fixtures before placing orders.
- .8 Verify all ceiling types with architectural drawings and the General Contractor before ordering fixtures.
- .9 Fluorescent lighting fixtures shall be so designed that the temperature on the ballast case shall not exceed a maximum of 70°C in an ambient temperature of 25°C.
- .10 Coordinate with drawings to ensure that all fluorescent fixtures are equipped with ballasts of a suitable voltage to match branch circuitry.
- .11 All fluorescent luminaires installed on branch circuits with voltages exceeding 150 volts-to-ground shall be provided with a disconnecting means integral with the luminaire that simultaneously opens all circuit conductors between the branch circuit conductors and the conductors supplying the ballast(s), and shall be marked in a conspicuous and permanent manner adjacent to the disconnecting means so as to identify the disconnect.
- .12 The new light fixture lamps shall not be used during construction. The contractor may use their own temporary lamps during construction at their own expense with the Owner's approval. The contractor shall replace temporary lamps with new lamps upon completion of work. All fixtures shall be cleaned inside and outside prior to substantial completion.
- .13 Provide lighting fixtures of type and quality as specified in the following schedule. Fixtures shall be complete with necessary accessories, lamps and ballasts. The contractor shall advise of any restrictions on providing luminaire, lamp and ballast as specified during tender period.
- .14 The lighting fixtures shall be as specified in the following schedule, and the manufacturer's numbers shown shall not reduce or amend the requirements as outlined under the description of each fixture type.

2.5 LUMINAIRE SCHEDULE (HOUSING)

- .1 Fixture A – Luminaire: Keyless ceramic socket c/w screw-in type A19 medium base 10 watt LED lamp.
- .2 Fixture L
 - .1 Wall mounted fixture with opal glass white finish, two lamps, 120 volt. 114mm in diameter and 395mm in length, 2 x 60 watts medium base lamps.
 - .2 Replace lamps with LED, A19 medium base, 10 watt lamps.
 - .3 Fixture is to be mounted horizontal, 150mm above vanity mirror.
 - .4 Manufacturer:
Russell #775-102/WH
Or approved equal.
- .3 Fixture N
 - .1 Ceiling fan and light kit.
 - .2 Ceiling mount fan on down rod, 5 blades at 12 degree pitch, housing in satin nickel finish and white / matching switch blades.
 - .3 Total width of 52" and height.
 - .4 Full function remote control adaptable.
 - .5 Three medium base lamp light kit c/w white glass shades and satin nickel housing, 120 volt lamps.
 - .6 Contractor shall replace standard incandescent lamps with 13w LED bulb.
 - .7 Full range dimming.
 - .8 Manufacturer:
Ceiling fan: 'Kendal' #AC6852-SN
Lighting kit: 'Kendal' #SG9042-WH
Or approved equal.
- .4 Fixture O
 - .1 Surface mounted fixture with brushed chrome finish and mounting clips, faux glass shade. 405mm in diameter x 127mm height, 3 x 60 watts medium base lamps, 120 volt.
 - .2 Contractor shall replace standard incandescent lamps with 13w LED bulb.
 - .3 Full range dimming.

- .4 Manufacturer:
Russell #341-716
Or approved equal.
- .5 Fixture P
 - .1 Recessed anodized LED downlight for wet location with white powder coat painted trim and white anodized aluminum reflector, frosted lens.
 - .2 67mm aperture.
 - .3 120 volts electronic dimming driver.
 - .4 8 watts, P16 LED input with 510 lumen output with 4000°K color temperature and CRI of 80+.
 - .5 Manufacturer:
Contrast Lighting #S3450-C-01
Or approved equal
- .6 Fixture Q
 - .1 Surface mounted ceiling mounted fixture with brushed chrome finish, faux glass shade, 381mm in diameter, 305mm high, 3x100 watts medium base 120 volt lamps.
 - .2 Contractor shall replace standard incandescent lamps with 13w LED bulb.
 - .3 Full range dimming.
 - .4 Manufacturer:
Russell #321-713/BCH
Or approved equal.
- .7 Fixture R
 - .1 Wall mounted quarter sphere outdoor fixture with faceplate in black finish.
 - .2 Polycarbonate opal lens, diameter 279mm. suitable for wet locations.
 - .3 Lamp LED 890 lumens, 25 watt input, 120 volt integral photocell.
 - .4 Manufacturer:
Eaton #TRE11 LED Series
Or approved equal.
- .8 Fixture S
 - .1 Recessed LED downlight suitable for mounting in **insulated drywall ceilings**, 6-inch aperture, clear specular reflector and white painted trim, medium beam reflector.

- .2 Recess depth of 200mm.
- .3 Lamp assembly complete with die-cast aluminum heat sink, fixed LED module, 20-watt, 1100 delivered lumens, 3500⁰K, CRI of 80, 120-volt electronic driver, dimmable to 10%.
- .4 Manufacturer:
Canlyte 'Lightolier' #C6L1520DL30KMCLW/C6L20N1 series
Cooper Lighting 'Halo' #H750ITAC- ML5612835-692SC series
Lithonia Gotham #ECSR series
Or approved equal.
- .5 LED Replacement Lamps:
- .6 Medium base
- .7 Rated average life: 25000 hours
- .8 Color Temperature 2700k and CRI of 80+
- .9 800 minimum lumen output
Or approved equal

2.6 LUMINAIRE SCHEDULE (GARAGE)

- .1 Fixture type 'BB'
 - .1 Luminaire: Surface mounted LED , 1219mm length x 219mm wide, die formed cold rolled steel housing and end plates in white finish, acrylic prismatic wrap-around lens. Mount to underside of deck unless noted otherwise on drawings.
 - .2 Lamps: LED, 3500K, 4800 Lumens minimum
 - .3 Driver: 120 Volt input, 0 – 10 Volt dimming, 53 Watts
 - .4 Manufacturer:
Cooper Metalux # WNLED Series
Philips Day-Brite #OWL LED Wraparound Series
Lithonia #SBL4 Series
Or approved equal
- .2 Fixture type 'CC'
 - .1 Luminaire: Surface mounted LED strip light, 1219mm length c/w wire guard, frosted lens, steel housing, white finish, Coordinate final mounting height and locations with mechanical equipment and ductwork on site. Row mounted as shown on drawings.
 - .2 Lamps: LED, 3500K, 3000 Lumens minimum
 - .3 Driver: 120 Volt input, 0 – 10 Volt dimming, 31 Watts
 - .4 Manufacturer:
Cooper Metalux #SNLED Series
Philips Day-Brite #LF FluxStream Series

Or approved equal.

.3 Fixture type 'T'

- .1 Luminaire: Exterior surface mounted LED suitable for wet locations, extruded aluminum driver enclosure, die cast aluminum housing in powder coat grey finish, vandal resistant one-piece injection molded clear polycarbonate lens. Type III cut-off lighting distribution pattern, <20% total harmonic distortion, >0.9 power factor, start-up operation -40 degree C to 40 degree C, 90% lumen maintenance at 60,000 hours, integral photocell control, c/w 178mm length wall bracket. Five year warranty. Mount up as noted on plans.
- .2 Lamps: 4000K, 5,374 Lumens minimum
- .3 Driver: 120 Volt input, 0 – 10 Volt dimming, 56 Watts
- .4 Manufacturers:
Cooper Lighting # GLEON series
Philips Gardco # ECOFORM series
Beacon #Viper Small 22NB series
Or approved equal.

.4 Fixture type 'PL1'

- .1 Luminaire: Exterior pole mounted LED suitable for wet locations, extruded aluminum driver enclosure, die cast aluminum housing in powder coat grey finish, vandal resistant one-piece injection molded clear polycarbonate lens. Type III cut-off lighting distribution pattern, 120 volt LED driver with 0-10V dimming, <20% total harmonic distortion, >0.9 power factor, start-up operation -40 degree C to 40 degree C, 90% lumen maintenance at 60,000 hours. 157 input watts, 15,669 delivered lumens, 4000°K, c/w c/w integral photocell control. Luminaire shall have five year warranty. Poles shall be 155mm square steel, 9144 mm (30 foot) and shall include anchor bolts, full base cover, hand hole, ground lug, top cap and all necessary accessories as required. Post top luminaire and lamp pole standard shall be grey finish. Refer to site plan drawings and details.
- .2 Manufacturers:
Cooper Lighting # GLEON series
Philips Gardco # ECOFORM series
Beacon #Viper Large 64NB series
Valmont Pole '6SS-(20-40) series
Keene SR2 series
Or approved equal.

2.7 ADDITIONAL MATERIALS

- .1 In addition to the materials specified and the quantity of materials as determined on the plans, provide for the supply and installation of the following additional materials, which shall be turned over to the owner if not installed during construction:
 - .1 Lamps:

- .1 Provide (4) replacement lamps for each specified fixture type.

Part 3 Execution

3.1 INSTALLATION

- .1 The contractor under this Division shall be responsible for expediting the delivery and installation of the fixtures to suite the construction schedule and the work of other trades.
- .2 Remove packing material and debris from the job site immediately after installation of fixtures and lamps. Debris shall not be allowed to accumulate more than a reasonable amount.
- .3 Lighting fixture diffusers are not to be installed until the area is completely finished in order to minimize the amount of dirt collection on these units.
- .4 Conduit installation shall conform to the specifications.
- .5 Emergency battery lighting units shall be connected to the room's 120-volt lighting circuit, non-switched leg.

3.2 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information
 - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
 - .1 Operation instructions
 - .2 Description of system operation
 - .3 Description of each subsystem operation
 - .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - .5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

3.3 WIRING

- .1 Each fixture shall be fed with a separate NMD drop, flex or AC-90 drop. Looping between fixtures or wiring rows through ballast channel will not be accepted.

3.4 LUMINAIRE SUPPORTS

- .1 Lighting fixtures shall be supported independent of plasterboard or acoustic tile. Support from structural members of the building or ceiling.

- .2 Fixtures installed in exposed ceilings may require plywood backing behind the acoustical panels. Confirm support requirements with manufacturer.

3.5 LUMINAIRE ALIGNMENT

- .1 Fixtures shall be installed accurately in line and level. Any fixtures which are not installed properly shall be taken down and re-installed at no change to the contract sum. Plaster frames and rings required for recessed fixtures shall be supplied under this section, and installed under the lathing and plaster or acoustic ceiling divisions. The work of the electrical division shall include the necessary coordination with the above divisions in regard to the correct location and installation of the plaster frame and rings.

3.6 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

3.7 VERIFICATION

- .1 Perform tests in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:
 - .1 That the system is complete in accordance with this specification
 - .2 That the system is installed in accordance with the manufacturer's best recommendations
- .3 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

3.8 TRAINING

- .1 Perform training in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 CSA C22.2 No. 141, Unit Equipment for Emergency Lighting
 - .3 National Building Code 2010 (NBC 2010)
 - .4 National Fire Code 2010

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Shop drawings for each fixture shall include but not be limited to, lamps, ballasts, fixture cuts, custom colors, and special mounting details. All pertinent information for each fixture shall be stapled separately from other fixtures.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance information
 - .1 Section 01 78 00 - Closeout Submittals
- .2 Include:
 - .1 Operation instructions
 - .2 Description of system operation
 - .3 Description of each subsystem operation
 - .4 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - .5 Parts list specifying parts used in equipment by identification numbers that are standard to electronic industry.

1.6 WARRANTY

- .1 The warranty period for the supply and installation of emergency battery units and remote emergency lighting fixtures shall commence on the date of substantial completion regardless of the manufacturer's specific warranty disclaimers with respect to date of shipment or date of installation of the equipment. The warranty period from date of substantial completion is one full year.
- .2 Provide a full replacement warranty of the emergency lighting equipment free of defects in material and workmanship for a period of (1) one year from date of substantial completion. In addition to this requirement:
 - .1 Batteries shall include a pro-rated warranty for a minimum (5) five years shall commence the date the full warranty period ends.
 - .2 Integral and remote MR16 LED lamps shall have a (5) year warranty from date of substantial completion.
- .3 A battery determined to be defective during the pro-rated warranty period shall be repaired or replaced at a cost equal to the net price in effect at the time, reduced by the percentage obtained in multiplying 10% by the number of full years remaining in the total warranty period. Such repair or replacement at this adjusted price shall be the purchaser's exclusive remedy.

Part 2 Products

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No. 141.
- .2 Supply voltage: 120 V, ac.
- .3 Output voltage: 12 V, dc.
- .4 Operating time: 60 minutes

- .5 Battery: sealed long-life, maintenance free lead acid battery with 10-year life expectancy.
- .6 Charger: solid state, pulse type charger, current limited, temperature-compensated, short-circuit proof, reverse-polarity protected. Unit standard with electronic lockout and brownout circuits. Complete battery recharge in 24 hours.
- .7 Solid state transfer circuit.
- .8 Low voltage battery circuit protection to disconnect the battery from the fused output circuit at the end of discharge.
- .9 Non-audible LED diagnostic display to identify source of failure: battery, charger circuitry or lamps.
- .10 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .11 Automatic self-test system: 1 minute every 30 days; 10 minutes on the 6th month and 30 minutes every 12 months.
- .12 Lamp heads: Integral to battery unit unless otherwise noted, 345° horizontal and 180° vertical adjustment without need for tools to adjust aim. Lamp type: 6 watt 12-volt MR16 LED.
- .13 Emergency lighting units and remote fixtures shall be as specified in the following schedule, and the manufacturer's numbers shown shall not reduce or amend the requirements as outlined under the description of each fixture type.

Fixture type 'E-MA': Emergency lighting battery contained unit with two integral lighting heads equipped with 2 x 6 watt, 12-volt MR16 LED lamps. The emergency battery unit shall have a minimum **144 watt** capacity for 30 minutes (63 watt capacity for 60 minutes). Fully gasketed cast aluminum back plate in white finish with clear polycarbonate cover, NEMA 4X certified. Equipped with tamper-proof screws.

Beghelli – Bravado BRV series

Emergi-Lite - #Survive-All NXM series

Lumacell #RG-NX series

Ready-Lite - #LDX-NM series

Fixture type 'E-R2' – Emergency remote light fixture powered from fixture type 'E-MA', 'E-MB' or 'E-MC' battery units as indicated, 2 x 6 watt 12-volt MR16 LED lamps, fully gasketed cast aluminium back plate in white finish, clear polycarbonate cover, NEMA 4X certified. Equipped with tamper-proof screws.

Beghelli – Bravado BRV-R series

Emergi-Lite – EF40 series

Lumacell – MQMP-NX series

Ready-Lite – TUF NM series

ADDITIONAL MATERIALS

- .14 In addition to the materials specified and the quantity of materials as determined on the plans, provide for the supply and installation of the following additional materials, which shall be turned over to the owner if not installed during construction:

Fixture type 'E-R2': 1 fixture

- .15 For each spare emergency light fixture listed, include in the base pricing the supply and installation of 2 # 10 RW90 and insulated ground in 10 meter length of 16mm conduit (including fittings).

Part 3 Execution

3.1 INSTALLATION

- .1 The contractor under this Division shall be responsible for expediting the delivery and installation of the fixtures to suite the construction schedule and the work of other trades.
- .2 Batteries for lighting units if placed in storage prior to installation shall be placed in an environment protected from cold and extreme heat. Store batteries in accordance with the manufacturer's recommendations. Batteries shall have a maximum storage life (shelf life) of 6 months. Batteries must be recharged or placed in service within the 6 months of storage life.
- .3 Remove packing material and debris from the job site immediately after installation of fixtures and lamps. Debris shall not be allowed to accumulate more than a reasonable amount.
- .4 Lighting fixtures installed in any area that is not completely finished shall be cleaned at the end of the construction.
- .5 Emergency battery lighting units shall be direct connected to the room's 120-volt light circuit (non-switched leg). Branch circuit as indicated on the drawings.
- .6 Battery units shall be labeled with identification numbers to match the owner's existing numbering system. Contractor shall coordinate with the owner.
- .7 Mounting heights: The minimum mounting height of emergency lighting battery units and remote emergency light fixtures shall be as noted herein, unless otherwise noted on drawings:
 - .1 Emergency battery units: 2100mm above finished floor.
 - .2 Emergency remote fixtures: Ceiling mounted or wall mounted as indicated on the floor plans. Wall mounted fixtures shall be a minimum 2100mm above finished.
- .8 Lighting heads shall be adjusted on site to provide optimum lighting within the area with an emphasis directed at illuminating means of egress towards the exits.

3.2 WIRING

- .1 Conduit: in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: In accordance with Section 26 05 21 – Wires and Cables 0 – 1000 V
 - .1 In accordance with Section 26 05 21 – Wires and Cables 0 – 1000 V

.2 Minimum #12 AWG Copper up to maximum 5% voltage drop.

.3 Each fixture shall be fed with a separate flex or AC-90 drop.

.4 Providing wiring from the battery unit emergency dc circuit to the exit sign DC terminal block.

3.3 LUMINAIRE SUPPORTS

.1 Lighting fixtures shall be supported independent of plasterboard or acoustic tile. Support from structural members of the building or ceiling.

.2 Fixtures installed in exposed ceilings may require plywood backing behind the acoustical panels. Confirm support requirements with manufacturer.

3.4 LUMINAIRE ALIGNMENT

.1 Fixtures shall be installed accurately in line and level. Any fixtures which are not installed properly shall be taken down and re-installed at no change to the contract sum.

3.5 VERIFICATION

.1 Perform tests in accordance with:

.1 Section 26 05 01 - Common Works Results - Electrical

.2 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:

.1 That the system is complete in accordance with this specification

.2 That the system is installed in accordance with the manufacturer's best recommendations

.3 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

3.6 TRAINING

.1 Perform training in accordance with section 26 05 01 - Common Works Results – Electrical.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 National Building Code 2010 (NBC 2010)
 - .3 National Fire Protection Association (NFPA)

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Shop drawings for each fixture shall include but not be limited to, lamps, ballasts, fixture cuts, custom colors, and special mounting details. All pertinent information for each fixture shall be stapled separately from other fixtures.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

Part 2 Products

2.1 STANDARD UNITS

- .1 Exit signs: NBC 2010 compliant. NRCAN/CSA C860 compliant. CSA C22.2 No.141 for self-powered exit signs.
- .2 Exit light fixtures shall have the following:
 - .1 LED (Lighting Emitting Diodes), high output or ultra-bright LED's.
 - .2 Solid state design.
 - .3 Voltage: Universal input voltage of **120**, 277 or 347 volt ac.
 - .4 Power consumption: Maximum 2 watts single or double face.
 - .5 Aluminum housing in white finish.
 - .6 Acrylic barrier
 - .7 Three green 'RUNNING MAN' pictogram for direction selection (straight, left and right).
 - .8 Universal mounting: ceiling, wall or end wall mounting.
 - .9 DC terminal block.
- .3 Exit signs shall be one of the following manufacturers:
 - AimLite 'RPALW' series
 - Beghelli 'Quandra' #RM series
 - Emergi-Lite #EA series
 - Lumacell #
 - Ready-Lite 'RA' Series,
 - Beghelli 'Quadra' #RM series

2.2 Fixture Type 'X1'

Exit sign, ceiling mounted, single face, direction indicators as shown on drawings.

2.3 Fixture Type 'X2'

Exit sign, ceiling mounted, double face, direction indicators as shown on drawings.

2.4 Fixture Type 'X3'

Exit sign, surface wall mounted, single face, bottom of fixture mounted 100mm above door, direction indicators as shown on drawings.

2.5 ADDITIONAL MATERIALS

- .1 In addition to the materials specified and the quantity of materials as determined on the plans, supply and install the following additional exit sign fixtures:
 - Fixture type 'X1': 2 exit sign fixtures
 - Fixture type 'X3': 2 exit sign fixtures

- .2 For each additional exit sign fixture listed, include supply and installation conduit/wire for connection of the additional exit fixtures:
 - .1 120 Volt AC: 10 meters of 2 # 12 RW90 plus insulated ground wire in 10 meters of 16mm conduit per fixture
 - .2 12 Volt DC: 10 meters of 2 # 10 RW90 in 10 meters of 16mm conduit per fixture.
- .3 Location of the additional exit sign fixtures to be confirmed on site with the Consultant.

Part 3 Execution

3.1 INSTALLATION

- .1 The contractor under this Division shall be responsible for expediting the delivery and installation of the exit fixtures to suit the construction schedule and work of other trades.
- .2 Install exit signs so as to be visible from the exit approach.
- .3 Exit signs shall be wired in a separate conduit system.
- .4 Interconnect exit fixtures to the emergency lighting battery unit emergency dc circuit.
- .5 Ensure the exit sign circuit breaker is locked in the 'ON' position.

3.2 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.

3.3 VERIFICATION

- .1 Perform tests in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:

- .1 That the system is complete in accordance with this specification
- .2 That the system is installed in accordance with the manufacturer's best recommendations
- .3 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

3.4 TRAINING

- .1 Perform training in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
- .2 Canadian Standards Association, (CSA International)
 - .1 CSA-T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568A with modifications).
 - .2 CSA-C22.2 No. 214, Communications Cables (Bi-national Standard, with UL 444).
 - .3 CAN/CSA-C22.2 No. 182.4, Plugs, Receptacles, and Connectors for Communication Systems.
- .3 Telecommunications Industry Association (TIA)
 - .1 TIA/EIA/ANSI – 568B.1/2/3 latest revision Commercial Building Telecommunications Cabling Standards for Telecommunications Pathways and Spaces;
 - .2 TIA/EIA/ANSI – 515000 Generic Specification for Optical Fibre and Cable Splices
 - .3 TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises;
 - .4 TIA-568-C Series Commercial Building Telecommunications Cabling Standard;
 - .5 TIA/EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces;
 - .6 TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Building;
 - .7 TIA/EIA-607-A Commercial Building Ground (Earthing) and Bonding Requirements for Telecommunications;

- .8 Category 6A system and testing as released by TIA/EIA/ANSI – latest revision
- .9 TIA/EIA T568-A UTP wiring/pinout

- .4 The structured communication wiring system shall comply with Treasury Boards Information Technology Standard for wiring as described in the TBITS 6.9 document. TBITS 6.9 – Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings – Technical Specifications) shall be as per Information and Technology Standards:
<http://www.tbs-sct.gc.ca/it-ti/itp-pti/its-nit-eng.asp>

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

1.5 SYSTEM DESCRIPTION

- .1 The data and voice cable installation, shall include all cable, connectors, patch panels, patch cords, racks, BIX blocks, etc., as specified and shown on the drawings
- .2 The cabling system shall meet or exceed the minimum characteristics as outlined TIA Standards Category 6A. In addition, the testing method and parameters shall be as per the TIA recommendations.
- .3 The cabling installer shall be a Belden Certified System Vender installing Belden components. Once completed, the installation must be a Belden Certified System. The data system and components shall be guaranteed for a period of twenty (20) years from the date of installation against defects in materials and workmanship.

1.6 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures and 26 05 01 – Common Work Results, Electrical.

- .2 Submit shop drawings for review prior to ordering equipment. Shop drawings shall include but not be limited to, photocopies of accredited installers, cabling, hardware and components, patch cords, tester information, and labeling.
- .3 Submit manufacturer's certification documentation that guarantees installation techniques, cable and cabling components and carry a minimum 20 year certification from the manufacturer for the capability to support gigabit applications such as 1000 Base-T, 622MB/s and 2.4 Gb/s ATM and work case channel performance based on the values indicated. The term channel performance incorporates manufacturer certified patch cords.
- .4 Upon request and at no cost, the contractor shall provide a manufacturer's technical representative to conduct an onsite visit to ensure complete technical compliance.
- .5 The manufacturer's certification must guarantee that design or installation negligence on the part of the certified contractor will not negate or void any portion of the certified system. The manufacturer must guarantee that all material, components and labour are covered for the full certification period. It must also guarantee that in the event a contractor is no longer in business, the full certification remains valid.

1.7 CONTRACTOR QUALIFICATIONS

- .1 The Installer (Firm and Employees) conducting the installation shall have full working knowledge of cabling low voltage applications such as, but not limited to data/voice communications cabling systems. The Installer shall have at least five years of continuous recent experience on similar projects. The Installer shall hold recent, up-to-date licenses, certifications and training certificates in the area the project is located and for the equipment to be installed. The Installer shall:
 - .1 Provide references of the type of installation provided for this specification;
 - .2 Be a Belden Certified System Vendor.
 - .3 Have a knowledge of all applicable Telecommunication standards such as but not limited to CSA, TIA/EIA, IEEE and ANSI;
 - .4 Have a experience in the installation of pathways and support for horizontal and backbone cabling;
 - .5 Be experienced in the installation and testing of telecommunication network cabling system, including the use of light meter and OTDR.
 - .6 Provide proof of being a manufacturer certified installer for all cable network components being installed such as but not limited to cables, connectors and end termination equipment. The use of non-manufacture certified installer is not permitted.

1.8 PROJECT CLOSEOUT

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures and 26 05 01 – Common Work Results, Electrical.

- .2 Operating and Maintenance Manuals at project closeout shall include
 - .1 List of cables, hardware and components;
 - .2 Copies of approved shop drawings;
 - .3 Record drawings.
 - .4 Warranty certification from the Manufacturer
 - .5 Receipts that include the listing of spare parts, materials and supplies, including patch cables and equipment cords.
 - .6 Test and verification reports (may be submitted on CD Disk inserted in an appropriate envelope page in the manual).

Part 2 Products

2.1 COMMUNICATION CABLES, PATHWAYS AND TERMINATION BLOCKS

- .1 Refer to Section 27 05 14 - Communication Cables Inside Buildings
- .2 Refer to Section 27 05 28 – Pathways for Communications Systems
- .3 Refer to Section 27 11 19 – Communications Termination Blocks

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 The communications cabling system and testing shall comply with the following standards. All standards shall be as per the latest revision at the time of tendering this project.
 - .1 TIA/EIA/ANSI – 568B.1/2/3 latest revision
 - .2 Category 6A system and testing as released by TIA/EIA/ANSI – latest revision
 - .3 TIA/EIA T568-A UTP wiring/pinout
 - .4 BICSI, TDMM Telecommunications Distribution Methods Manual (latest edition)
 - .5 CAN/CSA-T529-M91
 - .6 CAN/CSA-T530-M90
 - .7 CAN/CSA-T527-94, EIA/TIA-607
 - .8 CAN/CSA-T528-93, EIA/TIA-606
 - .9 EIA/TIA-TSB 40-A
 - .10 EIA/TIA-TSB 67
 - .11 EIA/TIA-569
 - .12 EIA/TIA-606
- .3 The total installation shall be completed by the cable Installer who is certified by the manufacturer for Category 6A cable installations. The Installer shall submit photocopies of accreditation certificates with the shop drawings. Submit testing method and tester with shop drawings.

- .4 The contractor shall submit the verified test result on each cable, connector, and connection for the total installation, including back-bone and horizontal cabling. The model number and manufacturer of the Category 6A cable shall be documented. The type of tester used for testing the Category 6A cabling must also be documented.
- .5 Test results shall be evaluated by the test equipment using the most up-to-date criteria from the TIA/EIA Standard. This information shall be supplied in electronic format.
 - .1 Room number of installation
 - .2 Wall plate ID
 - .3 Test Results with an identification of type of test used and whether the result was PASS or FAIL
- .6 Category 6A cable tests shall provide results for the following tests:
 - .1 Near End Crosstalk (NEXT)
 - .2 Attenuation
 - .3 Ambient Noise
 - .4 Attenuation to Crosstalk Ratio (ACR)
 - .5 Far End Crosstalk (FEXT)
- .7 Provide with maintenance manuals, a marked set of prints illustrating the network drop name for each drop location. No other as-built information shall be provided on these prints unless it relates to the data or voice network.
- .8 The consultant will spot test this testing following test completion. Contractor shall provide the testing technician for (2) hours, and the completed test charts, for spot check verifications.

3.2 GROUNDING AND BONDING FOR COMMUNICATION SYSTEM

- .1 Bonding Backbone shall consist of green jacketed stranded copper conductors and insulated ground bars.
- .2 Install a #6 AWG insulated ground connection directly to each equipment rack in LAN Rooms. Each ground connection shall be terminated at the existing building ground system.
- .3 Bus bars shall be an insulated pre-drilled, electro tin plated copper busbar, minimum 6mm thick x 100mm wide x 305mm long (or length that is determined by the number of required connections including space for additional bond connections). Mount up 300mm above finished floor near the equipment rack location.
- .4 Aluminum wires, clamps or terminal connectors will not be accepted for grounding and bonding.
- .5 Terminations to the telecommunication ground bus bars shall be installed without splices where possible. If splices are necessary, they shall be as few as possible. Use irreversible compression-type connectors, exothermic welding, or equivalent. The connection to the ground bus bar shall be done using 2-hole compression connectors.

3.3 WARRANTY

- .1 Testing and certification of the building network distribution cable installation shall be by the Installer and shall include the provision of a full Manufacturer's and Vendor's Warranty covering performance, products and installation. The Warranties shall cover the full repair and/or replacement of any component failing or failure to meet the design requirements within one (1) year. Warranties shall be delivered to the Project Manager with the Testing and Certification documentation.
- .2 Within ten (10) days after testing, the Installer shall submit the cable test results, and a marked up record drawing(s) of the as-built cable network. The record drawing(s) shall include the cable/jack identification at the outlet locations.
- .3 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .4 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts

3.4 VERIFICATION

- .1 Perform tests in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:
 - .1 That the system is complete in accordance with this specification
 - .2 That the system is installed in accordance with the manufacturer's best recommendations
- .3 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

3.5 TRAINING

- .1 Perform training in accordance with:
 - .1 Section 26 05 01 - Common Works Results – Electrical
- .2 Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 Audio Engineering Society (AES).
 - .8 Other Applicable CSA and UL approvals.
- .2 Telecommunications Industry Association (TIA)
 - .1 TIA/EIA/ANSI – 568B.1/2/3 latest revision Commercial Building Telecommunications Cabling Standards for Telecommunications Pathways and Spaces;
 - .2 TIA/EIA/ANSI – 515000 Generic Specification for Optical Fibre and Cable Splices
 - .3 TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises;
 - .4 TIA-568-C Series Commercial Building Telecommunications Cabling Standard;
 - .5 TIA/EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces;
 - .6 TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Building;
 - .7 TIA/EIA-607-A Commercial Building Ground (Earthing) and Bonding Requirements for Telecommunications;
 - .8 Category 6A system and testing as released by TIA/EIA/ANSI – latest revision
 - .9 TIA/EIA T568-A UTP wiring/pinout

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

1.5 SYSTEM DESCRIPTION

- .1 The data and voice cable installation, shall include all cable, connectors, patch panels, patch cords, racks, bix blocks, etc., as specified and shown on drawings.
- .2 The cabling system shall meet or exceed the minimum characteristics as outlined TIA Standards Category 6A. In addition, the testing method and parameters shall be as per the TIA recommendations and meet requirements for testing Category 6A installations.
- .3 The cabling system shall use matched components from a single manufacturer certified to deliver system performance over the lifetime of the applications which the cabling system was originally designed to support. The data system and components to be certified by the manufacturer and shall be guaranteed for a period of twenty-five (25) years from the date of installation against defects in materials and workmanship. The manufacturer shall be Belden.
- .4 Each cable shall be equipped with connectors on each end and connected to wall jacks or cable connectors. All field communications cabling to be terminated on patch panels located on the drawings.
- .5 The data cabling channel shall not exceed four (4) connections and shall not exceed 90m.

Part 2 Products

2.1 HORIZONTAL COMMUNICATIONS BUILDING CABLE (CBC)

- .1 All communication cable (data and voice) shall be unshielded twisted pair, Category 6A four (4) pair #23 AWG, CMP (FT6) rated and meet TIA/EIA/ANSI – 568-C.2, latest revision unless noted otherwise. Data and Voice cable shall be blue.

- .2 Each cable shall be equipped with connectors on each end at the wall jacks and patch panels at the data equipment racks.
- .3 The data cabling channel shall not exceed four (4) connections and overall length shall not exceed 90m. The maximum distance shall include an allowance of 3 meters from the outlet to the workstation and 6 meters for patch cords.
- .4 Data and Voice may be installed in a common box.
- .5 A minimum of two (2) Category 6A UTP cables shall be installed at each workstation unless otherwise noted on the drawings.

2.2 NETWORK PATCH CORDS

- .1 Pre-terminated, factory tested patch cords shall be of the same manufacturer as the installed system and shall be part of the certified system. Patch cables shall be labeled at both ends.
- .2 Patch cords for data and voice cables shall have stranded conductors and meets the requirements of TIA/EIA 568B (latest revision). Patch cords shall meet Category 6A criteria when tested with the components of the system. Patch cords at workstations shall be Category 6A cable terminated with 8 pin modular male jacks, TIA T568A pinout.
- .3 Provide two patch cords for each cable drop located on the plans.
- .4 Provide cords in the following lengths: 50% (data total) shall be 1.2m length; 30% (data total) shall be 1.8m length; 20% (data total) shall be 2.1m length.

Part 3 Execution

3.1 INSTALLATION OF COMMUNICATION CABLES

- .1 All cable shall be pulled using proper wire grips. Pulling force and bend radius shall not exceed manufacturer's specifications.
- .2 Velcro straps shall be used in all locations, cable ties are unacceptable.
- .3 Parts of cables not in cable management trays shall be strapped at least every 250mm along cable.

3.2 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance

agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:

- .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.
- .4 During the warranty period, provide three (3) separate site visits of four (4) hours each on site for owner revisions and additional training.

3.3 VERIFICATION

- .1 Perform tests in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
 - .2 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:
 - .1 That the system is complete in accordance with this specification
 - .2 That the system is installed in accordance with the manufacturer's best recommendations
- .3 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

3.4 TRAINING

- .1 Perform training in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
 - .2 Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 National Fire Protection Association (NFPA)
 - .6 Institute of Electrical and Electronic Engineers (IEEE).
 - .7 Audio Engineering Society (AES).
 - .8 Other Applicable CSA and UL approvals.
- .2 Telecommunications Industry Association (TIA)
 - .1 TIA/EIA/ANSI – 568B.1/2/3 latest revision Commercial Building Telecommunications Cabling Standards for Telecommunications Pathways and Spaces;
 - .2 TIA/EIA/ANSI – 515000 Generic Specification for Optical Fibre and Cable Splices
 - .3 TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises;
 - .4 TIA-568-C Series Commercial Building Telecommunications Cabling Standard;
 - .5 TIA/EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces;
 - .6 TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Building;
 - .7 TIA/EIA-607-A Commercial Building Ground (Earthing) and Bonding Requirements for Telecommunications;
 - .8 Category 6A system and testing as released by TIA/EIA/ANSI – latest revision
 - .9 TIA/EIA T568-A UTP wiring/pinout

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:

□

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 26 05 01 – Common Work Results

- .2 Submit shop drawings for review prior to ordering equipment. Shop drawings shall include but not be limited to, photocopies of accredited installers, outlets, coverplates, “water fall kits”, cable management.

1.4 PRODUCT APPROVALS

- .1 Manufacturers’ and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

1.5 SYSTEM DESCRIPTION

- .1 Telecommunications raceways system consists of outlet boxes, cover plates, cabinets, conduits, cable troughs, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.

Part 2 Products

2.1 MATERIAL

- .1 Conduits: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
- .2 Junction boxes, in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets

2.2 OUTLET BOXES

- .1 Outlet boxes shall be 100mm square boxes. Multiple boxes shall not be ganged unless noted otherwise.
- .2 Wall plates for communication cable systems shall have integral self label. The wall plates must support up to four (4) network drops and be run in a minimum of **27mm** conduit to the nearest equipment rack or stub at the basket tray in the accessible ceiling. Provide blank filler plates for unused drops.
- .3 Wall plates shall be modular and in ‘Keystone’ format opening to allow the possibility of changing connector types in the future without replacing the wall plate. Faceplates shall be equipped with small form factor terminating connectors to fit the individual outlet’s requirements (RJ45 and or Dual LC and or CATV bulkheads).

- .4 Wall plates shall be equipped with a minimum of four (4) angled keystone openings. The installer shall equip the wall plate with the required amount of blank inserts as required. The minimum standard of acceptance for wallplates are Corning WLL-PL-AP or Panduit NK4VSFWH.
- .5 When the wall plates are equipped with fibre optic port, it must be placed in the bottom keystone port position. Install 'Keystone' fibre 'SC' adapter for frame-station connector.

2.3 CABLE MANAGEMENT

- .1 Velcro ties shall be used. Each cable type shall be bundled separately; that is data bundle, voice bundle, and fibre bundle. Cable ties wraps are unacceptable.

Part 3 Execution

3.1 SECURITY

- .1 All cabling shall be installed in conduit in areas deemed unsecured. Unsecured areas, unless otherwise noted include the following:
 - .1 Any area accessible by more than one tenant or the public.
 - .2 Any area where cabling crosses from one tenant space to another tenant space.
- .2 No communication (data, voice or fibre) cabling shall share same raceway or junction boxes with any other pathway system.

3.2 INSTALLATION

- .1 All horizontal cables shall be run in conduit. All raceways shall be grounded. All conduits shall have suitable bushings.
- .2 Backbone/riser cables (fibre, copper) and horizontal cables shall be run in EMT conduit, minimum 27mm diameter unless otherwise noted on drawings. Maximum allowable percentage conduit fill shall not exceed 40%.
- .3 EMT conduit shall be reamed and bushed at both ends and bonded to the distribution system. Rigid PVC or flexible metallic or PVC conduits are not acceptable.
- .4 Inside radius bend in EMT conduit shall not be less than 6 times the internal diameter for conduit sizes up to 41mm inside diameter; 10 times the internal diameter for conduit sizes 53mm diameter and larger.
- .5 Pull boxes shall be installed in conduit runs where the total number bends exceed 180 degrees; where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.
- .6 Pull boxes shall be installed in the straight sections of the conduit run and shall not be used lieu of a bend. Corresponding ends of conduit shall be aligned with each other. Conduit fittings shall not be used in place of pull boxes or bends.

- .7 Use of LL, LR and LL conduit fittings is not permitted.
- .8 The use of J-Hooks, brackets, cable ties and other attachments to support cabling **is not** permitted. Meshed-basket Data Cable tray is required.
- .9 In all wall outlet boxes, the contractor shall leave 400mm length of cable in each box.
- .10 In all wall workstation drops, leave 300mm of cable slack before entering wall or workstation in suspended ceiling.

3.3 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.
- .4 During the warranty period, provide three (3) separate site visits of four (4) hours each on site for owner revisions and additional training.

3.4 VERIFICATION

- .1 Perform tests in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:
 - .1 That the system is complete in accordance with this specification
 - .2 That the system is installed in accordance with the manufacturer's best recommendations
- .3 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

3.5 TRAINING

- .1 Perform training in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 REFERENCES AND CODES

- .1 The Electrical Contractor shall be bound by industry standards, as interpreted by the Consultant, whether or not specifically referenced in this document. Comply with Electrical Protection Act and rules and regulations made pursuant thereto, including the 2012 Canadian Electrical Code. Also, comply with applicable standards of the following:
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.
 - .2 Electrical and Electronic Manufacturers Association of Canada (EEMAC).
 - .3 National Electrical Manufacturers Association (NEMA).
 - .4 National Building Code 2010 (NBC 2010)
 - .5 Institute of Electrical and Electronic Engineers (IEEE).
- .2 Canadian Standards Association (CSA) International
 - .1 CAN/CSA-C22.2 No.182.4, Plugs, Receptacles and Connectors for Communication Systems.
 - .2 CSA T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568a with modifications).
- .3 Telecommunications Industry Association (TIA)
 - .1 TIA/EIA/ANSI – 568-B.1/2/3 latest revision Commercial Building Telecommunications Cabling Standards for Telecommunications Pathways and Spaces;
 - .2 TIA/EIA/ANSI – 515000 Generic Specification for Optical Fibre and Cable Splices
 - .3 TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises;
 - .4 TIA-568-C Series Commercial Building Telecommunications Cabling Standard;
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 - .6 TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Building;
 - .7 TIA/EIA-607-A Commercial Building Ground (Earthing) and Bonding Requirements for Telecommunications;
 - .8 Category 6A system and testing as released by TIA/EIA/ANSI – latest revision
 - .9 TIA/EIA T568-A UTP wiring/pinout

- .4 Other Applicable CSA and UL approvals.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with:
 - .1 Section 01 33 00 - Submittal Procedures
 - .2 Section 26 05 01 – Common Work Results
- .2 Submit shop drawings for review prior to ordering equipment. Shop drawings shall include but not be limited to, photocopies of accredited installers, copper patch panels, copper termination jacks, coax jacks, communication racks, cable management, and sample labeling.

1.4 PRODUCT APPROVALS

- .1 Manufacturers' and model numbers named in these specifications indicate an acceptable technical standard of performance and are not intended to be exclusive. Products submitted as alternates must result in a control system that meets or exceeds all technical performance criteria as described.
- .2 Products proposed as alternatives to those specified, shall only be considered if submitted for approval no later than 15 working days before tender close. Submit alternates, for approval, as one complete listing. Provide complete product specification sheets with request for approval.
- .3 The Bidder must provide a complete list of primary system products offered with their bid.

1.7 SYSTEM DESCRIPTION

- .1 Termination, patch cords, and cross-connection equipment installed inside building for voice and data for telecommunications systems employing unshielded-twisted-pair (UTP), coaxial (CXC) cables. Refer to drawings for special details.

Part 2 Products

2.1 PATCH PANELS, CONNECTORS AND ADAPTORS

- .1 Data and voice patch panels shall be 24 or 48-port panels as indicated on drawings. A minimum of 12 ports shall be spare for future. Patch panels shall be compatible with Category 6A installations, and shall accept snap-in non keyed modular 8-pin jacks with T568-A pinout.
- .2 Connectors shall be modular 8 PIN jacks, rated Category 6A – TIA/EIA T568-A UTP wiring/pinout. All jacks shall be blue. All ESS network jacks shall be green.

Part 3 Execution

3.1 LABELLING

- .1 Cable labels shall be self laminating labels as manufactured by Burndy or Panduit.

- .2 Bix Blocks, patch panels, and wall plates shall have integral labeling; self-adhesive labels will not be acceptable. Wall plates shall have self-adhesive icons adjacent to each jack of either a telephone or workstation to illustrate type of jack.
- .3 Cable labels shall be self laminating labels as manufactured by Burndy or Panduit.
- .4 Labeling shall be neatly typewritten and be in accordance with TIA 660. Cabling shall be labeled with the drop ID number at both termination points. Cable labeling shall be a logical numbering system. Confirm if owner has special labeling system prior to installation. If owner has no set labeling system, confirm contractor suggested labeling with owner or consultant prior to any installation. The owner or consultant must sign off on labeling prior to installation; this sign-off shall be included in the maintenance manuals.
- .5 Bix Blocks, Patch panels, and wall plates shall have integral labeling; self-adhesive labels will not be acceptable. Wall plates shall have self-adhesive numbering label adjacent to each jack.

3.2 WARRANTY

- .1 The contractor must make available to the Owner a local service department of a duly authorized distributor of the equipment manufacturer, which shall stock the manufacturer's standard parts. The service department shall have at least one factory trained repair technician available to the Owner on 24 hours' notice.
- .2 Provide warranty of installation of equipment installed by this contractor to be free of defects for a period of (1) one year from date of Substantial Completion.
- .3 Provide during the warranty period, all service, maintenance, parts, etc., required for normal operation of the systems, such that Owner needs not purchase additional maintenance agreement or contracts. Upon request, the manufacturer and his agent shall provide direct to the Owner the following proposals:
 - .1 Continuation, after the warranty period, of full maintenance, including all service, labour, parts, etc. required to maintain the systems in a fully operational condition.
- .4 During the warranty period, provide three (3) separate site visits of four (4) hours each on site for owner revisions and additional training.

3.3 VERIFICATION

- .1 Perform tests in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 The entire installation shall be performed under the supervision of the manufacturer. Upon completion of the installation, the manufacturer shall check and test the entire system. Certification of all tests shall be submitted in writing to the Consultant and shall certify the following:
 - .1 That the system is complete in accordance with this specification
 - .2 That the system is installed in accordance with the manufacturer's best recommendations

- .3 During the certification tests, the contractor shall provide one (1) electrician and (1) helper to assist the manufacturer's representative. The contractor shall also provide any required equipment such as ladders, scaffolding, etc.

3.4 TRAINING

- .1 Perform training in accordance with:
 - .1 Section 26 05 01 - Common Works Results - Electrical
- .2 Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in the operating instructions and service manuals.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Salvaging and stockpiling topsoil.

1.2 RELATED WORK

- | | | |
|----|----------------------------|------------------|
| .1 | Tree Protection | Section 01 56 39 |
| .2 | Site Preparation | Section 02 41 13 |
| .3 | Site Grading | Section 31 22 00 |
| .4 | Topsoil and Finish Grading | Section 32 91 19 |
| .5 | Seeding | Section 32 92 20 |

Part 2 Products

2.1 MATERIALS

- .1 Existing Topsoil: existing natural onsite organic topsoil, capable of supporting good vegetative growth. Existing topsoil shall meet the requirements of Section 32 91 19 – Topsoil and Finish Grading. Do not screen.
- .2 Imported Topsoil: topsoil hauled from offsite sources. Imported topsoil shall meet the requirements of Section 32 91 19 – Topsoil and Finish Grading. Do not screen.

Part 3 Execution

3.1 TOPSOIL STRIPPING

- .1 Remove vegetation, stones, debris and other foreign material in excess of 50 mm diameter before start of work, per Section 02 41 13 - Site Preparation.
- .2 Strip existing topsoil only from those areas that will be disturbed by excavation, filling, road or building construction, or compaction by equipment.
- .3 Determine soil stripping depth by taking soil cores within areas to be stripped. Topsoil depth averages 80 mm, per Geotechnical Report by Clifton Associates Ltd., dated on July 2015, but may be variable throughout the site. Avoid mixing topsoil with subsoil.
- .4 Avoid stripping material in either wet or dry conditions to minimize degradation of soil structure.
- .5 Imported topsoil (if required) shall be hauled to the site and stockpiled in locations designated by the Owner of General Contractor.
- .6 Salvaged existing topsoil exceeding the quantity required shall be disposed of at Contractor's expense.
- .7 All planned erosion and sediment control practices shall be in place and functioning properly prior to stripping.

3.2 STOCKPILING

- .1 Do not screen salvaged existing topsoil or imported topsoil prior to stockpiling.
- .2 Locate stockpiles to avoid slopes, natural or constructed drainage, and traffic routes.
- .3 No soil stockpile shall exceed 2.0 meters in height.

- .4 All topsoil stockpiles shall be protected from sediment erosion by surface roughening, watering, and perimeter silt fencing.
- .5 Stabilize stockpiles within seven (7) days of stockpile formation by seeding with a temporary cover crop such as oats or barley nurse crop, or approved equivalent, or the approved specified final seed mixture. Maintain vegetative cover throughout life of stockpile; re-seed annually as required.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 The work under this Section shall include excavation of the police building crawlspace (if required) and grading of the site around the housing units and garage.

1.2 TESTING

- .1 Refer also to Section 01 45 30 – Material Testing.
- .2 Provide density testing on every 400 square metres at evenly spaced intervals for each lift of material.
 - .1 Include a drawing showing the location of each test with test results.
- .3 Obtain Consultant approval of test results prior to construction of the subsequent lifts of material.

1.3 SAFETY

- .1 Excavation shall be in accordance with municipal safety regulations and Occupational Health and Safety recommendations.

1.4 EXISTING UTILITIES

- .1 Locate buried utilities and services prior to excavation.
- .2 Locations of any utilities and services on the Drawings are approximate only. Further utilities and services may exist in addition to those shown.

1.5 PROTECTION OF PROPERTY

- .1 All work shall be executed in such a manner as to protect private property, fences, utility poles, survey pins and markers, manholes, valve boxes and other utility appurtenances. Any of these items which are damaged or removed by the Contractor in the performance of his work shall be repaired or replaced to their original condition at the expense of the Contractor.

1.6 MAINTENANCE

- .1 Defects or misalignment of any part of the work caused by settlement or faulty workmanship and materials during the maintenance period shall be corrected by the Contractor at his expense.

Part 2 Execution

2.1 SITE GRADING

- .1 After development area has been cleared, grubbed and stripped of topsoil, commence Site Grading. Co-ordinate clearing, grubbing and topsoil stripping with Landscape Drawings and specifications.
- .2 Excavate all non-organic materials to construct site area and road approach to the lines and grades as shown on the Drawings.
- .3 Place excavated material suitable for site grading on fill areas. Place excavated material unsuitable for site grading in the toe and side slopes of road approach, other back slope and non-traffic areas or otherwise waste or dispose of off-site.
- .4 Place fill material for site grading in maximum loose lift thickness of 150mm. Compact with mechanical compaction equipment to a minimum 98% of the maximum Standard Proctor Density at optimum moisture content.
- .5 The allowable moisture content tolerance during fill placement is +/- 2% of optimum. Water or dry soil material to achieve acceptable moisture conditions within the specified limits.
- .6 Rocks shall be included as common excavation. Remove rocks over 150mm in diameter from the fill material. No extra payment will be made for rock excavation. Dispose of rocks in a designated area.
- .7 No extra shall be allowed for wet excavation.
- .8 Remove and dispose of concrete, rubble, organic or frozen material or other debris such as brush and roots from fill and dispose off-site.
- .9 Dispose of other excess materials off-site.
- .10 Disposal of materials must be to a place approved by local governing authority or Municipality.

2.2 CRAWL SPACE EXCAVATION

- .1 Coordinate with architectural and structural drawings to excavate crawl space area to specified elevation.
- .2 Excavate area to provide level area beneath footprint of building. Level and compact excavated area to be within 25mm of design elevation. Dispose of excess excavated material off-site if not needed to grade other areas of the site.

2.3 GENERAL BACKFILLING

- .1 Use native backfill or imported backfill material free from organics and other deleterious materials for all other backfilling requirements on site. Compact backfill material to 98% of the standard proctor density at optimum moisture content. Place backfill in lifts not greater than 150mm compacted thickness.

- .2 Refer to structural drawings and design requirements for backfilling beneath structural components of the work.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This Section describes the work required for the excavation and backfilling of utility trenches for the installation of water distribution and sewage collection pipelines.

1.2 RELATED WORK

- .1 Site Water Utility Distribution Piping: Section 33 11 16.
- .2 Site Sanitary Utility Sewerage Piping: Section 33 31 15.

1.3 SAFETY

- .1 Trench excavation to be in accordance with municipal safety regulations and Occupational Health and Safety recommendations.

1.4 MAINTENANCE

- .1 Defects or misalignment of any part of the work caused by settlement or faulty workmanship and materials during the maintenance period shall be corrected by the Contractor at his expense.

1.5 REFERENCES

- .1 Canadian Standards Association:
 - .1 CSA A23.1: Concrete Materials and Methods of Concrete Construction
 - .2 CSA A3000: Cementitious Materials Compendium

1.6 TESTING

- .1 Refer also to Section 01 45 30 – Material Testing.
- .2 Provide density testing on every 75 lineal metres of trench for each lift of backfill.
 - .1 Include proctor testing as required for the project.
 - .2 Include a drawing showing the location of each test with test results.
- .3 Obtain Consultant approval of test results prior to construction of the next lift of material.

1.7 ROAD CLOSURES & TRAFFIC COORDINATION

- .1 Apply for road closures from governing authorities as required.
- .2 Coordinate road closures to ensure full access is available to the Stony Rapids community at all times.

Part 2 Products

2.1 BACKFILL MATERIAL

- .1 Backfill material over pipelines shall be native excavated material, free of large rocks or boulders, tree stumps, large roots or other deleterious material.

Part 3 Execution

3.1 GENERAL

- .1 Remove, load, haul and dispose of all excess materials and construction debris at an approved offsite facility.

3.2 TRENCH EXCAVATION

- .1 Obey laws, rules and ordinances respecting excavation. Excavate trenches in accordance with municipal safety regulations and Occupational Health and Safety recommendations. Open V-cut methods of excavation may be used provided the trench sides meet regulations.
- .2 The following is the maximum trench width at the top of the pipe:
 - .1 Pipe 900 mm nominal diameter and over: The diameter of the pipe plus 600 mm.
 - .2 Pipes under 900 mm nominal diameter: The diameter of the pipe plus 400 mm, except the Contractor will not be required to excavate a trench less than 900 mm wide.
- .3 Excavate sufficiently to allow for the installation of pipes, fittings and appurtenances to the lines, grades and elevations as shown on the Drawings. Place new pipelines on approved compacted granular material. Bring over-excavation up to grade using compacted granular material or crushed rock at no extra expense to the Owner.
 - .1 Replace unstable foundation material with compacted granular material, crushed rock or other special foundation as required. This is classified as extra work under the terms of the contract.
 - .2 A minimum clearance of 150 mm is required between rocks left in place in the trench and the wall of the pipe. Fill the space between the rock and the pipe with selected and compacted material.
- .4 Remove and dispose of existing pipeline materials offsite.
- .5 Dewater excavations. No extra will be allowed for wet excavation. Use new pipe for dewatering only upon the approval of the Consultant.
- .6 Ensure trench bottom is free from sloughed sidewall material, large stones, large dirt clods, frozen material or any other condition that could lead to non-uniform or unstable support of the pipe. Keep trench bottom dry during installation of the pipe and embedment material.

3.3 ROCK EXCAVATION

- .1 Where solid masses of rock are encountered in the excavation for water and sewer utility trenches, drill, blast and excavate detached rocks.
- .2 Rock masses shall be shattered 300mm below the rock subgrade for the full width of the cut section including the grade of the trench bottom. To obtain uniform shattering, drilling shall extend to a plane parallel to profile and cross-section at least 600mm below grade.

- .3 The spacing of drill holes shall not exceed the depth of the cut at the point of drilling.
- .4 Blasting shall be carried out in accordance with current Blasting Safety Regulations under the *Occupational Health and Safety Act* and performed by qualified, licenced personnel.
- .5 All blasting, if required, is to be included in the servicing price for the contract.

3.4 TRENCH BACKFILLING

- .1 The initial 300 mm above the pipe is considered pipe bedding, and is to be executed as described in the section for each utility.
- .2 Place approved excavated material in maximum 300 mm lifts and compact to a minimum of 98% of the Standard Proctor Density using mechanical compaction equipment.
 - .1 Remove stones or blast rock over 200 mm in diameter, chunks of concrete, organic or frozen material or other debris such as brush and roots from the backfill.
- .3 Where utility pipes cross each other, compact the material between the pipes to eliminate settlement.
- .4 Leave a maximum of 5 m of trench open at the end of a working day. This open trench must be appropriately secured and marked in accordance with applicable rules and regulations to ensure the safety of pedestrians and vehicles.
- .5 Upon completion of the work, remove and dispose all unused or damaged material and other construction debris off-site. Blade all areas smooth and level where work has been performed and leave the site in an acceptable appearance.
- .6 The Contractor is responsible for repairs required due to settlement of the trench during the warranty period.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This Section describes the work required for the preparation, gravelling, compaction, shaping and trimming of road approach, driving and parking surfaces within the Detachment site.

1.2 PROTECTION OF PROPERTY

- .1 All work shall be executed in such a manner as to protect private property, fences, utility poles, survey pins and markers, manholes, valve boxes and other utility appurtenances. Any of these items which are damaged or removed by the Contractor in the performance of the work shall be repaired or replaced to their original condition at the expense of the Contractor. Earth, rock or debris deposited in sewer manholes, pipes and in valve boxes shall be completely removed prior to acceptance of the work.

1.3 SUBMITTALS

- .1 The Contractor shall submit granular and bedding material sieve results prior to material being incorporated into the Work.
- .2 The Contractor shall coordinate and cover testing costs and submit all density testing results expeditiously as Work progresses.

Part 2 Products

2.1 SURFACE GRAVEL

- .1 The Contractor shall supply the gravel. Road approach, driving and parking surface gravel shall be composed of fragments of durable rock free from undesirable quantities of soft or flaky particles, loam, and organic or otherwise deleterious material.
- .2 Gravel used for road approach, driving and parking surfaces shall be Saskatchewan Ministry of Highways and Infrastructure Type 104 or approved alternate.

2.2 GRANULAR BASE

- .1 Granular base used for secure bay ramp shall be Saskatchewan Ministry of Highways and Infrastructure Type 31 or approved alternate.

Part 3 Execution

3.1 SURFACE PREPARATION

- .1 Upon completion of building construction and utility installations within the site, construct road approach, driving and parking surfaces to the lines and grades as shown on the Drawings.
- .2 Compact surfaces to a minimum Standard Proctor Density of 98%. Surface moisture shall be corrected as required to achieve the specified density.

3.2 GRANULAR BASE

- .1 Upon completion of the preparation of driving and parking surfaces, supply and place base granular to a compacted depth of 100mm.
- .2 Compact, shape and trim gravelled surfaces to ensure a smooth, dense surface to support normal road traffic without rutting or becoming unstable.

3.3 SURFACE GRAVEL

- .1 Upon completion of the installation of the granular base, supply and place Type 104 gravel to a finished compacted depth of 125mm.
- .2 Compact, shape and trim gravelled surfaces to ensure a smooth, dense surface to support normal road traffic without rutting or becoming unstable.

3.4 MANHOLE AND VALVE BOX ADJUSTMENTS

- .1 Adjust manholes and valves to approximately 100mm below finished grade.
- .2 Manholes shall be adjusted by removing or adding adjusting rings to a maximum ring depth of 300mm with a minimum depth of 100mm.
- .3 Valve boxes shall be adjusted by raising or lowering the telescoping top section of the box or by adding approved risers.
- .4 Gravel and earth shall be kept out of valve boxes and sanitary sewers. Any such material deposited in these appurtenances shall be removed by the Contractor. The Contractor shall be completely responsible for all conditions which arise as the result of this material entering the sanitary sewer systems.
- .5 Valve boxes, manholes, and curbs damaged by the Contractor shall be repaired or replaced at their expense.
- .6 Place temporary fabric underneath manhole frame to prevent granular material from entering the sanitary sewer system. Sanitary sewer manholes will be inspected prior to and upon completion of granular material placement. Any debris in the manholes shall be cleaned out and the sewer mains flushed, at the expense of the Contractor.

END OF SECTION

PART 1 General

1.1 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet.
- .3 Shop Drawings:
 - .1 Indicate location, type, size, arrangement, anchor and mounting details.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 STORAGE AND PROTECTION

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

1.4 SECTION INCLUDES

- .1 Fence framework, fabric, and accessories.
- .2 Excavation for post bases; concrete foundation for posts.
- .3 Manual gates and related hardware.

1.5 RELATED REQUIREMENTS

- .1 Division 1 – General Requirements
- .2 Section 03 30 00 – Cast-In Place Concrete

1.6 REFERENCES

- .1 ASTM A116 - Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
- .2 ASTM A121 – Zinc-Coated (Galvanized) Steel Barbed Wire.
- .3 ASTM A123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- .4 ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .5 ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.
- .6 ASTM F567 - Installation of Chain-Link Fence.

-
- .7 ASTM F669 - Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence.

PART 2 Products

2.1 PRODUCTS

- .1 Fence Fabric: 50 mm mesh by 9 gauge, zinc coated after weaving. Minimum zinc coating to be 490 grams per square metre of surface area.
- .2 Fabric height: See drawings.
- .3 Terminal and Straining Posts: The terminal posts and straining posts shall be 90 mm O.D. with minimum weight of 11.24 kg per metre, Schedule 40 pipe, zinc coated with minimum coating of 490 grams per square metre. The minimum length of terminal posts and straining posts shall be 2,900 mm
- .4 Line Posts: Posts shall be 60 mm O.D. with minimum weight of 5.43 kg per metre, Schedule 40 pipe, zinc coated with minimum coating of 490 grams per square metre. The minimum length of line posts shall be 2,670 mm unless otherwise indicated.
- .5 Top Rails and Pipe Braces: The top rails and pipe braces shall be 43 mm O.D., Schedule 40 pipe, zinc coated with minimum coating of 490 grams per square metre.
- .6 Top and Bottom Wire: Wire shall be Number 6 Gauge, single strand 57 grams electro-galvanized and be stretched taut along the top and bottom of the fabric fastened at 460 mm intervals
- .7 Gate Frames: Gate frames are to be made of 43 mm O.D., Schedule 40 pipe, zinc coated with minimum coating of 490 grams per square metre. All joints to be electrically welded. Gates are to be supplied complete with zinc coated malleable iron hinges, latch and latch catch. Double gates to have centre rest with drop bolt for closed position and chain hold open. Gate latches are to be suitable for padlock which can be attached and operated from either side of gate. Hinges are to permit gate to swing back 180 degrees against fence. Gate braces shall be 33 mm O.D. zinc coated steel pipe with minimum coating of 490 grams per square metre.
- .8 Accessories: other components such as tension bars, bands, rail ends, terminal post tops, line post tops, top rail sleeves, wire ties, nuts, bolts, and washers to be zinc coated steel with a minimum coating of 490 grams per square metre.

PART 3 Execution

3.1 INSTALLATION

- .1 Embed terminal posts and straining posts 900 mm. Set terminal posts and straining posts plumb and in accordance with the alignment staked.
- .2 Straining posts shall be installed as per the manufacturer's instructions.

-
- .3 Brace terminal sections, straining sections and corner sections with a pipe brace as per the manufacturer's instructions and as shown in the detailed plans and specifications.
 - .4 Attach fence fabric, wire ties, top rail, pipe braces, tension bar and fittings to the posts and assembled according to the manufacturer's instructions and as specified on the plans as designated by the Engineer.
 - .5 The chain link fence fabric shall be attached to the inside of the posts facing the dust collector. Gates open in the direction shown on the drawings.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Topsoil, planting mix, fertilizer and finish grading.

1.2 RELATED WORK

- | | | |
|----|-----------------------------------|------------------|
| .1 | Topsoil Stripping and Stockpiling | Section 31 14 13 |
| .2 | Site Grading | Section 31 22 00 |
| .3 | Seeding | Section 32 92 20 |
| .4 | Planting | Section 32 93 10 |

1.3 SOIL TESTS

- .1 Conduct soil tests of topsoil and planting mix as required to determine recommended soil amendments and fertilizer compositions for seeding, sodding and planting. Samples shall be taken in accordance with recommendations of approved testing laboratory. Testing regimen as follows:
- .1 PSA-2 (Particle size analysis).
 - .2 C-TOT-ORG (organic carbon).
 - .3 SAL-DETAIL+TGR (detailed salinity).
- .2 Soil tests shall be conducted by an approved testing laboratory.
- .3 Submit two (2) copies of soil test results and fertilizer recommendations to the Consultant for review.

Part 2 Products

2.1 MATERIALS

- .1 Topsoil: stripped and stockpiled or imported material to be reasonably free from subsoil, roots, grass, weeds, toxic materials, stones and foreign objects, and shall be subject to analysis by a testing laboratory before use. Topsoil shall consist of black topsoil, a fertile, friable natural loam, neither heavy clay nor very light sand; 5-20% organic matter by weight; acidity value ranging from pH 6.0 to 7.5. Amend as recommended by soil tests. Topsoil to be in a moist, not wet, condition when incorporated into the work. Submit a one (1) litre sample to Consultant for approval prior to incorporation into the work. Do not screen topsoil.
- .2 Manure: well decomposed cattle excrement, rich in organic matter and humus containing balanced proportions of nitrogen, phosphorus and potash; reasonably free of living vegetation, weed seeds, and couch grass or brome grass rhizomes; in a pulverised, friable condition, not containing fresh or "green" manure, clay, silt, gravel or foreign material.
- .3 Fertilizer: Complete commercial synthetic slow release fertilizer with maximum 35% water soluble nitrogen; uniform in composition and free flowing. Formulation ratio: as recommended by soil tests.

Part 3 Execution

3.1 COORDINATION

- .1 Ensure proper scheduling of work to avoid conflicts with completed and intended work.

3.2 PREPARATION

- .1 Eliminate uneven areas and low spots from areas that have been rough graded. Ensure positive drainage in accordance with grading plans. Notify Consultant of grading problems before proceeding. Remove debris, roots, branches, stones in excess of 50 mm diameter and other extraneous materials. Remove subsoil that has been contaminated with oil, gasoline, calcium chloride or other undesirable chemicals. Dispose of removed materials off-site on a daily basis and at a location approved by local officials.
- .2 Cultivate all areas, which are to receive topsoil, to depth of 100 mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted the subgrade.
- .3 Do not damage structures, membranes, fabrics, gravel or other materials adjacent to or below landscaped areas.

3.3 TOPSOIL AND PLANTING MIX

- .1 Do not spread topsoil until Consultant has inspected subgrade.
- .2 Spread topsoil with adequate moisture in uniform layers during dry weather over approved, dry, unfrozen subgrade, where seeding, sodding and planting is indicated.
- .3 Bring topsoil to finish grade, taking mulching into account.
- .4 Uniformly place topsoil or planting mix, as indicated, in maximum 300 mm loose lifts to the following minimum compacted depths:
 - .1 100 mm topsoil for seeded areas.
 - .2 Compact each lift to maximum 80% of standard Proctor density.

3.4 FERTILIZER

- .1 Apply fertilizer at least 6 days before seeding or planting.
- .2 Spread fertilizer uniformly with mechanical spreaders over entire area of topsoil at rate determined on basis of soil tests.
- .3 Incorporate fertilizer thoroughly into upper 50 mm of growing media.

3.5 FINISH GRADING

- .1 Remove stones, roots, grass, debris and foreign non-organic objects from growing media.
- .2 Manually spread topsoil around existing trees and at areas subject to damage by equipment.
- .3 Fine grade entire landscaped area to contours and elevations as indicated. Eliminate rough spots and low areas to ensure positive drainage in accordance with the grading plans. Notify Consultant of grading problems before proceeding.
- .4 Fine grade and loosen topsoil prior to seeding or sodding. Prepare loose friable bed by means of shallow discing or harrowing and subsequent raking. Roll lightly and rake wherever growing media is loose.
- .5 Leave surface smooth and uniform, with a fine loose texture.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Seed and application of seed.

1.2 RELATED WORK

- | | | |
|----|-----------------------------------|------------------|
| .1 | Topsoil Stripping and Stockpiling | Section 31 14 13 |
| .2 | Site Grading | Section 31 22 00 |
| .3 | Topsoil and Finish Grading | Section 32 91 19 |

Part 2 Products

2.1 MATERIALS

- .1 **Grass seed:** Certified Canada No. 1 Grade to Government of Canada Seeds Regulations and having minimum germination of 75% and minimum purity of 97%. Submit original seed bag labels for each seed mix.
- .2 **Fertilizer:** refer to Section 32 91 19

2.2 SEED MIXES (by weight)

- .1 Seed Mix A - Dryland Mix:
- | | |
|-----|---|
| 26% | Kentucky Bluegrass (Alene I, Touchdown or Brooklawn) |
| 10% | Kentucky Bluegrass (Midnight, Quantum Leap or Rugby) |
| 9% | Perennial Rye Grass (Cutter, Playmate or Citation Fore) |
| 18% | Creeping Red Fescue (Aberdeen, Jasper II, or Boreal) |
| 15% | Tall Fescue (Mustang III, Watchdog or Guardian) |
| 10% | Hard Fescue (Osprey, Eureka II, or Discovery) |
| 10% | Annual Rye, Oats or Barley nurse crop |

Seed rate: 2.2 kg/100 m²

Part 3 Execution

3.1 SEEDING

- .1 All areas to be seeded shall be harrowed once with a landscape harrow to a maximum depth of 50 mm.
- .2 Fertilize: Apply fertilizer at least 6 days before seeding. Spread fertilizer uniformly with mechanical spreaders over entire area to be seeded at rate determined on basis of soil tests. Incorporate fertilizer thoroughly into upper 50 mm of soil surface.
- .3 Seed shall be evenly applied with an approved mechanical seeder. Seeding shall be done in two operations at right angles to one another.
- .4 Sow during calm weather (winds less than 10 km/h), using equipment suitable for area involved. Sow half of required amount of seed in one direction and remainder at right angles. Incorporate seed into soil to a maximum depth of 13 mm simultaneously or within one hour after seeding operation. Mix carefully with light chain harrow or wire rakes.

- .5 Water with fine spray, avoiding washing out of seed. Apply enough water to ensure penetration of minimum 50 mm.
- .6 Protect seeded areas against damage. Maintain protection until acceptance of seeded areas.
- .7 Reseed at 2 week intervals where germination has failed.

3.2 MAINTENANCE

- .1 Keep soil moist during germination period and adequately water seeded areas until accepted by Consultant.
- .2 Apply water to ensure moisture penetration of 50 to 100 mm. Control watering to prevent wash-outs.
- .3 Cut grass when it reaches height of 100 mm and cut to a height of 65 mm. Evenly distribute (do not remove) clippings which exceed 10 mm in depth.
- .4 Maintain grassed areas free of weeds and disease.

3.3 ACCEPTANCE

- .1 Seeded areas will be accepted provided that:
 - .1 Seeded areas are properly established for the intended purpose and to the satisfaction of the Consultant and true to grade.
 - .2 Turf is free of eroded, bare or dead spots and 90 - 95% free of weeds.
 - .3 Seeded areas have been cut at least twice, the last cut being carried out within 24 hours of acceptance.
- .2 Areas seeded in fall will be accepted in the following spring one month after start of growing season provided acceptance conditions are fulfilled.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Plant material.

1.2 RELATED WORK

- | | | |
|----|----------------------------|------------------|
| .1 | Topsoil and Finish Grading | Section 32 91 19 |
| .2 | Plant List | Section 32 93 11 |
| .3 | Mulches | Section 32 93 20 |
| .4 | Landscape Maintenance | Section 32 93 40 |

1.3 REFERENCE STANDARD

- .1 Comply with the current edition of the *Canadian Landscape Standard* of the Canadian Society of Landscape Architects (CSLA) and the Canadian Nursery Landscape Association (CNLA).

1.4 CONTRACTOR QUALIFICATIONS

- .1 Contractors supplying and/or installing plant material are required, at the discretion of the Consultant, to be Members in-good-standing of the Saskatchewan or Canadian Nursery Landscape Association. Upon request, provide evidence of such standing to the satisfaction of the Consultant.

1.5 SOURCE QUALITY CONTROL

- .1 Imported plant material must be accompanied with necessary permits and import licenses and conform to federal and provincial regulations.
- .2 Trees and shrubs shall have strong fibrous root systems, and be structurally sound and free of disease, insects, insect eggs, sunscald, frost cracks, rodent damage, defects, injuries and damage.
- .3 Plant material with dieback or tip kill, that adversely affects the structure of the tree, is unacceptable (e.g. damaged leader or severe tip kill to lateral branches).
- .4 Plant material with stumps included in the root ball is unacceptable.
- .5 Container and basket trees must have well-developed branches and foliage. Trees with sparse foliage or over-elongated branches are unacceptable.
- .6 Black Ash trees must be grafted on to Green Ash rootstock unless otherwise approved by the Consultant.
- .7 Plants dug from native stands, woodlots, Christmas tree lots, orchards or neglected nurseries, and have not received proper maintenance as advocated by CNLA, shall be designated as "collected plants". "Collected plants" are acceptable subject to written approval by Consultant.
- .8 Plant material shall meet or exceed the sizes specified on the Plant List. If larger plants are used, the root ball shall be increased in proportion to the size of the plant to conform to CNLA specifications. If acceptable plant material is not commercially available at the minimum size specified, smaller sizes of the same species may be acceptable, subject to Consultant approval. The Consultant reserves the right to reject plant material that does not meet the minimum size requirements.
- .9 Cold storage: Consultant approval required for plant material which has been held in cold storage. Inspection to occur at site of storage.

- .10 Bare root material: unacceptable outside natural dormancy period.
- .11 Tree spade material: turf surrounding the source material to be free from invasive perennial species. If invasive species are present, treat with Round-Up a minimum of seven (7) days before transplanting.
- .12 To prevent the importation of Dutch Elm disease:
 - .1 Elm trees shall not be imported from an area where Dutch Elm Disease has been confirmed (governed by federal and provincial legislation).
 - .2 Imported elm trees must be accompanied by written certification, stating that the trees are free of disease and have been sprayed with Dursban Turf or other approved insecticide to control the elm bark beetle.
 - .3 Transportation of elm trees must comply with Provincial DED regulations.

1.6 SUBSTITUTIONS

- .1 Substitutions to plant material are not permitted unless written approval is obtained from the Consultant prior to tender close, except under extraordinary circumstances. Plant substitutions must be of similar species and of equal size to those originally specified.

1.7 SHIPMENT AND PRE-PLANTING CARE

- .1 Coordinate shipping of plants and site preparation to ensure minimum time lapse between transport and planting.
- .2 Pack plants in damp peat moss, place in bales or boxes, and keep damp until arrival at the site.
- .3 Cover plant foliage with tarpaulin, to prevent loss of moisture during transit and storage. Avoid crushing or breaking of tops of plants.
- .4 Keep roots moist and protected from sun and wind. If trees and shrubs cannot be planted within 24 hours of arrival on site: heel in, protect from direct sun, and water well.
- .5 Place bundles of whips and seedlings in pails with 50 mm of moist peat moss. Keep roots moist at all times. Avoid breaking or stripping bark from bundles.
- .6 Remove broken and damaged roots with sharp pruning shears. Make clean cuts.
- .7 Protect root balls against sudden changes in temperature and exposure to heavy rainfall.
- .8 Protect bales or boxes from sun and wind exposure during planting.

1.8 PLANTING TIME

- .1 Provide planting schedule. Undertaking planting operations over an extended period, with limited personnel, is unacceptable.
- .2 Plant only under conditions that are conducive to health and optimum physical conditions of plants.
- .3 Plant material growing in containers may be planted throughout growing season.

1.9 WARRANTY

- .1 Warranty plant material to remain healthy for one full year following date of Substantial Performance; and warranty that invasive perennial species are not imported into the project site with the plant material. Plant material damaged by accidental causes or vandalism is exempted from warranty provisions.
- .2 The Consultant reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

1.10 REPLACEMENTS

- .1 During warranty period, promptly remove plant material that has died or failed to grow satisfactorily as directed by Consultant.
- .2 Replace plant material the same or next planting season.
- .3 Extend warranty on replacement plant material for a period equal to the original warranty period.
- .4 Continue such replacement and warranty until plant material is acceptable.

1.11 INSPECTIONS AND APPROVALS

- .1 Consultant reserves the right to approve nursery plant material at source. Notify Consultant of source, minimum 7 days in advance of shipment. No work under this Section is to proceed without approval.
- .2 Acceptance of plant material at source does not prevent rejection on site prior to, or after, planting operations.
- .3 Stake location of trees, shrubs and edge of planting beds for inspection by Consultant. Obtain Consultant approval before planting.
- .4 Notify the Consultant if the layout has been altered from the design drawings. Adjustments may be required as a consequence of site conditions, and must be approved by the Consultant before installing plant material.
- .5 Inspection of plant material to include, but not limited to: species; size; health; location/massing; installation; and invasive perennial species.
- .6 Inspection of shrub beds to include, but not limited: clean crisp edge and smooth continuous curve.

1.12 AS BUILT DRAWINGS

- .1 Keep one set of drawings and specifications on the job for the sole purpose of recording any changes to the work. Update drawing set daily as work progresses.

1.13 PAYMENT

- .1 No additional payment will be made for: excavation, tree supports, mulching of trees in grass areas, and related work which is incidental to plant material.
- .2 Plant material that has been rejected after installation and prior to substantial completion will not be certified for payment.
- .3 No additional payment will be made for plant material larger than the minimum size specified.
- .4 Undersized plant material is subject to Consultant approval and may be rejected.

Part 2 Products

2.1 MATERIALS

- .1 Plant list: refer to Section 32 93 11.
- .2 Water: free of minerals and contaminants which may be detrimental to plant growth.
- .3 Supports: refer to details.
- .4 Tree tie: Arbortape or equivalent; 19 mm flat, woven polypropylene tree tie material.
- .5 Mulch: refer to Section 32 93 20.

Part 3 Execution

3.1 PLANTING SETBACKS

- .1 Locate and flag underground utilities within 5 metres of proposed planting sites.
- .2 Unless otherwise approved by the Consultant, trees shall be set back the following minimum distances, measured from the center of the tree:
 - .1 0.6 m: 120 B 240 voltage lines (e.g., streetlight power lines), traffic control lines
 - .2 1.0 m: sidewalks, pathways
 - .3 1.5 m: local road curb face, driveways and private walks
 - .4 2.0 m: buried high voltage power lines, overhead power lines ,
SaskTel/AT&T/telephone lines, Sask Energy/gas distribution lines,
Shaw/telecable lines, utility pedestals, curb face of arterial or collector roadways,
roadway signs except from the front of stop and yield signs
 - .5 3.0 m: fibre optic lines, water and sewer lines, electrical transformers, street
lights, fire hydrants, buildings, side and back of bus stop signs, front of bus stop
signs where tree is more than 3.0 m from curb face
 - .6 7.0 m: street corners, front of stop and yield signs
 - .7 10.0 m: Transgas/gas transmission lines
 - .8 12.0 m: front of bus stop signs where tree is less than 3.0 m from curb face,
railway tracks
- .3 Set shrubs back a distance equal to one half of shrub spacing at shrub bed perimeters.

3.2 EXCAVATION

- .1 Seedlings: 300 mm x 300 mm x 450 mm deep.
- .2 Shrubs: in continuous planting beds excavated to a depth of 300 mm.
- .3 Small trees (up to 3.0 m): depth: equal to height of root ball; diameter: double the width
of root spread or root ball.

- .4 Large trees (over 3.0 m): depth equal to height of root ball; diameter: double the diameter of root ball; if tree location has heavy clay soil, in an irrigated turf area; increase planting hole widths by 50 mm for each 100 mm of root ball diameter; if tree location has heavy clay soil, in an dryland turf area: increase planting hole widths by 100 mm for each 100 mm of root ball diameter.
- .5 Provide drainage for planting holes in heavy clay soil if natural drainage does not exist; method to be approved by Consultant.
- .6 Remove water from excavations prior to planting.
- .7 Scarify the wall and bottom of tree holes before installing spade, basket or container material.

3.3 PLANTING

- .1 Remove tags, flagging, string, or other shipping materials. Retain protective coverings on trunks until tree is installed.
- .2 Install plant material in upright position.
- .3 Bare root material: position top of root system, indicated by the trunk flare or dark stain on the trunk, at finished grade; backfill with planting mix to maintain natural root structure; damaged or broken roots to be cut back with a sharp knife to living wood; roots to be spread out to prevent girdling of the root system; water immediately - refer to Section 32 93 40.
- .4 Container stock: remove container without disturbing root ball; for small trees: if roots have grown to the edge of the container, cut three (3) vertical slices around the root ball; install plant immediately with top of root ball flush with proposed finished grade; backfill with planting mix and compact firmly around the plant; water immediately - refer to Section 32 93 40.
- .5 Balled and burlapped plant material:
 - .1 Rest root ball on undisturbed / compacted subgrade.
 - .2 Place top of root ball at the same level as it was in the nursery (+/- 50 mm), allowing for future settlement
 - .3 If tree location is in heavy clay soil, place top of the root ball 50 mm above the level it was in the nursery (+/- 50 mm).
 - .4 Provide planting mix at edges of excavation to support root ball.
 - .5 Tamp planting mix around root system in 150 mm layers, eliminating air voids. When 2/3 of planting mix has been placed, fill hole with water. After water has completely penetrated into soil, complete backfilling.
 - .6 Remove top 1/3 of wire basket.
 - .7 When planting mix is installed to half the root ball height, cut and remove the top 1/3 of the burlap; remove carefully so as to not disturb the root ball.
 - .8 Build a 100 mm high by 100 mm wide soil ring around the perimeter of the root ball to assist with maintenance watering.
 - .9 Set trees plumb and in the centre of the tree hole and positioned to give the best appearance and relationship to adjacent structures, walkways, roadways or park features.
 - .10 Water immediately - refer to Section 32 93 40.

.6 Tree Spade material:

- .1 Dig plant material with mechanized digging equipment of hydraulic spade type. Dig with a firm natural cone of earth of sufficient diameter and depth to encompass enough of the root systems necessary for full recovery of the plants. The following will govern the material size allowable for transplant by the tree spade method:

Tree spade size	Maximum tree caliper (300 mm above ground)	Tree height
1350 mm (44")	75 mm (3")	3.0 - 3.6 m (10-12')
1500 mm (60")	100 mm (4")	3.0 - 3.6 m (10-12')
1650 mm (66")	150 mm (6")	3.6 - 4.2 m (12-14')
2100 mm (84")	200 mm (8")	4.2 - 4.8 m (14-16')

- .2 Dig tree hole with same mechanical equipment as used to dig plant material. Ensure hole dug is upright.
- .3 Scarify the top half of the tree spade dug hole to a depth of 75 mm.
- .4 Remove excess soil from the bottom of the hole before placing tree.
- .5 Place tree plumb. Backfill crevices with planting mix, and water immediately - refer to Section 32 93 40. Repeat until soil is flush with finished grade.

3.4 PRUNING

- .1 Prune dead, injured and rubbing branches.
- .2 Remove projecting stubs back to branch collar.
- .3 Postpone pruning of trees, where heavy bleeding may occur, until in full leaf. **Do not prune elms between 01 April and 31 August.**

3.5 MULCH

- .1 Refer to Section 32 93 20.

3.6 CLEAN UP

- .1 Provide a final washing of foliage to remove settled construction dust.
- .2 Prune branches damaged during construction.
- .3 Remove shipping materials, tags, flags, wire, burlap and protective coverings from the plant material and beds.

END OF SECTION

QUANTITY	COMMON / <i>Botanical Name</i>	SIZE AND REMARKS
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DECIDUOUS TREES:

3	CLUMP PAPER BIRCH / <i>Betula papyrifera</i>	- 25 cal. min.; 1500 – 2000 ht. min.; clump form with 3 or more stems; 3 branches per stem; container grown or B&B; groups of 3 single stem trees planted in close proximity are acceptable in lieu of multi-stem specimens.
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NOTES:

- in the case of discrepancy between the plant list and the drawings, the planting plans shall be taken as correct.
- sizes are in millimetres unless noted otherwise.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Landscape mulches.

1.2 RELATED WORK

- | | | |
|----|----------------------------|------------------|
| .1 | Topsoil and Finish Grading | Section 32 91 19 |
| .2 | Planting | Section 32 93 10 |
| .3 | Landscape Maintenance | Section 32 93 40 |

1.3 LAYING OUT WORK

- .1 Lay out work and be responsible for accuracy. Provide the necessary personnel to assist the Consultant in checking the work.

Part 2 Products

2.1 WOOD MULCH

- .1 Untreated shredded fibres or chips; to Consultant approved sample.

Part 3 Execution

3.1 WOOD MULCH

- .1 Mulch shrub beds and individual trees and shrubs.
- .2 Minimum uniform compacted mulch depths: 50 mm in irrigated areas; 100 mm in non-irrigated areas.
- .3 Install planting bed mulch following turf establishment. Remove weeds prior to mulching.
- .4 Do not install mulch within 100 mm of tree trunks.
- .5 Taper mulch layer at base of shrubs to provide a 100 mm diameter saucer centered on the shrub, with no mulch directly on the base of the stem(s).
- .6 Finish by hosing down to settle in place.
- .7 Do not install mulch on non-vegetated swales or drainage strips.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This Section describes the work required for the installation of sanitary sewer manholes and related structures complete as shown on the Drawings.

1.2 MATERIALS

- .1 Materials required to complete the work shall be supplied by the Contractor. They shall be new and of the type specified. They shall be handled and stored in accordance with the manufacturers' written instructions.

1.3 MAINTENANCE

- .1 Defects or misalignment of any part of the work caused by settlement or faulty workmanship and materials during the maintenance period shall be corrected by the Contractor at his expense.

1.4 RELATED WORK

- .1 Water & Sewer Utility Trench Excavation and Backfill: Section 31 23 16.
- .2 Site Sanitary Utility Sewerage Piping: Section 33 31 15.

Part 2 Products

2.1 MANHOLES

- .1 Manhole Sections: 1050mm diameter manhole barrels and flat top sections as specified shall conform to ASTM C478-82a. Joints shall be suitable for either rubber gaskets or mastic sealants. Precast base sections may be used. Aluminium steps shall be cast into the sections using polyethylene anchors.
- .2 Frame & Cover: Frame and cover shall be Blanchard Foundry Co. No. 4005 or as otherwise approved.
- .3 Insulation Plug: Premanufactured Urecon three section insulation plug or field constructed insulated pressure treated plywood plug to fit manhole barrel, complete with lifting rope.
- .4 Insulation: 100mm Plasti-Fab Type 2 insulation molded to fit outside surface of manhole barrel.
- .5 Joint Sealant: Ram-Nek Joint Sealant.

2.2 BEDDING SAND

- .1 Bedding sand shall conform to the following gradation limits:

<u>Sieve Size</u>	<u>% Passing</u>
5 mm	95 - 100
2 mm	75 - 100
900 mm	40 - 80
400 mm	15 - 45
160 mm	0 - 20
71 mm	0 – 5

Part 3 Execution

3.1 MANHOLES

- .1 Construct manholes accurately as detailed and at the locations and grades as shown on the Drawings. Align ladder rungs with manhole cover entry.
- .2 Place a layer of 100mm Plasti-Fab Type 2 insulation, molded to fit the outside surface of the manhole barrel, from the top of the pipe to the bottom of the manhole cover according to the manufacturer's instructions.
- .3 Fill completely all spaces between manhole sections and ring with mortar or use gaskets. Mortar shall consist of 1 part sulphate resisting cement, 2 parts clean sharp sand and sufficient water to make the mixture workable.
- .4 All joints between barrel section (including cone section) shall use Ram-Nek joint sealant to ensure a water tight joint. Install the joint sealant as per the manufacturer's recommendations.
- .5 Pipes shall not protrude more than 40 mm inside the manhole. All spaces between the pipes and walls shall be filled with mortar.
- .6 Install smooth flow channels to 1/2 pipe diameters as shown on the Drawings. Slope manhole floors to flow channels.
- .7 The maximum depth of 600 mm neck sections shall be 200 mm.
- .8 Manholes shall have a minimum of 100mm and maximum of 300mm of grade ring below the frame and cover.
- .9 Place a 50mm levelling course of bedding sand beneath the manhole.

3.2 INSULATION PLUG

- .1 Construct and install insulation plug complete as shown on the Drawings. If using a premanufactured plug, install as per manufacturers specifications.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Water service connections.

1.2 REFERENCES

- .1 American Water Works Association:
 - .1 AWWA C800: Underground Service Line Valves and Fittings
- .2 ASTM International:
 - .1 ASTM D2737: Standard Specification for Polyethylene (PE) Plastic Tubing
 - .2 ASTM F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - .3 ASTM F594: Standard Specification for Stainless Steel Nuts.
- .3 Canadian Standards Association:
 - .1 CSA B182.1: Plastic drain and sewer pipe and pipe fittings

Part 2 Products

2.1 GENERAL

- .1 Bolts and nuts: Unless otherwise specified, bolts, nuts and washers used in buried metal products shall be Type 316 stainless steel as per ASTM F593/594.

2.2 WATER SERVICE ASSEMBLY

- .1 Water Service Pipe: SDR 9 CTS polyethylene (PE) tubing in conformance with ASTM D2737.
- .2 Compression fittings: In accordance with AWWA C800.
- .3 Inserts for compression fittings:
 - .1 Stainless steel tube or SDR13 polyethylene.
 - .2 38mm long.
 - .3 One bevelled end and one flanged.
- .4 Corporation Stop in accordance with AWWA C800.
 - .1 Mueller Corporation Ball Valve or equal.
 - .2 Inlet: Standard thread.
 - .3 Outlet: Compression connection compatible with PE tubing.
- .5 Curb Stop in accordance with AWWA C800.
 - .1 Mueller Oriseal or equal.
 - .2 Non-draining, complete with compression fittings.
- .6 Curb Box:

- .1 Top section:
 - .1 Schedule 40, Type 304 stainless steel.
 - .2 32 mm diameter.
 - .3 Threaded to accept cover.
- .2 Bottom section:
 - .1 PVC or Schedule 40, Type 304 stainless steel.
 - .2 25 mm diameter.
- .3 Boot:
 - .1 Cast iron, coated with asphaltic varnish.
 - .2 Designed to rest level on concrete block without touching the curb stop or service tubing.
 - .3 Total height range: 2460 to 2900 mm above curb stop.
- .4 Cover:
 - .1 Cast iron, coated with asphaltic varnish.
 - .2 Complete with brass plug and threaded connection to top section.
- .5 Operating rod:
 - .1 15 mm diameter stainless steel rod with yoke and brass cotter key for connection to the curb stop.
 - .2 Flat top to fit the curb stop key.
 - .3 Sufficient length to extend within 450 mm of the finished design ground surface when installed.
- .6 Pre-cast concrete block: 400 x 400 x 65 mm.

2.3 GRANULAR MATERIAL

- .1 Crushed rock: Uniformly sized crushed 20 mm rock.
- .2 Bedding sand: Shall conform to the following gradation limits:

Canadian Metric Sieve Designation	% Passing
5.0 mm	95 - 100
2.0 mm	75 - 100
0.900 mm	40 - 80
0.400 mm	15 - 45
0.160 mm	0 - 20
0.071 mm	0 - 5

2.4 CORROSION PROTECTION

- .1 Petrolatum wax tape system: Denso Paste, Densyl Mastic and Densyl Tape; to AWWA C217.

2.5 HEAT TRACING CABLE

- .1 Urecon #147E Thermocable complete with accessory kits as required.

2.6 INSULATED HALF-SHELL COVERS FOR FITTINGS

- .1 Urecon UIP insulated half-shell covers.

2.7 HEAT SHRINK SLEEVES

- .1 CanusaWrap Heat Shrink Sleeves.

2.8 ELECTRONIC THERMOSTAT

- .1 Urecon Model No. UTC-2030 and Model No. UTC-2230 with circuit breaker 120/208v, complete with Power Feed Kit PFK-1 and audible alarm.

Part 3 Execution

3.1 TRENCH EXCAVATION AND BACKFILL

- .1 As described in Section 31 23 20.

3.2 WATER SERVICE INSTALLATION

- .1 Complete water service as shown on the Drawings.
- .2 Tap main with approved tapping tool following manufacturer's instructions.
 - .1 Tap service level and perpendicular to the water main and not closer than 450 mm from a joint or other tapping.
 - .2 Tap service into the water main at an elevation equal to or higher than the crown of the adjacent sanitary sewer service.
- .3 Lay water service pipe in trench with sewer service pipe.
 - .1 Create a horizontal gooseneck extending in two curves a distance of 400 mm on each side of the centre line of the connection.
- .4 Install curb box.
 - .1 Install the curb box, boot, and anode as shown on the Drawings.
 - .2 Support the curb box so that it will remain plumb during and after backfill.
 - .3 Set the top of the box 150 mm below finished grade.
 - .4 Extend the operating stem to within 450 mm of the top of the box.
- .5 Secure a piece of tubing to the curb box top section so that at least 1.0 metres is visible above ground.

3.3 EXISTING WATER SERVICE DECOMMISSIONING

- .1 Existing water service location to the existing detachment is approximate. Contractor to undertake whatever work necessary to satisfy themselves with the precise location of this existing utility.
- .2 Coordinate with local municipality as to the preferred capping method for the existing water service to the detachment. The local municipality may require the service be decommissioned at the main.

- .3 Remove existing curb stop on site once existing water service has been decommissioned or capped in accordance with local requirements.

3.4 HEAT TRACING CABLE

- .1 As pipe is joined, pull heat tracing cable through the factory installed trace conduit on pipe sections.
- .2 Install heat tracing cable continuously along the length of the pipe, including fittings in accordance with manufacturer's instructions.
- .3 Install sensors at proper locations in accordance with manufacturers recommendations.
- .4 Ensure trace conduits are positioned on top of the water pipe for heat transfer efficiency.
- .5 Use manufacturer approved accessory kits for splicing and terminating cable.
- .6 Leave adequate length of heat trace cable to allow heat trace to be run to the underside of the detachment and housing unit floor structures. Coordinate length with on-site mechanical and electrical contractors.
- .7 Heat trace cable on the mainline will be run continuously to the terminal end near SS MH3 so the system can operate from the controller in the detachment building.
- .8 Service connection heat trace systems will be controlled from individual controllers located within the housing units. Coordinate controller installation complete with alarms with mechanical and electrical contractors.
- .9 Install sensors securely to pipe wall. Locate sensors 180° away from heating cable. Install all sensors in accordance with manufacturers requirements.

3.5 INSULATED HALF SHELL COVERS FOR FITTINGS

- .1 Install insulated half shell covers on all fittings and curb stops according to manufacturer's instructions. Ensure a snug fit with the mating of the two halves, trimming ends where necessary.
- .2 Notch insulated half shell covers where heat tracing cable rests against the pipe to prevent cable from being pinched between the pipe and the insulation.
- .3 When a proper fit is achieved, caulk the mating surfaces with silicone caulking and mate the insulated half shell covers. Fasten with stainless steel bands and gear clamps provided with the covers. Tighten clamps until caulking begins to ooze from seams.
- .4 Seal seams with heat shrink sleeves.

3.6 HEAT SHRINK SLEEVES

- .1 Before lowering into trench, install heat shrink sleeves on all pipe joints and insulated fittings according to manufacturer's instructions.
- .2 Backfill with material free of sharp edges and large particles that may damage the sleeve backing.

3.7 ELECTRONIC THERMOSTAT

- .1 Install thermostat complete with power feed to heat tracing cable according to manufacturer's instructions.
- .2 Thermostat with power feed connection to be located in the garages Mechanical Room for all mainlines. Co-ordinate installation of controllers with Mechanical and Electrical.
- .3 Thermostat with power feed connection to be located in the Housing units for all service lines. Co-ordinate installation of controllers with Mechanical and Electrical.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Construction of sanitary sewer mains.

1.2 REFERENCES

- .1 ASTM International:
 - .1 ASTM D3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .2 Canadian Standards Association:
 - .1 CSA B182.2: PSM type Polyvinylchloride (PVC) sewer pipe and fittings.

1.3 SUBMITTALS

- .1 The Contractor shall submit pipe material specifications and heat trace shop drawings prior to the material being incorporated into the Work.
- .2 The Contractor shall supply shop drawings of the Urecon insulation system for the sanitary sewer.
- .3 The Contractor shall supply operation & maintenance manuals for the entire heat tracing system complete with initial commissioning report indicating all systems are operational prior to acceptance of the work.
- .4 The Contractor shall supply as-built drawings of all sewerage utility piping infrastructure installed.

Part 2 Products

2.1 PIPE & FITTINGS

- .1 PVC sanitary sewer pipe:
 - .1 Pipe: SDR28 PVC, certified to ASTM D3034 and CSA B182.2, complete with fittings and factory installed elastomeric gaskets.
 - .2 Pre-insulated pipe: Specified pipe as above, complete with Urecon Standard U.I.P. system for below grade piping.
 - .3 Pipe joint lubricant: As recommended by pipe manufacturer.

2.2 FASTENERS

- .1 Bolts, nuts, and pins: Unless otherwise noted, metal fasteners shall be Type 316 stainless steel as per ASTM F593/594.

2.3 INSULATED HALF-SHELL COVERS FOR FITTINGS

- .1 Urecon UIP insulated half-shell covers.

2.4 HEAT SHRINK SLEEVES

- .1 CanusaWrap Heat Shrink Sleeves.

2.5 GRANULAR MATERIAL

- .1 Crushed rock: Uniformly sized 20 mm crushed rock.
- .2 Bedding sand: Conforming to the following gradation limits:

Canadian Metric Sieve Designation	% Passing
5.0 mm	95 - 100
2.0 mm	75 - 100
0.900 mm	40 - 80
0.400 mm	15 - 45
0.160 mm	0 - 20
0.071 mm	0 - 5

Part 3 Execution

3.1 TRENCH EXCAVATION AND BACKFILL

- .1 As described in Section 31 23 20.

3.2 PIPE BEDDING

- .1 Excavate unsuitable subgrade soils for pipe laying and replace with compacted bedding material.
- .2 Place granular bedding material from 100 mm below the pipe to 300 mm above the crown of pipe.
 - .1 Ensure bedding material is adequately packed into the haunch area of the pipe to limit vertical deflection during backfill.
- .3 Provide bell holes to assure continuous bearing on firm material for the full pipe length. Do not wedge or block the pipe.
- .4 Compact using hand and mechanical methods to achieve pipe manufacturer installation requirements.
- .5 For pipes that do not require granular bedding in the manufacturer's recommendations, ensure the bottom of the trench is smooth, straight and free of large rocks such that the piping is supported along its entire length.

3.3 PIPE LAYING

- .1 Lay pipes accurately to the lines and grades shown on the Drawings or as directed by the Consultant.
 - .1 Alignment and grade hubs will be provided by the Consultant. Transfer line and grade to the work using two of the following approved methods:
 - .1 Batterboard system
 - .2 Laser system

.3 Optical level

- .2 Batterboards must be available on site, and are to be erected at the direction of the Consultant if required to control elevation.
- .3 Constantly check grade and alignment. If an error in grade or alignment is suspected, stop the work immediately and notify the Consultant.
- .2 Commence pipe laying at the lowest point of the sewer. Lay pipe uphill with the spigot ends in the direction of flow.
- .3 Inspect piping and fittings for damage before lowering into the trench. Remove damaged materials or those not meeting the Specifications from site.
- .4 Keep earth and other foreign material out of pipelines and pipe joints. Place a suitable cover over the end of the pipe during excavation and when the work is shut down.
- .5 Install fittings in accordance with manufacturer's recommendations.
- .6 Join pipes and fittings in accordance with manufacturer's instructions using gaskets and lubricants as supplied or specified by the manufacturers.

3.4 INSULATED HALF SHELL COVERS FOR FITTINGS

- .1 Install insulated half shell covers on all fittings according to manufacturer's instructions. Ensure a snug fit with the mating of the two halves, trimming ends where necessary.
- .2 Notch insulated half shell covers where heat tracing cable rests against the pipe to prevent cable from being pinched between the pipe and the insulation.
- .3 When a proper fit is achieved, caulk the mating surfaces with silicone caulking and mate the insulated half shell covers. Fasten with stainless steel bands and gear clamps provided with the covers. Tighten clamps until caulking begins to ooze from seams.
- .4 Seal seams with heat shrink sleeves.

3.5 HEAT SHRINK SLEEVES

- .1 Before lowering into trench, install heat shrink sleeves on all pipe joints and insulated fittings according to manufacturer's instructions.
- .2 Backfill with material free of sharp edges and large particles that may damage the sleeve backing.

3.6 SANITARY SEWER CLEANOUTS

- .1 Construct sewer cleanouts as detailed. Use sweep bends where bends are required.
- .2 Use pre-insulated pipes as specified.
- .3 Install female threaded fitting with threaded cap at top of cleanout. Install manhole frame and cover complete with crushed rock over each cleanout. Ensure cleanout is 150mm below the underside of the manhole cover.

3.7 CONNECTIONS TO EXISTING SANITARY SEWERS

- .1 Confirm elevation and alignment of sanitary sewer at connection location and notify the Consultant of any variation from the information shown on the Drawings.
- .2 Connect new pipe to existing sanitary sewer at locations shown on the Drawings using approved adaptors.
- .3 Do not allow construction debris to enter pipelines.
- .4 Dispose excess materials at an approved off-site facility.
- .5 Backfill and compact the excavated area as described in Section 31 23 20.
- .6 Repair all areas disturbed during the connection to their original condition.

3.8 CAPPING EXISTING DETACHMENT SEWER SERVICE

- .1 Existing sewer service location to the existing detachment is approximate. Contractor to undertake whatever work necessary to satisfy themselves with the precise location of this existing utility.
- .2 Coordinate with local municipality as to the preferred capping method for the existing sewer service to the detachment. The local municipality may require the service be decommissioned at the main.

3.9 CLEAN-UP

- .1 The Contractor shall clean up the site as work progresses.
- .2 The Contractor shall remove all equipment, plant, tools and surplus material from the site of the finished work and shall repair and restore all drainage facilities which have been blocked or damaged as a result of the Contractor's operations.

3.10 INFILTRATION

- .1 Infiltration shall not exceed 170 liters/day/mm diameter of pipe/km of pipe.
- .2 If infiltration appears to exceed the allowable rate, infiltration tests are to be carried out at the expense of the Contractor in the presence of the Consultant.

END OF SECTION