



# Public Services and Procurement Canada

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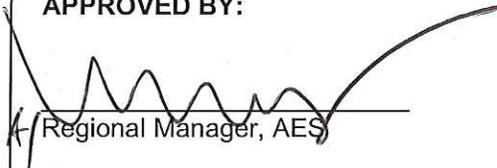
Buy & Sell I.D. No. \_\_\_\_\_

SPECIFICATIONS  
for  
Existing Utility Rehabilitation

Fort Langley National Historic Site  
Existing Utility Rehabilitation  
(Project No. R.081111.001)  
Fort Langley, B.C

August 2017

## APPROVED BY:

  
\_\_\_\_\_  
Regional Manager, AES

2017-09-06  
Date

  
\_\_\_\_\_  
Construction Safety Coordinator

2017-09-23  
Date

## TENDER:

  
\_\_\_\_\_  
Project Manager

2017.09.06  
Date

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Appendix A - Arborist Report

SEP 05 2017

1. CODES
- .1 Perform work to CURRENT Codes, Construction Standards and Bylaws, including Amendments up to the TENDER closing date.
2. DESCRIPTION OF WORK
- .1 Work under this Contract comprises water and sanitary sewer construction at Fort Langley National Historic Site in Langley, BC. Work includes installation of new water mains and appurtenances, abandonment of the existing water system on completion of the new system, installation of new sanitary sewer lines, abandonment of two existing sanitary pump stations, and connection to new services. The work will also include coordination with the Township of Langley who will be completing offsite improvement. The work will occur on existing site at the Fort Langley National Historic Site.
- .2 Work to be performed under this Contract includes, but is not limited to, the following items covered further in the Contract documents:
- .1 Submit Traffic Management Plan to Departmental Representative for review prior to mobilizing to site.
- .2 Locate all existing utilities and crossings prior to construction including by not limited to those indicated on Sheet 2. At all pre-locate locations mechanically excavated in maximum 20 cm lifts to allow for inspection of the soils and sediments for cultural materials. Allow for 4 days to complete the pre-locate test holes on Sheet 2. The Department Representative will provide an Archeologist to monitor and inspect the soils and sediments.
- .3 Install, test, chlorinate, flush and commission new main in stages.
- .4 Abandon existing water infrastructure where indicated on the drawings.
- .5 Install, test, flush and commission new sanitary sewers
- .6 Connect existing buildings to new sanitary sewers.
- .7 Cap and abandon existing sanitary sewers as indicated include the existing pump station adjacent to the Visitor Centre and the existing pump station within the basement of the Operations building.
- .8 Install new fibre optic conduits and pull boxes

complete with pull strings for future fibre optic installations by others.

- .9 Coordinate with the onsite archaeological specialist to avoid disruption or damage to existing archaeological resources on the site.
- .10 Retain an Arborist to monitor the construction activities necessary to protect the existing trees. Follow the recommendations of the Arborist report included in Appendix A.
- .11 Complete site restorations to match existing conditions.
- .12 Provide the Department Representative with all test reports and final documentation.

3. CONTRACT DOCUMENTS

- .1 The Contract documents, drawings and specifications are intended to complement each other, and to provide for and include everything necessary for the completion of the work.
- .2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.

4. OTHER CONTRACTS

- .1 Cooperate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.
- .2 Coordinate work with that of other Contractors (if applicable). If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of this Work.

5. DIVISION OF SPECIFICATIONS

- .1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.
- .2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.
- .3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

6. TIME OF COMPLETION

- .1 Total completion of the site work shall be no later than 16 weeks from contract award date.

7. HOURS OF WORK .1 Hours of work shall accommodate operation of the Fort Langley National Historic Site. Hours of work shall meet Township of Langley construction noise bylaw requirements (Monday to Friday 7 am to 8pm Saturday 9am to 5pm). Work within the Palisade walls shall be completed before 10am or after 2pm. Weekend work will only be accepted outside of the palisade walls subject to the Township noise bylaw restrictions.
8. WORK SCHEDULE .1 Carry on work as follows:
- .1 Within 5 working days after Contract award, provide a schedule showing anticipated progress stages and final completion of the work within the time period required by the Contract documents. Indicate the following:
    - .1 Submission of shop drawings, product data, MSDS sheets and samples.
    - .2 Commencement and completion of work of each section of the specifications or trade for each phase as outlined.
    - .3 Final completion date within the time period required by the Contract documents.
  - .2 Do not change approved Schedule without notifying Departmental Representative.
  - .3 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.
9. COST BREAKDOWN .1 Before submitting the first progress claim, submit a breakdown of the Contract unit prices in detail and as directed by the Departmental Representative and aggregating Contract price, for the details shown in the schedule of quantities provided.
10. CODES, BYLAWS, STANDARDS .1 Perform work in accordance with the National Building Code of Canada, and other indicated Codes, Construction Standards and/or any other Code or Bylaw of local application, including MMCD Platinum Edition.
- .2 Comply with applicable local bylaws, rules and regulations enforced at the location concerned.
  - .3 Meet or exceed requirements of Contract documents, specified standards, codes and referenced documents.
  - .4 In any case of conflict or discrepancy, the most stringent requirements shall apply.
11. DOCUMENTS REQUIRED .1 Maintain 1 copy each of the following at the job

site:

- .1 Contract drawings.
- .2 Contract specifications.
- .3 Addenda to Contract documents.
- .4 Copy of approved work schedule.
- .5 Reviewed/approved shop drawings.
- .6 Change orders.
- .7 Other modifications to Contract.
- .8 Field test reports.
- .9 Reviewed/approved samples.
- .10 Manufacturers' installation and application instructions.
- .11 One set of record drawings and specifications for "as-built" purposes, and
- .12 Current construction standards of workmanship listed in technical Sections.

12. REGULATORY REQUIREMENTS .1 Obtain and pay for - Building Permit, Certificates, Licenses and other permits required by regulatory municipal, provincial or federal authorities to complete the work.

.2 Provide inspection authorities with plans and information required for issue of acceptance certificates.

.3 Furnish inspection certificates in evidence that the work installed conforms with the requirements of the authority having jurisdiction.

13. ARCHAEOLOGICAL RESOURCES .1 Fort Langley NHS possesses numerous features relating to both the early historic homestead era and to First Nations villages and burials. All ground disturbance at the historic fort sites require archaeological assessment and/or monitoring.

.2 The contractor will inform the Site Representative, Parks Canada, and Terrestrial Archaeology of the schedule of work and provide adequate advance notice of the work schedule so that archeologists will be able to attend the site during construction in order that any and all site features will be completely attended during construction. In addition, in cases where artifacts are encountered when an archaeologist is not present, the "accidental finds" clause outlined below will apply. This clause outlines what the procedures and contact requirements are in these circumstances.

.3 If artifacts or archaeological features (including historic structures or objects) are encountered by the contractor or Site representative, whether an archaeologist is onsite or not, construction should be **stopped**, and the Cultural Resource Manager or

Environmental Surveillance Officer or contract archaeologist (whichever is applicable) shall be notified who will contact Parks Canada's Terrestrial Archaeology Section for further guidance. Documentation provided by the Contractor should include, photographic evidence of what was seen, the location of where the material was encountered, what the surrounding soil looked like, how deep it was from the ground surface, or if it was at ground surface.

.4 Terrestrial Archaeology Departmental Contacts regarding Archaeological Resource Management:

Contact Name	Contact Information
Bill Perry, Archaeologist, Archaeology and History Branch, Indigenous Affairs and Cultural Heritage Directorate Parks Canada, Calgary	<a href="mailto:Bill.perry@pc.gc.ca">Bill.perry@pc.gc.ca</a>  Tel 403-221-7989 Cell 403-701-0614
Brian Smith Federal Infrastructure Investments Project Archaeologist Archaeology and History Branch Indigenous Affairs and Cultural Heritage Directorate Parks Canada, Winnipeg	<a href="mailto:BrianJ.Smith@pc.gc.ca">BrianJ.Smith@pc.gc.ca</a>  Telephone (204) 984-2962 Cell 204-292-1208
Gwyn Langemann, Archaeologist, Archaeology and History Branch, Indigenous Affairs and Cultural Heritage Directorate Parks Canada, Calgary	<a href="mailto:Gwyn.langemann@pc.gc.ca">Gwyn.langemann@pc.gc.ca</a>  Tel 403-292-4692

14. CONTRACTOR'S  
 USE OF SITE

- .1 Site located on Fort Langley National Historic Site property at Fort Langley, BC.
- .2 Use of site:
  - .1 Assume responsibilities for work areas for performance of this work.
  - .2 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative.
  - .3 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with indicated phasing.
  - .4 Do not unreasonably encumber site with material

- or equipment.
- .5 Accept liability for damage, safety of equipment and overloading of existing equipment.
  - .6 Provide portable toilet for use by crew during construction.
  - .7 Do not leave any uncovered open excavations during non-working hours including weekends, overnight, and daily between 10am to 2pm within the Palisade wall.
- .3 The Fort Langley National Historic Site will remain fully operational during entire construction period and the contractor is expected to work with Parks Canada to minimize any disruptions with continuous water supply and sanitary sewer services as shown on the Drawings, except for scheduled disruptions of a limited duration scheduled in advance. Provide temporary service for any water and sanitary sewer disruptions exceeding 24 hours.
- .4 The Fort Langley National Historic Site receives a large number of children as visitors during the school year. All equipment shall be moved outside of the Palisade wall between 10am and 2pm. All excavations shall be backfilled or covered and the site made safe during this time period.
- .5 Co-operate with Department Representative in scheduling operations to minimize conflict with Fort Langley National Historic Site or public.
- .6 Execute work with least possible interference or disturbance to the operations and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.
- .7 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
- .8 At completion of operations condition of existing work: equal to or better than that which existed before new work started.
- .9 Attend progress, safety and site security orientation meetings.

15. EXAMINATION

- .1 Examine site and be familiar and conversant with existing conditions likely to affect work.
- .2 Provide photographs of existing conditions, objects and structures prior to the start of the project.

16. 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, give the Departmental Representative 48 hours notice for necessary interruption throughout course of work. Minimize duration of interruptions. Provide temporary service for any water and sanitary sewer disruptions exceeding 24 hours. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian, vehicular traffic and tenant operations.
- .3 Provide alternative routes and parking access for personnel and pedestrian and vehicular traffic as applicable.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide adequate bridging over trenches which traveled areas to permit normal traffic.
- .7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.

17. 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 his approval for actual

location.

- .4 Submit field drawings or shop drawings to indicate the relative position of various services and equipment when required by the Departmental Representative and/or as specified.

18. SETTING OUT OF WORK

- .1 Assume full responsibility for and execute complete survey layout of work to locations, lines and elevations indicated.
- .2 Provide devices needed to lay out and construct work.
- .3 Supply such devices as templates required to facilitate Departmental Representative's inspection of work.

19. QUALITY OF WORK

- .1 Ensure that quality workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.
- .2 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

20. WORKS COORDINATION

- .1 Coordinate work of subtrades:
  - .1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.
  - .2 Convene meetings between subcontractors whose work interfaces and ensure awareness of areas and extent of interface required.
- .2 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective work.
- .3 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.
  - .1 Pay particularly close attention to overhead work above ceilings and within or near to building structural elements.
  - .2 Identify on coordination drawings, building elements, services lines, rough-in points and indicate location services entrance to site.
  - .3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.
  - .4 Publish minutes of each meeting.
  - .5 Plan and coordinate work in such a way to minimize quantity of service line offsets.
  - .6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.

- .4 Work cooperation:
    - .1 Ensure cooperation between trades in order to facilitate general progress of Work and avoid situations of spatial interference.
    - .2 Ensure that each trade provides all other trades reasonable opportunity for completion of Work and in such a way as to prevent unnecessary delays, cutting, patching and removal or replacement of completed work.
    - .3 Ensure disputes between subcontractors are resolved.
  - .5 The Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.
  - .6 Maintain efficient and continuous supervision.
21. APPROVAL OF SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
- .1 In accordance with Section 013300, submit the requested shop drawings, product data, MSDS sheets and samples indicated in each of the technical Sections.
  - .2 Allow sufficient time for the following:
    - .1 Review of product data.
    - .2 Approval of shop drawings.
    - .3 Review of re-submission.
22. PROJECT MEETINGS
- .1 Departmental Representative will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.
23. TESTING AND INSPECTIONS
- .1 See Section 01 45 00 - QUALITY CONTROL
  - .2 The contractor shall engage and pay for the services of an approved independent testing agency of test laboratory to complete all testing at indicated in Section 01 45 00.
  - .3 Employment of inspection / testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
  - .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for re-testing and re-inspection.
24. AS-BUILT DOCUMENTS
- .1 The Departmental Representative will provide 2 sets of drawings, 2 sets of specifications for "as-built" purposes.

- .2 As work progresses, maintain accurate records to show all deviations from the Contract documents. Note on as-built specifications, drawings and shop drawings as changes occur.
  - .3 Closeout submittals in accordance with Section 01 78 00.
25. CLEANING
- .1 Daily conduct cleaning and disposal operations. Comply with local ordinances and anti-pollution laws.
  - .2 Ensure cleanup of the work areas each day after completion of work.
26. ENVIRONMENTAL PROTECTION
- .1 Prepare an Erosion and Sediment Control Plan and provide monitoring and maintenance as per Section 01 35 43 - ENVIRONMENTAL PROCEDURES
  - .2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.
  - .3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.
27. ADDITIONAL DRAWINGS
- .1 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with plans referred to in the Contract documents.
28. SYSTEM OF MEASUREMENT
- .1 The metric system of measurement (SI) will be employed on this Contract.
29. SUBMISSION OF TENDER
- .1 Submission of a tender is deemed to be confirmation of the fact that the Tenderer has analyzed the Contract documents and is fully conversant with all conditions and site requirements.

-----END OF SECTION-----

PART 1 - GENERAL

1.1 ADMINISTRATIVE

- .1 Submit to the 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 coordinated 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 the 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 coordinated.
- .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 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 coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

- .3 Allow 5 working days for Departmental Representative's review of each submission.
- .4 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.
- .5 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.
- .6 Accompany submissions with transmittal letter, in duplicate, 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.
- .7 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.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit one PDF of shop drawings for each requirement requested in specification sections and as Departmental Representative may reasonably request.
- .10 Delete information not applicable to project.
- .11 Supplement standard information to provide details applicable to project.
- .12 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, transparency 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.
- .13 The review of shop drawings by the Departmental Representative is for sole purpose of ascertaining conformance with general concept.
- .1 This review shall not mean that the 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.
- 1.3 CERTIFICATES AND TRANSCRIPTS
- .1 Immediately after award of Contract, submit WorkSafe BC status.
- 1.4 APPROVALS
- .1 Approval of shop drawings: refer to Section 01 11 55, clause 20.0.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 32 11 16.01 Granular Sub-base
- .2 Section 32 11 23 Aggregate Base Courses
- .3 Section 33 11 16 Watermains

1.2 REFERENCES

- .1 Manual of Uniform Traffic Control Devices for Streets and Highways for Canada, Transportation Association of Canada.
- .2 Traffic Control Manual for Work on Roadways, BC Ministry of Transportation

1.3 PROTECTION OF PUBLIC TRAFFIC

- .1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.
- .2 Comply with most recent editions of the Traffic Control Manual for Work on Roadways published by the BC Ministry of Transportation and the Manual of Uniform Traffic Control Devices for Streets and Highways for Canada published by the Transportation Association of Canada.
- .3 During progress of the Work, make adequate provision to accommodate normal traffic along roads and highways immediately adjacent to or crossing the works so as to cause minimum inconvenience to the general public and the Fort Langley National Historic Site.
- .4 When working on travelled way:
  - .1 Place equipment in position to present minimum of interference and hazard to travelling public.
  - .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
  - .3 Do not leave equipment on travelled way overnight.
- .5 Do not close any lanes of road without prior approval of Departmental Representative. Before re-routing traffic erect suitable signs and devices in accordance with instructions reference manuals.
- .6 Keep travelled way graded, free of pot holes and of sufficient width for required number of lanes of traffic.
- .7 Provide and maintain road access and egress to property.

1.4 INFORMATIONAL AND

- .1 Provide and maintain signs, flashing warning lights

WARNING DEVICES

and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response.

- .2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as specified reference manuals.
- .3 Place signs and other devices in locations recommended in the reference manuals.
- .4 Meet with Departmental Representative prior to commencement of Work to prepare list of signs and other devices required for project. If situation on site changes, revise list to approval of Departmental Representative.
- .5 Continually maintain traffic control devices in use by:
  - .1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
  - .2 Removing or covering signs which do not apply to conditions existing from day to day.

1.5 CONTROL OF PUBLIC TRAFFIC

- .1 Provide competent flag persons, trained in accordance with, and properly equipped as specified in the reference manuals in following situations:
  - .1 When traffic is required to pass working vehicles or equipment that block all or part of travelled roadway.
  - .2 When it is necessary to institute one-way traffic system through construction area or other blockage.
  - .3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
  - .4 Where temporary protection is required while other traffic control devices are being erected or taken down.
  - .5 For emergency protection when other traffic control devices are not readily available.
  - .6 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.
  - .7 At each end of restricted sections where pilot cars are required.
  - .8 Delays to traffic due to contractor's operators: maximum 10 minutes.

1.6 OPERATIONAL  
REQUIREMENTS

- .1 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified and approved by Departmental Representative to protect and control traffic.

-----END OF SECTION-----

1. REFERENCES

- .1 Government of Canada.
  - .1 Canada Labour Code - Part II
  - .2 Canada Occupational Health and Safety Regulations.
- .2 National Building Code of Canada (NBC):
  - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 The Canadian Electric Code (as amended)
- .4 Canadian Standards Association (CSA) as amended:
  - .1 CSA Z797-2009 Code of Practice for Access Scaffold
  - .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes
  - .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures
  - .4 CSA Z1006-10 Management of Work in Confined Spaces.
  - .5 CSA Z462- Workplace Electrical Safety Standard
- .5 National Fire Code of Canada 2010 (as amended)
  - .1 Part 5 - Hazardous Processes and Operations and Division B as applicable and required.
- .6 American National Standards Institute (ANSI):
  - .1 ANSI A10.3, Operations - Safety Requirements for Powder-Actuated Fastening Systems.
- .7 Province of British Columbia:
  - .1 Workers Compensation Act Part 3-Occupational Health and Safety.
  - .2 Occupational Health and Safety Regulations
  - .3 B.C. Ministry of Transportation and Infrastructure Traffic Control Manual for Work on Roadways (as amended)

2. RELATED SECTIONS

- .1 Refer to the following current sections as required:
  - .1 Submittals procedures:  
Section 01 33 00
  - .2 Special Procedures for Traffic Control:  
Section 01 35 00.06

3. WORKERS' COMPENSATION  
BOARD COVERAGE

- .1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

4. COMPLIANCE WITH  
REGULATIONS

- .1 PSPC may terminate the Contract without liability to PSPC where the Contractor, in the opinion of PSPC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.
- .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

5. SUBMITTALS

- .1 Submit to Departmental Representative submittals listed for review. (in accordance with Section 01 33 00)
- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
  - .1 Site Specific Health and Safety Plan.
  - .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
  - .3 Copies of incident and accident reports.
  - .4 Complete set of current Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
  - .5 Emergency Procedures.
- .4 The Departmental Representative will review the Contractor's Site Specific Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.
- .5 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.
- .6 Submission of the Site Specific Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
  - .1 Be construed to imply approval by the Departmental Representative.
  - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.

- .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

6. RESPONSIBILITY

- .1 Assume responsibility as the Prime Contractor for work under this contract.
- .2 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.
- .3 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.

7. HEALTH AND SAFETY  
COORDINATOR

- .1 The Health and Safety Coordinator:
  - .1 Be responsible for completing all health and safety training and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
  - .2 Be responsible for implementing, revising, daily enforcing, and monitoring the Site Specific Health and Safety Plan.
  - .3 Be on site during execution of work.

8. GENERAL CONDITIONS

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
  - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
  - .2 Secure site at night time (or provide security guard) as deemed necessary to protect site against entry.

9. PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
  - .1 Multi-employer work site.
  - .2 Federal employees and general public.
  - .3 Energized electrical services.
  - .4 Working in the open exposed to unpredictable weather.
  - .5 High volumes of vehicular and pedestrian traffic

- 10. UTILITY CLEARANCES .1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work
- .2 The Contractor will not rely solely upon the Reference Drawings or other information provided for utility locations.
- 11. REGULATORY REQUIREMENTS .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.
- .2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.
- 12. WORK PERMITS .1 Obtain specialty permits related to project before start of work.
- 13. FILING OF NOTICE .1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.
- .2 Provide copies of all notices to the Departmental Representative.
- 14. HEALTH AND SAFETY PLAN .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:
  - .1 Primary requirements:
    - .1 Contractor's safety policy.
    - .2 Identification of applicable compliance obligations.
    - .3 Definition of responsibilities for project safety/organization chart for project.
    - .4 General safety rules for project.
    - .5 Job-specific safe work procedures.
    - .6 Inspection policy and procedures.
    - .7 Incident reporting and investigation policy and Procedures.
    - .8 Occupational Health and Safety Committee/Representative procedures.
    - .9 Occupational Health and Safety meetings.

- .10 Occupational Health and Safety communications and record keeping procedures.
  - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
  - .3 List hazardous materials to be brought on site as required by work.
  - .4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
  - .5 Identify personal protective equipment (PPE) to be used by workers.
  - .6 Identify personnel and alternates responsible for site safety and health.
  - .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- 
- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
  - .4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.
  - .5 Departmental Representative's review: the review of Site Specific Health and Safety Plan by PSPC shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

15. EMERGENCY PROCEDURES

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
  - .1 Designated personnel from own company.
  - .2 Regulatory agencies applicable to work and as per legislated regulations.
  - .3 Local emergency resources.
  - .4 Departmental Representative.
- .2 Include the following provisions in the emergency procedures:
  - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
  - .2 Evacuate all workers safely.
  - .3 Check and confirm the safe evacuation of all workers.
  - .4 Notify the fire department or other emergency responders.

- .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
- .6 Notify Departmental Representative.
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
  - .1 Work at high angles.
  - .2 Work in confined spaces or where there is a risk of entrapment.
  - .3 Work with hazardous substances.
  - .4 Underground work.
  - .5 Work on, over, under and adjacent to water.
  - .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.

16. HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.
- .2 Where use of hazardous and toxic products cannot be avoided:
  - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per [Section 01 33 00].
  - .2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.
  - .3 Provide adequate means of ventilation in accordance with Section 01 51 00.
  - .4 The contractor shall ensure that the product is applied as per manufacturers recommendations.
  - .5 The contractor shall ensure that only pre-approved products are brought onto the work site in an adequate quantity to complete the work.

17. ASBESTOS HAZARD

- .1 Carry out any activities involving asbestos in accordance with applicable Provincial Regulations.
- .2 Removal and handling of asbestos will be performed as indicated.

18. ELECTRICAL SAFETY REQUIREMENTS 1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.
- .1 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.
  - .2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.
19. ELECTRICAL LOCKOUT 1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.
- .2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.
  - .3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.
20. OVERLOADING .1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.
21. CONFINED SPACES .1 Carry out work in confined spaces in compliance with Provincial Regulations.
22. FIRE SAFETY AND HOT WORK .1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.
- .2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.
23. FIRE SAFETY REQUIREMENTS .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

- .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.
  - .3 Portable gas and diesel fuel tanks are not permitted on most federal work sites. Approval from the DR is required prior to any gas or diesel tank being brought onto the work site
24. FIRE PROTECTION AND ALARM SYSTEM
- .1 Fire protection and alarm systems shall not be:
    - .1 Obstructed.
    - .2 Shut off.
    - .3 Left inactive at the end of a working day or shift.
  - .2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.
  - .3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.
25. UNFORESEEN HAZARDS
- .1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.
26. POSTED DOCUMENTS
- .1 Post legible versions of the following documents on site:
    - .1 Site Specific Health and Safety Plan.
    - .2 Sequence of work.
    - .3 Emergency procedures.
    - .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
    - .5 Notice of Project.
    - .6 Floor plans or site plans.
    - .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
    - .8 Workplace Hazardous Materials Information System (WHMIS) documents.
    - .9 Material Safety Data Sheets (MSDS).
    - .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.
  - .2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

- .3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

27. MEETINGS

- .1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

28. CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.
- .3 The Departmental Representative may issue a "stop work order" if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

-----END OF SECTION-----

PART 1 - GENERAL

1.1 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 humankind; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2 FIRES

- .1 Fires and burning of rubbish on site not permitted.

1.2 DISPOSAL OF WASTES

- .1 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.
- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.
- .3 Safely dispose of wet concrete and pipe grout off-site in accordance with Municipal, Provincial and Federal authorities' requirements.

1.3 EROSION AND SEDIMENT CONTROL / DRAINAGE

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust that complies with the most stringent requirements of the authorities having jurisdiction.
- .2 The contractor shall inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 All work shall be undertaken and completed in such a manner as to prevent the release of sediment, silt, or sediment laden water, concrete or concrete leachate or any other deleterious substance into any ditch or water course.
- .4 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

- .5 The contractor shall keep all portions of the work drained during construction until completion. Where necessary, catch water ditch shall be constructed along the tops of excavations or fill slopes to prevent water flowing into or over the excavated or filled area. The contractor will be responsible for the repair for the damage, directly resulting for their operations and for the removal or dirt or debris from existing system, which may be caused by or which may result from water backing up or overflowing through, from, or along any part of the work or adjacent properties. The contractor shall bear all costs associated with these repairs until works are complete and accepted by the Department Representative.
  - .6 The contractor shall modify and/or provide additional silt control measures as necessary to accommodate construction activities and satisfy the requirements or the governing agencies.
  - .7 The contractor shall maintain all silt control facilities on an as-needed basis
  - .8 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
  - .9 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- 1.4 SITE CLEARING AND PLANT PROTECTION
- .1 Protect trees and plants on site and adjacent properties where indicated.
- 1.5 POLLUTION CONTROL
- .1 Maintain temporary erosion and pollution control features installed under this contract.
  - .2 Control emissions from equipment and plant to local authorities' emission requirements.
  - .3 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- 1.6 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.

- .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.

-----END OF SECTION-----

PART 1 - GENERAL

1.1 INSPECTION

- .1 The Contractor shall as part of the work perform, or cause to be performed, all tests, inspections and approvals of the work as required by the Contract Documents, and if a test, inspection or approval requires a representative sample of materials or workmanship the Contractor shall at the Contractor's own cost supply the labour and materials necessary to provide the sample.
- .2 If any portion of the work is designated for special tests, inspections or approvals (either as a requirement in the Contract Documents, or by the Department Representative's instructions, or by the laws or regulations applicable at the place of the work), then:
  - .1 if the Department Representative is to perform or arrange for the test, inspection or approval the Contractor shall give the Department Representative timely notice requesting such test, inspection or approval; and
  - .2 if other authorities are to perform the test, inspection or approval the Contractor shall arrange for such test, inspection or approval and shall give the Department Representative timely notice of the date and time for such test, inspection or approval.
- .3 Department 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, Department Representative shall pay cost of examination and replacement.
- .4 If the Contractor disagrees with Department Representative's determination of the Work not meeting the Specifications based on the results of inspection or testing required in the Contract Documents or ordered by the Department Representative, the Contractor may elect to carry out such further inspection or testing which the Department Representative agrees is acceptable for the purpose of determining whether the work complies with the requirements of the Contract Documents. If such further inspection or testing determines that the Work is not in accordance with the requirements of the Contract Documents, then the Contractor shall correct such Work and pay the costs of the inspection and testing including all costs of the correction and further testing. If

such further inspection or testing determines that the Work is in accordance with the requirements of the Contract Documents, then the Department shall pay all costs of the inspection and testing.

- .5 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 at the Contractor's own expense, and Contractor shall comply with such direction.
- .6 The Contractor shall promptly provide the Department Representative with 4 copies of all certificates, inspection and testing reports required by the Contract Documents or ordered by the Department Representative.
- .7 The Contractor shall not undertake any Work outside the working hours, as specified in the Contract Documents, which under the Contract Documents requires tests, inspection, or approval by the Department Representative unless the Contractor obtains the Department Representative's prior approval. The Contractor shall reimburse the Department for any additional costs incurred to provide tests, inspections or approvals outside such specified working hours.
- .8 Independent Inspection / Testing Agencies will be engaged by the Contractor for purpose of inspecting and/or testing portions of the Work. Cost of such services will be borne by the Contractor.
- .9 Submit for approval by Departmental Representative proposed Independent Inspection / Testing Agencies.
- .10 Employment of inspection / testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .11 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for re-testing and re-inspection.

1.2. ACCESS TO WORK

- .1 Allow Department Representative 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.

1.3 TESTING FREQUENCY

- .1 The following outlines the minimum testing frequency for various components of the Work:
  - .1 Asphalt Cores to confirm Density and Thickness:
    - .1 One per 500m<sup>2</sup>.
    - .2 For asphalt pavement areas less than 500m<sup>2</sup>, pavement is deemed to have met specifications if results from all cores average the design thickness  $\pm$  5mm with no individual core greater than 10mm less than the design thickness.
    - .3 Core holes shall be reinstated to the satisfaction of the Department Representative.
  - .2 Road and Path Granular Base Densities:
    - .1 One per 500 sq.m.
  - .3 Sieve Analyses and Proctors:
    - .1 One prior to commencing work.
    - .2 One every 200 tonne.
  - .4 Asphalt Marshall Test:
    - .1 One per asphalt type.
    - .2 Minimum one per full paving day.

1.4 REPORTS

- .1 Submit copies of inspection and test reports to Departmental Representative. The inspection and certification report are to be submitted in PDF format during the construction stage with hard copies included in the Close Out documentation.

1.5 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.

-----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 Departmental Representative or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times. Do not burn waste materials on site, unless approved by Departmental Representative.
- .3 Clear snow and ice from site to provide a safe working areas.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris. Dispose of waste materials and debris off site.
- .6 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

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.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds. Remove dirt and other disfiguration from exterior surfaces. Sweep and wash clean paved areas.

-----END OF SECTION-----

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00-Submittal Procedures.
- .2 Section 01 45 00-Quality Control

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Copy will be returned after final inspection with Departmental Representative comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Furnish evidence, for type, source and quality of products provided.
- .5 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .6 Pay costs of transportation.
- .7 Submit to Department Representative, final copies of all test reports completed for this project including compaction tests, granular material gradations, asphaltic concrete densities, thickness and marshall characteristics, a minimum 2 weeks prior to Substantial Performance of the Work.

1.3 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 216 x 279mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by process flow, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

- 1.4 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 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
  - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
  - .5 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.
- 1.5 AS-BUILTS .1 Maintain, in addition to requirements in General Conditions, 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 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.

1.6 RECORDING ACTUAL SITE  
CONDITIONS

- .1 Record information on set of blue line, opaque drawings, and in copy of Project Manual, 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, field test records, required by individual specifications sections to provide certification that all works have been completed as specified and that works are ready for tie-in.

-----END OF SECTION-----

## **1. GENERAL**

### **1.1 Intent**

- .1 Provide complete, fully tested and operational plumbing systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .2 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .3 Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise ordered by the Departmental Representative in writing during the bidding period.
- .4 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .5 Install equipment generally in locations and routes shown. Run piping close to building structure, parallel to building lines to maximize head room and with minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Departmental Representative at no extra cost.
- .6 Install equipment to provide access and ease of maintenance.
- .7 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance. The Contractor shall, at his own expense, repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing such work is not due to improper usage. The period of guarantee specified shall not in any way supplant any other guarantees of a longer period but shall be binding on work not otherwise covered.
- .8 If the equipment is used during construction, the guarantee or guarantee period shall not be shortened or altered.
- .9 'Provide' shall mean; supply and install'.

### **1.2 Coordination of Work**

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make reference to electrical, mechanical, structural and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for piping so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.
- .3 Where dimensional details are required, work with the applicable architectural and structural drawings.
- .4 Full size and detailed drawings shall take precedence over scale measurements from drawings. Drawings shall take precedence over specifications.
- .5 Any areas indicated as space for future materials or equipment shall be left clear.

### **1.3 Permits**

- .1 All work shall comply with provincial, municipal, bylaws and authorities having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the work.
- .3 Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

**1.4 Tender Price Breakdown**

- .1 Submit a tender price breakdown within thirty (30) days of tender closing and before first progress claim, in a format agreed to with the Departmental Representative.
- .2 As a minimum, include the following in the tender price breakdown:
  - .1 Site Services: Materials, labour
  - .2 Plumbing: Equipment, materials, labour

**1.5 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of supports and anchor bolts.
  - .2 Certification of compliance to applicable codes.
- .4 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.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .3 Operation data to include:
    - .1 Operation instruction for systems and component.
  - .4 Maintenance data to include:
    - .1 Servicing, maintenance, operation and trouble-shooting instructions.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .5 Approvals:
    - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
    - .2 Make changes as required and re-submit as directed by Departmental Representative.
  - .6 Additional data:
    - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
  - .7 Site records:
    - .1 Departmental Representative will provide 1 set of mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
    - .2 Use different colour waterproof ink for each service.
    - .3 Make available for reference purposes and inspection.

- .8 As-built drawings:
  - .1 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).
  - .2 Submit to Departmental Representative for approval and make corrections as directed.
  - .3 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
  - .4 Cost of transfer as-builts onto reproducible media & auto-cad disks are this contractor's responsibility. Departmental Representative will release drawings to contractor after signing a copy right form.
  - .5 Shall the contractor choose to undertake this Departmental Representative, allow \$400 / sheet. This will cover costs for drafting time & printing costs.

### **1.6 Quality Assurance**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety.

### **1.7 Delivery, Storage, and Handling**

- .1 Waste Management and Disposal:
  - .1 Construction Waste Management and Disposal: separate waste materials for reuse and recycling.

### **1.8 Existing Piping to Be Removed**

- .1 Unless otherwise specified, carry out demolition work in accordance with CSA S350-M1980, Code of Practice for Safety in Demolition of Structures.
- .2 Existing Conditions
  - .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this Section.
- .3 Protection
  - .1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety of such work. Be liable for any such movement or settlement and any damage or injury caused.
  - .2 Cease operations and notify the Prime Departmental Representative immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work in this Section.
  - .3 Prevent debris from blocking surface drainage inlets and all types of drainage piping systems which remain in operation
- .4 Salvageable Materials
  - .1 Except as otherwise stated, salvageable materials from area of demolition shall become the property of the Departmental Representative at his discretion. All material not taken over by the Departmental Representative or removed from the building under this contract shall be removed off from this site and disposed of as required by any applicable disposal regulations.
- .5 All existing plumbing piping systems that become abandoned as a result of the work or depicted on the drawings for abandonment shall be removed, and/ or disposed of if the Departmental Representative declines to retain, in the following situations:

**PLUMBING – GENERAL REQUIREMENTS**

- .6 Where specifically noted on the drawings for removal.
- .7 Where plumbing piping systems are exposed.

**1.9 Examination of Site**

- .1 Before submitting tender, visit and examine the site and note all characteristics and features affecting the work. No allowances will be made for any difficulties encountered or any expenses incurred because of any conditions of the site or item existing thereon, which is visible or known to exist at the time of tender.

**1.10 Quality of Work**

- .1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Departmental Representative.
- .2 Work which does not conform to standards accepted by the Departmental Representative and the trade may be rejected by the Departmental Representative. The Contractor shall redo rejected work to the accepted standard at no cost to the Departmental Representative.

**1.11 Metric Conversion**

- .1 All units in this division are expressed in SI units.
- .2 Submit all shop drawings and maintenance manuals in SI units.
- .3 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
  - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
  - .2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

EQUIVALENT NOMINAL DIAMETER OF PIPES					
mm	Inches (NPS)	mm	Inches (NPS)	mm	Inches (NPS)
3	1/8	65	2-1/2	375	15
6	1/4	75	3	450	18
10	3/8	100	4	500	20
15	1/2	125	5	600	24
20	3/4	150	6	750	30
25	1	200	8		
30	1-1/4	250	10		
40	1-1/2	300	12		
50	2				

**1.12 Alternate Materials and Equipment**

- .1 The price submitted for this contract shall be based on the use of materials and equipment as specified or as contained within the Acceptable Manufacturers List. If no acceptable manufacturer has been listed, refer to approved equivalents below.

- .2 Requests for approval for tendering purposes of equivalent materials or equipment shall be submitted to the Departmental Representative no later than seven (7) working days prior to the closing date of tender for mechanical trade, complete with all applicable technical data, including performance curves and physical details. Approval of requests shall only be given by addendum.
- .3 The Contractor shall, in his quotation, indicate the degree of approval obtained from the Departmental Representative. In the event that the product has been approved as "Alternate Only", this shall be stated in the quotation, and the contractor shall bear any and all costs for design/system modifications to accommodate the "alternate" equipment.
- .4 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.
- .5 The Contractor shall be fully responsible for any additional work or materials required by the trades or other Contractors to accommodate use of other than specified materials or equipment. Extras will not be approved to cover such work.

### **1.13 Drawings and Specifications**

- .1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.
- .2 Should any discrepancy appear between drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and specifications, obtain a ruling from the Departmental Representative, before submitting a tender. If this is not done, it will be assumed that the most expensive alternate had been included.
- .3 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out without changes to building.

### **1.14 Salvage**

- .1 Remove from site all equipment or piping which is no longer required because of work under this Contract.
- .2 Turnover to and deliver to the Departmental Representative's storage area all items which have been determined to have salvage value and has been removed due to the Work.

### **1.15 Cutting, Patching and Coring**

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Obtain written approval from the Structural Departmental Representative before cutting or burning structural members.
- .4 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm or larger in diameter. Field cut smaller than 100 mm.
- .5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

### **1.16 Excavation and Backfill**

- .1 Refer to requirements of Division 31.
- .2 Provide all excavating to facilitate installation of the mechanical work, including shoring, pumping, 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting.
- .3 Refer to details on drawings as well. Should a conflict occur, contact the Departmental Representative for clarification.

**1.17 Installation of Equipment**

- .1 Pipe all equipment drains to building drains.
- .2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.
- .3 Maintain permanent access to equipment for maintenance.

**1.18 Connections to Existing Services**

- .1 Maintain liaison with the Departmental Representative and provide a schedule to interrupt, re-route or connect to water, sanitary, or gas systems, with minimum interruption of services.
- .2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on site. Provide a minimum of 48 hours notice for all service shutdown.
- .3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

**1.19 Materials**

- .1 Materials installed shall be new, full weight and of quality specified.
- .2 Where two or more products of the same type are required, products shall be of the same manufacturer.
- .3 Make known in writing to the Departmental Representative ten (10) days prior to the tender closing date any materials specified that are required to complete the work which are not currently available or will not be available for use as called for herein. Failing to do so, it will be assumed that the most expensive alternate has been included in the tender price.

**1.20 Miscellaneous Metals**

- .1 Provide all necessary miscellaneous to hang or support materials, equipment and provide access for work under this contract.
- .2 All miscellaneous metals shall be prime painted.
- .3 Miscellaneous metals shall include but not limited to:
  - .1 Hangers for equipment, piping and ductwork.
  - .2 Support for equipment.
  - .3 Access platforms and catwalks.

**1.21 Pipe Sleeves**

- .1 Pipe sleeves shall be provided for piping passing through walls and floors. Minimum schedule 40 steel pipes. Sleeves shall extend 25 mm on either side of the wall.
- .2 Schedule 40 steel pipe shall be used as floor pipe sleeves in wet areas with a 50 mm up-stand.
- .3 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

**1.22 Escutcheon and Plates**

- .1 Provide escutcheon and plates on piping and ductwork passing through finished walls, floors and ceilings.
- .2 Escutcheons shall be split type, stainless or chrome plated steel.

## **2. PRODUCTS**

### **2.1 Operating and Maintenance Manuals**

- .1 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to Departmental Representative two (2) months prior to final inspection.
- .2 Provide four (4) 216 mm x 280 mm capacity, expanding spine catalogue binders, bound with heavy fabric, hot stamped lettering front and spine.
- .3 Index binder according to the following system:
  - .1 Tab-1.0 Mechanical Systems:
    - .1 Title page with clear plastic protection cover.
    - .2 Tab-1.1 List of Mechanical Drawings:
    - .3 Tab-1.2 System Descriptions:
      - .1 Provide complete description of the operating sequence for all systems. Include detailed system description, with individual components described, explanation of how components interface with others and to the complete system, location of thermostats, controllers or operating variances, and controller operating setpoints.
    - .4 Tab-1.5 List of Suppliers and Contractors:
      - .1 Provide list of suppliers and contractors, including address and telephone number. Outline procedures for purchasing parts and equipment.
    - .5 Tab-Certification (2.0, 2.1, ...):
      - .1 Include copy of test data on inspection approval certificates for plumbing system.
    - .6 Tab-Shop Drawings and Maintenance Bulletins (3.0, 3.1, ...):
      - .1 Provide materials received in compliance with clause "Shop Drawings".
  - .4 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 & Maintenance - 3.0 - 3.17 Yellow. Plastic tabs with typewritten card insertions will not be accepted.

## **3. EXECUTION**

### **3.1 Painting Repairs and Restoration**

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

### **3.2 Record Drawings:**

- .1 Enter dimensions from building line to all buried services, including coordinates and depth elevations of manholes, tanks, outside shut-off valves, and other similar elements.
- .2 At substantial completion, the Departmental Representative shall transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings, and change orders, on a "As Built" CADD files. From these files plot a set of as-built mylars. Drafting quality shall be same as original drawings.

- .3 The CADD disks may be borrowed from the Departmental Representative. Each "as-built" mylar shall bear the Contractor's identification, the date of record and the notation "We hereby certify that these drawings represent the As-Built Record of Construction." The Contractor's signature and company seal shall be placed below that notation. Contractor to sign release agreement before Departmental Representative shall provide drawings.
- .4 The cost per drawing sheet for transferring information to the record drawings by the Departmental Representative shall be as agreed in the contract documents. Should the Contractor undertake major re-routing of services where the original layout is appropriate or should major changes in the scope of work occur, additional charges may apply. Costs for printing are not included.

### **3.3 Cleaning**

- .1 Clean interior and exterior of all systems including strainers.

### **3.4 Existing Services**

- .1 Disconnect and cap all mechanical services in accordance with requirements of local authority having jurisdiction.
- .2 Building Mechanical Services: Maintain all building services during demolition/removal of existing.
- .3 Maintain all trap seals and ensure no sewer gas enters the building during renovations or demolition work. Maintain all existing sewer piping in a wet condition daily.

### **3.5 Demolition**

- .1 "Remove" is to include legal disposal of electrical, mechanical.
- .2 Completely demolish the items scheduled and remove all materials from the premises.
- .3 Carry out demolition in a manner to cause as little inconvenience to the occupied building area as building area as possible. Coordinate this activity with the Departmental Representative.
- .4 Carry out demolition in an orderly and careful manner
- .5 All coring, patching and removal of existing equipment, pipes, and ductwork which may affect the operation of occupied areas of the building shall be carried out outside of regular office hours or as scheduled with the Departmental Representative.

### **3.6 Asbestos**

- .1 When new work is required to be connected to existing plumbing and piping or equipment which contains asbestos insulation or products the following shall apply:
  - .1 Keep disruption to existing piping and equipment to a minimum
  - .2 Protect the site and all Contractors from the work
  - .3 Remove the asbestos at piping and equipment for new connections and carry out work in accordance with WCB requirements for asbestos removal.
- .2 The intent is for a Haz-Mat contractor to remove all asbestos containing material prior to Mechanical Division work taking place. Notify the Departmental Representative if asbestos containing material is suspected to remain on site.

### **3.7 Core Drilling**

- .1 Clearly identified all proposed piping penetrations through existing slabs, walls etc. and advise the Contractor. Obtain x-rays of the locations to ensure penetration will avoid any existing post tension cables or reinforced steel. Advise the structural Departmental Representative of any conflicts as a result of the x-rays.

END OF SECTION 22 05 00

## 1.0 GENERAL

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 The installation of drainage waste and vent piping.

### 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.

## 2.0 PRODUCTS

### 2.1 MATERIAL

### 2.2 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary, storm and vent piping: Type DWV - copper to: ASTM B306.
  - .1 Fittings:
    - .1 Cast brass: to CAN/CSA-B125.
    - .2 Wrought copper: to CAN/CSA-B125.
  - .2 Solder: lead free, tin- 95:5, to ASTM B32.

### 2.3 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary, storm and vent piping minimum NPS 3, to: CAN/CSA-B70.
  - .1 Joints:
    - .1 Mechanical joints:
      - .1 Neoprene or butyl rubber compression gaskets: to ASTM C564 or CAN/CSA-B70.
      - .2 Stainless steel clamps.
    - .2 Hub and spigot:
      - .1 Caulking lead: to CSA B67.
      - .2 Cold caulking compounds.
  - .2 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.

**3.0 EXECUTION**

PIPE MATERIAL APPLICATION SCHEDULE					
System Description	Location	Pipe Material	Joints	Spec Section	Notes
Sanitary Drainage Waste & Vent	Inside Building Above Ground	Copper DWV, Cast Iron	Solder, Gasket & Clamp	22 13 17	Soldered Or Brazed Fitting Only For Forced Main (Pressurized) Sections
Sanitary Drainage Waste & Vent	Inside Building Below Grade	Schedule 40 PVC DWV Solid Core, Schedule 40 ABS DWV Solid Core, Cast Iron	Socket Glued, Hub/Spigot	22 13 18, 22 13 17	
Sanitary Drainage Waste & Vent	Outside Building	Schedule 40 PVC DWV Solid Core, Cast Iron	Socket Glued, Hub/Spigot	22 13 18, 22 13 17	Minimum Depth Of Bury For Plastic In Traffic Areas Is 900mm

**3.1 INSTALLATION**

- .1 Install in accordance with Provincial Plumbing Code.
- .2 Grade horizontal drainage and storm piping @ 2% minimum, unless noted otherwise.

**3.2 TESTING**

- .1 Pressure test buried systems before backfilling to 10 feet of water column.
- .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.

END OF SECTION 22 13 17

PART 1 - GENERAL

- 1.1 RELATED SECTIONS .1 Section 01 33 00-Submittal Procedures.  
.2 Section 32 11 23-Aggregate Base Courses.
- 1.2 REFERENCES .1 ASTM; AWWA; CAN - As specified in the contract document
- 1.3 SOURCE QUALITY CONTROL .1 Submit samples in accordance with Section 01 33 00 -  
Submittal Procedures.  
.2 Inform Department Representative of proposed source  
and provide samples or access for sampling at least  
2 weeks prior to commencing production.  
.3 If, in opinion of Department Representative, materials  
from proposed source do not meet, or cannot reasonably  
be processed to meet, specified requirements, locate  
an alternative source or demonstrate that material from  
source in question can be processed to meet specified  
requirements.  
.4 Should a change of material source be proposed during  
work, advise Department Representative 2 weeks in  
advance of proposed change to allow sampling and  
testing.  
.5 Acceptance of material does not preclude future  
rejection if it is subsequently found to lack  
uniformity, or if it fails to conform to requirements  
specified.  
.6 Pay cost of sampling and testing of aggregates which  
fail to meet specified requirements.
- 1.4 WASTE MANAGEMENT AND  
DISPOSAL .1 Divert unused granular materials from landfill to local  
facility as approved by Department Representative.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Gravel to be composed of inert, durable material,  
reasonably uniform in quality and free from soft or  
disintegrated particles. In absence of satisfactory  
performance records over a five year period for  
particular source of material, soundness to be tested  
according to ASTM test procedure C-88 or latest revised  
issue. Maximum weight average losses for course and  
fine aggregates to be 30% when magnesium sulphate is  
used after five cycles.  
.2 All crushed gravel when tested according to ASTM C-136  
and ASTM C-117, or latest revised issue, to have a  
generally uniform gradation and conform to following  
gradation limits and 60% of the material passing each  
sieve must have one or more fractured faces.

Determination of the amount of fractured material shall be in accordance with the Ministry of Transportation and Highways' Specification I-11, Fracture Count for Coarse Aggregate, Method "A", which determines fractured faces by count. The Plasticity Index for crushed gravel to not exceed 6.0.

2.2 NATIVE MATERIAL .1 To be any workable soil free of organic or foreign matter; any material obtained within limits of Contract may be approved by the Department Representative. Native material content or compact to specified density.

2.3 PIT RUN GRAVEL .1 To be well graded granular material, substantially free from clay lumps, organic matter and other extraneous material, screened to remove all stones in excess of maximum diameter specified in material description (300 mm Pit Run Gravel, 200 mm Pit Run Gravel, 100 mm Pit Run Gravel). Material to compact to specified density and conform to following gradations:

Sieve Designation	Percent Passing
(300mm dia)	(100)
(200mm dia)	(100)
(100mm dia)	(100)
75mm	100
50mm	70-100
25mm	50-100
4.75mm	22-100
2.36mm	10-85
0.075mm	2-8

Recycled concrete free from contaminated and other extraneous material, conforming to the specified gradations may be used as pit run gravel.

2.4 PIT RUN SAND .1 To be well graded pit run sand, free from organic materials and conform to following gradations:

Sieve Designation	Percent Passing
12.5mm	100
4.75mm	35-100
2.36mm	20-70
1.18mm	13-50
0.600mm	8-35
0.300mm	5-25
0.150mm	2-15
0.075mm	0-6

2.5 RIVER SAND

- .1 River sand, to be used only where shown on Contract Drawings or otherwise specified and approved by Department Representative, to be free of organic material, salt and foreign objects and conform to following gradations:

Sieve Designation	Percent Passing
19mm	100
4.75mm	80-100
0.600mm	20-80
0.150mm	0-20
0.075mm	0-8

2.6 DRAIN ROCK

- .1 To consist of clean round stone or crushed rock conforming to the following gradations:

Sieve Designation	Percent Passing	
	Course	Fine
25.0mm	100	
19.0mm	0-100	
9.5mm	0-5	100
4.75mm	0	50-100
2.36mm		5-15
1.18mm		15-38
0.600mm		0-8
0.300mm		0-5
0.150mm		0-2
0.075mm		0

- .2 Drain rock to be used only where specified on Contract Drawings. Use of drain rock other than as specified requires approval of Department Representative after examination of soils against which drain rock will be placed.

2.7 GRANULAR PIPE BEDDING AND SURROUND MATERIAL

- .1 Crushed or graded gravels to conform to following gradations:

Sieve Designation	Percent Passing	
	Type 1*	Type 2*
25.0mm	100	100
19.0mm	90-100	90-100
12.5mm	65-85	70-100
9.5mm	50-75	
4.75mm	25-50	40-70
2.36mm	10-35	25-52
1.18mm	6-26	15-38
0.600mm	3-17	6-27
0.300mm		3-20
0.075mm	0-5	0-8

Type 1\* standard gradation

Type 2\* to be used only in dry trench conditions and with Departmental Representative's prior approval

Recycled concrete free from contaminated and other

extraneous material, conforming to the Type 1 gradations, may be used as pipe bedding and surround material.

- .2 Other permissible materials: only where shown on Contract Drawings or directed by Departmental Representative shall drain rock, pit run sand or approved native material be used for bedding and pipe surround.

2.8 SELECT GRANULAR SUB-BASE.1

To be well graded granular material, substantially free from lumps and organic matter, screened if required to conform to following gradations:

Sieve Designation	Percent Passing
75mm	100
25mm	50-85
0.150mm	0-15
0.075mm	0-8

2.9 CRUSHED GRANULAR SUB-BASE.1

To be 75mm crushed gravel conforming to following gradations:

Sieve Designation	Percent Passing
80mm	100
75mm	100
38mm	60-100
25.0mm	-
19.0mm	35-80
12.5mm	-
9.5mm	26-60
4.75mm	20-40
2.36mm	15-30
1.18mm	10-20
0.60mm	5-15
0.30mm	3-10
0.18mm	-
0.15mm	-
0.075mm	0-5

2.10 GRANULAR BASE AND SHOULDER GRAVEL.1

To be 19mm crushed gravel conforming to following gradations:

Sieve Designation	Percent Passing
19.0mm	100
12.5mm	75-100
9.5mm	60-90
4.75mm	40-70
2.36mm	27-55
1.18mm	16-42
0.600mm	8-30
0.300mm	5-20
0.075mm	2-8

2.11 RECYCLED AGGREGATE  
MATERIAL

- .1 Aggregates containing recycled material may be utilized if approved by the Department Representative. In addition to meeting all other conditions of this specification, recycled material should not reduce the quality of construction achievable with quarried materials. Recycled material should consist only of crushed Portland cement concrete; other construction and demolition materials such as asphaltic pavements, bricks, plaster, etc. are not acceptable.

PART 3 - EXECUTION

3.1 HANDLING

- .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .2 Do not use intermixed or contaminated materials. Remove and dispose rejected materials within 48 h of rejection.

-----END OF SECTION-----

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00-Submittal Procedures.
- .2 Section 01 35 33-Health and Safety Requirements
- .3 Section 31 23 33.01-Excavating, Trenching and Backfilling.

1.2 DEFINITION

- .1 Rock is defined as all solid rock in form of bedrock, masses, ledges, seams or layer and includes igneous rock of any sort, conglomerate, sandstone or shale, that requires breaking by continuous drilling and blasting before excavation and removal. Rock also includes rocks having individual volumes in excess of 1.0 m<sup>3</sup>, removed by blasting or other means.
- .2 Trench rock removal is defined as rock to be removed during roadway excavation, site grading, or other excavation work, generally, but not necessarily, in larger quantities, and not within the more confining limits of excavation specified for trench excavation.
- .3 Mass rock removal is defined as rock to be removed during roadway excavation, site grading, or other excavation work, generally, but not necessarily, in larger quantities, and not within the more confining limits of excavation specified for trench excavation.
- .4 Dense tills, hardpan, partially cemented materials, clay or frozen materials which do not require breaking by continuous drilling and blasting before excavation and removal are not classified as rock.

1.3 QUALIFICATIONS

- .1 Retain licensed explosives expert to program and supervise blasting work, and to determine precautions, preparation and operations techniques.

1.4 BLASTING OPERATION PROPOSAL

- .1 Submit to Departmental Representative for approval, written proposal of operations for removal of rock by blasting, in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate proposed method of carrying out work. Include details on protective measures, time of blasting and other pertinent details.
- .3 No blasting to proceed without written approval of Departmental Representative.

1.5 BLASTING SURVEY AND MONITORING

- .1 Departmental Representative will arrange for assessment of adjacent buildings and structures to determine existing conditions and will provide

proposed blasting procedures and copies of assessment reports and seismic recording operations.

- .2 Seismographic monitoring will be conducted during entire progress of blasting operations. Cost of seismic survey and monitoring reports will be paid by Department.

1.6 PROTECTION

- .1 Prevent damage to surroundings and injury to persons. Erect fencing, post guards, sound warnings and display signs when blasting to take place.

PART 2 - MATERIALS

NOT USED.

PART 3 - EXECUTION

3.1 BLASTING AND VIBRATION CONTROL

- .1 Complete all blasting before any structural elements are installed within 15m from blast holes.
- .2 Minimize ground vibrations which may damage structures or shatter or damage rock mass to remain.
- .3 Blasting not permitted within distance of 30m of concrete or grout less than 24 h after pouring.
- .4 Maintain complete and accurate record of all drilling and blasting operations. Submit records to Departmental Representative at end of each shift.

3.2 ROCK REMOVAL

- .1 Strip rock of all earth.
- .2 Notify Departmental Representative within reasonable time to enable Departmental Representative to obtain necessary measurements.
- .3 Do blasting operations in accordance with applicable bylaws.
- .4 Remove rock to alignments, profiles and cross sections as shown on Contract Drawings.
- .5 Locations where explosive blasting is not permitted, if applicable, are shown on Contract Drawings.
- .6 Use methods, techniques and procedures for control of all factors affecting operations in order to produce smooth and sound peripheral surfaces of all completed excavations, to minimize overbreak, and to avoid damage to adjacent structures.
- .7 Excavate trenches in accordance with 31 23 10 - Excavating, Trenching and Backfilling.

- .8 Excavate rock for concrete walls, columns and footings to horizontal surfaces not exceeding slope shown on Contract Drawings. Scale, pressure wash and broom clean rock surfaces to assist concrete bond.
  - .9 Except as specified otherwise or as directed by Departmental Representative employ pre-shearing, cushion blasting or other smooth wall drilling and blasting techniques to achieve final excavation surfaces.
  - .10 Remove boulders and fragments which may slide or roll into excavated areas.
  - .11 Correct unauthorized rock removal at no extra cost, in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.
- 3.3 ROCK DISPOSAL .1 Dispose of surplus removed rock at an approved off site location.

-----END OF SECTION-----

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 35 43-Environmental Procedures.
- .2 Section 31 05 16-Aggregate Materials.
- .3 Section 31 23 17-Rock Removal.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C 117, Standard Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D 422-63, Standard Test Method for Particle-Size Analysis of Soils.
  - .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m<sup>3</sup>).
  - .5 ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700 kN-m/m<sup>3</sup>).
  - .6 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
    - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
    - .2 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 DEFINITIONS

- .1 Excavation classes: one class of excavation will be recognized; common excavation.
  - .1 Rock : solid material in excess of 1.00m<sup>3</sup> and which cannot be removed by means of heavy duty mechanical excavating equipment with 1.0m<sup>3</sup> bucket. Frozen material not classified as rock.
  - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Topsoil:
  - .1 Material capable of supporting good

vegetative growth and suitable for use in top dressing, landscaping and seeding.

.2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material.

- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .6 Unsuitable materials:
  - .1 Weak, chemically unstable, and compressible materials.
  - .2 Frost susceptible materials:
    - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1.
    - .2 Coarse grained soils containing more than 10 % by mass passing 0.075 mm sieve.
- 7. Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.
- .7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of BC, Canada.
- .3 Keep design and supporting data on site.
- .4 Engage services of qualified professional Engineer who is registered or licensed in Province of BC, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .5 Health and Safety Requirements:

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.
- 1.5 WASTE MANAGEMENT AND DISPOSAL .1 Divert excess materials from landfill to local facility for reuse.
- 1.6 EXISTING CONDITIONS .1 Buried services:  
.1 Before commencing work establish location of buried services on and adjacent to site.  
.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.  
.3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.  
.4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.  
.5 Prior to beginning excavation Work, notify applicable Departmental Representative, establish location and state of use of buried utilities and structures.  
.6 Confirm locations of buried utilities by careful soil hydrovac methods.  
.7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.  
.8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing/re-routing.  
.9 Record location of maintained, re-routed and abandoned underground lines.  
.10 Confirm locations of recent excavations adjacent to area of excavation.  
.11 Contractor to provide emergency response plan in the event of sanitary forcemain break at construction crossings for new watermain.
- .2 Existing buildings and surface features:  
.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.  
.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.  
.3 Where required for excavation, cut roots or branches as directed by Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Type 1 and Type 2 fill: properties to Section 31 05 16 - Aggregate Materials and the following requirements:
  - .1 Crushed, pit run or screened stone, gravel or sand.
  - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.2.

- .2 Table

<u>Sieve Designation</u>	<u>Percent Passing</u>
75mm	100
50mm	70-100
25mm	50-100
4.75mm	22-100
2.36mm	10-85
0.075mm	0-5

- .3 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75mm, cinders, ashes, sods, refuse or other deleterious materials.

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENT CONTROL

- .1 All Erosion and Sediment Control to be completed as per Section 01 35 43 Environmental Procedures

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 PREPARATION/ PROTECTION

- .1 Protect existing features.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain

undisturbed.

3.4 STRIPPING OF  
TOPSOIL

- .1 Begin topsoil stripping of areas as directed by the Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.
- .2 Strip topsoil to depths as directed by Departmental Representative.
  - .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Departmental Representative.
  - .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil off site.

3.5 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
  - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 COFFERDAMS,  
SHORING, BRACING  
AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 33 - Health and Safety Requirements.
- .2 During backfill operation:
  - .1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.
  - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
  - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500mm above toe of sheeting.

3.7 DEWATERING AND  
HEAVE PREVENTION

- .1 Riprap and headwall installation are to be done at low tides and in dry conditions.
- .2 Keep excavations free of water while Work is in progress.
- .3 Provide for Departmental Representative's review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .4 Avoid excavation below groundwater table if quick

condition or heave is likely to occur.

.1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.5 Protect open excavations against flooding and damage due to surface run-off.

.6 Dispose of water in a manner not detrimental to public and private property, or portion of Work completed or under construction.

.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

.7 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

### 3.8 EXCAVATION

.1 Excavate to lines, grades, elevations and dimensions as indicated.

.2 Remove concrete, masonry, paving, walks demolished foundations and rubble and other obstructions encountered during excavation.

.3 Excavation must not interfere with bearing capacity of adjacent foundations.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain.

.1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.7 Restrict vehicle operations directly adjacent to open trenches.

.8 Dispose of surplus and unsuitable excavated material off site.

.9 Do not obstruct flow of surface drainage or natural watercourses.

.10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

- .11 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
  - .12 Correct unauthorized over-excavation as follows:
    - .1 Fill under bearing surfaces and footings with Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.
    - .2 Fill under other areas with Type 2 fill compacted to not less than 95% of corrected Standard Proctor maximum dry density.
  - .13 Hand trim, make firm and remove loose material and debris from excavations.
    - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
    - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.
- 3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES
- .1 Place and compact granular material for bedding and surround of underground services as indicated.
  - .2 Place bedding and surround material in unfrozen condition.
- 3.10 BACKFILLING
- .1 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.
    - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
  - .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
  - .3 Do not use backfill material which is frozen or contains ice, snow or debris.
  - .4 Place backfill material in uniform layers not exceeding 300mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
  - .5 Backfilling around installations:
    - .1 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
    - .2 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.30 m.

3.11 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as directed by Departmental Representative.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

-----END OF SECTION-----

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Materials and installation for water mains, hydrants, valves, valve boxes, and valve chambers, including service connections.
- 1.2 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures.  
.2 Section 01 78 00 - Closeout Submittals.  
.3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- 1.3 REFERENCES .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)  
.1 ANSI/AWWA B300-10, Hypochlorites.  
.2 ANSI/AWWA C153/A21.53-11, Ductile-Iron Compact Fittings for Water Service.  
.3 ANSI/AWWA C500-09, Metal-Seated Gate Valves for Water Supply Service  
.4 ANSI/AWWA C651-14, Disinfecting Water Mains.  
.5 ANSI/AWWA C800-12, Underground Service Line Valves and Fittings  
.6 ANSI/AWWA C900-16, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings (100 mm - 1200 mm)  
.2 American Society for Testing and Materials International, (ASTM)  
.3 American Water Works Association (AWWA)/Manual of Practice  
.1 AWWA M17-2006, Installation, Field Testing, and Maintenance of Fire Hydrants.  
.4 Canadian General Standards Board (CGSB)  
.5 Canadian Standards Association (CSA International)
- 1.5 CLOSEOUT SUBMITTALS .1 Provide record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions in accordance with Section 01 78 00 - Closeout Submittals.  
.1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.
- 1.6 WASTE MANAGEMENT AND DISPOSAL .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.  
.2 Place materials defined as hazardous or toxic in designated containers.

- .3 Handle and dispose of hazardous materials in accordance with the Canadian Environmental Protection Act (CEPA), Transportation of Dangerous Good Act (TDGA), Regional and Municipal regulations.
- .4 Ensure emptied containers are sealed and stored safely.
- .5 Divert unused materials from landfill to metal recycling facility.
- .6 Divert unused concrete materials from landfill to local facility.
- .7 Divert unused aggregate materials from landfill to facility for reuse.
- .8 Dispose of unused disinfection material at official hazardous material collections site.
- .9 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- .10 Fold up metal banding, flatten and place in designated area for recycling.

1.7 SCHEDULING OF  
WORK

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- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions to Department Representative for approval and adhere to interruption schedule as approved by Department Representative.
- .3 Notify Department Representative a minimum of 48 h in advance of interruption in service.
- .4 Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 h local time unless otherwise authorized.
- .5 Notify fire department of any planned or accidental interruption of water supply to hydrants.
- .6 Provide "Out of Service" sign on hydrant not in use.
- .7 Advise local police department of anticipated interference with movement of traffic.

PART 2 - PRODUCTS

- 2.1 PIPE, JOINTS AND FITTINGS
- .1 Polyvinyl chloride pressure pipe: to ANSI/AWWA C900, pressure class 235 psi, DR 18, 1 MPa gasket bell end
    - .1 CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket.
    - .2 Ductile Iron fittings: to ANSI/AWWA C153/A21.53-06.
- 2.2 VALVES AND VALVE BOXES
- .1 Valves to open counter clockwise.
  - .2 Gate valves: to ANSI/AWWA C500, ductile iron body, bronze mounted valves with non-rising stems, working pressure to 1380 kPa with hub or flanged ends. Valves to be complete with 50mm square operating nut for underground services, stem seal to be O-ring type.
  - .3 Air and vacuum release valves: heavy duty combination air release valves employing direct acting kinetic principle.
    - .1 Fabricate valves of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for 2 MPa working pressure.
    - .2 Valves to expel air at high rate during filling, at low rate during operation, and to admit air while line is being drained.
    - .3 Valve complete with surge check unit.
    - .4 Ends to be flanged to ANSI/AWWA.
- 2.3 TRACER WIRE
- .1 Direct Burial #12 AWG Solid (.0808" diameter), steel core hard drawn extra high strength tracer wire, 1150# average tensile break load, 45 mil high molecular weight-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating.
  - .2 Tracer Box shall include:
    - .1 Tube material shall be of high grade ABS, or equivalent rigid plastic that meets or exceeds ASTM D-1788, Type 1 requirements.
    - .2 Lid material shall be of cast iron or ductile iron. Tensile strength or ductility of such material shall be equal or superior to hi-tensile cast iron ASTM A126-B requirements.
    - .3 Lid-locking bolt material shall be made of aluminum material equal or superior to ASTM B253.
    - .4 Lid-locking mechanism material shall be made of plastic to meet or exceed ASTM A126-B requirements.
    - .5 Box shall be designed to be easily detected by magnetic and electronic locators even when box is covered by a minimum of 100mm of soil, sod and / or paving material.

.6 A magnet shall be securely attached at the top of the upper tube of the box for locating purposes.

2.4 VALVE CHAMBERS

- .1 Precast concrete sections to ASTM C478M. Cast ladder rungs integral with unit; field installation not permitted.
- .2 Valve chamber frames and covers:
  - .1 Design and dimensions as indicated.
  - .2 Cover to be marked "WATER"/"EAU" .
- .3 Ladder rungs for valve chambers: 20 mm diameter deformed rail steel bars to CAN/CSA-G30.18, hot-dipped galvanized after fabrication to CAN/CSA-G164. Rungs to be safety pattern.

2.5 SERVICE CONNECTIONS

- .1 Copper tubing: to ASTM B 88M type K, annealed.
- .2 Polyethylene pressure pipe:
  - .1 To CSA-B137.1, type PE, ASTM F714, Type PE, series DR 11 rated for 200psi..
  - .2 90 mm to 1600 mm: to CGSB 41-GP-25M, type PE, series 250.
- .3 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .4 Polyethylene pipe joints: thermal butt fusion welded
- .5 Brass corporation stops: compression type having threads to ANSI/AWWA C800.
- .6 Brass inverted key-type curb stops: compression type with drains.
  - .1 Curb stops to have adjustable bituminous coated cast iron service box with stem to suit depth of bury.
  - .2 Top of cast iron box marked "WATER"/"EAU".
- .7 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.
- .8 Service connections for PVC pipe:
  - .1 Service connections less than 100 mm: Corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
  - .2 Service connections 100 mm and over: Use tee fitting or tapping valve and sleeve.
- .9 Bronze type service clamps: for PVC pipe service connections.
  - .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.

.2 Clamps to be tapped with threads to ANSI/AWWA C800.

.10 Tee connections: for services above NPS 1. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

2.6 YARD HYDRANTS

.1 Yard Hydrants: Terminal City self-draining stand pipe, factory assembled unit:  
 .1 Hydrants to open threads to local standard, Provide metal caps and chains.  
 .2 Yard Hydrant to be manufactured with bronze operating and draining components.  
 .3 The stuffing box and draining mechanism to have "O" ring rubber gaskets for sealing purposes.  
 .4 Polyurethane anti-score seating material is used for the valve disc facing.  
 .5 Provide key operated gate valve located 1m from hydrant.  
 .6 Depth of bury 1.2 m.

.2 Hydrant paint: exterior enamel to CAN/CGSB-1.88,MPI #96.

2.6 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular material to: Section 31 05 16 - Aggregate Materials and following requirements:  
 .1 Crushed or screened stone, gravel or sand.  
 .2 Table

<u>Sieve Designation</u>	<u>Percent Passing</u>	
	<u>Type 1*</u>	<u>Type 2*</u>
25.0mm	100	100
19.0mm	90-100	90-100
12.5mm	65-85	70-100
9.5mm	50-75	-
4.75mm	25-50	40-70
2.36mm	10-35	25-52
1.18mm	6-26	15-38
0.600mm	3-17	6-27
0.300mm	-	3-20
0.075mm	0-5	0-8

\*Type 1: Standard Gradation  
 \*Type 2: To be used only in dry trench conditions and with prior approval of Department Representative.

2.7 BACKFILL MATERIAL

.1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.8 PIPE DISINFECTION

.1 Sodium hypochlorite to ANSI/AWWA B300 to disinfect water mains.

- .2 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
  - .1 Inspect materials for defects to approval of the Department Representative.
  - .2 Remove defective materials from site as directed by Department Representative.

3.2 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe of not less than 1.0 m from finished grade or as indicated.
- .3 Trench alignment and depth require Department Representative approval prior to placing bedding material and pipe.

3.3 CONCRETE  
BEDDING AND  
ENCASEMENT

- .1 Place concrete to details as indicated.
- .2 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR  
BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% maximum density to ASTM D 698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.

3.5 PIPE  
INSTALLATION

- .1 Lay pipes to manufacturer's standard instructions and specifications. Do not use blocks except as specified.
- .2 Join pipes in accordance with manufacturer's recommendations.
- .3 Bevel or taper ends of PVC pipe to match fittings.

- .4 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .5 Lay pipes on prepared bed, true to line and grade.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
  - .2 Take up and replace defective pipe.
  - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .6 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed one half of permissible deflection at joints as recommended by pipe manufacturer.
- .8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
  - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Position and join pipes with equipment and methods approved by Department Representative.
- .10 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .11 Align pipes before jointing.
- .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material.
  - .1 Remove disturbed or contaminated gaskets.
  - .2 Clean, lubricate and replace before jointing is attempted again.
- .14 Complete each joint before laying next length of pipe.
- .15 Minimize deflection after joint has been made.
- .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

- .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Department Representative.
- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .20 Install tracer wire along entire length of watermain with Test boxes located at maximum 1000m separation.
- .21 Do not lay pipe on frozen bedding.
- .22 Do hydrostatic and leakage test and have results approved by the Department Representative before surrounding and covering joints and fittings with granular material.
- .23 Backfill remainder of trench.

3.6 VALVE  
INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.

3.7 VALVE CHAMBERS

- .1 Use precast units as approved by the Department Representative.
- .2 Construct units as indicated, plumb and centered over valve nut, true to alignment and grade, and not resting on pipe.
- .3 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.
- .4 Plug lifting holes with precast concrete plugs set in cement mortar.
- .5 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.
- .6 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.

3.8 SERVICE  
CONNECTIONS

- .1 Terminate building water service 1 m outside building wall or as indicated opposite point of connection to main. Locate point of connection in advance and advise Department Representative.
  - .2 Cap or seal end of pipe and place temporary

marker to locate pipe end.

- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed.
- .4 Tappings on ductile iron, or PVC-C900 pipe, may be threaded without service clamps.
  - .1 Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used.
  - .2 Tappings PVC-C900 pipe to conform to following:

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

- .5 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .6 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
- .7 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .8 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .9 Install multiple corporation stops, [30 degrees] apart around circumference of pipe and minimum of [300] mm apart along pipe.
- .10 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m, whichever is greater.
- .11 Leave corporation stop valves fully open.
- .12 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .13 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.

- .14 Install curb stop with corporation box on services NPS 2 or less in diameter.
  - .1 Equip larger services with gate valve and cast iron box.
  - .2 Set box plumb over stop and adjust top flush with final grade elevation.
  - .3 Leave curb stop valves fully closed.
- .15 Place temporary location marker at ends of plugged or capped unconnected water lines.
  - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
  - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.9 YARD HYDRANTS

- .1 Install yard hydrants at locations as indicated.
- .2 Set hydrants plumb, with hose outlets parallel with edge of pavement with outlet facing roadway.
- .3 Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.
- .3 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.
- .4 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.10 THRUST BLOCKS  
AND RESTRAINED  
JOINTS

- .1 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Department Representative.
- .2 Keep joints and couplings free of concrete.
- .3 Do not backfill over concrete within 24 hours after placing.
- .4 For restrained joints: only use restrained joints approved by Department Representative

3.11 HYDROSTATIC  
AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Department Representative at least 24 hours in advance of proposed tests.

- .1 Perform tests in presence of Department Representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by the Department Representative.
- .6 Upon completion of pipe laying and after Department Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed as directed by Department Representative.
- .7 Leave hydrants, valves, joints and fittings exposed.
- .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .11 Expel air from main by slowly filling main with potable water.
  - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
  - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .12 Thoroughly examine exposed parts and correct for leakage as necessary.
- .13 Apply hydrostatic test pressure of 1035 kPa based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hours.
- .14 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .15 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .16 Repeat hydrostatic test until defects have been corrected.
- .17 Define leakage as amount of water supplied in order to maintain test pressure for 2 hours.

- .18 Locate and repair defects if leakage is greater than amount specified.
- .19 Repeat test until leakage is within specified allowance for full length of water main.

3.12 PIPE SURROUND

- .1 Upon completion of pipe laying and after Department Representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% maximum density to ASTM D 698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% maximum density to ASTM D 698.

3.13 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under roadways and pathways, compact backfill to at least 95% maximum density to ASTM D 698.

3.14 PAINTING OF HYDRANTS

- .1 After installation, paint hydrants red.
- .2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

3.15 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by Department Representative.
  - .1 Notify Department Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear. The contractor shall supply all water for flushing and testing.
- .3 Flushing flows as follows:

Pipe Size	Flow (L/s) Minimum
150	38
200	75
250	115
300	150

- .4 Provide connections and pumps for flushing as required.
  - .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
  - .6 When flushing has been completed to Department Representative approval, introduce strong solution of chlorine as approved by Department Representative into water main and ensure that it is distributed throughout entire system.
  - .8 Rate of chlorine application to be proportional to rate of water entering pipe.
  - .9 Chlorine application to be close to point of filling water main and to occur at same time.
  - .10 Operate valves, hydrants and appurtenances while main contains chlorine solution.
  - .11 Flush line to remove chlorine solution after 24 hours.
  - .12 Measure chlorine residuals at extreme end of pipe-line being tested.
  - .13 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
    - .1 Take samples daily for minimum of two days.
    - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
    - .3 Specialist contractor to submit certified copy of test results.
  - .14 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
  - .15 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
    - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- 3.16 SURFACE RESTORATION
- .1 After installing and backfilling over water mains, restore surface to original condition as approved by the Department Representative.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 35 00.06 -Special Procedures for Traffic Control.
- .2 Section 31 05 16-Aggregate Materials.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .4 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m<sup>3</sup>).
  - .5 ASTM D 1557-[00], Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700kN-m/m<sup>3</sup>).
  - .6 ASTM D 1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
  - .7 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused granular material from landfill to local facility as approved by Department Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Material for road base to be:
  - .1 Refer to Section 31 05 16-Aggregate Materials for material specifications for shoulder ground.

PART 3 - EXECUTION

3.1 INSPECTION OF UNDERLYING SUBGRADE SURFACE

- .1 Ensure underlying subbase surface true to cross-section and grade and compacted to 98% Modified Proctor Maximum Dry Density. Do not place granular subbase until subgrade is inspected and approved by Department Representative.

3.2 PLACING

- .1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.
- .2 Begin spreading sub-base material on crown line or high

side of one-way slope.

- .3 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .4 Place material to full width in uniform layers not exceeding 150mm compacted thickness. Department Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .6 Remove and replace portion of layer in which material has become segregated during spreading.

### 3.3 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 95% Modified Proctor Density.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Department Representative.

### 3.4 SITE TOLERANCES

- .1 Ensure finished base within plus or minus 10 mm of specified grade and cross-section but not uniformly high or low.
- .2 Ensure finished surface has no irregularities exceeding 10 mm when checked with a 3 m straight edge placed in any direction.
- .3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

### 3.5 PROOF ROLLING

- .1 For proof rolling use fully loaded single or dual axle dump truck.
- .2 Department Representative may authorize use of other acceptable proof rolling equipment.
- .3 Proof roll top of base upon completion of fine grading and compaction.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

- .5 Where proof rolling reveals area of unsuitable subgrade:
  - 1. Remove base, subbase and subgrade material to depth and extent as directed by Department Representative.
  - 2. Backfill excavated subgrade with approved embankment material and compact to specified density.
  - 3. Replace granular subbase material and compact.
  - 4. Replace base material and compact in accordance with this Section.

- .6 Where proof rolling reveals areas of unsuitable base or subbase, remove unsuitable materials to depth and extent directed by Department Representative and replace with new materials, at no extra cost.

3.6 MAINTENANCE

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Department Representative.

-----END OF SECTION-----

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 35 00.06-Special Procedures for Traffic Control.
  - .2 Section 31 05 16-Aggregate Materials.
- 1.2 REFERENCES
- .1 American Society for Testing and Materials (ASTM)
    - .1 ASTM C 117, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
    - .2 ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
    - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
    - .4 ASTM D 422, Standard Test Method for Particle-Size Analysis of Soils.
    - .5 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m<sup>3</sup>).
    - .6 ASTM D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (2,700kN-m/m<sup>3</sup>).
    - .7 ASTM D 1883, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
    - .8 ASTM D 4318, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
  - .2 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
    - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Divert unused granular material from landfill to local facility.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Granular sub-base material: in accordance with Section 31 05 16 - Aggregate Materials

PART 3 - EXECUTION

- 3.1 PLACING
- .1 Place granular sub-base after subgrade is inspected and approved by Departmental Representative.
  - .2 Construct granular sub-base to depth and grade in areas indicated.
  - .3 Ensure no frozen material is placed.

- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .7 Place material to full width in uniform layers not exceeding 300mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace portion of layer in which material has become segregated during spreading.

### 3.2 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 95% Modified Proctor Density.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 Compaction of each lift of backfill material shall be verified through in-place density testing by the nuclear densometer method.
- .6 Contractor to provide test reports from an independent testing agency to Department Representative indicating specified compaction has been achieved.
- .7 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .8 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

### 3.3 SITE TOLERANCES

- .1 Finished sub-base surface to be within 15mm of elevation as indicated but not uniformly high or low.

### 3.4 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is

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constructed, or until granular sub-base is accepted  
by Departmental Representative.

-----END OF SECTION-----

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00-Submittal Procedures.
  - .2 Section 31 23 33.01-Excavating, Trenching and Backfilling.
- 1.2 REFERENCES
- .1 American Society for Testing and Materials International (ASTM)
    - .1 ASTM A 48/A 48M, Standard Specification for Gray Iron Castings.
    - .2 ASTM C 117, Standard Test Method for Materials Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing.
    - .3 ASTM C 136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
    - .4 ASTM C 139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
    - .5 ASTM C 478M, Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
    - .6 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m<sup>3</sup>).
  - .2 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
    - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
  - .3 Canadian Standards Association (CSA International)
    - .1 CAN/CSA-A23.1/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
    - .2 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
      - .1 CSA-A3001, Cementitious Materials for Use in Concrete.
      - .2 CSA-A3002, Masonry and Mortar Cement.
    - .3 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
    - .4 CAN/CSA-G30.18, Billet Steel Bars for Concrete Reinforcement.
    - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).

- 1.3 SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- 1.4 DELIVERY, STORAGE AND HANDLING 1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- PART 2 - PRODUCTS
- 2.1 MATERIALS .1 Cast-in-place concrete:  
.1 Cement: to CAN/CSA-A3001, Type GU 50.  
.2 Concrete mix design to produce 30 MPa minimum compressive strength at 28 days and containing 25mm maximum size coarse aggregate, with water/cement ratio to CAN/CSA-A23.1.  
.1 Air entrainment to CAN/CSA-A23.1.
- .2 Precast manhole units: to ASTM C 478M, circular or oval.  
.1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
- .3 Joints: made watertight using rubber rings to ASTM C443 or cement mortar.
- .4 Mortar:  
.1 Aggregate: to CSA A82.56.  
.2 Masonry Cement: to CAN/CSA-A8.
- .5 Ladder rungs: to CAN/CSA-G30.18, No.25M billet steel deformed bars, hot dipped galvanized to CAN/CSA-G164.  
.1 Rungs to be safety pattern (drop step type).
- .6 Adjusting rings: to ASTM C 478.
- .7 Concrete Brick: to CAN3-A165 Series.
- .8 Drop manhole pipe: same as sewer pipe.
- .9 Galvanized iron sheet: approximately 2 mm thick.
- .10 Steel gratings, I-beams and fasteners: as indicated.
- .11 Frames, gratings, covers to dimensions as indicated and following requirements:  
.1 Metal gratings and covers to bear evenly on frames.  
.1 Frame with grating or cover to constitute one unit.  
.2 Assemble and mark unit components before shipment.  
.2 Cast iron manhole & catchbasin frames and covers must conform to ASTM A48 and be designed

to withstand H2O loading.

- .1 Must bear manufacturer identification on castings.
- .12 Granular bedding and backfill: in accordance with Section 31 05 16 - Aggregate Materials.
- .13 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

### 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 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.

#### 3.3 CONCRETE WORK

- .1 Position metal inserts in accordance with dimensions and details as indicated.

#### 3.4 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
- .3 Set precast concrete base on 100 mm minimum of granular bedding compacted to 95%. Modified proctor density in compliance with ASTM D1557.
- .4 Precast units:
  - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base.
  - .2 Make each successive joint watertight with Departmental Representative's approval rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
  - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
  - .4 Plug lifting holes with concrete plugs set in cement mortar or mastic compound.
- .5 For sewers:
  - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
  - .2 Bench to provide smooth U-shaped channel.
    - .1 Side height of channel to be 0.75 times diameter of sewer.
    - .2 Slope adjacent floor at 1 in 20.

- .3 Curve channels smoothly.
  - .4 Slope invert to establish sewer grade.
  - .6 Compact granular backfill to 95% Modified Proctor Density.
  - .7 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
  - .8 Installing units in existing systems:
    - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
    - .2 Make joints watertight between new unit and existing pipe.
    - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
  - .9 Set frame and cover to required elevation on no more than three courses of brick.
    - .1 Make brick joints and join brick to frame with cement mortar.
    - .2 Parge and make smooth and watertight.
  - .10 Clean units of debris and foreign materials.
    - .1 Remove fins and sharp projections.
    - .2 Prevent debris from entering system.
  - .11 Install safety platforms in manholes having depth of 6 m or greater, as indicated.
- 3.5 ADJUSTING TOPS OF EXISTING UNITS
- .1 Remove existing gratings, frames and store for re-use at locations designated by Departmental Representative.
  - .2 Sectional units:
    - .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
    - .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.
      - .1 When amount of raise is less than 300mm use standard manhole brick, moduloc or grade rings.
  - .3 Monolithic units:
    - .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to

required elevation with mortared brick course for 150 mm or less alteration.

.2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.

.3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.

.4 Install additional manhole ladder rungs in adjusted portion of units as required.

.5 Re-use existing gratings, frames and I-beams.

3.6 SEALING OVER  
EXISTING UNITS

- .1 Fill with material approved by Departmental Representative.

-----END OF SECTION-----

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Materials and installation for gravity sewers.
- 1.2 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures.  
.2 Section 01 78 00 - Closeout Submittals.  
.3 Section 31 23 33.01 - Excavating Trenching and Backfilling.  
.4 Section 31 05 16 - Aggregate Materials.
- 1.3 REFERENCES .1 American Society for Testing and Materials International, (ASTM)  
.1 ASTM C 117-[95], Standard Test Method for Material Finer Than 75 [MU] m (No. 200) Sieve in Mineral Aggregates by Washing.  
.2 ASTM C 136-[01], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.  
.3 ASTM D 698-[00a], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft<sup>4</sup>-lb/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).  
.4 ASTM D 3034-[00], Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .2 Canadian General Standards Board (CGSB)  
.1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.  
.2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)  
.1 CSA B1800-[02], Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).  
.1 CSA B182.1-06, Plastic Drain and Sewer Pipe and Pipe Fittings.  
.2 CSA B182.2-06, PVC Sewer Pipe and Fittings (PSM Type).  
.3 CSA B182.6-06, Profile Polyethylene Sewer Pipe and Fittings for Leak-Proof Sewer Applications.  
.4 CSA B182.11-06, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- .4 Department of Justice Canada (Jus)  
.1 Canadian Environmental Protection Act, 1999 (CEPA)

- .5 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)
  
- 1.4 DEFINITIONS .1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure which is part of sewer system.
  
- 1.5 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with manufacturers requirements.
  
- 1.6 WASTE MANAGEMENT AND DISPOSAL .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .2 Divert unused materials from landfill to recycling facility as approved by Department Representative.
  - .3 Place materials defined as hazardous or toxic in designated containers.
  - .4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
  
- 1.7 SCHEDULING .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
  - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
  - .3 Notify Department Representative 24hours minimum in advance of any interruption in service.
  
- PART 2 - PRODUCTS
  
- 2.1 PLASTIC PIPE .1 Type PSM Polyvinyl Chloride (PVC): to CSA-B182.2.
  - .1 Standard Dimensional Ratio (SDR):35.
  - .2 Include integral bell and spigot ends with stiffened wall section and formed groove for a rubber gasket; joints to conform to ASTM D3212, gaskets to ASTM F477
  - .3 Nominal lengths: 4m.
  
- 2.2 PIPE BEDDING AND SURROUND MATERIALS .1 Granular material to Section 31 05 16 - Aggregate Materials and following requirements:
  - .1 Crushed or screened stone, gravel or sand.
  - .2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.2.

.2 Table

<u>Sieve</u> <u>Designation</u>	<u>Percent Passing</u>	
	<u>Type 1*</u>	<u>Type 2*</u>
25.0mm	100	100
19.0mm	90-100	90-100
12.5mm	65-85	70-100
9.5mm	50-75	-
4.75mm	25-50	40-70
2.36mm	10-35	25-52
1.18mm	6-26	15-38
0.600mm	3-17	6-27
0.300mm	-	3-20
0.075mm	0-5	0-8

\*Type 1: Standard Gradation

\*Type 2: To be used only in dry trench conditions and with prior approval of Department Representative.

2.3 BACKFILL MATERIAL

- .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Clean and dry pipes and fittings before installation.
- .2 Obtain Department Representative approval of pipes and fittings prior to installation.

3.2 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Do not allow contents of any sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth require approval of Department Representative prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.  
 .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.

- .5 Compact each layer full width of bed to at least 95% Modified Proctor density
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

### 3.4 INSTALLATION

- .1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Department Representative.
- .2 Handle pipe using methods approved by Department Representative.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipe during construction, except as may be permitted by Department Representative.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 Pipe jointing:
  - .1 Install gaskets in accordance with manufacturer's recommendations..
  - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
  - .3 Align pipes before joining.
  - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
  - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
  - .6 Complete each joint before laying next length of pipe.
  - .7 Minimize joint deflection after joint has been made to avoid joint damage.

.8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.

.9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

.10 When stoppage of Work occurs, block pipes as directed by Department Representative to prevent creep during down time.

.11 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.12 Make watertight connections to manholes.

.1 Use shrinkage compensating grout when suitable gaskets are not available.

### 3.5 PIPE SURROUND

.1 Place surround material in unfrozen condition.

.2 Upon completion of pipe laying, and after Department Representative has inspected pipe joints, surround and cover pipes as indicated.

.1 Leave joints and fittings exposed until field testing is completed.

.2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Compact each layer from pipe invert to at least 95 % Modified Proctor Density.

### 3.6 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

### 3.7 FIELD TESTING

.1 Repair or replace pipe, pipe joint or bedding found defective.

.2 Remove foreign material from sewers and related appurtenances by flushing with water.

.3 Upon completion of cleaning and flushing of each section carry out leakage testing. Tests may include one or more of the following:

.1 Low Pressure Air Test

.2 Exfiltration test - using water

.3 Infiltration test

Testing to be completed as soon as practicable after jointing and bedding are complete, and service connections have been installed. All tests has be performed in presence of Department Representative.

.4 Carry out tests on each section of sewer between successive manholes including service connections.

.5 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.

.6 Low Pressure Air Test:

.1 Low pressure air test to include testing of sewer main and service connections in each section. Test manholes by either exfiltration test utilizing water or by low pressure air as specified.

.2 Wet inside perimeter of concrete pipes in test section then increase pressure in test section prior to conducting air tests. Then increase pressure in test section to 24 kPa above average groundwater pressure and observe rate of pressure drop.

.3 Maintain 25 kPa above average ground water pressure for at least 5.0 minutes before commencing internal air pressure test. Regulate air pressure to prevent pressure inside test section from exceeding 35 kPa above average ground water pressure.

.4 Commence test period when pressure decreases to 24.0 kPa above average groundwater pressure and end when pressure decreases to 20.5 kPa above average groundwater pressure. Do not add air to test section during test period. If test period is less than:

- 2 minutes and 32 seconds for 100mm pipe
- 3 minutes and 50 seconds for 150mm pipe
- 5 minutes and 6 seconds for 200mm pipe
- 6 minutes and 22 seconds for 250mm pipe
- 7 minutes and 39 seconds for 300mm pipe

Sewer shall be deemed to have failed test. Retest upon completion of repair to any leaks.

.5 Department Representative reserves right to withdraw permission to use this test procedure at any time and to require Contractor to carry out exfiltration test utilizing water.

.7 Exfiltration test:

.1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.

.2 Immediately prior to test period add water to

pipeline until there is head of 1.2 m over interior crown of pipe measured at highest point of test section or water in manhole is 1.2 m above static ground water level, whichever is greater.

.3 Duration of exfiltration test: 3 hours minimum and, unless excess exfiltration requires further testing, maximum of 8 hours

.4 Allowable leakage from pipe will be calculated using the following formula:

$$\text{Allowable Leakage (Litres)} = (H \times D \times L)/k$$

Where: H = duration of test in hours,  
D = pipe diameter in millimeters,  
L = length of test section in metres,  
k = 840

5. Where service connections exist along test section, allowable leakage from service connections to be calculated by use of above formula and added to that of main sewer leakage to arrive at total allowable leakage. No additional leakage allowance to be made for manholes in test sections.

6. Above exfiltration limits to constitute maximum total allowable leakage from sewer mains, service wyes, service lines, manholes, and appurtenant structures existing along test section of pipe.

7. Test manholes that have failed exfiltration test for water tightness by filling structure with water to 2m above invert of pipe (or to 150mm below ground level, if pipe invert is less than 2m). No measurable drop in one will constitute an acceptance test.

.8 Infiltration test:

.1 Infiltration test to include testing of sewer main, service connections and manholes in each section or sections.

.2 Seal test section at highest point with removable water tight plug. Measure leakage by means of any approved weir to meter. Duration not less than 1 hour.

.3 Allowable leakage to be same as that calculated for exfiltration less 10% if external head is 600mm or less. Above infiltration limits to constitute maximum total allowable infiltration for section.

.4 If test section has infiltration amount in excess of allowable, replace or repair section of sewer. Retest such section until they meet allowable leakage limits.

3.8 SURFACE  
RESTORATION

1 After installing and backfilling over gravity  
sanitary sewer mains, restore surface to original  
condition as approved by the Department Representative.

-----END OF SECTION-----

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Materials and installation for storm sewer.
- 1.2 RELATED SECTIONS .1 Section 01 33 00-Submittal Procedures.  
.2 Section 31 05 16-Aggregate Materials.  
.3 Section 31 23 33.01-Excavating, Trenching and Backfilling.  
.4 Section 33 05 13-Manholes Structures.
- 1.3 REFERENCES .1 American Society for Testing and Materials International, (ASTM)  
.1 ASTM C 14M, Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).  
.2 ASTM C 76M, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).  
.3 ASTM C 117, Standard Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.  
.4 ASTM C 136, Standard Method for Sieve Analysis of Fine and Course Aggregates.  
.5 ASTM C 443M, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).  
.6 ASTM C 506M, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.  
.7 ASTM C 507M, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe (Metric).  
.8 ASTM D 698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m<sup>3</sup>).  
.9 ASTM D 1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.  
.10 ASTM D 2680, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.  
.11 ASTM D 3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.  
.12 ASTM F 405, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.  
.13 ASTM F 667, Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.  
.14 ASTM F 794, Standard Specification for

Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

- .2 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-8.1, Sieves, Testing, Woven Wire, Inch Series.
    - .2 CAN/CGSB-8.2, Sieves, Testing, Woven Wire, Metric.
    - .3 CAN/CGSB-34.9, Asbestos-Cement Sewer Pipe.
  - .3 Canadian Standards Association (CSA International)
    - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).
      - .1 CAN/CSA-A5, Portland Cement.
    - .2 CAN/CSA-A257 Series-[M92(R1998)], Standards for Concrete Pipe.
    - .3 CSA B1800-[02], Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
      - .1 CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type).
      - .2 CSA B182.4, Profile PVC Sewer Pipe and Fittings.
      - .3 CSA B182.11, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- 1.4 MATERIAL CERTIFICATION
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Products having CSA certification to be used where readily available. Certification by Standards Council of Canada approved independent third body that products conform to CSA standards in acceptable in lieu of CSA certification.
  - .3 At least 2 weeks prior to commencing work, submit manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this Section. Include manufacturer's drawings where pertinent.
- 1.5 SCHEDULING OF WORK
- .1 Schedule Work to minimize interruptions to existing services. Maintain existing flow during construction.
  - .2 Submit schedule of expected interruptions to Departmental Representative for approval and adhere to interruption schedule as approved by

Departmental Representative.

1.6 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
- .3 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .4 Handle and dispose of hazardous materials in accordance with the Regional and Municipal regulations.
- .5 Dispose of unused asbestos cement pipe in accordance with regulations governing the disposal of hazardous materials.
- .6 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 CONCRETE PIPE

- .1 Non-reinforced circular concrete pipe and fittings: to ASTM C 14M maximum diameter 900 mm, strength class as shown on Contract Drawings, designed for flexible rubber gasket joints to ASTM C 443M.
- .2 Reinforced circular concrete pipe and fittings: to ASTM C76M for all pipe greater than 900 mm diameter, strength class as shown on Contract Drawings, designed for flexible rubber gasket joints to ASTM C 443M.
- .3 Reinforced circular concrete pipe and fittings: to ASTM C506M.
- .4 Reinforced concrete elliptical pipe: to ASTM C507M.
- .5 Lifting holes:
  - .1 Pipe 900mm and less diameter: no lift holes.
  - .2 Pipe greater than 900mm diameter: lift holes not to exceed two in piece of pipe.
  - .3 Provide pre-fabricated plugs to effectively seal lift holes after installation of pipe.

2.2 CORRUGATED  
STEEL PIPE

- .1 Corrugated steel pipe and couplers: to CSA-G401.
  - .1 Gaskets: to ASTM D 1056.
- .2 Corrugated steel pipe to 2.0mm wall thickness with aluminized Type 2 coating.

2.3 PLASTIC PIPE, MAINLINE

- .1 Polyvinyl chloride pipe up to 675mm in diameter,

SMOOTH  
PROFILE AND  
PERFORATED DRAIN TILE

DR35. Pipe to have minimum pipe stiffness (F/Y) of 320 kPa at 5.0% deflection, ASTM D2412. Pipe to be manufactured to specification for pipe size ranges as follows:

- .1 100mm dia. - 375mm dia. to ASTM D3034
- .2 450mm dia. - 1200mm dia. to ASTM F679.

.2 Pipes to be certified by Canadian Standards Association to standards for pipe size ranges below.

- .1 100mm dia. - 1200mm dia. to CSA B182.2

.3 Joint: Pipe to include integral bell and spigot ends with stiffened wall section and formed groove for a rubber gasket; joints to conform to ASTM D3212, gaskets to ASTM F477.

.4 Normal pipe length joint to joint to be 4.0 m.

.5 Maximum installed deflection not to exceed 7.5% of the base inside diameter.

2.4 SERVICE  
CONNECTIONS

.1 Storm sewer service connections to be 100mm minimum diameter; maximum diameter as specified on Contract Drawings.

.2 Storm sewer service connections 100mm and 150mm diameter to be PVC type DR28 sewer pipe.

.3 100mm and 150mm DR28 PVC storm service connection pipe to have a minimum pipe stiffness of 625kPa. Pipe to be manufactured to ASTM D3034 and certified by Canadian Standards Association to CSA B182.2

.4 Storm sewer service connections greater than 150mm diameter to be of size and material specified on Contract Drawings and to conform to applicable specifications for mainline pipe.

.5 Manufactured connections to non-reinforced or reinforced concrete mainline pipe to be made using sanded PVC pipe male end stub with integral bell by either:

- .1 Stub grouted into neatly chipped hole in pipe wall by concrete pipe manufacturer. Grout to be Portland cement based grout.
- .2 Stub epoxy resin cemented into neatly cored hole in pipe wall by concrete pipe manufacturer.

.6 Stub and bell orientation to be 45° to centerline of mainline pipe (wyes) for concrete pipe less than 1050mm diameter. Orientation may be 90° to centerline of mainline pipe (tees) for concrete pipe 1050mm diameter or larger. No section of service stubs to protrude past inside of concrete pipe wall.

- .7 Manufactured wye connections to PVC mainline pipe to be made with extrusion molded PVC or fabricated PVC fittings manufactured to ASTM D3034 and CSA B182.2
  - .8 Field installed tees and wyes:
    - .1 In-situ installation of tees and wyes into concrete or PVC mainline pipe shall be made with approved PVC swaddle installed to the manufacturer specifications into a neatly cored hole in the pipe wall.
    - .2 Connections to ribbed PVC pipe to be made with a preformed tee and wye fitting when connection is up to two sizes smaller than mainline pipe. For these pipes, in-situ installation of tees or wyes involving cutting across pipe ribs not permitted. For connections more than two sizes smaller than mainline pipe, an insertable tee for ribbed PVC pipe is permitted. When an insertable is used, hole cut into mainline pipe to cut as few ribs as possible.
  - .9 PVC service connection pipe and fitting joints: push-on type comprised of integral bell with single elastomeric gasket to ASTM D3212 and ASTM F477. Normal pipe laying length joint to joint to be 4.0m.
  - .10 Pipe and fitting joints for service connection pipe materials other than PVC type PSM sewer pipe to be as specified for applicable mainline pipe.
- 2.5 PIPE BEDDING  
AND SURROUND  
MATERIAL
- .1 Granular material in accordance with Section 31 05 16 - Aggregate Materials
  - .2 Concrete required for bedding cradles, encasement, and incidental uses to be minimum 20 MPa.
- 2.6 BACKFILL  
MATERIAL
- .1 As shown on Contract Drawings.
  - .2 In accordance with Section 31 05 16-Aggregate Materials.
- PART 3 - EXECUTION
- 3.1 PREPARATION
- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.
- 3.2 TRENCHING
- .1 Do trenching Work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.
  - .2 Do not allow contents of sewer or sewer connection to flow into trench.

- .3 Trench alignment and depth as shown on Contract Drawings.
- 3.3 CONCRETE  
BEDDING AND  
ENCASEMENT
- .1 Do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete. Place concrete to details as indicated.
- .2 Position pipe on concrete blocks to facilitate placing of concrete.  
.1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 h after placing
- 3.4 GRANULAR  
BEDDING
- .1 Fill over-excavation below design elevation of bottom of specified bedding with granular bedding placed and compacted. Drain rock may be used for backfill of over-excavation only with Departmental Representative's approval.
- .2 Place granular bedding material across full width of trench bottom in uniform layers not exceeding 150mm compacted thickness to depth as shown on Contract Drawings.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% Modified Proctor Density in compliance with ASTM D1557. (All following references to density imply in compliance with ASTM D1557).
- 3.5 INSTALLATION
- .1 Handle pipe in accordance with manufacturer's recommendations.  
.1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .2 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein. Concrete pipe as specified herein, PVC pipe to CSA B182.11.
- .3 Horizontal tolerances:  $\pm 50$  mm from specified alignment Vertical tolerances:  $\pm 10$  mm from specified grade. Reverse grade is not acceptable.
- .4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with

- shaped bed throughout its full length.
- .5 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
  - .6 Pipes on curved alignments:
    - .1 Concrete pipe and ribbed profile PVC plastic pipe. Do not exceed permissible joint deflection recommend by pipe manufacturer.
    - .2 Smooth PVC pipe: for 100 mm to 300 mm sizes conform to required curvature by bending pipe barrel. In no case shall radius of curvature to be less than 300 times outside diameter of pipe barrel. Joint deflection not permitted for smooth profile PVC pipe.
  - .7 Keep jointing materials and installed pipe free of dirt, water and other foreign materials. Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative.
  - .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
  - .9 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe and leave smooth end at right angles to axis of pipe.
  - .10 Joints:
    - .1 Install gaskets as recommended by manufacturer.
    - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
    - .3 Align pipes before joining.
    - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
    - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
    - .6 Complete each joint before laying next length of pipe.
    - .7 Minimize joint deflection after joint has been made to avoid joint damage.
    - .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
  - .11 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as specified otherwise.
  - .12 When any stoppage of Work occurs, restrain pipes as

directed by Departmental Representative, to prevent "creep" during down time.

- .13 Plug lifting holes with approved prefabricated plugs, to pipe suppliers recommendations for sealing methods.
- .14 Make watertight connections to manholes.
  - .1 Use shrinkage compensating grout when suitable gaskets are not available.
  - .2 Core neat circular holes in walls of existing manholes. Do not hammer or ship except as approved by Departmental Representative.

### 3.6 PIPE SURROUND

- .1 Upon completion of pipe laying, and after Departmental Representative has inspected work in place, surround and cover pipes as shown on Contract Drawings.
- .2 Hand place surround material in uniform layers not exceeding 150mm compacted thickness simultaneously on each side of pipe. Do not dump material within 1 m of pipe.
- .3 Compact each layer from pipe invert to underside of backfill to minimum 95% Modified Proctor Density.

### 3.7 CONNECTIONS TO EXISTING MAINLINE PIPES

- .1 Use prefabricated saddles or approved field connection materials and techniques to connect service pipes to existing mainline sewer pipe.
- .2 Where feasible, make connections to existing non-reinforced or reinforced concrete mainline pipe by coring or sawing circular holes in existing pipe walls. Where not feasible, make as follows:
  - .1 Break in to pipe by drilling small diameter holes, spaced at approximately 50 mm along pipe axis, using a drill or chipping gun. Use hammer to strike concrete adjacent to centre holes to create small core, and similarly expand core to suit outside dimensions of stub.
  - .2 Core dimensions to allow maximum 20 mm clearance around stub at any point.
  - .3 Trim stub to conform closely to shape of pipe interior when installed.
  - .4 Insert stub into core, ensuring that no portion of stub protrudes beyond interior of pipe.
  - .5 Prepare non-shrink, fast-setting cementitious grout to "dry pack" consistency. Pack grout tightly into void between stub and pipe.
  - .6 Hand finish interior and exterior grout surfaces to smooth surface.
  - .7 Allow sufficient time for strength development of grout prior to installation of

connecting pipe or trench backfill.

- .3 For new connections to existing PVC mainline sewers, drill hole in mainline to exact dimension of new connection. Use saddle or insertable tee for connections more than two sizes smaller than mainline. Insertable tees may be used for all types of gravity mains provided insertable tee designed for applicable pipe thickness is used.
- .4 For new connections to existing ribbed PVC pipe mainline sewers use performed tee or wye fitting when connection is up to two sizes smaller than mainline pipe. For these pipes, in-situ installation of tees or wyes involving cutting across pipe ribs not permitted. For connections more than two sizes smaller than mainline pipe, an insertable tee for ribbed PVC pipe is permitted. When an insertable tee is used, hole cut into mainline pipe to cut as few ribs as possible.

3.8 BACKFILL

- .1 Place backfill in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.
- .2 Backfill requirements, including type of material and compaction requirements, as shown on Contract Drawings.
- .3 Under paving and walks, compact backfill to at least 95% Modified Proctor Density.

3.9 SERVICE CONNECTIONS

- .1 Install service connections to 3.5 and as shown on Contract Drawings.
- .2 Install inspection chamber at specified location set plumb and to specified elevation. If inspection chamber located in driveway, lane or paved surface install cover or lid as shown on Contract Drawings.
- .3 Place location marker at ends of plugged or capped unconnected sewer lines.
  - .1 Each marker: 40 x 90 mm stake extending from pipe end at pipe level to 0.6 m above grade.
  - .2 Paint exposed portion of stake green with designation STM SWR LINE in black.

3.10 CLEANING AND FLUSHING

- .4 Sawcut adjacent curb on alignment of service connection and paint green.
- .1 Before flushing and testing, ensure sewer system is completely finished and make arrangements with Departmental Representative for scheduling of testing.
- .2 Water may be supplied from Department fire hydrants upon application for a Hydrant Use Permit.

- .3 Obtain Department approval prior to discharging flushing water to sewers or drainage ditches.
- .4 Comply Section 01 35 43-Environmental Procedures in regard to discharge of flushing water.
- .5 Provide Departmental Representative with all required approvals prior to discharging flushing water.
- .6 Remove foreign material from pipe and related appurtenances by flushing with water. Main to be flushed at water velocities as high as can be obtained from available water sources. Continue flushing at least until flow from most distant point has reached discharge point and until water discharged is clean and clear.

### 3.11 VIDEO INSPECTION

- .1 The Contractor shall video inspect completed storm sewers under 900 mm in diameter following completion of installation. The video inspection report shall be in the form specified by the Departmental Representative. Copies of the video tapes and written report shall be forwarded to the Departmental Representative when available.
- .2 Should video inspection indicate apparent deficiencies, Departmental Representative may direct Contractor to perform additional testing as follows.
- .3 Additional testing may include passing rubber ball, mandrel or test plug having a minimum dimension of 95% of diameter of sewer pipe completely through pipes and appurtenances. A light test may be performed in lieu of ball test at discretion of Departmental Representative.

### 3.12 INSTALLATION STANDARD

- .1 Repair all deficiencies and visible leaks.
- .2 Repair procedures and materials subject to approval of Departmental Representative.
- .3 Departmental Representative reserves right to require Contractor to replace defective installations at Contractor's sole cost.
- .4 Test Procedures, including video inspection, to be repeated and repairs made until satisfactory results are obtained.
- .5 Acceptable Ponding:
  - .1 Connections: 10mm maximum ponding over 3m length of pipeline.
  - .2 Mainline PVC sewers:

- .1 300mm diameter or less: 20mm maximum ponding over 3m length of pipe
- .2 Greater than 300mm diameter: 30mm ponding over 3m length of pipeline.
- .3 Mainline Concrete sewers:
  - .1 300mm diameter: 20mm maximum ponding over a 5m length of pipeline
  - .2 Greater than 300mm diameter: 30mm maximum ponding over a 5m length of pipeline.

3.13 CONNECTIONS TO EXISTING MAINS

- .1 Make connections to existing storm sewer systems unless shown otherwise on Contract Drawings. Notify Departmental Representative minimum 48 h in advance of scheduled connection.
- .2 Make connection in presence of Departmental Representative. To prevent damage to existing utilities, excavate last 300 mm over utility by hand.

3.15 PERFORATED DRAIN PIPE

- .1 Where shown on Contract Drawings or where directed by Departmental Representative install perforated drain pipe adjacent to sidewalk or curb and gutter.
- .2 Drain pipe to be 100 mm minimum.
- .3 Connect to catchbasins.
- .4 Install other perforated drain pipes as shown on Contract Drawings.
- .5 Install sweep bend and cap at ground grade at upstream end of run.
- .6 Install with perforations downward.

-----END OF SECTION-----

**Appendix A**

Arborist Report for Development Purposes  
Fort Langley National Historic Site, 23433 Mavis Avenue

# Arborist Report for Development Purposes

Fort Langley National Historic Site, 23433 Mavis Avenue, Surrey

May 30, 2017

BC PLANT HEALTH CARE INC.



KEEPING IT GREEN  
ONE TREE AT A TIME.™

**Andrew MacLellan**

**I.S.A. Certified Arborist - #ON-1978A  
I.S.A. Tree Risk Assessment Qualification  
Forestry Technician FtDip**



**BC Plant Health Care Inc.**

**18465 53rd Avenue | Phone: 604-575-8727  
Surrey, BC, V3S 7A4 | Fax: 604-576-2972**

**Email: info@bcplanthealthcare.com  
24 Hour Emergency Pager 604-607-1616**



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May 30, 2017

**ISL Engineering and Land Services Ltd.**

8506 200 Street, Unit #201

Langley, BC V2Y 0M1

Tel: 604-371-0091

Cell: 604-785-3344

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Email: [sverkaik@islengineering.com](mailto:sverkaik@islengineering.com)

**Attention: Mr. Steve Verkaik**

**Re: Arborist Report for Development Purposes at Fort Langley National Historic Site, 23433 Mavis Avenue, Surrey**

**1.0 SUMMARY**

-  [6] trees will be impacted by the proposed sanitary upgrade. (#662, 663, 664, 665, 666, and 667)
-  [2] trees will not be impacted by the proposed sanitary upgrade. (#1 and 2)
-  Maximum critical root mass depth is ~40 cm to 50 cm.
-  Hydro-vac excavation in critical root zones is recommended.

**2.0 INTRODUCTION**

-  BC Plant Health Care Inc. has been contracted by ISL Engineering and Land Services Ltd, to provide an arborist report for the planning and design phase of development. Our client has proposed a utility rehabilitation plan for the Parks Canada Property of Fort Langley, located at 23433 Mavis Avenue. The purpose of this plan is to upgrade sanitary services on the west side of the property. The purpose of this assignment is to prepare a tree management report evaluating the impact of the proposed development on the inventoried trees and make recommendations for tree retention, protection and preservation.
-  On May 9<sup>th</sup> and May 23<sup>rd</sup>, 2017, I, Andrew MacLellan, of BC Plant Health Care Inc., visited the site to perform my field assessment, where I met the project engineer Steve Clark. We walked the site and he indicated to me where the preferred locations of the sanitary pipe were. The scope of work was to utilize ground penetrating radar (GPR) to map roots within the Critical Root Zones. A CRZ is the minimal amount of root area required for the tree to remain structurally stable and be able to absorb the nutrients and water necessary to sustain life.
-  I began the assessment by attaching yellow tree tags [#662 – 673], measuring diameter, height, lean, general health, live crown ratio, defects, and overall TRAQ model qualitative risk rating to each tree which may be impacted. Details from this assessment can be found on the attached *Detailed Spreadsheet*. Following this inventory, I reviewed the site plans and I determined the critical root zone radius (CRZ) for the inventoried trees and laid out these locations with orange line paint. I determined the area of assessment for each scan block and placed marker flags to guide my field tests and data collection.
-  There were originally 4 scan blocks, however the first two were disregarded since the proposed location of the sanitary pipe was altered by the client. Scan block 5 depicts the amendment.



Keeping it Green... One Tree at a Time.™





**ISL Engineering and Land Services Ltd.**

Mr. Steve Verkaik  
Fort Langley National Historic Site, 23433 Mavis Avenue, Surrey  
May 30, 2017  
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**3.0 OBSERVATIONS**

[8] trees will be impacted by the proposed location of the sanitary lines.

- [2] Red oak trees (#662 and 663)
- [2] Douglas-fir trees (#665 and 666)
- [1] Western hemlock (#664)
- [1] Western red cedar (#667)

[2] trees will not be impacted by the proposed location of the sanitary lines.

- [2] Apple spp. (#1 and 2)

**Table 1: Snapshot of Impacted Trees.**

Tree #	Species	DBH (cm)	CRZ (m)	Picture
662	Red oak	68	4.08	2
663	Red oak	72	4.3	2
664	Western Hemlock	84	5.04	1
665	Douglas-fir	52	3.12	1
666	Douglas-fir	59	3.54	1
667	Western red cedar	43	2.58	1
1	Apple spp.	22	1.32	
2	Apple spp.	34	2.04	

Inventoried trees were in Fair to Good health and condition without any significant defects observed.

**4.0 TESTING AND ANALYSIS**

GPR testing was performed over 3 different locations, all in soil and grass mediums. Calibration of the unit was done prior to testing to accurately detect for the reflection, refraction and attenuation of the GPR at 900 MHZ. [16] scans were performed in 3 scan blocks covering potential conflicts between critical root zones and the proposed sanitary pipe location. Scans were oriented parallel to the proposed location of the sanitary pipe and spaced in 60cm graduated spacing.

Center of trees was marked on the scans and is indicated as a green dashed line on the scan visuals.

The gain was set at [0, 11.4, 21.4, 22.1, 23.1] for blocks 3 and 4. For block 5 it was set at [0, 14.8, 20.7, 25.0, 28.5] because of changing moisture levels in the soil profile.



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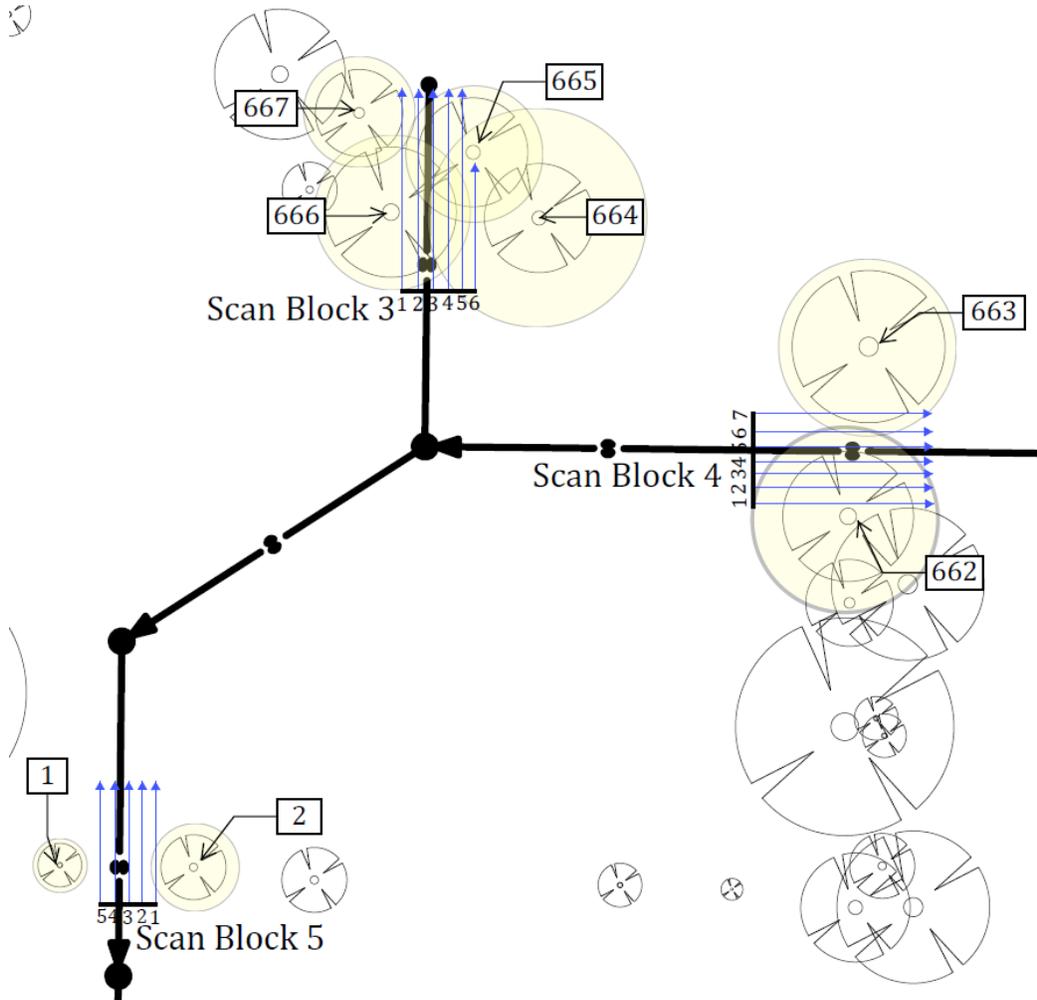


Figure 1: Scan block and scan line layout relative to tree and pipeline location.





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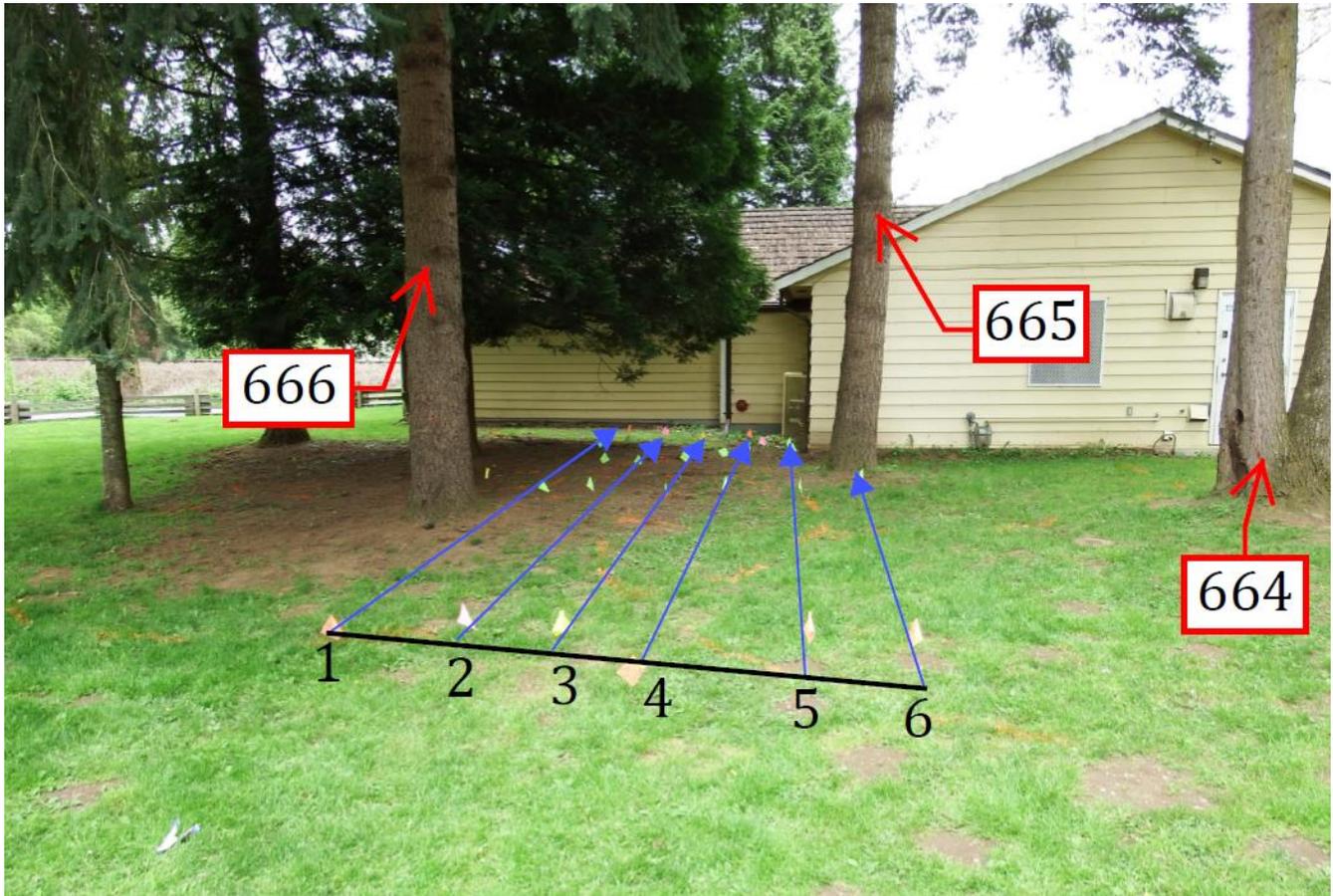
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4.1 Scan Block 3



Picture 1: Layout and scan lines of block 3.



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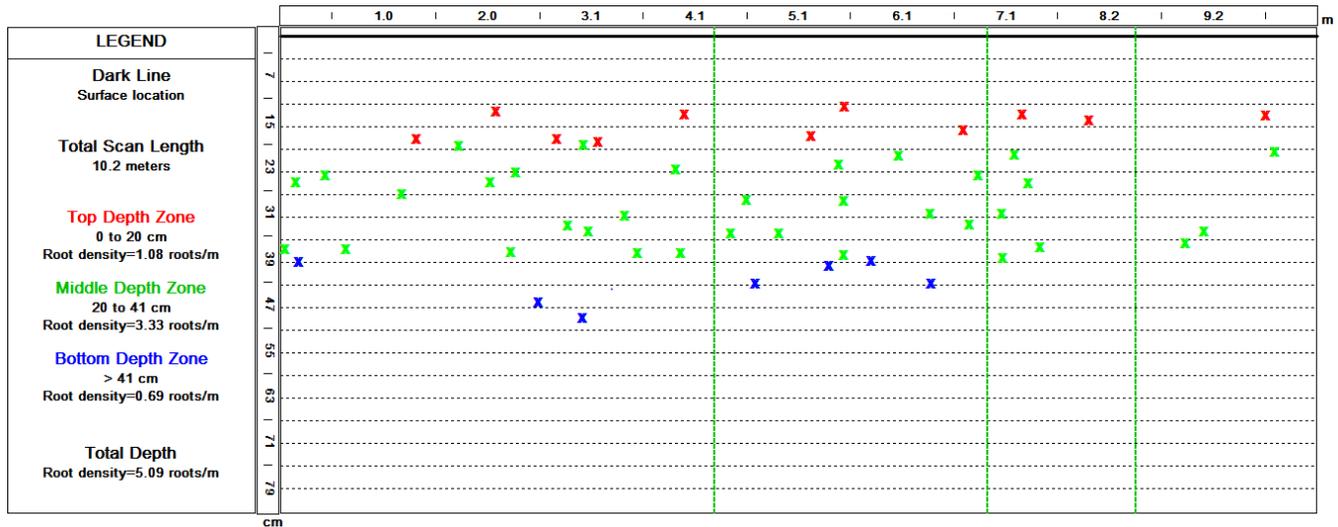


Figure 2: Block 3 Line 1

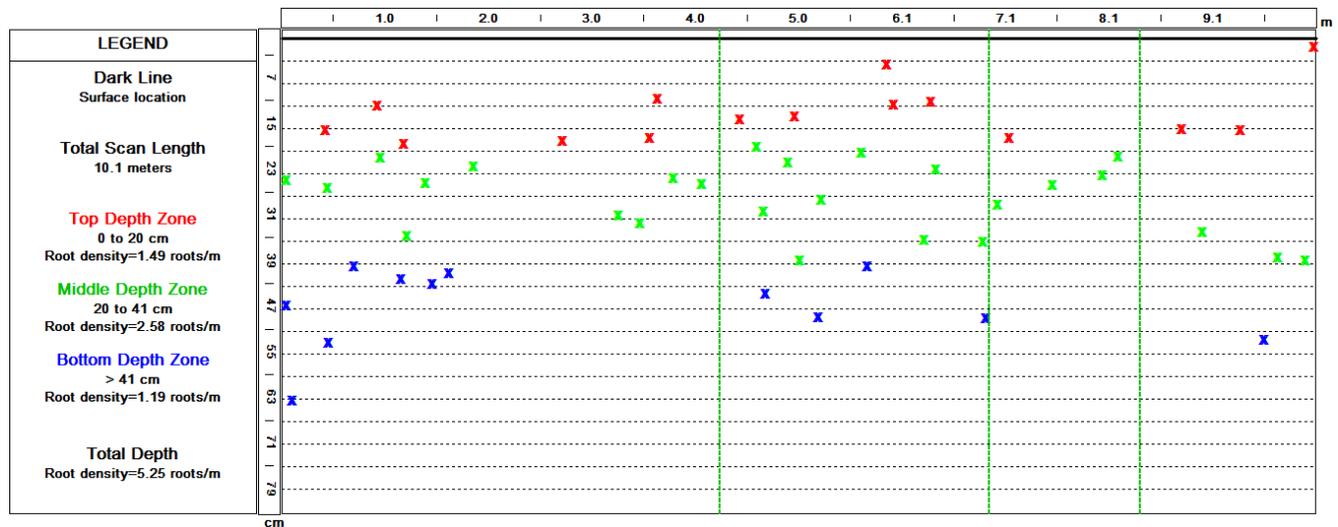


Figure 3: Block 3 Line 2



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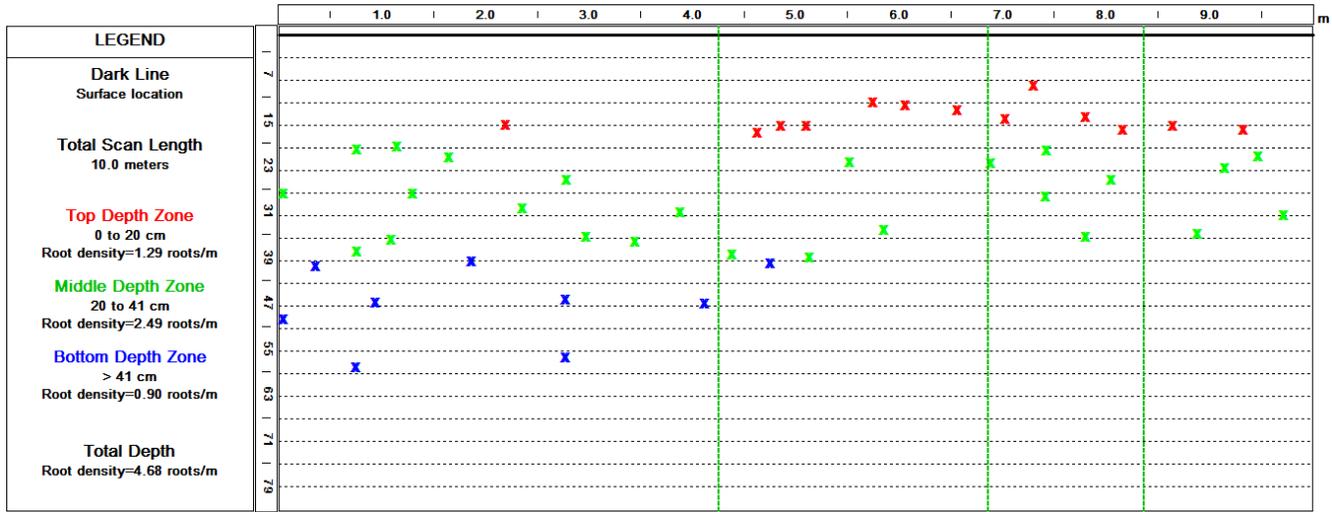


Figure 4: Block 3 Line 3

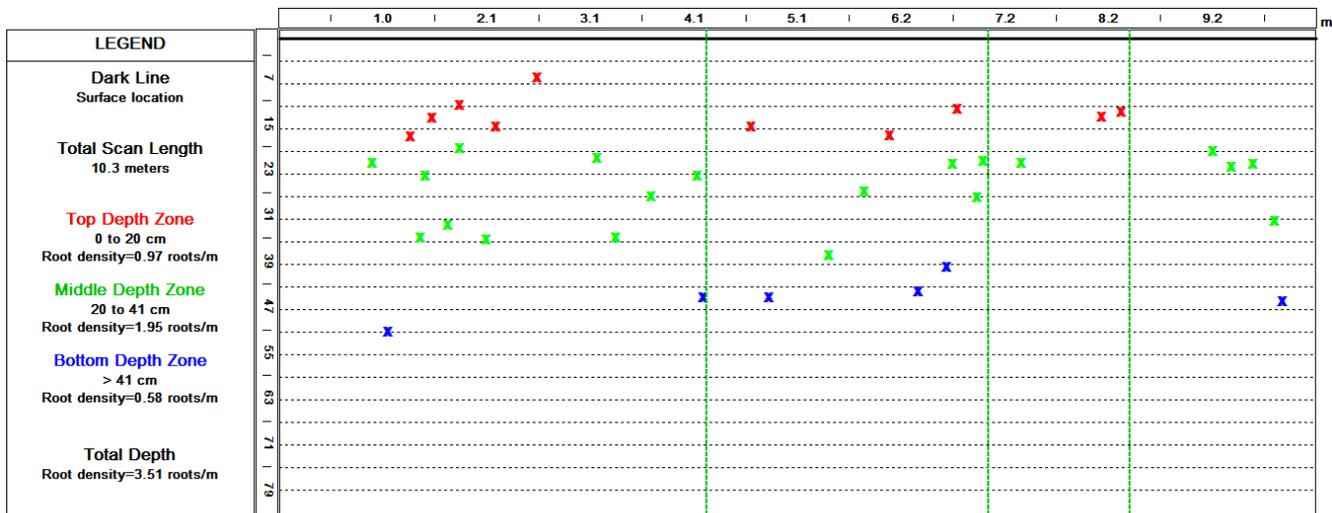


Figure 5: Block 3 Line 4



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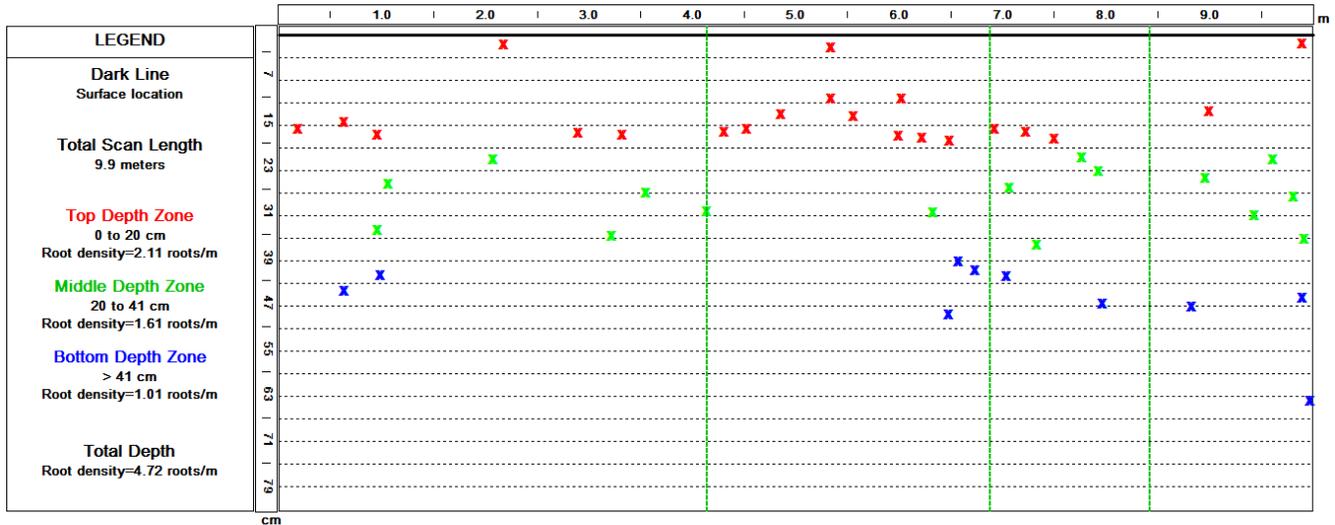


Figure 6: Block 3 Line 5

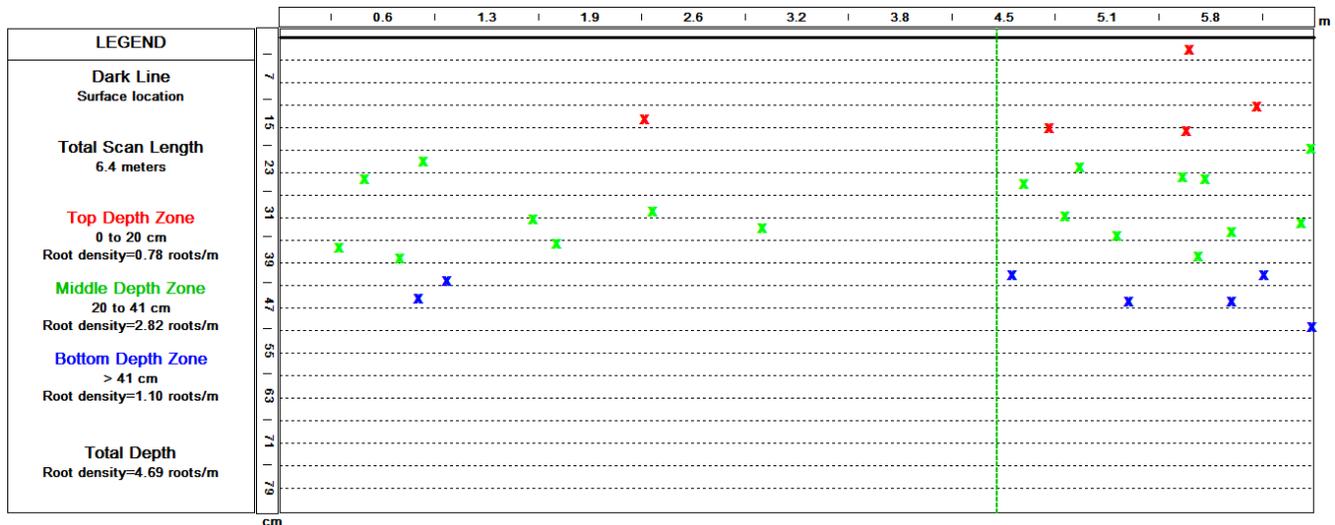


Figure 7: Block 3 Line 6

It is apparent that the critical root mass extends to a depth of approximately 47 cm.





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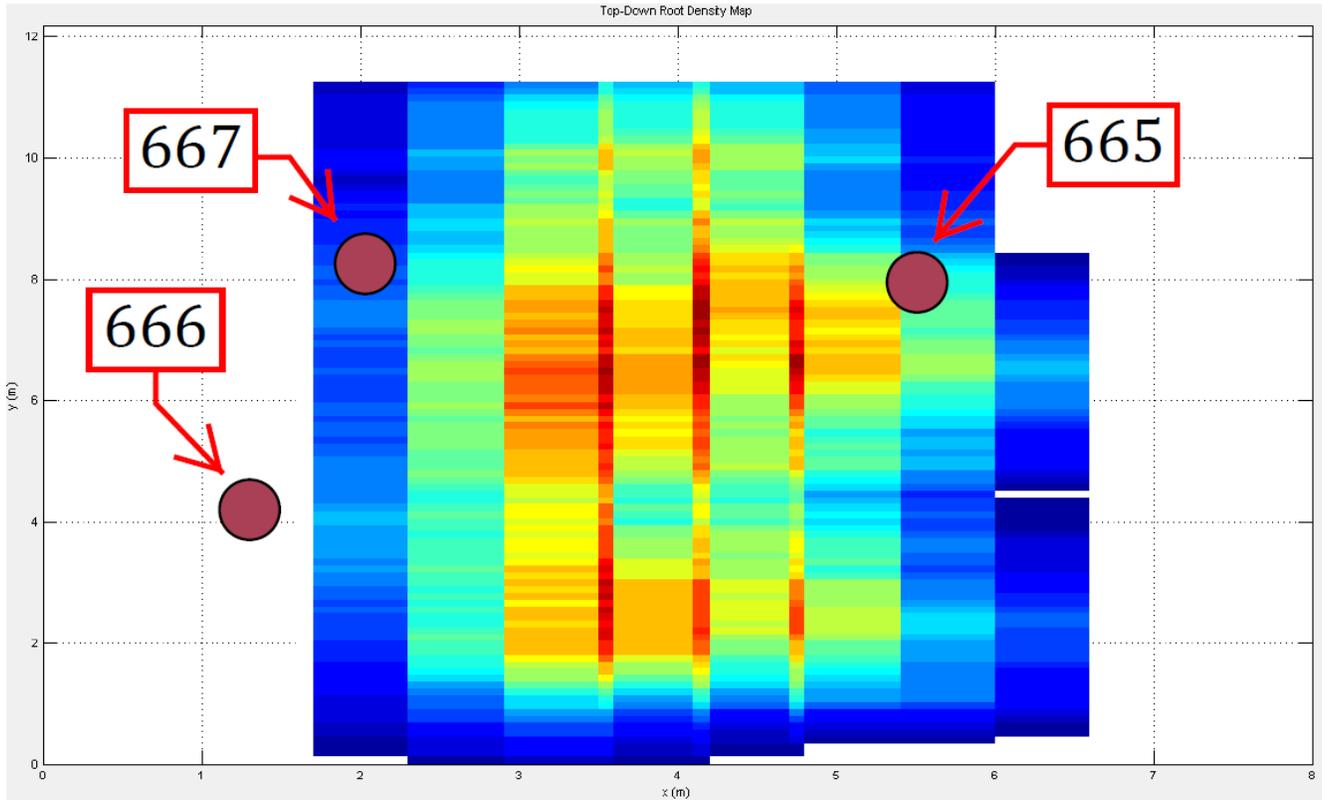


Figure 8: Block 3 Root density Heat Map

 The proposed location of the sanitary pile will conflict with the critical root zone of trees #665, 666 and 667.



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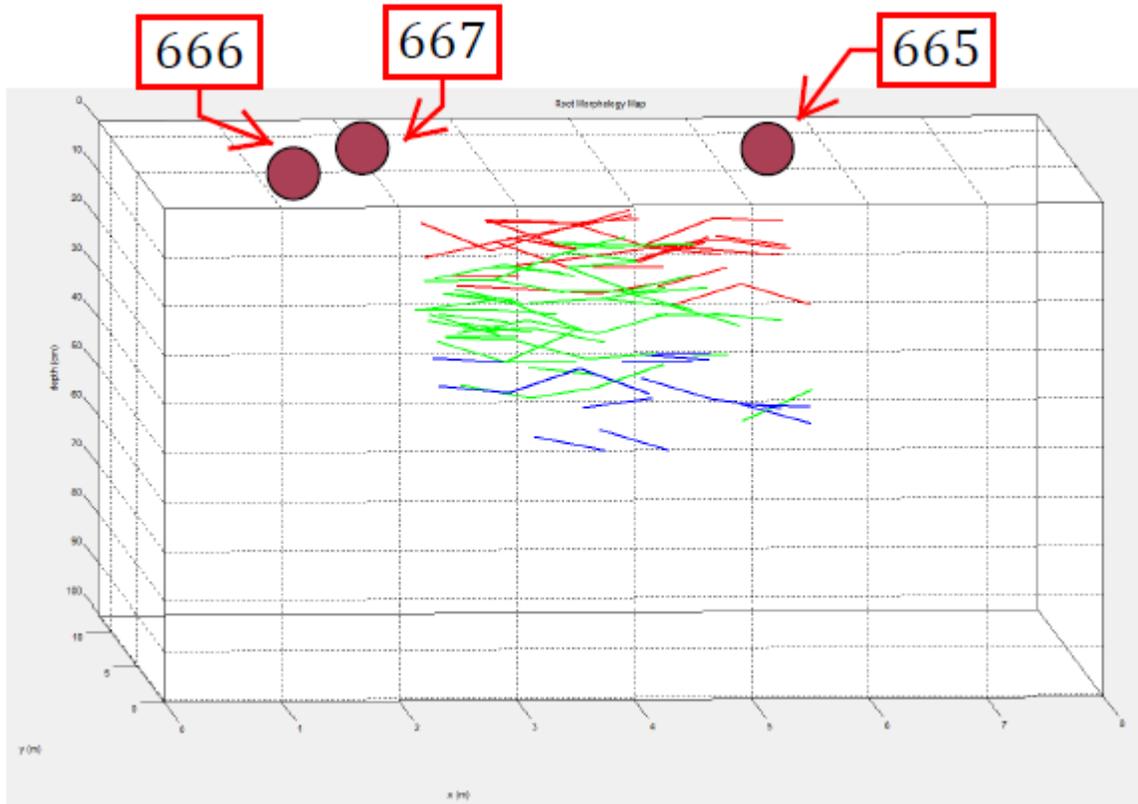


Figure 9: Block 3 Root Morphology.



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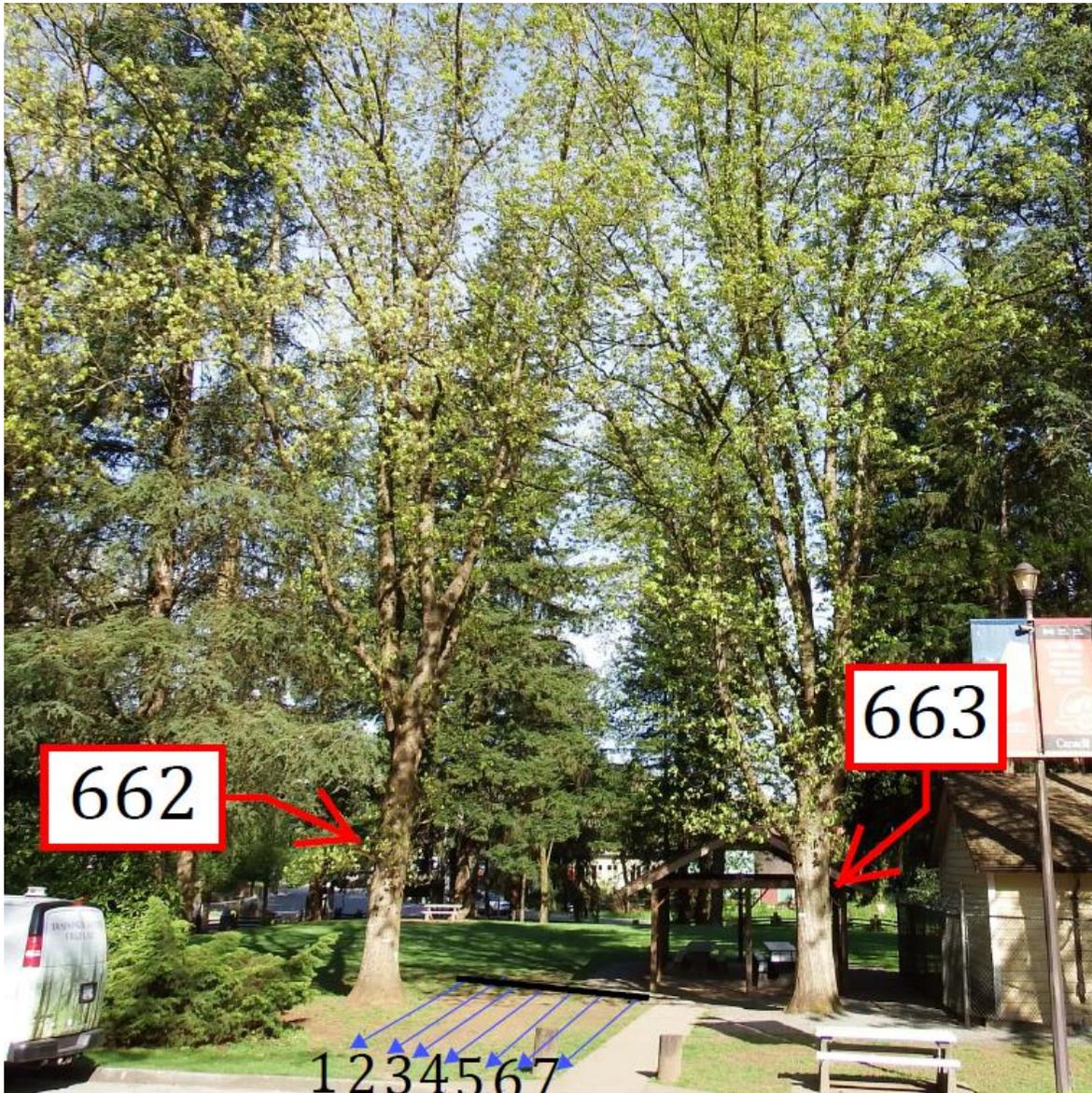
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4.2 Scan Block 4



Picture 2: Layout of scan block 4.



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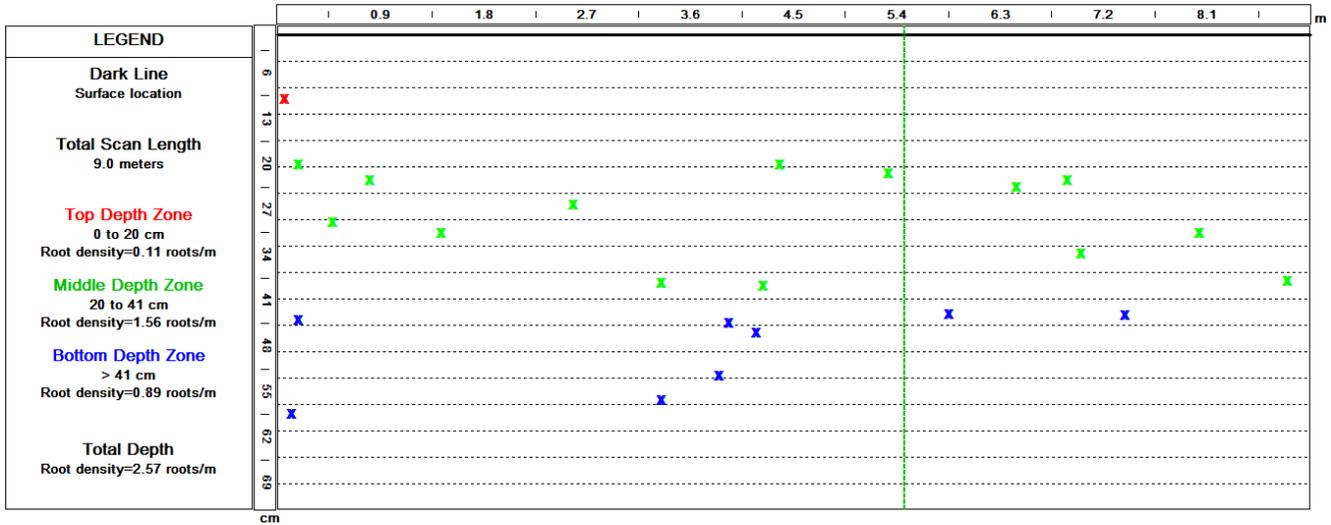


Figure 10: Block 4 Line 1

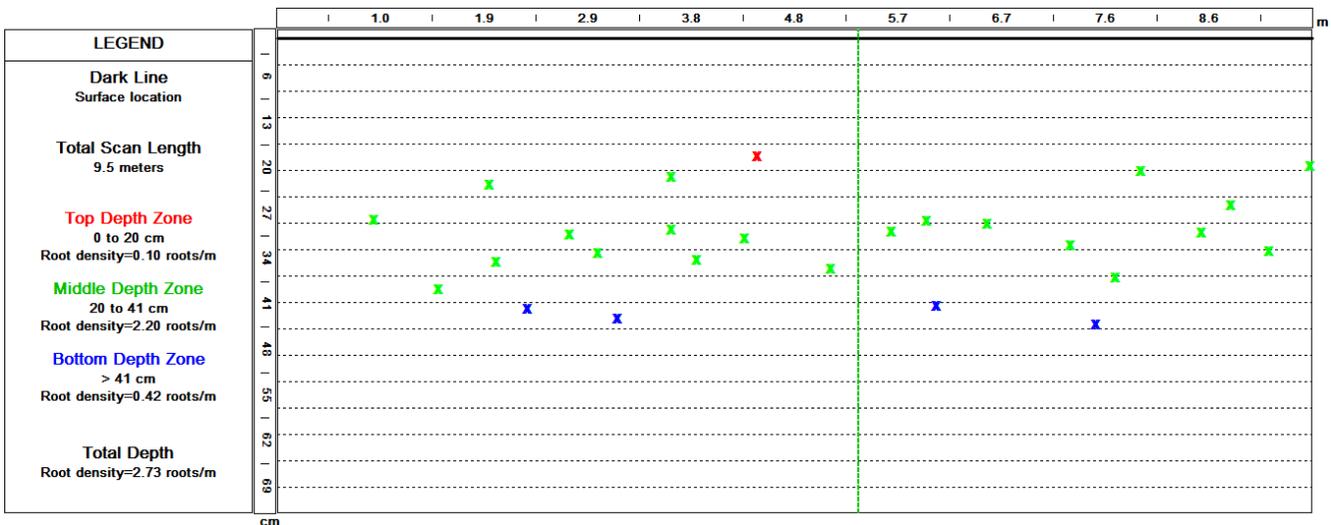


Figure 11: Block 4 Line 2



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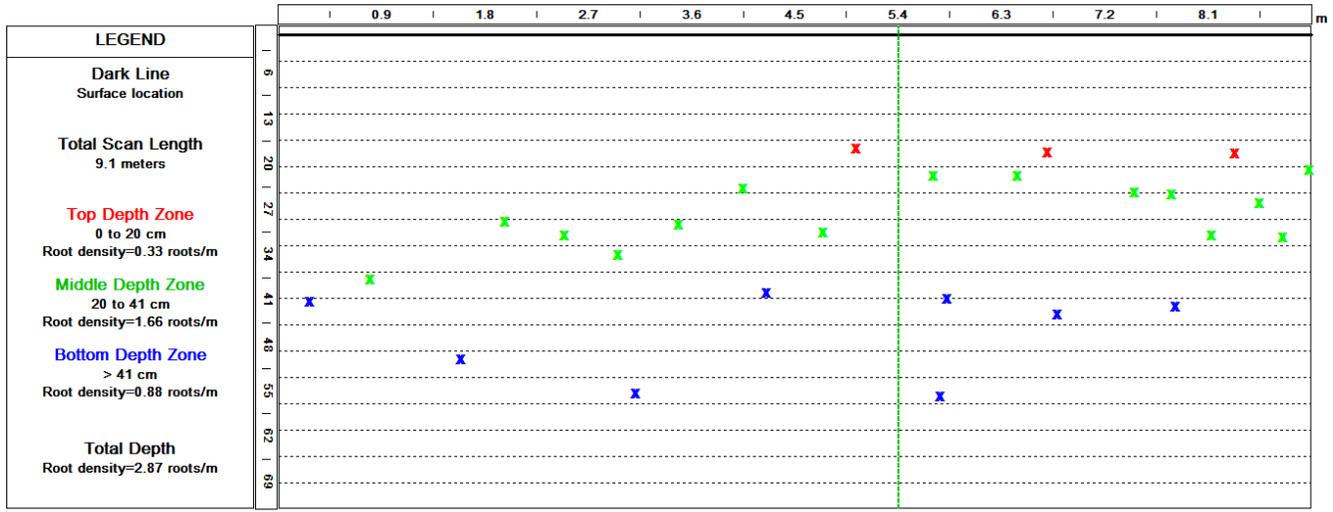


Figure 12: Block 4 Line 3

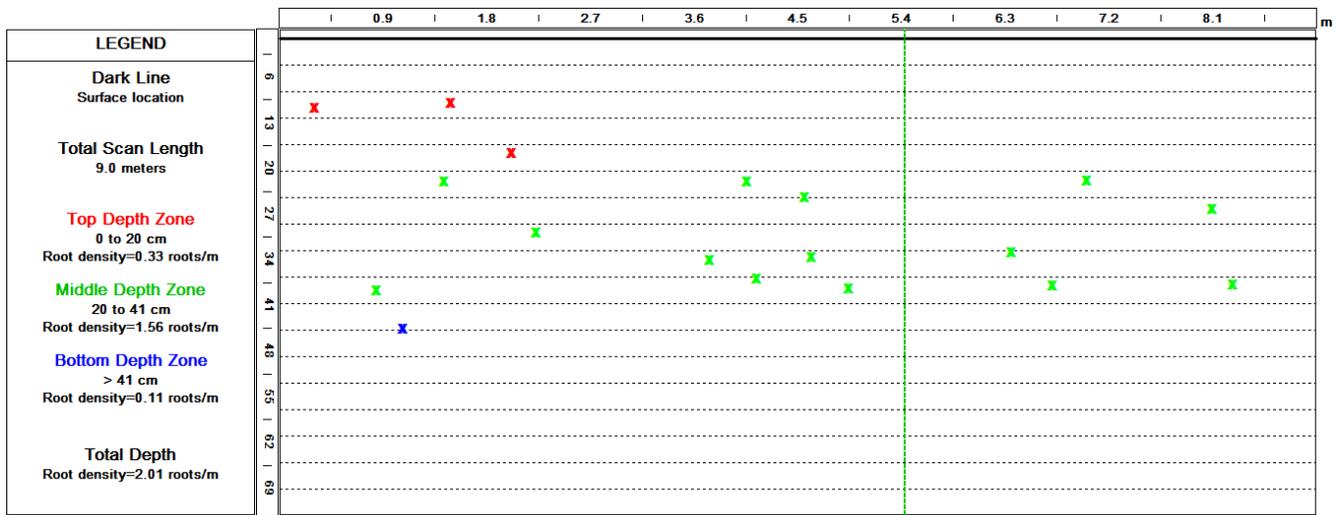


Figure 13: Block 4 Line 4



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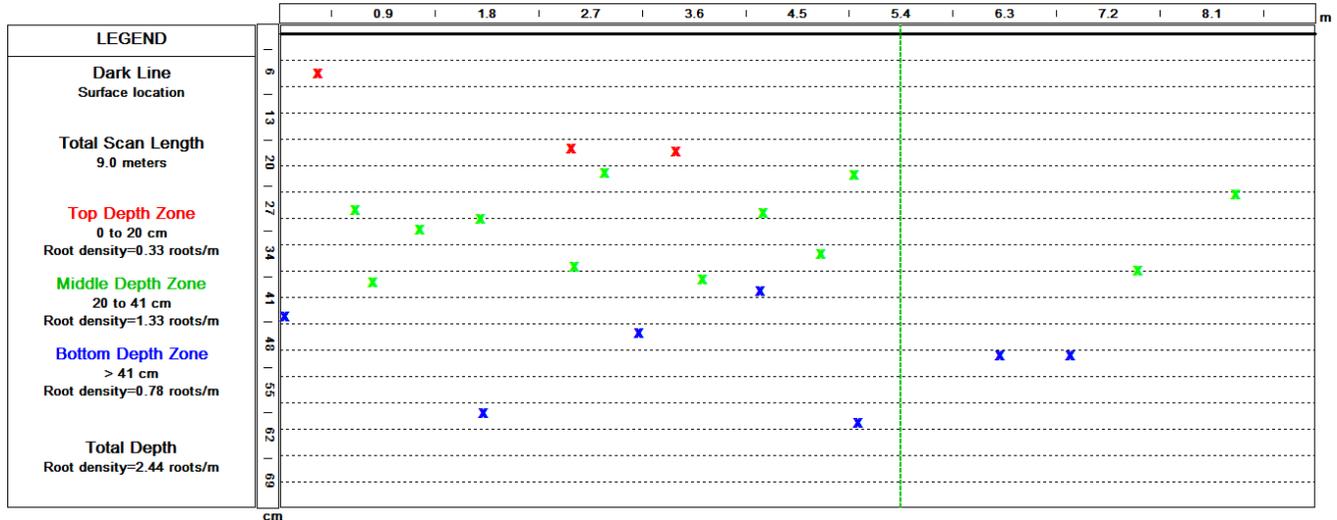


Figure 14: Block 4 Line 5

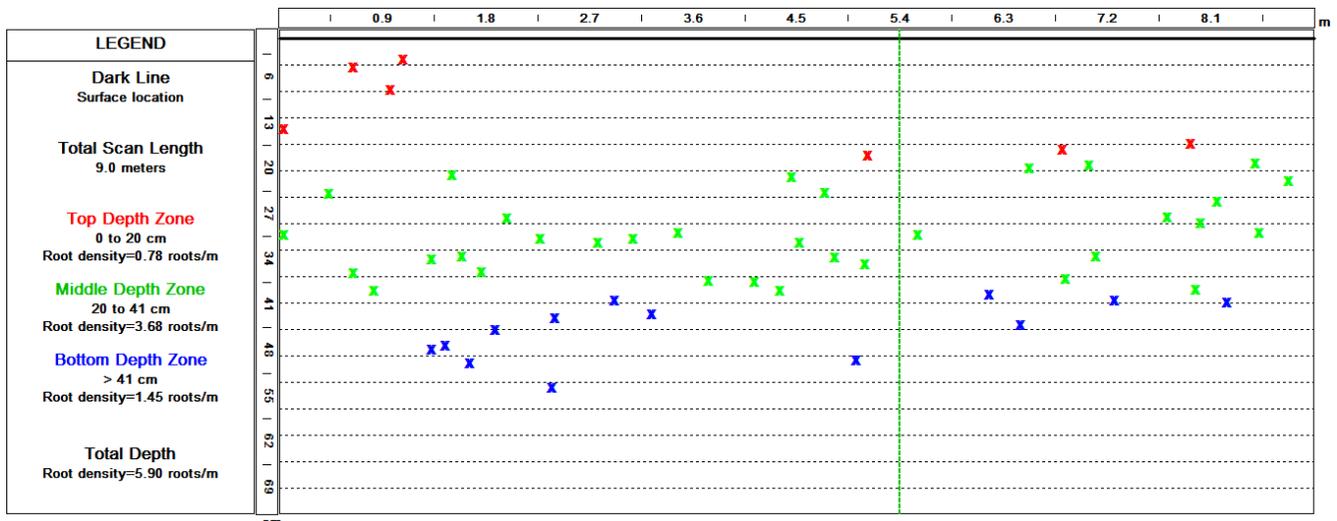


Figure 15: Block 4 Line 6





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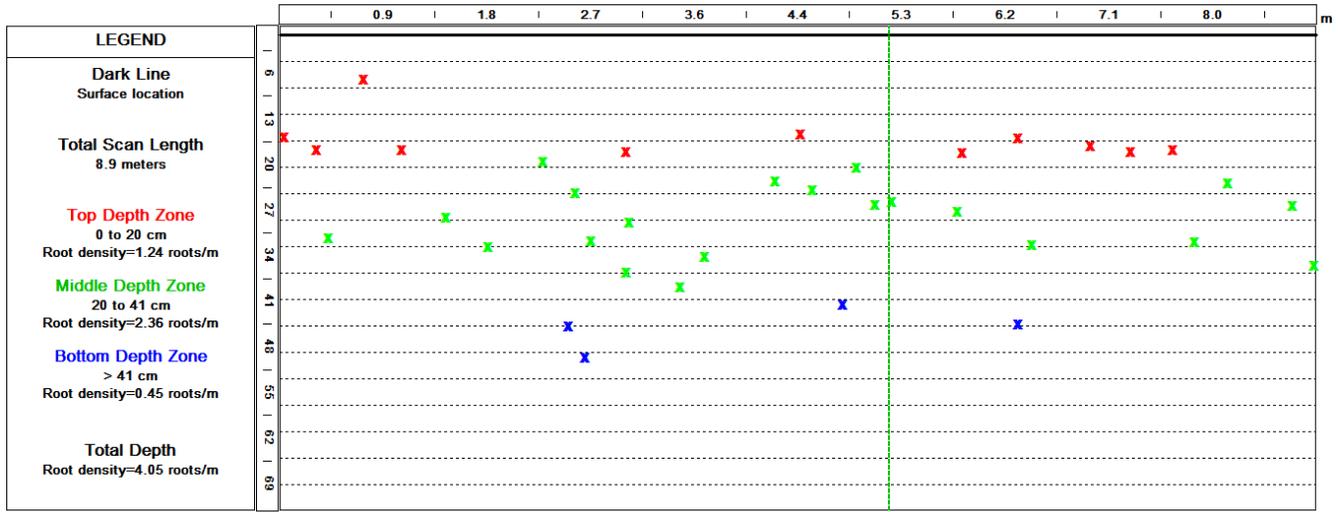


Figure 16: Block 4 Line 7



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It appears that the critical root mass goes to a depth of 50 cm.

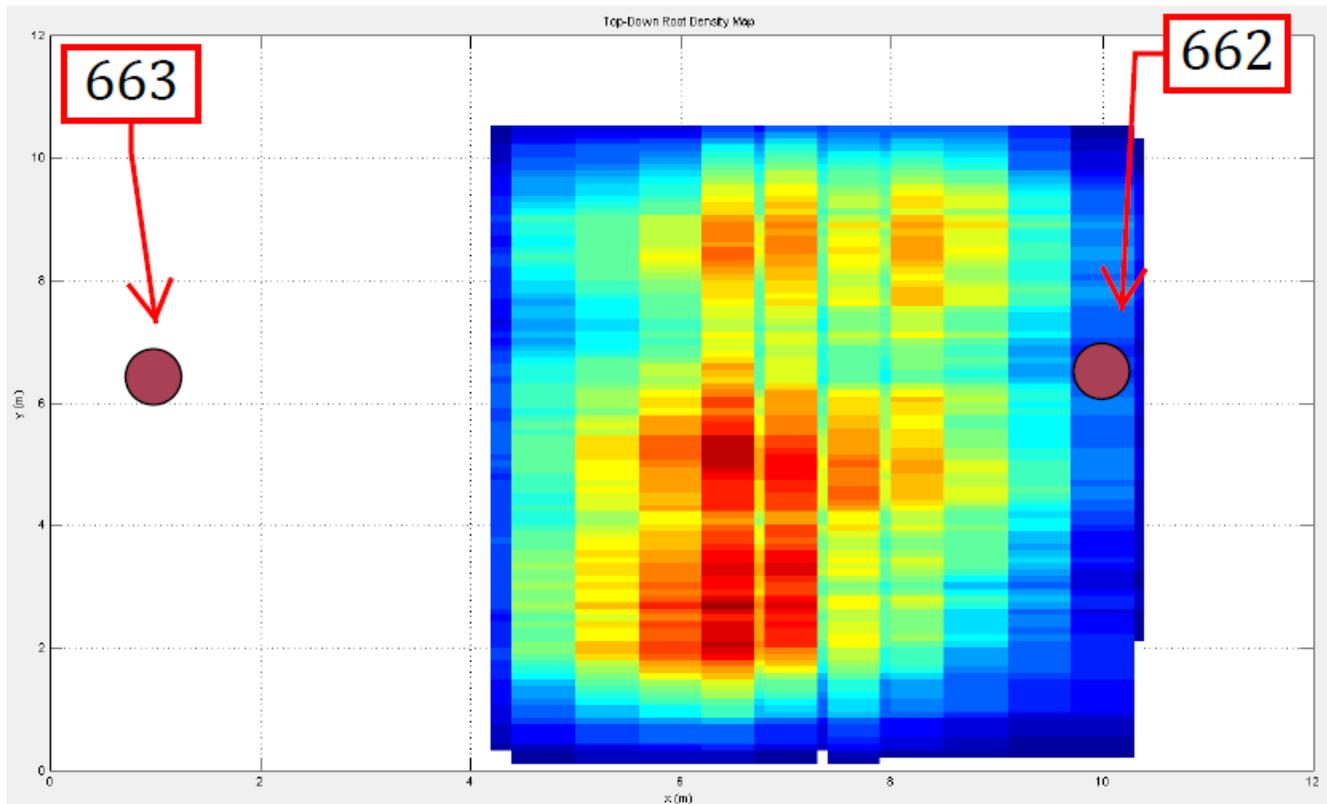


Figure 17: Block 4 root density heat map.

The proposed location of the sanitary pile will conflict with the critical root zone of trees #662 and 663.



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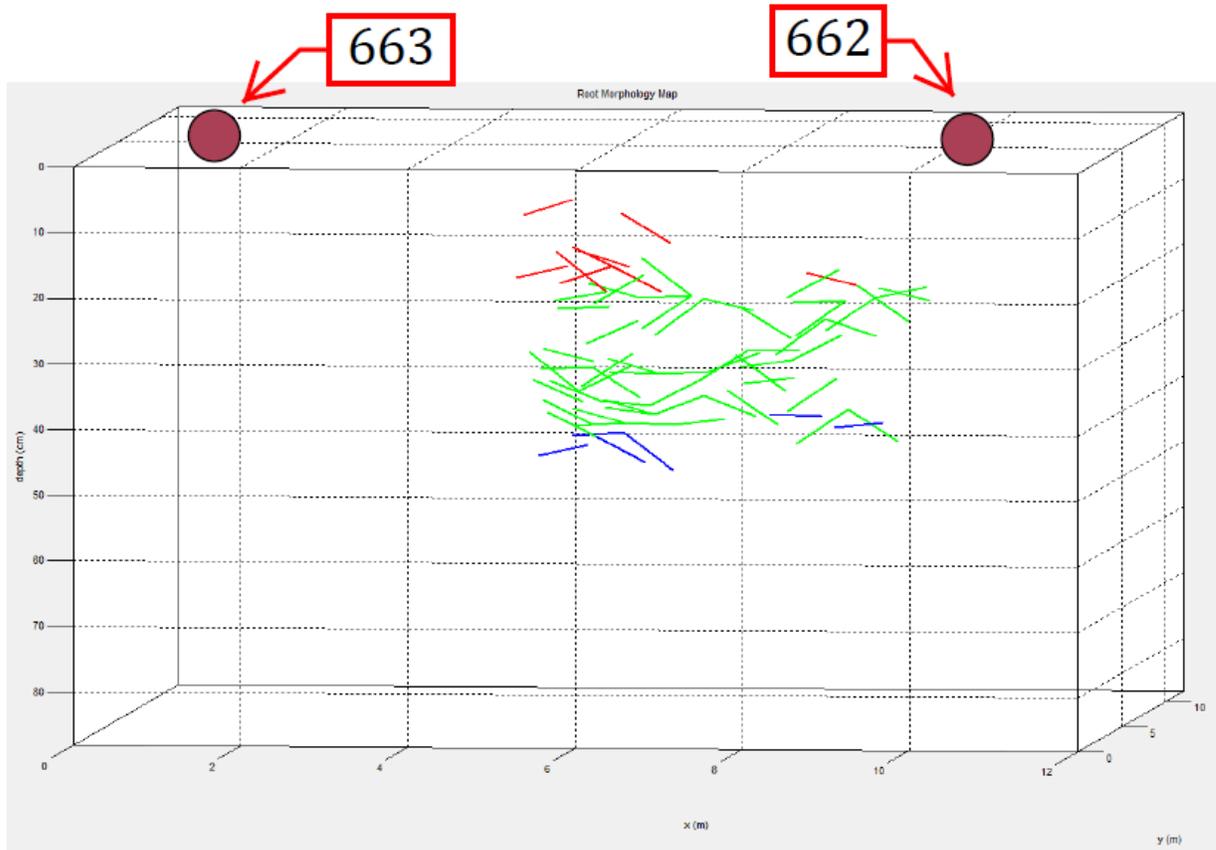


Figure 18: Block 4 root morphology.





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4.3 Scan Block 5

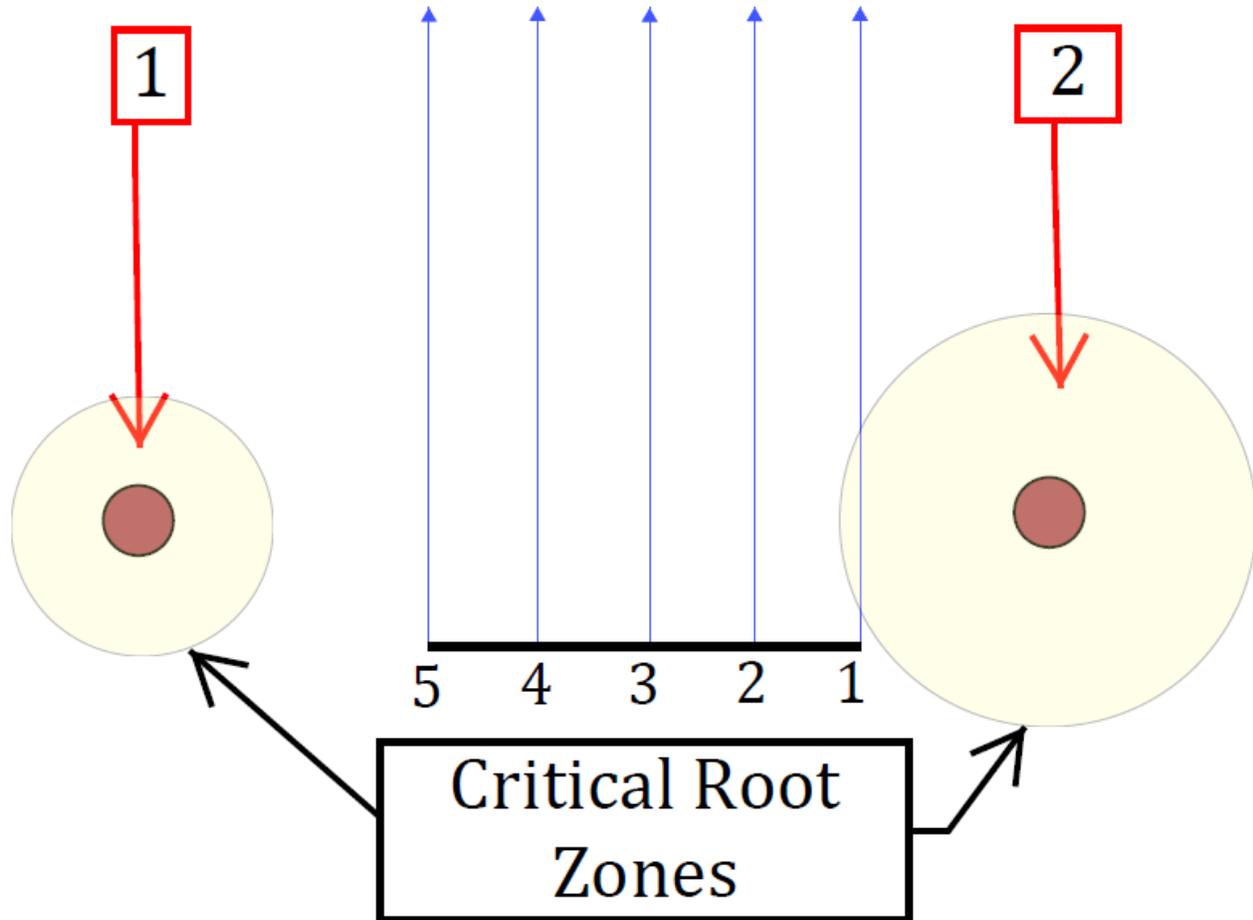


Figure 19: Layout of scan block 5.





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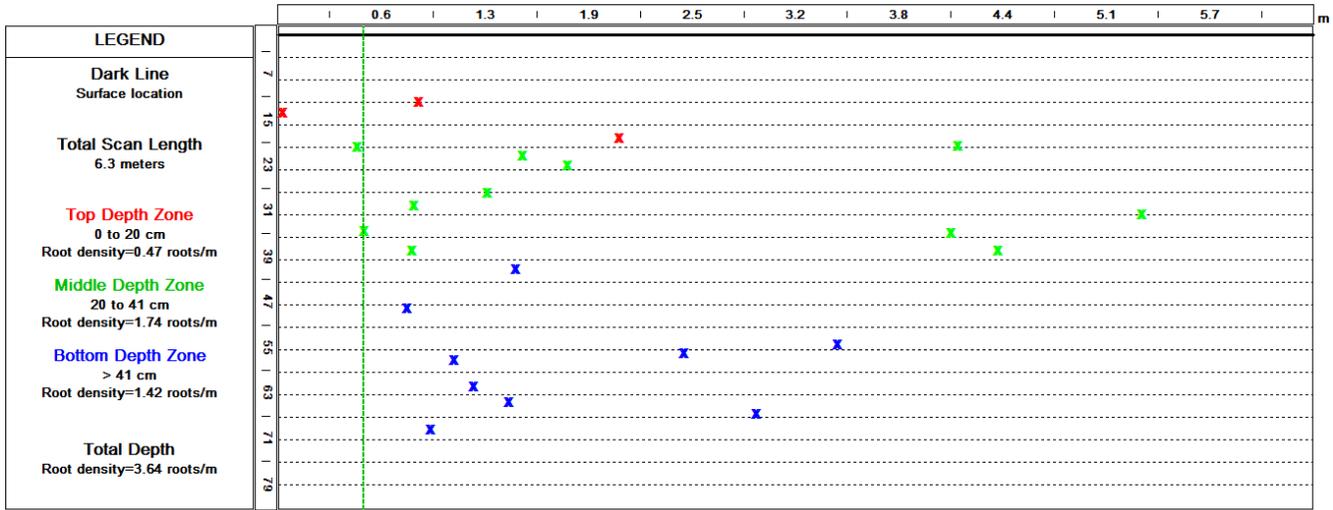


Figure 20: Block 5 Line 1

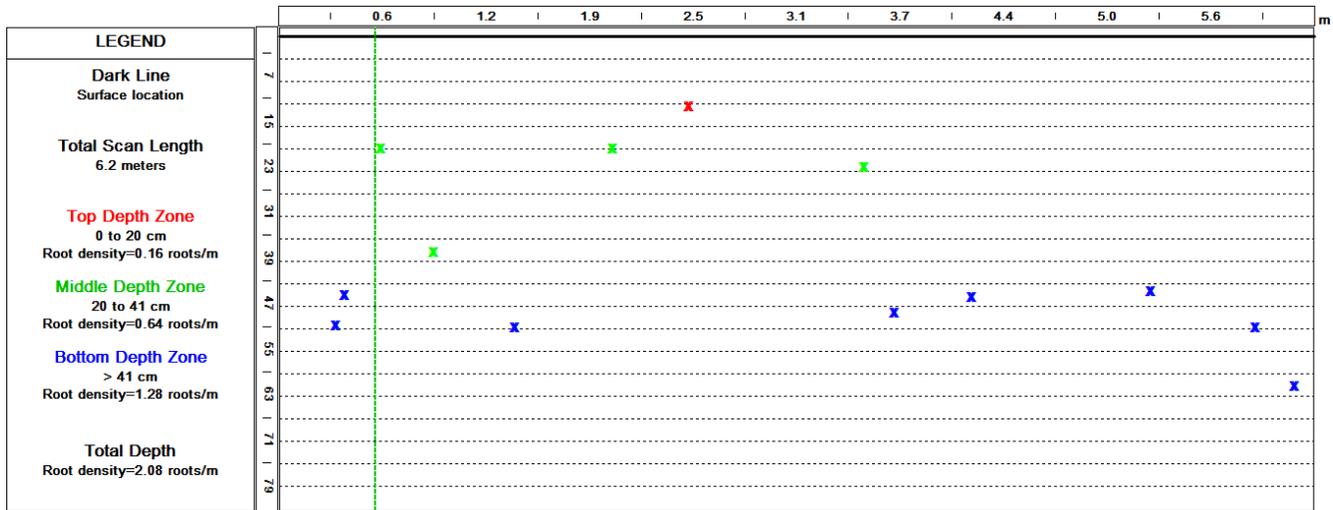


Figure 21: Block 5 Line 2



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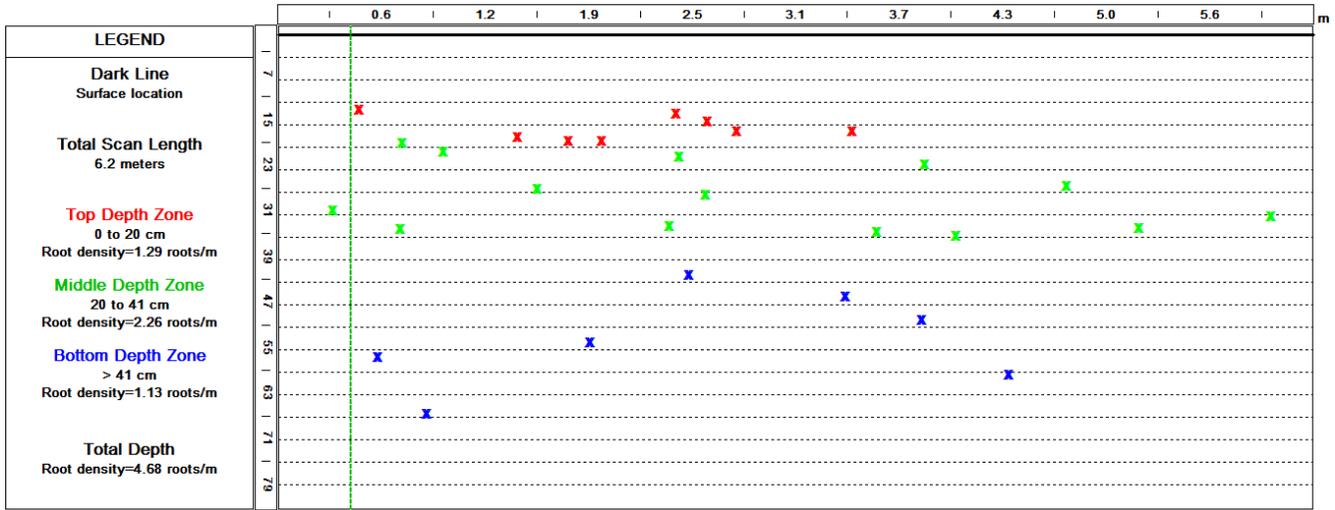


Figure 22: Block 5 Line 3

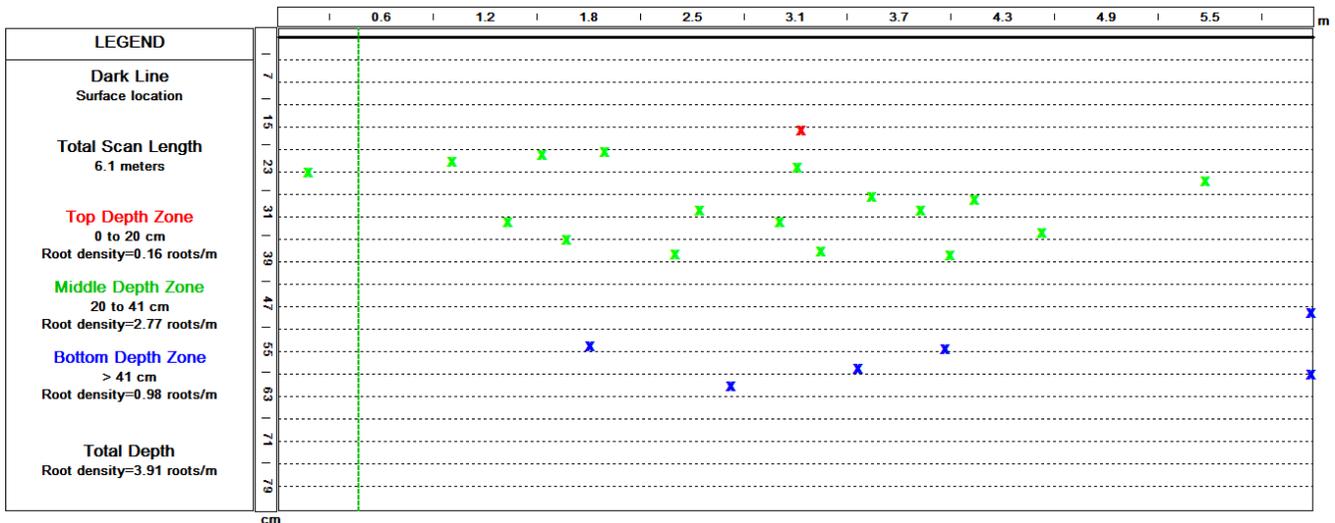


Figure 23: Block 5 Line 4



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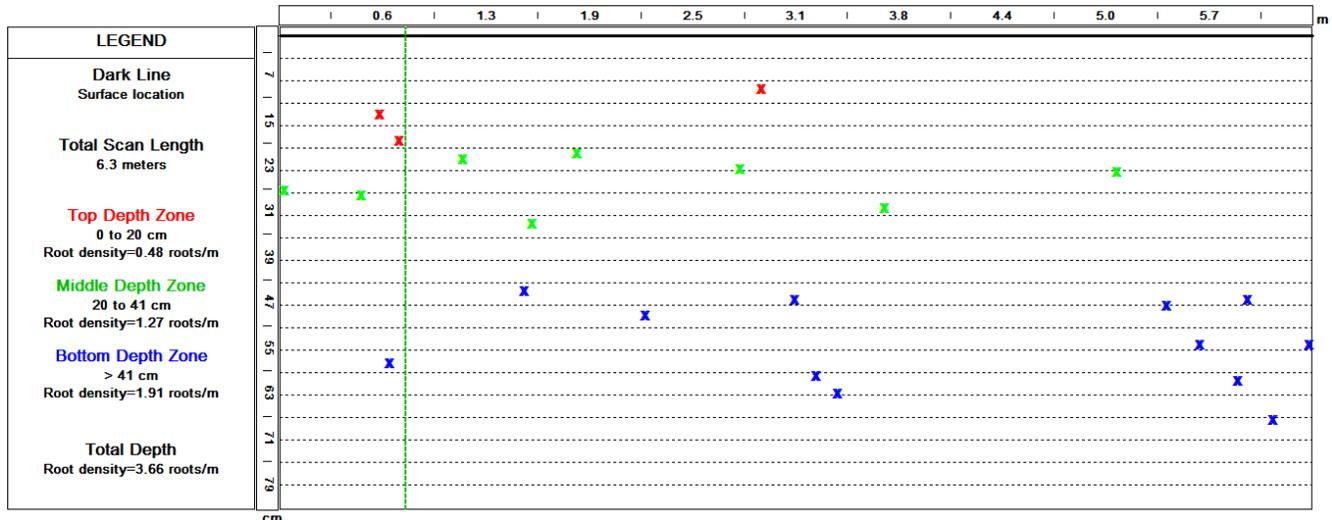


Figure 24: Block 5 Line 5

There is no conflict with the critical root mass of trees #1 and 2.

**6.0 CONCLUSION AND RECOMMENDATIONS**

The current proposed placement of the sanitary pipeline will likely conflict with critical roots of trees located in scan blocks 3 and 4 (#665, 665, 666, and 667) (#662 and 663). However, the impact may be minimized with the use of a hydro-vac and selective root pruning by an I.S.A. Certified arborist and Tree Risk Assessor. Since the maximum depth of the critical root mass for all trees in conflict rarely exceeds the ~40 cm – 50 cm range, it is possible to tunnel beneath these trees to accomplish the instillation of the sanitary upgrade.

Root pruning in accordance with I.S.A. Best Management Practices for Managing Trees During Construction (2012) should be adhered to while performing this work. Red oak, Douglas-fir, and western red cedar are all listed as tolerant to root loss in the book “Reducing Infrastructure Damage By Tree Roots”<sup>1</sup>

This report recommends reviewing and proceeding with the proposed installation with the use of a hydro-vac and tunneling beneath the critical root mass of impacted trees. If the excavation does not interfere with the maximum depth of the critical root mass, then impact should be minimal to moderate.

Backfill in contact with the critical root mass should be of quality organic soil and not compacted so as to retain the ideal 50% pore space necessary for root regeneration and recovery. Turf grass should be removed and organic mulch should be installed in a ring as large as practical around the impacted trees as well as these trees should receive ample watering during the dry season for an 18 month period post development to facilitate root regeneration.

<sup>1</sup> Costello, Laurence Raleigh., and Katherine S. Jones. Reducing Infrastructure Damage by Tree Roots: A Compendium of Strategies. Cohasset: Western Chapter of the International Society of Arboriculture (WCISA), 2003. Print.



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 A follow up impact assessment should be conducted 1 year after completion of this project to assess the recovery of the impacted trees.

**7.0 ATTACHMENTS**

 This report includes the following supporting documents:

-  Pictures 3-4
-  Detailed Spreadsheet
-  Arborist Site Plan
-  Tree Protection Plan
-  Overall Risk Rating
-  Limitations of Assessment

Should you have any questions or concerns, please do not hesitate to call me.

Yours truly,

**BC PLANT HEALTH CARE INC.**

**Andrew MacLellan**

**I.S.A. Certified Arborist # ON-1978A**

**I.S.A. Tree Risk Assessment Qualification**

**Forestry Technician FtDip**

/jm



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Pictures:



Picture 3: Critical Root Zone layout for scan block 4.



Picture 4: Scan block 3.



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Tree #	Species	Common Name	Site Description	Tree Notes	Diameter	Height (m)	CRZ (m)	Critical Root Diameter (m)	Critical Root Area	Trunk Lean	Condition	Live Crown Ratio	Age	Bylaw Class	Target	Location	Condition	Condition 1 Notes	Severity	Zone   Occ.   Move   Restrict	Failure Probability	Impact	Consequences	Risk Rating	Priority	Mitigation	Target 2	Condition 2	Location 2	Severity 2	Zone   Occ.   Move   Restrict	Failure Probability 2	Impact 2	Consequences 2	Risk Rating 2	Recommended Maintenance	
662	Quercus rubra	Red Oak	Parks Canada Heritage		68	29	4.08	6	52.27		Good	>50%	Mature (40+)	Heritage	Building	Roots	Girdling		Minor	Building   Within 1 X Ht   Occasional   No   Yes	Improbable	Low	Significant	Low												Retain and Monitor	
663	Quercus rubra	Red Oak	Parks Canada Heritage		72	30	4.32	9.36	58.6		Good	>50%	Mature (40+)	Heritage	Building	Soil	Compaction		Major	Building   Within Drip Line   Constant   No   Yes	Improbable	Medium	Significant	Low												Retain and Monitor	
664	Tsuga heterophylla	Hemlock	Parks Canada Heritage	Over septic bed	84	29	5.04	10.92	79.76	2e 2w	Good	40-50%	Semi-mature (20-40)	Heritage	Building	Trunk	Co-dominant stems (low)		Minor	Building   Within 1 X Ht   Constant   No   Yes	Possible	High	Significant	Moderate		Building	Decay (sapwood)	Trunk	Moderate	Building   Within 1 X Ht   Constant   No   Yes	Probable	Medium	Significant	Moderate	Retain and Monitor		
665	Pseudotsuga menziesii	Douglas-fir	Parks Canada Heritage	Over septic bed	52	30	3.12	6.76	30.57		Good	>50%	Mature (40+)	Heritage																						Retain and Monitor	
666	Pseudotsuga menziesii	Douglas-fir	Parks Canada Heritage	Over septic bed	59	31	3.54	7.67	39.35		Good	40-50%	Mature (40+)	Heritage																						Retain and Monitor	
667	Thuja plicata	Western red cedar	Parks Canada Heritage	Over septic bed	43	31	2.58	5.59	20.9		Good	40-50%	Mature (40+)	Heritage																						Retain and Monitor	
668	Sorbus decors	Showy mountain ash	Parks Canada Heritage	Over septic bed	24	20	1.44	3.12	6.511		Good	>50%	Semi-mature (20-40)	Heritage																						Retain and Monitor	
669	Pseudotsuga menziesii	Douglas-fir	Parks Canada Heritage	Over septic bed	54	30	3.24	7.02	32.96		Good	>50%	Mature (40+)	Heritage	Building	Trunk	Insects / borers		Moderate	Building   Within 1 X Ht   Constant   No   Yes	Possible	Medium	Significant	Low													Retain and Monitor
670	Pseudotsuga menziesii	Douglas-fir	Parks Canada Heritage		121	35	7.26	15.73	165.5		Fair	>50%	Mature (40+)	Heritage	Road	Trunk	Insects / borers		Moderate	Road   Within 1 X Ht   Occasional   No   No	Possible	Medium	Minor	Low												Retain and Monitor	
671	Pseudotsuga menziesii	Douglas-fir	Parks Canada Heritage		81	30	4.86	10.53	74.17		Good	>50%	Mature (40+)	Heritage		Soil	Compaction		Moderate	Road   Within 1 X Ht   Occasional   No   No	Improbable	Medium	Minor	Low												Retain and Monitor	
672	Populus trichocarpa	Cottonwood	Parks Canada Heritage		76	32	4.56	9.88	65.29		Good	20-30%	Semi-mature (20-40)	Heritage	Road	Soil	Compaction		Moderate	Road   Within 1 X Ht   Occasional   No   No	Improbable	Medium	Minor	Low												Retain and Monitor	
673	Pseudotsuga menziesii	Douglas-fir	Parks Canada Heritage		72	30	4.32	9.36	58.6		Good	>50%	Mature (40+)	Heritage		Soil	Compaction		Moderate	Road   Within 1 X Ht   Occasional   No   No	Improbable	Medium	Minor	Low												Retain and Monitor	
1	apple	0	0	0	22	5	1.32	2.86	5.471		Good	40-50%	Semi-mature (20-40)	Heritage																					Retain and Monitor		
2	apple	0	0	0	34	12	2.04	4.42	13.07		Fair	>50%	Semi-mature (20-40)	Heritage																					Retain and Monitor		

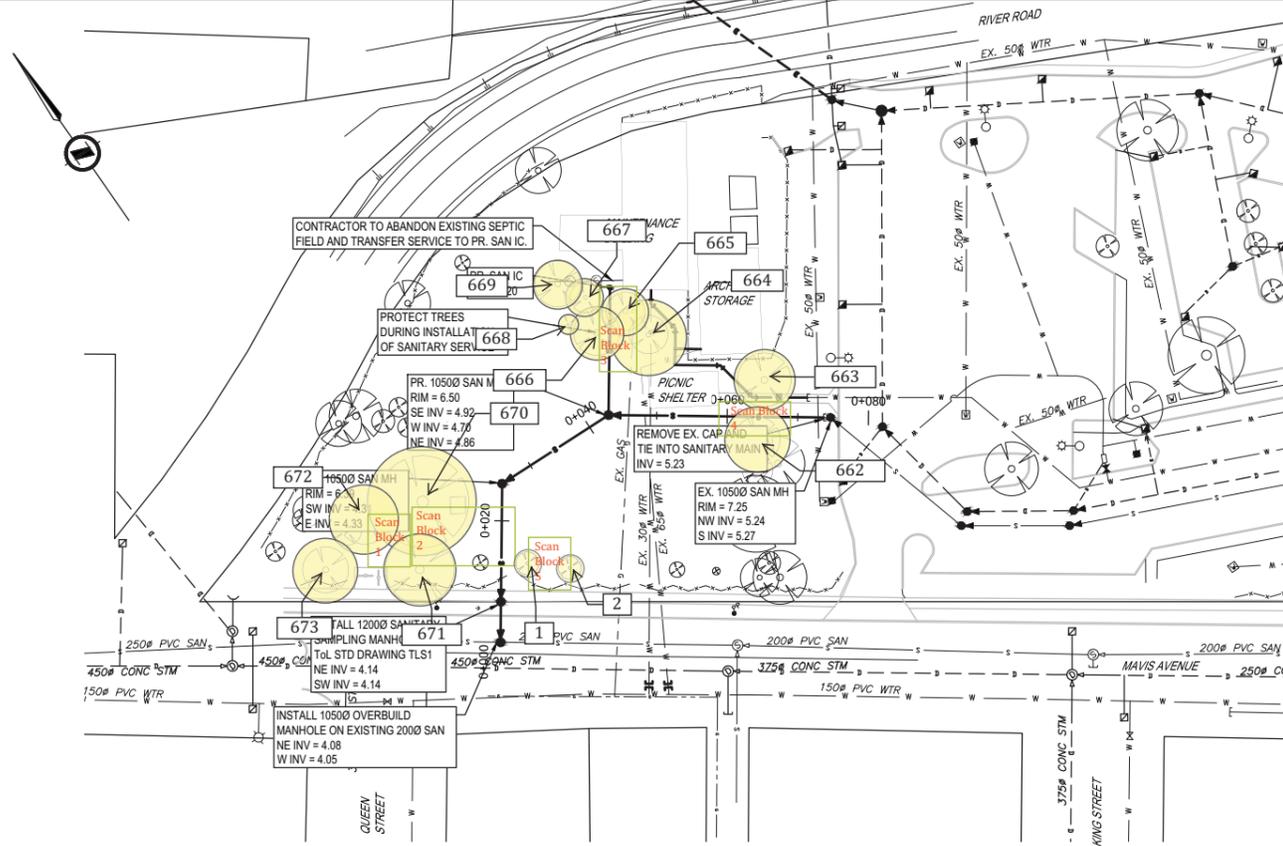
**Limitations of this Assessment**

- It is BC Plant Health Care Inc.'s policy to attach the following clause regarding limitations. We do this to ensure that developers or owners are clearly aware of what is technically and professionally realistic in retaining trees.
- The assessment of the trees presented in this report has been made using accepted arboricultural techniques.
- These include a visual examination of the above-ground parts of each tree for structural defects, scars, external indications of decay such as fungal fruiting bodies, evidence of insect attack, discolored foliage, the condition of any visible root structures, the degree and direction of lean (if any), the general condition of the tree(s) and the surrounding site, and the proximity of property and people.
- Except where specifically noted in the report, none of the trees examined were dissected, cored, probed, or climbed, and detailed root crown examinations involving excavation were not undertaken.
- Notwithstanding the recommendations and conclusions made in this report, it must be raised that trees are living organisms, and their health and vigour constantly change over time. They are not immune to changes in site conditions, or seasonal variations in the weather conditions.
- While reasonable efforts have been made to ensure that the trees recommended for retention are healthy, no guarantees are offered, or implied, that these trees, or any parts of them, will remain standing.
- It is both professionally and practically impossible to predict with absolute certainty the behavior of any single tree or group of trees or their component parts in all circumstances. Inevitably, a standing tree will always pose some risk. Most trees have the potential for failure in the event of adverse weather conditions, and this risk can only be eliminated if the tree is removed.
- Although every effort has been made to ensure that this assessment is reasonably accurate, the trees should be re-assessed periodically. The assessment presented in this report is valid at the time of inspection.

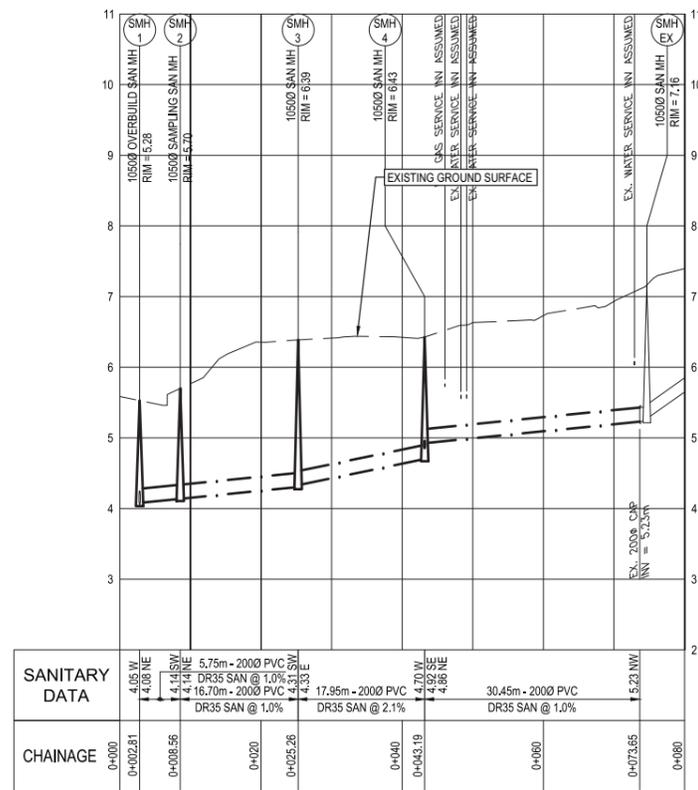
Qualitative Risk Assessment (TRAQ):-			
Likelihood of failure:	Improbable	Possible	Probable
Likelihood of impact:	Very Low	Low	Medium
Consequences:	Negligible	Minor	Significant
Overall tree risk:	Low	Moderate	High
			Extreme

Yours truly,  
**BC PLANT HEALTH CARE INC.**  
  
**Andrew MacLellan**  
 I.S.A. Certified Arborist - #ON-1978A  
 I.S.A. Tree Risk Assessment Qualification  
 Forestry Technician  
 /jm

Arborist's Site Plan



NOTE:  
1. CONTRACTOR TO PRE-LOCATE ALL EXISTING UTILITIES AND ADVISE ENGINEERING OF ANY CONFLICTS A MINIMUM OF 72 HOURS PRIOR TO CONSTRUCTION.



Prepared by:  
BC Plant Health Care Inc.  
Andrew C. MacLellan  
I.S.A. Certified Arborist #ON-1978A  
I.S.A. Tree Risk Assessment Qualification  
Forestry Technician (FtDipl.)



5		
4		
3		
2		
1		
0	ISSUED FOR 33% REVIEW	29/10/10

Client/Client  
**PUBLIC WORKS AND GOVERNMENT SERVICES CANADA**  
219 - 800 BARRARD STREET  
VANCOUVER, BC, V6Z 0B9

Project title/Titre du projet  
**FORT LANGLEY NHS EXISTING UTILITY REHABILITATION**

Consultant Signature Only  
S. VERKAIK  
Designed by/Concept par  
S. CLARK  
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PWGSC Project Manager/Administrateur de Projets TPSGC  
TOM DUNPHY  
Regional Manager, Architectural and Engineering Services  
Gestionnaire régionale, Services d'architecture et de génie, TPSGC  
TOM DUNPHY

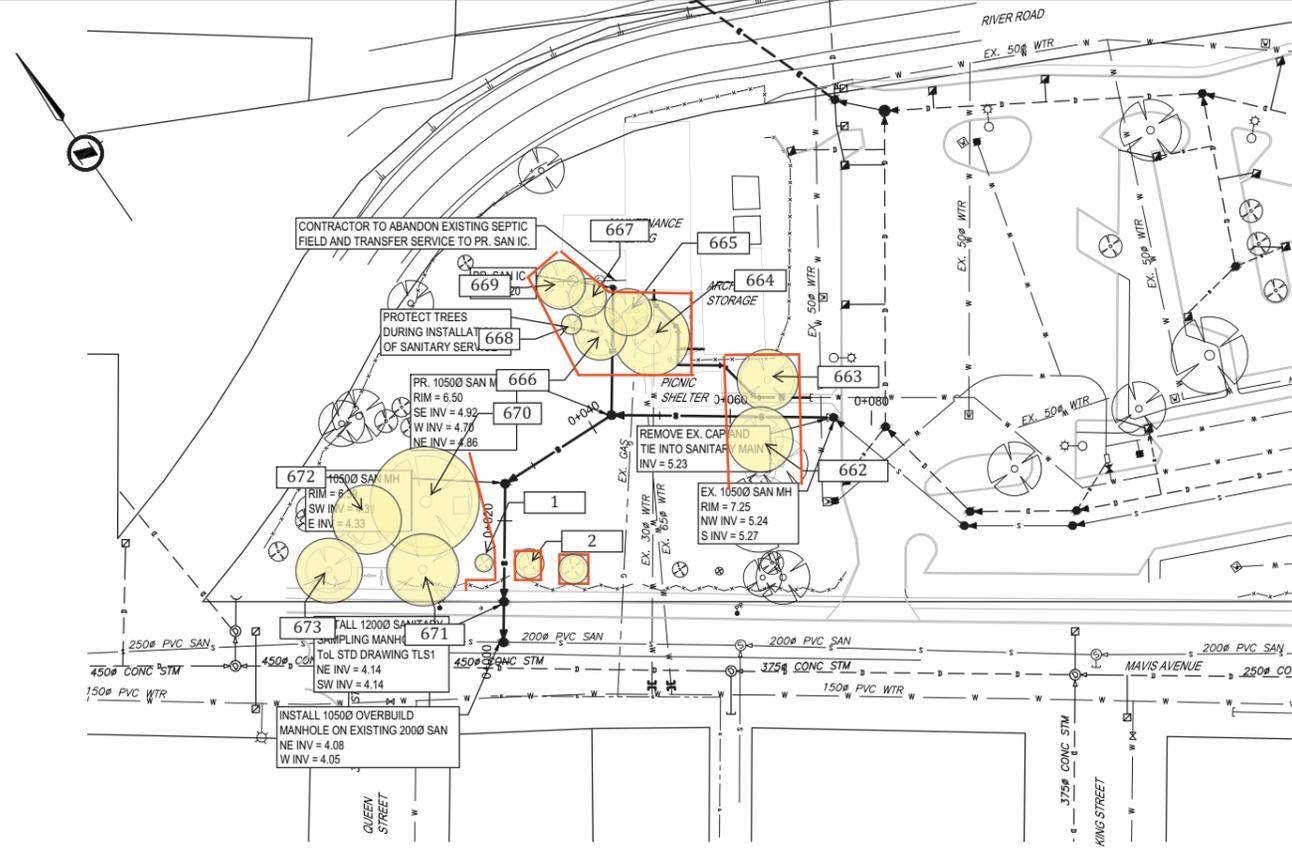
Drawing title/Titre du dessin  
**FORT LANGLEY WEST SIDE PROPOSED SANITARY**

Project No./No. du projet <b>R.081111.01</b>	Sheet/Fauille <b>2</b> OF 7	Revision no./ La Révision no. <b>1</b>
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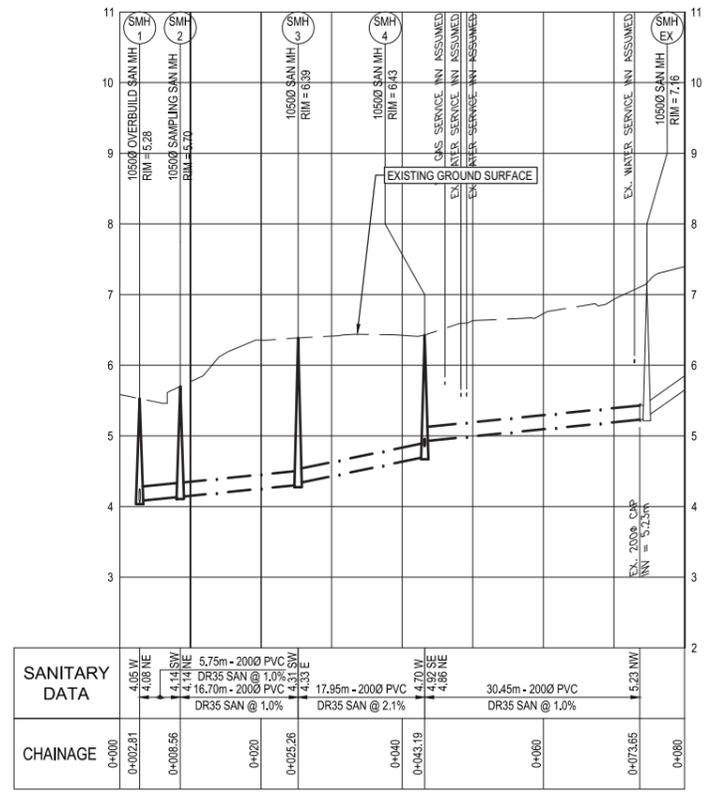
2017/May/15, 9:47am s:\clark p:\s\m-west h:\projects\31983\_Ft\_Langley\_NHS\02\_0400\_02\_Drafting\301\_Sheet\Fort\_Langley\31983-FortLangley-1m2.dwg



Tree Protection Plan



NOTE:  
1. CONTRACTOR TO PRE-LOCATE ALL EXISTING UTILITIES AND ADVISE ENGINEERING OF ANY CONFLICTS A MINIMUM OF 72 HOURS PRIOR TO CONSTRUCTION.



● Critical Root Zone  
□ Tree Protection Barrier



Revision/Revision	Description/Description	Date/Date
0	ISSUED FOR 33% REVIEW	2017/04/10

Client/Client  
**PUBLIC WORKS AND GOVERNMENT SERVICES CANADA**  
219 - 800 BARRARD STREET  
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Project title/Titre du projet  
**FORT LANGLEY NHS EXISTING UTILITY REHABILITATION**

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Project No./No. du projet	Sheet/Fauille	Revision no./Le Révision no.
R.081111.01	2 OF 7	1

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**ISL Engineering and Land Services Ltd.**

Mr. Steve Verkaik  
Fort Langley National Historic Site, 23433 Mavis Avenue, Surrey  
May 30, 2017  
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**QUALITATIVE TREE RISK ASSESSMENT GUIDELINES (TRAQ)**

*Qualitative risk assessment* is the process of using ratings of the likelihood and consequences of an event to determine a risk level and evaluate the level of risk against qualitative criteria.

This matrix is used to *estimate the likelihood of a tree failure impacting a specified target*

<b><u>Likelihood of failure</u></b>	<b><u>Likelihood of Impacting a Target</u></b>			
	<b><i>Very Low</i></b>	<b><i>Low</i></b>	<b><i>Medium</i></b>	<b><i>High</i></b>
<b><i>Imminent</i></b>	<i>Unlikely</i>	<i>Somewhat likely</i>	<i>Likely</i>	<i>Very likely</i>
<b><i>Probable</i></b>	<i>Unlikely</i>	<i>Unlikely</i>	<i>Somewhat likely</i>	<i>Likely</i>
<b><i>Possible</i></b>	<i>Unlikely</i>	<i>Unlikely</i>	<i>Unlikely</i>	<i>Somewhat likely</i>
<b><i>Improbable</i></b>	<i>Unlikely</i>	<i>Unlikely</i>	<i>Unlikely</i>	<i>Unlikely</i>

**Likelihood of failure**

***Improbable*** – the tree or branch is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified time period.

***Possible*** – failure could occur, but it is unlikely during normal weather conditions within the specified time period.

***Probable*** – failure may be expected under normal weather conditions within the specified time period.

***Imminent*** – failure has started or is most likely to occur in the near future, even if there is no significant wind of increased load. This is a rare occurrence for a risk assessor to encounter, and may require immediate action to protect people from harm.

**Likelihood of impacting a target**

***Very low*** – the chance of the failed tree or branch impacting the specified target is remote. This is the case in a rarely used site that is fully exposed to the assessed tree, or an occasionally used site that is partially protected by trees or structures.

***Low*** – it is not likely that the failed tree or branch will impact the target. This is the case in an occasionally used area that is fully exposed to the assessed tree, a frequently used area that is partially exposed to the assessed tree, or a constant target that is well protected from the assessed tree.

***Medium*** – the failed tree or branch may or may not impact the target, with nearly equal likelihood. This is the case in a frequently used area that is fully exposed on one side to the assessed tree, or a constantly occupied area that is partially protected from the assessed tree.

***High*** – the failed tree or branch will most likely impact the target. This is the case when a fixed target is fully exposed to the assessed tree.





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Risk rating matrix showing the **level of risk as the combination of likelihood of a tree failing and impacting a specified target, and severity of the associated consequences.**

<u><b>Likelihood of failure and impact</b></u>	<u><b>Consequences</b></u>			
	<i>Negligible</i>	<i>Minor</i>	<i>Significant</i>	<i>Severe</i>
<i>Very likely</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Extreme</i>
<i>Likely</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>High</i>
<i>Somewhat likely</i>	<i>Low</i>	<i>Low</i>	<i>Moderate</i>	<i>Moderate</i>
<i>Unlikely</i>	<i>Low</i>	<i>Low</i>	<i>Low</i>	<i>Low</i>

**Consequences of failure**

**Negligible** – consequences are those that involve low-value property damage or disruption that can be replaced or repaired, and do not involve personal injury.

**Minor** – consequences are those involving low to moderate property damage, small disruptions to traffic or a communication utility, or very minor injury.

**Significant** – consequences are those that involve property damage of moderate to high value, considerable disruption, or personal injury.

**Severe** – consequences are those that could involve serious personal injury or death, damage to high-value property, or disruption of important activities.

**Tree Risk Rating**

**Low** – some trees with this level of risk may benefit from mitigation and maintenance measures, but immediate action is not usually required. Tree risk assessors may recommend retaining and monitoring these trees, as well as mitigation that does not include removal of the tree.

**Moderate** – The tree risk assessor may recommend mitigation and/or retaining and monitoring. The decision for mitigation and timing of treatment depends upon the risk tolerance of the tree owner or manager.

**High** – tree risk assessor should recommend mitigation measures be taken as soon as is practical. The decision for mitigation and timing of treatment depends upon the risk tolerance of the tree owner or risk manager.

**Extreme** – tree risk assessor should recommend that mitigation measures be taken as soon as possible. In some cases, this may mean immediate restriction of access to the target zone area to avoid personal injury.





**BC Plant Health Care Inc.**

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Surrey, BC, V3S 7A4 | Fax: 604-576-2972

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May 30, 2017

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### **Limitations of this Assessment**

It is BC Plant Health Care Inc.'s policy to attach the following clause regarding limitations. We do this to ensure that developers or owners are clearly aware of what is technically and professionally realistic in retaining trees.

The assessment of the trees presented in this report has been made using accepted arboricultural techniques. These include a visual examination of the above-ground parts of each tree for structural defects, scars, external indications of decay such as fungal fruiting bodies, evidence of insect attack, discolored foliage, the condition of any visible root structures, the degree and direction of lean (if any), the general condition of the tree(s) and the surrounding site, and the proximity of property and people. Except where specifically noted in the report, none of the trees examined were dissected, cored, probed, or climbed, and detailed root crown examinations involving excavation were not undertaken.

Notwithstanding the recommendations and conclusions made in this report, it must be raised that trees are living organisms, and their health and vigor constantly change over time. They are not immune to changes in site conditions, or seasonal variations in the weather conditions.

While reasonable efforts have been made to ensure that the trees recommended for retention are healthy, no guarantees are offered, or implied, that these trees, or any parts of them, will remain standing. It is both professionally and practically impossible to predict with absolute certainty the behavior of any single tree or group of trees or their component parts in all circumstances. Inevitably, a standing tree will always pose some risk. Most trees have the potential for failure in the event of adverse weather conditions, and this risk can only be eliminated if the tree is removed.

Although every effort has been made to ensure that this assessment is reasonably accurate, the trees should be re-assessed periodically. The assessment presented in this report is valid at the time of inspection.

