November 6, 2018

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Attn: Gregory Ferraro, Senior Partner

Dear Mr. Ferraro,

RE: Peer Review of Additional Information, Proposed Upland Landfill, Campbell River, BC

In response to your request, Patrick Consulting Inc. ("PCI") has completed its peer review of additional technical information that was prepared by GHD Limited ("GHD") in support of an application for a proposed landfill at the Uplands Excavating Ltd. property located at 7295 Gold River Highway in Campbell River, BC. (the "Site"). It is my understanding that the information provided to PCI was developed in response to comments and recommendations made to GHD by PCI in its letter of September 8, 2017 to GHD, by GW Solutions Inc. ("GW Solutions") in its comments and recommendations to the Campbell River Environmental Committee in January, October and November 2017, and by the Ministry of Environment and & Climate Change Strategy ("ENV") in its letter of February 1, 2018.

This review was conducted by Mr. Guy Patrick, P.Eng. of PCI. Mr. Patrick is a Contaminant Hydrogeologist and a registered Professional Engineer in BC, Yukon, Alberta and Saskatchewan. He has been practicing in the field of hydrogeology and environmental engineering since 1981. It is our understanding that GHD requested an independent peer review of the geologic and hydrogeologic aspects of the additional information as it relates to further site characterization, compliance predictive modeling, and the environmental performance criteria selected by GHD for the proposed landfill.

1.0 Scope of Work and Documents Reviewed

Prior to the PCI comments and recommendations in September 2017, GW Solutions Inc. prepared and delivered a presentation to CREC on January 10, 2017 titled:

- Proposed Upland Landfill, Preliminary Hydrogeological Review by GW Solutions, Campbell River, January 10, 2017.

Subsequent to the PCI comments and recommendations, GW Solutions prepared and delivered a presentation and issued the following letter report on the proposed Upland Landfill:

- Proposed Upland Landfill, Hydrogeological Review, GW Solutions, Victoria October 6, 2017
- Letter – Review of GHD Technical Addendum and Peer Review Response, Upland Landfill – Waste Discharge Application Tracking Number 335965 and Authorization Number 107689, 7295 Golder River Highway, Campbell River, British Columbia, prepared by GW Solutions Inc. for Campbell River Environmental Committee, November 23, 2017

ENV responded with review comments that took into consideration of both PCI's and GW Solutions' comments. In response, GHD collected and developed additional information for the Uplands Excavating Site and the proposed Uplands Landfill, and provided the following four reports to PCI:

1. Letter – Technical Addendum – Peer Review Response, GHD October 20, 2017
2. Letter – Technical Response to ENV Review, GHD March 23, 2018
3. Letter – Technical Response to ENV Review - Task 7, GHD October 1, 2018
4. Letter – Technical Response to ENV Review – Task 8, GHD October 1, 2018

In addition to the above, GHD provided two additional geologic / hydrogeologic cross sections, which complement the information provided previously in the May 2017 Hydrogeology and Hydrology Characterization Report prepared by GHD.

PCI's scope of work comprised an independent peer review of each of the four GHD reports, as well as an independent review of the presentations and review comments provided by GW Solutions Inc. The specific focus of PCI's review was on the following:

a) Geologic/hydrogeologic characterization of Uplands Excavating Site
b) Groundwater compliance prediction modeling for the proposed landfill
c) Environmental Performance Criteria selected as being applicable to the Site

During my review, I considered the comments of GW Solutions and examined the work scope completed by GHD, and identified those work elements that relate to the specific focus items a), b) and c) above. I assessed the extent to which each of the work elements, results and data interpretation addresses the specific comments and recommendations made by PCI and/or ENV. Finally, I present my conclusions and opinions concerning the adequacy of the work.

As part of my review, I visited the Site on August 14, 2018, taking note of Site topography, drainage, surface water features, monitoring well locations, and bedrock outcrops. I also examined rock core stored in core boxes that were made available to me at the Site.

1.0 Background

GW Solutions completed a preliminary hydrogeological review of the proposed Upland Landfill in January 2017. Subsequently, PCI completed an independent peer review of two technical reports prepared by GHD for the Site, and presented its results and recommendations in a letter to GHD dated September 8, 2017. Reports reviewed by PCI at that time comprised:

- *"Hydrogeological and Hydrology Characterization Report, Proposed Upland Landfill, Campbell River, BC"* prepared for Uplands Excavating Ltd. by GHD Limited, May 27, 2016, amended May 31, 2017 (the "HHCR"); and
- *"2017 Design, Operations and Closure Plan, Proposed Upland Landfill, Campbell River, BC"* prepared for Uplands Excavating Ltd. by GHD Limited prepared by GHD Limited, May 27, 2016, amended May 31, 2017 (the "DOCP" report).

In its September 8, 2017 letter (the "PCI 2017 Review"), PCI provided several comments and suggestions, and made the following three recommendations:

1. The data set used to estimate advective groundwater flow velocities and flux is quite limited and therefore carries uncertainty. It is recommended that additional data, preferably the form of a pumping test or tests, be conducted at the Site to support the current estimates of hydraulic conductivity of the sand and gravel aquifer, advective groundwater velocity and flux, and predicted contaminant mass and concentrations.

2. The groundwater flux along the west boundary moves from west to east towards and into the relatively extensive permeable gravel aquifer that underlies the proposed landfill. The flux has not been quantified and is likely very small relative to the flux entering the aquifer via infiltration of precipitation. Nonetheless, to reduce this uncertainty, it is recommended that a more rigorous assessment be undertaken in the form of revised groundwater elevation contours supplemented with additional water-level data, to more clearly define groundwater flow and flux entering the Site.

3. Given the advective travel time for groundwater to migrate from the Site towards possible aquatic receptors (on the order of two years), in addition to applying CSR drinking water (DW) standards, consideration should be given to assessing compliance with AW standards.

In response to these recommendations, GHD undertook additional work at the Site in 2017 and completed additional data assessment. The results of that effort are reported in a separate document titled:

- Letter of October 20, 2017 prepared by GHD for Mr., Allan Leuschen, Ministry of Environment regarding *"Technical Addendum, Peer Review Response, Upland Landfill Waste Discharge Application, Tracking Number 335965 and Authorization Number 107689, 7295 Gold River Highway, Campbell River, British Columbia,"* (the "GHD Technical Addendum").

The scope of work completed by GHD and reported in the GHD Technical Addendum comprised:

- Completion of additional single well response tests in the Sand and Gravel Aquifer at MW1-14, MW3-14, MW9-17 on September 15, 2017;
- Re-assessment of advective groundwater velocity flux, and predicted concentrations downgradient of the proposed landfill based on the revised estimates of hydraulic conductivity of the aquifer and ranges in precipitation and infiltration estimates;
- Observations of bedrock exposures and potential seepage along rock faces; and
- Further clarification on the applicable groundwater standards for the Site.

GHD also recommended in the Addendum that an additional well nest be installed within an apparent bedrock ridge between the west boundary of the Site and Rico Lake to better define geologic and hydrogeologic conditions.

Subsequent to that submittal, a review of both the PCI 2017 Review and the GHD Technical Addendum was undertaken for CREC by Dr. Gilles Wendling of GW Solutions. Results were presented in a memorandum dated November 23, 2017 titled:

- "Review of GHD Technical Addendum and Peer Review Response Upland Landfill – Waste Discharge Application Tracking Number 335965 and Authorization Number 107689, 7295 Gold River Highway, Campbell River, British Columbia," (the GW Memo").

In January 2018, the Ministry of Environment & Climate Change Strategy (ENV) considered the review comments of both PCI and GW Solutions and undertook a review of the GHD Technical Addendum. ENV then prepared an internal memorandum titled:

- "Ministry Assessment Review," Upland Excavating Ltd. Landfill, Permit Auth. No. PR-10807, dated January 31, 2018 (the "ENV Memo").

ENV presented the memorandum in a letter to GHD dated February 1, 2018.

In the ENV Memo, a number of conclusions and recommendations were made that included those by the ENV reviewer, Mr. Arash Janfada, as well as "the relevant recommendations made by the independent reviewers of the HHCR and DOCP". These were summarized as eight specific recommendations in section 5.1 of the memorandum "to address the more critical data gaps in the hydrogeological characterization," and recommendations in section 5.2 to address requirements for a "robust monitoring program," should the proposed landfill expansion proceed.

The eight recommendations presented in section 5.1 of the ENV Memo can be summarized as follows:

1. A liner leak detection system should be installed.

2. Annual water quality results that are reported should also be interpreted.

3. Definitive criteria for the protection of applicable receptors should be provided, recognizing that the criteria may be used as triggers to implement contingency measures.

4. Hydrogeological investigations should capture the effects of seasonality (i.e., conditions during annual high and low periods of precipitation).

5. Monitoring should include an expanded list of indicator parameters, as suggested by ENV.

6. The potential discharge of groundwater to receptors within 500 m of the Site should be characterized.

7. Bedrock hydrogeology should be characterized via drilling of dedicated boreholes as part of an expanded investigation for determining the hydraulic properties and fracture frequencies of the bedrock. The potential for contaminant transport within the bedrock flow regime should be evaluated.

8. The estimated rate of liner leakage should be reported and used in the groundwater quality assessment.

Subsequent to the ENV Memo, GHD developed a work plan to address ENV's comments. The work plan presented eight tasks (Task 1 through 8) that collectively address the recommendations made in section 5.1 of the ENV Memo. GHD implemented the work plan and completed additional Site characterization and data assessment activities, and presented the results of their work in the following documents, which were provided to PCI for peer review:

- Letter of March 23, 2018 prepared by GHD for Mr., Allan Leuschen, Ministry of Environment regarding *"Technical Response to ENV Review (Pr-Auth N0.: 10807), Upland Landfill, Upland Excavating, Campbell River, British Columbia,"* ("GHD Response Letter Tasks 1-6");

- Letter of October 1, 2018 prepared by GHD for Mr., Allan Leuschen, Ministry of Environment regarding *"Technical Response to ENV Review (Pr-Auth N0.: 10807), Task 7 – Additional Bedrock Characterization, Upland Landfill, Upland Excavating, Campbell River, British Columbia,"* ("GHD Response Letter Task 7");

- Letter of October 1, 2018 prepared by GHD for Mr., Allan Leuschen, Ministry of Environment regarding *"Technical Response to ENV Review (Pr-Auth N0.: 10807), Task 8 – Sand and Gravel Aquifer Pumping Tests, Upland Landfill, Upland Excavating, Campbell River, British Columbia,"* ("GHD Response Letter Task 8").

In addition, GHD provided PCI with additional stratigraphic and hydrogeologic information in two cross sections, which extend through the western portion of the Site and are in addition to those provided in the May 2017 Hydrogeology and Hydrology Characterization Report.

In the GHD Response Tasks 1-6 document, GHD structured their responses to the ENV recommendations in terms of tasks related to Contingency Planning, Leak Detection System

Design, Updated Groundwater Compliance Prediction Modelling, and Characterization of the Potential for Groundwater Discharge within 500 m of the Site. Items addressed under Contingency Planning comprised the following:

- Review of Base Landfill Liner System Performance
- Modeling of Landfill Liner System Leakage rates
- Development of a Trigger Level Assessment Program
- Identification of Practical and Implementable Contingency Measures

The focus of the present review is not on the contingency plan and design details, or leak detection system design, and therefore no comments are provided on these aspects of the reports reviewed.

2.0 Geologic and Hydrogeologic Characterization

2.1 Objectives

Following its review of the GHD Technical Addendum and the review comments and recommendations presented by PCI and GW Solutions, ENV recommended additional work to a) characterize bedrock hydraulic properties and hydrogeology, b) further assess groundwater flow and flux through the Sand and Gravel Aquifer taking into consideration seasonality, and c) characterize the potential discharge of groundwater to receptors within 500 m of the Site. Among other items, this information would allow GHD to verify applicable environmental standards and performance criteria for the Site, reduce the uncertainty in its predictive models of off-site groundwater concentrations, and reduce the uncertainty in its assessment of potential future effects of the proposed landfill when operated as designed.

2.2 Additional Bedrock Characterization

Subsequent to ENV's comments and recommendations, GHD completed additional work to characterize bedrock geology at the Site, with a particular emphasis on conditions between the western boundary of the Site and Rico Lake. The scope of work undertaken by GHD included:

- Excavation of two test pits (TP12-18, TP13-18);
- Drilling of four boreholes; two were backfilled (BH13-18, BH14018) and two were completed as a nested well pair in overburden (MW15B-18) and bedrock (MW15A-18);
- Completing single-well response tests at each new well;
- Completing an electrical resistivity survey in the area between Rico Lake and the west Site boundary; and
- Surveying locations and elevations of the wells and bedrock outcrops, and measuring water levels from the new wells.

Of the test pits excavated and boreholes drilled, only borehole MW15A-18 penetrated the bedrock. Fractured basalt was encountered from 9.2 m to 15.24 m below ground surface (the maximum depth drilled). The borehole log of MW15A-18 describes the bedrock as basalt, with frequent weathered sub-vertical and horizontal fractures (on the order of several fractures observed per metre of core). The fractures were observed to be weathered (i.e., light brown) and sometimes infilled with precipitate.

Analysis of the single-well response tests yielded hydraulic conductivity (K) values of 7.5 x 10^{-4} cm/sec for the overburden aquifer at MW15B-18, and 8.3 x 10^{-3} cm/sec for the bedrock at MW15A-18. Of note, previous response tests in bedrock had been completed by GHD at MW14A-15 (2.2 x 10^{-2} cm/sec) and MW5A-15 (1.4 x 10^{-5} cm/sec).

Based on the occurrence and elevations of the top of bedrock, observations of outcrops, observations of bedrock retrieved from boreholes, and bedrock occurrence inferred from geophysics, it was concluded that the bedrock ridge identified previously was not continuous. Further, geologic and hydrogeologic information suggested the possibility of an infilled trough or crevice (located between boreholes BH13-18 and BH14-18, which had been drilled along the apparent ridge), that may permit a hydraulic connection between Rico Lake and the Site.

Water-level monitoring indicated that groundwater flow remained to the southeast across the Site. However, the new groundwater information allowed more definitive elevation contours to be drawn between Rico Lake and the Site. When the geologic interpretation is considered, both the potentiometric surface map provided by GHD (Figure 5.1, reproduced below as Figure 1) and the west-east stratigraphic cross section extending from Rico Lake to the east across the Site (Figure 2.10 of the HHCR, reproduced below as Figure 2), indicate a hydraulic connection between Rico Lake and the Site. Groundwater flow is directed east from Rico Lake to the sands and gravels beneath the current gravel pit within the Site (the “Pit”), and then directed to the southeast beyond the eastern Site boundary.

Vertically, the hydraulic gradients were measured to be upward from bedrock into the overburden both at the new well pair (MW15A-18/MW15B-18), and at the well pair within the Pit (MW4A-15/MW4B-15).

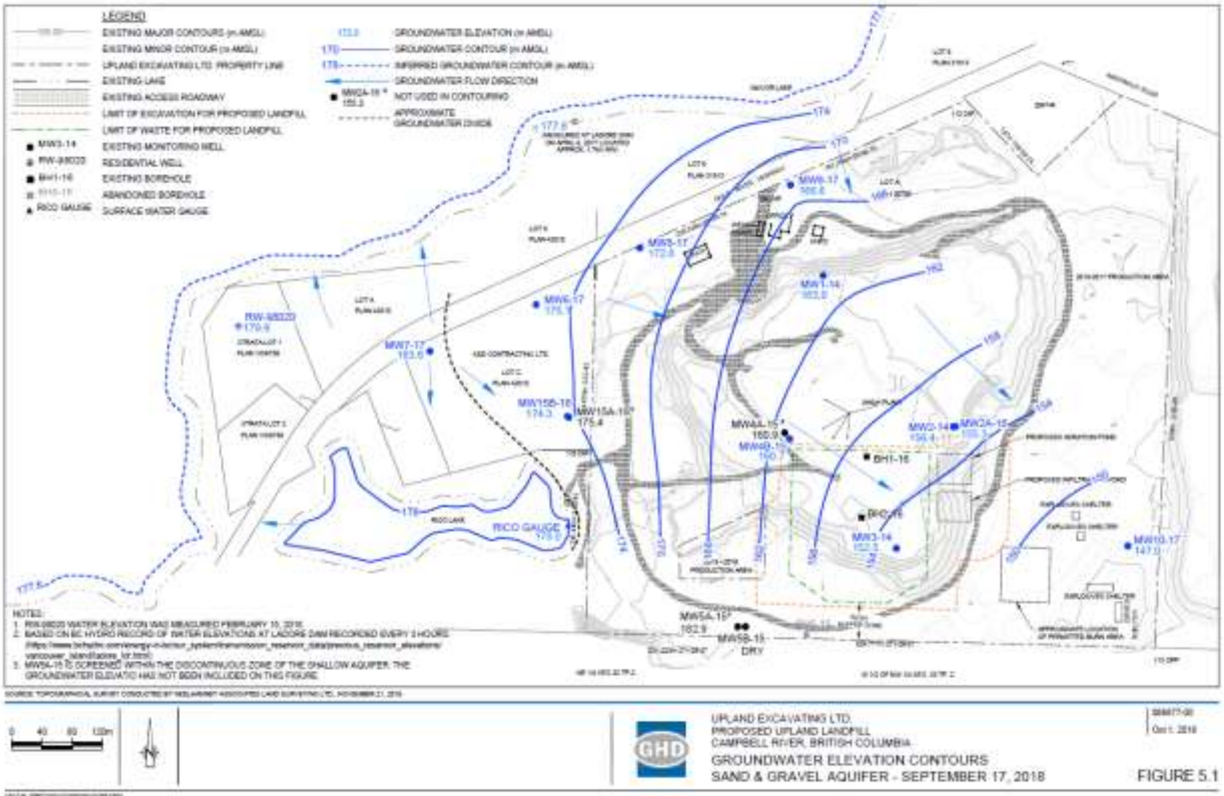


Figure 1. Water-level contours prepared by GHD, September 17, 2018 (from Figure 5.1, GD Response Letter Task 7).

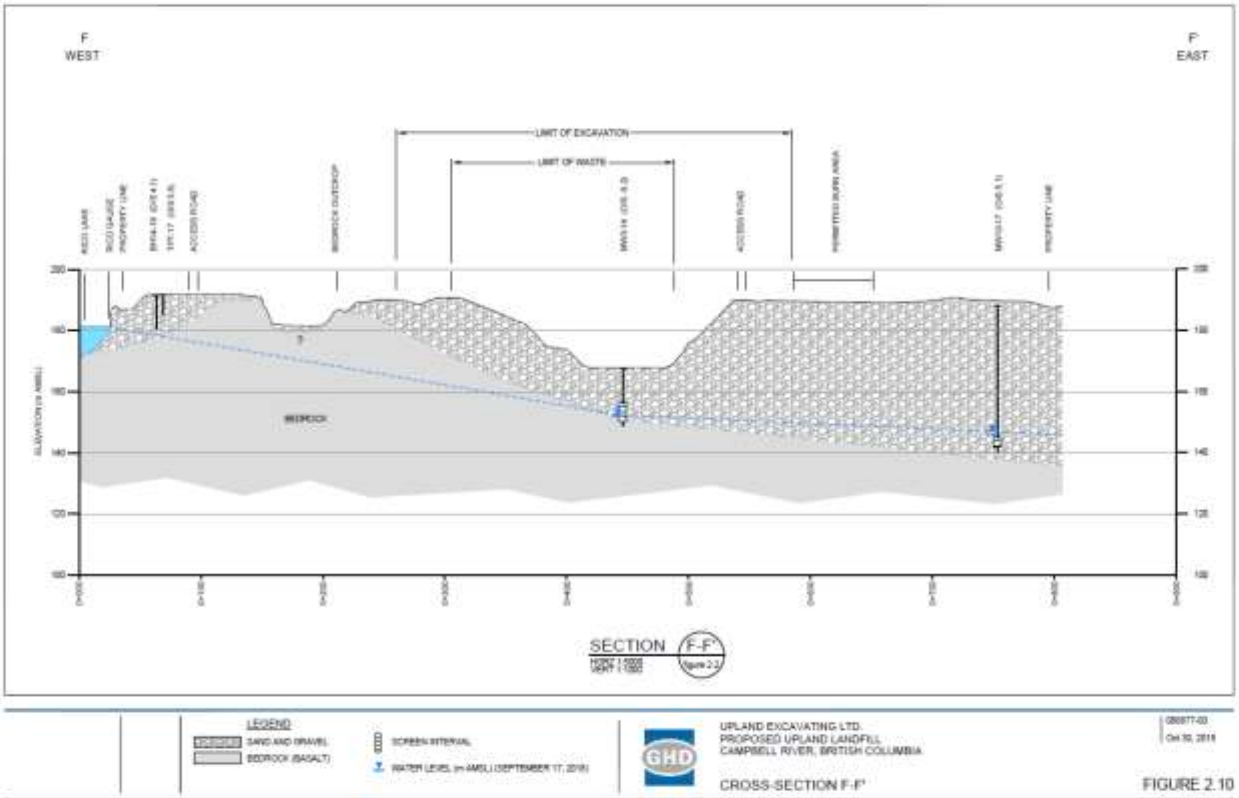


Figure 2. East-west stratigraphic cross section prepared by GHD (from Figure 2.10, additional information, HHCR Report).

2.3 Comments on Additional Bedrock Characterization

In their interpretation of Site geology, GHD states that the bedrock between Rico Lake and the Site "significantly restricts the movement of groundwater between these two features", and makes reference to areas of competent versus fractured bedrock. Estimates of bedrock K were noted to be variable (i.e., MW15A-18, 8.3 x 10^{-3} cm/sec; MW14A-15, 2.2 x 10^{-2} cm/sec; and MW5A-15, 1.4 x 10^{-5} cm/sec).

In my view, GHD's assessment understates the relevance of the fractured bedrock in conveying groundwater from Rico Lake to the Sand and Gravel Aquifer beneath the Site. Groundwater flow through the basalt occurs via secondary porosity features (i.e., open fractures), and the basalt bedrock across the Site is typically fractured (refer to Figure 3, below), as reported on all GHD borehole logs drilled into bedrock, and as I observed in rock cores from MW15A-18 and in bedrock outcrops during my Site visit.

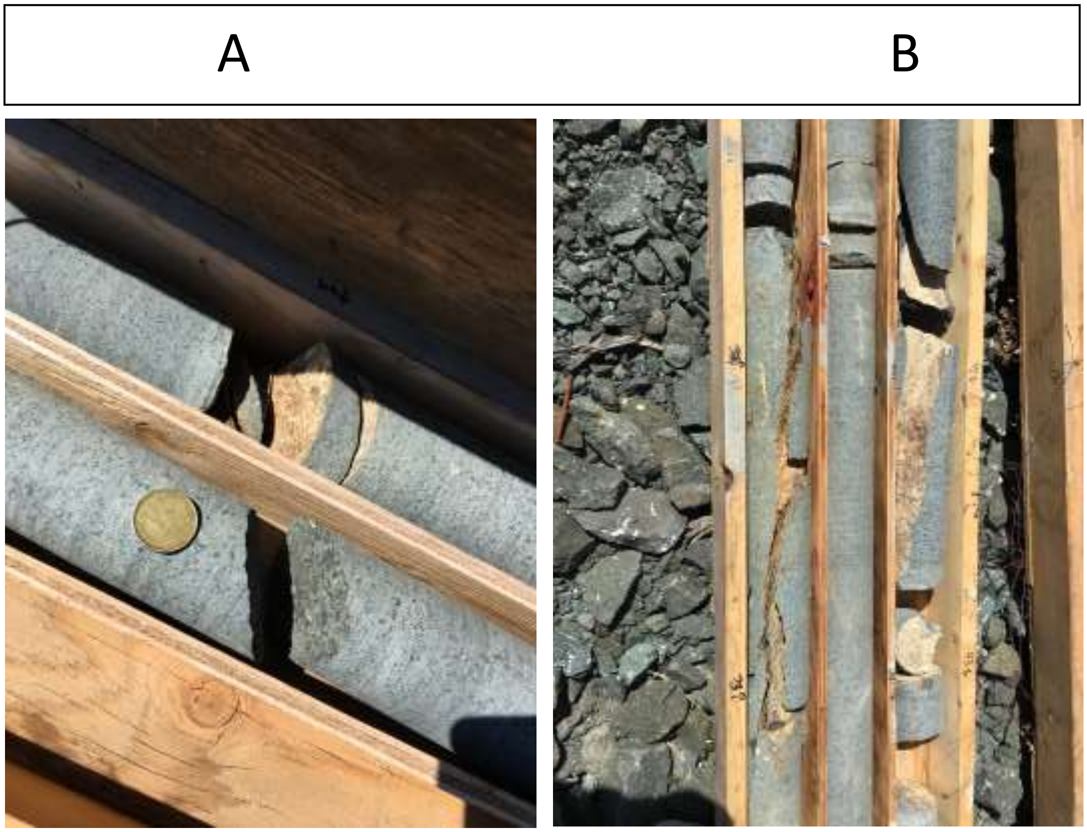


Figure 3. A) Rock core from MW15A-18 showing a weathered horizontal fracture (light brown weathered surface), and an unweathered fracture that probably resulted from coring. B) Weathered sub-vertical fractures is core from MW15A-18.

The hydraulic conductivity estimates for the bedrock, the recent groundwater elevation contour maps, and my observations all support the likelihood that the bedrock is a significant groundwater flow system at the Site. The frequency of fractures and groundwater contour maps indicate an interconnected fracture network, which in my view likely behaves as an equivalent porous medium at a volumetric scale of a few tens of cubic metres or less.

While there may be some zones of lower bulk hydraulic conductivity in the bedrock, there is nothing to suggest that these areas comprise a poorly connected system of isolated fractures, as speculated by GW Solutions Inc. The relatively high groundwater elevation to the south of the Site at MW5A-15 is consistent with more competent bedrock, and hence a much lower K, than elsewhere, and is possibly also indicative of perched conditions at that location. However, the estimated K of 1.4 x 10^{-5} cm/sec is consistent with secondary (i.e., fracture) porosity rather than primary porosity, as indicated by the presence of fractures noted on the borehole log for the well. Other bedrock wells at the Site indicate much higher K values, comparable with that of the Sand and Gravel Aquifer, and a well-connected fracture network.

The presence of a perched zone or deeper water table at MW5A-15 has no influence on groundwater flow beneath the Site (refer to Figure 5.1 of GHD, reproduced above as Figure 1), or the potential to reverse the measured vertically upward hydraulic gradients from bedrock into the Sand and Gravel Aquifer.

Hydraulic gradients in the bedrock convey the horizontal component of groundwater flow from areas of higher water elevation to the west, including Rico Lake, to lower elevations to the east and southeast, and vertically upward into the overlying Sand and Gravel Aquifer. This behaviour is consistent with observations and with expected hydraulic behaviour within a well-connected groundwater flow system through the fractured basalt. Consequently, groundwater from the Sand and Gravel Aquifer cannot enter the underlying bedrock, and groundwater from the Site, in either the Sand and Gravel Aquifer or in bedrock, cannot flow into Rico Lake.

The observed flow to the east and southeast is consistent with the anticipated regional flow system in the Sand and Gravel Aquifer and in bedrock. Regional flow is to the east and southeast, with groundwater discharge into the Quinsam River watershed or beyond with discharge to the sea. Vertically, the regional hydraulic gradients direct groundwater upward from the bedrock into the outwash sands.

Fractured bedrock is likely conveying a significant groundwater flux from Rico Lake to the east towards and beneath the Site. The groundwater contours presented on Figure 5.1 of GHD (reproduced as Figure 1 above), can be used to measure hydraulic gradients, which appear to have ranged from about 0.04 to 0.06 m/m in September 17, 2018. The gradients are significantly greater than the hydraulic gradient used by GHD in their analysis to estimate groundwater flux beneath the Site (0.03 m/m). The higher gradient in September 2018 indicates a greater groundwater flux on that date than estimated previously. Of relevance to the proposed landfill, greater measured gradients are indicative of larger groundwater fluxes beneath the proposed landfill which, in turn, indicate greater dilution of any mass loading from a liner leakage or failure scenario of the proposed landfill.

3.0 Sand and Gravel Aquifer Characterization

3.1 Sand and Gravel Aquifer Pumping Tests

Subsequent to ENV's recommendations, GHD completed two pumping tests within the Sand and Gravel Aquifer (Task 7) to improve the estimate of the hydraulic conductivity of the aquifer and the consequent estimated groundwater flux within the aquifer. The tests comprised two constant rate pumping tests (100 minutes and 8 hours duration, respectively) at MW4B-15, each under a pumping rate of 24 L/min (the maximum rate of the pump). Water levels were monitored manually or with pressure transducers within the adjacent bedrock well (MW4A-15), and in other select wells beyond the pumping well (MW1-14, MW2-14, and MW2A-16).

3.2 Updated Groundwater Flux Estimates and Mass Balance Model

A mass balance model developed previously by GHD was updated with the refined flux estimates to predict performance of the landfill (i.e., concentrations in groundwater) for various scenarios including a worst-case scenario of landfill liner failure. Initial flux estimates of groundwater flow passing beneath the footprint of the proposed landfill were developed by GHD as reported in the DOCP and HHCR. Based on April 2017 data, GHD used a saturated aquifer thickness of 5.46 m (as measured at MW3-14), a K estimate of 2.0 x 10^{-2} cm/sec and a hydraulic gradient of 0.03 m/m, yielding a flux estimate of 706 m^3/day, or 258,000 m^3 per year.

In response to reviewer comments, this estimate was refined in the GHD Technical Memo based on additional slug test data. Refined estimates of K of 1.7 x 10^{-2} cm/sec yielded a flux estimate of 600 m^3/day, or 220,000 m^3 per year. Subsequently, seasonality was taken into consideration by GHD in the flux estimates, as reported in the GHD Response Letter Tasks 1 – 6, section 4.1. As summarized by GHD, hydraulic gradients in the Sand and Gravel Aquifer were found to range from 0.026 to 0.031 based on measurements taken between 2015 and 2017 in January, March, April, September, October, and November. Water table fluctuations over the period monitored were about 2 m and, based on measurements at MW3-14, the saturated thickness of the aquifer was estimated to range from 4.45 m to 6.42 m. Using a rounded K value of 2.0 x 10^{-2} cm/sec, and considering maximum and minimum hydraulic gradients, the updated flux estimate was estimated to range from 500 to 865 m^3/day, or 180,000 to 320,000 m^3/year.

As reported in the GHD Technical Addendum, GHD updated its predictive model of downgradient groundwater concentrations using a hydraulic conductivity estimate of the geometric mean of the slug tests (1.7 x 10^{-2} cm/sec) and accounting for uncertainty by including a +/- 10% factor in the calculated flux estimate. This yielded a range in flux of 540 to 660 m^3/day.

In the GHD Response Letter Task 8, GHD included a value of 500 m^3/day as a lower bound of the flux in their predictive model of downgradient groundwater concentrations. For the worst-case scenario of landfill liner failure, predicted groundwater concentrations met applicable CSR AW and DW standards for key parameters (alkalinity, chloride, hardness, dissolved iron and manganese, sulphate, and total dissolved solids).

3.3 Pumping Test Results Summary

During pumping, drawdowns were only observed at the pumping well (MW4B-15) and within the adjacent monitoring well completed in bedrock (MW4A-15). The data generated using a pressure transducer at MW4A-15 was suspect, although drawdowns were confirmed by manual measurements. GHD stated that drawdown at the distant observations wells was “not unexpected”, given the radial distances from the pumping well of over 200 m. The drawdown observed in the bedrock well and the slight time lag, was interpreted to confirm the presence of a hydraulic connections between the bedrock and overlying aquifer.

Based on pumping test analysis using AQTESOLV and applying the Theis solution for an unconfined aquifer, GHD estimated the transmissivity of the aquifer and then calculated the hydraulic conductivity, K, to be 2.3 x 10^{-2} cm/sec and 2.5 x 10^{-2} cm/sec for the 100 min and 8 hr tests, respectively, with a geometric mean of 2.4 x 10^{-2} cm/s. K was calculated from T assuming a 16 m thick saturated zone that included the saturated thickness of the aquifer at the well (13 m) plus 3 m of bedrock (assumed to the weathered permeable upper part of the bedrock. Well losses were ignored in the analysis.

3.4 Comments on Pumping Test Results

In my view, the pumping test results are meaningful in that the pumping test stressed a much larger volume of aquifer than tested by the single well response tests, and yielded a very similar but slightly higher result than previously measured using a slug test, as I would expect (the geometric mean K of the pumping tests was 2.4 x 10^{-2} cm/sec, whereas the previous slug test at MW4B-15 yielded 2.0 x 10^{-2} cm/sec). The aquifer is relatively transmissive and can likely sustain much higher pumping rates than those imposed by the pumping test (i.e., much greater than 24 L/min). Pumping at a much higher rate would likely stress a large volume of aquifer and result in measurable drawdowns at the distant wells that were monitored; however, given the relatively uniform results developed by the single well response tests across the aquifer (the geometric mean of the slug tests was 1.7 x 10^{-2} cm/sec, and ranged from 1.3 x 10^{-2} cm/sec to 2.1 x 10^{-2} cm/sec), no significant change in the estimated K of the aquifer should be anticipated.

The estimated K from the pumping tests is considered conservatively low by GHD, and I concur. A larger assumed thickness results in a lower estimate of K, and thus the result is assumed to be conservatively low. The value is also considered conservatively low because well losses were ignored in the pumping test analysis. Well losses would be significant, given that the test was conducted on a conventional 51 mm (two-in.) PVC monitoring well completed with a conventional 10-slot PVC screen and sand pack.

In summary, it is my opinion that the K of the Sand and Gravel Aquifer is well characterised and reliable for use in predictive modeling and design. GHD chose to use both the geometric mean of 2.4 x 10^{-2} cm/sec and the more conservative value of 2.0 x 10^{-2} cm/sec in their design and predictive modeling which, in my opinion, adequately captures the uncertainty in the anticipated effective K of the Sand and Gravel Aquifer at the Site.

3.5 Comments On Updated Groundwater Flux Estimates

In my view, I concur with GHD that the estimates of advective groundwater flow velocities and groundwater flux used by GHD in predictive modeling are conservatively low. Actual fluxes or average fluxes may be higher and are likely much higher during prolonged periods of high precipitation as experienced during the rainy season. The effect of a higher flux would be increased dilution of any mass loading from the landfill, and a consequent reduction in predicted concentrations in groundwater downgradient of the Site. I concur with GHD that the groundwater flux estimates they developed (500 m^3/day) are conservatively low, and consider their use as a reasonable approach for design.

4.0 Applicable Environmental Performance Criteria

4.1 Assessment of Applicability of Groundwater Aquatic Life Standards

In the GHD Technical Addendum, clarification was provided on the applicability of Contaminated Sites Regulation (CSR) aquatic life (AW) standards for groundwater at the Site. ENV's Protocol 21 for Contaminated Sites – Water Use Determination states that AW standards apply to groundwater at sites where the groundwater occurs within 500 m of an aquatic receiving environment unless it can be demonstrated that groundwater does not flow to that receiving environment. An aquatic receptor assessment conducted in April 2017 was presented in the HHCR, which concluded that there are no aquatic receptors within 500 m of the downgradient Site boundary. GHD further noted that regional maps support the conclusion that all surface water courses downgradient of the Site boundary are all located more than 500 m beyond the boundary.

GHD also noted that, in accordance with Protocol 21, AW standards apply if substances in groundwater exceed AW standards and have the potential to migrate within 500 m of the aquatic receiving environment. To address this issue, GHD updated its groundwater quality assessment and revised its predicted groundwater concentrations at the downgradient property boundary using a mass balance approach. The assessment incorporated revised estimates of K for the Sand and Gravel Aquifer and groundwater flux (540 to 660 m^3/day). Based on GHD's calculations, AW standards were predicted to meet AW standards at the downgradient Site boundary for all groundwater substances considered, based on landfill development and assumed liner leakage rates.

In the GHD Response Letter Tasks 1-6, GHD noted that the April 2017 aquatic receptor assessment was updated in March 2018 with a follow-up confirmatory survey. The assessment identified two water courses (potential aquatic receptors) located to the southwest and within 500 m of the Site boundary. The assessment concluded that the water courses do not provide high quality aquatic habitat.

GHD further assessed the elevations of the water courses using published topographic maps, and noted that the two water courses occur at elevations of at least 200 m above mean sea level (asl), whereas the water table at the downgradient Site boundary is at an elevation of approximately 150 m asl and is likely to decline downgradient to the southeast and east. GHD presented a conceptual model in which they illustrated that groundwater from the Site would discharge into the Quinsam River channel at an elevation of approximately 75 m asl.

In the GHD Response Letter Tasks 1-6, GHD again updated its groundwater quality assessment for the Site, accounting for seasonal effects on groundwater flux through the Sand and Gravel Aquifer. Based on the results of their predictive modeling, groundwater concentrations were found to meet CSR DW and AW standards at the property boundary under all scenarios modeled.

Based on further assessment of the Sand and Gravel Aquifer, as discussed above, GHD further refined the estimate of K for the aquifer and estimated groundwater flux. Using both the revised estimate (600 m^3/day) and the previous conservative estimate (500 m^3/day), GHD found that predicted concentrations of key indicator parameters met CSR AW and DW standards at the Site boundary.

4.2 Comments on Applicable Groundwater Standards

Based on the assessment provided by GHD, I concur with their findings that DW standards apply to groundwater, and agree with their conclusion that CSR AW standards are not applicable to groundwater at the downgradient Site boundary. With respect to CSR AW standards and for clarity, it would be helpful if GHD could provide a revised Table 13.1 Groundwater Compliance Forecast presented in Attachment C of the GHD Technical Addendum that includes predicted results using the conservative flux estimate of 500 m^3/day. Based on my review of the magnitude of the changes in concentrations predicted for indicator parameters, it appears that all parameters assessed would meet both CSR AW and DW standards under the low flow and worst case liner failure scenario. However, this should be confirmed by GHD.

5.0 Summary of Opinion

In my view, the bedrock is sufficiently characterised and the groundwater flow system in the Sand and Gravel Aquifer sufficiently understood and the uncertainties sufficiently bounded to support the proposed landfill design presented by GHD. While GHD's assessment of bedrock conditions appears to understate the relevance of the fractured bedrock in conveying groundwater from Rico Lake to the Sand and Gravel Aquifer beneath the Site, the consequences do not affect the understanding of groundwater flow, transport of groundwater constituents, and groundwater flux beneath and downgradient of the Site. While there may be some zones of lower bulk hydraulic conductivity in the bedrock, there is nothing to suggest that these areas comprise a poorly connected system of isolated fractures, as speculated by GW Solutions Inc.

Hydraulic gradients in the bedrock convey the horizontal component of groundwater flow to the east and southeast, and vertically upward into the overlying Sand and Gravel Aquifer. Consequently, groundwater from the Sand and Gravel Aquifer cannot enter the underlying bedrock, and groundwater cannot flow in either the Sand and Gravel Aquifer or in bedrock from the Site into Rico Lake.

Of relevance to the proposed landfill, greater measured hydraulic gradients are indicative of larger groundwater fluxes beneath the proposed landfill which, in turn, indicate greater dilution of any mass loading from a liner leakage or failure scenario of the proposed landfill.

Pumping tests conducted by GHD in the Sand and Gravel Aquifer, although conducted at a relatively low rate for the aquifer (24 L/min), stressed a much larger volume of aquifer than the single well response tests. The estimated K from the pumping tests (2.4×10^{-2} cm/sec) is considered conservatively low by GHD, and I concur.

In summary, it is my opinion that the K of the Sand and Gravel Aquifer, hydraulic gradients and estimated groundwater fluxes are well characterised and reliable for use in predictive modeling and design. GHD chose to use both the geometric mean of 2.4×10^{-2} cm/sec and the more conservative value of 2.0×10^{-2} cm/sec for K in their design and predictive modeling which, in my opinion, adequately captures the uncertainty in the anticipated effective K of the Sand and Gravel Aquifer at the Site. I concur with GHD that the estimates of advective groundwater flow velocities and groundwater flux used by GHD in predictive modeling are conservatively low. Actual fluxes or average fluxes may be higher and are likely much higher during prolonged periods of high precipitation as experienced during the rainy season.

Finally, I concur with GHD's findings that DW standards apply to groundwater, and agree with their conclusion that CSR AW standards are not applicable to groundwater at the downgradient Site boundary. With respect to CSR AW standards and for clarity, it would be helpful if GHD could provide a revised Table 13.1 Groundwater Compliance Forecast presented in Attachment C of the GHD Technical Addendum that includes predicted results using the conservative flux estimate of 500 m^3/day.

6.0 Limitations

This review was conducted for the exclusive use of GHD Limited and their client. The report is intended to provide a technical review and opinion of information provided in the documents referenced above respecting the adequacy of the environmental Site investigations and remediation conducted at the subject Site. This report is not meant to represent a warranty, or a legal opinion regarding compliance with applicable laws. The reviewer makes no other representation or warranty as to the accuracy or completeness of the information provided.

This review followed the standard of care expected of professionals undertaking similar work in British Columbia under similar conditions. The reviewer's conclusions and opinions are entirely based on the information provided. The reviewer has relied on the accuracy and completeness of the background materials upon which the reported information was based, and is not responsible for errors or omissions in such background materials.

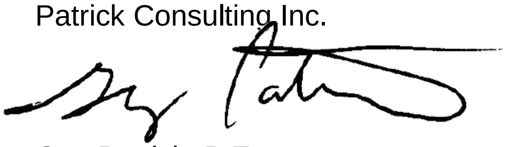
Any use by which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. The reviewer accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

5.0 Closure

We trust that you find this letter report satisfactory and welcome the opportunity to discuss any of the above at your convenience.

Sincerely,

Patrick Consulting Inc.



Guy Patrick, P.Eng.
Director