

October 20, 2015

Infrastructure Development Branch
Government of Yukon – Community Services (C-13)
307 Black Street
Whitehorse, Yukon Y1A 2N1

ISSUED FOR USE
FILE: ENVH2O03164-01
Via Email: Elise.Bingeman@gov.yk.ca

Attention: Ms. Elise Bingeman, EIT, A/ Senior Program Manager

Subject: Installation of a Groundwater Monitoring Well, Carcross Wastewater Treatment Facility, Yukon

1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by the Yukon Government – Community Services (YG-CS) to coordinate the drilling and installation of one groundwater monitoring well down-gradient of the sludge drying beds at the Carcross Wastewater Treatment Facility (herein referred to as the “Site”). The Site is located approximately 4 km north of the village of Carcross, Yukon, and is accessible via South Klondike Highway at km 109.8.

This new well, 15MW01, is intended to be used as an environmental monitoring well for long-term monitoring of groundwater quality in the vicinity of the sludge drying beds.

2.0 SCOPE OF WORK

The scope of services included the following:

- Background review for well site selection, preparation of monitoring well specifications, and request for quotes from three qualified drilling contractors;
- Assistance of YG-CS with the selection of a qualified contractor;
- Field oversight of the monitoring well installation to verify work was completed in accordance with the technical specifications and the Yukon Contaminated Sites Regulation Protocol No. 7 “Groundwater Monitoring Well Installation, Sampling and Decommissioning” (YE 2011); and
- Preparation of this letter-report summarizing the field activities completed on September 8, 2015 and providing installation details for the newly-installed groundwater monitoring well, denoted as 15MW01.

3.0 FIELD PROGRAM

3.1 Drilling Location Rationale

There are six existing groundwater monitoring wells on site (92-1A, 92-3A, 92-6A, NW-1, NW-2, NW-3) that provide information on the hydrogeological conditions in the area. Review of the available groundwater information indicates the followings:

- Groundwater in the northwestern part of the Site was inferred to flow in a southerly direction in fine grained glaciofluvial and glaciolacustrine sediments, based observations in monitoring wells 92-1A, 92-3A, and 92-6A (ELR 2010). However, it has to be noted that these three wells are located at distances greater than 700 m

from the sludge drying beds and the inferred flow direction may therefore not be representative of the area of the proposed new monitoring well.

- Depth to groundwater in the area of NW-3 is in the order of about 6 m (EDI 2015). Groundwater monitoring well NW-3 is located approximately 100 m northwest of the sludge drying beds; and,
- No survey information and well logs are available for monitoring wells NW-1, NW-2, and NW-3 to infer the groundwater flow direction in the area of these monitoring wells or to provide information on aquifer characteristics.

Due to the limited groundwater information available for review, the location of 15MW01 was selected with the assumption that groundwater in the southern and southeastern parts of the Site also flows south towards Bennett Lake. Based on additional information from geotechnical boreholes and test pits in the area of the proposed well location in Tetra Tech EBA's database, we further assumed that groundwater would occur within overburden in the area of the proposed well location.

3.2 Utility Clearance

Prior to the drilling program, YG-CS representative Michael Fuder, YG-CS Project Manager, was onsite on September 8, 2015 to confirm the proposed drilling location and clear buried utilities in the proposed drilling area.

3.3 Drilling and Well Installation

Based on the evaluation of the quotes obtained from the drilling contractors, YG-CS retained Donjek Drilling (Donjek) to complete the drilling and installation of 15MW01.

Tetra Tech EBA's Field Hydrogeologist Carol Ma, GIT oversaw the drilling and installation of groundwater monitoring well 15MW01 on September 8, 2015. Drilling was conducted by Donjek using a CME75 track-mounted drill rig equipped with hollow stem augers. Water ponding in the area south of the sludge drying beds was noted on September 8, 2015.

During drilling, the recovered cuttings were logged by Tetra Tech EBA's Field Hydrogeologist. Soil samples were not collected for laboratory analysis or field screened for presence/absence of vapours during the borehole advancement.

The original proposed drilling location is approximately 15 m south of the sludge drying bed #2. However, auger refusal, possibly due to the presence of bedrock was encountered at 1.5 m (5 ft) at the original location (15BH01). Following the auger refusal, 15BH01 was backfilled with drill cuttings and the drill rig was moved approximately 1 m north of 15BH01 for a second attempt. Auger refusal was encountered again at 1.5 m (5 ft) at the second borehole location (15BH02). Following the likely bedrock refusal at shallow depths at two locations, a quick site reconnaissance identified a bedrock outcrop located approximately 30 m south of 15BH01 and 15BH02. To avoid shallow bedrock, Tetra Tech EBA's Field Hydrogeologist instructed Donjek to move the rig as close as possible to sludge drying bed #2 in an attempt to encounter thicker overburden sediments for installation of a groundwater monitoring well.

At the final drilling location (15MW01), approximately 2.5 m (8.2 ft) of silty clay sediments with trace medium to coarse sub-rounded gravels was encountered above the bedrock surface. The soils were damp to wet. 15MW01 is located approximately 7 m south of sludge drying bed #2. The thickness of the overburden encountered at 15MW01 (2.5 m) was significantly less than that encountered at existing well and borehole locations reviewed prior to the field program.

Figure 1 attached to this letter-report shows the locations of 15BH01, 15BH02 and 15MW01 with respect to the existing monitoring wells NW-1 and NW-3.

Following borehole drilling, the hollow stem augers were left in the borehole prior to the installation of 15MW01 to keep the borehole open. The monitoring well was constructed of 50.8 mm (2 inch) diameter, threaded Schedule 40 polyvinyl chloride (PVC) pipe with a machine-slotted screen approximately 1.5 m long (slot size of 0.25 mm [0.010 inch]). Solid PVC pipe was used for the remainder of the well to ground surface. The borehole annulus was backfilled with silica filter sand to approximately 0.4 m above the screened interval. Bentonite chips were placed and hydrated above the filter sand pack in the borehole to ground surface to provide a hydraulic seal. The PVC pipe was set inside a steel protective casing.

At completion, the well was dry. The location of 15MW01 was surveyed to the existing structures (fence lines, sludge drying bed, etc.) and the UTM coordinates of 15MW01 were collected using a hand-held GPS unit.

The completion details for 15MW01 are shown on the monitoring well log attached to this letter-report. Table 1 below summarizes the installation details of 15MW01.

Table 1: Well Completion Details

Well ID	UTM Coordinates (NAD83 08V)		Casing Stickup (m-ags)	Depth to Well Bottom (m-bgs)	Depth to Groundwater (m-bgs)	Slotted PVC Interval (m-bgs)	Sand Pack Interval (m-bgs)	Bentonite Interval (m-bgs)
	Easting	Northing						
15MW01	0515675	6673608	0.80	2.52	Dry	0.91 to 2.44	0.61 to 2.52	0.0 to 0.61

Notes:

m-ags: metres above ground surface.

m-bgs: metres below ground surface.

UTM coordinates were collected using a hand-held GPS unit.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The results from the field program show that overburden is very thin in the area to the south of the sludge drying beds with a thickness of less than about 2.5 m. The overburden encountered in 15MW01 consists of silty clay sediments. Even though the monitoring well was dry upon completion it is possible that water will accumulate in the well over time based on the fact that the soil was damp to wet during drilling of the monitoring well and the very fine grained nature of the soils with an associated low permeability. It is also possible groundwater may occur seasonally perched at the shallow bedrock contact.

We therefore recommend the following:

- Check 15MW01 regularly during monitoring events for water accumulation;
- Survey monitoring wells NW-1, NW-2, NW-3, and 15MW01 to confirm the groundwater flow direction; and,
- If 15MW01 remains dry the installation of a deeper bedrock monitoring well downgradient of the sludge drying beds should be considered using a drill rig capable of penetrating both overburden and bedrock.

5.0 LIMITATIONS OF REPORT

This letter-report and its contents are intended for the sole use of Government of Yukon and their agents. Tetra Tech EBA Inc. does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Government of Yukon, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this letter-report is at the sole risk of the user. Use of this letter-report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are attached to this letter-report.

6.0 CLOSURE

We trust this letter-report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.



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REFERENCES

Ecological Logistics & Research Ltd (ELR). October 2010. Carcross Wastewater – Water License Renewal & Upgrades. Project No. 10-108.

EDI Environmental Dynamics Inc. March 2015. Carcross Wastewater Facility Water Licence MN10-082 2014 Annual Report. Project No. 14-Y-0416.

Yukon Environment. March 2011. Protocol No. 7 for the Contaminated Sites Regulation under the Environment Act. Groundwater Monitoring Well Installation, Sampling and Decommissioning.

ATTACHMENTS

- Attachment 1 Figure 1: Site Plan Showing Groundwater Monitoring and Borehole Locations (1 Page)
- Attachment 2 Groundwater Monitoring Well Log for 15MW01 (1 Page)
- Attachment 3 Photographs 1 to 5 (3 Pages)
- Attachment 4 Tetra Tech EBA's General Conditions (1 Page)

Q:\Whitehorse\Data\0201\Drawings\Carcross\ENVH2003164-01 Waste Treatment Facility GW Well Install\ENVH2003164-01 Fig.1-RO.dwg [FIGURE 1] September 29, 2015 - 1:22:12 pm (BY: BUCHAN, CAMERON)



NOTE : THE IMAGERY ON THIS PLAN WAS ACQUIRED USING GOOGLE EARTH PRO EDITION (DATED 2010)

ISSUED FOR USE

LEGEND

- - BOREHOLE LOCATION
- ▲ - MONITORING WELL LOCATION
- ➔ - INFERRED GROUNDWATER FLOW DIRECTION
- x- - FENCE

Scale: 1:3,000 @ 8.5"x11"

CLIENT

Yukon
Government
Department of Community Services

TETRA TECH EBA

GROUNDWATER MONITORING WELL INSTALLATION WASTE TREATMENT FACILITY - CARCROSS, YUKON				
SITE PLAN SHOWING GROUNDWATER MONITORING WELL AND BOREHOLE LOCATIONS				
PROJECT NO. ENVH2003164-01	DWN CB	CKD CM	REV 0	Figure 1
OFFICE EBA-WHSE	DATE September 3, 2015			

Carcross WTF- 15MW01 Installation	Yukon Government - Community Services	BOREHOLE NO: 15MW01				
km 109.8 on South Klondike Hwy		PROJECT: ENVH2003164-01				
Carcross, Yukon						
SAMPLE TYPE	<input checked="" type="checkbox"/> DISTURBED	<input type="checkbox"/> NO RECOVERY	<input checked="" type="checkbox"/> SPT	<input type="checkbox"/> A-CASING	<input type="checkbox"/> SHELBY TUBE	<input type="checkbox"/> CORE
BACKFILL TYPE	<input type="checkbox"/> BENTONITE	<input type="checkbox"/> PEA GRAVEL	<input type="checkbox"/> SLOUGH	<input type="checkbox"/> GROUT	<input type="checkbox"/> DRILL CUTTINGS	<input type="checkbox"/> SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Depth (ft)
0	CLAY - silty, damp to wet, soft, medium to high plastic, brownish grey, moisture increasing with depth		Pipe stickup = 0.80 metres	0
1				
2	- trace medium to coarse subangular gravel, wet, high plastic			5
3	<p>END OF BOREHOLE (2.52 metres) water - dry at completion. Monitoring well installed to 2.44 metres Screen - 0.91 to 2.44 metres Bentonite chips - 0 to 0.61 metres Sand - 0.61 to 2.52 metres Note: Stopped due to auger refusal.</p>			10



LOGGED BY: CM	COMPLETION DEPTH: 2.52 m
REVIEWED BY: SK	COMPLETE: 15/09/08
DRAWING NO:	Page 1 of 1



Photo 1: Hydroseeded area south of the sludge drying beds, looking southeast.



Photo 2: Sludge drying bed #2, looking southeast. Bedrock outcrop was noted behind the fence.



Photo 3: Setting up the drill rig at borehole location 15BH01.



Photo 4: Installation of 15MW01.



Photo 5: 15MW01, looking southeast.

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

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