

Peace River Project Water Use Plan

Williston Reservoir Trial Wetland

Implementation Year 6

Reference: GMSWORKS-17

*Williston Reservoir Wetland Demonstration Site 6-2 Airport
Lagoon. Final Report*

Study Period: January 1 – November 4, 2013.

**Golder Associates Ltd
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November 4, 2013



November 4, 2013

BC HYDRO - WILLISTON RESERVOIR WETLAND DEMONSTRATION SITE 6-2 AIRPORT LAGOON

Completion Report BC Hydro Report # N3589



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Distribution:

BC Hydro - 2 Copies
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REPORT





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1.0 INTRODUCTION

In 2009 Golder inventoried and identified a number of opportunities to create wetlands in the Williston Reservoir area. These opportunities were summarized in a report titled “GMSWORKS 16 – Williston Reservoir Wetlands Inventory”, Golder 2010¹. The broad objectives of GMSWORKS 16, identified in the Peace Williston Water Use Plan (PWUP 2003), included anticipated improvements to fisheries and wildlife habitat, riparian habitat along the reservoir’s foreshore and potentially dust control by creating “perched” wetlands.

BC Hydro selected two WDS from five candidates identified by Golder in 2009 for development, including WDS 6-2 (Airport Lagoon) and WDS 34 (Beaver Pond). In August of 2010, Golder Associates Ltd. (Golder) was retained by BC Hydro to develop preliminary engineering designs and associated construction cost estimates for the two selected demonstration wetland sites. A final report was submitted to BC Hydro in March 2011, titled “GMSWORKS 17, Williston Reservoir Wetland Demonstration Sites, Stage II – Detailed Design and Cost Estimate”, (Golder 2011)². In February 2013, BC Hydro requested that Golder update the designs for the two selected wetland demonstration sites, WDS 6-2 (Airport Lagoon) and WDS 34 (Beaver Pond) in preparation for tendering and construction in May 2013. The design basis for WDS 6-2 (Airport Lagoon) is outlined in Golder 2013 and consisted of installation of two culverts to allow backflooding of a wetland area by Williston reservoir.

BC Hydro requested that Golder provide an additional scope of work for construction monitoring services and the provision of Record Drawings for the WDS 6-2 Airport Lagoon site. The following scope of work was provided and agreed to by BC Hydro in a scope change report titled, “Scope Change – Construction Monitoring Services for Williston Lake Reservoir Wetland Demonstration Site 6-2 (Airport Lagoon) – BCH Contract Agreement #EC13-490215”, dated May 2, 2013.

This report provides a summary of the construction monitoring that occurred during the construction of the WDS 6-2 Airport Lagoon between May 22 and May 31, 2013. This report includes representative site photos taken during construction located in Appendix A, daily field inspection reports from Golder between May 22 and May 29 located in Appendix B, daily activity reports from the Contractor (Duz Cho Construction L.P.) between May 19 and May 3 located in Appendix C, and the ‘Record Drawings’ of the completed works located in Appendix D.

This report should be read in conjunction with the limitations of this report, appending this document.

2.0 CONSTRUCTION MONITORING

The construction of the WDS 6-2 Airport Lagoon commenced on May 22, 2013 and was constructed by the contractor, Duz Cho Construction L.P. Construction was substantially complete by May 31, 2013.

Golder provided construction monitoring and field reviews from May 22, 2013 to May 29, 2013. Duz Cho provided Daily Activity Reports from May 19 to May 31, 2013.

¹ BC Hydro, GMSWORKS 16, Williston Reservoir Wetlands Inventory, Golder Associates Ltd, February 2010.

² BC Hydro, GMSWORKS 17, Williston Reservoir Wetland Demonstration Sites, Stage II – Detailed Design and Cost Estimate, Golder Associates Ltd, March 2011.



The sequence of construction can be separated into five separate phases including 1) The Excavation and Removal of the Existing Culverts; 2) Base Preparation and the Installation of the New Culverts; 3) Placement and Compaction of Backfill up to Design Road Grade; 4) Installation of the Anchor Blocks and Log Booms; and, 4) Installation of Erosion Control Measures. The following provides a summary of the constructed works.

2.1 Excavation and Removal of Existing Culverts

Construction began on May 22 with the removal of approximately 0.5 m of the existing road base and sub-base layers (which were stockpiled on-site for later reuse). Excavation proceeded with the removal of the existing road embankment fill materials to the elevation of the invert of the existing culverts. The existing corroded 1200 mm diameter corrugated steel plate (CSP) culverts were then removed and disposed of off-site.

Due to rising water levels in Williston reservoir, temporary sheet pile coffer dams were installed by the Contractor at both the upstream (Wetland) and downstream (Reservoir) sides of the causeway road embankments to allow construction to proceed in the dry. These temporary structures were removed at the end of the construction period.

2.2 Base Preparation and installation of New Culverts

Once the old culverts were removed, the underlying base layer was graded and compacted. A layer of Geogrid (approximately 4.0 m wide by approximately 50 m long) was then placed along the alignment of the previous culverts as per the design drawings.

Native backfill material was then placed in 300 mm lifts and compacted to a minimum of 95% of the Standard Proctor Maximum Dry Density (SPMDD) up to the proposed invert elevations of the new culverts. The design drawings specified that the backfill was to be compacted to 98% SPMDD, however, based on site conditions the on-site geotechnical engineer agreed that compacting to a minimum of 95% SPMDD was sufficient. Free draining well graded 75 mm minus compacted sand and gravel was placed in the area underneath the ends of the proposed culverts as specified on the design drawings.

Non-woven geotextile filter fabric was placed from the bottom of the headwalls on both sides of the embankment down to the toe of the embankment slopes and covered with clean pit run gravel as a filter layer. Riprap was placed on top of the filter layer at both the upstream and downstream aprons as specified on the design drawings. The reservoir side riprap apron was shaped into a “V shape” to provide a better concentrated low flow channel for consideration of fish passage. This was a field fit.

The previously compacted native backfill that had been placed along the alignment of the culverts and in the immediate vicinity of each of the anti-seepage collars were then excavated out to allow for the installation of the anti-seepage collars. Once the anti-seepage collars were installed, the backfill was replaced and compacted.

The four precast concrete headwalls were installed and the proposed 1200 mm diameter corrugated steel pipe culverts were assembled with the couplings and neoprene gaskets.

The backfill around the culvert haunches were compacted using vibratory jumping jacks and vibratory plate tampers.



Grillage was installed on the precast culvert headwalls located on the Wetland side of the road embankment. No grillage was placed on headwalls on the reservoir side of the road embankment.

2.3 Placement and Compaction of Backfill up to Design Road Grade

Once the culverts had been installed, native backfill was used to infill around the culverts and to re-build the embankment to the original road elevation.

The backfill was placed in 300 mm lifts and compacted to a minimum of 95% SPMDD using a CAT CP563E vibratory smooth drum roller. The free draining well graded 75 mm minus sand and gravel was installed around the culvert inlets and outlets as specified on the design drawings and compacted.

The previously stockpiled road surface materials were then placed and compacted to complete the finished road grade.

2.4 Installation of Concrete Anchors and Log Booms

A modification to the design of the concrete anchor blocks was requested by the Contractor to replace the proposed 25 mm (1") diameter galvanized steel coil rod that was to be cast into the block with 37.5 mm (1.5") diameter stud link anchor chain that was cast into the anchor block. The 37.5 mm anchor chain extended 1.5 m from the face of the concrete block for the embankment anchors and each link was welded together to form a rigid 1.5 m long chain from which a shackle could be installed for connection to the log boom chain. This request was reviewed and approved by Golder as the service life with the thicker chain was expected to be similar to the galvanized material specified.

The four concrete embankment anchors and the four standard concrete anchors were installed as per the design drawings. The embankment anchor chains were surveyed and were located at an elevation of approximately 671 m.

The log booms were assembled and installed as shown on the record drawings.

2.5 Installation of Erosion Control Measures

The environmental monitor hand seeded with an erosion control mix and spread weed free straw on all exposed work areas above the culvert headwalls.

3.0 RECORD DRAWINGS

Golder has prepared record drawings of the constructed works which are included in Appendix D, Drawings 1 to 3.



4.0 EXPECTED PERFORMANCE, INSPECTION AND MAINTENANCE

Golder has designed the BC Hydro WDS 6-2 Airport Lagoon with the intent of creating approximately 27 to 34 ha of permanently wetted habitat in the wetland upstream of the causeway road. It was estimated that approximately 13 to 16 ha of this newly created water body will be less than 1.0 m deep.

As this is a demonstration site, the site should be inspected periodically to confirm that the structures are performing as intended and that there are no issues pertaining to erosion, scour, damage to the log booms or log boom chains, or damage to the embankment anchors.

Periodic maintenance is expected to be required in the form of replacing corroded anchor chains or log booms, cleaning out logs that may bypass the log booms and addressing minor erosion over time.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Golder provided on-site construction monitoring from May 22 to May 29, 2013. During this construction period, no significant construction issues were encountered. The works were constructed in accordance with the design drawings with changes reflected in the record drawings.

Duz Cho completed the construction a few days later on May 31, 2013 with the completion of the anchor block installations, log boom installations, final road base material placement and installation of the erosion control materials.

As mentioned in Section 4.0 above, Golder recommends that periodic site visits be performed to confirm that the constructed works are performing as intended and to identify any maintenance that may be required.

Golder understands that BC Hydro has inspected the site in October 2013 to confirm that the structures are performing as intended. BC Hydro noted that logs were bypassing the log boom located on the Williston Reservoir side of the causeway. A photograph was provided and has been included in Appendix E – Post Construction Inspection Photos, Photo 1. It appears that the log booms that have been installed near the embankment slope are too long and when the water levels are low, one end of the log sits up on the embankment slope while the other end is submerged allowing logs and debris to bypass the log boom. Golder recommends that the log booms located near the embankment slope, on both sides of the causeway road, be shortened, (perhaps into two sections) to allow more flexibility in the log booms as water levels rise and fall.

An inspection by the design engineer is recommended during snow free conditions, possibly in April 2014, if snow and ice conditions permit, or as late as mid-May 2014 in conjunction with the proposed work at the BC Hydro WDS 34, if reservoir levels permit. Recommendations regarding modifications to the log booms could be made at that time. In the meantime, Golder recommends cleaning out any logs that have bypassed the log boom as and when necessary.



6.0 CLOSURE

We trust this Completion Report for the construction of the WDS 6-2 Airport Lagoon meets your current requirements. Please contact the undersigned if you require any further information regarding this Completion Report.

GOLDER ASSOCIATES LTD.



Mike Sullivan, P.Eng.
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MS/KBD/tc

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APPENDIX A

Construction Photos



APPENDIX A Airport Lagoon - Construction Photographs

Construction May 22 – May 29, 2013



Photo 1 – Excavation & removal of old culverts.



Photo 2 – Placement of sheet pile coffer dam.



Photo 3 – Placement of geogrid.



Photo 4 – Placement of fill material and compaction.



APPENDIX A Airport Lagoon - Construction Photographs



Photo 5 – Placement of culvert headwalls & geotextile.



Photo 6 – Placement of Class 10 kg riprap.



Photo 7 – Culvert couplings and neoprene gaskets.



Photo 8 – Placement of anti-seepage collars.



APPENDIX A

Airport Lagoon - Construction Photographs



Photo - 9 Twin culvert installations.



Photo 10 – Twin culvert installation.



Photo 11 – Anti-seepage collar installation.



Photo 12 – Compaction.



APPENDIX A

Airport Lagoon - Construction Photographs



Photo 13 – Culvert installation – north side – lagoon.



Photo 14 – Culvert installation, south side – Williston Reservoir.



Photo 15 – Backfill around culverts and embankment.



Photo 16 – Grillage installation on upstream headwalls.



APPENDIX A

Airport Lagoon - Construction Photographs



Photo 17 – Log boom anchor block placement lagoon.



Photo 18 – Log boom anchor block placement reservoir.



Photo 19 – Fill placement & view of headwalls, Lagoon.



Photo 20 – Fill placement & view of headwalls, reservoir.



APPENDIX A

Airport Lagoon - Construction Photographs



Photo 21 – Embankment anchor installation.



Photo 22 – Embankment anchor & 37.5 mm chain.



Photo 23 – Log boom installed south side, reservoir.



Photo 24 – Log boom installed north side, Lagoon.



APPENDIX B

Golder - Field Inspection Forms (May 22 – May 29, 2013)



Exited Culvert



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Building Sheet Pile Wall



Excavating debris for Culvert base pre.



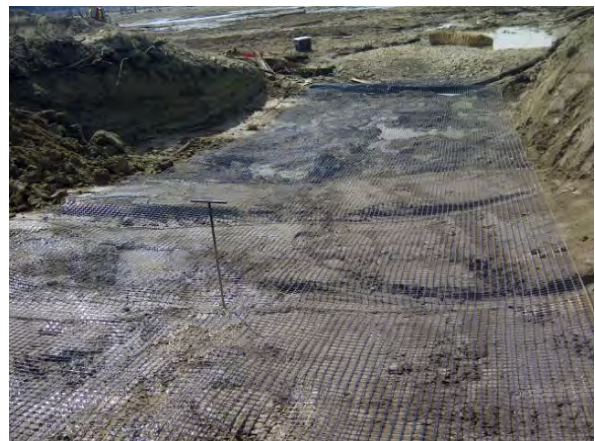
Placing Geo-grid and soil, upstream



Culvert base excavation



Testing density for 1st layer above Geo-grid



Placing Geo-grid downstream



Project No. 13-1434-0012
 Date May 24, 2013
 Shift Day Night
 Time arrived on site 07:00 hrs
 Time left site 17:00 hrs
 Time on site 10 hours
 Travel time 0.5 Hours
 Total time 10.5 hours

ENGINEER'S/INSPECTOR'S REPORT

Project Name BCH Airport Lagoon and Beaver Pond
 Weather Cloudy Temperature Range _____ °C
 Contractor's Working Hours 06:30 - 17:30

Work Carried Out In the morning:

My work started from placing the geogrids and placing material to the new culvert elevation.
 They placed pit run, clean sand and gravel, by both ends and fairly clean sand with trace non plastic fines in between.
 Lifts are 300 mm thick and I got 95% of the max dry density based on field reviews.
 Rest of the day's progress:
 Finished placing materials to the bottom of precast concrete headwalls' elevation, upstream and downstream.
 Compacted to approx. 95% of, field reviewed, max dry density.
 Placed non-woven geotextile for both ends of culverts, upstream and downstream, and covered with clean pit run
 Got culverts, couplers, and concrete embankment blocks ready for next day assembly
 Placed the upstream precast concrete headwalls and are ready for culvert assembly.

Distribution	Initials

 Engineer/Inspector Nader Gendy



Progressing compaction, upstream



Progressing compaction mid-section



Progressing compaction, upstream



Transforming Culvert Concrete Head



Placing Culvert Concrete Head



Placing Geo-textile, downstream.



May 24, 2013 - Daily Photos



Prep. Culvert base, upstream

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ENGINEER'S/INSPECTOR'S REPORT

Project No. 13-1434-0012
 Date May 25, 2013
 Shift Day Night
 Time arrived on site 07:00 hrs
 Time left site 17:00 hrs
 Time on site 10 hours
 Travel time 0.5 hours
 Total time 10.5 hours

Project Name BCH Airport Lagoon and Beaver Pond
 Weather Clear/Sunny Temperature Range _____ °C
 Contractor's Working Hours 06:30 - 1730

Work Carried Out

Rip rap placed and compacted with the excavator's bucket, upstream and downstream.

Anti-Seepage collars were placed, upstream and downstream.

Placed the downstream precast concrete headwall.

Placed 100% of culvert pieces on ground and about 80% assembled by gaskets and couplers.

The lake upstream has raised 8" since May 23, 2013 and it keeps rising. After assembling the remaining 20% of the culvert, which is already on the pond, water level will not be much of an issue, in respect to the construction. We are still waiting for a few couplers and top pieces of anti-seepage collars, hopefully will arrive tomorrow of Monday. Once the culvert is assembled, the remaining will be the earth work - compaction to the road level. Most likely work will be executed Tuesday night or Wednesday afternoon.

Distribution	Initials

 Engineer/Inspector Nader Gendy



Rip Rap added



Erecting culvert against the concrete head

Seals for tying culvert pieces together



Tying culvert pieces together



May 25, 2013 - Daily Photos



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Project No. 13-1434-0012

Date May 26, 2013

Shift Day Night

Time arrived on site 07:00 hrs

Time left site 17:00 hrs

Time on site 10 hours

Travel time 0.5 hours

Total time 10.5 hours

ENGINEER'S/INSPECTOR'S REPORT

Project Name BCH Airport Lagoon and Beaver Pond

Weather Cloudy Temperature Range °C

Contractor's Working Hours 06:30 - 17:30

Work Carried Out

100% of the culvert is assembled .
Connections between each culvert and precast headwalls are sealed with concrete.
Material was placed and compacted to 95% of field reviewed max dry density.
Discussed the issue of rip rap and fish trap in the downstream with Greg, site supervisor. Greg will bring the issue to Grant's attention.

We are still waiting for the anti-seepage top parts, expected to be delivered Monday morning. If any other material than what they have onsite will be placed, regarding the rip rap and fish trap, they will buy it from Prince George and will need something written from Golder.

Once we have the parts delivered we have two more days of back filling to execute this project.

Table with 2 columns: Distribution, Initials

Engineer/Inspector Nader Gendy



Culvert construction progress showing downstream and upstream



Culvert construction progress to top of culverts



Culvert construction progress showing downstream and upstream



Culverts with grout against concrete heads, upstream



Culverts with grout against concrete heads, downstream





May 26, 2013 - Daily Photos



Culverts against concrete heads, downstream

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Erecting steel guards against concrete heads



Rip Rap against concrete head



Placing concrete blocks for anchors, upstream.



May 27, 2013 - Daily Photos



Placed concrete blocks downstream



Compaction progress for road above culvert



Concrete blocks for anchors





Project No. 13-1434-0012
 Date May 28, 2013
 Shift Day Night
 Time arrived on site 07:00 hrs
 Time left site 17:00 hrs
 Time on site 10 hours
 Travel time 0.5 hours
 Total time 10.5 hours

ENGINEER'S/INSPECTOR'S REPORT

Project Name BCH Airport Lagoon and Beaver Pond
 Weather Cloudy Temperature Range _____ °C
 Contractor's Working Hours 06:30 - 17:30

Work Carried Out

As of noon today, there was approximately 4 m of material to place and compact. Considering that the contractor is pushing to be done by the end of tomorrow, we want to make sure that proper compaction continues. If proper compaction isn't achieved in the upper portions of the fill, trafficability issues could result.

Approximately 0.5 m of surfacing sand and gravel was removed from the road surface and stock piled prior to the culvert excavation, and that the contractor was planning on putting the material back in place, instead of providing the pavement structure in the design drawings. We do not know how the road performed in the past. Assuming that the thickness of the road base on either side of our project is the same as what we will be placing over our section of road (they recovered enough of the road surface material, and the stock piled material was not 'contaminated' with underlying sand), and that Canfor was happy with how the road performed in the past, then I do not see any reason why we shouldn't provide the same road surfacing that was used before.

Distribution	Initials

 Engineer/Inspector Nader Gendy



Concrete blocks upstream.



Compaction progress, road above culverts



Upstream compaction progress for the road

Downstream compaction progress for the road



May 28, 2013 - Daily Photos



During construction, downstream view



Upstream during construction



Downstream during construction

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Slopes close to finishing, downstream



Slopes close to finishing, downstream



Placing concrete blocks embedded in slopes





Slopes downstream, road compaction and slopes downstream



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APPENDIX C

Duz Cho - Daily Activity Reports (May 19 – May 31, 2013)



Airport Lagoon Culvert Replacement Project Daily Activity Report



May 19, 2013

Day 01

Airport Lagoon

16 cloudy & windy

Daily comment: Moved the equipment from the industrial subdivision, to the airport lagoon. All equipment is on site and ready to commence the start of the project and the road closure.

Issues and concerns:



Airport Lagoon Culvert Replacement Project Daily Activity Report



May 21, 2013

Day 02

Airport Lagoon

16 cloudy & windy

Daily comment: Held tailgate safety meeting. Reviewed all safety and environmental plans with the crew. Closed the road at 7 am, erected barricades at 2.5, 5, and 8.2 km on the Causeway FSR. Full equipment inspections were completed prior to start-up; ie hoses, lines and leaks. Used 2 excavators to excavate and load out material. The rock trucks were spotting loads along the Causeway. The dozers were maintaining the haul roads as well as the stockpile. The laborers were gathering material needed for the jobsite, and installing silt fence. We utilized the driftwood that was in the work area to build a berm as a safety precaution. There was a total of 22 loads of road material and 82 loads from the excavation hauled for the day. The environmental monitor determined the work area, equipment and materials on site in full compliance for our scope of work.

Issues and concerns: The weather forecast has raised some concern prior to start up of the project, with heavy rain in the forecast the silt fence was installed to prevent any sediment from leaving the worksite and entering the water ways. High winds today have kicked up a lot of dust from the Causeway Road. Early evening site visit with Nick VanderKwaak, Mike Galesloot and Grant Webber. No issues noted at this time.



Maintaining stockpile



Installing silt fence



Loading trucks/ Driftwood berm



Loading from both ends

Making sure the Footprints we leave behind are ones our Children will be proud to walk in



Airport Lagoon Culvert Replacement Project

Daily Activity Report



May 22, 2013

Day 03

Airport Lagoon

16 cloudy & windy

Daily comment: Held tailgate safety meeting. Excavators continued loading the haul trucks and excavating down to the existing culvert level. Installed the sheet pile cofferdam at the inlet of the culverts. The steel grates on the inlets of the existing culverts have been pulled out and removed from the work area. The rock trucks were stockpiling the material along the Causeway road. The dozers were maintaining the haul roads, as well as the stockpiles. The laborers have prepped the site with our pumps, generators, and packers for the removal of the culverts and start of the backfill.

Issues and concerns: The excavation is almost complete, the site is safe sloped and ready to remove the existing culverts. The New 1200 mm culverts were delivered this afternoon but without all of the required materials. There are no anti seepage collars, Geo Grid, or polypropylene gaskets as of yet. Without these items on site, this could delay the project, but most likely not enough to overtop the temporary cofferdam. The 1200 mm culverts are in good shape for being used, with some rust and a few are out of round. This will delay the install process. BCH and Golder were on site today and did not raise any concerns at this time. Golder approved the embankment block design (anchor chain welded horizontally in place).



Loading out steel grates



Installing coffer dam



Offloading culverts



Safe sloping excavation

Making sure the Footprints we leave behind are ones our Children will be proud to walk in



Airport Lagoon Culvert Replacement Project Daily Activity Report



May 23, 2013

Day 04

Airport Lagoon

22 c, clear and breezy

Daily comment: Held tailgate safety meeting, along with a walk through on the spill response program around water ways before commencing work. The environmental monitor inspected the pump off area and was satisfied with layout. Excavators closed off the rest of the cofferdam then excavated out the existing culverts and loaded them out. The rock truck hauled them out of the work area. The Geo Grid was placed along with the 75 mm minus pit run and the common fill as the culverts were removed. The laborers had set up the pumps and the generators prior to excavating and were also placing stray bales wherever erosion could occur in the discharge area. The first lift was 1 meter as requested by Mike with Golder Associates. Every lift after was 6 inches, raked, leveled and packed with plate packers. The Geo Tech had reviewed our procedure with our lifts and was satisfied with it. The water level throughout the day had only raised by 1 inch in the course of 10 hour shift.

Issues and concerns: Various minnows and amphibians were observed in the impoundment area. The EM removed them and put them back into the stream. The headwalls, culverts, and couplers are now on site, awaiting the rest of the anti seepage collars, and the gaskets to arrive on site.



Levelling and packing lifts



Geo Tech testing densities



Rolling out Geo Grid



Relocating minnows

Making sure the Footprints we leave behind are ones our Children will be proud to walk in

May 24, 2013

Day 06

Airport Lagoon

22^c clear

Daily comment: Held site safety meeting. The excavators prepped both ends of the culverts for rip rap. The trench was leveled and packed in preparation for the culverts and headwalls. The inlet end headwalls were placed and backfilled. The dozer leveled the trench bottom to grade, as well as forwarded material needed to bring the trench bottom to the proper grade. Four of the anti-seepage collars were installed on the upstream end (excavated, placed, backfilled and compacted). The rock truck spotted loads as needed for the backfill. Laborers raked and shoveled material for the headwalls, culverts and the anti-seepage collars as well as maintained the pumps throughout the day. The generator and pumps were left running overnight to keep water out of cofferdam area so rip-rap and filter fabric could be placed. 22 loads of 75 mm minus pit-run gravel have been delivered to site. E-mail discussion with engineer confirmed headwall to culvert fastening strategy (30 MPA 3/8" with hi-early accelerator behind the headwalls and non-shrinking grout for detailing the faces).

Issues and concerns: Some supplies were delivered today but Armtec has yet to deliver all of the anti-seepage collars or adequate bolts to fasten all of the collars and couplers. The outstanding supplies are to be delivered tomorrow (Saturday). Both the Golder representative and the environmental monitor have been inspecting the work regularly and have had no concerns to date.



Installing anti-seepage collars



Compacting the culvert beds



Headwalls on the inlet





Airport Lagoon Culvert Replacement Project Daily Activity Report



May 25, 2013

Day 06

Airport Lagoon

22^c clear

Daily comment: Held tailgate safety meeting. The headwalls, lower halves of the anti-seepage collars and all of the culverts have been placed. Neoprene gaskets were used on all culvert couplers. The environmental monitor and the Golder geo tech were on site throughout the day, raising no concerns and were satisfied with quality and progress of the project. The crew worked late in anticipation of the final anti-seepage collar and fastening hardware delivery from Armtec, which never came.

Issues and concerns: There are only have enough anti-seepage collars to install the first two complete sets on the upstream ends of the culverts, plus the bottom halves on the downstream sets. Until the remaining collars and fastening hardware is delivered, backfill will only be from the upstream headwalls to half-way across the excavation, leaving enough room open to complete the anti-seepage collar installations on the downstream ends. The culverts are out of round, which is making installation of the couplers and the anti-seepage collars quite challenging. Being out of round, it also made their installation into the headwalls problematic.



Compacting around anti-seepage collars



Installing rip-rap on downstream end



Placing culverts



Culverts in place

Making sure the Footprints we leave behind are ones our Children will be proud to walk in

May 26, 2013

Day 07

Airport Lagoon

18 c showers

Daily comment: Held tailgate safety meeting. Excavators continued backfilling the culverts and placing rip rap at the upstream and downstream ends of headwalls. The culverts have been sufficiently backfilled enough that the DT LGP dozer was able to spread a lift of common fill over top of the culverts. The inlet and outlet ends of the headwalls were both grouted. The laborers continued leveling and compacting even lifts of material on the north side of the excavation, but had to work around the areas of the missing anti-seepage collars on the south side. All of the headwalls have been formed up and ready for the concrete pour, scheduled for May 27. The grills for the inlets of the headwalls were also installed. A total of 18 loads rip rap and 32 loads of 75 mm minus pit run gravel have been delivered to site.

Issues and concerns: Both the Golder representative and the environmental monitor were on site throughout the day and raised no concerns. Lack of anti-seepage collars continues to prevent the project from moving ahead smoothly. Although the crew has done their best to work around the missing hardware, these missing pieces have set the project back considerably.



Framing head walls



Grouting head walls



Backfilling culvert



Installing Galvanized Grillage

May 27, 2013

Day 08

Airport Lagoon

18 c showers

Daily comment: Held tailgate safety meeting. The excavators did finish work on the rip rap in front of all of the headwalls, set out the anchor blocks for the log booms, disassembled the cofferdam then loaded rock truck with common fill and spotted loads for tomorrow's backfill. The laborers poured the concrete for the headwalls then removed the pumps, generators and miscellaneous supplies out of the work area. Three of the last 4 anti-seepage collars were installed and backfill compacted around them. The boom logs were delivered to site. 11 more loads total 75 mm minus pit-run backfill were delivered and stockpiled for the next day.

Issues and concerns: The anti-seepage collars did not arrive until 3:30 pm with only 3 of the 4 delivered. As per Ray Normandeau's request, the crew worked late installing them and backfilling as much as reasonable so as to minimize the remaining project time once the final collar section is delivered. The environmental monitor assisted with the cofferdam removal, noting that there was negligible siltation during the removal process.



Placing Anchor Blocks



Concrete Pour



Installing Collars



Backfilling Collars

May 28, 2013

Day 09

Airport Lagoon

20 c Overcast

Daily comment: Held tailgate safety meeting. The laborers removed the concrete forms from the head walls and installed the final seepage collar, leveling and packing material around it. The excavators loaded the rock trucks with common fill and the rock trucks spotted those loads for the dozers to spread. The dozers and the compactor worked together spreading and compacting the backfill in 30 cm lifts. The Golder geo-tech tested for compaction, confirming 98% density had been achieved.

Issues and concerns: The last seepage collar was finally delivered but did not show up until late morning, further delaying backfilling the excavation and completing the project. Due to product shipping delays, log boom installation is now planned for after the backfill is complete and the road is re-opened. Traffic control and dust management may be required at that time.



Concrete around culverts



Backfilling final anti-seepage collar



Spotting Loads



Spreading and compacting even lifts



Airport Lagoon Culvert Replacement Project Daily Activity Report



May 29, 2013

Day 11

Airport Lagoon

18 c Showers

Daily comment: Held tailgate safety meeting. The excavators continued loading rock trucks, which then spotted loads for the dozers. The packer and the dozers worked together spreading and packing even 30 cm lifts to achieve the desired compaction. The embankment anchors were placed, the old culverts (scrap) removed from the site and the excess material that wasn't used in the backfill was hauled away. The laborers started drilling holes in the boom sticks for the boom chains to pass through, backfilling the embankment anchors and doing cleanup around the site. The embankment anchors were left half exposed with the anchor chains left laying out for later welding. Opus DaytonKnight (contractor surveyor) and the Golder rep assisted with the placement of the anchor blocks. The surveyor confirmed that we had achieved the goal of a 11 meter road surface with a 2 to 1 slope and proper drainage through the culverts. There were 70 loads of common fill, and 23 loads of crushed gravel hauled for the backfill and the road surface.

Issues and concerns: Designed culvert placement could have been approximately 1.5m downstream so as to give the final completed project a more balanced appearance.



Backfilling embankment anchors



Spreading and compacting lifts



Spreading gravel base



Slope on downstream side

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May 30, 2013

Day 11

Airport Lagoon

18 c Showers

Daily comment: Held tailgate safety meeting. Excavators finished the slope work on the backfill and the backfill around the embankment anchors. They also placed the boom sticks on the upstream and downstream sides of the culverts. The dozer spread the last of the stockpiled gravel on the Causeway. The excess length was cut off of the downstream end of the western culvert at the headwall. The protecting log booms were installed on both sides of the Causeway. All embankment block chains were welded out horizontally and the blocks fully buried and compacted around before they were connected to the log booms. Tied nylon rope through the shackle pin eyes for an added safety measure on the shackles to ensure they wont work themselves loose.

Issues and concerns: Heavy rain at the end of the day delayed final road grading, site clean up and equipment demobilization.



Downstream log boom



Fastening log boom to embankment block



Placing upstream log boom



Drilling boom chain holes



Airport Lagoon Culvert Replacement Project Daily Activity Report



May 31, 2013

Day 12

Airport Lagoon

20 c Overcast

Daily comment: Held tailgate safety meeting. Finish graded and packed the Causeway FSR. Some of the grout around the culverts had cracked and pulled away, so those sections were re-grouted. The environmental monitor hand seeded an erosion control mix and spread weed free straw on all exposed work areas above the culvert headwalls. All supplies and materials were removed from the site. As per discussions with Ray Normandeau, the original ¾” crushed gravel with calcium additive that was salvaged off the road at the beginning of the project (approximately 7-10 cm lift) was re-spread, and, rather than putting on the 550 mm lift of 40mm minus crushed gravel sub-base and 150mm lift of 19mm minus crushed sand and gravel, Ray is going to arrange to have another lift of the calcium crush mix spread at a later date in conjunction with other road maintenance activities in the area. The road was re-opened to traffic in the early afternoon.

Issues & Concerns: The project took 6 days longer than anticipated mainly due to a single supplier (Armttec) not being able to deliver materials to the site in a timely fashion. They never were able to supply the geo-grid, which had to be sourced from a supplier in Ft. St. John. Heavy rains on the second to last day also added time to the project. A final as-built survey of the site is still required.



Grading and packing the Causeway



Re-grouting headwalls



Straw and seeding completed

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APPENDIX D

Record Drawings

golder.gds\p\k\loops\active\2013\1434-0012 Environmental Management\13-1434-0012 BCH Airport Lagoon & Beaver Pond\09 CAD\Drawing\13-1434-0012 Site 6-2 Base-Record\DWG1--BCH-R4.dwg Nov 22, 2013 - 3:29pm



LOG-BOOM - NORTH SIDE



LOG-BOOM - SOUTH SIDE

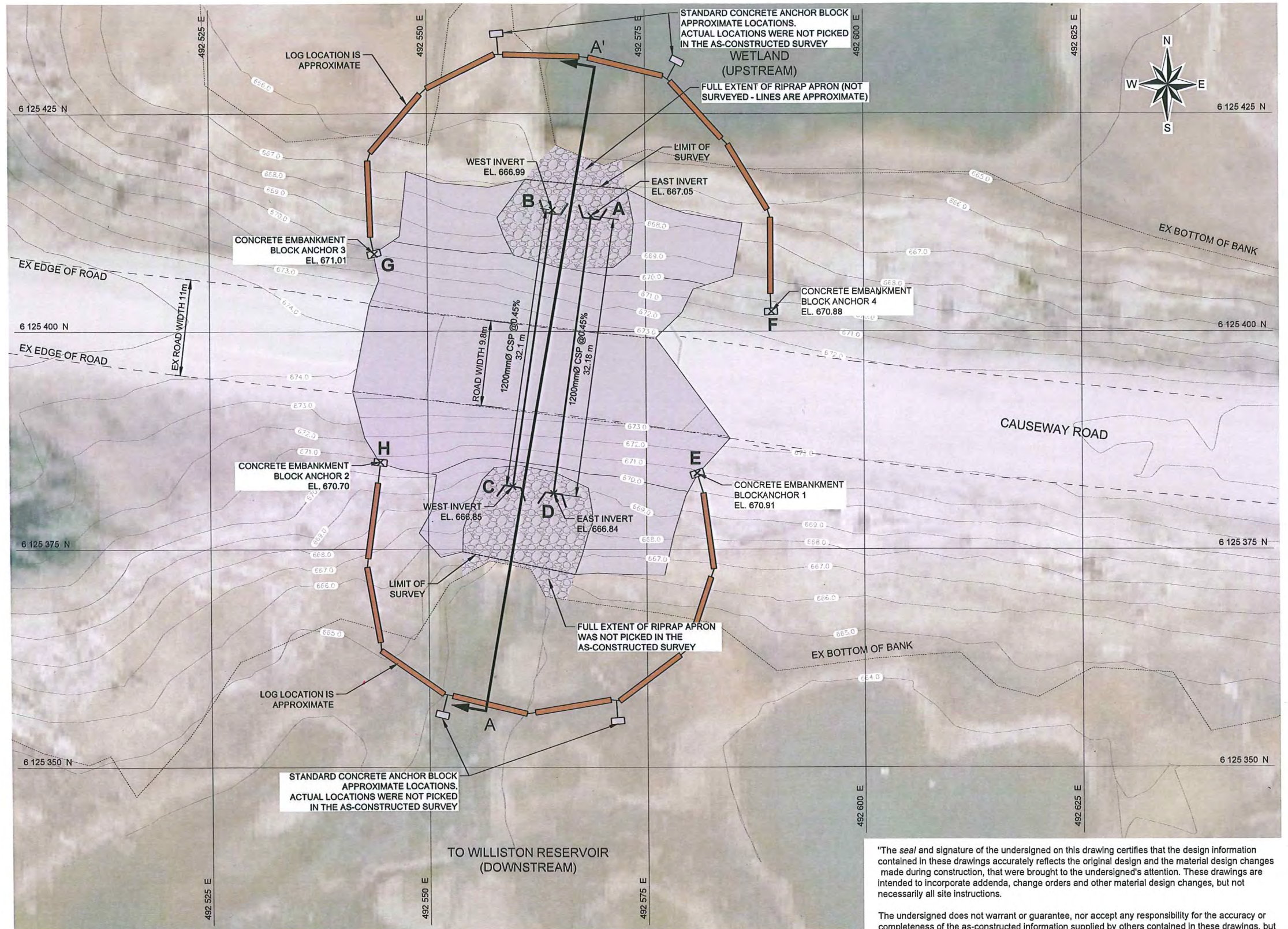
ANCHOR BLOCKS AND CULVERT INVERT TABLE			
LOCATION	NORTHING	EASTING	ELEVATION
A	6125413.30	492568.82	667.05
B	6125413.95	492564.40	666.99
C	6125382.20	492559.70	666.85
D	6125381.43	492564.39	666.84
E	6125383.74	492580.80	670.91
F	6125402.32	492589.43	670.88
G	6125408.89	492543.96	671.01
H	6125385.01	492544.55	670.70

LEGEND

- AS-CONSTRUCTED SURVEY LIMIT
- AS-CONSTRUCTED RIPRAP EXTENT

NOTES

1. TOPOGRAPHIC CONTOURS SHOWN AT 1.0m INTERVALS.
2. COORDINATES SHOWN ARE TO UTM ZONE 11n, NAD83.



PLAN VIEW

SCALE 1:250



"The seal and signature of the undersigned on this drawing certifies that the design information contained in these drawings accurately reflects the original design and the material design changes made during construction, that were brought to the undersigned's attention. These drawings are intended to incorporate addenda, change orders and other material design changes, but not necessarily all site instructions.

The undersigned does not warrant or guarantee, nor accept any responsibility for the accuracy or completeness of the as-constructed information supplied by others contained in these drawings, but does, by sealing and signing, certify that the as-constructed information, if accurate and complete, provides an as-constructed system which substantially complies in all material respects with the original design intent."

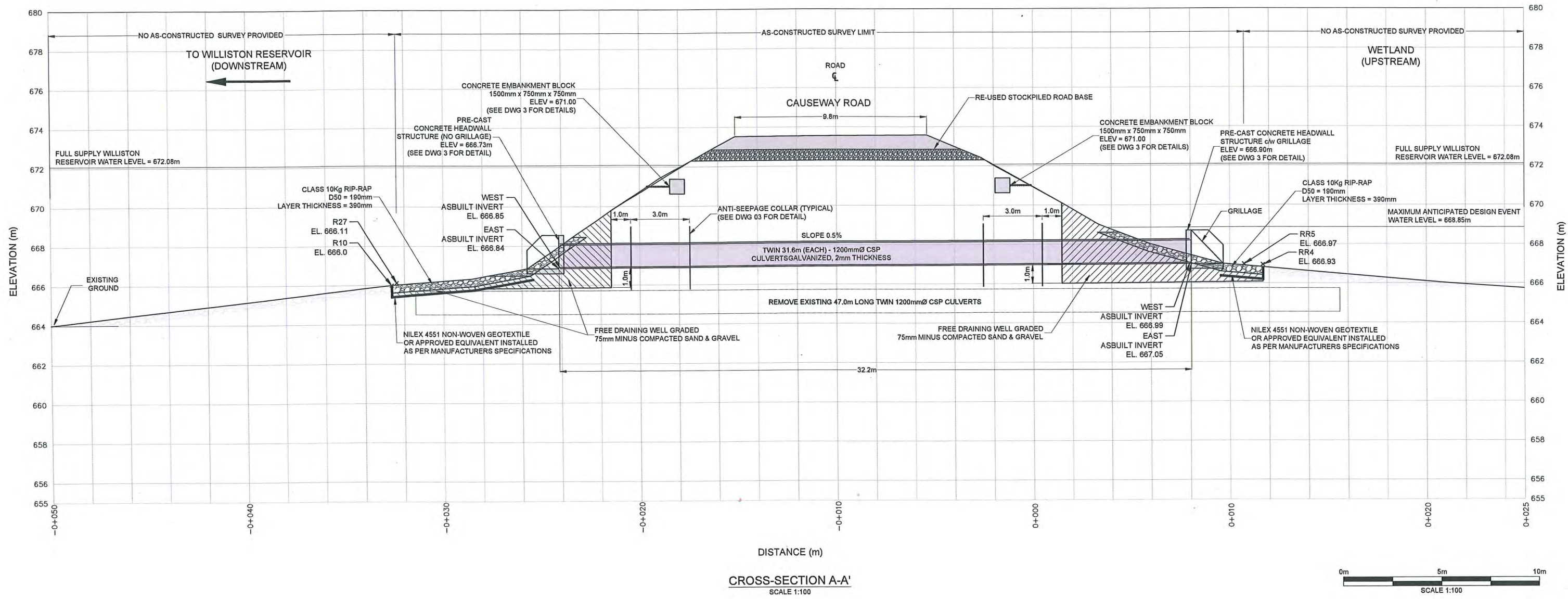
NO	REMARKS	DATE	DESIGNED	INDEP CHK	DFTG CHK	INSP	REV	ACPT
4	RECORD DRAWING	2013-11-22	M. SULLIVAN	KBD	JK	MS		
3	RECORD DRAWING - FOR REVIEW	2013-09-27	M. SULLIVAN	KBD	JK	MS		
2	ISSUED FOR CONSTRUCTION	2013-05-10	M. SULLIVAN	KBD	RP	MS		
1	ISSUED FOR TENDER	2013-03-30	M. SULLIVAN	KBD	RP	MS		

GMSWORKS 17
 WILLISTON RESERVOIR
 WETLAND DEMONSTRATION SITES
 STAGE II - DETAILED DESIGN AND COST ESTIMATE
 WDS 6-2 AIRPORT LAGOON
 SITE PLAN

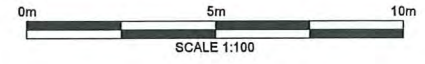
DATE: 2013-04-22 DIST: - DWG NO: 1006-C09-00165 SIZE: D R: 4

REF#	DRAWING NUMBER	TITLE
2	DB0104 - WILLISTON SURVEY BASIC LAYOUT.PDF	EXISTING FEATURES LINWORK (VECTOR GEOMATICS LAND SURVEYING LTD.)
1	AS BUILD 06.08.13.CSV	AS-BUILT SURVEY (OPUS DAYTON KNIGHT)

g:\polder.gds\polder\Kamloops\Active\2013\1434 Environmental Management\13-1434-0012 BCH Airport Lagoon & Beaver Pond\13-1434-0012 Site 6-2 Base-Record\dwg2-BCH-R4.dwg Nov 22, 2013 3:57pm



CROSS-SECTION A-A'
SCALE 1:100

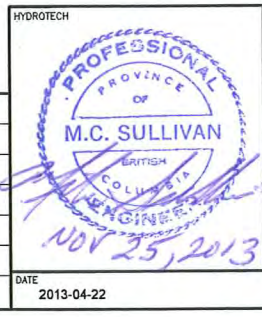


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NO	REVISIONS	DATE	DESIGNED	INDEP. CHK	DFTG. CHK	INSPECTION	REV.
4	RECORD DRAWING	2013-11-22	M. SULLIVAN	KBD	JK	MS	
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1	ISSUED FOR TENDER	2013-03-30	M. SULLIVAN	KBD	RP	MS	

DSGN	MS
INDEP. CHK	KBD
DFTG. CHK	RP
DFTG. CHK	MS
INSP	
REV	
ACPT	



GMSWORKS 17
 WILLISTON RESERVOIR
 WETLAND DEMONSTRATION SITES
 STAGE II - DETAILED DESIGN AND COST ESTIMATE
 WDS 6-2 AIRPORT LAGOON
 CROSS-SECTION A-A'

DATE: 2013-04-22
 DIST: -
 DWG NO: 1006-C09-00166
 SIZE: D
 R: 4



APPENDIX E

Post Construction Inspection Photo



APPENDIX E
Airport Lagoon - Post Construction Photograph

Post Construction Inspection – Photo received from BC Hydro



Photo 1 – October 2013 Post Construction Inspection – Logs bypassing log boom on reservoir side.

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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