



June 12, 2017

Reference No. 088877-02-05

Mr. Allan Leuschen
Senior Environmental Protection Officer
Authorizations – South
Environmental Protection Division
Ministry of Environment
2080 Labieux Road
Nanaimo, British Columbia
V9T 6J9

Dear Mr. Leuschen:

**Re: City of Campbell River Comments
Upland Landfill – Notification of Application for Operational Certificate for Solid,
Non Hazardous Waste Landfill
7295 Gold River Highway, Campbell River, British Columbia**

GHD Limited (GHD) has prepared this letter on behalf of Upland Excavating Ltd. (Upland) to provide the Ministry of Environment (MOE) with a technical response to the November 24, 2016 City of Campbell River letter (CCR Letter). The CCR Letter provides a list of comments and concerns with respect to Upland's Waste Discharge Application and is attached as Attachment A. Upland and GHD have reviewed the CCR letter and provide the following response.

1. Background

1.1 Waste Discharge Application

Upland submitted a Waste Discharge Application (Application) to the MOE to receive an Operational Certificate for the solid, non-hazardous waste engineered landfill (Landfill) located at 7295 Gold River Highway (Site or Upland Property), Campbell River, British Columbia. The Application was submitted to the MOE on May 27, 2016. The following Technical Reports were submitted in support of the Application to present the design, technical studies, and investigations completed by GHD and Upland:

- Technical Assessment Report
- 2016 Design, Operation, Closure Plan
- Hydrogeology and Hydrology Characterization Report
- 2016 Geotechnical Investigation Report

Upland has carried out two stakeholder consultation programs to engage and invite comment from government agencies, First Nations, adjacent property owners, community groups, and the public. The stakeholder consultation programs took place in February-March 2016 and September-October 2016, respectively. The stakeholder consultation programs were summarized in two separate Stakeholder Consultation Summary Reports provided to the MOE.



1.2 City of Campbell River (CCR)

The CCR was included in the stakeholder consultation process. GHD also met with CCR staff on November 10, 2016. Upland and GHD understand that CCR staff are familiar with the Application and Technical Reports. CCR provided comments regarding the Application in the CCR Letter.

2. Review and Response

Upland and GHD have reviewed the CCR Letter in detail. The comments and concerns provided in the CCR Letter are listed below by report title, and comment/question number. The text from the CCR Letter is presented in ***bold and italic***.

2.1 Stakeholder Consultation Summary Report

Comment 1. (1)

Council requested clarification on the relationship between the new Water Sustainability Act and the application of the Act to this project (14 April 2016). This information was not included in the Consultation Summary Report. Please clarify.

GHD Response

The *Water Sustainability Act* (Act) applies to the use and diversion of surface and groundwater, and establishes a licensing regime for such uses. The project proposes no use or diversion of any groundwater or surface water as defined by the Act. No authorization under this Act is required for the Upland Landfill project.

The Act's *Groundwater Protection Regulation* governs the installation, deactivation, and decommissioning of monitoring wells under an appropriate Qualified Professional and is being followed.

Comment 2. (2)

Council also requested a cross section showing McIvor Lake through Rico Lake and the Site that includes the depth of Rico Lake in order to determine subsurface drainage (14 April 2016). This request is not addressed in the consultation summary. Please address.

GHD Response

Please see Figure 3.0B and 3.0C (Conceptual Flow Models) in the Updated Hydrogeology and Hydrology Characterization Report.

Comment 3. (3)

City Staff previously noted that should the proposal proceed, the development would trigger the City of Campbell River's Watershed Development Permit process and the submission of an Environmental Impact Assessment report that assesses risks and that defines and evaluates the



cumulative effects of the landfill. Thank you for acknowledging that further discussion will occur on the development permit requirement subsequent to making an application under the Provincial Waste Discharge Regulation.

GHD Response

Comment Noted.

Comment 4. (4)

City Staff asked a question in relation to pre-landfilling baseline water quality “Since the site is already operating as a landfill, is it correct to call the baseline water quality “pre-landfilling” in the hydrology report? To what extent is the baseline water quality already impacted by past landfilling activity at the Site?” The answer in the consultation report notes that only ash is within the localized area above the pit wall. Does this mean that no leachate could be present in the various ground water samples collected from previous landfilling activities? Please clarify.

GHD Response

Groundwater quality monitoring has been carried out at the Site on three separate occasions between the fall of 2015 and the spring of 2017. As a result of this sampling, the groundwater quality on site was determined to be good with no exceedances of the *Contaminated Site Regulation* (CSR) Schedule 6 Drinking Water (DW) Criteria in the on-site sand and gravel aquifer. The only exceedance to the CSR Schedule 6 DW standards was detected in spring of 2017 for Nitrate, at monitoring well MW5A-15, This monitoring well is used for testing the shallow groundwater above the aggregate extraction pit wall adjacent to the area where rock extraction activities are being carried out. The nitrate exceedance is likely a residual impact from the blasting activities carried out in this area. No other exceedances of the Schedule 6 DW Standards were detected. The term baseline is used to refer to “prior to construction of the lined landfill cell.”

2.2 Technical Assessment Report

Comment 1. (5)

General question- If for some reason the landfill is not pursued and an Operational Certificate is not obtained, what happens to the existing fill and potential leachate generated from this material?

GHD Response

A closure plan for the existing waste discharge area would be prepared and submitted to the Ministry of Environment for their review and approval.



Comment 2. (6)

1.4.2 The last bullet references that draft reports be submitted to MoE for comment prior to the final application. Did MoE provide comments to Upland on the previous draft reports and if so, would these comments be available for City/public review?

GHD Response

The MOE did not provide comment on the draft technical reports. These reports were amended in response to additional work undertaken by GHD and Upland, and to respond to stakeholder comments.

Comment 3. (7)

9.2.13 Quarterly groundwater sampling will not capture extreme events. How will extreme events be captured?

GHD Response

As discussed in Section 13.1.1 of the 2017 Design, Operations, and Closure Plan the travel time of groundwater from the infiltration pond to the Site boundary is approximately 160 days. The groundwater travel time is not affected by extreme rainfall events as there is a thick vadose zone above the groundwater providing a buffering effect. Quarterly monitoring identified in the environmental monitoring program (EMP) will provide for an adequate frequency of monitoring to track groundwater quality trends over time.

As discussed in Section 14.0 of the 2017 Design, Operation, and Closure Plan, the EMP is designed in accordance with the 'Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills' prepared and published by the Ministry of Environment. The EMP will assess groundwater quality at quarterly intervals to assess the groundwater quality over space and time to ensure compliance with the applicable performance and compliance criteria. The monitoring well network throughout the Site will be used to monitor groundwater quality trends.

Comment 4. (8)

10.3 Thank you very much for including a section on avoided greenhouse gas emissions by providing a local solution to the local waste stream. The Comox Valley Waste Management Centre in Cumberland is used as the alternative location in the calculation presented. Note however that this facility does have a system in place to capture landfill gas which may mean that 442 tonnesCO₂e of avoided transportation emissions could be offset by the system to collect the gas generated once the material is landfilled.

GHD Response

The Comox Valley Waste Management Centre (CVWMC) in Cumberland was used to simplify the comparison and provide a conservative estimate of the greenhouse gas reductions related to transportation. In reality, it may not be feasible to divert all of the construction, demolition waste, and



landfill clearing debris to the CVWMC. If this is the case, the greenhouse gas emissions related to the transportation of waste may be significantly higher if the waste is barged to the lower mainland and/or shipped to the Interior/United States. The ultimate receiving facility may or may not have a landfill gas collection system.

Further, contaminated soil is not a contributor to landfill gas or greenhouse gas emissions, and the greenhouse gas emissions associated with the discharge of this waste stream is limited to the transportation.

The Landfill will consider the use of passive biofilters in the final cover system, as discussed in Section 10.7 of the Design, Operation, and Closure Report, which would reduce greenhouse gas emissions of the Landfill, if appropriate, dependent on the methane generation resultant from the actual waste streams landfilled.

Comment 5. (9)

11.1 and 11.2 Can Upland confirm if MoE will make the proposed quarterly and annual reports available to the public?

GHD Response

Annual reports are submitted directly to the MOE. Upland cannot comment on whether the MOE will make those reports publicly available.

Comment 6. (10)

11 Which bullet(s) in the proposed monitoring program cover the geotechnical investigation recommendations regarding short term settlement, long term settlement and a slope stability contingency plan? These considerations should be specifically referenced so there is no confusion as to whether or not they are included in the monitoring program.

GHD Response

Please see Section 14.7 of the 2017 Design, Operations, and Closure Plan, which includes a revision to the environmental monitoring program to include specific details on the monitoring of the geotechnical condition of the Landfill.

2.3 2016 Geotechnical Investigation

Comment 1. (11)

4.2 Please clarify the implication of the potential temporary saturation condition at the base of the east/northeast toes of the landfill caused by existence of the Gravel wash plant and a treated leachate infiltration pond.



GHD Response

Wash Plant: There is no significant implication that would result from the operation of the wash plant and ponds. The wash plant ponds for the most part are a closed system with marginal water loss to the underlying aquifer.

Treated Leachate Infiltration Pond: Due to the thickness and porosity of the vadose zone, it is expected that the relatively small cross-sectional area below treated leachate infiltration pond will experience temporary saturation; however, due to the thickness and porosity of the vadose zone the infiltrated treated leachate will readily reach the underlying principle groundwater flow system (sand and gravel aquifer). There will be no significant implications due to the temporary saturated condition that will develop below the treated leachate infiltration pond.

Comment 2. (12)

4.8 and 6 During the period of short term settlement, site reconnaissance by geotechnical professionals is recommended to identify locations of distress. What will the frequency of these inspections be and will the inspection results be included in the environmental management plan (EMP) quarterly or annual reporting described in the Technical Assessment Report? Similarly, will long term (primary consolidation) settlement repairs and creep (secondary consolidation) settlements be reported out on as part of the EMP? In relation to these issues, the conclusions section also recommends the development of a contingency plan as part of the continued use and closure design to address any sudden buildup of pore pressure in the landfill. Has this contingency plan been developed?

GHD Response

The Landfill operation staff will regularly monitor the condition of the Landfill. Please see Section 14.0 of the Updated Design, Operations, and Closure Plan for the details of the Environmental Monitoring Program. An annual geotechnical inspection will be carried out by a Qualified Professional. In the event a sudden change is observed by the operating staff, which has caused settlement, cracking, bulging or signs of instability, a Qualified Professional will perform a Site inspection. All notable Site observations or Site inspections will be discussed in the annual operations and monitoring report including recommendations for additional required actions.

Repairs required to remediate settlement, pore pressure build-up, creep, etc. will be conducted as part of the ongoing operations and maintenance of the Landfill. Contingency plans have been developed and a summary of each is presented in Section 9.0 of the updated Technical Assessment Report.

Comment 3. (13)

6 In the conclusions it is identified that “The potential for settlement of the landfilled waste should be considered when conducting a detailed evaluation of the landfill cover system.” When will this recommendation been actioned?



GHD Response

The detailed design of the Landfill cover system will be conducted at the time of progressive Landfill closure. At that time the potential remaining settlement of the landfilled waste will be evaluated based on the actual waste streams (i.e., quantity of compactible soils versus construction and demolition waste) landfilled. Please see Section 3.9 of the Updated Design, Operation, and Closure Plan.

2.4 Hydrogeology and Hydrology Characterization Report

Comment 1. (14)

We are very concerned that the GW Solutions review has identified that “there is insufficient characterization of the groundwater regime across and near the Site.” The report goes on to note that when they used the data provided by GHD their interpretation of groundwater is that it moves in an east-northeast direction as opposed to southeast. What additional studies would be required to determine which interpretation is correct and over what time frame would these studies need to be conducted?

GHD Response

We disagree with GW Solution’s conclusions about groundwater characterization. The groundwater contour plan prepared by GW Solutions includes the following technical errors, which result in a different groundwater flow direction than GHD’s interpretation:

- GW Solutions included the static groundwater elevation at MW5B-15 in its groundwater contouring. The groundwater level in this monitoring well should not be included in developing the groundwater contours for the sand gravel aquifer below the aggregate pit. As discussed in Section 2.3.2 of the Hydrogeology and Hydrology Characterization Report, MW5B-15 is completed within a thin shallow overburden aquifer overlying the bedrock above the pit wall. This aquifer is only recharged by infiltrating precipitation, may be ephemeral in nature and does not influence the thick sand and gravel aquifer below the base of the aggregate pit.
- GW Solution’s includes a static groundwater elevation from BH1-16. This borehole was not completed as a monitoring well and as such, the water level included on the stratigraphic and instrumentation log for this borehole represents a very approximate and preliminary water level that is likely affected by drilling fluids and process, and thus should not be considered a reliable static groundwater elevation.
- The groundwater contours presented by GW Solutions intersect Mclvor Lake at near-right angles. Mclvor Lake is a constant source of recharge to the sand and gravel aquifer underlying the Site. The contours as presented by GW Solutions imply that Mclvor Lake and the on-site aquifer do not share a hydraulic connection.

In the winter to spring 2017, GHD completed additional investigations to refine the groundwater characterization. The results of this additional investigation has allowed GHD to further refine the hydrogeologic characterization and evaluate the seasonal fluctuations of groundwater on the Site. As Mclvor Lake is a constant head, little seasonal fluctuation will occur with the thick sand and gravel aquifer.



Please see the groundwater levels within Section 2.3 of the Hydrogeology and Hydrology Characterization Report for a detail regarding the updated groundwater flow regime.

Comment 2. (15)

The GW Solutions report also notes that there is insufficient characterization of both the lithology and groundwater regime at and beyond the property boundary and insufficient information on the vertical and horizontal hydraulic gradients. What additional studies would be required and over what time frame would these studies need to be conducted to solve this issue?

GHD Response

In our opinion, the lithology and groundwater gradients on the Site have been sufficiently characterized. Additional investigations in the winter-spring 2017 included advancing boreholes, installing monitoring wells and excavating test pits to further refine the characterization of the geologic and hydrogeologic conditions for the Site characterization. The additional information is included in the Updated Hydrogeology and Hydrology Characterization Report.

Comment 3. (16)

The GW Solution requests a complete picture of the hydrological regime of Rico Lake and the City concurs with this recommendation.

GHD Response

Please see Figure 2.0B (Local Watershed Map) and Figure 2.9 (Groundwater Elevation Contours) of the Hydrogeological and Hydrology Characterization Report for additional information regarding the hydrologic and hydrogeologic interactions of Rico Lake with the Site. In summary, Rico Lake is part of Campbell River Watershed. Rico Lake is a hydrological basin that collects precipitation from the terrain directly adjacent to Rico Lake and discharges to Mclvor Lake.

Comment 4. (17)

Has consideration been given to the low flood control zone level of 172 m for Mclvor Lake in the BC Hydro Campbell River System Water Use Plan?

GHD Response

Yes, and it is not anticipated that a drop of 6 m in Mclvor Lake will have significant implications relating to the hydrogeologic conditions below the Site. The elevation in Mclvor Lake is approximately 178 metres (m) above mean sea level (AMSL) currently. The groundwater gradient from Mclvor Lake to below the proposed Landfill dips approximately 16 m. In the event the water level drops by 6 m to 172 m, the resulting hydrogeological gradient would be approximately 10 m, which will continue to be a significant hydrogeological gradient.



Comment 5. (18)

1.3 Future land use in the vicinity of the site may include private domestic wells. Could leachate potentially contaminate the aquifer for those wells?

GHD Response

No. The residential properties in the vicinity of the Site are located upgradient. Groundwater from beneath the Site does not flow toward these properties.

Comment 6. (19)

3.4.2 States "...bedrock surface is variable at site." Could areas of the sand and gravel aquifer potentially extend northeast to Mclvor Lake?

GHD Response

Yes, Mclvor Lake has a connection with the sand and gravel aquifer. The hydrogeologic conditions show that Mclvor Lake recharges the sand and gravel aquifer. Please see Sections 2.2.2.2 and 2.3 of the Hydrogeology and Hydrology Characterization for the details of the bedrock and groundwater contours on Site.

Comment 7. (20)

3.4.2 States "There are insufficient monitoring points to accurately map the groundwater flow direction within the fractured bedrock unit." There is only one bedrock aquifer monitoring well. How can this situation be remedied? How many more monitoring points are required and what are the plans for following through with this recommendation? Could groundwater move from the Site to Mclvor Lake?

GHD Response

The bedrock aquifer unit is not a receptor of infiltrating water from the base of the aggregate pit because the bedrock dips significantly upgradient (west) of the proposed Landfill footprint. The sand and gravel aquifer below the base of the aggregate pit and continuing downgradient becomes very thick. The sand and gravel aquifer is the only potential receptor, and as such is the focus of the hydrogeological investigations and future monitoring.

No, groundwater cannot move from the Site (i.e., below the proposed Landfill footprint) to Mclvor Lake. The Mclvor Lake water level is confirmed to be above the groundwater level below the Landfill by approximately 16 m (or 10 m during a period of low flood control zone level). Groundwater will not flow upgradient.

Comment 8. (21)

3.4.4 Notes that there are two water bearing perched aquifers identified in the southwest portion of the site and that these water bearing zones are not connected with the remaining ground water



units at the site. Figure 3.6 does not show the flow of groundwater in this location. Please clarify the groundwater flow path for these perched aquifers, or if unknown, please describe what works need to be completed to determine the flow. Would additional down-gradient monitoring wells be required in this location to determine baseline water quality?

GHD Response

Please see Section 2.3.3 of the Hydrogeology and Hydrology Characterization Report, which further characterizes the shallow aquifer along the western border of the Site. The Conceptual Flow Model Schematic Cross-Section on Figures 3.0C of the same reports provides a visual depiction of the groundwater interpretation in this area.

Comment 9. (22)

3.4.4 What is the water level at MW5A-15 during peak the precipitation period?

GHD Response

The water level in MW5A-15 ranged from 182.9 to 184.6 m AMSL in September 2015 and January 2016, respectively. The water level was recorded to be 184.2 m AMSL in April 2017. All water levels are presented in Table 2.0 of the Hydrogeology and Hydrology Characterization Report.

Comment 10. (23)

3.4.5; 4.2; 4.4 and 5 (recommendation section) The report recommends that a monitoring well be installed within the overburden sand and gravel aquifer near the down-gradient Site boundary (MW6-16) prior to landfill development to establish baseline water quality and to assess future water quality. What are the plans for following through with this recommendation? If the groundwater flows are not as interpreted (as GW suspects), MW6-16 may not be in the right location and additional monitoring wells may be required.

GHD Response

An additional downgradient monitoring well, referred to as MW10-17 in the Hydrogeology Characterization Report, was installed in March 2017. The characterization of the groundwater regime was further refined as presented in Section 2.3 of the same report.

Prior to the landfilling of waste, additional down-gradient and/or cross-gradient wells will be installed and included in the Environmental Monitoring Plan to ensure monitoring location meet the requirements of the 'Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills (BC MOE), as discussed in Section 14.0 of the Updated Design, Operation and Closure Plan.

Comment 11. (24)

3.4.5 and 5 (recommendation section) The report recommends that "In order to further investigate the nature of this bedrock ridge and further validate the direction and magnitude of groundwater



flow between the Site and McIvor and Rico Lakes, an investigation of the bedrock ridge and bedrock between Rico and McIvor Lakes should be undertaken through installation of three bedrock groundwater monitoring wells.” What are the plans for following through with this recommendation?

GHD Response

In 2017, four additional boreholes instrumented as monitoring wells were advanced along the Gold River Highway on the Upland owned properties to further investigate the bedrock ridge including the depth and integrity of the bedrock. A test pit program and survey of visible bedrock outcrops were also completed to further investigate the nature of the bedrock ridge. The bedrock ridge is discussed in Section 2.2.2.2 of the Updated Hydrogeology and Hydrology Characterization Report.

Comment 12. (25)

Figure 3.2 indicates the potential that the final elevation of proposed fill material may create a groundwater divide that directs a portion of groundwater on site to the West. Please comment on the potential for this to occur and what the implications might be.

GHD Response

Figure 2.2 of the Hydrogeology and Hydrology Characterization Report (GHD, May 27, 2016) presents the cross-section lines and locations of the five subsurface cross-sections shown on Figures 2.3, 2.4, 2.5, 2.6, and 2.7.

The final Landfill elevations are presented in Drawing C-05 of the 2017 Design, Operation, and Closure Plan. All precipitation that lands on landfill surface once that Landfill is closed will be directed via sheet flow and surface water swales/ditches to the base of the pit for infiltration, as presented in Section 8.0 of the 2017 Design, Operation and Closure Plan.

The watershed divide shown on Figure 2.0B of the Hydrogeology and Hydrology Characterization Report will not be affected by landfilling or the final contours of the Landfill.

Comment 13. (26)

Figure 3.3 Is the high elevation of the proposed landfill 191 m AMSL?

GHD Response

As shown in Drawing C-05 of the 2017 Design, Operation, and Closure Plan, the proposed Landfill crest is 192. The highest point of the closed Landfill is proposed to be 195 m.

Comment 14. (27)

Table 2.0 The water level at MW5B-15 on Jan 25, 2016 was 186.6 m AMSL. This is above even the maximum operating level of the Campbell Reservoir system. Could this lead to ground water flow towards McIvor Lake? Please refer to BC Hydro (2012). Campbell River System Water Use Plan.



Retrieved from:

https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/planning_regulatory/wup/vancouver_island/2012q4/campbell_river_WUP_accept_2012_11_21.pdf

GHD Response

Please see the Figures 2.9 (Groundwater Elevation Contours) and 3.0B (Conceptual Flow Model) of the Updated Hydrogeology and Hydrology Characterization Report. Water to the west of the groundwater divide presented on Figure 2.9 may flow to Mclvor Lake. There is no hydraulic connection between the aquifer along the southern boundary of the Site (MW5B-15) and Mclvor Lake.

Comment 15. (28)

4.0 Groundwater, residential, surface water, and wash plant samples collected to characterize baseline groundwater quality were restricted to the period Sept 2015 to Jan 2016. Please indicate why sampling has not covered a full year in order to determine seasonal variation in water quality?

GHD Response

Seasonal variations were identified in three monitoring events during September 2015, January 2016, and April 2017. This frequency of monitoring provides a reliable indication of groundwater quality during the dry season, wet season, and upon freshet. The results are presented in Section 4.0 of the Updated Hydrogeology and Hydrology Characterization Report.

In general, the water quality was consistent and has low concentrations of all parameters.

Comment 16. (29)

4.0 Since landfill is already occurring on the Site, is the sampling that is being conducted to determine baseline water quality potentially already being impacted by leachate?

GHD Response

See response to Comment 4 above.

Comment 17. (30)

4.1 Currently, freshwater aquatic life standards will be applied to only the western boundary of the site. Would it be feasible to apply these guidelines to all of the site boundaries?

GHD Response

The fresh water aquatic life standard does not apply to all Site boundaries due to the lack of groundwater discharge to aquatic receptors downgradient of the Site. Please see Section 4.1 of the Updated Hydrogeology and Hydrology Characterization Report for additional rationale.



Comment 18. (31)

4.2 Only selected parameters are used for baseline water quality data. MoE has set baseline waste quality objectives for Mclvor Lake including total zinc, copper, cadmium, and phosphorus. These should be included in baseline water quality data. Please reference the British Columbia Ministry of Environment (2012). Water Quality Assessment and Objectives for the John Hart Community Watershed and Mclvor Lake. Retrieved from:

http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/wqo_tech_john_hart_mclvor.pdf

GHD Response

Zinc, copper, cadmium, and phosphorus were included in the parameter list used to analyze the baseline water quality. The full list of parameters is presented in Tables 4.0 and 4.1 of the Updated Hydrogeology and Hydrology Characterization Report. A select list of typical indicator parameters, as noted in Section 4.2.1 of the same report, were chosen to highlight specific parameters that may be used in the future for comparison to leachate samples collected from the proposed Landfill.

Comment 19. (32)

4.2 Only surface water quality is discussed at Mclvor Lake and Rico Lake between September and October; please provide the number of samples taken at each – it appears that only two samples were taken. Given thermal stratification, the potential for groundwater infiltration subsurface, lake turnover and other potential characteristics of lakes that could cause wide variation of water chemistry at different depths and over seasons, please discuss how these restricted samples are adequate to determine baseline conditions.

GHD Response

The surface water quality was monitored for informational purposes only to provide a comparison to the on-site groundwater. An additional sampling event was conducted in April 2017, as presented in Section 4.2.3 of the Updated Hydrogeology and Hydrology Characterization Report.

Mclvor Lake is upgradient of the Site and there are sufficient upgradient monitoring wells on site to characterize upgradient water quality and as such additional surface water samples are not required for appropriate water quality monitoring of the Site. Rico Lake is hydraulically disconnected to the sand and gravel aquifer unit below the proposed Landfill and no further surface water samples were required for characterizing the Site.

Comment 20. (33)

4.2 Is one sample from on-Site wash plant enough to adequately determine if the wash plant is a source of impact to overburden sand and gravel aquifer? How would the water quality at the wash plant be expected to vary over the year?



GHD Response

An additional wash-plant sample was collected in April 2017 to confirm the initial water quality assessed.

The wash plant is used to wash fine material from the gravel and rock extracted from the on-site aggregate pit. The water quality from washing the on-site material would not affect the groundwater on site because the material washed are fine particles of minerals that originate on site. Seasonal fluctuations of the wash water would not occur other than the potential pH of rainwater. The sand and gravel aquifer has been monitored in the vicinity of the wash plant. Additional wash-plant samples are not considered to be required at this time.

2.5 2016 Design, Operations, and Closure Plan

Comment 1. (34)

2.1.2 What sources were referenced to determine drainage and watercourses features? Was the Sensitive Ecosystem Inventory referred to?

GHD Response

The BC Water Resource Atlas and IMapBC were referenced to determine drainage and watercourse features. The Sensitive Ecosystem Inventory (SEI) is referenced within the iMapBC database. The SEI is based on air photos and mapped at a 1:20,000 scale and can be used as a 'flagging tool'. The area 500 m to the south, southeast, and east of the Upland Property line was also verified by a registered professional biologist, as recommended by the SEI.

Comment 2. (35)

2.1.2 Several ephemeral creeks with drainage to the Quinsam River are noted but their distances to the Site are not referenced. Please provide these distances and the source of this information.

GHD Response

The ephemeral creeks are discussed in Section 2.1.2 of the Updated Hydrogeology and Hydrology Characterization Report. The distance to the ephemeral creeks located to the southeast is approximately 1 kilometre based on information contained in the BC Water Resource Atlas.

Comment 3. (36)

2.2.2.1 Can fractured bedrock seams exist that would allow groundwater flow to Mclvor Lake?

GHD Response

No, Mclvor Lake water level is confirmed to be above the groundwater level below the Landfill by approximately 16 m. Groundwater will not flow upgradient.



Comment 4. (37)

2.2.2.1 Is the “interbedded silt” area subject to mass wasting?

GHD Response

With respect to the geology in the vicinity of the Landfill, the answer is no because there are no interbedded silts adjacent to the Landfill. The only location of interbedded silt is a thin strata on top of the bedrock above the southern pit wall.

Comment 5. (38)

2.3.1.1 What is the static water elevation within Mclvor Lake? If Mclvor Lake fluctuates by about 1.5m, would the elevation differential still be great enough to support the interpretations as noted on page 7?

GHD Response

Please see Table 2.0 of the Updated Hydrogeology and Hydrology Characterization Report for the static water elevation of Mclvor Lake during each monitoring event. The elevation of Mclvor Lake is approximately 177.6 m AMSL. The hydraulic gradient in the overburden sand and gravel aquifer is significant, and the groundwater below the aggregate pit is approximately 16 m below the elevation of Mclvor Lake. There will be no impact to the on-site sand and gravel aquifer if Mclvor Lake fluctuates by 1.5 m.

Comment 6. (39)

2.3.2.2 The “expected” flow direction in the bedrock unit should be confirmed prior to any work on site.

GHD Response

The bedrock aquifer unit is not a receptor of infiltrating water from the vicinity of the proposed Landfill because the bedrock dips significantly upgradient (west) of the proposed Landfill. The sand and gravel aquifer below the Landfill and continuing downgradient becomes very thick. The sand and gravel aquifer is the only potential receptor of infiltration water from the base of the aggregate pit. As such the sand and gravel aquifer is the primary focus of the hydrogeological investigations.

Comment 7. (40)

2.3.1.3 Is the groundwater level in the perched aquifer above Mclvor Lake level?

GHD Response

Yes, please see Figure 2.9 (Groundwater Elevation Contours) of the Update Hydrogeology and Hydrology Characterization Report.



Comment 8. (41)

3.1 There are two environmentally sensitive wetland swamps that exist to the south and southwest of the site. What is the distance to these sites? Please reference Environment Canada (2004). Sensitive Ecosystems Inventory of East Vancouver Island and Gulf Islands Disturbance Mapping and Re-evaluation of Major Riparian Corridors March 2004. [Map]. On map sheet 092F.094 the wetland swamps are S0477A* and S0478 which can be found in the top left section of the map. Retrieve from: <http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=2124>

GHD Response

Please see Section 4.1 of the Updated Hydrogeology and Hydrology Characterization Report, where an assessment to confirm the presence of wetlands, watercourses and other potential aquatic receptors was completed within the 500 m south, southeast, and east of the Site.

Comment 9. (42)

3.1 There are three bullets in the list related to the 100m buffer zone between the limit of refuse and an environmentally sensitive area, surface water and seasonal high water mark of an inland lake. In a similar fashion as the other bullets where these criteria cannot be met, a brief explanation or reference to another part of the document should be included.

GHD Response

The referenced criteria are met.

The proposed limit of waste is more than 100 m from a surface water body, seasonal high water mark of an inland lake. The proposed limit of refuse is approximately 250 m from Rico Lake and greater to Mclvor Lake, which is both the nearest surface water and seasonal high water mark of an inland lake.

No environmentally sensitive area was identified within 100 m of the limit of waste, as discussed in Section 4.1 of the Updated Hydrogeology and Hydrology Characterization Report.

Comment 10. (43)

3.1 Landfill operation to be 1.5 m above groundwater. This should be above high groundwater level not static during dry season.

GHD Response

Correct. The depth of the base of the Landfill liner was confirmed to be at least 1.5 m above groundwater.



Comment 11. (44)

3.6 The City is concerned by the Campbell River Environmental Committee's comment that the "Nilex Civil Environmental Group provided a Chemical Compatibility Chart for the HDPE [base] liner [for the landfill]. Hydrocarbons and volatile organic compounds are not compatible to that liner, depending on their strength." Please comment on this statement given that these materials are expected to be within the contaminated soil accepted at the site. What is the risk to the major sand and gravel overburden aquifer under the landfill which is identified in the BC Water Resource Atlas that the report identifies as being the main receptor to potential landfill-related groundwater quality impairments on page 6 of the document?

GHD Response

The use of HDPE liner systems is an industry standard for all types of landfills. HDPE has a very high performance in containing common leachate constituents at concentrations found in leachate. The US Environmental Protection Agency (EPA) promotes the use of HDPE geomembranes in composite liner systems for both hazardous and non-hazardous waste landfills (Resource Conservation and Recovery Act (RCRA) Subtitle C and Subtitle D regulations).

The Canadian Council of Ministers of the Environment (CCME) National Guidelines for Hazardous Waste Landfills, 2006 specifies the use of HDPE geomembranes in combination with a clay layer or GCL for the containment of Hazardous wastes. The Guideline states:

Each material has advantages and disadvantages, so two liners are often used together to form a composite liner. These are commonly constructed from a geomembrane and a compacted clay soil that are selected and installed to meet specific requirements. The advantages of one material are used to offset the disadvantages of another. For example, a composite liner consisting of a geomembrane and a compacted clay liner can provide an excellent barrier to organic contaminants as well as heavy metals and salts. The combination of the two liners also substantially reduces the overall leakage as a result of the disadvantages in either one.

Because the Landfill is not a hazardous waste site, the concentrations of leachate constituents will be defined as low relative to HDPE compatibility. Many North American jurisdictions accept the performance life of HDPE membranes in landfill liner systems as being over 100 years, well beyond the contaminating life span of the landfill.

Infiltrating water east of the groundwater divide will reach the sand and gravel aquifer. Any leakage through the composite liner system (HDPE and Bentonite Clay), should it occur, will infiltrate down to the sand and gravel aquifer. The 2017 Design, Operations, and Closure Plan provides an assessment of a conservative leakage scenario and demonstrates that compliance with the applicable water quality standards will be maintained.



Comment 12. (45)

6.1 Please verify if chromated copper arsenate (CCA)-treated wood will be accepted at the proposed landfill. Also, please clarify if aquaculture related waste will be accepted.

GHD Response

Please see Sections 6.1 and 6.3 of the Updated Design, Operation, and Closure Plan for waste acceptance policies and procedures. The waste noted above may be accepted only if laboratory analysis, confirmed by a Qualified Professional, shows the concentrations of contaminants do not classify the waste as hazardous. In addition, the waste will not be accepted if it is considered a controlled waste. Controlled waste includes slaughter, poultry, fish hatchery, farming, animal by-product, and liquid or semi-liquid waste.

Comment 13. (46)

6.10 Can Upland include a copy of the open burn reports that are prepared and submitted to the Province in the annual Environmental Monitoring Report? In relation to the Upland proposal, the City received an email from the Provincial Air Quality Meteorologist encouraging the reduction of open burning given that fine particulate air pollution levels (PM2.5) at the Dogwood site in Campbell River exceeded the provincial objectives last year.

GHD Response

No decision on the continuation of the burn activities has been made at this time. A specific technical assessment report for burning operations will be prepared, submitted, and approved by the Ministry of Environment (MOE) prior to the continuation of burn activities on Site.

Comment 14. (47)

6.17 The Environmental Monitoring documents should be kept for longer than seven years. These records may be important in order to determine cumulative effects over time, especially if the landfill is extended beyond the current footprint at some point in the future. Please indicate if these records will be maintained.

GHD Response

The record keeping policies for the Landfill will follow the requirements of the Landfill Criteria for Municipal Solid Waste, Second Edition (MOE, 2016). All relevant documents will be maintained by the owner at least to the end of the Contaminating Lifespan, as described in Section 14.9 of the Updated Design, Operation and Closure Plan.

Comment 15. (48)

6.8.1 How will Upland determine if the proposed dust control measures will adequately address the potential for volatile or dust born contaminants to be transported to nearby water bodies?



GHD Response

The gravel used for daily and intermediate cover will be sand and gravel sourced on site, containing limited fine particle content and will not be susceptible to migration in the form of dust. Please see Section 6.8.1 of the Updated Design, Operation, and Closure Plan for additional dust suppression measures.

Comment 16. (49)

8.1 What is the plan to address an event where leachate or surface water that has come into contact with the waste, escapes to the surface water runoff from the watershed around the landfill? Are there any periodic water quality tests planned for the outflow locations of diverted water as a precautionary measure?

GHD Response

All water that comes into contact with the waste will be managed as leachate. Surface water will only be directed to the base of the aggregate pit if it has not come into contact with the waste. The regular inspections of the Landfill conducted by the Landfill operating staff will monitor for potential leachate breakouts. Leachate breakouts will be contained by the perimeter berm, and berm improvement, and maintenance will be implemented immediately if the potential for a leachate breakout is observed.

As part of the regular environmental monitoring program, surface water samples may be collected from the ditch outlets to monitoring the water quality in the surface water ditches, if the potential for a leachate breakout is observed. Groundwater monitoring wells will be maintained with the surface water infiltration zone.

Comment 17. (50)

9.4 This section notes that use of chloride as an indicator parameter must be evaluated further based on the observed leachate quality given that levels are typically lower at a construction and demolition landfill. Further, hydrocarbons are expected to be a major contaminant, but the report notes that these are not good leachate indicators given that there are many processes that degrade them. Metals are also listed as major contaminant expected. Please indicate what sort of monitoring program would need to be in place in order that metals could be used as a leachate indicator.

GHD Response

Please see Section 9.4 of the 2017 Design, Operation, and Closure Plan for the strategy to determine the leachate indicator parameters that will be used for the Site once Landfill operations have commenced and leachate has been generated, collected, and characterized. Metals, such as boron or manganese, may be used as indicator parameters, if present in the leachate; however, metals do not mobilize well in aquifers compared to ions (i.e., Chloride).



The proposed Environmental Monitoring Program presented in Section 14.0 of the Updated Design, Operation, and Closure Plan will remain the same and include analyzing for all CSR metals, general chemistry, and nutrients regardless of the chosen leachate indicator parameters.

Comment 18. (51)

9.8.1 The leachate treatment objective for the system is to meet the Schedule 6 Drinking Water standards as per the Contaminated Sites Regulation. How will this ensure that the Freshwater aquatic guidelines (which are stricter for certain parameters) are met at the west side of the site?

GHD Response

The treated leachate that is infiltrated in the infiltration pond is not hydraulically connected and will not migrate to the west side of the Site as demonstrated by the southeastward hydraulic gradients discussed in the Updated Hydrogeology and Hydrology Characterization Report (see Figure 2.9).

The construction and operation of the Landfill will have no effect on any aspect of Rico Lake. The pre-landfilling conditions in the Rico Lake are expected to remain unchanged. Rico Lake will be sampled periodically as part of the environmental monitoring plan to confirm the water quality remains unchanged.

Comment 19. (52)

9.8.3.2 The batch leachate treatment cycle is identified as 7 days. How was the 7 day figure determined; are there other reports or sites with similar waste streams used as a reference to determine this turnover time? It is understood that with freeboard and batch cycles there is the ability to hold batches longer than 7 days if required. If it turns out that 7 days is consistently not long enough, at what point would a second aeration pond be required in order to accommodate leachate generation? Please indicate on the site drawings where the additional aeration pond would go. Would an additional aeration pond also require an additional infiltration pond?

GHD Response

The 7-day leachate treatment cycle was based on similar landfill sites with treatment cycles ranging from 1 to 7 days. Forecasted leachate treatment system is based on the forecasted leachate generation rates. As noted in Table 9.4 (Estimate Leachate Generation Per Stage) of the Updated Design, Operation, and Closure Plan, the earliest stages (Stage 1A) of Landfill development will result in less leachate generation than during Stage 1B. The leachate treatment system will be oversized during Stage 1A compared to the design capacity forecasted in Stage 1C. During Stage 1A, additional leachate characterization including leachate generation quantity verification will be conducted. If during this stage the verification results suggest that the aeration pond will require additional capacity to accommodate Stage 1B and 1C leachate generation rates, an additional pond will be designed and constructed.

The additional pond will likely be in the form of a settling pond. This would allow the aeration pond to work full time as an aeration system, and the leachate would be decanted into the settling pond for the settling portion of the treatment cycle. Once settling has occurred the leachate would be decanted to the



infiltration pond. The location of the contingency settling pond is shown on Drawings C-02A of the Updated Design, Operation, and Closure Plan.

Comment 20. (53)

9.8.3.3 and Table 9.1 While it is understood that the drinking water quality guidelines will be used for compliance monitoring at the site boundary and not at the aeration pond, it is still concerning that the forecasted maximum treated leachate concentrations remain at (or potentially above?) the Schedule 6 Drinking Water Guidelines for chloride, sulphide, arsenic, boron, chromium, iron, lead, manganese and sodium. It is unclear from the report how these exceedances will be managed other than through dilution with groundwater between the infiltration pond and the site boundary. Are the forecasted potential exceedances before or after chemical precipitation? Is there a risk that additional batch time and chemical precipitation won't be able to achieve the water quality guidelines? If this is a risk, what will be done with the leachate? If freshwater aquatic life guidelines are to be met on the West side of the site, shouldn't these parameters also be listed for comparison in Table 9.1?

GHD Response

The leachate will be tested prior to discharge to the infiltration pond for a specified list of leachate indicator parameters to ensure the performance criteria is met. Leachate will not be discharged unless the criteria is met. The performance of the leachate treatment system was modeled based on forecasted leachate quality and leachate treatment efficiencies. The treatment system will be modified during the commissioning phase (approximately the first year of Landfill operations) to ensure that the performance criteria for the treatment system is met.

If the performance criteria are not met after the 7-day cycle, the leachate will be treated for a longer time period until the performance criteria is met. If the leachate treatment performance criteria is not met for an extended period of time, the leachate may be trucked off site to an authorized waste water treatment plant until the leachate treatment system can be upgraded. This contingency measure is discussed in Sections 9.2.8, 9.2.9, 9.2.10, and 9.2.11 of the Technical Assessment Report (May 27, 2016) and the Updated Technical Assessment Report (May 2017).

The water quality guidelines applicable to the west side of the Site are not applicable to the Landfill operations, leachate quality, leachate treatment or downgradient groundwater flow.

Comment 21. (54)

10.4.1 How many tonnes of waste does the site already have in place?

GHD Response

Following the segregation of recyclables and reusable material received at the Site, there is approximately 25,000 cubic metres of land clearing debris and approximately 10,000 cubic metres of ash and residual solids from burn operations.



Comment 22. (55)

10.5 As per the City's previous comments, please ensure that landfill gas is recognized as greenhouse gas that contributes to Climate Change, in addition to the immediate concerns of health and toxicity issues.

GHD Response

Please see Section 10.7 of the Updated Design, Operation, and Closure Plan that discusses Landfill Gas as a greenhouse gas.

Comment 23. (56)

10.6 The Stakeholder Consultation Summary Report notes in reply to a City question that "For Upland, the most appropriate [emission reduction approach] would be to consider the installation of passive biofilters as part of the Closure plan. If deemed appropriate the passive biofilters could reduce the lifecycle GHG emissions of the landfill." Section 10.6 does mention the evaluation of the biofilters but no further information is given. Please elaborate on how biofilters could help reduce greenhouse gas emissions.

GHD Response

Methane from the Landfill would be directed to a biofilter(s) via the passive venting system in the Landfill cover. Biofilters are typically a mix of sand and wood chips that facilitate the growth of aerobic bacteria that oxidizes methane to carbon dioxide, reducing the greenhouse gas emissions from the Landfill. Passive biofilters will be considered at the detailed design of the final cover system, when it is possible to assess the actual methane generation rates based on actual waste characteristics in the landfill.

Comment 24. (57)

12.0 The parameters used for modelling the contaminating life span of the landfill include chloride and sulphate. Chromium, copper and cadmium were also considered but ruled out because the forecasted leachate concentrations are below applicable environmental protection guidelines. Why were the other parameters with potential forecasted exceedances in Table 9.1 not considered? Could arsenic be a potential parameter for consideration?

GHD Response

The contaminated lifespan was completed based upon potential leachate indicator parameters that may be presented in the forecasted leachate quality. The contaminating lifespan will be updated regularly during the life of the Landfill based on the actual leachate indicator parameters observed within the leachate. If arsenic is determined to be a prominent contaminant of concern it will be included in the contaminating lifespan calculations.



At this time chloride and sulphate are considered suitable parameters as they are stable compounds that are not subject to biodegradation. As such, determining the contaminating lifespan only through leaching is a conservative approach.

The updated contaminating lifespan calculations will be completed as part of Design, Operation, and Closure Plan updates, completed at a minimum of every 5 years, or as part of the required Financial Security Plan updates.

Comment 25. (58)

13.3 Is there a solution for the expected potential drinking water quality guideline exceedance of manganese at the downgradient site boundary?

GHD Response

Dissolved manganese within the groundwater is naturally occurring within the Site area. As previously reported, the level of treatment necessary to address the leachate derived manganese to achieve compliance with the applicable drinking water criteria at the downgradient Site boundary will be carried out.

GHD trusts the technical responses provided herein are sufficient for the MOE to assess the CCR's comments and concerns. Should you have any questions or require additional information please do not hesitate to contact us.

Sincerely,

GHD

Gregory D. Ferraro, P.Eng.

SS/cs/04

Encl.

cc: Terry Stuart – Upland Excavating Ltd.
Mark Stuart – Upland Excavating Ltd.
Brian Fagan – Upland Excavating Ltd.

Shauna Sturgeon, P.Eng.

Attachment A
City of Campbell River Letter
(November 24, 2016)



Your File: MOE South Region Authorization # 107689

Our File: REF 16-010

24 November 2016

Upland Excavating Ltd.
7295 Gold River Highway
Campbell River, BC, V9H 1P1
Email: inquiries@uplandgroup.ca

Attention: Upland Excavating Ltd

Re: City of Campbell River Comments, Final Technical Reports, UPLAND LANDFILL – NOTIFICATION OF APPLICATION FOR OPERATIONAL CERTIFICATE FOR SOLID, NON-HAZARDOUS WASTE LANDFILL; 7295 Gold River Highway

Proponent: Upland Excavating Ltd

Legal Description: Lot A, District Lot 85, Sayward District, Plan 30709 except part in Plan EPP15087

Thank you for providing the City with copies of your Final Technical Reports and for providing this second opportunity for stakeholder submissions. In addition to these reports, Staff also reviewed the report entitled *Review of Upland Excavating Landfill Application Technical Assessment Reporting* (Gilles Wendling, GW Solutions Inc., 17 Oct 2016).

The City appreciates the detailed responses to the City's questions (22 March 2016) provided in the Stakeholder Consultation Summary Report along with the answers to the other Stakeholder concerns. This resulted in a number of changes and clarifications to the Final Technical Reports. As noted in our previous letter, the City of Campbell River recognizes the need for a local solution to the local waste stream including contaminated soil and asbestos. At the same time, any proposed facility has the potential to have environmental impacts of concern and the City must feel confident that every precaution has been considered to avoid impacts to the community's drinking watershed as well as the Quinsam River, Cold Creek and other environmental receptors.

Follows is a list of additional comments and concerns for your consideration. These comments are grouped according to the specific reports provided by Upland Excavating Ltd. and the section number within the report. These comments and questions have been reviewed and endorsed by Council at the 23 November 2016 Committee of the Whole meeting.

Thank you also for meeting with staff on 10 November 2016 to review the GW Solutions report. We recognize that some of the questions that follow were answered during that meeting. However we have left these questions in the list to ensure that the answers to these questions become part of the file records and we would very much appreciate written responses.

Stakeholder Consultation Summary Report

1. Council requested clarification on the relationship between the new *Water Sustainability Act* and the application of the Act to this project (14 April 2016). This information was not included in the Consultation Summary Report. Please clarify.
2. Council also requested a cross section showing McIvor Lake through Rico Lake and the Site that includes the depth of Rico Lake in order to determine subsurface drainage (14 April 2016). This request is not addressed in the consultation summary. Please address.
3. City Staff previously noted that should the proposal proceed, the development would trigger the City of Campbell River's Watershed Development Permit process and the submission of an Environmental Impact Assessment report that assesses risks and that defines and evaluates the cumulative effects of the landfill. Thank you for acknowledging that further discussion will occur on the development permit requirement subsequent to making an application under the Provincial Waste Discharge Regulation.
4. City Staff asked a question in relation to pre-landfilling baseline water quality "Since the site is already operating as a landfill, is it correct to call the baseline water quality "pre-landfilling" in the hydrology report? To what extent is the baseline water quality already impacted by past landfilling activity at the Site?" The answer in the consultation report notes that only ash is within the localized area above the pit wall. Does this mean that no leachate could be present in the various ground water samples collected from previous landfilling activities? Please clarify.

Technical Assessment Report

1. General question- If for some reason the landfill is not pursued and an Operational Certificate is not obtained, what happens to the existing fill and potential leachate generated from this material?
2. 1.4.2 The last bullet references that draft reports be submitted to MoE for comment prior to the final application. Did MoE provide comments to Upland on the previous draft reports and if so, would these comments be available for City/public review?
3. 9.2.13 Quarterly groundwater sampling will not capture extreme events. How will extreme events be captured?

4. 10.3 Thank you very much for including a section on avoided greenhouse gas emissions by providing a local solution to the local waste stream. The Comox Valley Waste Management Centre in Cumberland is used as the alternative location in the calculation presented. Note however that this facility does have a system in place to capture landfill gas which may mean that 442 tonnesCO₂e of avoided transportation emissions could be offset by the system to collect the gas generated once the material is landfilled.
5. 11.1 and 11.2 Can Upland confirm if MoE will make the proposed quarterly and annual reports available to the public?
6. 11 Which bullet(s) in the proposed monitoring program cover the geotechnical investigation recommendations regarding short term settlement, long term settlement and a slope stability contingency plan? These considerations should be specifically referenced so there is no confusion as to whether or not they are included in the monitoring program.

2016 Geotechnical Investigation

1. 4.2 Please clarify the implication of the potential temporary saturation condition at the base of the east/northeast toes of the landfill caused by existence of the Gravel wash plant and a treated leachate infiltration pond.
2. 4.8 and 6 During the period of short term settlement, site reconnaissance by geotechnical professionals is recommended to identify locations of distress. What will the frequency of these inspections be and will the inspection results be included in the environmental management plan (EMP) quarterly or annual reporting described in the Technical Assessment Report? Similarly, will long term (primary consolidation) settlement repairs and creep (secondary consolidation) settlements be reported out on as part of the EMP? In relation to these issues, the conclusions section also recommends the development of a contingency plan as part of the continued use and closure design to address any sudden buildup of pore pressure in the landfill. Has this contingency plan been developed?
3. 6 In the conclusions it is identified that “The potential for settlement of the landfilled waste should be considered when conducting a detailed evaluation of the landfill cover system.” When will this recommendation be actioned?

Hydrogeology and Hydrology Characterization Report

1. We are very concerned that the GW Solutions review has identified that “there is insufficient characterization of the groundwater regime across and near the Site.” The report goes on to note that when they used the data provided by GHD their interpretation of groundwater is that it moves in an east-northeast direction as opposed to southeast. What additional

- studies would be required to determine which interpretation is correct and over what time frame would these studies need to be conducted?
2. The GW Solutions report also notes that there is insufficient characterization of both the lithology and groundwater regime at and beyond the property boundary and insufficient information on the vertical and horizontal hydraulic gradients. What additional studies would be required and over what time frame would these studies need to be conducted to solve this issue?
 3. The GW Solution requests a complete picture of the hydrological regime of Rico Lake and the City concurs with this recommendation.
 4. Has consideration been given to the low flood control zone level of 172 m for Mclvor Lake in the BC Hydro Campbell River System Water Use Plan?
 5. 1.3 Future land use in the vicinity of the site may include private domestic wells. Could leachate potentially contaminate the aquifer for those wells?
 6. 3.4.2 States "...bedrock surface is variable at site." Could areas of the sand and gravel aquifer potentially extend northeast to Mclvor Lake?
 7. 3.4.2 States "There are insufficient monitoring points to accurately map the groundwater flow direction within the fractured bedrock unit." There is only one bedrock aquifer monitoring well. How can this situation be remedied? How many more monitoring points are required and what are the plans for following through with this recommendation? Could groundwater move from the Site to Mclvor Lake?
 8. 3.4.4 Notes that there are two water bearing perched aquifers identified in the southwest portion of the site and that these water bearing zones are not connected with the remaining ground water units at the site. Figure 3.6 does not show the flow of groundwater in this location. Please clarify the groundwater flow path for these perched aquifers, or if unknown, please describe what works need to be completed to determine the flow. Would additional down-gradient monitoring wells be required in this location to determine baseline water quality?
 9. 3.4.4 What is the water level at MW5A-15 during peak the precipitation period?
 10. 3.4.5; 4.2; 4.4 and 5 (recommendation section) The report recommends that a monitoring well be installed within the overburden sand and gravel aquifer near the down-gradient Site boundary (MW6-16) prior to landfill development to establish baseline water quality and to assess future water quality. What are the plans for following through with this recommendation? If the groundwater flows are not as interpreted (as GW suspects), MW6-16 may not be in the right location and additional monitoring wells may be required.
 11. 3.4.5 and 5 (recommendation section) The report recommends that "In order to further investigate the nature of this bedrock ridge and further validate the direction and magnitude of groundwater flow between the Site and Mclvor and Rico Lakes, an investigation of the

bedrock ridge and bedrock between Rico and Mclvor Lakes should be undertaken through installation of three bedrock groundwater monitoring wells.” What are the plans for following through with this recommendation?

12. Figure 3.2 indicates the potential that the final elevation of proposed fill material may create a groundwater divide that directs a portion of groundwater on site to the West. Please comment on the potential for this to occur and what the implications might be.
13. Figure 3.3 Is the high elevation of the proposed landfill 191 m AMSL?
14. Table 2.0 The water level at MW5B-15 on Jan 25, 2016 was 186.6 m AMSL. This is above even the maximum operating level of the Campbell Reservoir system. Could this lead to ground water flow towards Mclvor Lake? Please refer to BC Hydro (2012). Campbell River System Water Use Plan. Retrieved from:
https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/planning_regulatory/wup/vancouver_island/2012q4/campbell_river_WUP_accept_2012_11_21.pdf
15. 4.0 Groundwater, residential, surface water, and wash plant samples collected to characterize baseline groundwater quality were restricted to the period Sept 2015 to Jan 2016. Please indicate why sampling has not covered a full year in order to determine seasonal variation in water quality?
16. 4.0 Since landfill is already occurring on the Site, is the sampling that is being conducted to determine baseline water quality potentially already being impacted by leachate?
17. 4.1 Currently, freshwater aquatic life standards will be applied to only the western boundary of the site. Would it be feasible to apply these guidelines to all of the site boundaries?
18. 4.2 Only selected parameters are used for baseline water quality data. MoE has set baseline waste quality objectives for Mclvor Lake including total zinc, copper, cadmium, and phosphorus. These should be included in baseline water quality data. Please reference the British Columbia Ministry of Environment (2012). Water Quality Assessment and Objectives for the John Hart Community Watershed and Mclvor Lake. Retrieved from:
http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/wqo_tech_john_hart_mcivor.pdf
19. 4.2 Only surface water quality is discussed at Mclvor Lake and Rico Lake between September and October; please provide the number of samples taken at each – it appears that only two samples were taken. Given thermal stratification, the potential for groundwater infiltration subsurface, lake turnover and other potential characteristics of lakes that could cause wide variation of water chemistry at different depths and over seasons, please discuss how these restricted samples are adequate to determine baseline conditions.
20. 4.2 Is one sample from on-Site wash plant enough to adequately determine if the wash plant is a source of impact to overburden sand and gravel aquifer? How would the water quality at the wash plant be expected to vary over the year?

2016 Design, Operations, and Closure Plan

1. 2.1.2 What sources were referenced to determine drainage and watercourses features? Was the Sensitive Ecosystem Inventory referred to?
2. 2.1.2 Several ephemeral creeks with drainage to the Quinsam River are noted but their distances to the Site are not referenced. Please provide these distances and the source of this information.
3. 2.2.2.1 Can fractured bedrock seams exist that would allow groundwater flow to Mclvor Lake?
4. 2.2.2.1 Is the “interbedded silt” area subject to mass wasting?
5. 2.3.1.1 What is the static water elevation within Mclvor Lake? If Mclvor Lake fluctuates by about 1.5m, would the elevation differential still be great enough to support the interpretations as noted on page 7?
6. 2.3.2.2 The “expected” flow direction in the bedrock unit should be confirmed prior to any work on site.
7. 2.3.1.3 Is the groundwater level in the perched aquifer above Mclvor Lake level?
8. 3.1 There are two environmentally sensitive wetland swamps that exist to the south and southwest of the site. What is the distance to these sites? Please reference Environment Canada (2004). Sensitive Ecosystems Inventory of East Vancouver Island and Gulf Islands Disturbance Mapping and Re-evaluation of Major Riparian Corridors March 2004. [Map]. On map sheet 092F.094 the wetland swamps are S0477A* and S0478 which can be found in the top left section of the map. Retrieve from:
<http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=2124>
9. 3.1 There are three bullets in the list related to the 100m buffer zone between the limit of refuse and an environmentally sensitive area, surface water and seasonal high water mark of an inland lake. In a similar fashion as the other bullets where these criteria cannot be met, a brief explanation or reference to another part of the document should be included.
10. 3.1 Landfill operation to be 1.5 m above groundwater. This should be above high groundwater level not static during dry season.
11. 3.6 The City is concerned by the Campbell River Environmental Committee’s comment that the “Nilex Civil Environmental Group provided a Chemical Compatibility Chart for the HDPE [base] liner [for the landfill]. Hydrocarbons and volatile organic compounds are not compatible to that liner, depending on their strength.” Please comment on this statement given that these materials are expected to be within the contaminated soil accepted at the site. What is the risk to the major sand and gravel overburden aquifer under the landfill which is identified in the BC Water Resource Atlas that the report identifies as being the main

- receptor to potential landfill-related groundwater quality impairments on page 6 of the document?
12. 6.1 Please verify if chromated copper arsenate (CCA)-treated wood will be accepted at the proposed landfill. Also, please clarify if aquaculture related waste will be accepted.
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 14. 6.17 The Environmental Monitoring documents should be kept for longer than seven years. These records may be important in order to determine cumulative effects over time, especially if the landfill is extended beyond the current footprint at some point in the future. Please indicate if these records will be maintained.
 15. 6.8.1 How will Upland determine if the proposed dust control measures will adequately address the potential for volatile or dust born contaminants to be transported to nearby water bodies?
 16. 8.1 What is the plan to address an event where leachate or surface water that has come into contact with the waste, escapes to the surface water runoff from the watershed around the landfill? Are there any periodic water quality tests planned for the outflow locations of diverted water as a precautionary measure?
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order to accommodate leachate generation? Please indicate on the site drawings where the additional aeration pond would go. Would an additional aeration pond also require an additional infiltration pond?

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21. 10.4.1 How many tonnes of waste does the site already have in place?
22. 10.5 As per the City's previous comments, please ensure that landfill gas is recognized as greenhouse gas that contributes to Climate Change, in addition to the immediate concerns of health and toxicity issues.
23. 10.6 The Stakeholder Consultation Summary Report notes in reply to a City question that "For Upland, the most appropriate [emission reduction approach] would be to consider the installation of passive biofilters as part of the Closure plan. If deemed appropriate the passive biofilters could reduce the lifecycle GHG emissions of the landfill." Section 10.6 does mention the evaluation of the biofilters but no further information is given. Please elaborate on how biofilters could help reduce greenhouse gas emissions.
24. 12.0 The parameters used for modelling the contaminating life span of the landfill include chloride and sulphate. Chromium, copper and cadmium were also considered but ruled out because the forecasted leachate concentrations are below applicable environmental protection guidelines. Why were the other parameters with potential forecasted exceedances in Table 9.1 not considered? Could arsenic be a potential parameter for consideration?
25. 13.3 Is there a solution for the expected potential drinking water quality guideline exceedance of manganese at the downgradient site boundary?

We look forward to receiving a written copy of responses to these questions.

Sincerely,



Terri Martin, B.Sc., R.P.Bio.
Environmental Specialist



Matt Rykers, B.Sc.
Environmental Science Officer
Watershed Protection

Reviewed and endorsed by:



Marianne Wade, MCIP, RPP
Acting Manager of Community Planning
& Development Services

cc: Ministry of Environment - A. Leuschen, Senior Environmental Protection Officer
Mayor and Council
Deputy City Manager/General Manager of Operations – Ron Neufeld
Utilities Manager – Jennifer Peters
Water Supervisor Nathalie Viau
Development Services Supervisor – Kevin Brooks
Planner – Matthew Fitzgerald
Property file