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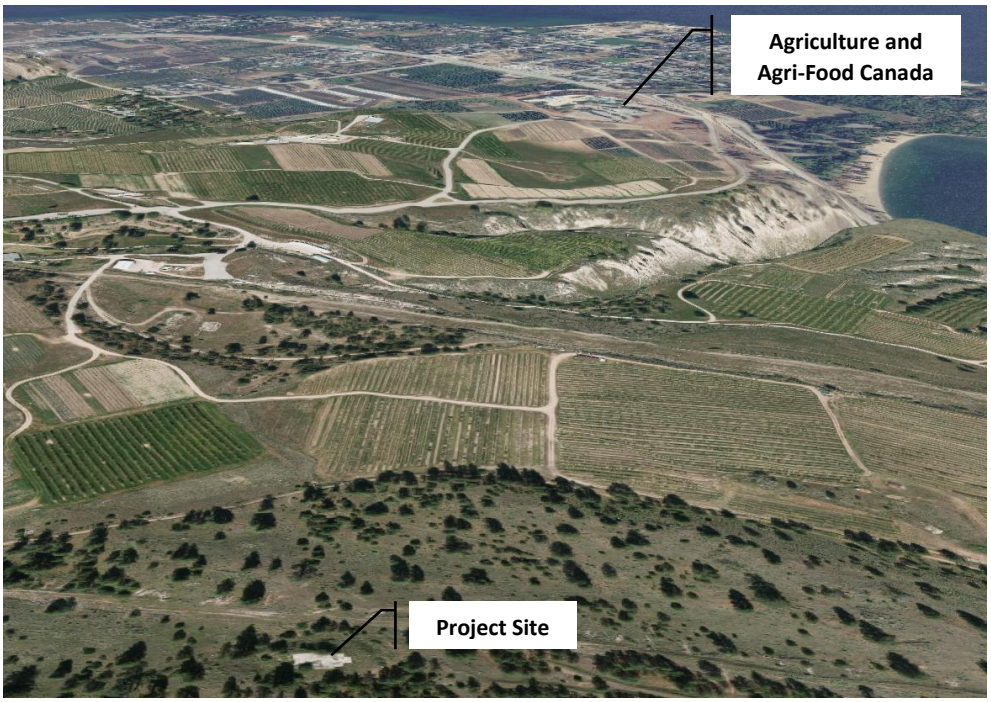

Underground Water Reservoir Tank
Inspection Program

Presented To: **Agriculture and Agri-Food Canada**
4200 BC-97
Summerland, BC V0H 1Z0

Submitted By: **Omega & Associates Engineering Ltd.**
9094 Young Road
Chilliwack, BC V2P 4R5

Dated: May 2020

Omega File No.: 2020.080.02CH

ENGINEERS & GEOSCIENTISTS BRITISH COLUMBIA

OQM CERTIFIED

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Presented To:

Agriculture and Agri-Food Canada
4200 BC-97
Summerland, BC V0H 1Z0

Prepared By:

Ali Ahmadi, Civil EIT May 11, 2020
Civil Engineer in Training
Ali.Ahmadi@ecora.ca

Reviewed and Approved By:

Mahyar Niroumand, P.Eng. MBA May 11, 2020
Civil Engineer
Mahyar.Niroumand@ecora.ca

Version Control and Revision History

Version	Date	Prepared By	Reviewed By	Notes/Revisions
A	04/23/2020	AA	MN	First Draft
B	05/11/2020	AA	MN	Final Submission

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1. INTRODUCTION

Ecora Engineering and Resource Group (hereinafter known as “Ecora”) was retained by Agriculture and Agri-Food Canada for the inspection of the concrete water reservoir tank located 1.5 kilometers southwest of the facility’s main building. The objective of the inspection was to inspect the concrete tank and to provide the client with information regarding the tank’s functionality, structural integrity, as well as recommendations for possible future repairs and inspections.

The selected reservoir tank consists of 2 cell chambers and a control chamber for all the valves and electrical components. This report presents the results of the inspections with consideration to the following criteria:

- Visual inspection of the tanks to determine their general condition
- Review of the cracks inside the tanks
- Perform hammer test in areas where concrete delamination is observed
- Measurement of concrete cover and depth of corrosion in various parts of the tank by scanning the concrete
- Estimate the depth of sediment accumulation inside each tank cell and inspect the condition of the inlet/outlet pipes as well as drain pipe.
- Provide photographic records of the tank cells

1.1. REPORT

A general Field Inspection Sheet with a ranking system was developed as a template to report the findings of the inspection. Tank information such as as-built drawings, tank ID, drawing number, and year constructed are not available and are not recorded on the template sheets. A copy of the ranking criteria that was used in the inspection field report can be found in Table 1 below.

Table 1- Underground Reservoir Tank Inspection Rating Criteria

Rating	Structural Integrity and Safety of User	Functionality - Secondary to Structural Integrity - Does it perform as originally designed	Maintenance Priority and Urgency of Repair	Urgency "U"	
				Monitor	M
				Routine	R
1	No Defects	New condition - No defects	Not Applicable	10 years	
2	Min Relevancy	Acceptable, functioning as intended but maintenance required	Not required before next principal inspection	< 5 years	

3		Functioning as intended but maintenance required	Preventative maintenance required within specified time period	< 3 years
4		Unacceptable, not functioning as intended. Major rehabilitation required.	Work required within specified time period	< 2 years
5	Max Relevancy	Immediate Action, Collapse Imminent	Danger to users- Immediate repair required	<1 year

1.2. SCOPE OF WORK

Based on the agreement with the client, the following primary activities were conducted for this inspection:

- Initiated communication with the project team and the client and organized a project kickoff meeting to obtain background information, review of work schedules, project deliverables and verify the project scope.
- Gathered and reviewed the location information for the tank chambers
- Reviewed safety plans and conducted safety meetings prior to entrance to the tanks
- Assessed the general condition of tank entrances, interior walls, slab surface, dividing walls, inlet/outlet piping systems and drainage channels
- Measured the depth of sediment in each tank
- Performed hammer sound test in areas where concrete delamination was observed and measured wall thickness and depth of corrosion using concrete scanner
- Identified the deficiencies inside the tanks. Provided field notes and supporting pictures of the deficiencies
- Recorded the findings in the general inspection sheet template

2. SAFETY AND INSPECTION METHODOLOGY

2.1. SAFETY

Ecora engaged with safety sub-consultant (Cumming Construction) to prepare detailed safety plans specific to the project. The plans included a detailed entry procedure, alternative entrance measures, confined space entry procedures and hazard assessment. These plans were prepared in accordance with the OH&S safety regulations and Confined Space Program prerequisites.

Before commencing the tank inspection process, the inspecting team members familiarized themselves with the location of the tanks and condition of their entrances. The members also received confined space training and

held valid training certificates throughout the inspection period. The rescue team members are all qualified to a confined space rescue technician level (National Fire Protection Association) and first aid as per WorkSafe BC (WSBC) regulation 32.7.

Cumming Construction provided rescue retrieval equipment for the duration of the tank inspection. The equipment consisted of a lifeline, personal harnesses, a tripod, an air blower, and air quality monitors. Safety pre-inspection meeting was conducted with the inspecting team and safety personnel prior to entrance to the tank outlining the general concerns and hazards. Air inside the tanks was tested prior to and after ventilation, as well as during the inspection.

The inspection of the tank was performed during dry weather period. Since the tank is located away from roads and traffic, a traffic control flagger was not required during the field inspection.

3. INSPECTION RESULTS

The inspection results of the tanks are provided in the field inspection sheet and are presented in Appendix A. Associated photographs taken during inspection of the tank are also included in Appendix A. Review and findings of concrete scanning of selected locations of tank walls and top slab can be found in Appendix B.

As previously mentioned, the inspection field report sheets provide a condition rating for structural members inspected, including top slabs, external walls, dividing walls, and bottom slabs. Notes related to inspection of the inlet/outlet system and comments regarding description and location of the defects, and any other information are also included in the field report.

4. CONCLUSION AND RECOMMENDATIONS

Based on the results of the field inspections presented in Appendix A, Ecora makes the following conclusions:

- Concrete reservoir cells and control chamber are generally in good condition with cells displaying signs of minor shrinkage cracking and efflorescence particularly on walls and top slabs. Some water leakage was also observed from joints and cracks particularly on north west corner of cell 1 and east of cell 2. These cracks are not considered to have a negative impact on the structural integrity and functionality of the tank cells.
- Vegetation growth on west and east of the reservoir tank was observed.
- Some cracks and rebar joints inside the tank’s cells were observed to have been patched and filled with concrete sealant material.
- Concrete cover over reinforcement inside the tanks were found to be in good condition. No signs of concrete delamination were visible inside the cells.

- Minor honeycombing was observed at top slab inside cell 1 though it is not considered to be of any concern.
- Accumulation of silt and debris inside the cells varied up to 300mm in depth, though the accumulated debris were mostly observed at northern end of the cells across from inlet/outlet and drainpipes.
- Access ladders are not present inside the tank cells. Access ladder is only installed inside the control chamber.
- 4” drainpipe and 8” inlet/outlet pipe located at southern wall of the tank were observed to have been heavily corroded.

Ecora recommends the following actions based on the above conclusion:

- Access ladder inside the chambers shall be installed.
- To ensure proper functionality and performance of the reservoir tanks, accumulated silt and debris shall be removed from the bottom of the reservoir. While the accumulated silt does not seem to have an adverse affect on the functionality of the tanks at the present time, Ecora recommends that the depth of accumulated silt be monitored to determine the frequency of cleanup of the tanks.
- Vegetation root growth next to concrete walls of the tank shall be cleared.
- Loose electrical box inside the control chamber shall be fixed in place.
- A summary of deficiencies and recommended actions are provided in Appendix A. There is nothing of immediate urgency worth noting, but the items should be reviewed and rectified at first available opportunity

We trust this report meets your present requirements. Please contact the authors if you have any questions or comments.

Sincerely,

Omega & Associates Engineering Ltd.

Prepared by:

May 11, 2020

Ali Ahmadi, Civil EIT
Junior Civil Engineer
Direct Line: 604.795.6652 x1133
ali.ahmadi@ecora.ca

Reviewed by:

May 11, 2020

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Appendix A

FIELD INSPECTION SHEETS AND PHOTOS

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Field Inspection Sheet

Water Reservoir Tank

Name	Reservoir Tank
ID No.	2020.080.02CH

Current Inspection		Inspector	Firm	Date (dd/mm/yy)	House No.	-
Principal	Monitoring R	Ali Ahmadi, Civil EIT	Ecora Engineering	2020-04-15	Street	-
Last Principal Inspection	-	Steven Mooney, M.Sci	Xradar	2020-04-15	Dwg. No.	-
Last Monitoring Inspection	-				Volume (m^3)	
Number of Cells/Compartments	2				Year Constructed	-
Number of Access MH	2				MH Link	-
Tank Shape	Rectangular				Tank Size L x W x H (m)	

Inspection Item	Rating 1	2	3	4	Rating 1	2	3	4	Rating 1	2	3	4	Rating 1	2	3	4	Rating 1	2	3	4	Rating 1	2	3	4	Rating 1	2	3	4	Rating 1	2	3	4
1.0 Reinf. Concrete Structure	1.1 Top Slab				1.2 Bottom Slab				1.3 East Wall				1.4 West Wall				1.5 North Wall				1.6 South Wall				1.7 Dividing Walls				1.8 Columns			
General Condition	√				√				√				√				√				√				√				X			
Concrete Cover Thickness	Refer to the attached report																															
2.0 Control Chamber																																

- Access ladder to control chamber is in good condition.
- 10" inlet/outlet A.C .pipe was observed to be ~10" above the bottom slab.
- 6" A.C. drain pipe is situatued underneath the 10" A.C. inlet/outlet pipe inside the chamber.
- Inlet/outlet pipe is branched off to the tank using 10"x8" 90° D.I. bend to cell 1 and 10"x10"x8" D.I. tee to cell 2.
- Gate valves are installed on 8" D.I. pipes to tank cells.
-4" drain pipe from bottom of each cell is connected to 6" main drain pipe inside the chamber. Each 4" drain pipes from the ce lls are accompanied with gate valves.
- 6" D.I. overflow pipe from each cell is connected to 6" drain pipe pipe.
- Electrical box inside the chamber is hanging loose on northern wall.

3.0 Other

Legend

N - Not Accessible **R - Routine**

X - Not Applicable **M - Monitor**

Rating	Structural Integrity and Safety of User	Functionality - Secondary to Structural Integrity - Does it perform as originally designed	Maintenance Priority and Urgency of Repair	Urgency "U" Monitor M / Routine R
1	No Defects	New condition - No defects	Not Applicable	10 years
2	Min. Relevancy	Acceptable, functioning as intended but maintenance required	Not required before next principal inspection	<5 years
3		Functioning as intended but maintenance required	Preventative maintenance required within specified time period	<3 years
4		Unacceptable, not functioning as intended. Major rehabilitation required.	Work required within specified time period	<2 years
5	Max Relevancy	Immediate Action, Collapse Imminent	Danger to users- Immediate repair required	<1 year

General Notes to Inspection Procedure

a) Inspection consisted of primarily visual, concrete cover measurement and hammer sounding in representative areas

b) Inspection was carried out in accordance with the procedures of the Confined Space Hazard Assessment and the Confined Space Entry Procedures.

c) Reservoir tank was inspected by a team consisting of two inspectors who entered the tank. A safety personnel fully equipped for emergencies equipments.

f) Refer to attached photos

Notes to Inspection Sheet (Refer to photos attached):

(1) Entrances to tank cell 1 and 2 do not have access ladder inside the tank.

(2) ~ 10" of ponding water inside cell 1 and ~ 9" of poinding water inside cell 2 was observed.

(3) multiple mounds of silt ~10" in depth was observed inside cell 1 and 2.

(4) Minor shrinkage cracking and efflorescence on east and north wall.

(5) 4 locations of shrinkage cracking was observed at the dividing wall between cell 1 and 2.

(6) Walls inside the tank cells were observed to have been treated with IPEX type material. No signs of exposed rebar or corrosion were observed.

Agriculture and
Agri-Food Canada
Water Reservoir Tank Inspection

OMEGA & ASSOCIATES
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ecora

Location:	Summerland, BC
Date of Inspection:	15-April-20
Omega File #:	2020.080.02CH

1: View of tank facing south

2: View of entrances to tank cells

3: Visible hairline crack on top slab

4: Extend of crack on top slab towards west

5: View of entrance to cell 1. Access ladder not present

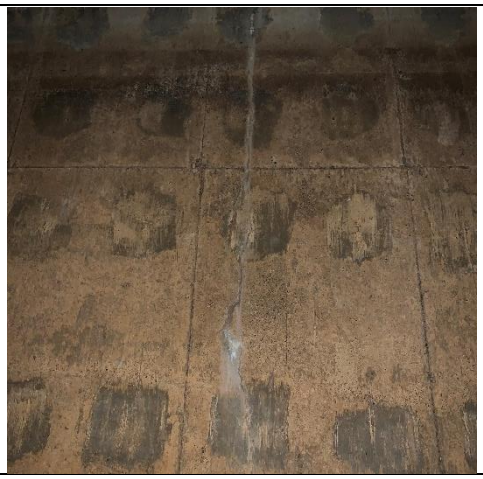
6: View of entrance to cell 2. Access ladder not present

Agriculture and
Agri-Food Canada
Water Reservoir Tank Inspection

OMEGA & ASSOCIATES
A DIVISION OF
ecora

Location:	Summerland, BC
Date of Inspection:	15-April-20
Omega File #:	2020.080.02CH

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>7: 4” drainpipe located at the bottom of cell 1</td><td>8: Corroded 8” inlet/outlet in south wall in cell 1</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>9: View of 6” overflow pipe along with sensor in cell 1</td><td>10: Up to 10” of ponding water and accumulated silt</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>11: Concrete sealant material was noted on walls in cell 1</td><td>12: More accumulated silt at bottom of cell 1 up to 10”</td></tr>
</table>

	
13: Minor cracking on top slab	14: Minor concrete cracking on dividing wall
	
15: Concrete sealant was observed at the location of crack on western wall	16: Performed hammer test. Note no concrete delamination
	
17: Noted more concrete crack on dividing wall	18: Diagonal concrete crack at dividing wall

OMEGA & ASSOCIATES
A DIVISION OF
ecora

Location: Summerland, BC
Date of Inspection: 15-April-20
Omega File #: 2020.080.02CH

19: Moisture and leakage of water was observed on northern wall due to proximity of vegetation

20: Minor crack on western wall of cell 1

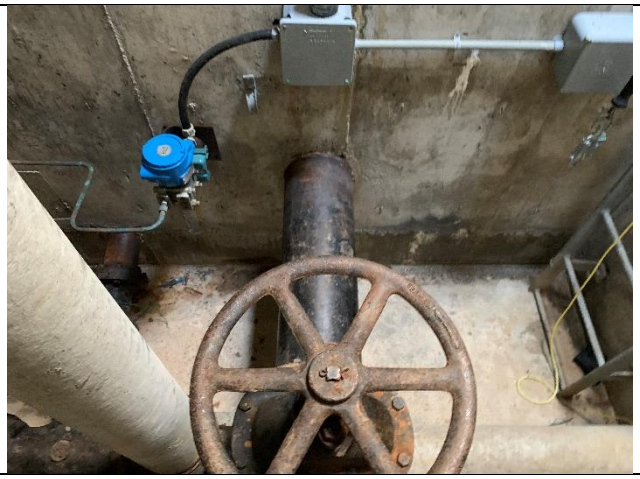
21: View of 6” overflow in cell 1 in good condition

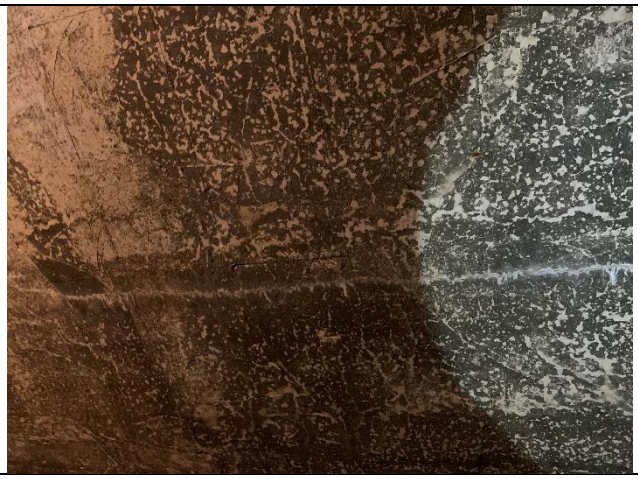
22: Loose electrical box inside control chamber

23: View of 6” overflow pipes inside control chambers

24: 4” drainpipes join 6” overflow pipe

Location: Summerland, BC
Date of Inspection: 15-April-20
Omega File #: 2020.080.02CH

	
25: 8” inlet/outlet pipe to cell 2 located above 4” drainpipe	26: View of 10” inlet/outlet pipe along with 6” drainpipe
	
27: View of 8” inlet/outlet pipe along with 4” drainpipe in cell 2	28: Minor concrete delamination is observed on south wall
	
29: Up to 9” of accumulated silt near entrance to the tank	30: Concrete sealant patches were visible on cell 2 walls

	
25: Crack on east wall is patched with concrete sealant	26: Hammer sound test was conducted on the crack. No sign of concrete delamination
	
27: Visible shrinkage cracking on top slab	28: Performed hammer test on northern wall. No sign of concrete delamination
	
29: Hairline shrinkage cracking on northern wall	

Appendix B

CONCRETE SCANNING RESULTS

Vancouver
5279 Still Creek Ave, Unit A9, Burnaby, BC V5C 5V1
(604) 305-2818

Xradar Concrete Scanning Summary Report

Xradar Reference: X200415-01

Site Address: Summerland Agriculture & Agri-Food Canada - 4200 Hwy 97, Summerland, BC

Inspection Date: 2020-04-15

Client: Omega & Associates Engineering Ltd.

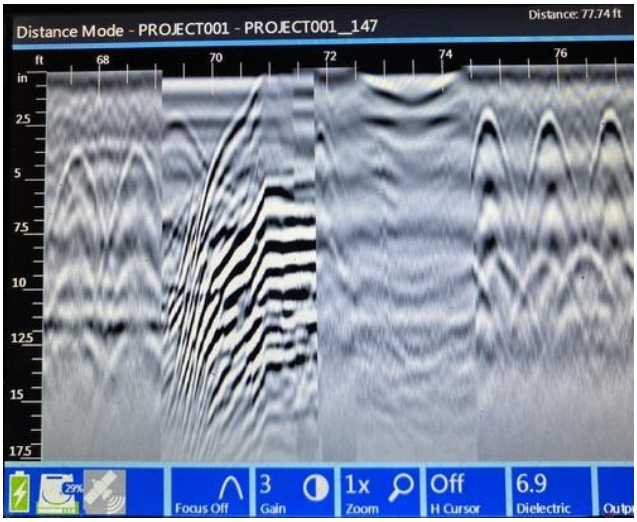
Summary	
	Details
Inspection date:	2020-04-15
Site address:	Summerland Agriculture & Agri-Food Canada - 4200 Hwy 97, Summerland, BC
Site contact:	Ali Ahmadi
Job summary	Survey various locations, chosen by the EIT, within an underground concrete water reservoir using Xradar scanning technology to located embedded rebar noting any detection of corrosion. Detail rebar spacing, rebar cover, rebar diameter and the level of corrosion, if any, at each of the chosen location.
Number of concrete slab types:	2
Type of concrete slab:	Suspended slab
Type of suspended slab:	Regular
Number of locations:	1
Slab thickness:	280-300mm
Type of concrete slab:	Wall
Number of locations:	5
Slab thickness:	250mm
Xradar lead technician:	Steven Mooney
Time on site scanning:	0800-1400
Lunch break:	None
Job complete:	Yes
Concrete coring required:	No
Utility locating required:	No
P.O number:	N/A
Quoted Job:	Yes
Quote number:	Email

Survey Details	
	Details
Xradar structural report required:	No
Xradar structural report recommended:	No
Number of concrete slab types:	2
Slab Type – Suspended slab	
Number of locations:	1
Type of concrete slab:	Suspended slab
Type of suspended slab:	Regular
Slab thickness:	280-300mm
Survey Locations:	
Location: #1 - Top side of suspended slab Notes: Scan location was selected by the Xradar technician - the ceiling height inside the chamber was too high to reach. The yellow hatched area indicates the partition wall between chambers below the suspended slab. The rebar pattern is consistent throughout the entire suspended slab. There are some visible surface cracks however no corrosion was noted. Rebar diameter is estimated to be 12mm (Rebar #4).	
	Details
The survey area was clear of obstructing items, debris and standing water:	Yes
Location was scanned from both sides:	No
Survey location was pin-pointed to other side:	No
Top steel reinforcement highlighted in green was present:	Yes
Depth of top steel reinforcement:	25-50mm
Bottom steel reinforcement highlighted in blue was present:	Yes

Depth of bottom steel reinforcement:	175-200mm
Steel reinforcement diameter was determined:	Yes
Steel reinforcement diameters:	12mm
Concrete corrosion was detected in the slab:	No
Slab bands, beams or column caps highlighted in yellow present:	Yes
Complete scan boundary highlighted in yellow present:	Yes
Notes:	

Slab Type – Walls	
Number of locations:	5
Type of concrete slab:	Wall
Slab thickness:	250mm
Survey Locations:	
Location: West Chamber - Location #1 - Exterior Wall (West) Notes: Minor surface crack visible. No corrosion noted. Location selected and tested by EIT.	

Location: West Chamber - Location #2 - Partition Wall Notes: Long surface cracks with visible efflorescence. No corrosion noted. Location selected by EIT.	
Location: East Chamber - Location #1 - Exterior Wall (East) Notes: Minor surface crack. Not corrosion noted. Section tested by EIT using hammer - note the “white” section on the image.	

Location: East Chamber - Location #2 - Exterior Wall (North) Notes: Original photo not saved. Screen shot of scan data was only available. Additional location selected by Xradar technician and scanned to fulfil the quoted scope (6 locations) No corrosion noted.	
Location: East Chamber - Location #3 - Exterior Wall (East) Notes: Minor surface crack. No corrosion noted. Location selected by EIT.	

	Details
The survey area was clear of obstructing items, debris and standing water:	Yes
Location was scanned from both sides:	No
Survey location was pin-pointed to other side:	No
Top steel reinforcement highlighted in green was present:	Yes
Depth of top steel reinforcement:	Varies 50-100mm
Bottom steel reinforcement highlighted in blue was present:	Yes
Depth of bottom steel reinforcement:	175-200mm

Steel reinforcement diameter was determined:	Yes
Steel reinforcement diameters:	12mm
Concrete corrosion was detected in the slab:	No
Complete scan boundary highlighted in yellow present:	Yes

General Limitations

- Where there is no access to the underside of the slab or pinpointing of the underside of the slab is not possible, marked location of slab bands or walls below the slab are approximations. The exact location of slab bands or walls cannot be confirmed. Strapped conduits or pipes may also exist on the underside of the slab.
- Estimations of rebar sizes are accurate to within 1 rebar size.

Disclaimer

Where:

1. The presence and/or location and/or depth of targets in the slab/wall cannot be confirmed due to any of the limitations set out above;
2. The recommendations set out above are not followed;
3. The markings on the slab indicating the locations of targets are no longer present; and/or
4. The scan has not been completed,

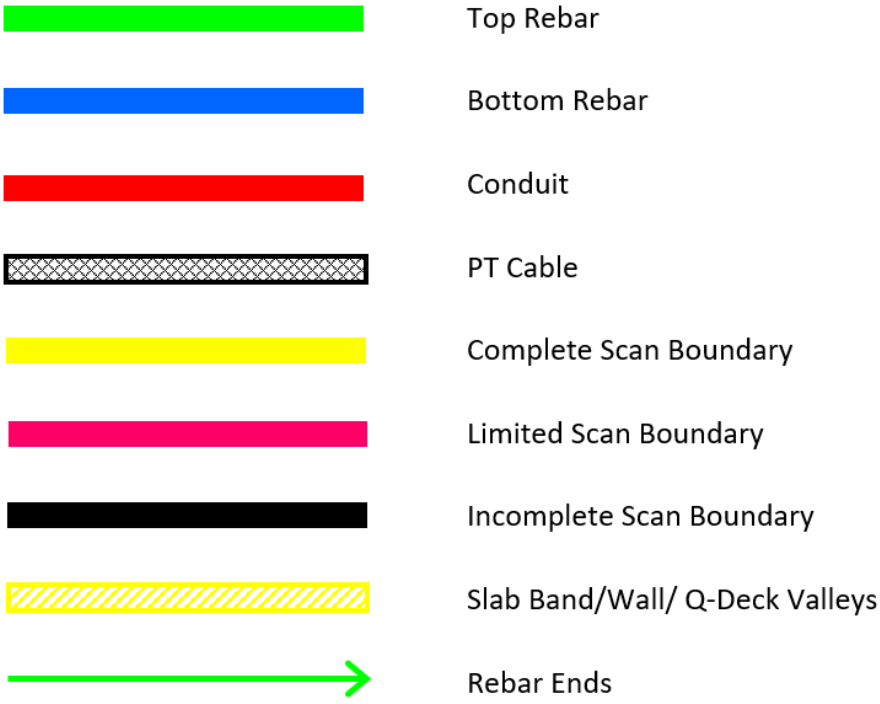
Xradar shall not be liable for any loss or damage caused in respect of any such targets hit when drilling, coring or cutting the slab/wall.

Client Representative

Name:	Ali Ahmadi
Client Representative Present on Site:	Yes

Due to COVID-19 measures, we are not collecting signatures at this time.

Legend


Top Rebar
Bottom Rebar
Conduit
PT Cable
Complete Scan Boundary
Limited Scan Boundary
Incomplete Scan Boundary
Slab Band/Wall/ Q-Deck Valleys
Rebar Ends

Thank you for your business!

This is a standard Xradar™ summary report.

Additional reporting options are available for Xradar™ Concrete Scanning & Structural Surveys.

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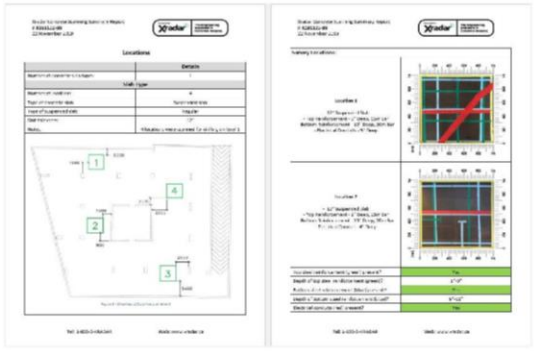
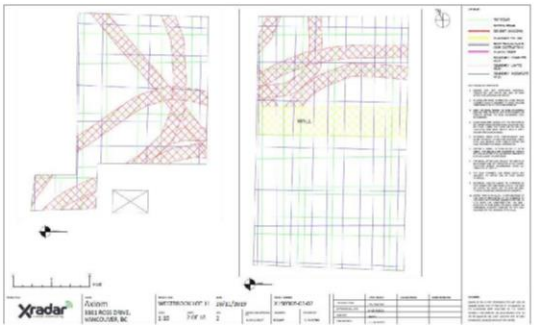
- Presented in the same format as the Summary Report
- Ideal for engineering review of each scan location
- Scaled images of each scan location provided
- Overview map displaying the location of each scan (Drawing to be provided)
- Typically 24 hour turnaround for these reports



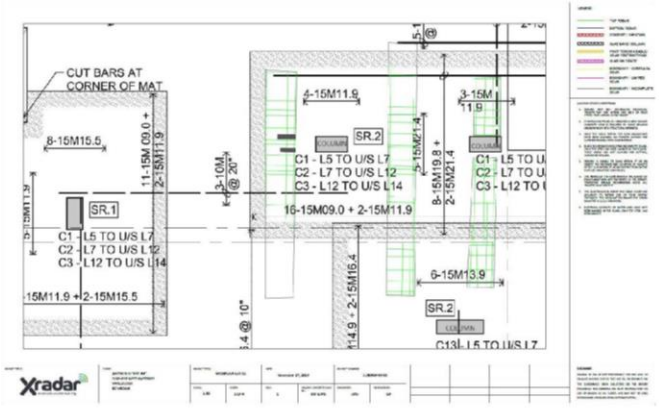
Xradar™ Concrete Scanning CAD Report

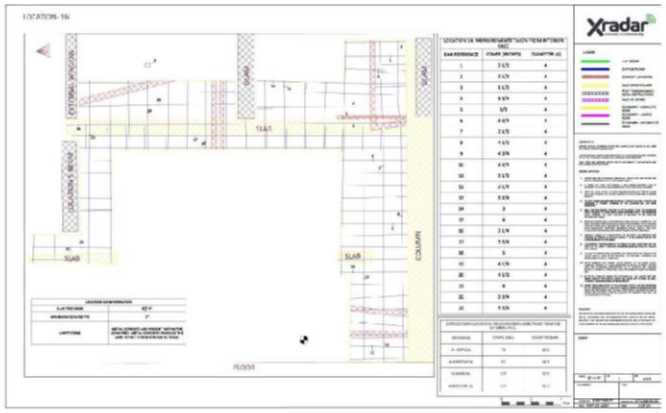
- Most comprehensive report
- Delivered in CAD .dwg format
- Also available as a 3D point cloud model



Xradar™ Structural Investigation

- Map slab thicknesses, reinforcement cover & size, spacing presence and location of beams, slab thickenings and more...
- Create as-builts for the concrete slab for structural analysis, load bearing calculations and design considerations.
- Deliverables include AutoCAD drawing & 3D point cloud model





Xradar™ help clients all over Canada mitigate risk and plan projects effectively.

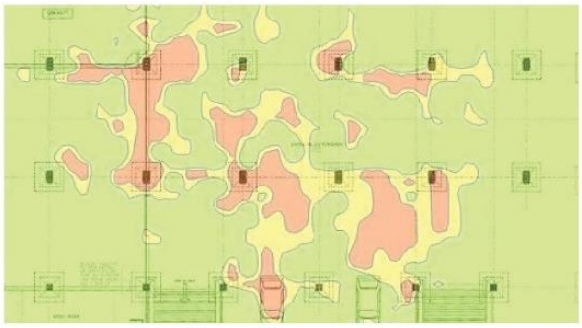
Get in touch for more information on the other services we offer.

Xradar

Other Xradar™ Services:

Void, Crack & Defect Detection

- Map and detect voids, honeycombs, cracks and defects within the concrete
- Highlight exact location and size
- Multiple report formats including AutoCAD drawing and 3D models
- State of the art non-destructive testing equipment including Ultrasound Pulse Echo and Xradar.

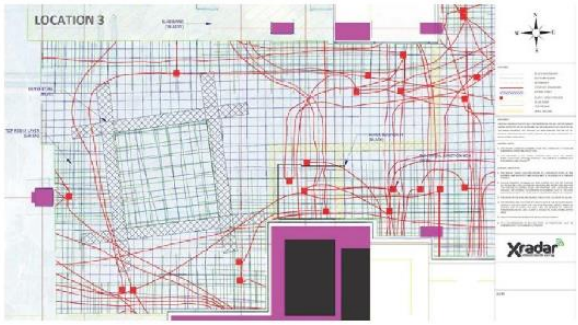


Concrete Corrosion Mapping

- Identify & map the corrosion of concrete at the reinforcement level
- Non-Destructive, fast & accurate. Avoid costly lane-closures
- Evaluate the integrity of any structure and make informed decisions on the maintenance of the structure
- Over 10 years of proven results
- More accurate and efficient than both half cell and chain drag surveys

Pre-Design Concrete Scanning

- Smart space planning for designers and engineers
- Ideal for Design & Build Contractor
- Cost savings of approximately $3.50 for every $1.00 spent on Pre-Design Scanning
- Detailed floor plans featuring all embedded objects, lay-out your space 100% conflict free
- Avoid redesign costs and delays!



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