Alberni-Clayoquot Regional District

WEST COAST COMMITTEE MEETING
WEDNESDAY, JUNE 14, 2017, 10:00 AM

Regional District Board Room, 3008 Fifth Avenue, Port Alberni, BC

AGENDA

PAGE #

1. CALL TO ORDER

   Recognition of Traditional Territories.

2. APPROVAL OF AGENDA
   (motion to approve, including late items requires 2/3 majority vote)

3. ADDOPTION OF MINUTES

   a. **West Coast Committee Meeting – April 5, 2017** — **3-7**

   THAT the minutes of the West Coast Committee meeting held on April 5, 2017 be received.

4. REQUEST FOR DECISIONS & BYLAWS

   a. **Traverse Trail Connections Options** — **8-13**

   THAT the West Coast Committee provide direction

   b. **West Coast Landfill (WCLF) – Rate changes & cardboard disposal ban** — **14-24**

   THAT the West Committee recommend that the Alberni-Clayoquot Regional District Board of Directors adopt "Bylaw No. R1028, 2017 – A Bylaw for the Regulation of Solid Waste Disposal and Tipping Fees at the West Coast Landfill".

   c. **Memorandum of Understanding – West Coast Multiplex Fundraising** — **25-29**

   THAT the West Coast Committee recommend that the ACRD Board of Directors enter into a Memorandum of Understanding with the West Coast Multiplex Society to work collaboratively on the acquisition of corporate sponsorships, grants and related fundraising for the proposed West Coast Multiplex facility.

5. REPORTS

   a. Administrative Report - West Coast Project To Do List 2017 — 30

b. West Coast Emergency Planning – Meeting – June 8, 2017 – W. Thomson (verbal)

c. Waiving of Tipping Fees - A. McGifford (verbal)

d. Memorandum – Update on the West Coast Multiplex Project – Phase 1 "The Arena" Update 31-33
- Survey Update – Verbal Scott Kenny

e. Memorandum - Long Beach Recreation Cooperative Water Fees Update 34-35

f. Memorandum - West Coast Landfill – Annual Report 2014 36-199

g. Organic Processing Facility Feasibility Analysis and Grant Application Update – WCLF 200-227

h. Proposed Transit Service between Ucluelet, Long Beach and Tofino 228-230

THAT the West Coast Committee receive the Committee reports a-h

6. UNFINISHED BUSINESS

7. LATE BUSINESS

8. ADJOURN

Alberni-Clayoquot Regional District

MINUTES OF THE WEST COAST COMMITTEE MEETING
HELD ON WEDNESDAY, APRIL 5, 2017, 10:00 AM
Tofino District Council Chambers, 121 3rd Street, Tofino, BC

MEMBERS PRESENT:	Chairperson Dianne St. Jacques, Mayor, District of Ucluelet Josie Osborne, Mayor, District of Tofino Tony Bennett, Director, Electoral Area "C" (Long Beach) Alan McCarthy, Member of Legislature, Yuułuʔiłʔatḥ Government Kirsten Johnsen, Member of Council, Toquaht Nation Jessie Hannigan, Parks Canada
STAFF PRESENT:	Wendy Thomson, Acting Chief Administrative Officer Mike Irg, Manager of Planning & Development Mark Fortune, Airport Superintendent

1. CALL TO ORDER

The Chairperson called the meeting to order at 10:03 am.

The Chairperson recognized the meeting being held in the Tla-o-qui-aht First Nation traditional territories.

2. APPROVAL OF AGENDA

MOVED: *Director Bennett*
SECONDED: *Director McCarthy*

THAT the agenda be approved as circulated.

CARRIED

3. ADOPTION OF MINUTES

a. **West Coast Financial Planning Committee Meeting – February 1, 2017**

MOVED: *Director Osborne*
SECONDED: *Director Bennett*

THAT the minutes of the West Coast Financial Planning Committee Meeting held on February 1, 2017 be received.

CARRIED

4. CORRESPONDENCE FOR ACTION

a. **Correspondence from Mr. Don MacKinnon, Area "C" resident, dated March 13, 2017 requesting consideration to access recent tree removal for runway visibility – Long Beach Airport Area "C".**

MOVED: Director Bennett
SECONDED: Director Osborne

THAT the correspondence from Mr. MacKinnon regarding access to recent tree removal at the Long Beach Airport be received and this request be forwarded to the Airport Superintendent to develop a plan for stock piling the wood at the Long Beach Airport and options for disposition.

CARRIED

5. CORRESPONDENCE FOR INFORMATION

6. REQUEST FOR DECISIONS & BYLAWS

a. **Request for Decision regarding Special Operating Facilitation Agreement (SOFA).**

MOVED: Director Osborne
SECONDED: Director McCarthy

THAT the West Coast Committee recommend that the Alberni-Clayoquot Regional District Board of Directors approve and enter into the Special Operations Facilitation Agreement (SOFA) between Nav Canada Nanaimo FSS, the Tofino-Long Beach Airport, and Point Break Skydiving to allow Point Break Skydiving to operate at the airport.

CARRIED

b. **Request for Decision regarding Kiosks #6 & 7 – Long Beach Airport Terminal Building.**

MOVED: Director Bennett
SECONDED: Director Osborne

THAT the West Coast Committee recommends that the Alberni-Clayoquot Regional District Board of Directors enter one year lease agreement with an additional one year renewal option with Devon Transportation Ltd. for kiosk #6 at the Long Beach Airport terminal building, commencing May 1, 2017 to April 30, 2018 for $6,000 per year plus GST plus applicable taxes plus CPI increase at renewal.

CARRIED

c. **Request for Decision regarding Kiosk # 9 – Long Beach Airport Terminal Building.**

MOVED: Director Bennett
SECONDED: Director McCarthy

THAT the West Coast Committee recommend that the Alberni-Clayoquot Regional District Board of Directors enter into a five year lease agreement with Orca Air for kiosk #9 at the Long Beach Airport terminal building, commencing May 1, 2017 to April 30, 2022 for $6,720 per year plus GST plus applicable CPI increases.

CARRIED

d. **Administrative Memorandum regarding Alberni-Clayoquot Regional District Trail Connections to Parks Canada Traverse Trail**

MOVED: Director Bennett
SECONDED: Director Osborne

THAT the West Coast Committee recommend that the Alberni-Clayoquot Regional District Board of Directors engage the services of McElhanney Engineering to undertake preliminary design and costing for the south side of the Traverse Trail proposed extension for a cost of $6,420.00 with the funding coming from Regional Parks.

CARRIED

7. REPORTS

a. Parks Canada – Pacific Rim National Park Update – J. Hannigan (verbal)

Mr. Hannigan provided an update on progress made to date on the Traverse Trail project and circulated copies of the Traverse Trail Construction Plan for the North section.

b. Long Beach Airport Update – M. Fortune (verbal)

The Airport Superintendent provided an update on the following projects at the Long Beach Airport:

- OLS clearing conducted on runway approaches 07,16,25 and 34
- Confirmation survey with SNC lavallin for OLS obstructions completed
- Removal of final OLS obstructions on runway 07, 25 and 34, completed prior to March 31 Parks Canada cut permit
- BCAAP lighting upgrade on Apron III, civil works completed

- Telus Fibre optic installation to terminal completed April 04, open public fibre WIFI to be installed in terminal by April 21
- ACAP projects, Taxiway and Apron rehab and Chemical spreader applications submitted to Transport Canada for 2018 consideration
- McGill engineering, Parks Canada water connection review
- CYAZ pump house (water) filter failure support / assistance

c. Long Beach Airport Marketing Project Update – M. Fortune (verbal)

The Airport Superintendent reported the draft logo has been distributed to the Long Beach Airport Advisory Committee for consideration.

d. West Coast Multiplex – Design Services – Update - W. Thomson (verbal)

The Acting CAO provided an update on the design and costing stage of the West Coast Multiplex Project. Submissions were received from three Architectural firms to undertake the project. The ACRD has appointed a Selection Committee to review and interview the firms. The Selection Committee will meet on April 13th in Tofino.

e. Administrative Report - West Coast Project To Do List 2017

The Committee reviewed the project list for 2017.

f. Administrative Report - Proposed Transit Service Between Ucluelet, Long Beach & Tofino

The Acting CAO spoke to the report on the proposed transit service between Ucluelet, Long Beach and Tofino. Staff will work with BC Transit to develop and RFP to retain the services of a consultant to develop a market/demand analysis for the proposed service.

g. Administration Report - West Coast Emergency Planning Update

The Acting CAO spoke to the report on West Coast Emergency Planning. Staff will develop a draft RFP to retain the services of a consultant to develop an emergency plan for the Long Beach electoral area. $7,000.00 was budgeted in 2017 to undertake the plan.

h. West Coast Cardboard Disposal Ban Update – M. Irg, Manager of Planning & Development (verbal)

The Manager of Planning and Development provided an update on the cardboard disposal ban on the West Coast.

MOVED: *Director Bennett*
SECONDED: *Director McCarthy*

THAT the West Coast Committee instruct staff to conduct a public engagement session in Ucluelet and Tofino regarding the proposed cardboard disposal ban on the west coast starting on July 1, 2017.

CARRIED

MOVED: Director Bennett
SECONDED: Director McCarthy

THAT reports a-h be received.

CARRIED

8. LATE BUSINESS

9. ADJOURN

MOVED: Director Osborne
SECONDED: Director Bennett

THAT this meeting be adjourned 11:38 am.

CARRIED

Certified Correct:

___________________________________	___________________________________
Dianne St. Jacques,	Wendy Thomson,
Chairperson	Acting Chief Administrative Officer

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT
3008 Fifth Avenue, Port Alberni, B.C. CANADA V9Y 2E3 Telephone (250) 720-2700 FAX: (250) 723-1327

REQUEST FOR DECISION

To: West Coast Committee

From: Mike Irg, Manager of Planning and Development

Meeting Date: May 31, 2017

Subject: Traverse Trail Connections Options

Recommendation:

Committee direction requested.

Desired Outcome:

To have clear direction on how the Traverse trail Connections will be acquired, managed, paid for and which service area would be responsible for the trails.

Summary:

Parks Canada is in the process of constructing the Traverse Trail though Pacific Rim National Park. There is potential to connect existing trails in Tofino and Ucluelet, through ACRD jurisdiction, to Parks Canada's Traverse Trail. There is 1.2 kilometers of trail to construct in the ACRD to connect to the Traverse Trail with the existing Ucluelet/South Long Beach Multi Use Path and 2.785 kilometers of trail to construct (1.97 km in the District of Tofino and 0.845 Km in the ACRD) to connect the Traverse Trail with the District of Tofino trail. (see attached map)

With the creation of the Traverse Trail in Pacific Rim National Park Reserve, there is an opportunity to connect to existing trail systems that will run the entire length of the Peninsula. Trail development is one of the most cost effective and appealing park systems. Providing this linkage will benefit both tourism and local users.

Background:

The ACRD and the District of Tofino are currently applying for grant funding to cover the cost of the trail construction. The West Coast Committee has asked staff to provide options for operating the trail. If the ACRD assumes responsibility for the trail or a component of the trail, it must be within a service area. There is also the option for the Districts of Tofino and Ucluelet to acquire the right of way for the trail and manage the trail independently of the ACRD.

Time Requirements – Staff & Elected Officials:

Significant staff time would be required to apply for grants, oversee trail construction and maintenance.

Financial:

The McElhanney estimate for the 1.2-kilometer trail connection on the south end is $1,133,000.00.
The McElhanney Estimate for the 2.785-kilometer trail connection on the North end is $3,394,000.00.
Both the District of Tofino and the ACRD are in the process of applying for grant funding for the construction costs.

Policy or Legislation:

The ACRD has the ability to acquire, construct and operate parks and trails.

In order to build the trail connections right of ways will need to be acquired from the Ministry of Forests Lands and Natural Resource Operations (FLNRO) and Yuułuʔiłʔatḥ Government. In several areas, the road right of way is not wide enough to accommodate a trail.

Options Considered:

Key questions for the committee are; who acquires, constructs and owns the trail?
There are several options available for managing the trail.

1. Ucluelet acquires the southern portion of the trail right of way and the ACRD includes the additional costs in the Multi-use Path service area to include the trail connection on the South end and Tofino would own and maintain the Trail connection on the North end.

   The ACRD adopted bylaw E1011, South Long Beach Multi-Purpose Path Contribution Local Service Establishment in 1997 and is a service to provide a portion of the cost of maintaining the Ucluelet Multi-Use Path. This is not a parks and trail service. (A copy of Bylaw E1011 is attached)
   The ACRD established a local service within a part of electoral area C for contributing to the District of Ucluelet's costs of operating a multi-purpose path.
   The maximum cost annually for this service is $7,000.00, which is paid to the District of Ucluelet.
   The ACRD asked the Yuułuʔiłʔatḥ Government to consider joining the service in 2013. To date, Yuułuʔiłʔatḥ Government has not joined the service.

   The following steps would be required to amend the boundaries of the service area in bylaw E1011 to include the portion of land in Area C to link up to Traverse Trail for the maintenance cost component:

- Approval (or petition from property owners within the proposed area that they wish to participate
- Consent from the Area "C" Director
- Draft bylaw with new boundaries for consideration of 3 readings by the ACRD Board
- If the annual maximum cost is increased, the Inspector of Municipalities must approve the amendment.
- Bylaw for consideration of adoption (must be a clear day between 3rd and adoption).

   The District of Tofino acquires the northern portion of the trail right of way and bylaw similar to E1011 is created for the ACRD to contribute to a portion of the trail maintenance.

Note: Inspector approval is not required for boundary amendments. We are just required to file a copy after adoption.

2. A right of way owned by the Districts of Tofino and or Ucluelet. The Trail would be owned and operated by the municipalities with no ACRD involvement.

3. Community Parks. There is a community Parks function for Long Beach Electoral Area established through letter patent. Funding would be through tax requisition from the Long Beach area. Currently there are no funds for construction. Money from previous subdivisions where cash in lieu of Parkland was provided is available for land acquisition.

4. Regional Parks. The ACRD has a Regional Parks Service that includes all municipalities and electoral areas. If agreed to by a majority of the participants, the Traverse Trail connections, or a portion of the trail could be included in the Regional Parks Service. There is a limited operating budget and a capital reserve in the Regional Parks budget.

5. Create a new service area that includes the District of Tofino, the District of Ucluelet, Long Beach and Yuułuʔiłʔatḥ Government.

Submitted by: ____
Mike Irg, MCIP, RPP
Manager of Planning and Development

Approved by: ____
Wendy Thomson, Acting Chief Administrative Officer

ALBERNI-CLAYOQUOT REGIONAL DISTRICT

BY-LAW NO. E1011

A By-law to establish a Local Service within a portion of Electoral Area "C" (Long Beach) to contribute to the District of Ucluelet's costs of operating a Multi Purpose Path

WHEREAS the Regional Board of the Alberni-Clayoquot Regional District may, by by-law, establish and operate a Local Service under provisions of the Municipal Act[1];

AND WHEREAS the Regional Board of the Alberni-Clayoquot Regional District has been requested to establish a local service within a part of Electoral Area "C" (Long Beach) for the purpose of contributing to the District of Ucluelet's costs of operating a multi-purpose path;

AND WHEREAS the assent of the electors is required before adopting the bylaw to establish a local service within a part of Electoral Area "C" (Long Beach) for the purpose of contributing to the District of Ucluelet's costs of operating a multi-purpose path;

AND WHEREAS the Board wishes to establish a local service within a part of Electoral Area "C" (Long Beach) for the purpose of contributing to the District of Ucluelet's costs of operating a multi-purpose path;

AND WHEREAS the approval of the Inspector of Municipalities is required under the Municipal Act[2];

NOW THEREFORE the Board of Directors of the Alberni-Clayoquot Regional District in open meeting assembled, enact as follows:

Service being Established

1. The Local Service hereby established under this by-law is for the purpose of contributing to the District of Ucluelet's costs of operating a multi-purpose path;

Service Area Boundaries

2. The Local Service Area is a portion of Electoral Area "C" (Long Beach), as identified on the map attached to and forming part of this bylaw as Schedule "A".

[1] Section 798

[2] Section 807(1)(a)

Cost Recovery

3. The annual costs of providing the service shall be recovered by the requisition of money collected by way of a parcel tax from owners of property in the service area.

Limit on Annual Cost

4. The maximum that may be requisitioned under Section 3 for the service provided under Section 1 is $7,000.00 per year.

Citation

5. This bylaw may be cited as the "South Long Beach Multi Purpose Path Contribution Local Service Establishment Bylaw No. E1011, 1997"

Read a first time this	12th day of	December	,1997
Read a second time this	12th day of	December	,1997
Read a third time this	12th day of	December	,1997

I HEREBY CERTIFY THE FOREGOING to be a true and correct copy of By-law No. E1011 cited as "South Long Beach Multi Purpose Path Contribution Local Service Area Establishment By-law No. E1011, 1997" as read a third time by the Regional Board of the Alberni-Clayoquot Regional District at a meeting held on the 12th day of December, 1997

Dated at Port Alberni, B.C. this 13th day of December, 1997

____

Robert A. Harper, CGA
Secretary-Treasurer

APPROVED by the Inspector of Municipalities this 9th day of April, 1998

ASSENTED to by the Electors this 6th day of July, 1998

ADOPTED this 22nd day of July, 1998

Filed with the Inspector of Municipalities the 23rd day of July, 1999

Certified a true and correct copy of "South Long Beach Multi Purpose Path Contribution Local Service Area Establishment Bylaw No. E1011, 1997"

The Corporate seal of the Alberni-Clayoquot Regional District was hereto affixed in the presence of:

Robert A. Harper, CGA
Secretary-Treasurer

Gary Swann
Chairperson

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

3008 Fifth Avenue, Port Alberni, B.C. CANADA V9Y 2E3 Telephone (250) 720-2700 FAX: (250) 723-1327

REQUEST FOR DECISION

To: West Coast Committee

From: Andrew McGifford, CPA, CGA, Manager of Environmental Services

Meeting Date: June 14, 2017

Subject: West Coast Landfill (WCLF) – Rate changes & cardboard disposal ban

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Recommendation:

THAT the West Committee recommend that the Alberni-Clayoquot Regional District Board of Directors adopt "Bylaw No. R1028, 2017 – A Bylaw for the Regulation of Solid Waste Disposal and Tipping Fees at the West Coast Landfill".

Desired Outcome:

To amend the rates at the WCLF to a level that maintains a tipping rate that is in line with the current rates charged on Vancouver Island. To also maintain a consistent tax requisition for the service area and to set up a structure that will provide room to divert organic materials if feasible and to fund the additional landfill diversion initiatives.

Summary:

The WCLF tipping fee has been at the rate of $95 per tonne for residential waste since 2008 at which time the rate was $65 per tonne prior to that increase. The ACRD's rate for disposal is one of the lowest on the island. Staff recommend increasing to $120 per tonne. The ACRD would still have a rate lower than all regional district's besides the Capital Regional District which is at $110 per tonne currently.

If a diversion program is put in place there needs to be improved site supervision at the tipping bins to ensure that the public is following the bylaw, and where that is not the case, there will be increased fees as listed in the West Coast Landfill Tipping Fee and Regulation Bylaw. The first step is to have an additional transfer station attendant stationed at the bins at all times. Guidance will be the first step to get the public to comply and after a period of time the public will be charged the rates as per the bylaw.

Other classifications of waste were adjusted to bring the West Coast Landfill in line with the other regional districts and are as follows:

- Wrecked automobiles and trucks are not tipped at the WCLF and would normally go to an auto wrecker to be recycled. ACRD staff are recommending that the automobiles and trucks be removed from the fees listing and be considered metal – a prohibited waste in Schedule "C". The recreational vehicles (RV's) can still be tipped and an attempt to remove all metal from the RV's be removed to the best of the user's ability should be undertaken. A minimum charge of $300 is suggested, as the operator must break down unit to landfill effectively.

- Surcharge for Solid waste containing Prohibited Recyclable Materials is part of the bylaw that will double the residential waste rate at $240 per tonne. Materials mixed that are not permitted in with solid waste include

Batteries, Corrugated Cardboard, Fridges and Freezers, Metal, RecycleBC Stewardship Materials, and Tires.

- Improperly covered loads tipping fee premium has not been enforced as stated in the bylaw. ACRD staff have asked the WCLF contractor to begin enforcing this part of the bylaw. Staff are preparing cards for the public advising if not in compliance and all loads must be covered. After a period of education and awareness of the issue there will be surcharges applied on waste arriving at the landfill uncovered.

- If the public wishes to use the weigh scale at the WC Landfill, staff are suggesting that there be a charge of $10.00 per occurrence. Other Regional District's charge fees for this service.

- Corrugated cardboard (CC) – the rate if containing recyclable CC will be set at $300 per tonne to keep in line with the rate the contractor charges on the West Coast to recycle the product. Volumes are unknown as this material is currently tipped in mixed solid waste. The current fee structure has permitted the commercial users that have not been recycling CC, to do so without motivation to divert. Staff and contractors will work with the landfill users over the first six months to find solution to divert this material.

Other considerations

- Asbestos was listed as a material accepted at the WCLF in the bylaw but has not been accepted and has been removed. The AVLF charges $500 per tonne and is in line with the Regional District of Nanaimo and still provides an option to those within the ACRD to dispose of the asbestos waste.

- The removal of Drywall/Gypsum from the landfill has occurred at the AVLF and will ship to the lower mainland to be recycled. Materials that are from pre 1990 may contain asbestos and will not be accepted for recycling unless tested. The rate to process Drywall/Gypsum will be set at $250 per tonne to cover the cost of handling and shipping to the lower mainland.

  The WCLF contractor has offered a trial and this could be considered by the West Coast Committee as an initiative. The AVLF could accept the recyclable material from the WCLF at a per tonne rate and transport and handling cost would need to be subsidized or charge a higher rate to tip on the West Coast.

- Fish Farm waste – operations at the landfill are finding the waste from fish farms is difficult waste to process. First issue is the poly piping that is brought in, it does not landfill well (difficult to compact) and is light weight – which in turn equates a low tipping fee. Staff propose we charge a high rate for material or ban it and explore options for recycling. Secondly, the material tipped has large volumes of metal. Staff considers a high rate for tipping metal - $1,000 per tonne if tipping recyclable metal to discourage this practice.

<u>Time Requirements – Staff & Elected Officials:</u>

Staff and Elected Official's time to prepare and approve the changes to West Coast Landfill Tipping Fee and Regulation Bylaw No. R1028, 2017. Staff will send a mail out to commercial waste haulers to advise of the tipping fee increase for the WCLF in 2017, and how the these changes will be made. Advertisements on the radio and the newspaper will also occur and staff will work with the public through these changes.

<u>Financial:</u>

The 2017-2021 Financial Plan does not reflect an increase in the tipping fees for the 2017 year and the plan to move to $120 is not reflected in the budgeted amounts for 2017. The estimated increase in tipping fees could be an additional $62,500 in 2017 and $125,000 annualized. Fees need to increase in order to cover additional costs that will be incurred by diverting materials. Each $100,000 in cost associated with diversion and increased supervision at the landfill will require an increase of $20 per tonne of waste to cover additional costs.

Policy or Legislation:

The Local Government Act and West Coast Landfill Tipping Fee and Regulation Bylaw, staff aim to make the changes take effect on July 1, 2017. The suggested bylaw is attached for reference.

Options Considered:

1) Increasing the tax requisition instead of increasing the tipping fees.
2) Increasing both the tax requisition and the tipping fees in smaller increments.
3) Make no changes, with no diversion strategy be reviewed and steps to undertake.

Submitted by: ______________________________
Andrew McGifford, CPA, CGA, Manager of Environmental Services

Approved by: ______________________________
Wendy Thomson, Acting Chief Administrative Officer

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

BYLAW NO. R1028

A Bylaw to Provide for
the Regulation of Solid Waste Disposal and Tipping Fees
at the West Coast Landfill

WHEREAS by Supplementary Letters Patent, dated August 10, 1973 as amended, the Regional District of Alberni-Clayoquot was granted the function of Garbage Disposal under Division XIV of its Letters Patent;

AND WHEREAS the Regional District of Alberni-Clayoquot is empowered to establish a scale of charges payable for depositing Municipal Solid Waste at the West Coast Landfill;

AND WHEREAS the Board of Directors of the Regional District of Alberni-Clayoquot deems it advisable to enact regulations pertaining to solid waste disposal and to establish a charge for depositing Municipal Solid Waste;

NOW THEREFORE, the Board of Directors of the Regional District of Alberni-Clayoquot in open meeting assembled enacts as follows:

1. DEFINITIONS

In this bylaw, unless the context otherwise requires:

1.1 **"Biomedical Waste"** means solid waste such as soiled sheets, garments and other similar solid waste. Excluded is waste material from pathology, operating rooms, laboratories and other hospital operations, which produce potentially infectious waste considered to be special waste;

1.2 **"Controlled Waste"** means certain hazardous waste, liquid waste and Municipal Solid Waste which is approved for disposal at the West Coast Landfill site but which, because of its inherent nature and quantity, may require special handling and disposal techniques to avoid creating health hazards, nuisances, or environmental pollution. Controlled Waste includes, but is not limited to:

- a. Demolition wastes including:
  - i. roofing materials;
  - ii. Clean construction materials;
  - iii. Drywall/Gypsum board;
  - iv. Stumps, land clearing debris;
  - v. Yard and Garden Waste (branches 2" & under)
- b. Contaminated soils:
  - i. traces of petroleum products;
  - ii. Catch basin and manhole material;
- c. Fish shrimp shells, animal carcasses;
- d. Steel cable;
- e. Biomedical waste;
- f. Loads containing fish feed totes

1.3 **"Corrugated Cardboard"** means recyclable waste from residential, industrial, commercial, institutional sources which includes, but is not limited to containers or materials used in containers consisting of 3 or more layers of Kraft paper material and having smooth exterior liners and a corrugated or rippled core, but excluding containers which are impregnated with blood, grease, oil, chemicals, food residue, was; or have polyethylene, foil or other non-paper liners; or are contaminated with a material which will render the corrugated cardboard not marketable;

1.4 **"Construction/Demolition Waste"** means waste produced from the construction, renovation, and demolition of buildings, bridges, wharfs, rail lines and other structures, but does not include waste containing or contaminated with asbestos, creosote, PCB treatments, paints or chemicals of any kind;

1.5 **"Environmental Management Act"** means the Environmental Management Act (British Columbia), as amended or replaced and any successor legislation and any regulations thereunder;

1.6 **"Disposal Site"** means the Alberni Valley Landfill;

1.7 **"Gypsum"** includes, but is not necessarily limited to new construction off-cuts or scraps and old wallboard that has been painted, covered in wallpaper, vinyl or ceramic tiles and is removed during renovation, but excluding wallboard from demolition sites or wallboard associated with asbestos;

1.8 **"Hazardous Waste"** means gaseous, liquid and solid waste which, because of its inherent nature and quantity, requires special disposal techniques to avoid creating health hazards, nuisances, or environmental pollution. Hazardous Wastes are toxins or poisons, corrosives, irritants, strong sensitizers, flammables, explosives, infectious waste, condemned food, etc. Flammable wastes excluding plastics, paper products and the like;

1.9 **"Ignitable"** means having the properties of:

a. flammable gas,

b. flammable liquid, or

c. flammable solids, or substances susceptible to spontaneous combustion or substances that on contact with water emit flammable gases as defined in the Special Waste Regulations of the Environmental Management Act;

1.10 **"Metal"** means recyclable ferrous and non-ferrous metallic materials which include, but are not limited to: sheet metal, siding, roofing, rebar, flashings, pipes, window frames, doors, furnaces, duct work, wire, cable, bathtubs, fencing, bicycle frames, automotive parts, machinery, appliances, garbage cans, metal furniture, tire rims and metal cans. It does not include metal that is incorporated into a product or packaging, such as a couch, that does not compose more than 50% of produce weight and that cannot be readily separated from the non-metallic components.

1.11 **"Municipal Solid Waste" (MSW)** means refuse that originates from residential, commercial or institutional, demolition, land clearing or construction sources within the Regional District of Alberni-Clayoquot;

1.12 **"Person"** means an individual, a body corporate, a firm, a partnership, association or any other legal entity or an employee or agent thereof.

1.13 **“Prohibited Waste”** means a waste prohibited from disposal under Schedule ‘C’ attached to and forming part of this bylaw;

1.14 **“Radioactive Waste”** means waste containing a prescribed substance as defined in the Atomic Energy Control Act in sufficient quantity or concentration to require a licence for possession or use under the Act and regulations made under that Act;

1.15 **“Reactive Waste”** means waste which is;

a. explosive, oxidizing, or so unstable that it readily undergoes violent change in the presence of air or water;
b. generates toxic gases, vapours, or fumes by itself or when mixed with water; and
c. polymerizes in whole or in part by chemical action and causes damage by generating heat or increasing volume; as defined in the Special Waste Regulations of the Environmental Management Act;

1.16 **“Refuse”** means discarded or abandoned materials, substances or objects; but does not include Controlled Waste and Prohibited Waste;

1.17 **“Regional Board”** means the Board of Directors of the Regional District of Alberni-Clayoquot;

1.18 **“Regional District**” means the Regional District of Alberni-Clayoquot;

1.19 **“Special Waste”** means any chemical, compound, mixture, substance or article which is defined as such in the Special Waste Regulation of the BC Environmental Management Act.

1.20 **“Stewardship Materials”** means any waste or recyclable materials in an approved stewardship plan as defined in the Recycling Regulation of the BC Environmental Management Act;

1.21 **“Tires”** means the outer pneumatic rubber covering of wheels of passenger’s vehicles, light service trucks and motorcycles with an inner diameter of less than 43 centimetres.

1.22 **“Waste Asbestos”** means a waste containing friable asbestos fibres or asbestos dust in a concentration greater than 1% by weight either at the time of manufacture, or as determined using a method specified in section 40 (1); of the BC Hazardous Waste Regulation;

1.23 **“Waste Oil”** means automotive lubricating oil, cutting oil, fuel oil, gear oil, hydraulic oil or any other refined petroleum based oil or synthetic oil where the oils are in the waste in a total concentration greater than 3% by weight and the oils through use, storage or handling have become unsuitable for their original purpose due to the presence of impurities or loss of original properties;

1.24 **“Yard and Garden Material”** means uncontaminated organic materials, substances or objects including, but not necessarily limited to, grass, lawn and hedge clippings, grass sod, flowers, leaves, vegetable stalks, shrubs and shrub tree branches less than 2” in diameter, but excluding Scotch Broom.

2. CONDITIONS

2.1 No person shall, in depositing Municipal Solid Waste (MSW) at the Disposal Site;

a. deposit a Prohibited Waste;
b. deposit MSW except as directed by regulations for the use of the Disposal Site;

c. unless permitted by the Regional District, deposit MSW without first having it weighted on the scales at the Disposal Site;
d. drive a vehicle anywhere on the Disposal Site except on roads provided by the Regional District for that purpose unless otherwise instructed;
e. act in a manner contrary to the posted site regulations.

2.2 Controlled Waste will not be accepted for disposal at the Disposal Site without written approval of the Regional District. This requirement may be waived, if the Regional District or its agent determines that special handling and disposal techniques are not required to dispose of the Controlled Waste. Controlled Waste for which special handling and disposal techniques are required are subject to fees as outlined in Schedule "A" attached to and forming part of this bylaw.

2.3 No person shall salvage or remove material deposited at the Disposal Site without prior written approval of the Regional District.

2.4 No person shall loiter or leave their vehicle unattended at the Disposal Site.

2.5 Persons entering the Disposal Site do so at their own risk. The Regional District accepts no liability whatsoever for damage and/or injury to persons or property at the Disposal Site.

2.6 Children under 13 and pets shall not be permitted at the Disposal Site except inside a vehicle.

2.7 No person shall deposit Municipal Solid Waste at the Disposal Site, which does not originate from within the Regional District. Any person doing so will be in contravention of this bylaw.

3.0 CHARGES

3.1 Every person depositing Municipal Solid Waste at the Disposal Site shall pay to the Regional District the applicable charges set out in Schedule "A" hereto.

3.2 Where a charge is not paid within the time specified in Schedule "B", attached to and forming part of this bylaw, for its payment the person liable to pay such a charge shall:
a. In addition to such a charge pay interest thereon at a rate set out in Schedule "A" from the date the charge was due to the date of payment;
b. Not deposit any Municipal Solid Waste on or at the Disposal Site until such a charge and interest owing thereon has been paid in full.

4. VIOLATIONS AND PENALTIES

4.1 No persons shall do any act or suffer or permit any act or thing to be done in contravention of this Bylaw.

4.2 Every person who contravenes this bylaw, by doing any act which the bylaw forbids, or omits to do any act which the bylaw requires:
a. is guilty of an offence and is liable, on summary conviction, to a fine of not less than TWO HUNDRED ($200.00) DOLLARS and not more than TEN THOUSAND ($10,000.00) dollars for a first offence and for each subsequent offence to a fine of not less than FIVE HUNDRED ($500.00) and not more than TEN THOUSAND ($10,000.00) DOLLARS. A separate offence shall be deemed to be committed upon each day during and in which the contravention occurs or continues;

b. may be prohibited from depositing Municipal Solid Waste at the Disposal Site.

5. TITLE

This bylaw may be cited as the "West Coast Landfill Tipping Fee and Regulation Bylaw No. R1028, 2017"

6. EFFECTIVE DATE

Bylaw No. R1028 "West Coast Landfill Tipping Fee and Regulation" comes into effect on July 1, 2017.

7. REPEAL

Bylaw No. R1010, R1010-1, R1010-2, and R1010-3, cited as the "West Coast Landfill Tipping Fee and Regulation Bylaw" is hereby rescinded as of July 1, 2017.

Read a first time this day of ,

Read a second time this day of ,

Read a third time this day of ,

ADOPTED this day of ,

Certified true and correct copy **of "West Coast Landfill Tipping Fee and Regulation Bylaw No. R1028, 2017"**

____

Wendy Thomson
Acting Chief Administrative Officer

The Corporate seal of the Regional District of Alberni-Clayoquot was hereto affixed in the presence of:

____

John Jack
Chair

Schedule A
Charges

Solid Waste, excluding Controlled Waste	**Tipping Fee**	**Other Charges**
Loads of 83 kg or greater	$120.00 per tonne	$10.00 minimum
Loads under 83 kg (each garbage bag or can)	$2.00 each	$8.00 maximum
Wrecked recreational vehicle	$240.00 per tonne	$300.00 minimum
Surcharge for Solid waste containing Prohibited "Recyclable Materials"	$240.00 per tonne	
Surcharge for improperly covered or secured loads	$240.00 per tonne	
Weighing Service		$10.00 per occurrence

Recyclable Materials	**Tipping Fee**	**Other Charges**
Automotive Batteries – separated and placed in hazardous waste container	No Charge	
Corrugated Cardboard – *not accepted on site*	$300 per tonne	
Fridges and Freezers	$20 each	
Recyclable Metal – if separated into metal bin	No Charge	
Recyclable Metal – if mixed with solid waste	$1,000 per tonne	
Stewardship Materials – *not accepted on site*	$240.00 per tonne	
Tires	$2.00 each or $170 per tonne whichever is greater	

Controlled Waste	**Tipping Fee**	**Other Charges**
Construction/Demolition Waste	$160.00 per tonne	
Stumps, land clearing debris	$240.00 per tonne	
Yard and Garden Waste (branches 2" & under)	No charge	
Catch basin and manhole material	$160.00 per tonne	
Fish, shrimp shells, animal carcasses provided that there will be no charge for animal carcasses removed from public roadways by a public body or their contractor	$200.00 per tonne	$100.00 minimum
Steel Cable	$500.00 per tonne	
Biomedical waste	$132.00 per tonne	
Loads containing fish feed totes	$400.00 per tonne	$160.00 minimum
Contaminated Soils:		
Provided that the Ministry of Environment has approved of disposal of the contaminated soil, without treatment, at the WCLF	$50.00 per tonne	
Provided that the Ministry of Environment has approved of the treatment and disposal of the contaminated soil at the WCLF	$100.00 per tonne	Plus estimated out-of-pocket treatment costs

Schedule B
Policies and Procedures

1. In the event that the scales provided are not operational, weight shall be estimated by the Scale Clerk employed by the Regional District of Alberni-Clayoquot.

2. All charges payable under this Bylaw shall be paid prior to the deposit of the solid waste for which the charge is made unless it is necessary to weigh the vehicle depositing solid waste loaded and empty to determine the weight of solid waste, in which case the charge shall be paid immediately after weighing the vehicle empty.

3. The person paying a charge shall obtain a receipt for such payment and shall produce such receipt for inspect ion on request of a person employed for that purpose at a disposal site as a condition of depositing solid waste at a disposal site.

4. Notwithstanding anything to the contrary in this Bylaw, persons depositing solid waste at a disposal site on a regular basis may apply to the Regional District for credit and if credit is granted to that person, then payment of the charge imposed under Schedule A shall be made and the credit extended on condition that:

    a. Payment in full shall be received by the Regional District within thirty (30) days of the last day of the month for which an invoice has been submitted. The Regional District will invoice monthly for material delivered during the preceding month. The invoice amount will be based on the total quantity of the Municipal Solid Waste delivered during the month, and the posted disposal rates in effect at the time of delivery.
    b. In order to reflect the additional administration costs associated with accounts in arrears, an overdue charge will be calculated monthly as the greater of:
        i. $2.00; or
        ii. Interest of 2% per month (effective interest rate of 26.824%) on the unpaid balance.
    c. The Regional District reserves the right to cancel the credit offered herein for late payment, non-payment or other justified cause.

Schedule C
Prohibited Waste

The following gaseous liquids and municipal solid wastes are not acceptable for disposal at the Disposal Site and include, but are not limited to:

i. Liquids, except as permitted herein;
ii. Ignitable wastes;
iii. Reactive wastes;
iv. Radioactive wastes;
v. Hazardous waste;
vi. Special Waste, as defined in the *Special Waste Regulation* (British Columbia) except asbestos;
vii. Medical waste
viii. Solid Waste that is on fire or smouldering
ix. Corrugated Cardboard
x. Metal – including wrecked autos and trucks
xi. Municipal Solid Waste that does not originate from within the Regional District;
xii. Stewardship Materials
xiii. Tires

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

3008 Fifth Avenue, Port Alberni, B.C. CANADA V9Y 2E3 Telephone (250) 720-2700 FAX: (250) 723-1327

REQUEST FOR DECISION

To: West Coast Committee

From: Wendy Thomson, Acting CAO/
Scott Kenny, Consultant

Meeting Date: June 14, 2017

Subject: **Memorandum of Understanding – West Coast Multiplex Fundraising**

Recommendation:

THAT the West Coast Committee recommend that the ACRD Board of Directors enter into a Memorandum of Understanding with the West Coast Multiplex Society to work collaboratively on the acquisition of corporate sponsorships, grants and related fundraising for the proposed West Coast Multiplex facility.

Desired Outcome:

To reach agreement with the West Coast Multiplex Society (WCMS) respecting future fundraising accounting procedures related to the potential development of the West Coast Multiplex Arena facility.

Background:

With the recent completion of the West Coast Multiplex Arena business plan update and the current work on functional design and costing by VDA Architecture, it is important that project planning for this potential development continue in step with the current activities.

One of the critical future tasks will be facility fundraising. This will be a major undertaking for the West Coast Multiplex Society, the West Coast Communities and the ACRD and one which will require a collaborative relationship between the Parties with respect to acquisition of corporate sponsorship, grants and related fundraising activities for the proposed West Coast Multiplex facility. Therefore, former CAO Russell Dyson suggested an agreement be drafted which would outline appropriate procedures for fundraising and that this be reviewed by the West Coast Multiplex Society prior to sending to the West Coast Committee. The Society has reviewed and approved the draft Fundraising MOU and have subsequently requested it be forwarded to the ACRD for formal approval.

Time Requirements – Staff & Elected Officials:

Modest – Should the ACRD approve the development of the West Coast Multiplex Arena facility and fundraising proceed, it will require the assistance of ACRD Finance Department staff to manage the funds as well as West Coast Community staff in the preparation of possible grant applications. The Regional District will have the support of the West Coast Multiplex Society.

Financial:

Support for the coordination of this project is funded by the West Coast multiplex service – current participants Tofino, Ucluelet and Long Beach.

Policy or Legislation:

ACRD Policies & Procedures apply.

Submitted by: Wendy Thomson
Wendy Thomson, Acting Chief Administrative Officer

MEMORANDUM OF UNDERSTANDING

March 27, 2017

BETWEEN:

WEST COAST MULTIPLEX SOCIETY (“WCMS”)

AND:

ALBERNI CLAYOQUOT REGIONAL DISTRICT (“ACRD”)

(Collectively the “Parties” and each a “Party” to this agreement)

BACKGROUND

A. ACRD is collaborating with the WCMS, a registered charity, raising funds to develop the West Coast Multiplex arena, a multiuse facility to be located within the TLA-O-QUI-AHT FIRST NATIONS (TFN) Traditional Territory, in the Alberni-Clayoquot Regional District area, serving those who are interested in improved health and wellness through a variety of year-round recreational and educational activities.
B. The proposed facility is located on the west coast of Vancouver Island adjacent the Long Beach airport on vacant land owned by the Alberni Clayoquot Regional District. The arena is to be part of a planned multiplex facility that, in the future could include an aquatic centre and other recreational amenities.
C. This multipurpose and fully accessible community facility, will include one single sheet NHL size ice surface with arena seating for a minimum of 200. Additional dry floor seating for community events shall boost this capacity by 1000 portable seats. The arena will also have a sound system suitable for tradeshows, school graduations, figure skating and special community events. Heavy timber construction will be featured in the west coast themed entry, complete with First Nations amenities.
D. The Parties have deemed it in their mutual interest to address certain matters with respect to fundraising for the facility.

NOW THEREFORE, the parties covenant and agree as follows:

1. **PURPOSE**

1.1. The purpose of this Memorandum of Understanding (“MOU”) is to facilitate the development of a collaborative relationship between the Parties with respect to acquisition of corporate sponsorship, grants and related fundraising activities for the proposed West Coast Multiplex facility.

1.2. This MOU is not a binding legal agreement and does not create any binding obligations on either of the Parties.

2. **OBJECTIVES**

2.1. The objectives of this MOU are to provide a process for:

A. The collection of sponsorships, grants and donations to be used for the development of the West Coast Multiplex; and

B. Recording and holding all contributions and commitments.

3. **FUNDRAISING COMMITTMENTS**

3.1. For the period between the execution and delivery of this MOU and the completion of the of the Multiplex facility construction, the Parties, in a spirit of collaboration and cooperation agree as follows:

A. The ACRD will manage and hold the funds collected for the project in trust, until such time that either the facility construction commences or the facility project is cancelled;

B. Should the project be cancelled, funds collected for the project will be returned by either the ACRD or the WCMS to the respective donors in full with no administrative deductions;

C. The WCMS, in consultation and assistance of the ACRD, will organize and manage the fundraising campaign;

D. The ACRD, in consultation with the WCMS, will apply for major Federal and Provincial grants; and

E. Funds collected by the WCMS will be held in trust and transferred to the ACRD in lump sums on a quarterly basis or as agreed between the two Parties.

4. **DELIVERBLES**

4.1. The ACRD acknowledges and agrees that the funds and commitments collected are for the express purpose for the development of the West Coast Multiplex arena facility and may not be used for alternative projects.

4.2. The WCMS will issue an Letter of Understanding (“LOU”) to all cash or in-kind sponsors which clearly identifies the nature of the donation or commitment and the expected recognition. The LOU will be signed by the Sponsor, Chair of the WCMS and the Chair of the West Coast Committee.

4.3. The WCMS will provide a monthly fundraising report to the ACRD following the regular monthly meeting of the WCMS.

4.4. The ACRD will provide a monthly financial fundraising report to the WCMS.

5. **AMENDMENT, TERM AND TERMINATION**

5.1. This MOU may be amended by agreement in writing between the two Parties.

5.2. This MOU will remain in effect until:

A. It is replaced by the Parties;

B. The Parties determine that the development of the West Coast Multiplex arena facility is not viable and will not be constructed; or

C. The Parties agree that they have been unable to raise the capital funds required for the project.

6. **NOTICES**

6.1. For any notice or other communication under this MOU to be valid, it must be in writing and may be delivered personally, faxed, emailed or mailed, regular post, as follows:

If to ACRD

Alberni Clayoquat Regional District
3008 5th Avenue
Port Alberni, B.C. V9Y 2E3
Fax: 250-723-1327
Email: mailbox@acrd.bc.ca

If to WCMS

West Coast Multiplex Society
Samantha Hackett, Chair
Box 304
Tofino, B.C. V0R 2Z0
Email: Info@westcoastmultiplex.org

West Coast Project To Do List 2017

Project #	Project Name	Assigned to	Status
1	LBA - Marketing plan	Kathy	Consultant working on plan
2	LBA - Access road signage	Mark	On hold
3	LBA - Access road upgrade	Mark	Tree removal ongoing
4	LBA - Building assessment / abatement	Luc	
5	LBA - Drainage culvert repairs	Mark	Awaiting drier weather
6	LBA - Fire suppression upgrade	Mark	Awaiting drier weather
7	LBA - House renovation	Luc	
8	LBA - Caretaker/house agreement	Andrew	
9	LBA - Obstacle limitations	Mark	Complete except Runway 16 (fall 2017)
10	LBA - Maintenance & terminal building upgrades	Luc	
11	LBA - Navigational aids	Mark	Near completion (July 2017)
12	LBA - Parking lot upgrades	Mark	Awaiting drier weather
13	LBA - Perimeter fencing ACAP application	Mark	On hold
14	LBA - Runway painting	Mark	Completed
15	LBA - Taxiway H, C, F upgrade	Mark	ACAP application submitted
16	LBA - Water system upgrades	Andrew	Awaiting the agreement for water supply before proceeding
17	LBA - Water wells	McGill Engineering	After source change
18	LBA - Lease lot disposition	Andrew	Provide report to the committee - clear direction to be sought
19	LB - Stream assessment	Mike	Awaiting report from West Coast Aquatic
20	WC Emergency Coordination	Wendy	
21	Long Beach Emergency Plan	Wendy	Investigation consultant options
22	WC Multiplex - Design	Wendy	Proposal received to be evaluated by committee
23	WC Multiplex - Survey	Wendy	To be done after design complete
24	WCLF - Review tipping fees	Andrew/Teri	Memo to the committee - May 31
25	WCLF - Disposal bans	Andrew	Public meeting held and committee RFD to be provided
26	WCLF - Food waste composting study	Andrew	New costing updates as part of grant being investigated
27	WCLF - Share sheds	Andrew	On hold
28	WCLF - MOE design criteria	McGill Engineering	
29	WCLF - Leachate remediation	McGill Engineering	
30	WCLF - Pump station upgrade	McGill Engineering	
31	WCLF - Software upgrade	George	Waiting - training/upgrade schedule from vendor
32	WCLF - Vegetation treatment	Andrew	
33	WCLF - Biosolids investigation		Will need to be in future work plans if desire
34	WC Assistant - adjust position for new duties	Andrew	Posted to start July 1, 2017
35	BC Transit study for West Coast	Wendy	
36	Pacific Traverse Trail	Heather	Applying for grant for south end connection.

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

3008 Fifth Avenue, Port Alberni, B.C. CANADA V9Y 2E3 Telephone (250) 720-2700 FAX: (250) 723-1327

MEMORANDUM

To: West Coast Committee

From: Wendy Thomson, Acting Chief Administrative Officer

Date: May 25, 2017

Subject: **Update on the West Coast Multiplex Project – Phase 1 "The Arena"**

Meeting with Yuułuʔiłʔatḥ First Nation

On May 18, 2017, Teri Fong, Manager of Finance and myself along with representatives of the West Coast Multiplex Society made a presentation to the Yuułuʔiłʔatḥ Executive Committee on the West Coast Multiplex project and spoke to the request from the Regional District to join the service area. The presentation was very well received. Yuułuʔiłʔatḥ Council will consider joining the service along with the Toquaht Nation. Once notice has been received from Yuułuʔiłʔatḥ, Regional District staff will prepare an amending bylaw to expand the boundaries of the service area.

Phase 1 - Design & Costing

VDA Architecture held the first meeting of the design and costing portion of the project in Tofino on May 19th. Attached are notes from the initial meeting from Scott Kenny. VDA will circulate a summary from the initial meeting next week.

Next Steps

- A status report on the project to date is being developed by W. Thomson, S. Kenny and the WCMS for the District of Tofino Committee-of-the-Whole meeting in June. A copy of the status report will also be provided to the District of Ucluelet, area "C" and First Nations on the West Coast
- Design & Costing study estimated completion date - August 2017
- Scott Kenny to work with the WCMS and ACRD staff to develop a Memorandum of Understanding for working together, fundraising, sponsorships, grants etc.
- Scott Kenny/W. Thomson to work with the parties to develop a survey
- VIU to undertake the survey at the beginning of September 2017
- The WCMS to commence fundraising mid October or November after completion of Survey and results

Wendy Thomson

Wendy Thomson, Acting CAO

West Coast Multiplex
Design and Costing Meeting #1
Meeting Summary Notes from S. Kenny
May 19, 2019

This was the first and introductory meeting for the West Coast Multiplex design and costing project which was held in the Tofino Council chambers. There were 14 attendees including Mayors from Tofino and Ucluelet, First Nations representatives from Ahousaht, Tla-O-Qui-Aht and Ucluelet First Nations and invited guests.

The Agenda was prepared by VDA Architecture and covered topics including:

- Project Objectives
  - This topic took the greatest time to discuss and the group was engaged and provided many thoughtful comments and suggestions
    - Ted Bailey of Blackrock Resort, indicted the space could become a much needs venue to host major events. He recently had to turn down a Ducks Unlimited fundraiser as there was a need to seat 400 and they did not have suitable space. This led to a discussion about the possible need for portable flooring which in turn would create the need for additional storage space and major arena access for larger vehicles.
    - The need for concession space was also discussed. It could be shell space for future private sector development of vending machine space for slower periods.
    - The suggestion from Mayor Osborne was the need to build to the "Best bang for the buck"! ….and that it is extremely important to get the West Coast Communities on board.
    - Ted Bailey-School training programs like the PEP Hockey Academy may be a great fit for the facility; they could create an al FN Junior Hockey program.
    - It will be important to include a West Coast/ First Nations theme that could include logs from each of the area nations.
    - With respect to green initiatives, it was agreed that cost and facility were most important factors and that LEED certification was not required.
    - It is important to build responsibility
    - Keep cost in check so it is achievable
    - The NTC should be included as should all 14 area First Nations
    - Washrooms could be constructed to meet the needs of the basic facility operation and portable units would be brought on site for special events or they could be enlarged to a size that would allow additional use door possibly a future connection with the aquatic centre.
    - The question about whether the refrigeration system would be Ammonia or Freon was discussed and will be referred to the ice consultant Bradley.
- Final report expectations
    - The plan developed in the report may not be the actual and final plan for the building but it will be developed to a level that will include the expressed needs which will be used to develop accurate costing.

        - Samantha followed up with a request that the cost breakdown developed would be usable in their future fundraising campaign.
- Background information
    - A data stick was provided to VDA which included most of the reports from previous years.
        - The question about potable water was discussed and Mayor Osborn suggested Parks Canada be called with respect to their Lost Shoe Creek water supply initiative.
- Site layout options
    - The initial site layout provided in the RFP was a quick site sketch prepared by McGill and associates based on the information provided a that time. The site is open for VDA to consider various options, all of which would include space for the future aquatic centre.
        - Site servicing cost must be included in the final report. McGill have done considerable work on this and VDA will consult with them.
        - There was also a mention of a future sewage connection to Tofino.
- Building envelope options to explore
    - Considerable discussions on the possible building options including the three listed below. After the discussion, it was agreed that the Sprung and Pre-engineered option would be explored further for costing.
        - Pre-engineered
            - More uniform design
            - Less time to build than structural steel
            - Excellent insulation value
        - Sprung Building System
            - Shortest time to construct
            - Some water issues evident in Shawnigan Lake that need to be addressed
            - Insulation value needs to be confirmed due to thermal bridging
        - Structural Steel
            - More forgiving design options
            - Longer to construct
            - Stiffer building structure
- Project schedule
    - A project schedule was circulated at the end of the meeting which shows the project to be complete the first week in August. VDA will circulate their meeting summary on Ma 23.
    - The next meeting is scheduled to be held in Ucluelet on June 26.

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REGIONAL DISTRICT

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MEMORANDUM

To: West Coast Committee

From: Teri Fong, CPA, CGA, Manager of Finance

Date: May 24, 2017

Subject: Long Beach Recreation Cooperative Water Fees

This memo is a follow-up to a report that was provided to the West Coast Committee in the fall of 2016 regarding the outstanding water fees of the Long Beach Recreation Cooperative.

Please find attached a letter to the Cooperative explaining that an error has been occurring in the calculation of their quarterly water fees. This adjustment does not have a negative impact on the 2017 budget for the Long Beach Airport as the outstanding amounts in 2016 were adjusted as an allowance for doubtful accounts because the collectability was unknown at that time.

Staff are planning on meeting with the Long Beach Recreation Cooperative later this year to discuss the options in the drafting of a new lease agreement.

Submitted by: Fong
Teri Fong, CPA, CGA, Manager of Finance

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

3008 Fifth Avenue, Port Alberni, B.C. CANADA V9Y 2E3 Telephone (250) 720-2700 FAX: (250) 723-1327

May 9, 2017

Chris Bird
Long Beach Recreation Cooperative
PO Box 998
Ucluelet, BC
V0R 3A0

RE: Long Beach Airport Water Fees

Dear Chris,

In the fall of 2016, a report was provided to the West Coast Committee regarding the outstanding water fees of the Long Beach Recreation Cooperative. At the meeting, you expressed your confusion as to the excessive consumption amount and staff was directed to investigate. It was staffs' assumption that the excess consumption was a result of a leak in the system due to the aging infrastructure. Late last week discussions between the Environmental Services Department and the Finance Department revealed that it was actually a major calculation error.

An error was in the conversion of the water usage and the units of the meter read. Finance staff were converting the amounts from gallons to cubic meters but the meter is actually read in liters. The total consumption since the bylaw started in February of 2014 is 6,993 cubic meters not 24,238 cubic meters as was billed. As a result, a significant reduction of $34,489.66 in the billing amount has been made. The outstanding balance is now $7,302.00. Please find attached a revised invoice reflecting the adjustment.

I sincerely apologize for the error and any additional stress that it may have caused the society. Please give me a call if you have any questions.

Regards,

Fong

Teri Fong, CPA, CGA
Manager of Finance

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

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MEMORANDUM

To: West Coast Committee

From: Andrew McGifford, CPA, CGA, Manager of Environmental Services

Meeting Date: May 31, 2017

Subject: West Coast Landfill – Annual report 2014

Summary:

These reports are provided to the West Coast Committee for your information.

The Alberni-Clayoquot Regional District (ACRD) operates the West Coast Landfill (WCLF) under Operational Certificate MR-05634. The *Landfill criteria for Municipal Solid Waste* and the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills* require that the reports completed annually to ensure a monitoring program is conducted in accordance with the monitoring guidelines and best practices are being followed for landfilling in British Columbia. The landfill engineer and water monitoring engineers have prepared the reports and have been submitted to the Ministry of Environment (MOE).

The report must include:

1) An executive summary;
2) Tonnage of each type of waste discharged to the landfill for the year;
3) Remaining life and capacity;
4) Review of the preceding year of operation, plans for the next year and any new information of proposed changes relating to the facilities and plans;
5) Comparison of the monitoring data with he performance criteria in section 4 of the *Landfill Criteria for Municipal, Solid Waste Landfills*, interpretation trends, recommendations, and any proposed changes to the monitoring

The WCLF has been in operation since 1980 and with the future expansion to the southeast section is estimated to reach capacity in 2080 (per 2014 annual report). This capacity year will increase over time with diversion. The estimated greenhouse gas emissions form the WCLF was 264.30 tonnes for 2014 based on the MOE landfill gas generation model results.

Submitted by: ____
Andrew McGifford, CPA, CGA, Manager of Environmental Services

WEST COAST LANDFILL

2014 OPERATIONS AND MONITORING REPORT

ANNUAL REPORT

Submitted To: **British Columbia Ministry of Environment**

Prepared By: **McGill & Associates Engineering Ltd. (File #2772)**

On behalf of the Alberni-Clayoquot Regional District

Date: **March 2017**

EXECUTIVE SUMMARY

The Alberni-Clayoquot Regional District (ACRD) operates the West Coast Landfill (WCL) under Operational Certificate MR-05634. The WCL has operated as a landfill since 1980 and accepts solid waste from the District of Ucluelet, District of Tofino, Parks Canada, ACRD Electoral Area C (Long Beach) and First Nations Communities Toquaht, Ucluelet, Ahousaht, Tla-o-qui-aht and Hesquiaht. Daily operations were carried out by Berry & Vale Contracting, under contract to the ACRD.

This report is intended to meet the annual reporting requirements for the 2013 operating year, as required by the operational certificate and the *Landfill Criteria for Munipcal Solid Waste* published by the BC Ministry of Environment (MoE) in 1993.

During 2014, approximately 5,015 tonnes of waste was landfilled at the WCL. As of the end of 2014, there is an estimated 118,200 tonnes of solid waste at the WCL. The most recent topographic surveys resulted in filling density of approximately 0.63 tonnes/m^3. Based on the design criteria from the *Design, Operations and Closure Report*, there is an estimated 767,000 m^3 volume remaining at the WCL. At the current filling rates, it is estimated that the landfill will reach capacity around the year 2080.

The operations and maintenance expenditures for 2014 were $641,200. These expenditures included daily operations, miscellaneous expenditures such as recycling programs, water quality monitoring and engineering fees, administration and landfill closure and post-closure fund allocations. No major capital projects were completed in 2014.

The bi-monthly water quality sampling program continued throughout 2014. The results indicated slight leachate impacts. Leachate generated in the landfill is collected and directed to the leachate storage lagoon, where it is then pumped and dispersed through an irrigation system and treated by overland and subsurface flow. Monitoring results indicate that the irrigation treatment is reducing leachate concentrations, even during summer months when dilution is lowest and concentrations are highest. Sample results in Sandhill creek, the downstream receiving water body, have increased over the past few years. Only a very slight leachate impact was indicated for 2014.

Recommendations include continuing the sampling program, running a broad spectrum analysis on the leachate in summer, upgrading the gauging station on Sandhill Creek and use the data to estimate potential leachate loadings from the seep in the west leachate collection ditch, a flow gauging site should be established on the drainage past SW-11 and water quality samples should be collected during overflow events.

In January 2012, a *Landfill Gas Generation Assessment Report for the West Coast Landfill* was prepared to estimate the annual methane production at the WCL. The report estimated that 257 tonnes of methane was generated in 2011, far below the level requiring a landfill gas collection

system. The *Landfill Gas Generation Estimation Tool* was updated using 2014 data and estimated that 264 tonnes of methane was generated in 2014, still far below the level requiring a landfill gas collection system.

Filling continued near the centre of the existing landfill footprint, and then operations were moved to the western landfill footprint, as outlined in an amendment letter to the *West Coast Landfill Design, Operations and Closure Report.* In 2014, remedial work continued to re-shape the west side of the landfill to 3:1 slope.

While there are no major capital projects planned at the WCL for the 2015 year, planned work includes additional vegetation clearing for fire setbacks, implementing disposal bans, vegetation treatment and enhancement and updating the 2007 Solid Waste Management Plan.

Contingency measures have been developed to plan for events that may disrupt regular operations. Some of the possible events include emergency accidents, power outages, leachate excursions and fire events.

The closure plan estimates that closure and post-closure costs will be in the order of $5,600,000. It is estimated that there is over 60 years of operating life at the landfill. In 2014, just over $70,000 was added to the closure fund. This amount should be added annually in order to build up the required closure fund. As closure is so far in the future, the estimate should be updated regularly to reflect current technology and prices.

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1. INTRODUCTION

The Alberni-Clayoquot Regional District (ACRD) operates the West Coast Landfill (WCL) under the British Columbia Waste Management Act Operational Certificate Number MR-05634, issued April 12, 2005. A copy of the operational certificate has been attached in Appendix A. The operational certificate provides the conditions for which the WCL is authorized to manage recyclable material and waste from the ACRD.

The WCL has been used as a landfill since 1980. The WCL is located approximately 9 km northwest of the Tofino-Ucluelet junction, on the east side of the highway. A site location plan is included as Figure 1. The landfill accepts various forms of solid waste that is collected from the District of Tofino, District of Ucluelet, Parks Canada, ACRD Electoral District C (Long Beach) and First Nations communities Toquaht, Ucluelet, Ahousaht, Tla-o-qui-aht and Hesquiaht. In 2014, the landfill was operated by Berry and Vale Contracting Ltd. under contract to the ACRD. They were responsible for daily operations and maintaining landfill records.

This report is intended to meet the 2014 annual reporting requirements for operations and environmental monitoring at the WCL, as required by the operational certificate and the *Landfill Criteria for Municipal Solid Waste* published by BC Ministry of Environment (MoE) in 1993. Thus, this report includes discussion of:

- Total volume and/or tonnage of waste discharged into the landfill for the year;
- Approved design volume;
- Remaining site life and capacity;
- Operational plans for the next 12 months;
- Operation and maintenance expenditures;
- Leachate, water quality and landfill gas monitoring data and interpretation;
- Amounts of leachate collected, treated and disposed;
- Any changes from approved reports, plans and specifications;
- An up to date contingency plan, noting any amendments made to the plan during the year;
- Amount of landfill gas collected and its disposition; and,
- Review of the closure plan and associated estimated costs.

2. SOLID WASTE QUANTIFICATION AND LANDFILL CAPACITY

A Solid Waste Management Plan (SWMP) was prepared for the ACRD by Gartner Lee Limited in 2007. The objective of the report was to update the 1996 Regional Solid Waste Management Plan to reflect the current status of solid waste operations and the current public and political direction. The SWMP outlines how the ACRD will comply with relevant regulations and operational certificates. Several programs are being implemented to reduce the amount of solid waste entering the landfill. Some of these programs include a composting program and curbside recycling program.

The WCL is currently accepting waste and charging tipping fees according to ACRD Bylaw No. R1010-1. A copy of ACRD Bylaw No. R1010-1 is attached as Appendix B. The weight of solid waste entering the landfill in 2014 is summarized in Table 1 below.

Table **1**: Measured Weight of Solid Waste Entering the WCL in 2014

Accepted Waste	**Weight (tonnes)**
Commercial Waste	2,818.8
Residential Waste	1,108.2
Mixed Construction/Demolition Waste	802.4
Roofing	90.1
Gyproc	33.8
Land clearing	5.3
Septic Tank Pumping (Catch Basin Material)	9.7
Contaminated Soil	67.8
Animal/Fish	1.0
Asbestos	0
Fish Feed Totes	0
Fridges and Freezers (each)	73
Metal	25.8

Of the above listed weights, the fridges and freezers and steel are not landfilled but are stockpiled and subsequently removed for recycling. Any contaminated soil is not directly landfilled but is used as an intermediate cover layer inside of fire cells.

The data for the 2014 operating year was provided by the ACRD and is based on categorized scale records. When available, the direct weight of the categorized material was used. The amount of solid waste dropped off by individual users to the landfill site was provided based on the number of bags of garbage, as this is how payment is calculated. This is different from data provided for past years, where the weight of solid waste in the transfer bins was used. In order to convert the number of bags of garbage to a representative weight, an average weight of 7.5 kg per bag was used (based on information provided in an Ergonomic Assessment study completed by the University of Ontario and the Transportation Health and Safety Association of Ontario). Where the number of bags is not specified (due to a maximum charge), it has been assumed that the load contains the maximum weight of 145 kg, as specified in ACRD Bylaw No. R1010-1.

The amount of material landfilled during 2014 is approximately 5,015 tonnes.

In 2014, landfilling operations continued on the western face in the southwest corner of the landfill footprint, denoted as Cell D in the West Coast Landfill Design, Operations & Closure Report.

The active filling area, landfill footprint and other notable site features are shown on Figure 2. As of the end of 2014, there is an estimated 118,200 tonnes of solid waste at the WCL. A table of the estimated historic weights from 1980 to 2014 is included in Appendix C.

The most recent topographic surveys of the landfill face were conducted on January 17, 2014 and January 21, 2015. The survey indicated a fill volume of approximately 7,978 m^3. The estimated weight of solid waste filled during this period is approximately 5,015 tonnes, resulting in an estimated filling density of about 0.63 tonnes/m^3.

After negotiation with Ministry of Environment, property setbacks have been reduced to 15m on portions of the east and south edges of the property. Land to the north, east and west is owned by forestry companies and zoned A4 – Forest Service Area. The land is currently undeveloped and will not be developed in the foreseeable future. Land to the south of the property consists of a dedicated road allowance adjacent to the Pacific Rim National Park reserve.

The Design, Operations and Closure Report, prepared by McGill & Associates Engineering Ltd. in January 2012, and subsequent Amendment dated June 17, 2013, provides a filling plan for the future operations of the landfill. As per the draft plan, the landfill will continue to be constructed in a series of cells, with finished slopes of 3 horizontal to 1 vertical and a finished elevation of approximately 120 m (based on the local survey datum). The footprint area is based on that currently approved by the Ministry of Environment and will cover an area of approximately 9.1 hectares. The objective of the amendment will be to seal the western slope of the landfill, prior to commencing with filling Cells A through D. The amendment does not change the physical layout of the landfill closure design.

The remaining volume in each cell, as of a topographic survey on January 21, 2015, is provided in the table below.

Table 2: Estimated Volume Remaining in Each Cell

Cell	Estimated Volume Remaining (m^3)
A	1,000
B	43,000
C	148,000
D	113,000
E	462,000
Total	**767,000**

There is an estimated 767,000 m3 available before the landfill reaches full capacity, according to the current design. While it is expected that there will be an increase in population, it has been assumed that an increase in the amount of recycling and a reduction of solid waste material will balance this, if not reduce it.

Based on a filling density of approximately 0.41 tonnes/m3 and an average annual solid waste weight of 4,900 tonnes, the landfill is estimated to reach capacity in approximately the year 2080. The variations in filling density will have an impact on the remaining landfill capacity, and therefore this number is still a rough estimate.

More detailed analysis of the future landfill design is provided in the *Design, Operations and Closure Report.*

3. OPERATION AND MAINTENANCE EXPENDITURES FOR 2014

A summary of the 2014 expenditures for the WCL are provided in Table 3 below.

Table 3: 2014 WCL Operation and Maintenance Expenditures

Item	Cost
Daily Operations (Staff, utilities, equipment)	$416,600
Miscellaneous Operations Costs (promotional/educational materials, recycling)	$23,300
Administration	$65,500
Capital Cost Contribution	$24,900
Engineering, Monitoring & Consulting Fees	$36,600
Landfill Closure & Post-Closure Fund Allocation	$74,300
Total	**$641,200**

The expenditures listed above do not include costs associated with residential pickup and garbage collection services operated by ACRD. In 2014, there were no major capital projects undertaken at the WCL.

4. MONITORING DATA AND INTERPRETATION

The regular water quality monitoring program continued at the WCL through 2014. The intention of the sampling program is to determine the background surface water quality, monitor surface flow paths from the landfill, and to characterize the leachate quality produced.

A description of the Leachate Collection System and a discussion of the monitoring results are provided below.

4.1. Leachate Collection System

Leachate generated at the landfill is collected into overland leachate collector ditches that are located along the east and west edges of the landfilled areas. The collector ditches drain to the leachate storage lagoon located near the southwest corner of the property. When large enough quantities of leachate are collected in the storage lagoon, the leachate is pumped to the northern portion of the landfill where it is dispersed overland through an irrigation system. The system utilizes the existing natural terrain to treat leachate using a combination of overland flow and subsurface flow. The leachate collection system is shown on Figure 2.

4.2. Leachate & Water Quality

The water quality monitoring program for 2014 included six water sampling events. Piteau Associates Engineering Ltd. prepared and submitted a report entitled "*2014 Monitoring Report – West Coast Landfill – Alberni-Clayoquot Regional District*", dated November 2015. The report provides the monitoring data and interpretation of results from the surface water and leachate samples. A copy of the report is included in Appendix D. A summary of the results are as follows:

Overall Water Quality

- Overall monitoring data indicate a slight leachate impact but with no obvious long term increasing trends;
- Chloride and ammonia data for the concentrated leachate show a consistent seasonal variation with precipitation and temperature; and
- For this sampling year, the only parameters that exceeded the guidelines in the concentrated leachate were ammonia, total aluminum, total cadmium, total and dissolved chromium, total copper, total and dissolved iron, total and dissolved manganese and total selenium.

Leachate Collection and Treatment

- The leachate quality in the storage lagoon is comparable to concentrations around the perimeter prior to construction of a leachate collection system and exceed the guidelines for ammonia and some metals;
- Samples collected down from the irrigation site indicate that ammonia concentrations are consistently less than at the leachate lagoon, indicating that the system is reducing ammonia concentrations, even during the summer months (growing season) when dilution is lowest and concentrations are highest; and
- During wet periods, slight leachate impacts are present in surface water downstream from the irrigation system.

South Boundary

- Results for samples on Sandhill Creek downstream of the leachate storage lagoon and east leachate collector ditch show only slight leachate impacts; however, the location of these samples is no longer considered appropriate to confirm that containment is adequate to mitigate migration and impacts south of the site.

West Boundary

- Slight leachate impact was observed at sample site SW-11, located west of the landfill and downstream from the suspected leachate seep in Leachate Ditch #2. Ammonia concentrations have met the guidelines for the past 3 years, with the exception of slight exceedance on one sample in October 2013 and one in August of 2014. Chloride concentrations follow slightly below the trend of ammonia, lower in the wet months and higher in the dry months. Iron and manganese have chronically exceeded the guideline in the past, however manganese only exceeded the guideline three times in the past year. The 2014 data suggest improvement relative to 2010/2011, indicating the work done on the leachate ditch may have had a slight effect.

Sandhill Creek

- The receiving water quality monitoring site indicated only very slight leachate impact, with aluminum the only parameter to chronically exceed the guidelines, with isolated exceedances of cadmium, chromium, iron, manganese, and mercury. Based on other sites, the increased manganese concentration in the Sandhill Creek may be due to background chemistry or the landfill; and

- Over the past decade, there have been some apparent changes to the water quality in the Sandhill Creek tributary, with slight increases in ammonia and chloride concentrations, and the elevated iron and manganese concentrations observed on two occasions. The ammonia risk was partially mitigated by the construction and operation of the irrigation system in 2004, however they may continue to increase gradually over time as a function of the volume and age of waste that is contained in the landfill.

Overflow Events

- Leachate lagoon overflow events occur at the West Coast Landfill after significant storm events, during which water decants from the lagoon's perforated overflow pipe. Piteau Associates documented the events and made sampling recommendations during 2014 (included in Appendix D). The resulting sampling indicated that the general chemistry of the overflow water is diluted compared to the bimonthly lagoon samples, with the exception of phosphorous, BOD, and aluminum, associated with the high turbidity of the lagoon. It is assumed that further dilution occurs as the overflow travels through the buffer zone on the west side and enters the gulley leaving the landfill site. Due to the high water level during these storm events, an improved access to the sampling point SW-1 is required in order to confirm the level of dilution.

4.3. Landfill Gas

The following sections summarize the annual reporting requirements of the *Landfill Gas Regulation*.

In January 2012, the draft *Landfill Gas Generation Assessment Report for the West Coast Landfill* was prepared by McGill & Associates Engineering Ltd. The assessment was completed as the landfill is estimated to contain greater than 100,000 tonnes of solid waste. This was the first landfill gas assessment completed for the WCL, and included data to the end of 2011. A summary of this report and updated results for 2014 data is provided below.

4.3.1. Introduction

The following section has been prepared in accordance with the requirements of the British Columbia Ministry of Environment's Landfill Gas Management Regulation (Regulation), approved and ordered on December 8, 2008, and in accordance with the Landfill Gas Generation Assessment Procedure Guidance Report, as prepared for the British Columbia Ministry of Environment (MOE) by Conestoga-Rovers & Associates (CRA), dated March 2009. This section has been prepared by a qualified professional and meets the requirements of Section 4(3)(e) of the Regulation.

4.3.2. Records

The following section presents the information required under Section 12(3), 13, and 14(1)(a) of the Regulation.

The Alberni-Clayoquot Regional District certifies that all records required under Section 12(3) of the British Columbia Ministry of Environment Landfill Gas Management Regulation are retained for a period of at least 10 years after they are made. Furthermore, the records will be produced for inspection or copying, upon written request from the director, in the time period specified by the director as required in Section 13 of the Regulation.

4.3.3. Quantity, Source and Composition of Municipal Waste Received

The following section presents the information required under Sections 12(1)(a), 12(1)(b), 12(1)(c), 14(1)(a) and 14(2)(g) of the Regulation and as described in Section 5.1 of the Guidelines.

A breakdown of the quantity and type of solid waste entering the WCL in 2014 has been provided in Section 2. The waste composition was been categorized and a summary is provided in Table 1 in Appendix E. This table includes measured waste categorization from 2009 to 2014.

As no solid waste categorization studies have been completed for the solid waste generation area, the solid waste composition was based on a combination of scale records and the *British Columbia's Solid Waste Flow Report, 2006 Summary Report* prepared for MoE by BC Stats in February 2010. Further discussion on the methodology used can be found in the *Landfill Gas Generation Assessment Report for the West Coast Landfill*, prepared by McGill & Associates Engineering Ltd. in January 2012 (LFG Report).

The 2014 Material Weight Reports prepared by the landfill operator show that the WCL received 10 tonnes of "septic tank pumpings". As this type of material is not accepted at this site, the records were reviewed and it was found that the material was actually catch basin trappings. For the purposes of the landfill gas assessment, this material is considered to be moderately decomposable as it is assumed to contain both decomposable organic material and considerable amounts of relatively inert grit and sediments.

Using the assumptions provided in the Landfill Gas Generation Assessment Report for the West Coast Landfill, in 2014, the WCL received 1,730 tonnes (34%) of relatively inert material, 1,774 tonnes (35%) of moderately decomposable material, and 1,511 tonnes (30%) of decomposable material. A table showing the breakdown of the waste composition for 2014 has been included in Appendix E.

4.3.4. Waste Diversion

The following section presents the information required under Section 14(1)(b) of the Regulation.

There is currently no organic waste collection program within the ACRD or WCL collection area. Backyard composting of organic waste is encouraged through distribution of backyard composters and educational material on the ACRD website. In addition, some resorts have begun their own composting programs for both food and yard waste. Land clearing debris is accepted at the landfill.

4.3.5. Landfill Gas Generation Model Results

The *Landfill Gas Generation Estimation Tool* was used to estimate the annual amount of methane produced at the WCL. The estimated quantities of methane generated by the WCL from 2014 to 2019 is presented in the table below.

Table 4: Estimated Landfill Gas Generation Rates

	Year	**Mass of Methane Generated (tonnes)**
Estimated Quantity of Methane Produced in year Preceding the Assessment	2014	264
Estimated Quantity of Methane Produced in Year of the Assessment	2015	270
Estimated Quantity of Methane Produced One year after the Assessment	2016	274
Estimated Quantity of Methane Produced Two Years after the Assessment	2017	278
Estimated Quantity of Methane Produced Three Years after the Assessment	2018	282
Estimated Quantity of Methane Produced Four Years after the Assessment	2019	285

According to the model, there was an estimated 264 tonnes of methane generated in 2014. A copy of the methane generation spreadsheet model results from the Landfill Gas Generation Estimation Tool is provided in Appendix F.

In the year preceding the assessment (2014) there was an estimated 264 tonnes of methane generated at the WCL. As the estimate is below 1,000 tonnes, a Landfill Gas Management Design Plan is not yet required. An annual landfill gas update will be prepared and submitted to MoE along with the annual operations and monitoring report each year. A supplementary landfill gas generation assessment will be conducted in 2017, the fifth calendar year following the assessment.

5. REVIEW OF OPERATING PLAN

Operation of the landfill in 2014 continued as set out in the *West Coast Landfill Design, Operations and Closure Report* prepared by McGill & Associates Engineering Ltd. as amended in June 2013. Active filling continued in Cell D, on the west face near the southwest corner of the existing landfill footprint (Figure 2). As discussed in Section 2, the filling plan was amended to switch active filling to the western edge of the landfill. A letter, dated June 17, 2013, was sent to the Ministry of Environment describing the rationale for the amendment.

Notable work related to WCL operations in 2014 included:

- Continuation of the remedial work to re-shape the west side of the landfill to 3:1 slope.

6. 2015 OPERATIONAL PLAN

No changes are planned to landfilling operations at the WCL in 2015. Landfilling will continue along the western slope.

The water quality monitoring program will continue throughout 2015, and should include the minor changes recommended by Piteau Associates Engineering Ltd. Flow monitoring of the gauging station on Sandhill Creek and the seepage pathway past SW-11 is recommended, and will be considered in 2015.

Projects that have been planned for the 2015 year include:

- Additional vegetation clearing for fire setbacks;
- Implementing disposal bans;
- Vegetation treatment and enhancement;
- Updating the 2007 Solid Waste Management Plan.

The recommendations provided in the "*2014 Monitoring – West Coast Landfill – Alberni-Clayoquot Regional District*" report are:

- To continue the bi-monthly sampling program throughout 2015;
- The sampling location of SW-12 should be modified to a gully downgradient of SW-5 and the leachate storage lagoon;

- SW-10 should be continued to be sampled, but a background sample should be taken uphill from Sandhill Creek when conditions are favourable;
- Samples should be collected from sampling site SW-5;
- A VOC analysis should be collected from SW-1 for the two autumn/winter sampling events;
- Run a broad spectrum contaminant analysis on the leachate in the early summer, as well as any follow up samples, if required;
- Upgrade the gauging station on Sandhill Creek and add a flow gauging site on the drainage course near sampling site SW-11 (near seepage pathway) to estimate flows and calculate leachate loadings can be compared;
- Use the flow monitoring data from Sandhill Creek and the seepage pathway to estimate how the seepage pathway is impacting the results at Sandhill Creek. If the seepage pathway is determined to be the source of the increased iron concentrations, additional mitigation measures may be required, such as diverting leachate flow into the leachate pond with a pump; and,
- Water quality samples should be collected from the leachate lagoon decant flow, SW-11, and Sandhill Creek SW-1 during overflow events.

7. CONTINGENCY PLAN

Contingency measures have been developed to plan for any events that may disrupt regular landfill operations. These measures are discussed below.

Vehicles onsite are all equipped with radios that communicate with each other and the scale building. In the event of an accident or emergency, vehicles can contact the scale shed and the 911 emergency number can be called from the landline phone at the scale building.

A backup generator is connected to the scale building to provide power in the event of a power outage. The backup generator provides power to the scale and building to prevent disruption to the landfill operations. The backup generator does not provide backup power to the leachate pumps. In the event of a power loss, the pond has freeboard and some capacity to handle additional volume before an overflow event would occur.

Should a leachate excursion be observed visually or through the results of the water quality monitoring program, several contingency measures are available to contain the leachate. The works include constructing a permanent clay berm to block shallow groundwater or surface flow or excavating a shallow sump to intercept the flow and pumping the leachate into the leachate collection system. The landfill operators have the available equipment onsite and clay is available locally.

Two water tanks are located onsite to provide dust control and initial fire protection. A portable pump is also onsite should initial response firefighting be required. The ACRD is in the process of negotiating a co-operative fire protection agreement for the WCL and Long Beach Airport with the Districts of Tofino & Ucluelet, Parks Canada, the landfill operator, and the BC Forest Service.

Due to the size of the landfill, rural location, limited surrounding properties and placement of daily cover, odours are not a concern at the WCL. A plan will be developed in the future should odours become an issue.

No changes to the contingency plan were made during 2014.

8. CLOSURE PLAN

In January 2012, a draft *West Coast Landfill Design, Operations & Closure Report* was prepared by McGill & Associates Engineering Ltd. along with an amendment dated June 2013. The report outlines a proposed filling plan and closure design. The proposed plan includes expanding the landfill in a series of cells to a maximum footprint area of approximately 9.1 ha, as currently shown on the operation certificate. Based on this design, the estimated solid waste volume at closure is estimated to be 1,100,000 m^3. Based on the current annual tonnage accepted at the WCL, it is estimated that there is over 60 years of operating life left at the WCL.

Based on the proposed closure design outlined in the report, the cost of closure and post closure is estimated to be $5,600,000. The estimate is based on the assumptions outlined in the report. The current closure fund has approximately $393,098.16. In order to obtain the required amount at closure, approximately $70,000 should be added to the fund annually for each of the remaining years of operation. In 2014, a total of <u>$74,523</u> was added to the closure fund (annual contributions and interest).

As closure is estimated to be 60 to 80 years in the future, the costs should be updated regularly to reflect current technology and prices.

9. 2014 SITE INSPECTION

The last compliance review was completed with a Ministry of Environment representative on November 15, 2012. A compliance review was not completed during 2013 or 2014.

10. LIMITATIONS

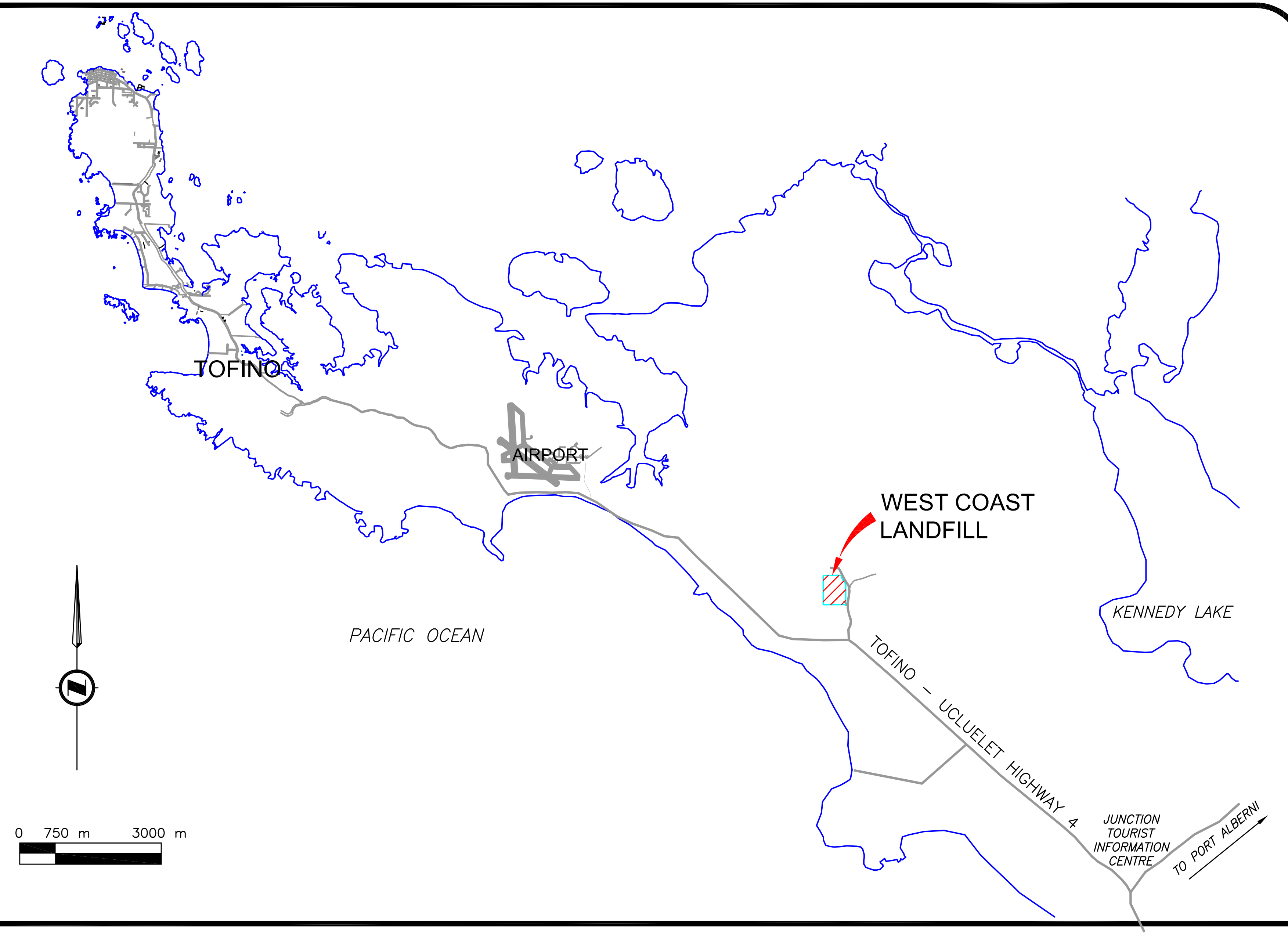
This document was prepared by McGill & Associates Engineering Ltd. for the Ministry of Environment, on behalf of the Alberni-Clayoquot Regional District. Its material, recommendations and conclusions represent the best material available to McGill & Associates Engineering Ltd. at the time of the report preparation. Any use 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. McGill & Associates Engineering Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Yours truly,

for **McGill & Associates Engineering Ltd.**

Brad West, P. Eng.

FIGURES



APRIL 2017

ALBERNI CLAYOQUOT REGIONAL DISTRICT

WEST COAST LANDFILL - 2014 OPERATIONS AND MONITORING REPORT

SITE LOCATION PLAN

FIGURE 1

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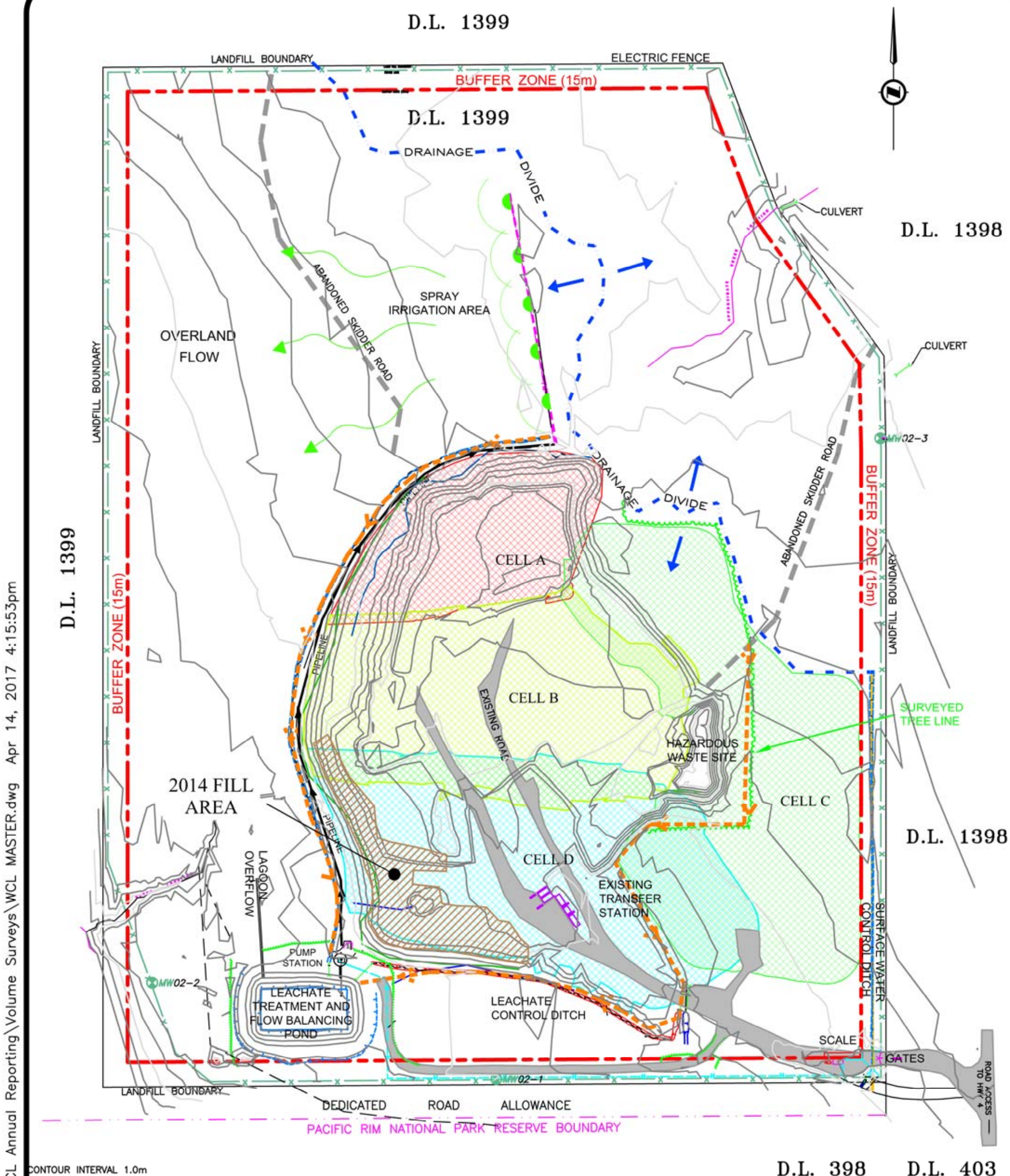


ALBERNI CLAYOQUOT REGIONAL DISTRICT

FIGURE 2

WEST COAST LANDFILL - 2014 OPERATIONS AND MONITORING REPORT - SITE PLAN

APPENDIX A

WEST COAST LANDFILL OPERATIONAL CERTIFICATE MR-05634

BRITISH COLUMBIA

MINISTRY OF WATER, LAND AND AIR PROTECTION

Vancouver Island Region
Environmental Protection
2080-A Labieux Road
Nanaimo, British Columbia
V9T 6J9
Telephone: (250) 751-3100
Fax: (250) 751-3103

OPERATIONAL CERTIFICATE

MR-05634

Under the Provisions of the Environmental Management Act

Regional District of Alberni-Clayoquot

3008 Fifth Avenue

Port Alberni, British Columbia

V9Y 2E3

is authorized to manage recyclable material and waste from the Regional District of Alberni-Clayoquot and environs at the West Coast landfill located between Ucluelet and Tofino, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

1. MANAGEMENT OF WASTE AND RECYCLABLE MATERIAL

1.1. Sanitary Landfill

1.1.1. This subsection applies to the discharge of waste to a sanitary landfill.

1.1.2. Waste may be discharged to the sanitary landfill shown on attached Site Plan A.

1.1.3. The characteristics of the discharge must be municipal solid waste as defined under the *Environmental Management Act* and other wastes as approved in writing by the Director.

1.1.4. The authorized works are a sanitary landfill, and related appurtenances approximately located as shown on attached Site Plan A.

1.1.5. The authorized works must be complete and in operation on and from the date of this operational certificate.

1.2. Leachate

1.2.1. This subsection applies to the management and disposal of leachate from the landfill.

R. Alexander
for Director, *Environmental Management Act*

Date Issued: APR 12 2005
Date Amended:
(most recent)

1.2.2. The characteristics of the leachate at the property boundary must not exceed concentrations set in the *British Columbia Approved Water Quality Guidelines (Criteria)* and *A Compendium of Working Water Quality Guidelines for British Columbia*. Where natural background water quality concentrations exceed the aforementioned guidelines, characteristics of the leachate must not exceed background concentrations.

1.2.3. The authorized works are a leachate collection and conveyance system, leachate treatment works, discharge distribution pipe, and related appurtenances approximately located as shown on Site Plan A.

1.2.4. The authorized works must be complete and in operation on or before September 30, 2005.

1.3. Location of authorized facilities

The location of the facilities for the management of waste and recyclable material to which this operational certificate is applicable is Lot A, Plan VIP 68534 and Plan VIP 38600, District Lot 1399, Clayoquot Land District.

2. GENERAL REQUIREMENTS

2.1. Entrance facilities

2.1.1. The authorized facilities are signs, weigh scales, recyclable material and waste drop-off and storage facilities and related appurtenances approximately located as shown on attached Site Plan A.

2.1.2. The authorized facilities must be complete and in operation on and from the date of this operational certificate.

2.2. Bear-Proof Facilities

2.2.1. Bears must not access putrescible waste at the landfill facility. All putrescible waste that arrives at the landfill facility must be immediately contained within a bear-proof bin or an area enclosed by a bear-proof electric fence. Grass, leaves, weeds, branches and woodwaste are exempt from bear-proofing requirements.

2.2.2. A bear-proof electric fence must be installed around the landfill.

2.2.3. The bear-proof fence must be designed, constructed, operated and maintained to prevent bears from penetrating the fence.

2.2.4. The bear-proof electric fence must be complete and in operation on and from the date of this operational certificate.

R. Alexander
for Director, *Environmental Management Act*

2.3. Qualified Professionals

All facilities and information, including works, plans, assessments, investigations, surveys, programs and reports, must be certified by qualified professionals.

2.4. Plans

2.4.1. Site development, operating, leachate management, closure and post closure plans must be submitted to the Regional Manager, Environmental Protection, by December 31, 2005.

2.4.2. The plans must address, but not be limited to, each of the subsections in the *Landfill Criteria for Municipal Solid Waste* including performance, siting, design, operational and closure and post-closure criteria.

2.4.3. The facilities must be developed, operated and closed in accordance with the plans.

2.5. Landfill Gas

2.5.1. When 100,000 tonnes of waste have been discharged at the landfill, an assessment of the potential for landfill gas generation must be submitted to the Regional Manager, Environmental Protection.

2.5.2. The landfill gas assessment must address, but is not limited to, subsections 4.2 and 6.4 of the *Landfill Criteria for Municipal Solid Waste* and section 6 of the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills.*

2.5.3. The potential for landfill gas generation is to be re-assessed at least once every 5 years after the initial assessment.

2.6. Seismic and Fault Activity

A report that assesses the risk from seismic and fault activity must be submitted to the Regional Manager, Environmental Protection, by December 31, 2005.

2.7. Additional Facilities or Works

The Director may require investigations, surveys, and the construction of additional facilities or works including, but not limited to, additional leachate and landfill gas management facilities. The Director may also amend the requirements of any of the information required by this operational certificate including plans, programs, assessments and reports.

R. Alexander
for Director, *Environmental Management Act*

3. MONITORING AND REPORTING

3.1. Monitoring Program

3.1.1. A monitoring program must be developed to identify any impacts to the environment and public health from the landfill.

3.1.2. The monitoring program must address, but not be limited to, subsections 4.1, 4.2 and 7.15 of the *Landfill Criteria for Municipal Solid Waste* and the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*.

3.1.3. Monitoring must be conducted in accordance with the monitoring program.

3.2. Annual Operating and Monitoring Report

3.2.1. An annual operating and monitoring report for the preceding 12 month period from January 1 to December 31 must be submitted to the Regional Manager, Environmental Protection, by June 1 of each year.

3.2.2. The report must include:

- An executive summary;
- Tonnage of each type of waste discharged to the landfill for the year;
- Remaining site life and capacity;
- Review of the preceding year of operation, plans for the next year and any new information or proposed changes relating to the facilities and plans;
- Comparison of the monitoring data with the performance criteria in section 4 of the *Landfill Criteria for Municipal Solid Waste* and the *Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills*, interpretation of the monitoring data, identification and interpretation of irregularities and trends, recommendations, and any proposed changes to the monitoring program.

4. SITE CLOSURE

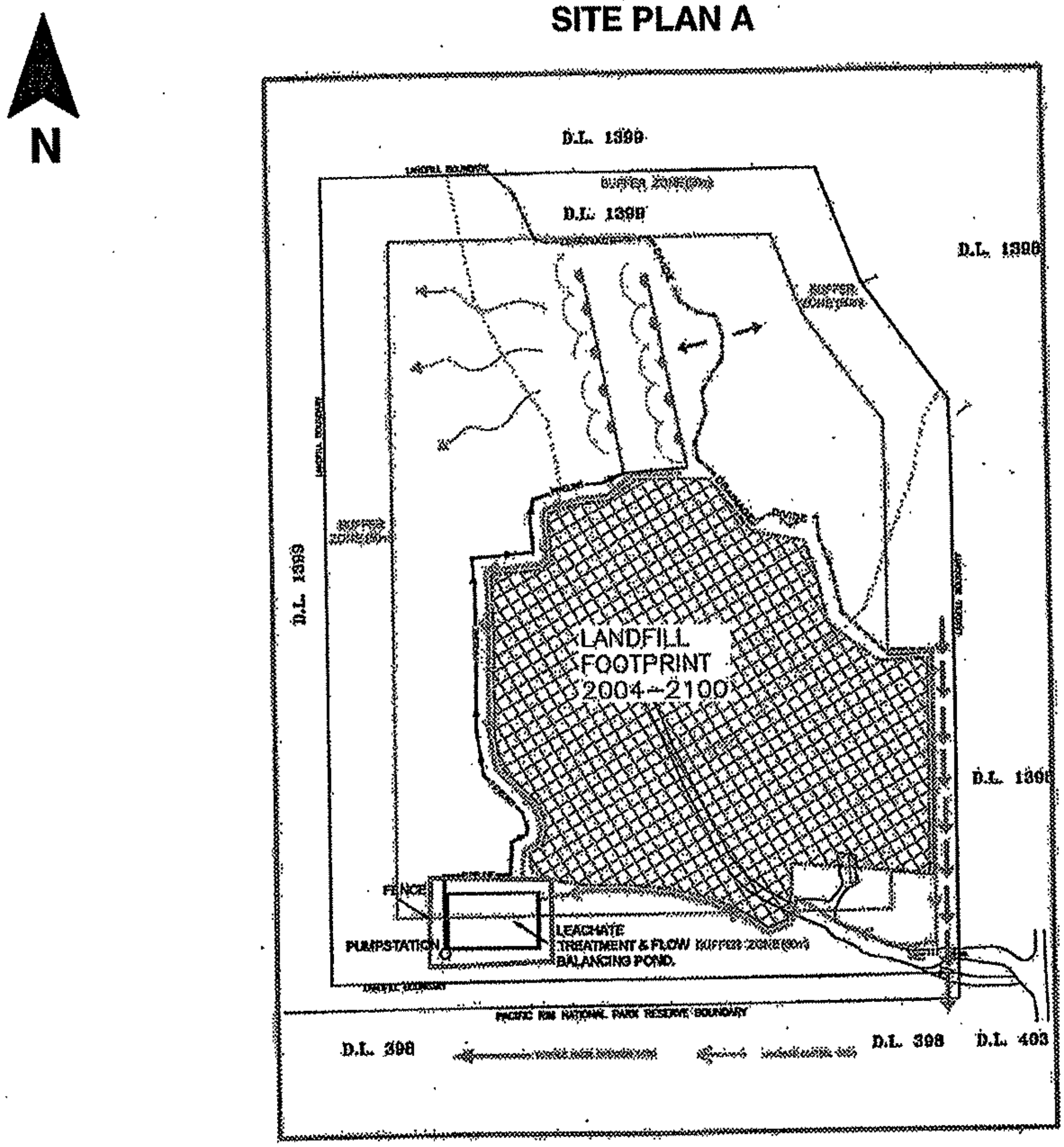
4.1. Closure and Post-Closure Fund

A closure and post-closure fund must be built up over time. The closure and post-closure fund must ultimately meet or exceed the estimated closure and post-closure costs plus a reasonable contingency for any remediation that may be required.

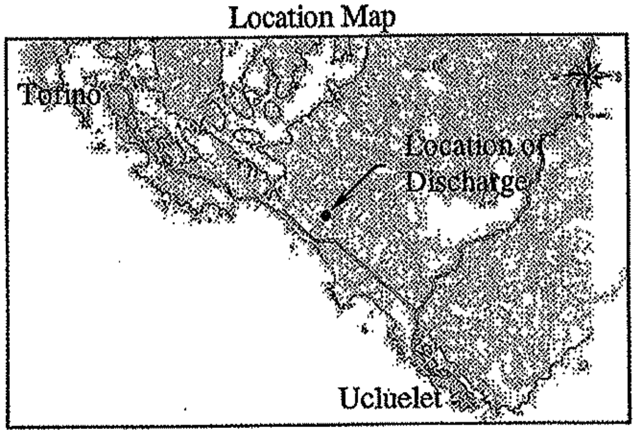
R. Alexander
for Director, *Environmental Management Act*

Date Issued: APR 12 2005
Date Amended:
(most recent)

SITE PLAN A



Location Map



Scale: NTS

OPERATIONAL CERTIFICATE: MR-05634

Date: APR 12 2005

R. Alexander
for Director, *Environmental Management Act*

APPENDIX B

ALBERNI-CLAYOQUOT REGIONAL DISTRICT BYLAW

NO. R1010, R1010-1, R1010-2, R1010-3

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

BYLAW NO. R1010

A Bylaw to Provide for
the Regulation of Solid Waste and Tipping Fees
at the West Coast Landfill

WHEREAS by Supplementary Letters Patent, dated August 10th, 1973 as amended, the Regional District of Alberni-Clayoquot was granted the function of Garbage Disposal under Division XIV of its Letters Patent;

AND WHEREAS the Regional District of Alberni-Clayoquot is empowered to establish a scale of charges payable for depositing refuse at a disposal site;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot deems it advisable to enact regulations pertaining to solid waste disposal and to establish a charge for depositing refuse;

NOW THEREFORE, the Board of the Regional District of Alberni-Clayoquot in open meeting assembled enacts as follows:

1. DEFINITIONS

In this bylaw, unless the context otherwise requires:

1.1 **"Biomedical Waste"** means solid waste such as soiled sheets, garments and other similar solid waste. Excluded is waste material from pathology, operating rooms, laboratories and other hospital operations which produce potentially infectious waste considered to be special waste;

1.2 **"Controlled Waste"** means certain hazardous waste, liquid waste and refuse which is approved for disposal at the West Coast Landfill site but which, because of its inherent nature and quantity, may require special handling and disposal techniques to avoid creating health hazards, nuisances, or environmental pollution. Controlled Waste includes, but is not limited to:

a. Demolition Wastes including:

i. roofing materials

ii. stumps, land clearing debris;

b. Waste oils (commercial)

c. Material containing the following:

i. traces of petroleum products;

ii. pumpings from domestic septic tanks;

iiii catch basin and manhole material;

d. Waste asbestos;

e. Fish shrimp shells, animal carcasses;

f. Bulk items including fridges, stoves, hot water tanks;

g. Batteries

h. Steel Cable

i. Biomedical Waste

1.3 **"Corrugated Cardboard"** means recyclable waste from industrial, commercial, institutional, sources which includes, but is not limited to containers or materials used in containers consisting of 3 or more layers of Kraft paper material and having smooth exterior liners and a corrugated or rippled core, but excluding containers which are impregnated with blood, grease, oil, chemicals, food residue, wax; or have polyethylene, foil or other non-paper liners; or are contaminated with a material which will render the corrugated cardboard not marketable.

1.4 **"Construction/Demolition Waste"** means waste produced from the construction, renovation, and demolition of buildings, bridges, wharfs, rail lines and other structures, but does not include waste containing or contaminated with asbestos, creosote, PCB treatments, paints or chemicals of any kind.

1.5 **"Disposal Area"** means the West Coast Landfill

1.6 **"Gypsum"** includes, but is not necessarily limited to new construction off-cuts or scraps and old wallboard that has been painted, covered in wallpaper, vinyl or ceramic tiles and is removed during renovation, but excluding wallboard from demolition sites or wallboard associated with asbestos;

1.7 **"Hazardous Waste"** means gaseous, liquid and solid waste which, because of its inherent nature and quantity, requires special disposal techniques to avoid creating health hazards, nuisances or environmental pollution. Hazardous Wastes are toxins or poisons, corrosives, irritants, strong sensitizers, flammables. explosives, infectious wastes, condemned foods, etc. Flammable wastes excluding plastics, paper, paper products and the like;

1.8 **"Ignitable"** means having the properties of:

a. flammable gas,

b. flammable liquid, or

c. flammable solids, or substances susceptible to spontaneous combustion or substances that on contact with water emit flammable gases as defined in the Special Waste Regulations of the Waste management Act;

1.9 **"Person"** means an individual, a body corporate, a firm, a partnership, association or any other legal entity or an employee or agent thereof.

1.10 **"Prohibited Waste"** means gaseous liquid and solid waste not acceptable for disposal at a Solid Waste Management Facility and includes, but is not limited to:

a. liquids, except as permitted herein;

b. ignitable wastes;

c. reactive wastes;

d. radioactive wastes;

e. hazardous waste;

f. special waste, as defined in the Special Waste Regulations of the Waste Management Act and medical waste;

g. solid waste that is on fire or smouldering;

1.11 **"Radioactive Waste"** means waste containing a prescribed substance as defined in the Atomic Energy Control Act in sufficient quantity or concentration to require a licence for possession or use under that Act and regulations made under that Act;

1.12 **"Reactive Waste"** means waste which is;

a. explosive, oxidizing, or so unstable that it readily undergoes violent change in the presence of air or water;

b. generates toxic gases, vapours, or fumes by itself or when mixed with water; and

c. polymerizes in whole or in part by chemical action and causes damage by generating heat or increasing volume; as defined in the Special Waste Regulations of the Waste Management Act;

1.13 **"Refuse"** includes, but is not necessarily limited to food wastes, market wastes, combustibles such as paper, cardboard, plastics, leather, yard trimmings, non-combustibles such as; metal cans, glass containers, crockery, dirt, ashes from fireplaces and onsite incinerators, street sweepings, bulk wastes, construction and demolition refuse such as; pipe, concrete, lumber, plastic and wire, all arising from domestic, commercial, institutional or municipal activities. Refuse resulting from industrial operations is not included.

1.14 **"Regional Board"** means the Board of the Regional District of Alberni-Clayoquot;

1.15 **"Regional District"** means the Regional District of Alberni-Clayoquot;

1.16 **"Solid Waste"** means that it is acceptable for deposit at the solid Waste Management Facilities but does not include prohibited waste;

1.17 **"Special Waste"** means any chemical, compound, mixture, substance or article which is defined as such in the Special Waste Regulation;

1.18 **"Special Waste Regulation"** means a regulation of the Province of British Columbia under the Waste Management Act.

1.19 **"Waste Asbestos"** means waste containing friable asbestos fibres or asbestos dust as defined in the Special Waste Regulation.

1.20 **"Waste Oil"** means automotive lubricating oil, cutting oil, fuel oil, gear oil, hydraulic oil or any other refined petroleum based oil or synthetic oil as defined in the Special Waste Regulation.

2. CONDITIONS

2.1 No person shall, in depositing refuse at the Disposal Site ;

a. deposit a Prohibited Waste;

b. deposit Solid Waste except as directed by regulations for the use of the disposal site.

c. unless permitted by the Regional District, deposit solid waste without first having it weighed on the scales at the disposal site;

d. drive a vehicle anywhere on the disposal site except on roads provided by the Regional District for that purpose unless otherwise instructed;

e. act in a manner contrary to the posted site regulations.

2.2. Controlled Waste will not be accepted for disposal at the West Coast Landfill site without the written approval of the Regional District. This requirement may be waived, if the Regional District or its agent determines that special handling and disposal techniques are not required to dispose of the Controlled Waste. Controlled Waste for which a special handling and disposal techniques are required are subject to a Special Disposal Fee as outlined in Schedule "A" of this Bylaw.

2.3 No person shall salvage or remove material deposited at the Solid Waste Management Facilities without prior written approval of the Regional District.

2.4 No person shall loiter or leave their vehicle unattended at the Solid Waste Management Facilities.

2.5 Persons entering the Solid Waste Management Facilities do so at their own risk. The District accepts no liability whatsoever for damage and/or injury to persons or property at the Solid Waste Management Facilities.

2.6 Children under 13, and pets shall not be permitted at the Solid Waste Management Facilities except inside a vehicle.

2.7 No person shall deposit Solid Waste which does not originate from within the Regional District at the disposal site without authorization from the Regional District.

3. CHARGES

3.1 Every person depositing solid waste at the Solid Waste Management Facilities shall pay to the District the applicable charges set out in Schedule "A" hereto,

3.2 Where a charge is not paid within the time specified in Schedule "A" for its payment the person liable to pay such charge shall:

a. In addition to such charge pay interest thereon at a rate set out in Schedule "A" from the date the charge was due to the date of payment;

b. Not deposit any refuse on or at the Disposal Site until such charge and interest owing thereon has been paid in full.

4. VIOLATIONS AND PENALTIES

4.1 No persons shall do any act or suffer or permit any act or thing to be done in contravention of this Bylaw.

4.2 Every person who contravenes this bylaw, by doing any act which the bylaw forbids, or omits to do any act which the bylaw requires:

a. is guilty of an offence and is liable, on summary conviction, to fine of not less than TWO HUNDRED ($200.00) DOLLARS and not more than TWO THOUSAND ($2,000.00) DOLLARS for a first offence and for each subsequent offence to a fine of not less than FIVE HUNDRED ($500.00) and not more than TWO THOUSAND ($2,000.00) DOLLARS. A separate offence shall be deemed to be committed upon each day during and in which the contravention occurs or continues;

b. may be prohibited from depositing refuse at the Solid Waste Management Facilities;

c. The penalties imposed under subsection (b) hereof, shall be in addition to and not in substitution for any other penalty or remedy imposed by this Bylaw or any other statute, law or regulation.

5. REPEAL

5.1 Bylaw R1009-1, cited as “West Coast Landfill Tipping Fee and Regulation Bylaw No. R1009-1, 1999" is hereby repealed.

TITLE

This bylaw may be cited as the “West Coast Landfill Tipping Fee and Regulation Bylaw No. R1010, 2001"

Read a first time this	22^{nd}	day of	August, 2001
Read a second time this	22^{nd}	day of	August, 2001
Read a third time this	22^{nd}	day of	August, 2001
ADOPTED this	22^{nd}	day of	August, 2001

Robert Harper, Secretary-Treasurer

Gary Swann, Chairperson

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

SCHEDULE "A" - BYLAW NO. R1010

CHARGES - West Coast Landfill

1. The charge for depositing covered solid waste at the disposal ground is:
   a. Loads 145 kg or greater $65.00/tonne ($8.00 minimum)
   b. Loads under 145 kg - $2.00 each garbage bag or can ($8.00 maximum)
   c. $2.00 for each tire or $170 per tonne, whichever is greater
   d. $50.00 for each wrecked auto
   e. $100.00 for each wrecked truck or bus
2. In the event that the scales provided are not operational, weight shall be estimated by the Scale Clerk employed by the Regional District of Alberni-Clayoquot.
3. The fee to be charged for all loads of solid waste which arrives at the landfill site uncovered shall be double the normal fee for loads of covered solid waste.
4. There shall be no charge for segregated materials, including but not limited to metal goods.
5. There shall be a $1.00 discount given for each load where part of the load is segregated materials, including but not limited to metal goods.
6. All charges payable under this Bylaw shall be paid prior to the deposit of the solid waste for which the charge is made unless it is necessary to weigh the vehicle depositing solid waste loaded and empty to determine the weight of solid waste, in which case the charge shall be paid immediately after weighing the vehicle empty.
7. The person paying a charge shall obtain a receipt for such payment and shall produce such receipt for inspection on request of a person employed for that purpose at a disposal site as a condition of depositing solid waste at a disposal site.
8. Not withstanding anything to the contrary in this Bylaw, persons depositing solid waste at a disposal site on a regular basis may apply to the Regional District for credit and if credit is granted to that person, then payment of the charge imposed under Section 1 shall be made and the credit extended on condition that:
   a. Payment in full shall be received by the Regional District within thirty (30) days of the last day of the month for which an invoice has been submitted. The Regional District will invoice monthly for material delivered during the proceeding month. The invoice amount will be based on the total quantity of the refuse delivered during the month, and the posted disposal rates in effect at the time of delivery.
   b. Late payment(s) will be subject to an interest charge of 2% per month

(effective annual interest of 24%)

c. The Regional District reserves the right to cancel, upon five (5) days' notice, the credit offered herein for late payment, non-payment or other justified cause.

9. Controlled Waste

The charges, as measured by weight on the scales, for the depositing of Controlled Waste at the disposal site are:

a. Construction/Demolition Waste - $82.50 per tonne; if the Demolition Waste is crushed to pieces 7 cubic centimetres or smaller the charge is $40.00 per tonne;

b. Stumps, land clearing debris - $82.50 per tonne;

c. Waste oil (commercial) - $0.50 per litre;

d. Material containing pumpings from domestic septic tanks - $82.50 per tonne;

e. Material containing catch basin and manhole material - $82.50 per tonne;

f. Waste asbestos - $170.00 per tonne ($85.00 minimum);

g. Fish, shrimp shells, animal carcasses - $65.00 tonne, except that there shall be no charge for animal carcasses that have been removed from a road allowance and brought to the landfill by a public body.

h. Fridges and freezers - $15.00 each;

i. Batteries - no charge if separated and placed in hazardous waste container;

j. Steel Cable - $500.00 per tonne;

k. Biomedical waste - $132.00 per tonne;

l. Loads containing Gypsum - $120.00 per tonne;

m. Loads containing Corrugated Cardboard - $130.00 per tonne.

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

BYLAW NO. R1010-1

A Bylaw to Amend Tipping Fees for
the West Coast Landfill

WHEREAS by Supplementary Letters Patent, dated August 10th, 1973 as amended, the Regional District of Alberni-Clayoquot was granted the function of Garbage Disposal under Division XIV of its Letters Patent;

AND WHEREAS the Regional District of Alberni-Clayoquot is empowered to establish a scale of charges payable for depositing refuse at a disposal site;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot has established regulations and a scale of charges for the West Coast Landfill;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot wishes to amend the tipping fees for the West Coast Landfill;

NOW THEREFORE, the Board of the Regional District of Alberni-Clayoquot in open meeting assembled enacts as follows:

1. Bylaw R1010, cited as “West Coast Landfill Tipping Fee and Regulation Bylaw No. R1010, 1999” is hereby amended by replacing Schedule “A” with Schedule “A” attached to and forming part of this bylaw.
2. This bylaw comes into effect on September 1, 2008.
3. This bylaw may be cited as the “West Coast Landfill Tipping Fee Amendment Bylaw No. R1010-1, 2008"

Read a first time this	23rd	day of July, 2008
Read a second time this	23rd	day of July, 2008
Read a third time this	23rd	day of July, 2008
ADOPTED this	23rd	day of July, 2008

________________________ Secretary-Treasurer

________________________ Chairperson

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

SCHEDULE "A" to BYLAW NO. R1010-1

CHARGES

1. The charge for depositing covered solid waste at the disposal ground is:
   a. Loads 145 kg or greater $95.00 per tonne ($8.00 minimum)
   b. Loads under 145 kg - $2.00 each garbage bag or can ($8.00 maximum)
   c. $2.00 for each tire or $170 per tonne, whichever is greater
   d. $100.00 for each wrecked auto
   e. $200.00 for each wrecked truck, bus or recreational vehicle
   f. $10.00 each for stoves, washers, dryers, dishwashers, hot water tanks
   g. $85.00 per tonne for metal
2. In the event that the scales provided are not operational, weight shall be estimated by the scale clerk at the landfill.
3. The fee to be charged for all loads of solid waste which arrives at the landfill site uncovered shall be double the normal fee for loads of covered solid waste.
4. There shall be no charge for recyclable materials, including but not limited to paper, boxboard, Corrugated Cardboard, compostable materials and other materials as determined by the Regional District but excludes any material contaminated by food or oil and any material that is a Controlled Waste.
5. All charges payable under this Bylaw shall be paid prior to the deposit of the solid waste for which the charge is made unless it is necessary to weigh the vehicle depositing solid waste loaded and empty to determine the weight of solid waste, in which case the charge shall be paid immediately after weighing the vehicle empty.
6. The person paying a charge shall obtain a receipt for such payment and shall produce such receipt for inspection on request of a person employed for that purpose at a disposal site as a condition of depositing solid waste at a disposal site.
7. Not withstanding anything to the contrary in this Bylaw, persons depositing solid waste at a disposal site on a regular basis may apply to the Regional District for credit and if credit is granted to that person, then payment of the charge imposed under Section 1 shall be made and the credit extended on condition that:
   a. Payment in full shall be received by the Regional District within thirty days of the last day of the month for which an invoice has been submitted. The Regional District will invoice monthly for material delivered during the proceeding month. The invoice amount will be based on the total quantity of the refuse delivered during the month, and the posted disposal rates in

effect at the time of delivery.

b. Late payments will be subject to an interest charge of 2% per month (effective annual interest of 24%)

c. The Regional District reserves the right to cancel, upon five days' notice, the credit offered herein for late payment, non-payment or other justified cause.

8. Controlled Waste

The charges, as measured by weight on the scales, for the depositing of Controlled Waste at the disposal site are:

a. Construction/Demolition Waste - $120.00 per tonne; if the Demolition Waste is crushed to pieces 7 cubic centimetres or smaller the charge is $95.00 per tonne;

b. Stumps, land clearing debris - $120.00 per tonne;

c. Waste oil (commercial) - $0.50 per litre;

d. Material containing traces of contaminated soils:

   i. $10.00 per tonne provided that the Ministry of Environment has approved of disposal of the contaminated soil, without treatment, at the Alberni Valley Landfill or;

   ii. $70.00 per tonne plus the Regional District’s estimated out-of-pocket treatment costs, provided that the Ministry of Environment has approved of the treatment and disposal of the contaminated soil at the Alberni Valley Landfill.

e. Material containing pumpings from domestic septic tanks - $120.00 per tonne;

f. Material containing catch basin and manhole material - $120.00 per tonne;

g. Waste asbestos - $250.00 per tonne ($120.00 minimum);

h. Fish, shrimp shells, animal carcasses - $170.00 per tonne ($95.00 minimum), provided that there will be no charge for animal carcasses removed from public roadways by a public body or their contractor;

i. Fridges and freezers - $20.00 each;

j. Batteries - no charge if separated and placed in hazardous waste container;

k. Steel Cable - $500.00 per tonne;

l. Biomedical waste - $132.00 per tonne;

m. Loads containing Gypsum - $120.00 per tonne;

n. Loads containing Corrugated Cardboard - $130.00 per tonne;

o. Loads containing fish feed totes - $400.00 per tonne ($120.00 minimum).

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

BYLAW NO. R1010-2

A Bylaw to Amend Tipping Fees for
the West Coast Landfill

WHEREAS by Supplementary Letters Patent, dated August 10th, 1973 as amended, the Regional District of Alberni-Clayoquot was granted the function of Garbage Disposal under Division XIV of its Letters Patent;

AND WHEREAS the Regional District of Alberni-Clayoquot is empowered to establish a scale of charges payable for depositing refuse at a disposal site;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot has established regulations and a scale of charges for the West Coast Landfill;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot wishes to amend the tipping fees for the West Coast Landfill;

NOW THEREFORE, the Board of the Regional District of Alberni-Clayoquot in open meeting assembled enacts as follows:

1. Bylaw R1010-1, cited as "West Coast Landfill Tipping Fee and Regulation Bylaw No. R1010-1, 2008" is hereby amended by replacing Schedule "A" with Schedule "A" attached to and forming part of this bylaw.

2. This bylaw may be cited as the "West Coast Landfill Tipping Fee Amendment Bylaw No. R1010-2, 2010"

Read a first time this **24th** day of **February, 2010**

Read a second time this **24th** day of **February, 2010**

Read a third time this **24th** day of **February, 2010**

ADOPTED this **24th** day of **February, 2010**

Secretary-treasurer	Chairperson

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

SCHEDULE "A" to BYLAW NO. R1010-2

CHARGES

1. The charge for depositing covered solid waste at the disposal ground is:
   a. Loads 145 kg or greater $95.00 per tonne ($8.00 minimum)
   b. Loads under 145 kg - $2.00 each garbage bag or can ($8.00 maximum)
   c. $2.00 for each tire or $170 per tonne, whichever is greater
   d. $100.00 for each wrecked auto
   e. $200.00 for each wrecked truck, bus or recreational vehicle
   f. $10.00 each for stoves, washers, dryers, dishwashers, hot water tanks
   g. $85.00 per tonne for metal
   h. $100.00 per scale use for the sole purpose of determining weight with no material entering the landfill
2. In the event that the scales provided are not operational, weight shall be estimated by the scale clerk at the landfill.
3. The fee to be charged for all loads of solid waste which arrives at the landfill site uncovered shall be double the normal fee for loads of covered solid waste.
4. There shall be no charge for recyclable materials, including but not limited to paper, boxboard, Corrugated Cardboard, compostable materials and other materials as determined by the Regional District but excludes any material contaminated by food or oil and any material that is a Controlled Waste.
5. All charges payable under this Bylaw shall be paid prior to the deposit of the solid waste for which the charge is made unless it is necessary to weigh the vehicle depositing solid waste loaded and empty to determine the weight of solid waste, in which case the charge shall be paid immediately after weighing the vehicle empty.
6. The person paying a charge shall obtain a receipt for such payment and shall produce such receipt for inspection on request of a person employed for that purpose at a disposal site as a condition of depositing solid waste at a disposal site.
7. Not withstanding anything to the contrary in this Bylaw, persons depositing solid waste at a disposal site on a regular basis may apply to the Regional District for credit and if credit is granted to that person, then payment of the charge imposed under Section 1 shall be made and the credit extended on condition that:
   a. Payment in full shall be received by the Regional District within thirty days of the last day of the month for which an invoice has been submitted. The Regional District will invoice monthly for material delivered during the

proceeding month. The invoice amount will be based on the total quantity of the refuse delivered during the month, and the posted disposal rates in effect at the time of delivery.

b. Late payments will be subject to an interest charge of 2% per month (effective annual interest of 24%)

c. The Regional District reserves the right to cancel, upon five days' notice, the credit offered herein for late payment, non-payment or other justified cause.

8. Controlled Waste

The charges, as measured by weight on the scales, for the depositing of Controlled Waste at the disposal site are:

a. Construction/Demolition Waste - $120.00 per tonne; if the Demolition Waste is crushed to pieces 7 cubic centimetres or smaller the charge is $95.00 per tonne;

b. Stumps, land clearing debris - $120.00 per tonne;

c. Waste oil (commercial) - $0.50 per litre;

d. Material containing traces of contaminated soils:

   i. $10.00 per tonne provided that the Ministry of Environment has approved of disposal of the contaminated soil, without treatment, at the West Coast Landfill or;

   ii. $70.00 per tonne plus the Regional District's estimated out-of-pocket treatment costs, provided that the Ministry of Environment has approved of the treatment and disposal of the contaminated soil at the West Coast Landfill.

e. Material containing pumpings from domestic septic tanks - $120.00 per tonne;

f. Material containing catch basin and manhole material - $120.00 per tonne;

g. Waste asbestos - $250.00 per tonne ($120.00 minimum);

h. Fish, shrimp shells, animal carcasses - $170.00 per tonne ($95.00 minimum), provided that there will be no charge for animal carcasses removed from public roadways by a public body or their contractor;

i. Fridges and freezers - $20.00 each;

j. Batteries - no charge if separated and placed in hazardous waste container;

k. Steel Cable - $500.00 per tonne;

l. Biomedical waste - $132.00 per tonne;

m. Loads containing Gypsum - $120.00 per tonne;

n. Loads containing Corrugated Cardboard - $130.00 per tonne;

o. Loads containing fish feed totes - $400.00 per tonne ($120.00 minimum).

Regional District of Alberni-Clayoquot

Bylaw No. R1010-3

A Bylaw to Amend Tipping Fees for the West Coast Landfill

WHEREAS by Supplementary Letters Patent, dated August 10th, 1973 as amended, the Regional District of Alberni-Clayoquot was granted the function of Garbage Disposal under Division XIV of its Letters Patent;

AND WHEREAS the Regional District of Alberni-Clayoquot is empowered to establish a scale of charges payable for depositing refuse at a disposal site;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot has established regulations and a scale of charges for the West Coast Landfill;

AND WHEREAS the Regional Board of the Regional District of Alberni-Clayoquot wishes to amend the credit terms for customers of the West Coast Landfill;

NOW THEREFORE, the Board of the Regional District of Alberni-Clayoquot in open meeting assembled enacts as follows:

1. Bylaw cited as, 'West Coast Landfill Tipping Fee and Regulation Bylaw No. R1010, 2001', as amended, is hereby amended by replacing Schedule 'A' with Schedule 'A' attached to and forming part of this bylaw.
2. This bylaw may be cited as the '**Bylaw No. R1010-3 West Coast Landfill Tipping Fee Amendment, 2013**'.

Read a first time this	**12th**	day of	**June**	, 2013.
Read a second time this	**12th**	day of	**June**	, 2013.
Read a third time this	**12th**	day of	**June**	, 2013.
ADOPTED this	**12th**	day of	**June**	, 2013.

Certified true and correct copy of
"Bylaw No. R1010-3, West Coast Landfill Tipping Fee Amendment, 2013"

Russell Dyson,
Chief Administrative Officer

The Corporate seal of the Regional District of Alberni-Clayoquot was hereto affixed in the presence of:

Cindy N. Solda,
Chairperson

Schedule "A"
Charges

1. The charge for depositing covered solid waste at the disposal ground is:
   a. Loads 145 kg or greater $95.00/tonne ($8.00 minimum)
   b. Loads under 145 kg - $2.00 each garbage bag or can ($8.00 maximum)
   c. $2.00 for each tire or $170 per tonne, whichever is greater
   d. $100.00 for each wrecked auto
   e. $200.00 for each wrecked truck, bus or recreational vehicle
   f. $10.00 each for stoves, washers, dryers, dishwashers, hot water tanks
   g. $85.00 per tonne for metal
   h. $100.00 per scale use for the sole purpose of determining weight with no material entering the landfill
2. In the event that the scales provided are not operational, weight shall be estimated by the scale clerk at the landfill.
3. The fee to be charged for all loads of solid waste which arrives at the landfill site uncovered shall be double the normal fee for loads of covered solid waste.
4. There shall be no charge for recyclable materials, including but not limited to paper, metal, boxboard, Corrugated Cardboard, compostable materials and other materials as determined by the Regional District but excludes any material contaminated by food or oil and any material that is a Controlled Waste.
5. All charges payable under this Bylaw shall be paid prior to the deposit of the solid waste for which the charge is made unless it is necessary to weigh the vehicle depositing solid waste loaded and empty to determine the weight of solid waste, in which case the charge shall be paid immediately after weighing the vehicle empty.
6. The person paying a charge shall obtain a receipt for such payment and shall produce such receipt for inspection on request of a person employed for that purpose at a disposal site as a condition of depositing solid waste at a disposal site.
7. Notwithstanding anything to the contrary in this Bylaw, persons depositing solid waste at a disposal site on a regular basis may apply to the Regional District for credit and if credit is granted to that person, then payment of the charge imposed under Section 1 shall be made and the credit extended on condition that:

a. Payment in full shall be received by the Regional District within thirty days of the last day of the month for which an invoice has been submitted. The Regional District will invoice monthly for material delivered during the proceeding month. The invoice amount will be based on the total quantity of the refuse delivered during the month, and the posted disposal rates in effect at the time of delivery.

b. In order to reflect the additional administration costs associated with accounts in arrears, an overdue charge will be calculated monthly as the greater of:

   i. $2.00; or

   ii. Interest of 2% per month (effective interest rate of 26.824%) on the unpaid balance.

c. The Regional District reserves the right to cancel the credit offered herein for late payment, non-payment or other justified cause.

8. Controlled Waste

The charges, as measured by weight on the scales, for the depositing of Controlled Waste at the disposal site are:

a. Construction/Demolition Waste - $120.00 per tonne; if the Demolition Waste is crushed to pieces 7 cubic centimetres or smaller the charge is $95.00 per tonne;

b. Stumps, land clearing debris - $120.00 per tonne;

c. Waste oil (commercial) - $0.50 per litre;

d. Material containing traces of contaminated soils:

   i. $10.00 per tonne provided that the Ministry of Environment has approved of disposal of the contaminated soil, without treatment, at the West Coast Landfill or;

   ii. $70.00 per tonne plus the Regional District's estimated out-of-pocket treatment costs, provided that the Ministry of Environment has approved of the treatment and disposal of the contaminated soil at the West Coast Landfill.

e. Material containing pumpings from domestic septic tanks - $120.00 per tonne;

f. Material containing catch basin and manhole material - $120.00 per tonne;

g. Waste asbestos - $250.00 per tonne ($120.00 minimum);

h. Fish, shrimp shells, animal carcasses - $170.00 per tonne ($95.00 minimum), provided that there will be no charge for animal carcasses removed from public roadways by a public body or their contractor;

i. Fridges and freezers - $20.00 each;

j. Batteries - no charge if separated and placed in hazardous waste container;

k. Steel Cable - $500.00 per tonne;

l. Biomedical waste - $132.00 per tonne;

m. Loads containing Gypsum - $120.00 per tonne;

n. Loads containing Corrugated Cardboard - $130.00 per tonne;

o. Loads containing fish feed totes - $400.00 per tonne ($120.00 minimum).

APPENDIX C

ESTIMATED HISTORIC WASTE QUANTITIES AT THE

WEST COAST LANDFILL

Estimated Historic Waste Quantities at the West Coast Landfill

Year	Annual Weight (tonnes)	Cumulative Weight (tonnes)
1980	2,400	2,400
1981	2,400	4,800
1982	2,400	7,200
1983	2,400	9,600
1984	2,400	12,000
1985	2,400	14,400
1986	2,400	16,800
1987	2,400	19,200
1988	2,400	21,600
1989	2,400	24,000
1990	2,520	26,500
1991	2,520	29,000
1992	2,520	31,500
1993	2,520	34,000
1994	2,520	36,500
1995	2,650	39,200
1996	2,650	41,900
1997	2,650	44,600
1998	2,650	47,300
1999	2,650	50,000
2000	3,536	53,500
2001	3,106	56,600
2002	3,678	60,300
2003	4,390	64,700
2004	4,348	69,000
2005	4,752	73,800
2006	4,686	78,500
2007	5,390	83,900
2008	5,456	89,400
2009	4,540	93,900
2010	4,560	98,500
2011	4,740	103,200
2012	5,055	108,300
2013	4,870	113,200
2014	5,015	118,200

Notes:

1. Weights from 1999 and earlier are estimates as scale data was not available.
2. Weights from 2000 to present are from the ACRD.

APPENDIX D

2014 MONITORING – WEST COAST LANDFILL
PITEAU ASSOCIATES ENGINEERING LTD., Nov. 2015

PITEAU CORRESPONDENCE – OVERFLOW EVENTS

PITEAU ASSOCIATES
GEOTECHNICAL AND
HYDROGEOLOGICAL CONSULTANTS

SUITE 300 - 788 COPPING STREET
NORTH VANCOUVER, B.C.
CANADA - V7M 3G6
TEL: (604) 986-8551 / FAX: (604) 985-7286
www.piteau.com

ALBERNI-CLAYOQUOT REGIONAL DISTRICT

2014 MONITORING REPORT

WEST COAST LANDFILL

Prepared by

PITEAU ASSOCIATES ENGINEERING LTD.

PROJECT 1576 **NOVEMBER 2015**

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TABLES

FIGURE

Fig. 1 Plan Showing Property Boundaries and Sampling Locations

1. INTRODUCTION

Six suites of samples were collected from the West Coast Landfill monitoring network for the current reporting period, as listed below:

February 19, 2014
May 7, 2014
June 11, 2014
August 27, 2014
October 29, 2014
December 15, 2014

Seven sites (SW-1 through SW-7) were monitored at the West Coast Landfill between 1996 and 2004 prior to the construction of the leachate collection ditch system and leachate storage lagoon in the late summer and autumn of 2004 (Fig. 1). In late 2004, after the leachate management works had been implemented, the sampling sites were adjusted and expanded to a total of ten sites. The sampling sites were reviewed in 2005 and two additional sites were incorporated into the program on July 6, 2005. All sampling sites are shown on Fig. 1. Historical sites that are no longer sampled are shown in a light green shade. Current sites, as shown to Jennifer Mancer of Piteau Associates Engineering Ltd. (Piteau) in February 2015, are shown in a dark green shade.

The original seven sites were intended to monitor water quality along preferential surface flow paths from the landfill to Sandhill Creek, background surface water quality at a site to the north of the landfill, and water quality in Sandhill Creek. The additional sites, and modified locations for the original sites, are intended to characterize the leachate quality, to measure impact to Sandhill Creek, and to better document background chemistry.

Three groundwater monitoring wells (MW02-1, -2 and -3) were installed in August 2002. These were sampled in October 2003 and June 2006, and field parameters were measured on a bi-monthly basis. Water levels were monitored on bi-monthly schedules from April 2003 to November 2009; however, no sampling was conducted. The monitoring well locations are shown on Fig. 1.

A brief description of the sampling sites follows:

SW-1	Receiving creek (Sandhill Creek tributary), immediately downstream of where leachate collected along the cutline discharges into the creek. Moved 10m downstream in December 2008, below where overflow from the leachate storage lagoon would enter.
SW-2	Near downstream end of the west leachate collector ditch, sampled at pipe outlet to storage lagoon. Prior to December 2004, this site was located along a preferential leachate flow path from the landfill.
SW-3a	Leachate storage lagoon decant. Prior to December 2004, the SW-3 sampling site was a dug out located along the cutline to the west of the landfill, where there was preferential leachate flow.
SW-3b	Leachate storage lagoon at pump intake or along edge of pond when access to pump intake not available. Sampled in lieu of SW-3a when decant is not occurring at time of sampling, which is the usual condition.
SW-4	Near downstream end of the south leachate collector ditch, sampled from pipe outlet into storage lagoon. Prior to December 2004, samples were collected from a dug out in a swampy area to the south of the landfill, near the site of the leachate storage lagoon.
SW-5	Historically this was a dug out in a swampy area to the south of the landfill. It was moved to an area of temporal ponding southeast of the leachate storage lagoon in December 2004. The most recent SW-5 samples were collected in May and July 2012; since then, the area has had no standing water.
SW-6	Historically this was a dug out into the top of marine clay along the northernmost leachate flow path. Since July 2005, this sampling point has been at an area of

temporal water ponding in a low lying area in the buffer zone along the west side of the landfill. There is no apparent surface flow path from this point to Sandhill Creek.

SW-7 Small natural drainage to the north of the landfill. Background site.

SW-8 Located north of landfill along an abandoned skidder road. Low point in the receiving area for leachate irrigation flow located about 100m downstream of the leachate distribution pipe. Sampled since December 2004.

SW-9 Located north of SW-8, where the north end of the abandoned skidder road becomes overgrown. Receiving area for leachate irrigation flow downstream of the discharge pipe. Sampled since December 2004.

SW-10 Initial site, sampled in December 2004 and February/May 2005, was on north property line, and was intended to provide additional background data. In July 2005, this site was moved to Sandhill Creek above a point where leachate could enter the creek, to provide a background (upstream) sampling site on Sandhill Creek (SW-10 background data on Fig. 1). However, since prior to September 2006, this site has been sampled approximately 50m upstream of SW-1.

SW-11 Located west of the landfill, in a natural gulley that exhibits perennial flow characteristics and appears to be receiving leachate that seeps past the west leachate collector ditch or overflows from the leachate pond after periods of heavy rain. Sampled since July 2005.

SW-12 Located near the south landfill property boundary, downgradient of the leachate storage lagoon, where a small tributary of Sandhill Creek rises when recharged by shallow groundwater flow. Sampled since July 2005. However, since prior to September 2006, this site has been sampled from Sandhill Creek on the south property boundary.

SW-13 Located inside the south fence line along the south side of the leachate lagoon access road. This location has not been sampled since 2009.

SHC Sandhill Creek at downstream site, 20m upstream of the Highway 4 culvert.

MW02-1 Monitoring well located near south landfill property boundary.

MW02-2 Monitoring well located near southwest landfill property boundary.

MW02-3 Monitoring well located near northeast landfill property boundary (background site).

Electrical conductance (EC), pH, temperature and oxidation-reduction potential (ORP) were measured in the field, and all sites were sampled for leachate indicator parameters (chloride, sulphate, ammonia, nitrate, and phosphate). The standard sampling program, as performed in 2014, is summarized in Table B-1 in Appendix B. SW-1, SW-3, SW-7, SW-10, and SW-11 were sampled for dissolved and total metals, chemical oxygen demand (COD) and biological oxygen demand (BOD). Metal analyses for the remaining sampling locations were limited to total aluminum, iron, and manganese. Samples from SW-2, SW-4, SW-8, and SW-9 were also analyzed for COD. Volatile organic compound (VOC) analyses were performed on all six samples from SW-3b.

Results of the field measurements and laboratory analyses for the above surface water sampling sites are summarized in Tables I through XIV, and are plotted on Figs. A-1 through A-14 in Appendix A.

2. LEACHATE FLOW PATHS

2.1 SURFACE WATER

Virtually all of the leachate flow from the landfill follows surface pathways, as the effective base of the groundwater flow regime is the top of the unweathered marine clay at a nominal depth of between 0.4 and 1m. Leachate historically seeped from the landfill along four primary flow paths. These paths were routed through the historical SW-2, SW-3, SW-4, and SW-6 sampling sites, towards the cutline indicated on Fig. 1. Once on the cutline, the flow historically concentrated in tracks left by the dozer used to construct the cutline. Flows then continued south along the cutline, until they intersected the tracks on the east-west cutline between SW-1 and SW-4. Leachate then flowed along this cutline to the Sandhill Creek tributary (Fig. 1). This flow path was only obvious during wet periods, as dry period flow was through the shallow peaty soils towards the tributary.

In the autumn of 1998, measures were taken to prevent concentration of flows along the cutline. This involved constructing storm bars across the cutline to divert surface flow towards the creek at roughly 75m intervals. Approximate locations of the storm bars are shown on Fig. 1.

Based on sampling results collected in 2004, the primary pathways for leachate seepage from the landfill were past sampling sites SW-2, SW-3, SW-4, and SW-6.

The leachate collection ditches and leachate lagoon, shown on Fig. 1, were commissioned in the late summer of 2004, following the August sampling event. This leachate collection system has effectively routed all surface leachate flows into the lagoon since its implementation. Samples collected from the leachate lagoon (SW-3a/b) and the two leachate collector ditches (SW-2 and SW-4), provide a good indication of the average quality of leachate generated by the entire landfill.

Sampling results collected at SW-11 from 2005 through 2014 indicate some leachate impact at this location (see location on Fig. 1), apparently due to shallow seepage under the west leachate collector ditch (Leachate Ditch #2).

A recent BC Ministry of Environment (MOE, 2012) landfill inspection letter indicated concerns that SW-11 was located outside the potential leachate pathway identified by the 2009 EM Survey conducted by Frontier Geosciences Inc. (Frontier, 2009). Frontier's report indicated that, *"the presence of a small creek that traverses the start of lines A, B, and C and extends northward along line D shallowing into a slough, is reflected in the high conductivity anomaly that extends coincident with the location of this water feature. This anomaly, that extends northeast from the southwest corner of the grid area to the middle of line I, is believed to be related to elevated surface and groundwater conductivities and not to changes in soil conditions."* SW-11 is located in the gulley that drains the area of the conductive anomaly mapped by Frontier. This is also the only natural surface drainage course from the landfill area. Any seepage from the landfill that passes through the conductive anomaly will collect in this channel; hence, monitoring data for this location will be representative of the escaped leachate. Sampling from within the actual extent of the anomaly may result in higher concentrations of leachate indicator parameters, but sampling frequency would be sporadic, as the sampling site would likely be dry during the summer, and the sample would only represent one discrete location in the broad potential leachate seepage zone. The SW-11 site provides a continuous, composite sample of the leachate seepage, and will be representative of the actual leachate loading that is not intercepted by Leachate Ditch #2.

2.2 GROUNDWATER

As noted above, three groundwater monitoring wells (MW02-1, -2, and -3) have been installed at three sites along the landfill property boundary (Fig. 1). Monitoring well MW02-3 is located upgradient of the landfill to provide background chemistry data for local groundwater. The other two monitoring wells are located downgradient of the landfill, along interpreted subsurface seepage pathways from the site. A detailed description of the drilling and testing program is provided in a letter to McGill dated November 5, 2002 (Piteau, 2002).

All three monitoring wells encountered marine clay to a nominal 12m depth. The hydraulic conductivity for the clay is estimated to be less than 10^{-9} m/s, and the estimated seepage velocity through the clay is less than 2 cm/year.

The wells were sampled in October 2003, after repeated purging over the previous 12 months. The wells were then purged on six occasions in the 2003/2004 reporting period, and temperature, pH, and EC were measured to be very consistent over this period. The wells were not purged or sampled in 2005, to provide a year of reliable static water level data. The monitoring wells were sampled again on June 13, 2006. The wells have not been sampled since June 2006, but water levels were monitored bi-monthly until June 2011.

The rationale for not continuing the groundwater monitoring program is presented below:

- The two suites of water samples obtained from the three monitoring wells in October 2003 and June 2006 (Table XV), and field parameters measured in 2003, 2004 and 2006 (Table XVI), indicate that the chemistry is not changing significantly, and that the two suites of samples obtained from these wells are representative of marine connate water (pore water at time of deposition) within the clay layer.
- Groundwater velocity was calculated to be about 2 cm/year (Piteau, 2002). This very slow flow rate is confirmed with the high total dissolved solids (TDS) of the sampled groundwater, which indicates the connate formation water has only been partially flushed by meteoric recharge since the marine clay was deposited approximately 10,000 to 15,000 years ago. The leachate loading transported by the groundwater flow regime below the surficial peat is therefore extremely small.
- Due to the residual connate water in the clay, concentrations of many of the monitored parameters (TDS, chloride, sodium and ammonia) are similar to or higher in the natural groundwater than at the most heavily impacted surface water sampling locations. Monitoring of groundwater will therefore not provide any resolution with regard to the presence or absence of leachate.

The recommendation to not sample the groundwater wells is based on the very high background concentrations of TDS, chloride, sodium, sulphate and ammonia, which are residual from the marine water in the clay pores at the time of deposition, and the very low seepage velocity. Groundwater flow through the marine clay sediments underlying the landfill is not a significant leachate transport pathway, and monitoring groundwater chemistry will not detect the presence of leachate.

3. DISCUSSION OF SAMPLING RESULTS

3.1 SITE SW-7 AND SITE SW-10 (BACKGROUND WATER QUALITY)

Alkalinity and hardness are low at both sites, with the sampling record to date exhibiting a typical range of 8 to 69 mg/L as $CaCO_3$ (Tables VIIa and Xa).

Background water quality for SW-7 during 2014 was characterized by a TDS range between 55 and 115 mg/L (Fig. A-1 in Appendix A). Sodium concentrations varied from 7.4 to 13.1 mg/L, and chloride concentrations ranged between 10.3 and 22.3 mg/L (Fig.A-3). Concentration ranges for sodium and chloride over 2013 and 2014 were consistently higher than in 2012, and likely reflect the drier-than-average summers and autumns of the past two years. Ammonia concentrations ranged between <0.01 and 1.5 mg/L-N in 2014, which is higher than average, but below the freshwater aquatic life (FWAL) criterion of about 1.84 mg/L-N and within the envelope of historical data (Fig. A-5). Corresponding nitrate concentrations ranged from 0.01 to 0.396 mg/L-N. All results were well below the FWAL guideline of 3 mg/L-N (Fig. A-7).

COD at SW-7 ranged between 20 and 30 mg/L in 2014 (Table VIIa). The highest concentration recorded at this site to date was the 71 mg/L-O result for the June 2000 sample (Fig. A-8).

Historically, samples have been acidic, with pH typically ranging between 5 and 6.4. pH varied between 6.1 and 7.4 in 2014. Low pH is characteristic of peat bogs.

BOD results for the SW-7 site during 2014 peaked at 53 mg/L-O in February 2014, and were measured at 6 and 13 mg/L-O in May and June, respectively (Fig. A-9). In August the site was dry, and in October and December, BOD concentrations were below the 4 mg/L-O detection limit. Historically, BOD concentrations have remained below the detection limits of 10 mg/L-O (May 2000 to June 2010) and 5 mg/L-O (December 2010 to December 2013). The increase in BOD in early and mid-2014 is likely due to organic matter upstream of the SW-7 sampling site that was flushed out over time.

Background metals concentrations have all been less than the FWAL guidelines during 2014, with the following exceptions:

- Total iron concentrations at SW-7 have historically exceeded the FWAL guideline about 60% of the time, and dissolved iron concentrations have exceeded about 25% of the time. Updated guidelines for both total and dissolved iron were published in 2008. Total iron concentrations have exceeded the new guideline in 27% of samples taken in the past four years. In 2014, total iron concentrations ranged between 0.225 and 6.25 mg/L (Table VIIb) and exceeded the FWAL guideline for two of the five sampling suites. Dissolved iron concentrations ranged between 0.116 and 1.08 mg/L, and exceeded the FWAL guideline of 0.35 mg/L in June. Historically, iron exceedances at this site usually occur during dry periods. This site was not sampled in August in 2012 or 2014, as it was dry.
- Total lead exhibited an anomalously high concentration of 0.06 mg/L on one occasion in June 2010. This reading was the only time in the historical record when the total lead concentration exceeded the FWAL guideline. The result was interpreted as an error. In 2014, the total lead concentrations ranged between <0.00005 and 0.00015 mg/L, and were less than the FWAL guideline of 0.004 mg/L in all the samples.
- Total copper concentrations have equalled or exceeded the FWAL guideline of 0.002 mg/L on three recent occasions, including September 2003 (0.004 mg/L), April 2004 (0.009 mg/L), and October 2007 (0.006 mg/L). Total copper concentrations complied with the FWAL guideline during the current sampling period. Elevated copper results are likely attributable to sediment in the samples.
- Total manganese concentrations exhibited anomalously high values of 0.926 mg/L in June 2011 and 0.879 mg/L in June 2014, exceeding the FWAL guideline of 0.83 mg/L, based on a hardness of 30 mg/L-$CaCO_3$. Other than these two exceptions, historical concentrations for total manganese have always been less than the FWAL guideline. The elevated manganese results occur in tandem with other anomalously high metals results, and are attributed to low creek water levels and sediment in the samples.
- Total cadmium concentrations fluctuated between <0.00001 and 0.00002 mg/L for the current sampling period, and exceeded the FWAL guideline of 0.00001 mg/L on one occasion in June 2014. Dissolved cadmium concentrations were consistently less than detection. Total cadmium concentrations have exceeded the FWAL guideline in 19% of the samples since the detection limit was moved below the FWAL in 2010.

- Total chromium concentrations varied from <0.0005 to 0.0012 mg/L in the current sampling period, exceeding the FWAL guideline of 0.001 mg/L in June 2014 (Table VIIb). Historical total chromium concentrations have not exceeded the FWAL guideline of 0.001 mg/L, with the exception of two sampling events in 2011 (June and August).

- Total zinc concentrations exceeded the hardness-varying FWAL guideline of 0.0075 mg/L on 12 occasions prior to the 2014 sampling program. Total zinc concentrations ranged between <0.005 and 0.007 mg/L for the current sampling period, with all results remaining below the FWAL guideline of 0.0075 mg/L.

- Prior to this sampling period, dissolved zinc at SW-7 had exceeded the hardness-varying FWAL guideline of 0.0075 mg/L in June 2007 (0.011 mg/L), October 2012 (0.009 mg/L), and June 2013 (0.008 mg/L). Dissolved zinc concentrations ranged between <0.002 and 0.005 mg/L during the current sampling period.

- Dissolved aluminum is typically elevated at this background monitoring location, with concentrations chronically exceeding the FWAL guideline of 0.05 mg/L by a considerable margin (Table VIIb and Fig. A-11). Concentrations ranged from 0.08 to 0.178 mg/L in 2014.

- Aside from one exceedance in July 2005 (0.07 µg/L), total mercury remained consistently below the 0.02 µg/L FWAL guideline until 2011, when the detection limit was raised to 0.1 µg/L for most samples. No exceedances have been noted, with all samples remaining below the varying detection limit, until the current reporting period where the May and June samples had mercury concentrations at the FWAL guideline (0.02 µg/L).

For the current reporting period, SW-10 (upstream sampling site on Sandhill Creek) data exhibited concentrations of ammonia that were below or slightly above detection levels, with a maximum of 0.11 mg/L-N measured in October 2014 (Table Xa). Nitrate concentrations were slightly higher, and ranged between 0.064 mg/L-N in April, and 1.01 mg/L-N in December.

Total and dissolved aluminum concentrations exceeded the FWAL guideline in all sampling events in 2014. Total and dissolved iron concentrations at SW-10 were below the FWAL guideline in 2014, for all but the August sampling event, when values of 1.66 and 0.624 mg/L exceeded the guidelines of 1.0 and 0.35 mg/L for total and dissolved iron, respectively. Total copper also reached the guidelines in the August sampling event. Dissolved mercury was measured at the FWAL criterion of 0.02 mg/L in the August 2014 sample, and dissolved selenium was measured at the FWAL alert concentration of 0.001 mg/L (half of the FWAL criterion) in the June 2014 sample. However, since the respective total concentrations were only 0.01 mg/L, and 0.0005 mg/L for those samples, they are considered erroneous lab results associated with the samples not being filtered in the field.

SW-10 chloride concentrations ranged from 6.9 to 33.9 mg/L, with the highest concentration occurring in the driest period (August), when groundwater discharge to the creek would have had a significant effect on surface water quality. The above chloride concentrations are therefore considered to be background for this portion of Sandhill Creek, which will have a small baseflow component comprised of the naturally brackish groundwater that discharges from marine clay sediments that underlie the area. As per the 2006 to 2013 sampling results (Fig. A-3), the elevated summer 2014 chloride concentrations are indicative of a summer drought condition, when groundwater will comprise a large proportion of the creek baseflow.

3.2 SITES SW-2, SW-3 AND SW-4 (COLLECTED LEACHATE QUALITY)

Sampling results for these three sites characterize the concentrated leachate chemistry.

Elevated TDS, chloride, and ammonia concentrations (Tables II, IIIa, and IV, Figs. A-1, A-3, A-4, and A-6) are indicative of concentrated leachate. Hardness and alkalinity are also elevated, with SW-2 results for 2014 ranging from 282 to 495 mg/L as $CaCO_3$ and 359 to 648 mg/L as $CaCO_3$, respectively. Hardness and alkalinity results for SW-3 ranged from 223 to 289 mg/L as $CaCO_3$ and 258 to 418 mg/L as $CaCO_3$, respectively. Hardness and alkalinity results for SW-4 ranged from 381 to 621 mg/L as $CaCO_3$ and from 391 to 995 mg/L as $CaCO_3$, respectively.

Prior to implementation of the leachate interception measures in 2004, TDS results for the SW-2 and SW-3 sites varied from highs of about 450 to 1600 mg/L in dry periods (June to September), to less than 300 mg/L in wet periods, when dilution is highest (February). TDS results for the three leachate sampling sites ranged from 108 to 1010 mg/L in 2014, with the high values exceeding the envelope of data collected since 2004 (Fig. A-2). The higher TDS is attributed to the dry weather experienced in the summer of 2014.

Since 2004, chloride concentrations in the leachate monitored at SW-2 and SW-3 have fluctuated between 7.6 and 80 mg/L, with peak concentrations occurring in the summer/autumn samples

(Fig. A-4). Data for the three leachate sampling sites during the summer of 2014 all exceeded the historical range for the summer samples since the leachate collection system was implemented, with maximum values of 113, 92.6 and 96.2 mg/L measured at SW-2, SW-3 and SW-4, respectively. Results collected for the remainder of the year fall within the upper part of the historical range. The SW-4 samples displayed slightly higher chloride concentrations than the SW-2 site, indicating that flows in Leachate Ditch #1 (east side) received less dilution than those in Leachate Ditch #2 (west side). Chloride concentrations for SW-3a/b samples, which represent the mixed leachate for the entire site, ranged between 23 and 92.6 mg/L in 2014. The peak concentration occurred in August, when the background concentrations also peaked due to the significance of the brackish groundwater baseflow in the surface flows. All chloride concentrations remained below the 150 mg/L chloride FWAL criterion.

Ammonia concentrations sampled at SW-2 varied between 13 and 21 mg/L-N for the current reporting period (Fig. A-6 and Table II). After the current leachate ditches were commissioned in late-2004, results for SW-2 have been generally higher than those observed at SW-3 and SW-4. In 2012, ammonia concentrations at SW-4 approached those measured at SW-2, and surpassed them in the current reporting period. Ammonia concentrations at SW-4 varied from about 14.6 to 44.0 mg/L in 2014. The current SW-3 sampling results are quite a bit lower than results for SW-2 and SW-4 (Fig. A-6). Ammonia concentrations in the leachate lagoon (SW-3) ranged between 0.5 and 12.6 mg/L-N during 2014, slightly lower than the other two sampling sites. The slight reduction in the SW-3 ammonia concentrations indicates that some nitrification may be occurring in the leachate storage lagoon.

The maximum 2014 nitrate concentration in SW-2 was 2.62 mg/L-N, below the FWAL guideline of 3 mg/L-N (Table II and Fig. A-7). Nitrate concentrations were generally lower at both SW-3 and SW-4. The highest SW-3 and SW-4 nitrate concentrations of 0.976 and 0.26 mg/L-N, respectively, occurred in August and October. The pattern of nitrate and ammonia concentrations in 2014 suggests that some nitrification occurs in the leachate storage lagoon and possibly within the ditches, during the summer months.

Over the current reporting period, COD concentrations at SW-2 ranged between 68 and 170 mg/L-O (Table II and Fig. A-8). COD concentrations ranged from 85 to 220 mg/L-O at SW-3 and from 80 to 300 mg/L-O at SW-4. The relative concentrations of the three sampling sites may reflect the mixing ratio of the SW-2 and SW-4 waters in the storage lagoon. COD concentrations from the three sites were below those measured in 2013, but slightly higher than over the previous five years. The dry weather was likely responsible for the high COD in the concentrated leachate over the past two years, and the renovation that occurred in the leachate storage lagoon can likely be attributed to residence time in the leachate storage lagoon.

Historical BOD levels at SW-2, SW-3 and SW-4 are typically less than 40 mg/L-O (Fig. A-9), reflecting the low strength of the leachate. In 2014, BOD at SW-3 ranged between <4 and 38 mg/L-O, and displayed an increasing trend with the highest value measured in the December sample (Table IIIa and Fig. A-9). The 180 mg/L-O result for SW-3 measured in 2013 is the highest on record, and is anomalous in relation to other data. No BOD results from SW-2 and SW-4 are available for the current reporting period.

Dissolved iron concentrations ranged from 0.011 to 3.25 mg/L in SW-3, with the peak concentration exhibited in the October 2014 sample (Table IIIb and Fig. A-10). Dissolved metals are not included in the SW-2 and SW-4 sampling suite. Total iron concentrations at SW-2 and SW-3 fluctuated between 0.275 and 6.78 mg/L, and 0.88 and 18 mg/L, respectively, and exceeded the FWAL guideline in almost all six sampling events in 2014. Non-exceedances were in June and August for SW-2 and August for SW-3 (Tables II and IIIb). Total iron concentrations at SW-4 ranged between 8.48 and 73.1 mg/L, and exceeded the FWAL guideline in all five sampling events in 2014 (Table IV).

For the current reporting period, total manganese concentrations at SW-2, exceeded the FWAL guideline for half of the sampling events, based on the approximate average hardness of 300 mg/L. Total and dissolved manganese concentrations in SW-3 were below FWAL guideline for all 2014 sampling events at SW-3, based on an average hardness of 250 mg/L $CaCO_3$. Total manganese concentrations at SW-4 exceeded the 2.37 mg/L guideline at SW-4 for four of five sampling events in 2014, based on a hardness of 400 mg/L $CaCO_3$.

Total chromium concentrations at SW-3 exceeded the FWAL guideline in all sampling events in 2014. Dissolved chromium concentrations at SW-3 exceeded the FWAL guideline in February and October. Total cadmium concentrations at SW-3 were typically below or near the detection limit (0.00001 mg/L) for all six sampling events in 2014, and exceeded the FWAL guideline of

0.00003 mg/L only in December for total cadmium. Dissolved cadmium concentrations for all 2014 samples were below the detection limit.

During 2014, total aluminum concentrations exceeded the FWAL guideline for all sampling events at SW-2, SW-3 and SW-4, except the August sampling event at SW-2 and the May sampling event at SW-3. Dissolved aluminum was only analyzed in SW-3 samples, and the concentrations did not exceed the FWAL guideline in any of the five samples collected (Table IIIb). The background concentration of dissolved aluminum (at SW-7) exceeded the FWAL guideline in all five sampling events in 2014.

The only other 2014 metals exceedances in SW-3 were a slight total copper exceedance (0.0113 mg/L compared to the FWAL guideline of 0.01 mg/L) in December 2014, and two total selenium exceedances. Total selenium concentrations ranged from <0.0005 mg/L to 0.0041 mg/L, with two of the six samples exceeding the total selenium FWAL guideline of 0.002 mg/L.

There are no year-over-year increasing trends apparent in the concentrated leachate monitoring data. Seasonal low concentrations are often noted in December-January, when dilution effects would be greatest, and highs often occur during the dry summer and early autumn periods.

VOC analyses were performed on all five sample suites collected from SW-3 in 2014. All results were non-detect with the exception of toluene in three of the six samples, with concentrations ranging from 1.8 to 9.8 µg/L, compared to the FWAL criterion of 0.5 µg/L (Table XIV). The 21.5 µg/L result for August 2013 is the second highest recorded to date, and is only exceeded by the 568 µg/L result sampled in November 1996.

Other than toluene, the only VOC detections since 2008 have been one xylene result of 0.5 µg/L and five benzene results of 0.1 or 0.2 µg/L. These concentrations are well below the respective FWAL guidelines of 30 and 40 µg/L.

The VOC detections in the past three years have been more frequent than in previous years, but exceedances of the FWAL guidelines have not been consecutive until October and December

2014. The VOC detections appear to be due to specific events. A VOC sample was collected during the November 2014 overflow event, and is discussed in Section 4.

3.3 SITES SW-5 AND SW-12 (RECEIVING AREA SOUTH OF LANDFILL)

Impacts at SW-5 had been fairly constant from 2002 through 2004, but displayed a significant improvement since Leachate Ditch #1 was commissioned in the autumn of 2004, and this sampling site was moved to the downstream side of the ditch in an area of ephemeral ponded water. This ephemeral ponding area receives water from the diversion ditch around the east side of the landfill, and other local runoff water.

This site is sampled occasionally due to its ephemeral nature. No samples were collected in 2013 or 2014 and only two samples were collected from SW-5 in 2012 (May and July). TDS at SW-5 dropped from a range of 100 to 600 mg/L prior to implementation of the leachate collector ditches, to between 45 and 170 mg/L in 2006, between 40 and 86 mg/L in 2008 to 2010, and between 40 and 106 mg/L in 2012 (Table V and Fig. A-1). Chloride concentrations have displayed a similar decline, dropping from the 8 to 55 mg/L range prior to 2004, to between 2.4 and 5.9 mg/L in 2010. The recent data are essentially background levels (Fig. A-2). Chloride has not been sampled since 2010.

Ammonia concentrations, which ranged from 1.2 to 68 mg/L-N prior to the commissioning of the leachate collection system, dropped to detection levels from 2005 to 2007, and ranged between <0.01 and 0.03 mg/L-N in 2012 (Table V and Fig. A-3). The highest recent ammonia concentration was 0.54 mg/L-N in December 2008. Nitrate concentrations were near or below the detection limit in 2010 and 2012.

Total aluminum, iron and manganese were the only metals sampled at this site in 2012. Iron was slightly elevated compared to background, which is expected for a stagnant area in a bog environment (Table V). Total aluminum concentrations were slightly elevated in 2012.

Site SW-12 is located near the park boundary down gradient from the leachate lagoon, but since 2006 has been sampled from Sandhill Creek. TDS at this site has ranged from 32 to 227 mg/L since the leachate collection ditches were commissioned in late 2004 (Fig. A-1). TDS ranged from 56 to 115 mg/L in the current reporting period (Table XII). Ammonia concentrations are also typically low, with a historical range between <0.01 and 0.34 mg/L-N, with the exception of the December 2005, June 2006, and August 2007 results which were 1.84, 1.05, and 0.72 mg/L-N, respectively (Fig. A-5). The six samples collected in 2014 ranged between <0.01 and 0.11 mg/L-N), and remained well below the FWAL criterion of 1.8 mg/L-N.

The historical peak nitrate concentration of 1.94 mg/L-N was coincident with the 1.05 mg/L-N ammonia result in June 2006. For the 2014 reporting period, the highest nitrate concentration measured was 0.91 mg/L-N, in December. The June 2013 result of 9.96 mg/L is the only nitrate concentration that has exceeded the FWAL guideline of 3 mg/L-N at this location. It is considered to be an anomaly, possible related to a calculation error.

All 57 total iron concentrations measured to date ranged between 0.19 and 2.9 mg/L, with approximately 10% of the results exceeding the current FWAL guideline (1 mg/L). The historical peak iron concentration of 2.9 mg/L was sampled in August 2011. All 2014 iron concentrations were in compliance with the FWAL guideline.

Total aluminum concentrations in 2014 ranged from 0.204 to 0.411 mg/L, and exceeded the FWAL guideline in all sampling events (Table XII). Although these concentrations exceed the FWAL guideline, all total aluminum and total iron results have been within the typical envelope for background concentrations.

Results for the SW-5 sampling site, which represents a very small flow, and SW-12, which represents the south landfill impact on Sandhill Creek, suggest only a very slight leachate impact in relation to the SW-7 background data. Leakage from the leachate lagoon, and southward seepage from the landfill in general, are therefore interpreted to be minimal, indicating that leachate containment provided by Leachate Ditch #1 and the storage lagoon is effective.

3.4 SITES SW-8 AND SW-9 (IRRIGATION WATER RECEIVING AREA)

SW-8 and SW-9 were each sampled four times in 2014. A lack of water during the summer sampling sessions meant they could not be sampled in June or August. TDS varied between 273 and 338 mg/L at SW-8, and between 203 and 370 mg/L at SW-9 (Tables VIII and IX, and Fig. A-1) during the current reporting period. Chloride concentrations ranged between 22.8 and 27.9 mg/L at SW-8, and between 18.3 and 33.7 mg/L at SW-9. Typically, the peak concentrations occur in the summer months at both sites (Figs. A-3 and A-4). These results indicate significant leachate effect at both sites due to the upslope application of irrigation water.

Ammonia results exhibited concentrations ranging between 0.18 and 7.30 mg/L-N at SW-8, with three of the four results exceeding the 30-day average FWAL guideline of 1.84 mg/L-N (Fig. A-5). Two of the four ammonia results for SW-9 exceeded the FWAL guideline, with the higher concentrations ranging from 6.9 to 9.8 mg/L-N. The higher ammonia concentrations occurred in February and May. The variation between the sampling events suggests that treatment provided by winter irrigation is likely limited to dilution, plus some nitrification. All nitrate concentrations during 2014 for SW-8 and SW-9 were below the FWAL guideline of 3.0 mg/L-N, except the December 2014 value of 5.12 mg/L-N measured at SW-9 (Fig. A-7).

COD concentrations sampled at the SW-8 and SW-9 sites ranged from 40 to 255 mg/L with all results above detection limits (Fig. A-8). BOD was not measured in 2014 at SW-8 or SW-9.

Total iron concentrations at SW-8 and SW-9 exceeded the FWAL guideline of 1.0 mg/L in all of the 2014 samples, except for the February sample from SW-8 (Tables VIII and IX). Measured iron concentrations ranged from 0.515 to 6.48 mg/L at SW-8 and 1.06 to 66.2 mg/L at SW-9.

Monitoring results for sites SW-8 and SW-9 show varying leachate impact in response to the irrigation of water over the upland area. In general, sampling results indicate that:

- The irrigation system promotes significant nitrification year round,
- Irrigation promotes plant uptake of nutrients and increases evapotranspiration losses of leachate in the summer months, and
- The irrigation system increases leachate dilution prior to discharge to Sandhill Creek in the winter months.

In previous years it was stated that the lagoon/irrigation system promotes oxidation and precipitation of iron. The high total concentrations measured in the last two years suggest this may not be the case, but concentrations were mostly lower than in the leachate samples from SW-2, SW-3 and SW-4, indicating iron concentrations are reduced relative to typical leachate.

Overall, the irrigation system does appear to reduce iron and ammonia loading to Sandhill Creek, particularly during the growing season, when ammonia impacts on Sandhill Creek are expected to be the most significant.

3.5 SITES SW-6 AND SW-11 (RECEIVING AREA WEST OF LANDFILL)

The SW-6 site is located in an area of ephemeral ponding in the buffer zone along the west edge of the landfill. In 2013, this location was sampled six times, compared to previous years when it was often too dry to sample in the summer. As the latter half of 2013 was drier than previous years, the ability to collect samples may relate to more irrigation water reporting to this sampling site. In 2014, this site was sampled just four times, as the site was too dry to sample for the June and August sampling events.

TDS varied between 170 and 323 mg/L for the 2014 sampling events (Fig. A-2). Ammonia concentrations exceeded the 30-day FWAL guideline of 1.84 mg/L-N twice in 2014, with a peak concentration of 3.0 mg/L-N (Table VI and Fig. A-6). Nitrate concentrations ranged from 0.295 to 2.59 mg/L, with no results exceeding the FWAL guideline in 2014.

All of the 2014 aluminum results exceeded the FWAL guidelines. The elevated total aluminum and iron concentrations for the October 2013 sampling event (9.42 and 17.8 mg/L, respectively) were not repeated in 2014. Other sampling results in 2014 were similar to background.

Overall, historical TDS, chloride, ammonia and nitrate data suggest water quality at SW-6 is slightly impacted by leachate. The 2014 data exceeded the ammonia FWAL criterion on two occasions while the nitrate concentrations remained below the FWAL criterion. Both ammonia and nitrate data were within the envelope of historical data at this site. Chloride concentrations in 2014 were down slightly from 2013, when they were generally elevated in comparison to previous years. However, no samples could be collected in the summer of 2014, when the highest concentrations are typically measured. The elevated chloride data may be due to some changes to the surface water and shallow groundwater flow paths from the point where irrigation water is applied, or to the drier-than-average weather in the late summer of 2013 and 2014, but the effects are more significant than in previous years.

SW-11 has been sampled 57 times since it was incorporated into the sampling program in July 2005. TDS and chloride results for this site have exhibited high concentrations, ranging between 54 and 571 mg/L, and 9.6 and 94.7 mg/L, respectively (Figs. A-2 and A-4). Concentrations for the current reporting period fall within the bottom half of the historical range, with the 2014 peak chloride concentration of 54.2 mg/L measured in August (Fig. A-4 and Table XIa).

Ammonia concentrations for samples from SW-11 exceeded the FWAL guideline of 1.84 mg/L-N in 17 sampling events from 2005 to 2008, with results varying from 0.42 to 19.6 mg/L-N. The only sampling results to exceed the FWAL guideline since mid-2008 are the 2.1 mg/L-N results for October of 2013 and August of 2014 (Table XIa and Fig. A-5). Nitrate concentrations ranged between <0.005 and 0.24 mg/L-N in 2014 (Table XIa and Fig. A-7), with the highest concentration measured in January. Nitrate sampling results have not exceeded 1.0 mg/L-N since mid-2008, and have remained well below the 30-day FWAL guideline of 3 mg/L-N. However, concentrations were significantly higher than background, indicating some leachate impact.

Total and dissolved metals concentrations were measured at the SW-11 site during the current reporting period. Iron, manganese, aluminum, chromium, cadmium, copper, and mercury concentrations exceeded their respective FWAL criteria on one or more occasion in 2014. Total and dissolved iron concentrations exceeded the respective FWAL guidelines of 1 and 0.35 mg/L for all six sampling events in the 2014 reporting period. Total iron displayed concentrations varying from 1.89 to 49.2 mg/L and dissolved iron ranged from 0.42 to 1.66 mg/L (Table XIb). Iron concentrations chronically exceed FWAL guidelines at this site, and are greater than background concentrations measured at SW-10. The highest concentrations are observed in the summer months, and appear to show an increasing trend with the highest concentration measured in 2014 (Fig. A-13).

Total manganese concentrations exceeded the FWAL guideline in June, August, and October during 2014. Dissolved manganese concentrations only exceeded the FWAL guideline in August. Manganese concentrations have chronically exceeded FWAL guidelines at this sampling site during the summer months, and display seasonal variations similar to the iron data (Fig. A-13).

Total aluminum concentrations ranged from 0.177 to 0.585 mg/L, with all samples exceeding the FWAL guideline of 0.05 mg/L. Dissolved aluminum concentrations ranged from 0.017 to 0.121 mg/L and exceeded the FWAL guideline for four of the six sampling events during 2014 (Table XIb). The aluminum concentrations were similar to the background values measured at SW-7.

Total cadmium concentrations exceeded the FWAL guideline of 0.021 μg/L (based on a hardness of 60 mg/L) on one occasion, in October of 2014, while dissolved cadmium remained below the guideline for all samples. Total chromium concentrations ranged between 0.0009 and 0.0022 mg/L, exceeding the Cr(VI) FWAL guideline of 0.001 mg/L in five of the six sampling events in 2014. Dissolved chromium concentrations ranged between <0.0005 and 0.0006 mg/L, all below the Cr(IV) FWAL guideline.

While the dissolved copper concentration in May 2014 of 0.0051 mg/L exceeds the FWAL guideline, the dissolved concentration is greater than the total concentration and is considered to be a sampling or analytical error. The October 2014 total copper concentration exceeded the hardness-varying guideline of 0.0026 mg/L, based on the average hardness of SW-11, but remained below the 0.0036 mg/L standard calculated with the October 2014 hardness of 90 mg/L $CaCO_3$.

Two of the 2014 samples had detectable total mercury measured at the FWAL guideline, 0.02 μg/L, with the remaining samples either <0.01 μg/L or <0.05 μg/L. The higher detection limit for the February 2014 sample was due to use of an inappropriate sample container and preservative. No mercury exceedances had occurred prior to 2014, but on several occasions the detection limit has been greater than the guideline.

Total selenium concentrations ranged from <0.0005 to 0.0027 mg/L, with one of the six 2014 results exceeding the FWAL guideline of 0.002 mg/L. All six dissolved selenium concentration results were non-detect (Table XIb).

The 2005 to 2014 monitoring results indicate the small gulley in which SW-11 is located represents a seepage pathway for leachate to reach Sandhill Creek. There must therefore be a shallow seepage pathway beneath or around Leachate Ditch #2 at some point along its length.

Leachate effects appear to be less than in 2008, and may have been mitigated by recent deepening of Leachate Ditch #2 (Fig. 1). The single slight exceedances of the ammonia FWAL in the late summers of 2013 and 2014 are considered to be anomalies. Leachate effects at SW-11 are not currently significant with respect to FWAL criteria, but the iron and chromium concentrations, and occasionally manganese concentrations, exceed their respective 30-day FWAL guidelines.

3.6 SITE SW-1 (RECEIVING SANDHILL CREEK TRIBUTARY)

Sample site SW-1 is located downstream of the leachate irrigation area and the documented leachate discharge past SW-11. All significant leachate impacts should therefore be mixed into the creek flow at this site.

Samples from this site have historically displayed chloride concentrations of up to 100 mg/L (Fig. A-3). In 2014, chloride concentrations were in the lower half of the historical range, with a peak value of 42.6 mg/L sampled in August (Table Ia). As noted above, the Sandhill Creek upstream result was 33.9 mg/L on this date; thus, the elevated value can be primarily attributed to natural background, during the dry late summer of 2014. TDS concentrations ranged from 65 mg/L in October to 120 mg/L in June and August 2014 (see Table Ia and Fig. A-1). Hardness ranged between 13 and 50 mg/L as $CaCO_3$ during 2014, with the highest values occurring in June. Alkalinity ranged from 12 mg/L to 45 mg/L as $CaCO_3$.

Samples from this site have historically displayed ammonia concentrations of up to 7.7 mg/L-N (Fig. A-5). Ammonia results for the current reporting period were slightly higher than the previous two years, but remained in the lower portion of the historical range, with a peak concentration of 0.28 mg/L-N sampled in August. Ammonia concentrations exceeded the FWAL guideline most recently in December 2005 (2.11 mg/L-N). Ammonia concentrations during low-flow periods are due partially to the effect of natural groundwater contributions to streamflow, as ammonia concentrations of about 5 mg/L-N have been documented in the three drilled monitoring wells (see below).

Nitrate concentrations are typically low at this site and did not exceed 0.78 mg/L-N (December) in 2013. The 2.29 mg/L-N nitrate concentration measured in August 2012 was not repeated, and the highest nitrate concentration measured in 2014 was 0.94 mg/L-N in December. The last time the SW-1 nitrate concentration exceeded the current FWAL guideline of 3 mg/L-N was the 3.9 mg/L-N concentration recorded in August 2006. Nitrate concentration appears to be attributable to a background source, based on the 1.01 mg/L-N nitrate concentration measured at the upstream Sandhill Creek site (SW-10) in December 2014 (Table Xa), and the higher nitrate concentrations measured at this site relative to SW-1 in August and October 2014 (Fig. 1).

COD concentrations fluctuated between 21 and 50 mg/L-O in 2014, slightly above the background concentrations recorded at SW-7 (Fig. A-8). The 50 mg/L-O result was sampled in October. BOD at this site remained under the 4 mg/L-O detection limit for all sampling events in 2014, except June (14 mg/L) and August (9 mg/L), mirroring the BOD results measured at SW-11 (Table Ia and Fig. A-9).

Dissolved iron concentrations exceeded FWAL guidelines in June, but all other iron concentrations were within compliance throughout the year (Table Ib). Total iron concentration has exceeded the FWAL guideline of 1 mg/L a total of 17 times in the monitoring record, with the highest value of 9.98 mg/L recorded in August 2010 and two exceedances in June and August of 2014 (Fig. A-13). Concentrations at SW-1 typically exceed the SW-10 concentrations (Fig. A-13), indicating the iron loading is entering the creek downstream of SW-10. Other than the peak concentration of 9.98 mg/L, which exceeds the 4.2 mg/L concentration measured at SW-11 on that day, a higher iron concentration at SW-11 accompanied all other iron exceedances at SW-1. However, it is likely that iron exceedances are due in part to naturally elevated iron in baseflow during very dry conditions, as well as loading from SW-11. The peak SW-1 iron concentrations in the summer of 2014 are associated with the extremely high iron concentrations measured at SW-11.

Total or dissolved manganese results have only exceeded the 0.83 mg/L FWAL guideline on six occasions through the monitoring record, with four of the exceedances and the highest result to date (10.3 mg/L) recorded in the summers of 2010 and 2011 (Fig. A-14). Prior to 2010, manganese concentrations were typically well below the FWAL guideline (Fig. A-14). Peak total and dissolved manganese concentrations recorded during the current sampling period were 1.73 and 0.309 mg/L, respectively (Table 1b). SW-1 total manganese concentrations in the summers of 2010 and 2011 were greater than the background concentrations sampled at SW-7 and SW-10 on the same date, and were also greater than the SW-11 concentrations (Fig. A-14). These elevated concentrations are therefore attributed to a natural, but undefined, source. The

2014 manganese exceedance of 1.73 mg/L in August is attributed to very low baseflows and seepage from SW-11, where a concentration of 2.67 mg/L was measured on the same day.

Elevated iron concentrations are attributed to the very sluggish flow regime in the summer months, and to the effect of flow from the drainage course sampled at SW-11. Iron concentrations monitored at SW-11 appear to be high enough to account for most of the elevated iron concentrations at SW-1, but there is also considerable variability in background concentrations, as indicated by the historical SW-10 data and by the peak SW-1 concentrations measured in August 2010 that exceed all other concentrations sampled on that date (Figs. A-10 and A-13). Manganese concentrations are typically below the FWAL guideline at this site, and the high values that exceeded the FWAL guideline in 2010 and 2011 appear to be anomalous in relation to other monitoring sites, indicating analytical or sampling error, or a background source. The 2014 manganese exceedances is attributable to seepage at SW-11 (Fig. A-14).

During the current reporting period, total and dissolved aluminum concentrations for SW-1 samples exceeded the 30-day mean FWAL guideline of 0.05 mg/L on all six occasions, but the data are consistent with SW-7 results, indicating a background source (Fig. A-11). The elevated aluminum concentrations are attributed to the low pH of the water in the natural peaty environment.

Dissolved cadmium concentrations in 2014 were all below the detection limit. Only one of the 2014 samples had detectable total cadmium (0.00002 mg/L), slightly exceeding the hardness-varying FWAL guideline of approximately 0.000015 mg/L.

Total chromium was measured at the FWAL threshold of 0.001 mg/L in August 2014, while all dissolved chromium concentrations were non-detect and/or below the FWAL threshold. In August 2011, total chromium was also measured at 0.001 mg/L but prior to or since August 2011, no other exceedances have been reported (Table Ib).

Mercury concentrations were also slightly elevated over previous years, with total mercury reaching or exceeding the guideline in August and December, and dissolved mercury reaching the guideline in August (Table Ib). The mercury was not attributable to discharge from SW-11, as results were at or below the detection limit for these sampling events.

Results for the creek sampling program do display a slight leachate impact in relation to the SW-7 background data. The impact is manifested by slightly elevated chloride, ammonia, and nitrate concentrations, and iron and manganese concentrations during the summer months. The alkalinity in the creek is also higher than values recorded at SW-7 during low flow periods, reflecting the contribution of natural groundwater to the SW-1 flow. Leachate impact is not considered to be significant in comparison to background water quality, especially considering the slightly brackish chemistry of the natural groundwater in the area. Elevated concentrations of iron and manganese measured in the summers of 2010 and 2011 were not been repeated in 2012 or 2013. However, iron and manganese concentrations above the guideline but below concentrations measured in 2010 and 2011 were measured in the summer of 2014, during a period of very low baseflow.

3.7 SITE SW-13 (STANDING WATER BESIDE ACCESS ROAD TO LEACHATE LAGOON)

Standing water inside the south fence line was interpreted to come from the truck wash area located directly to the north. It was sampled three times in 2009 to check for leachate indicator parameters and metals. Ammonia, nitrate, TDS and chloride concentrations were all similar to background concentrations. Only total aluminum and iron results, and one manganese result, exceeded FWAL criteria. Due to no apparent effects and the stagnant occurrence of this water (no flow), it has not been sampled since June 2009.

3.8 SITE SHC (SANDHILL CREEK UPSTREAM OF HIGHWAY 4)

The SHC site has been sampled since 2003. Data for the past three years are summarized in Table XIII. Chloride concentrations are similar to SW-7 concentrations (background) for most of the year, but are very elevated during low-flow periods in August (Fig. A-3). The August 2012 concentration of 54 mg/L was the highest on record for this site, and was higher than the approximate 38 mg/L chloride concentrations sampled at SW-1 and SW-10 on the same date. Similarly, the August 2014 result of 51.5 mg/L was also higher than the chloride concentrations measured at SW-1 and SW-10. The August results indicate that during very dry baseflow conditions, the lower reaches of Sandhill Creek receive a greater component of groundwater from the marine clay than the upper reaches.

Total manganese concentrations at SHC have always been less than the FWAL guideline. The only two exceedances of the FWAL guideline for iron occurred in August 2010 and August 2011. The exceedances were slight and remain within the envelope of background chemistry for the area.

The chemistry at this sampling site is comparable to background surface water at SW-10. It is also noteworthy that the chloride concentrations sampled at SHC are very comparable to those sampled at SW-1, indicating that the water quality at SW-1 is very similar to the quality of recharge to Sandhill Creek downstream of the landfill. The water quality at this sampling site does not exhibit any leachate effects.

3.9 GROUNDWATER MONITORING WELLS

Samples have only been collected from the three groundwater monitoring wells (MW02-1, -2, and -3) during the October 29, 2003 and June 13, 2006 sampling events. The data are presented in Tables XVa and XVb. A brief summary of the groundwater chemistry is presented below.

TDS concentrations ranged from 4370 mg/L at MW02-3 up to 7670 mg/L at MW02-1, well above all of the surface water monitoring data collected at the site to date. Chloride concentrations also greatly exceeded the surface water monitoring, with a range of 2610 to 4090 mg/L (MW02-3 and MW02-02, respectively). These levels are more than ten times the Guidelines for Canadian Drinking Water Quality (GCDWQ) Aesthetic Objective (AO) of 250 mg/L, and are much higher than would be expected for even concentrated leachate at this site.

Sulphate and dissolved sodium concentrations also exceeded the receiving water quality criteria at the three groundwater monitoring wells. Sulphate concentrations ranged from 290 to 778 mg/L, exceeding the FWAL criteria of 100 mg/L at all three locations. The highest concentrations, measured in the MW02-1 sample, also exceeded the GCDWQ AO of 500 mg/L. Dissolved sodium concentrations ranged between 1440 and 2010 mg/L, exceeding the AO of 200 mg/L by a factor of 7 to 10.

Ammonia concentration at the monitoring wells ranged from 3.1 to 6.4 mg/L-N and averaged about 5 mg/L-N, which is less than typical concentrations recorded for the concentrated leachate sampling sites, but is still in excess of the FWAL guideline of approximately 1.84 mg/L-N.

Dissolved iron concentrations in the groundwater samples did not exceed the FWAL guideline; however, total iron concentrations were above the FWAL guideline of 1 mg/L in two of the three monitoring wells, with concentrations ranging from 0.58 to 1.65 mg/L.

Both total and dissolved manganese concentrations were in compliance with the 1.9 mg/L FWAL guideline in all three wells. The maximum total and dissolved concentrations were 0.82 and 0.67 mg/L, respectively.

Both suites of samples collected from the monitoring wells, and field chemistry measurements for samples withdrawn from the three monitoring wells in 2003, 2004 and 2006, indicate that the chemistry is not changing significantly, and that the samples obtained from these wells are representative of formation water within the marine clay sediments.

Overall, the chemistry of the groundwater samples collected from the monitoring wells is representative of a very low permeability marine sediment deposit, in which connate pore water has not been completely flushed out by meteoric waters. Groundwater quality within the marine clay deposit exhibits very high TDS, conductance, chloride, sodium, and sulphate concentrations, all interpreted to be residual from pore water derived from the marine depositional environment. Ammonia concentrations in the pore water also exceed the FWAL guideline of 1.84 mg/L-N by a factor of about 2.5. Due to residual connate water in the marine sediments, concentrations of many of the monitored parameters are higher in the natural groundwater than at the most heavily impacted surface water sampling locations, and therefore previous recommendations to discontinue groundwater monitoring and sampling are reiterated.

Groundwater level and field chemistry parameter data measured since the wells were installed in 2003 are listed in Table XVI. Water level data collected since April 2006 have not been affected by purging for sampling, so represent actual groundwater levels. Levels fluctuated over a range of about 0.35m for the years 2008 through 2011. Water levels were not monitored as part of the 2014 sampling program.

4. OVERFLOW EVENTS

Leachate lagoon overflow events occur at the West Coast Landfill after significant storm events. During these events, water decants from the northwest corner of the lagoon through perforated overflow pipes (Fig. 1). Overflow events have been documented on an approximately annual frequency since the lagoon was commissioned in the fall of 2004, and were documented three times in 2014. A letter summarizing the results of the April 17, 2014 overflow was prepared for McGill & Associates Engineering Ltd. on June 16, 2014 (Piteau, 2014a), and a follow-up letter providing sampling and flow monitoring recommendations was prepared on September 15, 2014 (Piteau, 2014b). Following two more overflow events in October and November, a third letter was prepared to summarize water quality results and reiterate sampling and flow monitoring recommendations (Piteau, 2015).

The 2014 overflow events were sampled on April 17, October 22, and November 25, after precipitation in the days prior reached 85, 111 and 101mm, respectively, at the Tofino Airport Climate Station. Water quality data available for all sampled overflow events at the decant are tabulated in Table XVII. The general chemistry of the overflow samples is diluted compared to the bimonthly samples from the leachate pond, with the exceptions of total phosphorus, BOD and total aluminum, which are likely associated with high turbidity in the lagoon during periods of high precipitation.

For the SW-3 overflow samples, total aluminum, cadmium, chromium, and iron regularly exceed their respective maximum FWAL criteria, by factors of about 10, 5, 2 and 5, while total zinc and dissolved aluminum, cadmium, chromium, and iron have occasionally exceeded the maximum criteria. In addition, ammonia, total copper, and dissolved aluminum, iron and zinc have exceeded the 30-day average aquatic life criteria but not the maximum FWAL criteria, for some or all of the samples collected. Results for the only sample to be submitted for VOC analysis in November 2014 were non-detect for all analytes, except toluene which exceeded the FWAL criteria by a factor of 4.6.

As the leachate overflow events have been of short duration, results are compared against the FWAL maximum criteria which protect aquatic life against short-term lethal effects. The 30-day average criteria represent long-term, sub-lethal effects, and are not considered relevant for the leachate overflow events. It should be noted that cadmium and toluene are among the parameters for which only one standard has been developed, which likely represents a long-term exposure scenario.

Water quality data at SW-1 are not available for any overflow events. However, concentrations for parameters sampled at the leachate overflow would comply with their respective FWAL guidelines with about 5:1 dilution, with the exception of aluminum which would require about 10:1 dilution. However, based on aluminum concentrations of two to five times the FWAL maximum guideline at SW-1 in recent years, 5:1 dilution would be adequate to lower aluminum levels to background. This level of dilution would presumably occur at SW-1, but should be confirmed with sampling from SW-1 and the leachate overflow pipe during future overflow events, and flow monitoring during these events.

Recommendations from the above-referenced letters included sample collection for water quality during overflow events and installing equipment for continuous flow monitoring. It was recommended that during an overflow event, water samples be collected from the overflow pipe as well as at SW-1, to measure effects on receiving water. Flow monitoring would include measuring flow and duration of overflow events at the decant pipe from the leachate lagoon, monitoring flows in the SW-11 gulley and in Sandhill Creek at SW-1, and discharge from the leachate lagoon during normal operation with a weekly cumulative flow meter reading.

5. CONCLUSIONS

Overall, the 2014 monitoring data indicate a slight leachate impact. There are no obvious long-term increasing trends apparent in the data that would suggest the effects of the landfill are increasing over time.

Recent chloride and ammonia data for the concentrated leachate display a consistent seasonal variation with monthly precipitation and temperature. Chloride concentrations generally increase when precipitation decreases, due to the absence of surface runoff and the naturally brackish chemistry of the groundwater in the clay sediments that underlie the peat. Ammonia concentrations generally decrease when precipitation decreases, due to less leachate flushing and more residence time, and hence renovation, along seepage pathways.

Results for the past ten years of sampling following the commissioning of the leachate collection and irrigation system have characterized the strength of the collected leachate (SW-3) generated by the landfill, and it is very similar to that indicated by the perimeter sampling sites monitored prior to 2004. Concentrations in the leachate storage lagoon, which represent the mixed quality of all seepage and surface flows from the landfill, varied within the following ranges over the past three years:

TDS	108 to 626 mg/L
Alkalinity	180 to 500 mg/L as $CaCO_3$
Chloride	16.2 to 92.6 mg/L
Ammonia	<0.01 to 29.7 mg/L-N
Nitrate	<0.05 to 0.976 mg/L-N
Dissolved Iron	0.011 to 3.83 mg/L
Dissolved Manganese	<0.001 to 2.52 mg/L
Dissolved Copper	<0.001 to 0.007 mg/L

In 2014, the only parameters which exceeded receiving water guidelines (FWAL) in the concentrated leachate were ammonia, total aluminum, total cadmium, total and dissolved chromium, total copper, total and dissolved iron, and total selenium (Tables IIIa and IIIb). Over the history of the monitoring program, cadmium, copper and zinc exceedances are slight and occasional.

Results for sampling site SW-12, located on Sandhill Creek downstream of the leachate storage lagoon, indicate only a slight leachate effect. One elevated ammonia result of 13.8 mg/L-N in SW-12 in August 2012 is considered an anomaly, and is likely attributable to sampling/analytical error. The highest ammonia concentration sampled at this site in 2013 and 2014 was 0.13 mg/L-N. The location from which the SW-12 samples have been collected since 2006 does not serve the site's intended objective, which is to confirm that containment provided by the leachate storage lagoon and Leachate Ditch #1 is adequate to mitigate leachate migration and impact across the south boundary of the site.

Sampling results for sites SW-8 and SW-9, located on the overland flow pathway from the irrigation site to Sandhill Creek, indicate that some renovation of leachate quality (e.g., nitrification and plant uptake of nutrients) does occur during the growing season, when temperatures are highest. The monitoring record to date for these two sites demonstrates a consistent reduction in ammonia concentration relative to the leachate lagoon (SW-3), indicating that the irrigation system will mitigate ammonia impacts during the summer and early autumn months, when receiving water dilution is lowest and ammonia concentrations present the highest level of risk.

The results of 19 sampling events available for the SW-6 site from 2011 to 2014 indicate some slight but varying leachate impact at this site, apparently due to operation of the irrigation system.

The six recent sampling results for SW-11, located in a natural gulley to the south of SW-6, exhibited a slight leachate impact. Ammonia concentrations have been in compliance with the FWAL guideline of 1.84 mg/L-N for the past three years, except for the slight exceedances to 2.1 mg/L-N in October of 2013 and August of 2014. Chloride concentrations at SW-11 over the past few years have tracked the chloride trends in the leachate but at slightly lower concentrations; lower in the wet months and higher in the dry months. Monitoring results for this site indicate that significant amounts of leachate are seeping past or around Leachate Ditch #2, and are not being directed to the leachate storage lagoon. The most significant effects are noted for iron and manganese. Iron concentrations chronically exceed the FWAL guideline, but manganese concentrations only exceeded the FWAL guideline three times in 2014, with lower peaks than in 2010 and 2011. The recent data therefore suggest some improvement relative to 2010/2011. An Electromagnetic (EM) survey conducted in this area in November 2009 identified a potential seepage pathway (Piteau, 2010). We understand that work was done on Leachate Ditch #2 to mitigate seepage losses in the summer of 2012. This work may have had a slight effect, based on recent monitoring data.

Sampling results for the receiving water monitoring site (SW-1) indicated only very slight impact during the current reporting period. The only parameter to chronically exceed FWAL criteria in 2014 was aluminum, while isolated exceedances of cadmium, chromium, iron, manganese and mercury were also reported. Based on SW-10 and SW-11 data, elevated manganese concentrations at SW-1 that sometimes occur during the summer months may be due to background chemistry, but could also include some effect from the landfill (Fig. A-14).

Bioassay data for SW-1 samples collected in 2007, 2008 and 2009 indicated >100% survival in the undiluted sample. The bioassay sampling program was discontinued in 2010, due to the difficulty in obtaining the large samples that are now required, and the consistent nontoxic results from 2006 through 2009.

Although 2005 to 2014 impacts in Sandhill Creek have generally been within the allowable envelope defined by the FWAL guidelines, and/or typical background concentrations for the area, there have been some apparent changes to the water quality in Sandhill Creek over the past decade. The most significant changes have been the slight increases in ammonia and chloride concentrations, and the elevated iron and manganese concentrations observed in 2010 and 2011. The potential for ammonia concentrations to increase in the future presents the most significant risk. Recent summer increases in iron and manganese concentrations are also a concern, as noted below.

The ammonia risk to Sandhill Creek was partially mitigated with the irrigation system that was fully commissioned prior to the 2005 reporting period. Chloride and ammonia concentrations in Sandhill Creek have not shown a statistically significant increase in the past seven years. However, ammonia concentrations may increase gradually over time, as a function of the volume and age of waste that is contained in the landfill, and it is important the irrigation system be properly monitored and managed, to optimize its performance.

The source of the recent elevated iron and manganese concentrations in the SW-1 samples is likely partially attributable to the loading discharged from the drainage course sampled at SW-11. Sampling data for 2014 only exhibited exceedances of the iron or manganese FWAL guidelines in the low-flow summer months, suggesting that work on Leachate Ditch #2 may have mitigated leachate seepage losses to the gulley at SW-11. No manganese or iron exceedances were reported in 2013, the first year following these improvement works. Further assessment of this potential leachate pathway is recommended, as discussed in the recommendations.

Ten years of sampling data for the Sandhill Creek site above Highway 4 do not exhibit any indication of leachate impact in the lower reaches of the creek. While low-flow chloride concentrations measured in the summer appear to have risen slightly compared with other sampling sites, ammonia, nitrate, iron and manganese have remained consistently low.

6. RECOMMENDATIONS

Following the field sampling review of February 2015, and the above results, the following actions are recommended for 2015:

- The current bi-monthly sampling program should be continued through 2015 (Table B-1, Appendix B). The complete list of metals analyses should be continued for the SW-11 sampling suite, until the seepage pathway to this site is fully remediated. As has been the practice since 2010, the bioassay sampling for SW-1 can be omitted, unless leachate effects to Sandhill Creek are noted to change.
- The sampling location of SW-12 should be modified to the gulley downgradient of SW-5 and the leachate storage lagoon, where a small tributary of Sandhill Creek rises when recharged by shallow groundwater flow. This location should be sampled whenever water is present, which may only be during winter months. When this site is dry, it should be documented. No further SW-12 samples should be collected from Sandhill Creek.
- The current SW-10 site on Sandhill Creek, sampled from 2006 to 2014, is located less than 100m upstream of SW-1. On an approximately annual basis, when weather conditions are favourable, a background sample should be collected from the upstream Sandhill Creek site. Access can be from the abandoned logging road to the west of the landfill, sampling where the creek is closest to the logging road. A GPS waypoint should be collected at the time of sampling. For the other sampling sessions, a sample should continue to be collected from the established SW-10 station, to document how water quality changes along Sandhill Creek where surface water enters from the landfill.
- Samples should be collected from SW-5 in 2015 when there is sufficient water at the site, and analyzed for the same suite as SW-6. Instances of insufficient quantity of water should be documented.
- A VOC analysis should be collected from SW-1 for the two autumn/winter sampling events in 2015.
- The mid-summer sample from SW-3 should be submitted for analysis of a broad spectrum of potential contaminants, to include: LEPH-HEPH, PAHs, Organophosphate pesticides, GC-MS pesticide scan, Chlorinated Phenolics, Non-Chlorinated Phenolics and Nitro-

Phenolics. If any contaminants are detected at significant concentrations, samples for those specific analytes should be collected again later in the year.

- Future analyses for cadmium concentrations should continue to request a detection limit of 0.01 µg/L or lower.
- A cumulative flow meter should be installed on the leachate irrigation system to measure flows that are discharged from the leachate lagoon during normal operation. Readings should be recorded monthly, to document the leachate quantity that is discharged via the irrigation system.
- The gauging station established at SW-1 on Sandhill Creek in mid-2005 should be calibrated to provide reliable flow monitoring data. Flow at SW-1 should be measured at each sampling visit with a velocity meter, and recorded along with the staff gauge measurement to establish a stage-discharge relationship at this location. The data loggers at SW-1 should be downloaded twice per year. Flow data derived from the data logger readings and a stage-discharge relationship can then be used to calculate loadings in the creek and relate those to leachate strengths and quantities.
- A flow gauging site should also be established on the drainage past SW-11, so that the concentrations/loadings past the SW-11 sampling point can be calculated, and compared to the concentrations/loadings at SW-1. A small weir should be constructed across the gulley, and a data logger and staff gauge would record levels. As with Sandhill Creek, the staff gauge should be read every time a sample is collected from SW-11, and the data logger should be downloaded twice per year.
- The seepage pathway past SW-11 currently presents a slight risk to the water quality in Sandhill Creek that may not be managed by the leachate collection, storage and irrigation system. Recent monitoring data for this site indicate less significant leachate effects than prior to 2008, but the increases in iron concentrations at SW-1 during the summers of 2010 and 2011 are likely attributable, at least in part, to the flow past SW-11. Current monitoring data do not indicate any need to further investigate this possible leachate seepage source, other than the flow monitoring recommended above. This flow monitoring will provide some indication of whether the SW-11 drainage course is the primary source of the iron. If the SW-11 flow is determined to be a significant source of the iron at SW-1, further measures to mitigate leachate losses along this pathway would

likely involve diverting this flow into the leachate storage lagoon with a pump, during low-flow periods.

- Water quality samples should be collected from the leachate lagoon decant flow, SW-11 and from the Sandhill Creek SW-1 site during overflow events. It would preferable to collect the samples near the mid-point of the event, but sampling could be conducted at any convenient time, and sooner would be better than later if there is a chance the decant event would be of short duration. Two coolers, each with the required bottles for one sampling suite, should be kept on site for this program. If the decant event continues for more than week, a second suite of samples should be collected. The landfill operator should collect the samples, and should be given instruction on sample collection and preservation methods. Sample bottles and coolers should be restocked following each overflow event.

7. LIMITATIONS

Piteau Associates Engineering Ltd. (Piteau) has exercised reasonable skill, care and diligence in obtaining, reviewing, analyzing and interpreting the information acquired during this study, but makes no guarantees or warranties, expressed or implied, as to the completeness of the information contained in this report. Conclusions and recommendations provided in this report are based on the information available at the time of this assessment.

In preparing the recommendations contained herein, Piteau has relied on information and interpretations provided by others. Piteau is not responsible for any errors or omissions in this information. This report is comprised of text, figures, tables, and appendices, and all components must be read and interpreted in the context of the whole report. The report has been prepared for the sole use of the Alberni - Clayoquot Regional District and McGill & Associates Engineering Ltd., and no representation of any kind is made to any other party.

We trust this report adequately presents and discusses the leachate sampling data collected to date. If you wish to discuss the 2014 sampling results, please contact us.

Respectfully submitted,

PITEAU ASSOCIATES ENGINEERING LTD.

ORIGINAL SIGNED

Jennifer Mancer, P.Eng.

ORIGINAL SIGNED

Andrew T. Holmes, P.Eng.

8. REFERENCES

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Piteau, 2014a. Letter report addressed to Mr. Alan McGill entitled, “2014 Leachate Lagoon Overflow – West Coast Landfill – Alberni-Clayoquot Regional District”, June 16.

Piteau, 2014b. Letter report addressed to Mr. Alan McGill entitled, “2014 Leachate Lagoon Overflow Sampling Recommendation – West Coast Landfill – Alberni-Clayoquot Regional District”, September 15.

Piteau, 2015. Letter report addressed to Mr. Alan McGill entitled, “2015 Leachate Lagoon Overflow Sampling Recommendation – West Coast Landfill – Alberni-Clayoquot Regional District”, January 12.

TABLES

TABLE Ia
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-1

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	20-Feb-12	02-May-12	03-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	13-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	16.0	14.0	19.0	72.0	16.0	22.0	24.0	46.0	50.0	28.0	54.0	47.0	23.6	33.1	48.9	44.2	13.2	35.6
Total Dissolved Solids	mg/L	-	54.0	74	64	210	92.0	76	30	96	136	92	126	100	73	75	120	120	65	75
pH - Lab	pH	-	6.6	6.30	6.40	6.70	6.0	6.71	6.78	6.80	6.70	6	6.7	6.8	6.60	6.98	6.89	7	6.2	6.3
pH - Field	pH	-	7.4	6.81	8.88	5.18	6.5	7.03	-	6.98	7.29	-	-	6.96	7.28	7.75	7.29	-	7.03	7.58
ORP - Lab	mV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ORP - Field	mV	-	128.0	100.3	96.4	209.7	171.1	95.8	111.4	59.6	102.3	-	-	41.8	49.8	40.1	-166.2	-	105.9	-
Conductivity - Lab	µS/cm	-	75	63	75	281	74	82	91	148	183	126	211	162.0	91	126	187	227	56	117
Conductivity - Field	µS/cm	-	73	56	69	269	66	76	85	141	190	-	-	142	74	109	183	-	56	108
Temperature - Field	ºC	-	5.6	7.3	11.0	12.1	9.5	4.7	6.0	6.9	11.4	-	-	3.6	4.7	8.1	10.8	-	11.4	7.4
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	<20	<20	<20	42	<20	<20	20.0	44.0	38.0	<20	42	40.0	16.0	35.0	42.0	45	12	28.0
Chloride	mg/L	150	10.1	9.3	9.3	37.3	9.3	8.2	10.8	14.3	22.1	16.2	29.3	20.6	12.0	15.1	29.7	42.6	7.08	12.4
Sulphate [4]	mg/L	100	3.0	2.3	2.3	23.4	5.7	5.4	3.8	3.1	14.7	14.7	11.1	4.1	3.0	2.5	2.8	1.2	2.1	5.0
DISSOLVED CATIONS																				
Calcium	mg/L	-	4.50	3.60	5.20	20.00	4.3	6.70	6.70	13.80	14.20	7.22	14.70	13.50	6.70	9.74	13.90	11.90	3.56	10.60
Magnesium	mg/L	-	1.30	1.10	1.40	5.30	1.37	1.40	1.70	2.76	3.40	2.37	4.14	3.32	1.68	2.14	3.45	3.52	1.04	2.17
Potassium	mg/L	-	0.70	0.50	0.70	2.80	0.6	0.90	1.00	1.60	1.70	0.90	2.20	1.70	-	-	-	-	-	-
Sodium	mg/L	-	6.60	6.30	7.30	24.00	7.1	6.30	8.40	10.90	15.30	10.70	18.90	13.40	8.12	10.90	17.60	25.50	6.07	9.94
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	<0.01	<0.01	<0.01	0.05	<0.01	0.11	<0.01	0.07	0.06	0.05	<0.02	0.11	0.04	0.01	0.08	0.28	0.11	< 0.01
Nitrate Nitrogen	mg/L as N	3.0	0.44	0.17	0.26	2.29	0.16	0.35	0.43	0.19	0.31	0.15	0.52	0.78	0.57	0.55	0.04	0.02	0.086	0.94
Total Phosphorus	mg/L as P	-	0.01	0.01	0.01	0.02	0.011	0.01	<0.003	0.01	0.01	0.00	0.012	0.01	0.02	0.02	0.03	0.06	0.009	<0.005
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	40	40	60	36	61	28	27	27	28	49	28	24	30	40	30	40	50	21
Biological Oxygen Demand	mg/L as O	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<4	<4	14	9	<4	<4

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW1-2014.XLS]NON-VOLATILES

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 40 mg/L-$CaCO_3$

TABLE Ib
METAL MONITORING DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-1

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	20-Feb-12	02-May-12	03-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	13-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**0.295**	**0.206**	**0.486**	**0.1**	**0.47**	**0.279**	**0.35**	**0.185**	**0.078**	**0.385**	**0.194**	**0.243**	**0.23**	**0.208**	**0.281**	**0.263**	**0.401**	**0.215**
Arsenic	mg/L	0.005	<0.0002	<0.0002	0.0005	0.0005	0.00021	0.00012	0.0001	0.00015	0.0004	0.0004	0.0004	0.00015	0.0002	0.0002	0.0004	0.0028	<0.0001	0.0001
Barium	mg/L	1.0	0.004	<0.001	0.004	0.013	0.00476	0.00393	0.00481	0.0064	0.008	0.007	0.009	0.00747	0.0044	0.0056	0.01	0.0104	0.0039	0.0056
Boron	mg/L	1.2	0.047	0.034	0.094	0.405	0.058	0.045	0.054	0.078	0.158	0.102	0.14	0.07	0.039	0.066	0.111	0.106	0.031	0.069
Cadmium [5]	mg/L	0.000015	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00002**	0.00001	**0.00002**	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	**0.00002**	<0.00001	<0.00001
Chromium	mg/L	0.001	0.0007	0.0004	0.0007	0.0005	0.0006	0.0006	<0.0005	<0.0005	0.0006	0.0009	0.0006	0.0008	<0.0005	<0.0005	0.0007	**0.001**	0.0005	0.0005
Copper [5]	mg/L	0.002	<0.001	<0.001	<0.001	<0.001	0.0009	0.0007	0.0017	0.0008	<0.001	<0.001	<0.001	0.0005	0.0007	0.0005	<0.001	<0.001	0.001	0.0007
Iron	mg/L	1	0.239	0.218	0.5	**1.05**	0.439	0.306	0.28	0.27	0.668	0.701	0.811	0.451	0.225	0.417	**3.5**	**3.2**	0.372	0.258
Lead [5]	mg/L	0.0043	0.0002	<0.0001	0.0001	0.0002	0.0002	0.0001	0.0002	0.0001	0.0001	0.0002	0.0001	0.0002	0.00006	<0.00005	0.00007	0.00014	0.00017	0.00008
Manganese [5]	mg/L	0.83	0.011	0.008	0.023	0.416	0.0161	0.0128	0.0115	0.0378	0.109	0.0623	0.0945	0.0341	0.009	0.042	0.812	**1.73**	0.042	0.018
Mercury	µg/L	0.02	<0.01	<0.01	0.01	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01	0.011	<0.01	<0.01	<0.05	0.01	0.01	**0.02**	<0.01	**0.06**
Nickel	mg/L	0.025	<0.001	<0.001	<0.001	0.002	0.0007	0.0004	0.0006	0.0007	0.001	0.001	<0.001	0.001	<0.0005	0.0006	0.0012	0.0015	<0.0005	0.0006
Selenium	mg/L	0.001	<0.0006	<0.0006	<0.0006	0.0007	0.0001	<0.0001	<0.0001	0.0002	<0.0006	<0.0006	<0.0006	<0.0001	<0.0005	0.0006	<0.0005	0.0014	<0.0005	0.0005
Zinc [5]	mg/L	0.0075	0.002	0.001	0.003	0.003	0.0016	0.0021	0.0019	0.0023	0.002	**0.013**	0.003	0.0043	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
DISSOLVED METALS																				
Aluminum [4]	mg/L	0.05	**0.187**	**0.186**	**0.352**	0.03	**0.424**	**0.193**	**0.187**	**0.117**	**0.093**	**0.348**	**0.068**	**0.118**	**0.145**	**0.131**	**0.054**	**0.071**	**0.293**	**0.128**
Arsenic	mg/L	0.005	<0.0002	<0.0002	<0.002	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0005	0.0003	<0.0002	<0.0001	0.0002	0.0002	0.0014	<0.0001	<0.0001
Barium	mg/L	1.0	0.003	0.002	<0.01	0.011	0.004	0.004	**0.005**	**0.006**	**0.007**	**0.006**	**0.007**	**0.006**	0.0037	0.0052	0.0093	0.0039	0.0037	0.0053
Boron	mg/L	1.2	0.047	0.035	0.07	0.46	0.022	0.051	0.053	0.09	0.153	0.106	0.148	0.076	0.038	0.064	0.116	0.099	0.033	0.072
Cadmium [5]	mg/L	0.000015	<0.00001	<0.00001	<0.00010	<0.00001	<0.00001	**0.0003** [6]	**0.00005** [6]	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Chromium	mg/L	0.001	0.0005	<0.0004	<0.004	0.0007	0.0006	<0.0005	<0.0005	0.0004	0.0006	0.0008	0.0006	0.0007	<0.0005	<0.0005	<0.0005	0.0008	<0.0005	<0.0005
Copper [5]	mg/L	0.002	<0.001	<0.001	<0.01	<0.001	<0.001	0.002	**0.003**	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	<0.001	<0.001	<0.001	0.001	0.0006
Iron	mg/L	0.35	0.14	0.157	**0.377**	**0.417**	0.287	0.182	0.156	0.164	0.312	<0.005	0.284	0.229	0.116	0.272	**0.606**	<0.005	0.281	0.131
Lead [5]	mg/L	0.0043	0.0004	<0.0001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00014	0.00012	<0.0001
Manganese [5]	mg/L	0.83	0.01	0.009	0.02	0.115	0.0081	0.01	0.01	0.0178	0.0396	<0.001	0.045	0.023	0.008	0.029	0.309	<0.001	0.019	0.016
Mercury	µg/L	0.02	<0.01	<0.01	0.01	<0.01	<0.01	<0.1	<0.1	<0.01	<0.10	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	**0.02**	0.01	<0.01
Nickel	mg/L	0.025	<0.001	<0.001	<0.01	0.002	<0.001	<0.0005	0.0012	<0.001	0.001	<0.001	0.001	<0.001	0.0004	0.0006	0.0004	0.0006	0.0004	0.0006
Selenium	mg/L	0.001	<0.0006	<0.0006	<0.006	<0.0006	<0.0006	<0.2	<0.0002	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0005	0.0005	0.0006	<0.0005	<0.0005	0.0007
Zinc [5]	mg/L	0.0075	<0.001	<0.001	**0.01** [6]	<0.001	<0.001	**0.008** [6]	0.005	<0.001	0.001	0.002	<0.001	<0.001	0.002	0.003	<0.002	0.003	<0.002	<0.002

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW1-2014.XLS]Metals

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed December 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 40 mg/L-$CaCO_3$
6. These values exceed the total concentrations, and are considered to be sampling or analytical errors.

TABLE II
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-2

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	21-Feb-12	2-May-12	4-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	233	324	341	347	281	269	263	414	374	370	443	386	323	282	467	495	292	333
Total Dissolved Solids	mg/L	-	292	494	488	612	460	546	436	676	590	744	722	586	495	425	715	820	403	498
pH - Lab	pH	-	7.50	7.30	7.30	7.70	7.50	7.50	7.60	6.90	7.40	7.40	7.40	7.40	7.37	8.00	7.86	7.59	7.41	7.21
pH - Field	pH	-	6.67	7.07	7.15	6.43	7.24	7.86	-	7.24	7.74	-	-	7.46	7.74	7.44	7.83	-	7.29	7.45
ORP - Field	mV	-	-34.7	-93.0	-82.5	148.0	-54.1	-52.6	-56.7	-113.3	-67.9	-	-	-12.2	-51.5	-26.2	-102.1	-	22.0	-
Conductivity - Lab	µS/cm	-	628	861	902	1031	775	729	801	1091	1046	1230	1394	1104	914	816	1370	1510	796	847
Conductivity - Field	µS/cm	-	568	789	826	989	742	700	755	1095	1051	-	-	1003	776	1018	1314	-	746	797
Temperature - Field	°C	-	7.3	12.1	15.0	15.7	12.2	4.9	9.0	17.7	18.3	-	-	5.9	9.9	14.1	15.1	-	13.7	8.0
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	250	370	400	410	300	330	350	480	500	480	610	530	414	385	646	648	359	384
Chloride	mg/L	150	25.1	37.5	38.9	64.0	39.7	27	34.1	39.1	54.3	80.0	73.0	53.1	38.1	38.1	71.7	113.0	34.5	33.3
Sulphate [4]	mg/L	429	14.0	14.0	4.4	23.4	33.9	19.0	10.0	3.1	1.9	31.6	14.4	6.7	16.3	10.2	6.2	9.1	14.7	3.5
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	**8.2**	**13.4**	**12.2**	**6.8**	**8.1**	**9.1**	**12.4**	**19.6**	**20.2**	**22.0**	**33.6**	**26.3**	**16**	**21**	**21**	**16.7**	**13.4**	**13**
Nitrate Nitrogen	mg/L as N	3.0	0.86	0.9	1.04	1.83	1.61	1.42	1.47	0.39	0.17	<0.05	0.86	0.84	0.304	0.057	2.62	0.112	<0.005	0.205
Total Phosphorus	mg/L as P	-	0.03	0.03	0.03	0.04	0.03	0.04	<0.0023	0.16	0.10	22.00	0.06	0.18	0.382	0.144	0.014	0.053	0.317	0.11
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	50	140	60	88	68	38	47	418	148	231	203	88	170	80	90	100	100	68
Biological Oxygen Demand	mg/L as O	-	-	-	-	-	-	-	-	-	-	55	6.4	7.2	-	-	-	-	-	-
TOTAL METALS																				
Aluminum [5]	mg/L	0.05	**0.29**	0.036	0.03	**1.9**	**0.28**	**0.24**	**0.18**	190	**0.66**	**1.2**	**0.233**	**0.763**	**0.28**	**0.087**	**0.089**	0.037	**0.056**	**0.129**
Iron	mg/L	1	**10.5**	**15.9**	**10.2**	**10.7**	**11.3**	**7.32**	**9.38**	**57.8**	**19.9**	**20.1**	**6.55**	**12**	**6.78**	**5.61**	0.952	0.275	**4.79**	**6.39**
Manganese [4]	mg/L	1.93	1.22	**2.43**	**2.02**	**2.58**	1.4	1.29	1.58	**3.74**	**2.35**	**1.98**	**3.0**	**2.4**	1.79	**3.05**	**2.65**	**2.26**	0.9	1.88

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW2-2014.xls]TableII

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 300 mg/L-$CaCO_3$
5. FWAL guideline for indicated parameter changes with pH < 6.5

TABLE IIIa
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-3

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	21-Feb-12	02-May-12	04-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	150	243	278	266	311	199	273	306	252	285	384	Not	265	284	289	223	236	242
Total Dissolved Solids	mg/L	-	212	368	390	438	520	326	376	502	482	574	626	Sampled	108	425	518	495	344	385
pH - Lab	pH	-	7.5	7.50	8.14	8.20	7.50	7.47	7.74	7.10	8.10	7.80	7.60	(Frozen)	7.46	7.96	8.18	7.90	7.34	7.15
pH - Field	pH	-	7.47	7.56	7.72	7.95	7.28	7.86	-	7.38	7.96	-	-		7.77	8.96	8.71	-	7.45	7.41
ORP - Lab	mv	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
ORP - Field	mv	-	-28.2	3.1	21.0	41.7	-62.8	24.0	-36.6	-112.4	8.0	-	-		-27.0	28.6	-87.5	-	-15.8	-
Conductivity - Lab	μS/cm	-	-	629	716	764	831	516	709	826	767	990	1205		737	821	955	877	621	586
Conductivity - Field	μS/cm	-	395	574	658	726	792	499	640	769	755	-	-		629	683	938	-	599	557
Temperature - Field	ºC	-	7.3	13.6	18.9	16.0	13.0	4.2	8.3	17.3	20.7	-	-		8.8	17.1	23.1	-	13.7	7.0
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	180	260	320	300	290	190	290	350	350	360	500		309	385	418	321	265	258
Chloride	mg/L	150	16.2	26.7	32.6	49.7	36.5	19.4	29.5	29.9	50.9	64	63		31.5	38.2	67.2	92.6	26.6	23
Sulphate[4]	mg/L	429	19.2	18.9	13.7	17.6	73.0	35.7	23.4	10.7	4.9	36.4	19.3		28.7	10.2	10.1	8.0	24.0	16.1
DISSOLVED CATIONS																				
Calcium	mg/L	-	50.1	82.3	93.4	81.2	104.0	67.4	90.1	105.0	77.7	89.8	123.0		91	92.8	83.6	54.6	79.9	76.5
Magnesium	mg/L	-	6	9.2	10.9	15.3	12.8	6.8	9.9	10.9	14.2	14.7	18.8		9.28	12.6	19.5	21	7.47	7.63
Potassium	mg/L	-	5.6	8.2	10.1	11.6	11.8	7.4	9.8	11.4	16.3	19.7	24.1		-	-	-	-	-	-
Sodium	mg/L	-	15.3	26.4	33.7	48.0	34.7	20.0	30.3	34.6	55.5	60.5	69.3		42.1	40.0	83.4	89.7	28.2	24.1
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	**6.97**	**8.0**	**7.3**	<0.01	**9.6**	**4.1**	**9.8**	**10.4**	**8.1**	**14.0**	**29.7**		**9.3**	**12.6**	**12.0**	**0.49**	**8.6**	**9.2**
Nitrate Nitrogen	mg/L as N	3.0	0.23	0.44	0.41	0.88	0.37	0.64	0.6	<0.05	<0.05	<0.05	0.22		0.258	0.295	0.746	0.976	<0.005	0.006
Total Phosphorus	mg/L as P	-	0.062	0.03	0.00	0.06	0.04	0.08	0.031	0.22	0.20	0.12	0.041		0.273	0.95	0.20	0.17	0.254	0.35
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	40	80	60	76	101	92	74	317	114	150	122		150	220	110	90	100	85
Biological Oxygen Demand	mg/L as O	-	<5.0	21	6.8	<5.0	>34	>39	20	180	19	16	6.3		<4	8	8	16	19	38

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW3-2014.xlsx]NON-VOLATILES

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed December. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 300 mg/L-$CaCO_3$

TABLE IIIb
METAL MONITORING DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-3

PARAMETERS	units	RECEIVING WATER CRITERIA Aquatic Life (FWAL)[1]	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
			21-Feb-12	02-May-12	04-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
TOTAL METALS																				
Aluminum	mg/L	0.05	**0.846**	**0.063**	0.04	**0.64**	**0.148**	**1.3**	**0.751**	**0.393**	**0.095**	**0.613**	**0.248**	Not Sampled	**0.628**	0.049	**0.074**	**0.064**	**0.17**	**3**
Arsenic	mg/L	0.005	0.0012	0.0007	0.0008	0.0012	0.00149	0.00106	0.00087	0.00109	0.0015	0.0029	0.0018		0.0012	0.0008	0.0012	0.001	0.0013	0.0024
Barium	mg/L	1.0	0.039	0.04	0.039	0.046	0.0783	0.0437	0.0536	0.0872	0.054	0.081	0.087		0.0542	0.051	0.0515	0.0471	0.0507	0.0607
Boron	mg/L	1.2	0.337	0.514	0.781	0.872	0.829	0.4	0.549	0.468	0.794	0.925	0.916		0.438	0.612	0.909	1.05	0.36	0.415
Cadmium	mg/L	0.000073	0.00003	0.00002	<0.00001	<0.00001	**0.00008**	**0.0001**	0.00003	0.00003	0.00001	0.00003	0.00002		0.00007	0.00003	<0.00001	<0.00001	0.00003	**0.00012**
Chromium	mg/L	0.001	**0.0018**	0.001	<0.0005	**0.0014**	**0.0017**	**0.0032**	**0.0016**	**0.0018**	**0.0011**	**0.0027**	**0.0017**		**0.0027**	**0.001**	**0.0009**	**0.0006**	**0.0045**	**0.0046**
Copper	mg/L	0.01	0.004	<0.001	0.002	0.001	0.0034	0.0044	0.002	0.0018	0.001	0.003	0.001		0.004	0.0009	0.0012	0.0007	0.0025	**0.0113**
Iron	mg/L	1	**5.36**	**3.72**	**1.76**	**2.92**	**9.06**	**5.38**	**7.47**	**29.8**	**11.9**	**11.6**	**7.12**		**5.69**	**5.22**	**2.72**	0.88	**4.7**	**18**
Lead	mg/L	0.014	0.0056	0.0002	<0.0001	0.0003	0.001	0.0011	0.0008	0.0004	0.0003	0.0005	0.0002		0.00071	<0.00005	<0.00005	<0.00005	0.00031	0.00388
Manganese	mg/L	1.7	1.21	1.27	0.442	0.284	**1.95**	1.05	1.55	**2.51**	1.16	1.65	**2.12**		1.59	1.25	0.619	0.055	1.21	1.46
Mercury	µg/L	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.10	<0.010	<0.01		<0.05	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	mg/L	0.025	0.003	0.003	0.0029	0.004	0.0066	0.005	0.0037	0.0034	0.004	0.007	0.006		0.0047	0.0032	0.0049	0.0047	0.003	0.0051
Selenium	mg/L	0.002	<0.0006	<0.0006	0.0003	0.0014	0.0002	0.0001	0.0003	0.0002	<0.0006	**0.0028**	**0.0026**		<0.0005	**0.0022**	0.0011	**0.0041**	0.0008	0.0015
Zinc	mg/L	0.13	0.024	0.012	0.005	0.006	0.047	0.0921	0.0224	0.0208	0.007	0.016	0.007		0.06	0.013	<0.005	<0.005	0.015	0.064
DISSOLVED METALS																				
Aluminum	mg/L	0.05	0.013	<0.005	0.004	0.005	**0.364**	0.011	0.007	<0.005	<0.005	<0.005	<0.005		0.009	0.006	0.009	0.006	0.02	0.007
Arsenic	mg/L	0.005	0.0005	0.0005	0.0008	0.0012	<0.2	0.0007	0.0005	0.0007	0.0012	0.0022	0.0013		0.0006	0.0007	0.0007	0.0008	0.0007	0.0008
Barium	mg/L	1.0	0.029	0.034	0.034	0.036	0.004	0.04	0.046	0.065	0.033	0.044	0.055		0.0386	0.04	0.0448	0.0325	0.0474	0.0406
Boron	mg/L	1.2	0.288	0.51	0.667	0.975	0.049	0.486	0.522	0.602	0.724	0.953	0.963		0.429	0.611	0.906	1.02	0.407	0.413
Cadmium	mg/L	0.000073	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00017**	0.00002	<0.00001	<0.00001	<0.00001	<0.00001		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Chromium	mg/L	0.001	**0.0026**	**0.0018**	<0.0005	**0.0025**	0.0006	**0.0016**	0.0007	**0.0024**	0.0008	**0.0023**	**0.0042**		**0.0014**	0.0006	0.0006	0.0006	**0.0013**	0.0005
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.003	<0.001	0.007	0.002	<0.001		0.0003	0.0019	0.0007	0.0004	0.0007	0.0004
Iron	mg/L	0.35	0.096	0.03	0.04	0.058	0.045	0.125	0.044	**3.83**	0.014	0.039	0.015		0.189	0.014	0.011	0.029	**3.25**	0.044
Lead	mg/L	0.014	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0002	<0.0001		<0.00005	0.00007	<0.00005	<0.00005	0.00008	<0.00005
Manganese	mg/L	1.7	1.05	0.817	0.298	0.137	1.69	0.983	1.43	**2.52**	0.756	0.0132	0.994		1.64	0.849	0.395	<0.001	1.17	1.24
Mercury	µg/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.01	<0.1	<0.01	<0.01		<0.05	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	mg/L	0.025	0.002	0.003	0.002	0.004	<0.001	0.0046	0.0036	0.004	**0.025**	0.006	0.006		0.0043	0.0035	0.0043	0.0037	0.0028	0.0025
Selenium	mg/L	0.002	<0.0006	<0.0006	<0.0002	<0.0006	<0.0006	<0.0002	<0.0002	<0.0006	<0.0006	0.0027	<0.0006		<0.0005	<0.0005	0.0009	<0.0005	0.0009	0.0008
Zinc	mg/L	0.13	0.002	0.002	0.002	<0.001	0.002	0.056	0.006	<0.001	0.005	0.002	0.002		0.008	0.003	<0.002	0.002	<0.002	<0.002

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW3-2014.xlsx]Metals

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed December 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for Al changes with pH
5. FWAL guideline for Cd, Cu, Pb, Mn, and Zn changes with hardness. Value shown appropriate for hardness of 250 mg/L-$CaCO_3$
6. Dissolved chromium concentrations exceeded the total concentrations in February, May and August 2012, and are considered to be sampling or analytical errors.

TABLE IV
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-4

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	21-Feb-12	2-May-12	4-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	134	272	380	305	324	339	328	450	505	370	540	432	434	580	621	-	381	-
Total Dissolved Solids	mg/L	-	170	414	560	530	540	70	582	872	934	638	846	644	620	835	1010	-	514	633
pH - Lab	pH	-	7.60	7.50	7.40	7.60	7.30	7.20	7.50	6.80	7.00	7.30	7.20	7.30	7.35	7.37	7.31	-	7.33	7.23
pH - Field	pH	-	7.28	7.69	7.32	7.03	7.22	7.78	-	7.17	7.36	-	-	7.44	7.70	7.55	7.55	-	7.20	7.38
ORP - Field	mv	-	-42.3	-96.2	-109.6	-41.0	-78.8	-51.4	-77.4	-110.4	-99.5	-	-	-52.3	-65.5	-133.4	-141.0	-	2.3	-
Conductivity - Lab	µS/cm	-	353	664	968	909	850	878	969	1241	1438	1165	1574	1213	1123	1550	1940	-	911	1020
Conductivity - Field	µS/cm	-	331	615	903	891	824	843	917	1140	1493	-	-	1096	944	1390	1866	-	872	979
Temperature - Field	ºC	-	7.4	12.0	13.3	15.6	13.1	4.9	9.2	16.3	18.0	-	-	6.4	9.4	14.2	15.0	-	14.1	8.9
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	140	280	640	340	300	300	370	530	640	510	680	550	487	746	995	-	391	446
Chloride	mg/L	150	12.8	22.6	39.9	52	36.6	35.7	40	46.5	71	61	75	58.7	44	64.7	96.2	-	34.1	38.6
Sulphate [5]	mg/L	429	18.8	31.7	11.8	54	87	89	53.0	26.3	32.6	22	65	32	55.7	17.3	5.4	-	47	49
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	**5.52**	**7.9**	**11.5**	1.26	**9.62**	**8**	**11.9**	**15.8**	**32.8**	**20**	**34.9**	**26.5**	**18.1**	**29.7**	**44**	-	**14.6**	**15**
Nitrate Nitrogen	mg/L as N	3.0	0.08	<0.05	<0.05	0.22	0.34	0.35	0.28	<0.05	<0.05	<0.05	0.13	0.22	0.335	0.009	<0.005	-	0.26	0.16
Total Phosphorus	mg/L as P	-	0.05	0.04	0.05	0.05	0.04	0.10	0.06	0.54	0.59	0.17	0.05	0.20	0.46	0.62	1.83	-	0.14	0.14
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	30	60	180	57	112	232	194	645	569	90	152	130	270	300	210	-	110	80
Biological Oxygen Demand	mg/L as O	-	-	-	-	-	-	-	-	-	-	5.5	11	38	-	-	-	-	-	-
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**1.2**	0.056	**0.21**	**1.34**	**0.187**	**0.324**	**0.198**	**0.178**	**0.519**	**0.359**	**0.245**	**0.348**	**0.214**	**0.071**	**2.05**	-	**0.077**	**1.17**
Iron	mg/L	1	**5.57**	**5.89**	**13.9**	**9.59**	**12.7**	**14.3**	**13.8**	**76.8**	**47.1**	**14.8**	**22.7**	**15.9**	**8.48**	**44.8**	**73.1**	-	**11.4**	**34.9**
Manganese [5]	mg/L	2.37	1.23	1.94	**2.96**	1.61	2.08	2.28	**2.57**	**4.02**	**3.99**	1.24	**3.07**	**2.42**	**2.44**	**4.6**	**3.85**	-	2.11	**2.94**

Notes:

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW4-2014.XLS]TableIV

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 400 mg/L-$CaCO_3$

TABLE V
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-5

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIODS (Not sampled in 2011)												CURRENT REPORTING PERIOD
		Aquatic Life (FWAL)[1]	6-Jan-10	3-Mar-10	27-Apr-10	30-Jun-10	18-Aug-10	13-Dec-10	21-Feb-12	02-May-12	03-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	Not Sampled in 2013 or 2014
PHYSICAL TESTS															
Total Hardness ($CaCO_3$)	mg/L	-	Not Sampled	9.1	13.8	Not Sampled	Not Sampled	Not Sampled	Not Sampled	52	14	Not Sampled	Not Sampled	Not Sampled	
Total Dissolved Solids	mg/L	-		25	44					106	40				
pH - Lab	pH	-		6.79	6.60					7.40	7.50				
pH - Field	pH	-		7.11	6.06					6.78	10.21				
ORP - Lab	mV	-		-	-					-	-				
ORP - Field	mV	-		142.3	132.4					93.4	66.6				
Conductivity - Lab	µS/cm	-		23	52					139	44				
Conductivity - Field	µS/cm	-		23.0	49.0					124	63				
Temperature - Field	ºC	-		8.8	10.3					16.2	20.3				
DISSOLVED ANIONS															
Alkalinity - Total	mg/L	-		8.40	9.3					-	-				
Chloride	mg/L	150		2.4	5.9					-	-				
Sulphate [5]	mg/L	309		1.5	1.6					-	-				
DISSOLVED CATIONS															
Calcium	mg/L	-		-	-					-	-				
Magnesium	mg/L	-		-	-					-	-				
Potassium	mg/L	-		-	-					-	-				
Sodium	mg/L	-		-	-					-	-				
NUTRIENTS															
Ammonia Nitrogen	mg/L as N	1.84		< 0.01	0.03					0.03	<0.01				
Nitrate Nitrogen	mg/L as N	3.0		< 0.05	0.06					-	-				
Total Phosphorus	mg/L as P	-		0.04	0.01					0.021	0.074				
ORGANIC PARAMETERS															
Chemical Oxygen Demand	mg/L as O	-		-	0					-	-				
Biological Oxygen Demand	mg/L as O	-		-	0					-	-				
TOTAL METALS															
Aluminum [4]	mg/L	0.05		**2.36**	**0.68**					**0.526**	**0.815**				
Iron	mg/L	1		**3.51**	0.878					**1.1**	**1.16**				
Manganese [5]	mg/L	1.05		0.042	0.017					0.108	0.025				

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW5-2014.xlsx]TableV

Notes:
1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed December 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 100 mg/L-$CaCO_3$

TABLE VI
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-6

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	20-Feb-12	02-May-12	03-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	52.6	110.0	153	Not Sampled	149.0	106	138.0	190.0	263	207	158.0	218	127.0	212.0	Not Sampled	Not Sampled	91.9	-
Total Dissolved Solids	mg/L	-	94	196	250		290	158	236	260	366	422	280	340	203	323			170	233
pH - Lab	pH	-	7.30	6.80	7.40		7.20	7.10	7.30	7.20	6.90	6.80	7.20	7.50	7.33	7.66			7.12	6.89
pH - Field	pH	-	7.17	6.46	7.79		7.05	7.76	-	7.50	7.29	-	-	7.72	7.15	7.08			7.22	7.26
ORP - Field	mV	-	80.6	93.2	69.7		162.6	80.1	56.4	67.6	81.0	-	-	16.8	39.3	6.0			105.4	-
Conductivity - Lab	µS/cm	-	152	307	411		416	280	402	480	546	617	474	577	362	569			289	317
Conductivity - Field	µS/cm	-	141	270	376		385	255	379	445	531	-	-	513	301	478			271	309
Temperature - Field	ºC	-	6.5	8.6	13.9		10	4.2	6.3	11.5	15.8	-	-	3.8	4.6	11.1			12	7.3
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	-	-	-		-	-	-	-	-	70.0	130	220	137	251			106	110
Chloride	mg/L	150	-	-	-		-	-	-	-	-	44.4	41.3	37.9	24	30.4			20.2	19
Sulphate [4]	mg/L	309	-	-	-		-	-	-	-	-	139	35.8	7.7	10.4	3.2			9.1	11.2
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	0.04	0.01	<0.01		<0.01	0.33	1.13	**2.56**	**1.86**	0.06	0.07	**3.26**	1.31	**3.0**			**1.9**	0.79
Nitrate Nitrogen	mg/L as N	3	-	-	-		-	-	-	-	-	2.33	0.37	**5.02**	2.14	2.47			0.295	2.59
Total Phosphorus	mg/L as P	-	0.028	0.007	0.056		0.026	0.014	<0.003	0.027	0.041	0.009	0.067	0.015	0.025	0.029			0.017	<0.005
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**1.48**	**0.082**	**0.05**		**0.22**	**0.42**	**0.403**	0.033	**0.11**	**0.13**	**9.42**	**0.18**	**0.325**	**0.104**			**0.35**	**0.26**
Iron	mg/L	1.0	**1.35**	0.105	0.26		0.51	0.70	0.71	0.223	**8.37**	0.52	**17.80**	0.32	0.48	0.359			0.52	0.39
Manganese [5]	mg/L	1.05	0.03	0.008	0.01		0.02	0.01	0.07	**2.92**	**9.73**	0.08	**1.50**	0.07	0.01	0.173			0.02	0.06

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW6-2014.XLS]TableVI

Notes:
1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 100 mg/L-$CaCO_3$

TABLE VIIa
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-7

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	21-Feb-12	2-May-12	3-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	10	10	12	Not	10	11	14	21	29	22	29	21	17.6	19.6	30.8	Not	49.6	50.7
Total Dissolved Solids	mg/L	-	25	62	20	Sampled	58	78	40	46	88	80	82	64	55	55	115	Sampled	97	110
pH - Lab	pH	-	6.2	6.06	6.55		5.9	6.35	6.68	6.2	6.1	6.1	6	6.1	6.46	6.42	6.48		6.99	6.67
pH - Field	pH	-	7.95	6.64	7.85		6.31	6.23	-	6.16	6.77	-	-	5.92	7.31	6.61	6.36		6.13	7.36
ORP - Lab	mV	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-		-	-
ORP - Field	mV	-	136.5	109.6	129		219.4	165	152.6	211.7	160.9	-	-	100.6	88.2	53.9	158		135.9	-
Conductivity - Lab	µS/cm	-	50.2	49	58		57	52	70	88	114	112	140	101	78	93	134		167	160
Conductivity - Field	µS/cm	-	122	44	50		51	47	77	94	128	-	-	87	62	79	57.8		148	146
Temperature - Field	ºC	-	6.55	7.8	10.86		9.86	4.81	6.07	7.03	11.84	-	-	3.75	5.27	8.89	11.63		12.29	7.28
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	<20	<20	<20		<20	<20	<20	24	28	<20	22	50	12	24	29		62	54
Chloride	mg/L	150	6.8	6.9	7.5		7.7	7.3	9	10.5	17	15	23.7	16.4	10.3	12.5	22.3		10.9	12.6
Sulphate [4]	mg/L	128	1.3	1.1	1		3.3	2.8	2	1	1	6.9	0.5	1.8	2.2	1	0.6		2	5.1
DISSOLVED CATIONS																				
Calcium	mg/L	-	2.5	2.5	3.1		2.51	2.7	3.4	5.51	<0.10	5.54	7.03	5.23	4.75	4.99	7.77		15.1	14.9
Magnesium	mg/L	-	0.9	0.9	1.1		0.92	0.9	1.3	1.7	<0.1	1.96	2.75	2.05	1.39	1.74	2.77		2.66	2.78
Potassium	mg/L	-	0.5	0.4	<0.4		0.4	0.6	0.6	1	0.1	0.6	0.9	0.8	-	-	-		-	-
Sodium	mg/L	-	4.7	4.8	6.2		5.4	5.7	6.8	7.5	<0.1	9.1	13.7	9.5	7.35	9.35	13.1		10.4	11.3
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	0.05	<0.01	0.04		<0.01	<0.01	0.16	0.02	0.03	0.04	0.04	0.03	0.07	<0.01	0.08		1.5	0.77
Nitrate Nitrogen	mg/L as N	3.0	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	0.06	0.142	0.018	0.014		0.01	0.396
Total Phosphorus	mg/L as P	-	0.008	0.006	0.028		0.013	0.007	<0.003	0.48	0.012	<0.003	0.006	0.008	0.015	0.059	< 0.005		0.011	<0.005
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	20	20	20		34	15	16	22	22	22	35	13	20	30	40		40	29
Biological Oxygen Demand	mg/L as O	-	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	53	6	13		<4	<4

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW7-2014.XLS]NON-VOLATILES

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH

TABLE VIIb
METALS MONITORING DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-7

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	21-Feb-12	2-May-12	3-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**0.205**	**0.251**	**0.25**	Not Sampled	**0.364**	**0.299**	**0.224**	**0.153**	**0.28**	**0.204**	**0.234**	**0.168**	**0.236**	**0.35**	**0.55**	Not Sampled	**0.231**	**0.115**
Arsenic	mg/L	0.005	<0.0002	<0.0002	<0.0002		0.00015	0.00018	0.00021	0.00016	0.0004	0.0003	0.0006	0.00014	0.0002	0.0002	0.0007		0.0003	0.0002
Barium	mg/L	1.0	0.004	<0.001	0.004		0.00426	0.00328	0.00468	0.00508	0.006	0.006	0.007	0.00544	0.0041	0.0502	0.0091		0.008	0.007
Boron	mg/L	1.2	0.035	0.033	0.045		0.053	0.032	0.037	0.036	0.062	0.111	<0.0010	<0.0001	0.043	0.055	0.087		0.084	0.099
Cadmium [5]	mg/L	0.000012	<0.00001	<0.00001	<0.00001		**0.00002**	<0.00001	<0.00001	0.00001	**0.00002**	0.00001	**0.00002**	<0.00001	<0.00001	0.00001	**0.00002**		<0.00001	0.00001
Chromium	mg/L	0.001	0.0009	0.0005	0.0008		0.0007	0.0006	<0.0005	<0.0005	0.0007	0.0008	0.0007	0.0006	<0.0005	0.0007	**0.0012**		0.0009	0.0006
Copper [5]	mg/L	0.0012	<0.001	<0.001	<0.001		0.0009	0.0008	0.0006	0.0007	0.001	<0.001	<0.001	<0.0001	0.0007	0.0009	**0.0014**		0.0009	0.0006
Iron	mg/L	1	0.327	0.273	0.52		0.269	0.222	0.367	0.337	**1.46**	0.609	**4.7**	0.671	0.245	**1.02**	**6.25**		0.563	0.225
Lead [5]	mg/L	0.0040	0.0002	<0.0001	<0.0001		<0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001	0.0001	<0.00005	0.00011	0.00015		0.00009	0.00006
Manganese [5]	mg/L	0.83	0.0015	0.0012	0.004		0.0199	0.0146	0.0672	0.0429	0.229	0.125	0.519	0.102	0.018	0.087	**0.879**		0.196	0.051
Mercury	µg/L	0.02	<0.00001	<0.01	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01	<0.05	**0.02**	**0.02**		<0.01	<0.01
Nickel	mg/L	0.025	<0.001	<0.001	<0.0005		0.0007	0.0005	0.0004	0.0008	0.001	<0.001	0.001	0.0007	<0.0005	0.0007	0.0015		0.0007	0.0007
Selenium	mg/L	0.002	<0.0006	<0.0006	<0.0002		0.0001	0.0002	<0.0001	0.0001	<0.0006	<0.0006	0.0007	<0.0001	<0.0005	0.0005	<0.0005		<0.0005	0.0009
Zinc [5]	mg/L	0.0075	0.006	0.002	0.003		0.0029	0.0025	0.0022	0.0032	**0.012**	0.004	**0.015**	0.0039	<0.005	<0.005	0.007		<0.005	<0.005
DISSOLVED METALS																				
Aluminum [4]	mg/L	0.05	**0.217**	**0.196**	**0.166**		0.006	**0.249**	**0.156**	**0.116**	**0.095**	**0.126**	**0.058**	**0.084**	**0.178**	**0.101**	**0.087**		**0.166**	**0.08**
Arsenic	mg/L	0.005	<0.0002	<0.0002	0.0002		0.0012	<0.0002	0.0002	<0.0002	0.0003	0.0004	0.0004	<0.0002	<0.0001	<0.0001	0.0005		0.0003	0.0001
Barium	mg/L	1.0	0.003	0.002	0.004		0.06	0.004	0.006	0.004	0.005	0.006	0.006	0.005	0.0032	0.0012	0.0077		0.0081	0.0064
Boron	mg/L	1.2	0.033	0.029	0.04		0.903	0.044	0.039	0.042	0.053	0.106	0.072	0.051	0.036	0.047	0.075		0.085	0.101
Cadmium [5]	mg/L	0.000012	<0.00001	<0.00001	<0.00001		<0.00001	**0.00004** [6]	**0.00002**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001		<0.00001	<0.00001
Chromium	mg/L	0.001	0.0005	0.0006	<0.5		**0.0022**	0.0006	<0.0005	0.0005	0.0005	0.0007	0.0006	0.0005	<0.0005	<0.0005	<0.0005		0.0006	<0.0005
Copper [5]	mg/L	0.0012	<0.001	<0.001	<0.001		<0.001	**0.002**	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0041**	**0.0021**	0.0009		0.0009	0.0004
Iron	mg/L	0.35	0.129	0.189	0.212		0.191	0.114	0.216	0.211	<0.005	0.281	**0.958**	**0.351**	0.124	0.238	**1.08**		0.323	0.116
Lead [5]	mg/L	0.0040	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.00005	0.0001	0.00012		0.00015	<0.00005
Manganese [5]	mg/L	0.83	0.008	0.01	0.023		0.0112	0.01	0.044	0.0214	<0.001	0.0185	0.198	0.02	0.012	0.031	0.177		0.106	0.042
Mercury	µg/L	0.02	<0.01	<0.01	<0.1		<0.1	<0.1	<0.1	<0.01	<0.1	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01		<0.01	<0.01
Nickel	mg/L	0.025	<0.001	<0.001	0.0005		0.007	0.0007	0.0007	<0.001	0.001	<0.001	0.001	0.001	0.0004	0.0006	0.0011		0.0006	0.0006
Selenium	mg/L	0.002	<0.0006	<0.0006	<0.0002		<0.0006	<0.0002	<0.0002	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0005	0.0005	<0.0005		<0.0005	0.0007
Zinc [5]	mg/L	0.0075	0.003	0.001	0.002		**0.009** [6]	0.007 [6]	0.003	0.002	**0.008**	0.003	0.01	0.003	0.002	0.005	0.004		<0.002	<0.002

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW7-2014.XLS]Metals

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 30 mg/L-$CaCO_3$
6. These values exceed the total concentrations, and are considered to be sampling or analytical errors.

TABLE VIII
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-8

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	21-Feb-12	2-May-12	03-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	122	146	Not Sampled	Not Sampled	132	144	144	205	197	163	187	173	195	204	Not Sampled	Not Sampled	212	333
Total Dissolved Solids	mg/L	-	174	254			244	206	234	276	338	332	336	266	275	273			283	338
pH - Lab	pH	-	7.60	7.20			7.1	7.3	7.30	7.30	7.20	6.90	7.1	7.4	7.63	7.57			7.6	7.2
pH - Field	pH	-	8.10	7.82			6.99	7.60	-	7.63	7.35	-	-	7.23	7.21	7.15			7.91	7.40
ORP - Field	mV	-	46.4	47.0			137.2	141.8	155.2	12.3	48.9	-	-	93.9	69.3	54			-19.3	-
Conductivity - Lab	µS/cm	-	320	376			369	346	403	496	508	508	511	442	523	515			587	499
Conductivity - Field	µS/cm	-	285	327			340	321	375	478	501	-	-	382	443	439			548	458
Temperature - Field	ºC	-	6.3	9.8			10.2	3.3	6.4	15.7	13.4	-	-	3.8	5.8	12.4			12.7	7.2
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	110	140			100	120	150	230	210	78	160	100	218	241			262	207
Chloride	mg/L	150	16.0	20.0			23.2	18.6	19.9	21.1	34.8	43.8	35.5	29.8	27.9	25.3			25.8	22.8
Sulphate [5]	mg/L	429	10.6	12.1			39.5	24.1	12.6	<0.5	8.3	98.0	40.0	7.1	13.6	0.5			10.7	12.7
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	0.72	0.34			0.09	0.94	1.28	**2.33**	0.81	0.05	0.13	0.68	**3.80**	0.18			**7.30**	**5.90**
Nitrate Nitrogen	mg/L as N	3.0	1.82	1.02			0.99	1.53	1.14	0.22	0.330	0.140	0.45	2.00	1.03	0.75			0.01	0.97
Total Phosphorus	mg/L as P	-	0.02	0.01			0.01	0.06	<0.003	0.03	0.05	0.01	0.21	0.04	0.03	0.05			0.05	0.02
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	30	30			44	74	31	52	66	51	258	40	40	70			80	48
Biological Oxygen Demand	mg/L as O	-	-	-			-	-	-	-	-	<5.0	11	7.4	-	-			-	-
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**0.24**	0.048			**0.109**	**0.86**	**0.076**	0.035	**0.07**	**0.13**	**7.17**	**0.335**	0.049	**0.264**			**0.074**	**0.186**
Iron	mg/L	1.0	0.474	0.217			0.306	**2.84**	0.222	0.6	**2.04**	**1.08**	**35.8**	**1.7**	0.515	**4.69**			**2.24**	**6.48**
Manganese [5]	mg/L	1.85	0.077	0.054			0.054	0.447	0.0978	**4.42**	0.89	0.462	**8.84**	0.645	0.092	**3.72**			**6.48**	**1.37**

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW8-2014.xlsx]TableVIII

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 200 mg/L-$CaCO_3$

TABLE IX
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-9

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	21-Feb-12	2-May-12	3-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	190	222	Not Sampled	Not Sampled	211	197	194	268	202	269	Not Sampled	299	237	277	Not Sampled	Not Sampled	125	-
Total Dissolved Solids	mg/L	-	244	356			366	280	316	418	432	548		434	328	370			203	320
pH - Lab	pH	-	7.80	7.80			7.60	7.70	7.80	7.50	7.30	7.00		7.80	7.84	7.76			7.54	6.98
pH - Field	pH	-	8.02	7.73			7.31	8.18	-	7.78	7.49	-		7.69	7.74	7.76			7.82	7.55
ORP - Field	mV	-	58.8	47.8			132.0	77.5	138.2	-144.5	21	-		102.2	-51.5	30.5			31.8	-
Conductivity - Lab	µS/cm	-	485	570			565	526	543	730	710	755		774	637	755			363	423
Conductivity - Field	µS/cm	-	441	513			529	498	505	691	708	-		689	776	648			334	401
Temperature - Field	ºC	-	6.5	10.0			10.6	3.4	7.0	12.5	14.2	-		2.7	5.4	13.1			12.1	7.0
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	190	230			190	210	230	350	240	62		400	285	378			122	146
Chloride	mg/L	150	21.8	25.7			31.0	20.3	23.2	26.6	43.2	50.4		45.3	30.0	33.7			18.3	21.4
Sulphate[5]	mg/L	429	15.9	17.4			49.9	34.9	6.0	5.2	84.0	**213.0**		5.7	13.7	<0.5			24.3	16.8
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	**5.38**	**4.20**			1.42	**4.21**	**5.28**	**5.96**	**4.91**	0.06		**8.60**	**6.90**	**9.80**			0.43	0.31
Nitrate Nitrogen	mg/L as N	3.0	1.74	1.93			2.03	0.32	0.29	<0.05	0.11	1.98		2.78	0.45	0.24			2.05	**5.12**
Total Phosphate	mg/L as P	-	0.07	0.03			0.03	0.11	0.00	0.11	0.11	0.03		0.02	0.07	0.07			0.07	0.31
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	60	50			50	109	40	178	86	52		54	60	100			60	255
Biological Oxygen Demand	mg/L as O	-	-	-			-	-	-	-	-	<5.0		<5.0	-	-			-	-
TOTAL METALS																				
Aluminum[4]	mg/L	0.05	**1.47**	0.047			**0.144**	**0.71**	**0.65**	**0.24**	**0.08**	**0.09**		0.024	**0.062**	**0.087**			**0.109**	**2.5**
Iron	mg/L	1.0	**4.51**	0.97			0.964	**4.36**	**2.91**	**10.8**	**1.11**	**1.63**		0.787	**1.06**	**17.8**			**2.49**	**66.2**
Manganese[5]	mg/L	1.85	**2.91**	0.189			0.0898	**2.86**	**2.23**	**23.7**	0.334	0.589		0.462	0.424	**13.7**			**1.64**	**33.2**

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW9-2014.xlsx]TABLEIX

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 200 mg/L-$CaCO_3$

TABLE Xa

WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-10

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
			U/S SANDHILL CREEK												U/S SANDHILL CREEK					
		Aquatic Life (FWAL)[1]	20-Feb-12	2-May-12	4-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	17	13.0	13.0	69.0	16.0	24	24	45.0	48.0	27.0	51.0	48	24	33.6	42.8	36.6	12.4	35.3
Total Dissolved Solids	mg/L	-	60	74	42	216	98	106	48	80	124	96	126	118	93	75	103	97	57	81
pH - Lab	pH	-	6.8	6.21	6.20	6.80	6.00	6.73	6.66	6.80	6.70	6.20	6.80	7	6.59	6.93	6.91	6.70	6.19	6.44
pH - Field	pH	-	7.46	7.05	7.26	5.42	6.47	7.03	-	7.52	7.42	-	-	7.68	7.17	8.22	7.25	-	7.22	7.34
ORP - Lab	mV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ORP - Field	mV	-	131.7	119.2	146.0	251.3	188.7	124.3	134.7	94.9	84.8	-	-	62.8	52.8	32.2	-176.0	-	107.3	-
Conductivity - Lab	µS/cm	-	74	61	66	279	75	83	91	148	182	126	203	163	93	129	167	171	54	122
Conductivity - Field	µS/cm	-	71	31	59	271	71	87	86	140	180	-	-	157	75	102	162	-	56.0	113
Temperature - Field	ºC	-	5.8	7.2	10.3	12.0	9.7	4.7	5.8	6.8	11.6	-	-	3.7	4.7	8.3	10.4	-	11.6	7.5
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	<20	<20	<20	48	<20	<20	22	44	38	<20	38	40	21	38	38	27	9	28
Chloride	mg/L	150	10.1	9.2	10.8	38.9	9.3	8.2	10.7	14.3	22	16.6	28.8	20.4	12	15.2	26.8	33.9	6.9	12.2
Sulphate [5]	mg/L	100	2.9	2.2	2	23	5.6	5.5	3.6	2.9	15	16	11	4.1	3.1	2.5	<0.5	1.1	1.9	5
DISSOLVED CATIONS																				
Calcium	mg/L	-	4.5	3.5	-	19	4.12	6.9	6.9	13.6	14	7.07	14	13.7	6.83	9.91	12	9.4	3.06	10.7
Magnesium	mg/L	-	1.3	1.1	-	5.25	1.3	1.5	1.8	2.72	3.27	2.35	3.96	3.31	1.68	2.15	3.12	3.19	0.962	2.16
Potassium	mg/L	-	0.7	0.4	-	2.7	0.6	0.9	0.9	1.6	1.7	0.9	2.1	2						
Sodium	mg/L	-	6.6	6.2	-	25.5	6.7	6.6	8.4	10.9	14.8	10.5	18.3	14.3	8.15	11	15.7	18.4	5.84	9.83
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	0.04	<0.01	0.05	0.13	0.07	0.09	0.25	0.08	0.05	0.04	<0.02	0.12	0.04	0.04	0.01	0.02	0.11	< 0.01
Nitrate Nitrogen	mg/L as N	3.0	0.45	0.17	0.07	1.22	0.16	0.37	0.47	0.2	0.24	0.18	0.47	0.82	0.584	0.558	0.064	0.067	0.089	1.01
Total Phosphorus	mg/L as P	-	0.013	0.01	0.01	0.02	0.01	0.006	<0.003	0.01	0.01	0.01	0.01	0.009	0.017	0.02	0.01	0.04	0.01	<0.005
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	30	30	40	37	60	28	27	23	26	55	<10	23	30	20	30	40	60	16
Biological Oxygen Demand	mg/L as O	-	<5.0	<5.0	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<4	<4	<4	8	<4	<4

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW10-2014.xlsx]NON-VOLATILES

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed December 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. Sample exceeded holding time for measurement of ammonia nitrogen.
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 30 mg/L-$CaCO_3$

TABLE Xb
METAL MONITORING DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-10

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	20-Feb-12	2-May-12	4-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**0.286**	**0.251**	**0.45**	**0.152**	**0.468**	**0.234**	**0.286**	**0.222**	**0.05**	**0.444**	**0.205**	**0.253**	**0.244**	**0.184**	**0.196**	**0.52**	**0.424**	**0.228**
Arsenic	mg/L	0.005	<0.0002	<0.0002	-	0.0007	0.00014	0.00014	0.00012	0.00014	0.0002	0.0003	0.0003	0.00014	0.0002	0.0001	0.0002	0.0004	0.0002	<0.0001
Barium	mg/L	1.0	0.004	<0.001	-	0.006	0.00479	0.00359	0.00449	0.00695	0.007	0.007	0.008	0.00714	0.0048	0.0053	0.0063	0.0083	0.0038	0.0056
Boron	mg/L	1.2	0.048	0.035	-	0.379	0.055	0.043	0.053	0.081	0.16	0.102	0.137	0.072	0.043	0.07	0.093	0.055	0.031	0.072
Cadmium [5]	mg/L	0.000012	<0.00001	<0.00001	-	<0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	0.00001	<0.00001	<0.00001
Chromium	mg/L	0.001	0.0009	<0.0004	-	0.0006	0.0006	<0.0005	<0.0005	0.0005	0.0006	<0.0004	0.0006	<0.0005	<0.0005	<0.0005	0.0005	0.0009	0.0006	<0.0005
Copper [5]	mg/L	0.0012	<0.001	<0.001	-	<0.001	0.0008	0.001	0.0009	0.0008	<0.001	<0.001	<0.001	0.0011	0.0007	0.0006	0.001	**0.0012**	0.0008	0.0007
Iron	mg/L	1	0.184	0.198	0.45	0.915	0.373	0.221	0.223	0.275	0.461	0.571	0.488	0.343	0.263	0.295	0.622	**1.66**	0.357	0.267
Lead [5]	mg/L	0.0040	0.0002	<0.0001	-	0.0001	0.0002	0.0001	0.0002	0.0001	<0.0001	0.0002	<0.0001	0.0001	0.00008	<0.00005	<0.00005	0.00021	0.00018	0.00007
Manganese [5]	mg/L	0.83	0.005	<0.005	0.01	0.232	0.01	0.0126	0.0073	0.0418	0.0258	0.0349	0.0206	0.014	0.014	0.016	0.15	0.342	0.01	0.01
Mercury	µg/L	0.02	<0.01	<0.01	-	<0.010	<0.1	<0.1	<0.1	<0.1	<0.1	0.011	<0.01	<0.01	<0.05	0.01	0.01	0.01	<0.01	<0.01
Nickel	mg/L	0.025	<0.001	<0.001	-	0.002	0.0006	0.0005	0.0006	0.0006	0.001	0.001	<0.001	0.0008	<0.0005	0.0006	0.0009	0.0012	<0.0005	0.0007
Selenium	mg/L	0.002	<0.0006	<0.0006	-	0.0008	0.0002	<0.0001	0.0001	0.0002	<0.0006	<0.0006	<0.0006	<0.0001	<0.0005	0.0008	0.0005	0.0011	<0.0005	0.0007
Zinc [5]	mg/L	0.0075	0.002	0.001	-	0.003	0.0022	0.0022	0.0014	0.0015	0.001	0.003	0.002	0.0019	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
DISSOLVED METALS																				
Aluminum [4]	mg/L	0.05	**0.193**	**0.185**	**-**	0.038	**0.38**	**0.174**	**0.188**	**0.12**	**0.091**	**0.355**	**0.073**	**0.128**	**0.147**	**0.13**	**0.077**	**0.111**	**0.301**	**0.128**
Arsenic	mg/L	0.005	<0.0002	<0.0002	-	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0003	0.0002	<0.0002	<0.0001	<0.0001	<0.0001	0.0003	<0.0001	0.0002
Barium	mg/L	1.0	0.003	0.002	-	0.005	0.004	0.004	0.005	0.005	0.006	0.006	0.007	0.006	0.0036	0.005	0.0069	0.0049	0.0032	0.005
Boron	mg/L	1.2	0.044	0.033	-	0.418	0.047	0.049	0.05	0.094	0.153	0.102	0.137	0.074	0.038	0.062	0.09	0.053	0.032	0.073
Cadmium [5]	mg/L	0.000012	<0.00001	<0.00001	-	<0.00001	<0.00001	<0.00001	**0.00002**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Chromium	mg/L	0.001	0.0004	<0.0004	-	0.0006	0.0006	<0.0005	<0.0005	0.0005	0.0005	<0.0004	0.0005	0.0006	<0.0005	<0.0005	<0.0005	0.0007	<0.0005	<0.0005
Copper [5]	mg/L	0.0012	<0.001	<0.001	-	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0005	**0.0013**	0.0005	0.001	0.001	0.0005
Iron	mg/L	0.35	0.128	0.138	**-**	**0.39**	0.253	0.119	0.14	0.136	0.184	**0.389**	0.177	0.189	0.109	0.161	0.19	**0.624**	0.243	0.117
Lead [5]	mg/L	0.0040	<0.0001	<0.0001	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	0.00008	0.00008	<0.00005	0.0001	0.00013	<0.00005
Manganese [5]	mg/L	0.83	0.002	<0.001	-	0.177	0.0042	<0.005	0.006	0.0099	0.0045	0.0246	0.012	0.005	0.007	0.007	0.025	0.192	0.007	0.008
Mercury	µg/L	0.02	<0.01	<0.01	-	0.01	<0.01	<0.1	<0.1	<0.01	<0.1	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	**0.02** [6]	0.01	0.01
Nickel	mg/L	0.025	<0.001	<0.001	-	0.002	<0.001	<0.0005	0.001	<0.001	0.001	0.001	0.001	<0.001	0.0004	0.0007	0.0007	0.0011	0.0002	0.0007
Selenium	mg/L	0.002	<0.0006	<0.0006	-	<0.0006	<0.0006	<0.0002	<0.0002	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0005	<0.0005	0.001 [6]	<0.0005	<0.0005	<0.0005
Zinc [5]	mg/L	0.0075	0.002	<0.001	-	<0.001	0.001	0.003	0.003	<0.001	0.001	0.002	0.001	<0.001	<0.002	0.002	<0.002	<0.002	<0.002	<0.002

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Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed December 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 30 mg/L-$CaCO_3$
6. These values exceed the total concentrations, and are considered to be sampling or analytical errors.

TABLE XIa
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-11

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[2]	20-Feb-12	2-May-12	3-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	64	60	60	158	42	31	38	44	71	76	132	72	25.5	49	79.6	90.9	89.6	35.6
Total Dissolved Solids	mg/L	-	148	146	144	368	144	100	66	100	190	198	280	180	80	120	205	170	161	155
pH - Lab	pH	-	7	6.7	6.8	6.9	6.3	6.7	6.7	6.4	6.5	6.8	6.6	6.7	6.3	6.7	7.0	6.4	6.9	6.5
pH - Field	pH	-	5.9	6.7	7.4	5.1	6.6	6.9	-	6.7	7.3	-	-	6.8	7.2	6.9	7.0	-	6.8	7.2
ORP - Lab	mV	-	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-	
ORP - Field	mV	-	51.4	33.1	40.4	12.5	114.4	75.9	81.8	51.6	-0.6	-	-	41.4	53.8	34.6	-175.6	-	97.1	-
Conductivity - Lab	µS/cm	-	227	201	212	540	176	122	160	174	290	333	484	279	109	197	329	375	280	183
Conductivity - Field	µS/cm	-	223	184	194	531	159	120	149	162	307	-	-	255	93	179	162	-	263	167
Temperature - Field	ºC	-	5.9	7.6	12.9	12.5	9.7	5.1	6.2	11.9	12.4	-	-	3.7	5.5	9.2	7.3	-	12.0	7.2
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	66	74	68	180	36	26	36	46	88	90	170	<20	26	60	91	102	97	52
Chloride	mg/L	150	20.3	17.9	17.7	62	20.8	14	19	19.3	36.1	37	48.5	35.2	14.1	22.6	45.1	54.2	19.5	20.5
Sulphate [4]	mg/L	218	5.1	3.8	3	1.3	13.2	6	6.4	4.5	2.7	9.9	5.5	6.8	4.3	3.8	2.1	0.8	13.2	4.7
DISSOLVED CATIONS																				
Calcium	mg/L	-	18.7	17.6	17.3	45.9	11.9	8.3	10.7	12.4	20	20.8	36.2	20.3	6.96	13.5	21.8	25.6	26.9	14.7
Magnesium	mg/L	-	4.3	4	3.9	10.5	3.07	2.1	2.8	3.18	5	5.86	10.2	5.21	1.96	3.71	6.12	6.54	4.75	3.57
Potassium	mg/L	-	2.7	2.3	2.4	5.8	2.3	1.6	1.9	2.1	3.2	3.6	5.4	3	-	-	-	-	-	-
Sodium	mg/L	-	16.4	15.6	16.4	45.4	16.6	48	15.8	15	28.2	30	45	27.9	10.7	18.8	50.5	33.8	16.9	16.1
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	1.02	0.73	0.63	1.46	0.09	0.17	0.24	0.19	0.40	1.12	**2.10**	0.75	0.17	0.37	0.68	**2.10**	1.83	0.87
Nitrate Nitrogen	mg/L as N	3.0	0.38	0.25	0.26	<0.05	0.41	0.26	0.26	0.09	<0.05	0.34	<0.05	<0.05	0.24	0.099	<0.005	<0.005	0.042	0.204
Total Phosphorus	mg/L as P	-	0.019	0.023	17.5	0.039	13.3	0.00	40	0.034	0.039	0.009	0.016	0.02	0.047	0.054	0.054	0.085	0.064	0.02
ORGANIC PARAMETERS																				
Chemical Oxygen Demand	mg/L as O	-	40	40	60	73	51	32	32	37	48	54	106	39	40	40	50	90	60	37
Biological Oxygen Demand	mg/L as O	-	<5.0	<5.0	<5.0	5.3	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<4	<4	16	10	10	<4

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW11-2014.xlsx]NON-VOLATILES

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed February 2012. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH

TABLE XIb
METAL MONITORING DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-11

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	20-Feb-12	2-May-12	4-Jul-12	28-Aug-12	30-Oct-12	20-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**0.108**	**0.408**	**0.504**	**0.13**	**0.596**	**1.08**	**0.805**	**0.532**	**0.081**	**0.307**	**0.116**	**0.192**	**0.585**	**0.304**	**0.177**	**0.361**	**0.421**	**0.398**
Arsenic	mg/L	0.005	0.0005	0.0004	0.0008	0.0014	0.00038	0.0004	0.00035	0.00044	0.0009	0.001	0.0015	0.00045	0.0004	0.0005	0.0008	0.0027	0.0007	0.0004
Barium	mg/L	1.0	0.012	0.007	0.012	0.038	0.0121	0.00952	0.011	0.011	0.019	0.018	0.033	0.0148	0.0093	0.0118	0.0259	0.0507	0.0192	0.0127
Boron	mg/L	1.2	0.185	0.164	0.246	0.379	0.226	0.097	0.122	0.118	0.267	0.359	0.38	0.216	0.07	0.15	0.311	0.205	0.194	0.138
Cadmium [5]	mg/L	0.000021	0.00001	0.00002	<0.00001	<0.00001	0.00002	0.00001	<0.00001	0.00001	0.00001	0.00002	0.00001	<0.00001	0.00001	0.00001	<0.00001	<0.00001	**0.00005**	0.00002
Chromium	mg/L	0.001	**0.0014**	**0.0011**	**0.0014**	**0.0012**	**0.0013**	**0.0018**	**0.0014**	**0.0013**	**0.0011**	**0.0016**	**0.001**	**0.0012**	**0.0011**	**0.0012**	**0.0011**	**0.0017**	**0.0022**	0.0009
Copper [5]	mg/L	0.0024	0.002	0.001	0.001	<0.001	0.0016	0.0015	0.0012	0.0011	<0.001	0.001	<0.001	0.0003	0.0017	0.0009	0.0007	0.0009	0.0026 [7]	0.0012
Iron	mg/L	1	**2.68**	**2.62**	**3.67**	**15.9**	**2.12**	**2.33**	**2.64**	**4.12**	**11.4**	**5.26**	**21.8**	**6.7**	**1.89**	**6.01**	**17**	**49.2**	**2.47**	**3.13**
Lead [5]	mg/L	0.0050	0.0004	0.0001	0.0002	0.0001	0.0002	0.0003	0.0003	0.0002	0.0001	0.0002	<0.0001	0.0001	0.00025	0.00014	<0.00005	0.00012	0.00026	0.00016
Manganese [5]	mg/L	0.87	0.44	0.423	0.516	**3.3**	0.129	0.158	0.287	0.62	**1.62**	**1.26**	**2.72**	**1.3**	0.157	0.737	**1.8**	**2.67**	**1.05**	0.491
Mercury	µg/L	0.02	<0.01	<0.01	<0.01	<0.010	<0.1	<0.1	<0.1	<0.1	<0.10	0.011	<0.01	<0.01	<0.05	**0.02**	**0.02**	<0.01	<0.01	<0.01
Nickel	mg/L	0.025	0.001	<0.001	0.001	0.002	0.0009	0.0008	0.0007	0.0007	0.001	0.002	0.002	0.0011	0.0006	0.0007	0.0011	0.0008	0.0018	0.0007
Selenium	mg/L	0.002	<0.0006	<0.0006	<0.0006	0.0008	0.0002	0.0001	<0.0001	0.0002	<0.0006	<0.0006	0.0006	0.0001	<0.0005	0.0013	0.0009	**0.0027**	0.0005	0.0013
Zinc [5]	mg/L	0.0075	0.007	0.003	0.005	0.003	0.0034	0.0047	0.0036	0.0036	0.003	0.005	0.004	0.0033	<0.005	<0.005	<0.005	<0.005	0.007	<0.005
DISSOLVED METALS																				
Aluminum [4]	mg/L	0.05	**0.081**	**0.086**	**0.116**	**0.01**	**0.129**	**0.137**	**0.08**	**0.082**	0.042	0.042	0.011	0.024	**0.121**	**0.075**	0.025	0.017	**0.065**	**0.065**
Arsenic	mg/L	0.005	0.0003	0.0003	0.0003	0.0009	0.0002	0.0002	<0.0002	0.0002	0.0005	0.0007	0.0006	0.0004	0.0002	0.0003	0.0003	0.0005	0.0007	0.0003
Barium	mg/L	1.0	0.009	0.007	0.009	0.021	0.009	0.007	0.009	0.008	0.013	0.014	0.019	0.01	0.0053	0.0107	0.0186	0.0166	0.0144	0.01
Boron	mg/L	1.2	0.176	0.158	0.197	0.427	0.2	0.108	0.124	0.139	0.25	0.36	0.392	0.214	0.064	0.141	0.333	0.169	0.197	0.13
Cadmium [5]	mg/L	0.000021	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	**0.00006**	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00002	0.00001
Chromium	mg/L	0.001	**0.0016** [6]	**0.001**	**0.0009**	**0.0017** [6]	0.0009	0.0006	0.0005	0.0007	**0.0012** [6]	**0.0012**	**0.0016** [6]	**0.0012**	0.0006	0.0006	<0.0005	<0.0005	<0.0005	<0.0005
Copper [5]	mg/L	0.0024	<0.001	0.001	0.001	<0.001	**<0.001**	**0.009** [6]	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0008	**0.0051** [6]	0.0003	0.0014	0.0016	0.0007
Iron	mg/L	0.35	**0.72**	**0.903**	**1.25**	**0.847**	**0.607**	**0.409**	0.276	**1.02**	**2.22**	**0.841**	**0.79**	**0.978**	**0.42**	**1.5**	**0.911**	**1.66**	**0.526**	**0.701**
Lead [5]	mg/L	0.0050	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00007	0.00038	<0.00005	0.00012	0.00008	<0.00005
Manganese [5]	mg/L	0.87	0.377	0.144	0.065	**2.02**	0.0699	0.113	0.169	0.252	0.825	0.473	**2.14**	**1**	0.134	0.624	0.244	**2.15**	0.177	0.367
Mercury	µg/L	0.02	<0.01	<0.01	<0.01	0.01	<0.001	<0.1	<0.1	<0.01	<0.1	<0.1	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	0.01
Nickel	mg/L	0.025	<0.001	<0.001	<0.001	0.002	<0.001	0.0006	0.0009	<0.001	0.001	0.001	0.002	0.001	0.0004	0.0006	0.001	0.0006	0.0012	0.0006
Selenium	mg/L	0.002	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0002	<0.0002	<0.0006	<0.0006	**0.0011** [6]	<0.0006	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc [5]	mg/L	0.0075	0.001	0.001	0.002	<0.001	0.001	0.007 [6]	0.004	0.002	0.002	0.002	0.001	<0.001	0.003	0.006	<0.002	<0.002	0.004	<0.002

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW11-2014.xlsx]Metals

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed December 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 60 mg/L-$CaCO_3$
6. These values exceed the total concentrations, and are considered to be sampling or analytical errors.
7. Although total copper for this sample (0.0026 mg/L) exceeds the 0.0024 mg/L guideline based on a hardness of 60 mg/L, the calculated hardness is 89.6 mg/L CaCO3 for this sample.
   The resulting FWAL guideline is 0.0036 mg/L, above the 0.0024 mg/L measured concentration.

TABLE XII
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-12

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD												SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	20-Feb-12	2-May-12	4-Jul-12	28-Aug-12	30-Oct-12	20-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	17	13	19	59	16	21	21	45	53.1	30.3	57	45	23	33.4	45.6	55.2	132	-
Total Dissolved Solids	mg/L	-	50	60	78	110	92	40	78	90	130	110	134	96	73	93	113	107	56	115
pH - Lab	pH	-	6.80	6.30	6.30	6.50	6.00	6.50	6.60	6.80	6.80	6.30	6.80	7.00	6.60	7.01	7.09	6.81	6.25	6.57
pH - Field	pH	-	7.24	6.63	7.99	5.53	6.47	7.13	-	7.00	7.72	-	-	6.98	7.68	8.08	8.18	-	8.08	8.33
ORP - Field	mV	-	136.7	120.5	91	234.2	181	126.5	116.1	85.3	67.1	-	-	62.6	35.2	24.3	-141	-	70.1	-
Conductivity - Lab	µS/cm	-	76.2	63	75	246	72	81	91	149	181	122	226	160	90	126	183	236	58	115
Conductivity - Field	µS/cm	-	73	57	67	240	67	80	85	126	169	-	-	139	72	115	172	-	56	112
Temperature - Field	ºC	-	5.6	7.2	10.7	11.8	9.6	4.6	5.7	6.8	11.3	-	-	3.5	4.6	8.4	10.0	-	11.5	7.3
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	<20	<20	<20	38	<20	20	<20	<20	38	<20	44	<20	21	42	44	47	12	26
Chloride	mg/L	150	10.3	9.3	9.4	35.9	9.2	8.2	10.7	14.2	22.2	16.6	31.1	20.8	11.9	15	28.8	43.7	7.4	12.2
Sulphate [5]	mg/L	128	2.9	2.3	2.6	22.2	5.7	5.3	3.6	3.1	14.1	15.6	10.7	4.1	3	2.5	2.7	1.4	2.2	4.9
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	0.06	0.01	<0.01	**13.8**	<0.01	0.20	0.18	0.04	0.04	0.04	<0.02	0.09	0.04	0.03	0.07	0.04	0.11	0.02
Nitrate Nitrogen	mg/L as N	3.0	0.42	0.17	0.29	1.45	0.16	0.35	0.44	0.19	**9.96**	0.16	0.53	0.76	0.57	0.54	0.12	0.29	0.09	0.91
Total Phosphorus	mg/L as P	-	0.42	0.01	0.06	0.02	0.01	0.01	<0.003	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.04	0.01	<0.005
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**0.287**	**0.275**	**0.479**	**0.082**	**0.468**	**0.237**	**0.296**	**0.167**	**0.086**	**0.248**	**0.175**	**0.486**	**0.215**	**0.204**	**0.236**	**0.286**	**0.411**	**0.23**
Iron	mg/L	1	0.233	0.225	0.479	0.849	0.376	0.234	0.274	0.248	0.598	0.668	0.899	0.397	0.218	0.425	0.942	0.603	0.383	0.244
Manganese [5]	mg/L	0.83	0.009	0.009	0.02	0.116	0.0101	0.0093	0.0098	0.0157	0.0437	0.0515	0.0602	0.0225	0.01	0.027	0.077	0.697	0.042	0.017

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SW12-2014.xlsx]TableXII

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved . Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 30 mg/L-$CaCO_3$

TABLE XIII
WATER CHEMISTRY DATA SUMMARY FOR SANDHILL CREEK SAMPLING SITE (SHC)

PARAMETERS	units	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIOD						SAMPLING DATE - CURRENT REPORTING PERIOD						SAMPLING DATE - CURRENT REPORTING PERIOD					
		Aquatic Life (FWAL)[1]	20-Feb-12	02-May-12	04-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
PHYSICAL TESTS																				
Total Hardness ($CaCO_3$)	mg/L	-	11	10	11	34	10	10	11	16	17.9	16.4	27	18	12.7	13.9	22.2	31	8.3	-
Total Dissolved Solids	mg/L	-	42	68	40	262	86	34	70	58	80	76	100	66	35	65	85	123	59	120
pH - Lab	pH	-	6.6	6.4	6.4	6.6	5.9	6.4	6.7	6.9	6.7	6.4	6.8	6.8	6.29	6.89	6.68	6.36	5.94	6.32
pH - Field	pH	-	8.91	7.64	8.48	7.30	6.49	6.60	-	6.94	6.89	-	-	6.63	7.91	7.65	7.16	-	6.79	8.39
ORP - Lab	mV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ORP - Field	mV	-	159.9	88.7	62.9	214.6	193.1	186.9	143.5	152.5	182.5	-	-	45.7	74.1	27.2	-49.1	-	110.8	-
Conductivity - Lab	µS/cm	-	60.5	56	58	220	57	54	66	85	105	88	159	101	64	78	144	210	44	75
Conductivity - Field	µS/cm	-	256	122	54	272	59	106	349	77	127	-	-	110	55	74	245	-	57	70
Temperature - Field	ºC	-	6.0	7.3	10.3	12.5	9.8	5.7	6.5	6.5	11.2	-	-	3.3	5.1	8.7	10.6	-	11.7	7.3
DISSOLVED ANIONS																				
Alkalinity - Total	mg/L	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	6	13	11	10	5	9
Chloride	mg/L	150	10.7	9.8	10.6	54	8.9	8.4	10.7	13.5	21.7	15.6	32	19.8	12.2	14.2	34.3	51.5	7.09	12.3
Sulphate [5]	mg/L	128	2	1.7	1.6	3.5	3.1	2.7	2.4	2.2	4.1	6.8	5.6	2.8	2.2	1.9	2.9	2.6	1.6	2.8
NUTRIENTS																				
Ammonia Nitrogen	mg/L as N	1.84	0.05	<0.01	0.05	0.31	0.06	<0.01	0.15	<0.01	<0.01	0.04	<0.02	<0.02	<0.01	<0.01	< 0.01	<0.01	0.06	< 0.01
Nitrate Nitrogen	mg/L as N	3.0	0.2	0.12	0.06	0.11	0.07	0.13	0.15	0.09	0.06	0.1	0.63	0.18	0.192	0.162	0.037	0.054	0.035	0.349
Total Phosphorus	mg/L as P	-	0.009	0.009	0.008	0.020	0.01	0.007	0.008	0.018	0.009	0.004	0.004	0.007	0.017	0.015	0.01	0.016	0.01	<0.005
TOTAL METALS																				
Aluminum [4]	mg/L	0.05	**0.342**	**0.318**	**0.51**	**0.146**	**0.514**	**0.303**	**0.434**	**0.234**	**0.277**	**0.28**	**0.162**	**0.188**	**0.275**	**0.221**	**0.232**	**0.263**	**0.491**	**0.278**
Iron	mg/L	1	0.262	0.28	0.57	0.902	0.42	0.267	0.363	0.269	0.445	0.6	0.51	0.32	0.246	0.373	0.64	**1.27**	0.446	0.324
Manganese [5]	mg/L	0.83	<0.005	<0.005	0.01	0.0555	0.0109	0.0082	0.0075	0.0098	0.0125	0.0149	0.0216	0.0098	0.012	0.015	0.032	0.062	0.015	0.009

H:\Project\1576\CHEM\2014_CHEM\Updated Tables\[SHC-2014.xls]TableXIII

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for indicated parameter changes with pH
5. FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 30 mg/L-$CaCO_3$

TABLE XIV

SURFACE WATER CHEMISTRY DATA SUMMARY FOR VOC'S

PARAMETERS	units	RECEIVING WATER CRITERIA	RECEIVING WATER CRITERIA	SAMPLING DATE - PREVIOUS REPORTING PERIODS												SAMPLING DATE - CURRENT REPORTING PERIOD					
				SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3
		GCDWQ MAC or AO[1]	Aquatic Life (FWAL)[1]	21-Feb-12	2-May-12	4-Jul-12	28-Aug-12	30-Oct-12	18-Dec-12	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	19-Feb-14	7-May-14	11-Jun-14	27-Aug-14	29-Oct-14	15-Dec-14
HALOGENATED VOLATILES	**ATES ENGINEERING LTD.**																				
Bromodichloromethane	µg/L	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.1	<0.1	Not Sampled	<1	<1	<1	<1	<1	<1
Bromoform	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
Bromomethane	µg/L	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1
Carbon Tetrachloride	µg/L	5	13.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	µg/L	80	1.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
Chloroethane	µg/L	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1
Chloroform	µg/L	-	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.1	<0.1		<1	<1	<1	<1	<1	<1
Chloromethane	µg/L	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1
Dibromochloromethane	µg/L	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.1	<0.1		<1	<1	<1	<1	<1	<1
1,2-Dibromoethane	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		-	-	-	-	-	-
Dibromomethane	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		-	-	-	-	-	-
Dichlorodifluoromethane	µg/L	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		-	-	-	-	-	-
1,2-Dichlorobenzene	µg/L	200	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
1,3-Dichlorobenzene	µg/L	-	150	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	µg/L	5	26	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichlororethane	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		-	-	-	-	-	-
1,2-Dichloroethane	µg/L	5	100	<0.5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1	<1	<1	<1	<1	<1
1,1-Dichloroethylene	µg/L	14	-	<0.5	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		-	-	-	-	-	-
cis-1,2-Dichloroethylene	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
trans-1,2-Dichloroethylene	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
Dichloromethane	µg/L	50	98.1	-	-	-	-	-	-	-	-	-	-	-		<1	<1	<1	<1	<1	<1
1,2-Dichloropropane	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
cis-1,3-Dichloropropylene	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		-	-	-	-	-	-
trans-1,3-Dichloropropylene	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		-	-	-	-	-	-
Methylene Chloride	µg/L	-	98.1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
Tetrachloroethylene	µg/L	10	111	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		-	-	-	-	-	-
1,1,1-Trichloroethane	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
Trichloroethylene	µg/L	5	21	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		-	-	-	-	-	-
Trichlorofluoromethane	µg/L	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1
Vinyl Chloride	µg/L	2	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<1	<1	<1	<1	<1	<1
NON-HALOGENATED VOLATILES																					
Benzene	µg/L	5	40	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.2	<0.1	0.1	<0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/L	140	200	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	µg/L	-	72	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	µg/L	60	0.5	0.2	0.3	<0.1	<0.1	**0.7**	<0.1	0.1	**0.6**	0.2	**21.5**	<0.1		**8.7**	<0.5	<0.5	<0.5	**9.8**	**1.8**
Xylenes	µg/L	90	30	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<1	<1	<1	<1	<1	<1

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Notes:
1. GCDWQ = Guidelines for Canadian Drinking Water Quality (Health Canada, 2014)
MAC = Maximum acceptable concentration; AO = Aesthetic objective.
FWAL = Fresh Water Aquatic Life Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed February 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE XVa
WATER CHEMISTRY DATA SUMMARY FOR MONITORING WELLS

PARAMETERS	units	RECEIVING WATER CRITERIA		MW02-1		MW02-2		MW02-3	
		GCDWQ MAC or AO[1]	Aquatic Life (FWAL)[2]	29-Oct-03	13-Jun-06	29-Oct-03	13-Jun-06	29-Oct-03	13-Jun-06
PHYSICAL TESTS									
Colour	CU	15	-	-	-	-	-	-	-
Total Hardness ($CaCO_3$)	mg/L	-	-	957	-	1100	-	480	-
Total Dissolved Solids	mg/L	500	-	**6830**	**7670**	**7000**	**7100**	**4370**	**4730**
pH - Lab	pH	6.5-8.5	-	7.85	8.02	7.84	8.03	8	8.16
pH - Field	pH	6.5-8.5	-	7.4	7.29	6.79	7.73	6.92	6.47
ORP - Lab	mv	-	-	-	-	-	-	-	-
ORP - Field	mv	-	-	-55.1	29	-28.8	27	-40.2	54
Conductivity - Lab	µS/cm	-	-	12700	14400	13300	14500	9340	9250
Conductivity - Field	µS/cm	-	-	11000	11410	11700	8280	7570	7730
Temperature - Field	ºC	-	-	11.8	15.4	11	24.7	12.3	15
DISSOLVED ANIONS									
Alkalinity - Total	mg/L	-	-	259	247	234	242	314	315
Chloride	mg/L	250	-	**3920**	**4030**	**4090**	**3890**	**2610**	**2760**
Sulphate	mg/L	500	100	**778**	**657**	**499**	**496**	**334**	**290**
DISSOLVED CATIONS									
Calcium	mg/L	-	-	112	-	129	-	57.9	-
Magnesium	mg/L	-	-	149	-	168	-	68.5	-
Potassium	-	-	-	35.6	-	35.2	-	27.9	-
Sodium	mg/L	200	-	**2010**	**-**	**1950**	**-**	**1440**	**-**
NUTRIENTS									
Ammonia Nitrogen	mg/L as N	-	~1.84	**5.6**	**4.34**	**6.4**	**3.94**	**5.7**	**3.12**
Nitrate Nitrogen	mg/L as N	10	3	< 0.05	<25	< 0.05	<25	< 0.05	<2.5
Total Phosphate	mg/L as P	-	-	0.15	0.06	0.12	0.13	0.2	0.4
ORGANIC PARAMETERS									
Chemical Oxygen Demand	mg/L as O	-	-	-	-	-	-	-	-
Biological Oxygen Demand	mg/L as O	-	-	< 10	-	< 10	-	< 10	-
BIOASSAYS									
96 hour LC-50	-	-	-	-	-	-	-	-	-

H:\Project\1576\CHEM\2006_chem\[MWELLS.xls]NON-VOLATILES

Notes:
1. GCDWQ = Guidelines for Canadian Drinking Water Quality (Health and Welfare, 2006)
   MAC = Maximum acceptable concentration: AO = Aesthetic objective
2. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environ.
   Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL").
3. Bolding denotes parameters which exceed water quality criteria.
4. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE XVb
METAL MONITORING DATA SUMMARY FOR MONITORING WELLS

PARAMETERS	units	RECEIVING WATER CRITERIA		MW02-1	MW02-2	MW02-3
		GCDWQ MAC or AO[1]	Aquatic Life (FWAL)[2]	29-Oct-03	29-Oct-03	29-Oct-03
TOTAL METALS						
Arsenic	mg/L	0.01	0.005	**0.006**	**0.007**	0.005
Barium	mg/L	1.0	1.0	0.11	0.14	0.097
Boron	mg/L	-	1.2	**3.97**	**3.34**	**3.05**
Cadmium	mg/L	0.005	0.00013	< 0.0002	< 0.0002	< 0.0002
Chromium	mg/L	0.05	0.001	**0.002**	**0.002**	0.001
Copper	mg/L	1.0	0.004	0.003	**0.005**	0.003
Iron	mg/L	0.3	0.3	**1.65**	**1.52**	**0.58**
Lead	mg/L	0.01	0.028	< 0.001	< 0.001	< 0.001
Manganese	mg/L	0.05	1.9	0.75	0.82	0.45
Mercury	ug/L	1.0	0.02	< 0.02	< 0.02	< 0.02
Nickel	mg/L	-	0.065	0.011	0.013	0.011
Selenium	mg/L	0.01	0.002	< 0.001	< 0.001	< 0.001
Zinc	mg/L	5.0	0.315	0.016	0.012	0.008
DISSOLVED METALS						
Arsenic	mg/L	0.01	0.005	**0.006**	**0.006**	0.004
Barium	mg/L	1.0	1.0	0.1	0.11	0.086
Boron	mg/L	-	1.2	**3.7**	**3.08**	**2.81**
Cadmium	mg/L	0.005	0.00013	< 0.0002	< 0.0002	< 0.0002
Chromium	mg/L	0.05	0.001	0.001	< 0.001	< 0.001
Copper	mg/L	1	0.020	0.002	0.003	0.003
Iron	mg/L	0.3	0.3	0.24	0.13	0.18
Lead	mg/L	0.01	0.028	< 0.001	< 0.001	< 0.001
Manganese	mg/L	0.05	1.9	0.67	0.67	0.37
Mercury	ug/L	1.0	0.02	< 0.02	< 0.02	< 0.02
Nickel	mg/L	-	0.065	0.01	0.011	0.009
Selenium	mg/L	0.01	0.002	< 0.001	< 0.001	< 0.001
Zinc	mg/L	5	0.315	0.009	0.008	0.006

H:\Project\1576\CHEM\2006_chem\[MWELLS.xls]metals

Notes:

1. GCDWQ = Guidelines for Canadian Drinking Water Quality (Health and Welfare, 2006)
   MAC = Maximum acceptable concentration: AO = Aesthetic objective
2. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. Hardness dependent values assume hardness of 500 mg/L. Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
3. Bolding denotes parameters which exceed water quality criteria.
4. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE XVI
2003-2011 FIELD MONITORING DATA FOR THE WEST COAST LANDFILL MONITORING WELLS

Site	Date	WELL DEPTH Depth	WELL DEPTH Elevation	STATIC ELEVATION Depth to Water	STATIC ELEVATION Elevation	PURGED ELEV WLE	PURGED ELEV Elevation	Temp.	pH	Elec. Cond.	ORP	Comments
		(m-asl)	(m-asl)	(m)	(m-asl)	(m)	(m-asl)	(°C)		(mS/cm)	mV	
MW02-1	25-Feb-03	12.20	83.65	1.090	94.756			N/A	N/A	N/A	N/A	Measurement only - No bailing done
	28-Apr-03	12.20	83.65	1.050	94.796	9.310	86.536	N/A	N/A	N/A	N/A	Bailed approximately 20L
	02-Jul-03	12.20	83.65	1.215	94.631	11.195	84.651	N/A	N/A	N/A	N/A	Bailed approximately 20L
	15-Sep-03	12.20	83.65	1.320	94.526	11.050	84.796	N/A	N/A	N/A	N/A	Bailed approximately 20L
	29-Oct-03	12.20	83.65	1.300	94.546	11.510	84.336	11.8	7.40	11.00	-55.1	Bailed approximately 20L
	18-Dec-03	12.20	83.65	1.210	94.636	10.050	85.796	???	???	10.80	???	Bailed approximately 20L
	26-Feb-04	12.20	83.65	1.100	94.746	10.920	84.926	???	???	11.00	???	Bailed approximately 20L
	27-Apr-04	12.20	83.65	1.180	94.666	9.820	86.026	???	???	10.00	???	Bailed approximately 20L
	28-Jun-04	12.20	83.65	1.230	94.616	11.060	84.786			11.74		Bailed approximately 20L
	30-Aug-04	12.20	83.65	1.210	94.636	11.030	84.816			11.62		Bailed approximately 20L
	26-Oct-04	12.20	83.65	1.080	94.766	9.860	85.986			11.12		Bailed approximately 20L
	14-Dec-04	12.20	83.65	1.000	94.846	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	14-Feb-05	12.20	83.65	0.850	94.996	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	19-May-05	12.20	83.65	0.980	94.866	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	06-Jul-05	12.20	83.65	1.030	94.816	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	29-Aug-05	12.20	83.65	-----	95.846	------	------	N/A	N/A	N/A	N/A	Field data sheet lost
	24-Oct-05	12.20	83.65	0.980	94.866	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	19-Dec-05	12.20	83.65	0.840	95.006	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Feb-06	12.20	83.65	0.700	95.146	8.880	86.966	N/A	N/A	N/A	N/A	Bailed approximately 20L
	25-Apr-06	12.20	83.65	0.870	94.976	9.250	86.596	N/A	N/A	N/A	N/A	Bailed approximately 20L
	13-Jun-06	12.20	83.65	1.080	94.766	------	------	15.4	16.4	11.41	29.0	**Conductivity off scale in uS/cm range. Used mS/cm**
	09-Aug-06	12.20	83.65	1.150	94.696	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	25-Oct-06	12.20	83.65	1.220	94.626	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Dec-06	12.20	83.65	0.950	94.896	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Mar-07	12.20	83.65	0.900	94.946	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Apr-07	12.20	83.65	0.600	95.246	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Jun-07	12.20	83.65	0.930	94.916	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	15-Aug-07	12.20	83.65	1.030	94.816	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	16-Oct-07	12.20	83.65	0.990	94.856	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Dec-07	12.20	83.65	0.880	94.966	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	12-Dec-07	12.20	83.65	0.880	94.966	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	20-Feb-08	12.20	83.65	0.830	95.016	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	23-Apr-08	12.20	83.65	0.840	95.006	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	11-Jun-08	12.20	83.65	0.960	94.886	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Aug-08	12.20	83.65	1.060	94.786	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Oct-08	12.20	83.65	1.030	94.816	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Dec-08	12.20	83.65	0.880	94.966	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Feb-09	12.20	83.65	0.880	94.966	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Apr-09	12.20	83.65	0.880	94.966	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Jun-09	12.20	83.65	0.980	94.866	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Aug-09	12.20	83.65	1.150	94.696	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Nov-09	12.20	83.65	1.020	94.826	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	05-Jan-10	12.20	83.65	0.91	94.936	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	03-Mar-10	12.20	83.65	0.82	95.026	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	28-Apr-10	12.20	83.65	0.81	95.036	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	29-Jun-10	12.20	83.65	0.91	94.936	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Oct-10	12.20	83.65	1.10	94.746	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Dec-10	12.20	83.65	1.12	94.726	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	24-Feb-11	12.20	83.65	0.79	95.056	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Apr-11	12.20	83.65	0.82	95.026	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	23-Jun-11	12.20	83.65	0.96	94.886	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	09-Aug-11	12.20	83.65	------	------	------	------	------	------	------	------	No longer measured

TABLE XVI
2003-2011 FIELD MONITORING DATA FOR THE WEST COAST LANDFILL MONITORING WELLS

Site	Date	WELL DEPTH		STATIC ELEVATION		PURGED ELEV						
		Depth (m-asl)	Elevation (m-asl)	Depth to Water (m)	Elevation (m-asl)	WLE (m)	Elevation (m-asl)	Temp. (°C)	pH	Elec. Cond. (mS/cm)	ORP mV	Comments
MW02-2	25-Feb-03	12.20	80.86	1.880	91.180			N/A	N/A	N/A	N/A	Measurement only - No bailing done
	28-Apr-03	12.20	80.86	1.790	91.270	9.680	83.380	N/A	N/A	N/A	N/A	Bailed approximately 20L
	02-Jul-03	12.20	80.86	2.280	90.780	10.625	82.435	N/A	N/A	N/A	N/A	Bailed approximately 20L
	15-Sep-03	12.20	80.86	2.280	90.780	11.440	81.620	N/A	N/A	N/A	N/A	Bailed approximately 20L
	29-Oct-03	12.20	80.86	3.240	89.820	11.730	81.330	11.0	6.79	11.70	-28.8	Bailed approximately 20L
	18-Dec-03	12.20	80.86	3.170	89.890	11.570	81.490	???	???	11.00	???	Bailed approximately 20L
	26-Feb-04	12.20	80.86	2.430	90.630	10.940	82.120	???	???	11.00	???	Bailed approximately 20L
	27-Apr-04	12.20	80.86	2.570	90.490	11.190	81.870	???	???	9.20	???	Bailed approximately 20L
	28-Jun-04	12.20	80.86	2.630	90.430	11.650	81.410			11.69		Bailed approximately 20L
	30-Aug-04	12.20	80.86	2.800	90.260	11.760	81.300			11.80		Bailed approximately 20L
	26-Oct-04	12.20	80.86	3.010	90.050	11.530	81.530			11.38		Bailed approximately 20L
	14-Dec-04	12.20	80.86	3.110	89.950	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	14-Feb-05	12.20	80.86	1.850	91.210	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	19-May-05	12.20	80.86	1.660	91.400	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	06-Jul-05	12.20	80.86	1.680	91.380	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	29-Aug-05	12.20	80.86	-----	93.060	------	------	N/A	N/A	N/A	N/A	Field data sheet lost
	24-Oct-05	12.20	80.86	1.770	91.290	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	19-Dec-05	12.20	80.86	1.690	91.370	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Feb-06	12.20	80.86	1.580	91.480	9.030	84.030	N/A	N/A	N/A	N/A	Bailed approximately 20L
	25-Apr-06	12.20	80.86	2.160	90.900	11.010	82.050	N/A	N/A	N/A	N/A	Bailed approximately 20L
	13-Jun-06	12.20	80.86	3.670	89.390	------	------	24.7	25.7	8.28	27.0	**Conductivity off scale in uS/cm range. Used mS/cm**
	09-Aug-06	12.20	80.86	2.320	90.740	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	25-Oct-06	12.20	80.86	2.070	90.990	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Dec-06	12.20	80.86	1.870	91.190	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	17-Apr-07	12.20	80.86	1.760	91.300	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	12-Jun-07	12.20	80.86	1.810	91.250	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	15-Aug-07	12.20	80.86	1.880	91.180	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	16-Oct-07	12.20	80.86	1.870	91.190	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Dec-07	12.20	80.86	1.810	91.250	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	12-Dec-07	12.20	80.86	1.810	91.250	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	20-Feb-08	12.20	80.86	1.760	91.300	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	23-Apr-08	12.20	80.86	1.790	91.270	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	11-Jun-08	12.20	80.86	1.850	91.210	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Aug-08	12.20	80.86	1.940	91.120	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Oct-08	12.20	80.86	1.940	91.120	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Dec-08	12.20	80.86	1.870	91.190	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Feb-09	12.20	80.86	1.820	91.240	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Apr-09	12.20	80.86	1.840	91.220	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Jun-09	12.20	80.86	1.900	91.160	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Aug-09	12.20	80.86	1.980	91.080	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Nov-09	12.20	80.86	1.960	91.100	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	05-Jan-10	12.20	80.86	1.86	91.200	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	03-Mar-10	12.20	80.86	1.80	91.260	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	28-Apr-10	12.20	80.86	1.97	91.090	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	29-Jun-10	12.20	80.86	1.86	91.200	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Oct-10	12.20	80.86	1.99	91.070	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Dec-10	12.20	80.86	1.96	91.100	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	24-Feb-11	12.20	80.86	1.80	91.260	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Apr-11	12.20	80.86	1.71	91.350	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	23-Jun-11	12.20	80.86	1.75	91.310	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	09-Aug-11	12.20	80.86	------	------	------	------	------	------	------	------	No longer measured

TABLE XVI
2003-2011 FIELD MONITORING DATA FOR THE WEST COAST LANDFILL MONITORING WELLS

Site	Date	WELL DEPTH Depth (m-asl)	WELL DEPTH Elevation (m-asl)	STATIC ELEVATION Depth to Water (m)	STATIC ELEVATION Elevation (m-asl)	PURGED ELEV WLE (m)	PURGED ELEV Elevation (m-asl)	Temp. (°C)	pH	Elec. Cond. (mS/cm)	ORP mV	Comments
MW02-3	25-Feb-03	12.20	88.87	1.700	99.370			N/A	N/A	N/A	N/A	Measurement only - No bailing done
	28-Apr-03	12.20	88.87	1.580	99.490	8.940	92.130	N/A	N/A	N/A	N/A	Bailed approximately 20L
	02-Jul-03	12.20	88.87	1.730	99.340	11.430	89.640	N/A	N/A	N/A	N/A	Bailed approximately 20L
	15-Sep-03	12.20	88.87	1.900	99.170	10.810	90.260	N/A	N/A	N/A	N/A	Bailed approximately 20L
	29-Oct-03	12.20	88.87	2.360	98.710	11.580	89.490	12.3	6.92	7.57	-40.2	Bailed approximately 20L
	18-Dec-03	12.20	88.87	2.300	98.770	11.590	89.480	???	???	7.57	???	Bailed approximately 20L
	26-Feb-04	12.20	88.87	1.850	99.220	10.980	90.090	???	???	7.80	???	Bailed approximately 20L
	27-Apr-04	12.20	88.87	1.890	99.180	11.440	89.630	???	???	6.65	???	Bailed approximately 20L
	28-Jun-04	12.20	88.87	1.970	99.100	10.920	90.150			7.39		Bailed approximately 20L
	30-Aug-04	12.20	88.87	2.080	98.990	11.470	89.600			7.92		Bailed approximately 20L
	26-Oct-04	12.20	88.87	2.140	98.930	11.350	89.720			7.50		Bailed approximately 20L
	14-Dec-04	12.20	88.87	2.270	98.800	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	14-Feb-05	12.20	88.87	1.560	99.510	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	19-May-05	12.20	88.87	1.480	99.590	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	06-Jul-05	12.20	88.87	1.500	99.570	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	29-Aug-05	12.20	88.87	-----	------	------	------	N/A	N/A	N/A	N/A	Field data sheet lost
	24-Oct-05	12.20	88.87	1.620	99.450	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	19-Dec-05	12.20	88.87	1.520	99.550	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Feb-06	12.20	88.87	1.450	99.620	9.460	91.610	N/A	N/A	N/A	N/A	Bailed approximately 20L
	25-Apr-06	12.20	88.87	1.630	99.440	10.220	90.850	N/A	N/A	N/A	N/A	Bailed approximately 20L
	13-Jun-06	12.20	88.87	1.980	99.090	------	------	15.0	6.47	7.73	54.0	**Conductivity off scale in uS/cm range. Used mS/cm**
	09-Aug-06	12.20	88.87	1.800	99.270	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	25-Oct-06	12.20	88.87	1.750	99.320	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Dec-06	12.20	88.87	1.670	99.400	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Mar-07	12.20	88.87	1.520	99.550	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Apr-07	12.20	88.87	1.430	99.640	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Jun-07	12.20	88.87	1.470	99.600	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	15-Aug-07	12.20	88.87	1.560	99.510	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	16-Oct-07	12.20	88.87	1.650	99.420	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Dec-07	12.20	88.87	1.610	99.460	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	12-Dec-07	12.20	88.87	1.610	99.460	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	20-Feb-08	12.20	88.87	1.470	99.600	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	23-Apr-08	12.20	88.87	1.430	99.640	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	11-Jun-08	12.20	88.87	1.480	99.590	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Aug-08	12.20	88.87	1.610	99.460	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Oct-08	12.20	88.87	1.680	99.390	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Dec-08	12.20	88.87	1.650	99.420	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Feb-09	12.20	88.87	1.530	99.540	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Apr-09	12.20	88.87	1.560	99.510	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Jun-09	12.20	88.87	1.560	99.510	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Aug-09	12.20	88.87	1.720	99.350	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	01-Nov-09	12.20	88.87	1.720	99.350	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	05-Jan-10	12.20	88.87	1.620	99.450	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	03-Mar-10	12.20	88.87	1.550	99.520	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	28-Apr-10	12.20	88.87	1.480	99.590	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	29-Jun-10	12.20	88.87	1.490	99.580	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	18-Oct-10	12.20	88.87	1.700	99.370	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Dec-10	12.20	88.87	1.660	99.410	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	24-Feb-11	12.20	88.87	1.500	99.570	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	13-Apr-11	12.20	88.87	1.430	99.64	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	23-Jun-11	12.20	88.87	1.450	99.62	------	------	N/A	N/A	N/A	N/A	Measurement only - No bailing done
	09-Aug-11	12.20	88.87	------	------	------	------	------	------	------	------	No longer measured

TABLE XVII
WATER CHEMISTRY MONITORING SUMMARY FOR OVERFLOW EVENTS

PARAMETERS	UNITS	RECEIVING WATER CRITERIA		SW-3 Overflow				
		Aquatic Life (FWAL)[1] (30 day)	Aquatic Life (FWAL)[1] (Max)	12-Nov-07	14-Jan-08	17-Apr-14	22-Oct-14	25-Nov-14
PHYSICAL TESTS								
Colour	CU	-	-	-	-	-	44.4	35.4
Conductivity	uS/cm	-	-	393	327	-	420	324
Hardness (as CaCO3)	mg/L	-	-	128	107	181	149	114
Total Hardness	mg/L	-	-	160	109	-	-	-
pH	pH	-	-	7.55	7.34	-	7.77	8.03
ORP	mV	-	-	-	-	-	223	266
Total Dissolved Solids	mg/L	-	-	199	175	-	275	167
Total Suspended Solids		-	-	23	41	-	-	-
ANIONS AND NUTRIENTS								
Alkalinity	mg/L	-	-	141	106	-	29.4	134
Bicarbonate Alkalinity	mg/L	-	-	171	130	-	-	-
Carbonate Alkalinity	mg/L	-	-	< 0.5	< 0.5	-	-	-
Hydroxide Alkalinity	mg/L	-	-	< 0.5	< 0.5	-	-	-
Ammonia	mg/L	1.84	20.5	*6.94*	*4.2*	*7.8*	*5.95*	*4.44*
Bromide	mg/L	-	-	-	-	-	-	-
Chloride	mg/L	150	600	19.4	11.8	19.2	21.3	15.0
Fluoride	mg/L	Variable, see below		-	-	-	-	-
Nitrate as N	mg/L	3	32.38	0.23	0.21	-	-	-
Nitrite as N	mg/L	3.7	-	-	-	-	-	-
Phosphorus	mg/L	-	-	0.04	0.1	0.213	0.211	0.0917
Sulfate[4]	mg/L	Variable	-	26.2	28.1	13.7	25.2	14.0
AGGREGATE ORGANICS								
BOD	mg/L	-	-	14	24	32.5	18.6	8.6
COD	mg/L	-	-	97	64	106	120	42
VARIABLE CRITERIA								
Sulphate FWAL (30-Day)	mg/L			309	309	429	309	309
Fluoride FWAL	mg/L			1	1	2	1	1

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PARAMETERS	UNITS	RECEIVING WATER CRITERIA		SW-3 Overflow				
		Aquatic Life (FWAL)[1] (30 day)	Aquatic Life (FWAL)[1] (Max)	12-Nov-07	14-Jan-08	17-Apr-14	22-Oct-14	25-Nov-14
TOTAL METALS								
Aluminum[5]	mg/L	0.05	0.1	**0.88**	**1.66**	**1.18**	**0.553**	**0.919**
Antimony	mg/L	-	-	< 0.001	< 0.001	<0.00050	<0.00050	<0.00050
Arsenic	mg/L	0.005	0.005	< 0.001	0.001	0.00099	0.0012	0.00096
Barium	mg/L	1	5	0.042	0.031	0.036	0.037	0.030
Beryllium	mg/L	-	-	< 0.001	< 0.001	<0.0010	<0.0010	<0.0010
Bismuth	mg/L	-	-	< 0.001	< 0.001	-	-	-
Boron	mg/L	1.2	1.2	0.37	0.17	0.3	0.26	0.20
Cadmium[4]	mg/L	Variable, see below		< 0.0002	< 0.0002	**0.000086**	**0.000223**	**0.000196**
Calcium	mg/L	-	-	52.5	37	66.1	49.2	40.5
Cesium	mg/L	-	-	-	-	-	-	-
Chromium	mg/L	0.001	0.001	**0.002**	**0.004**	**0.0028**	**0.0021**	**0.0017**
Cobalt	mg/L	-	-	0.002	0.002	0.00141	0.00116	0.00114
Copper[4]	mg/L	Variable, see below		*0.007*	*0.009*	*0.0071*	0.0058	*0.0081*
Iron	mg/L	1	1	**4.14**	**5.95**	**5.41**	**3.17**	**3.06**
Lead[4]	mg/L	Variable, see below		0.004	*0.008*	0.00097	0.00078	0.00154
Lithium	mg/L	-	-	0.002	0.002	<0.0050	<0.0050	<0.0050
Magnesium	mg/L	-	-	7.05	3.96	6.66	5.82	4.35
Manganese[4]	mg/L	Variable, see below		0.99	0.73	0.89	0.833	0.526
Mercury[6]	mg/L			< 0.02	< 0.00002	<0.000010	<0.000010	<0.000010
Molybdenum	mg/L	-	-	< 0.0005	< 0.0005	<0.0010	<0.0010	<0.0010
Nickel[4]	mg/L	Variable, see below		0.005	0.005	0.0032	0.0028	0.0036
Potassium	mg/L	-	-	7.5	5.4	8.7	9.3	5.6
Rubidium	mg/L			-	-	-	-	-
Selenium[7]	mg/L	0.002	n/a	< 0.001	< 0.001	0.00014	0.00012	<0.00010
Silicon	mg/L	-	-	4	4.9	-	-	-
Silver	mg/L	-	-	< 0.00025	< 0.00025	<0.000020	0.000021	<0.000020
Sodium	mg/L	-	-	20.9	10.6	20.4	19.4	13.1
Sulfur	mg/L	-	-	-	-	-	-	-
Strontium	mg/L	-	-	0.28	0.2	-	-	-
Tellerium	mg/L	-	-	< 0.001	< 0.001	-	-	-
Thallium	mg/L	-	-	< 0.0001	< 0.0001	<0.00020	<0.00020	<0.00020
Thorium	mg/L	-	-	< 0.0005	< 0.0005	-	-	-
Tin	mg/L	-	-	< 0.001	< 0.001	<0.00050	<0.00050	<0.00050
Titanium	mg/L	-	-	0.038	0.075	0.056	0.034	0.050
Tungsten	mg/L	-	-					
Uranium	mg/L	-	-	< 0.0005	< 0.0005	<0.00020	<0.00020	<0.00020
Vanadium	mg/L	-	-	0.003	0.006	0.0041	0.0022	0.0028
Zinc[4]	mg/L	Variable, see below		**0.1**	**0.12**	0.0483	0.0316	*0.0360*
Zirconium	mg/L	-	-	< 0.01	< 0.01	-	-	-
VARIABLE CRITERIA								
Cadmium FWAL (Unspecified)	mg/L			0.00004	0.00004	0.00006	0.00005	0.00004
Copper FWAL (30-Day)	mg/L			0.0051	0.0043	0.0072	0.0060	0.0046
Copper FWAL (Max)	mg/L			0.1223	0.1026	0.1721	0.1421	0.1092
Lead FWAL (30-Day)	mg/L			0.0077	0.0068	0.0101	0.0086	0.0071
Lead FWAL (Max)	mg/L			0.1118	0.0890	0.1738	0.1356	0.0965
Manganese FWAL (30-Day)	mg/L			1.3	1.3	2.4	1.3	1.3
Manganese FWAL (Max)	mg/L			2.2	2.2	4.9	2.2	2.2
Nickel FWAL (Unspecified)	mg/L			0.110	0.036	0.150	0.110	0.036
Zinc FWAL (30-Day)	mg/L			0.036	0.02025	0.07575	0.05175	0.0255
Zinc FWAL (Max)	mg/L			0.0615	0.0458	0.1013	0.0773	0.0510

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WATER CHEMISTRY MONITORING SUMMARY FOR OVERFLOW EVENTS

PARAMETERS	UNITS	RECEIVING WATER CRITERIA		SW-3 Overflow				
		Aquatic Life (FWAL)[1] (30 day)	Aquatic Life (FWAL)[1] (Max)	12-Nov-07	14-Jan-08	17-Apr-14	22-Oct-14	25-Nov-14
DISSOLVED METALS								
Aluminum[5]	mg/L	0.05	0.1	*0.058*	0.022	*0.0713*	**0.493**	0.0308
Antimony	mg/L	-	-	< 0.001	< 0.001	<0.00050	<0.00050	<0.00050
Arsenic	mg/L	0.005	0.005	< 0.001	< 0.001	0.00053	0.0011	<0.00050
Barium	mg/L	1	5	0.03	0.022	0.027	0.037	<0.020
Beryllium	mg/L	-	-	< 0.001	< 0.001	<0.0010	<0.0010	<0.0010
Bismuth	mg/L	-	-	< 0.001	< 0.001	-	-	-
Boron	mg/L	1.2	1.2	0.3	0.16	0.3	0.25	0.20
Cadmium[4]	mg/L	Variable, see below		< 0.0002	< 0.0002	0.000018	**0.000212**	0.000021
Calcium	mg/L	-	-	41.9	37.1	62.6	50	38.9
Cesium	mg/L	-	-	-	-	-	-	-
Chromium	mg/L	0.001	0.001	< 0.001	< 0.001	**0.0011**	**0.0017**	<0.0010
Cobalt	mg/L	-	-	< 0.001	0.001	0.00087	0.00108	<0.00030
Copper[4]	mg/L	Variable, see below		*0.006*	*0.008*	0.0011	0.0056	0.0018
Iron	mg/L	0.35	1	*0.84*	0.26	*0.58*	**2.91**	*0.411*
Lead[4]	mg/L	Variable, see below		< 0.001	< 0.001	<0.00050	0.00072	<0.00050
Lithium	mg/L	-	-	0.001	0.001	<0.0050	<0.0050	<0.0050
Magnesium	mg/L	-	-	5.56	3.45	6.01	5.89	4.04
Manganese[4]	mg/L	Variable, see below		0.76	0.69	0.812	0.804	0.0471
Mercury[6]	mg/L	0.02	n/a	< 0.02	< 0.02	<0.000010	<0.000010	<0.000010
Molybdenum	mg/L	-	-	< 0.0005	< 0.0005	<0.0010	<0.0010	<0.0010
Nickel[4]	mg/L	Variable, see below		0.003	0.003	0.0021	0.0028	0.0019
Phosphorus	mg/L	-	-	< 0.15	< 0.15	-	-	-
Potassium	mg/L	-	-	6.1	5.4	8.1	9.4	5.5
Rubidium	mg/L	-	-	-	-	-	-	-
Selenium[7]	mg/L	0.002	n/a	< 0.001	< 0.001	<0.00010	0.00016	<0.00010
Silicon	mg/L	-	-	2.5	2.2	-	-	-
Silver	mg/L	-	-	< 0.00025	< 0.00025	<0.000020	<0.000020	<0.000020
Sodium	mg/L	-	-	17.2	10.4	19.2	19.7	12.8
Strontium	mg/L	-	-	0.22	0.19	-	-	-
Sulfur	mg/L			-	-	-	-	-
Tellerium	mg/L	-	-	< 0.001	< 0.001	-	-	-
Thallium	mg/L	-	-	< 0.0001	< 0.0001	<0.00020	<0.00020	<0.00020
Thorium	mg/L	-	-	< 0.0005	< 0.0005	-	-	-
Tin	mg/L	-	-	< 0.001	< 0.001	<0.00050	<0.00050	<0.00050
Titanium	mg/L	-	-	0.003	0.002	<0.010	0.038	<0.010
Tungsten	mg/L	-	-	-	-	-	-	-
Uranium	mg/L	-	-	< 0.0005	< 0.0005	<0.00020	<0.00020	<0.00020
Vanadium	mg/L	-	-	< 0.001	< 0.001	<0.0010	0.0019	<0.0010
Zinc[4]	mg/L	Variable, see below		0.035	*0.037*	0.0093	0.031	0.0075
Zirconium	mg/L	-	-	< 0.01	< 0.01	-	-	-
VARIABLE CRITERIA								
Cadmium FWAL (Unspecified)	mg/L			0.00004	0.00004	0.00006	0.00005	0.00004
Copper FWAL (30-Day)	mg/L			0.0051	0.0043	0.0072	0.0060	0.0046
Copper FWAL (Max)	mg/L			0.1223	0.1026	0.1721	0.1421	0.1092
Lead FWAL (30-Day)	mg/L			0.0077	0.0068	0.0101	0.0086	0.0071
Lead FWAL (Max)	mg/L			0.1118	0.0890	0.1738	0.1356	0.0965
Manganese FWAL (30-Day)	mg/L			1.3	1.3	2.4	1.3	1.3
Manganese FWAL (Max)	mg/L			2.2	2.2	4.9	2.2	2.2
Nickel FWAL (Unspecified)	mg/L			0.110	0.036	0.150	0.110	0.036
Zinc FWAL (30-Day)	mg/L			0.036	0.02025	0.07575	0.05175	0.0255
Zinc FWAL (Max)	mg/L			0.0615	0.0458	0.1013	0.0773	0.0510

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PARAMETERS	UNITS	RECEIVING WATER CRITERIA		SW-3 Overflow				
		Aquatic Life (FWAL)[1] (30 day)	Aquatic Life (FWAL)[1] (Max)	12-Nov-07	14-Jan-08	17-Apr-14	22-Oct-14	25-Nov-14
VOLATILE ORGANICS								
Benzene	mg/L	0.04	0.04	-	-	-	-	<0.00050
Bromodichloromethane	mg/L	-	-	-	-	-	-	<0.0010
Bromoform	mg/L	-	-	-	-	-	-	<0.0010
Carbon Tetrachloride	mg/L	0.0133	0.0133	-	-	-	-	<0.00050
Chlorobenzene	mg/L	0.0013	0.0013	-	-	-	-	<0.0010
Dibromochloromethane	mg/L	-	-	-	-	-	-	<0.0010
Chloroethane	mg/L	-	-	-	-	-	-	<0.0010
Chloroform	mg/L	0.0018	0.0018	-	-	-	-	<0.0010
Chloromethane	mg/L	-	-	-	-	-	-	<0.0050
1,2-Dichlorobenzene	mg/L	0.0007	0.0007	-	-	-	-	<0.00070
1,3-Dichlorobenzene	mg/L	0.15	0.15	-	-	-	-	<0.0010
1,4-Dichlorobenzene	mg/L	0.026	0.026	-	-	-	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	-	-	-	-	<0.0010
1,2-Dichloroethane	mg/L	0.1	0.1	-	-	-	-	<0.0010
1,1-Dichloroethylene	mg/L	-	-	-	-	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	-	-	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	-	-	-	-	<0.0010
1,3-Dichloropropene (cis&trans)	mg/L	-	-	-	-	-	-	<0.0014
Dichloromethane	mg/L	0.0981	0.0981	-	-	-	-	<0.0050
1,2-Dichloropropane	mg/L	-	-	-	-	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	-	-	-	-	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	-	-	-	-	<0.0010
Ethylbenzene	mg/L	0.2	0.2	-	-	-	-	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	3.4	3.4	-	-	-	-	<0.00050
Styrene	mg/L	0.072	0.072	-	-	-	-	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	-	-	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	-	-	-	-	<0.0010
Tetrachloroethylene	mg/L	0.111	0.111	-	-	-	-	<0.0010
Toluene	mg/L	0.0005	0.0005	-	-	-	-	**0.00230**
1,1,1-Trichloroethane	mg/L	-	-	-	-	-	-	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	-	-	-	-	<0.0010
Trichloroethylene	mg/L	0.021	0.021	-	-	-	-	<0.0010
Trichlorofluoromethane	mg/L	-	-	-	-	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	-	-	-	-	<0.0010
ortho-Xylene	mg/L	0.03	0.03	-	-	-	-	<0.00050
meta- & para-Xylene	mg/L	0.03	0.03	-	-	-	-	<0.00050
Xylenes	mg/L	0.03	0.03	-	-	-	-	<0.00075
Surrogate: 4-Bromofluorobenzene (SS)	%	-	-	-	-	-	-	88.4
Surrogate: 1,4-Difluorobenzene (SS)	%	-	-	-	-	-	-	98.2

H:\Project\1576\overflow\[1576_OverflowEvents_ChemistrySummary.xls]TABLE I-2014

Notes:

[1] FWAL = Fresh Water Aquatic Life Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html Accessed December 2014. Guidelines for the Protection of Fresh-Water Aquatic Life (FWAL).

[2] Bolding denotes parameters which exceed maximum FWAL water quality criteria.

[3] Italics denotes parameters which exceed 30 day average FWAL water quality criteria.

[4] FWAL guideline for indicated parameter changes with hardness. Water quality criteria was calculated on a per-sample basis (last rows of table). Water quality criteria shown in the "Receiving Water Criteria" columns is an average from all samples.

[5] FWAL guideline for indicated parameter changes with pH < 6.5.

[6] FWAL guideline for indicated parameter changes with ratio MeHg/THg.

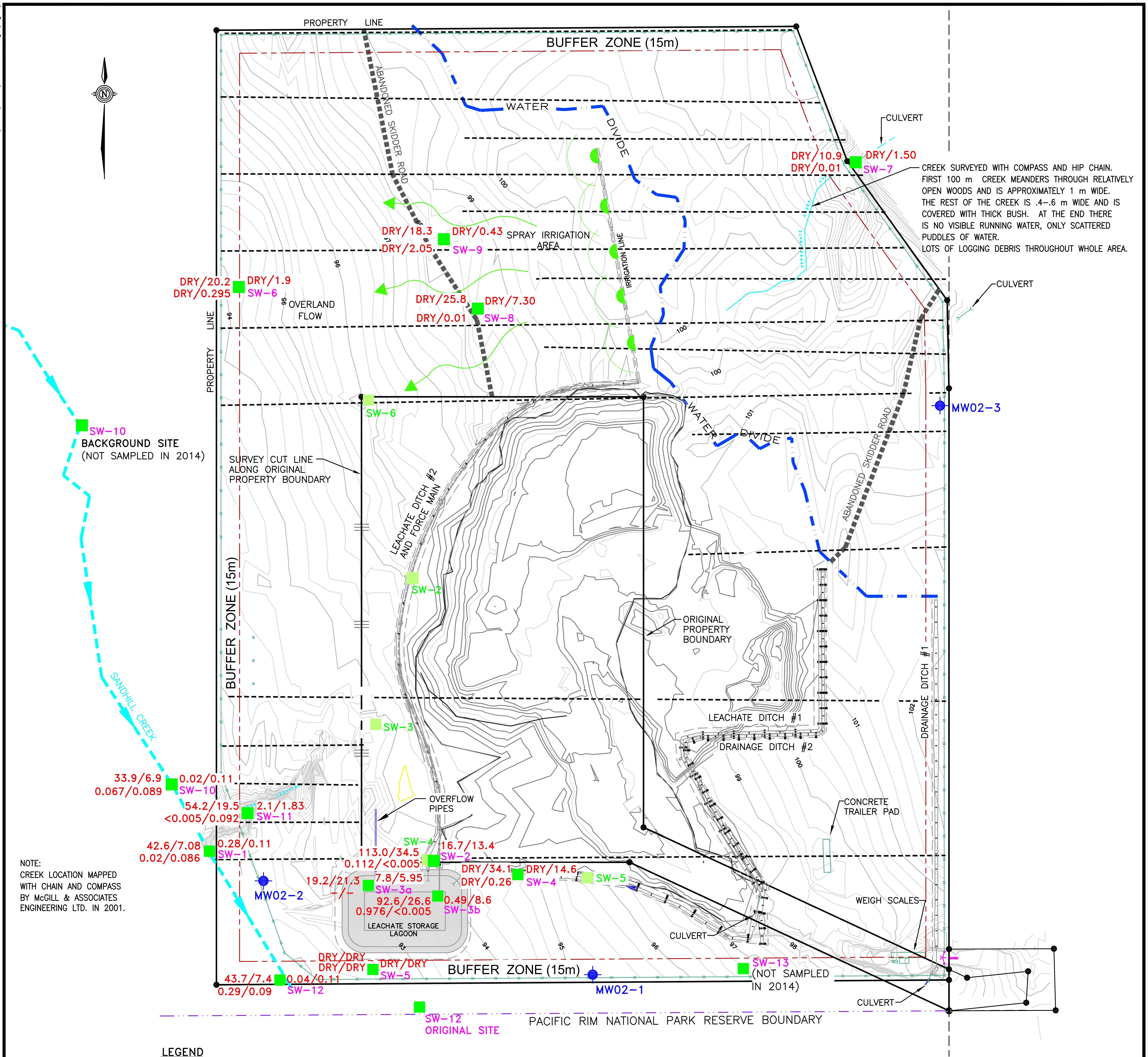
[7] Selenium alert concentration is 0.001 mg/L. Guideline is 0.002 mg/L.

[8] "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

[9] Underline denotes dissolved parameters which exceed the total concentrations, and are considered to be sampling or analytical errors.

FIGURE

DWG. NUMBER: K:\1576\Cadd\1576-035.dwg (Fig 1)



LEGEND

9.3/37.3 <0.01/0.05 / 0.17/2.29 SW-1	SAMPLING SITE AND PARAMETER CONCENTRATIONS (mg/L) (AUGUST, 2014 / OCTOBER, 2014) EXCEPT AS NOTED
CHLORIDE / AMMONIA / NITRATE / SAMPLING SITE	
SW-4	HISTORICAL SAMPLING SITES TO OCTOBER 2004
- - - - -	TYPICAL SURVEY LINE
MW02-2	MONITORING WELL

NOTES:

1. LEACHATE POND AND COLLECTION DITCHES CONSTRUCTED LATE SUMMER AND AUTUMN OF 2004.
2. SW-5 NOT SAMPLED IN 2014 DUE TO ABSENCE OF STANDING WATER.
3. SHC SAMPLING SITE LOCATED 900m SOUTH, AT HIGHWAY 4 CULVERT.
4. SW-13 SAMPLED IN 2009, THEN DISCONTINUED DUE TO ABSENCE OF LEACHATE INDICATORS.

ALBERNI - CLAYOQUOT REGIONAL DISTRICT

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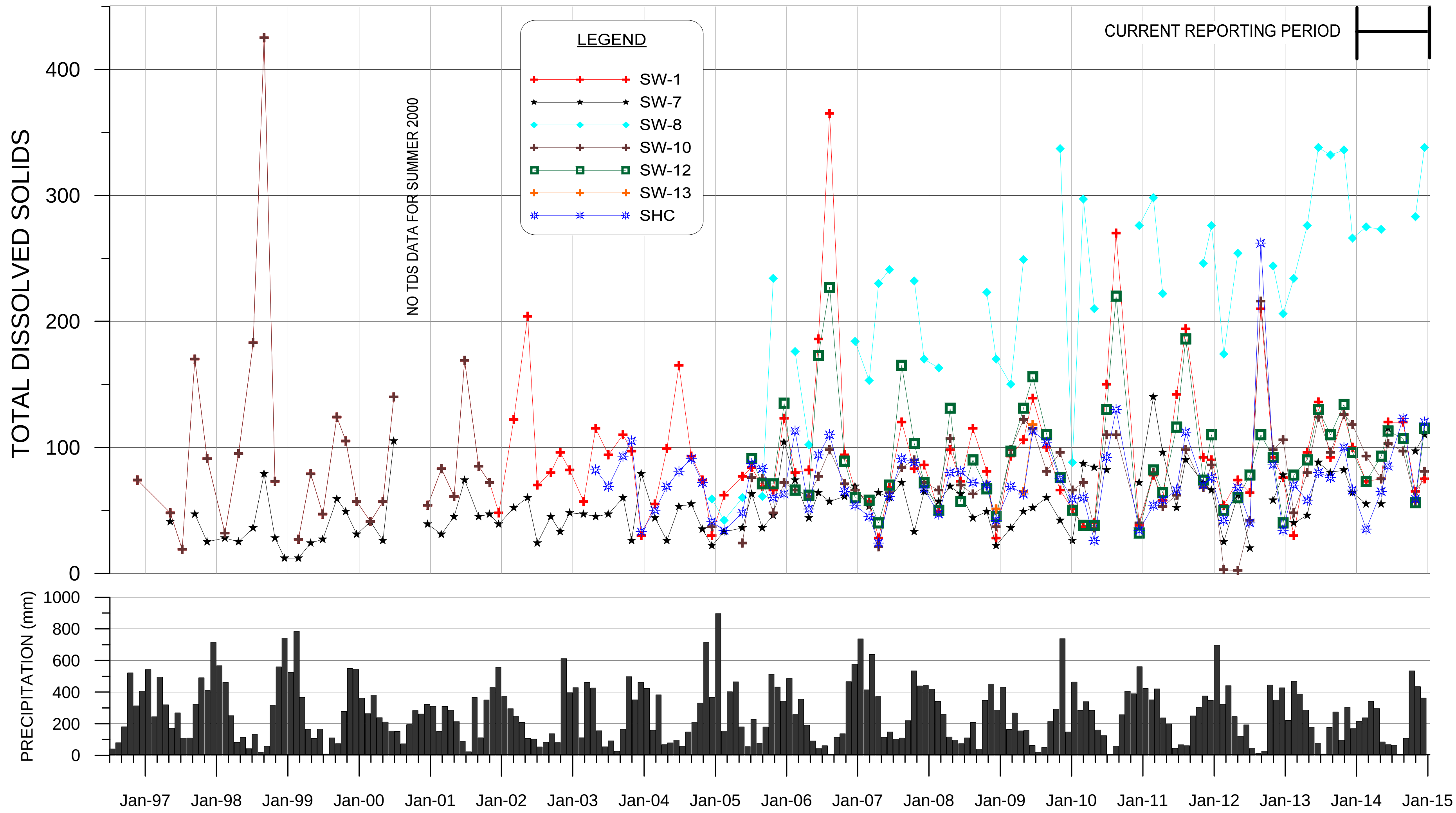
WEST COAST LANDFILL
UCLUELET, BC

PLAN SHOWING PROPERTY BOUNDARIES AND SAMPLING LOCATIONS

BY: JM/lf
DATE: APR 15
APPROVED: ATH
FIG: 1

APPENDIX A

MONITORING DATA PLOTS



NOTES:
1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data unavailable).

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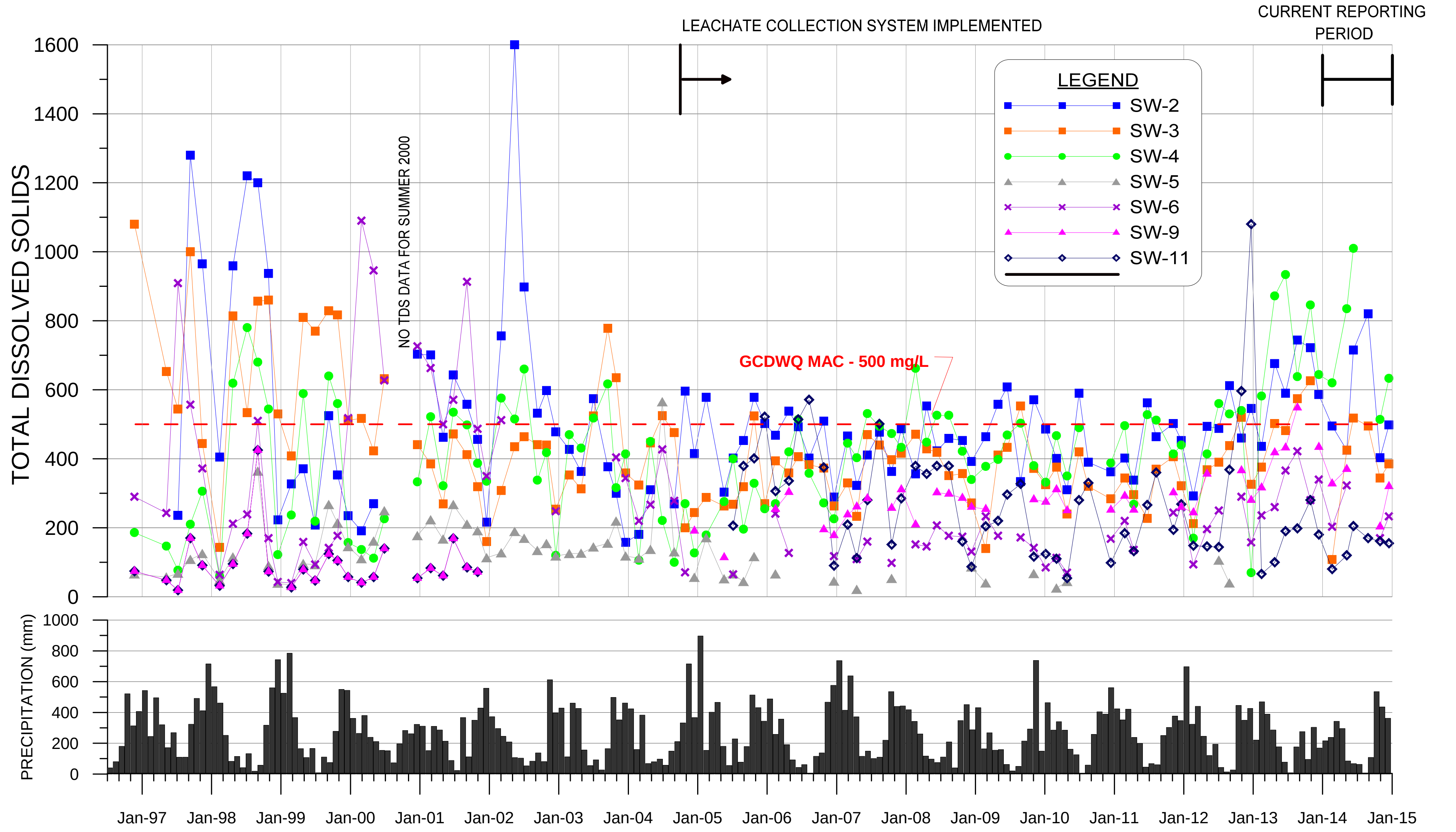
TOTAL DISSOLVED SOLIDS CONCENTRATION PLOT LOWER RANGE VALUES

BY:	DATE:
CAB	FEB 15
APPROVED:	FIG:
ATH	A1



NOTES:
1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data unavailable).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. SW-3 samples are from leachate lagoon commissioned in October 2004, and represents average quality of entire leachate flow.

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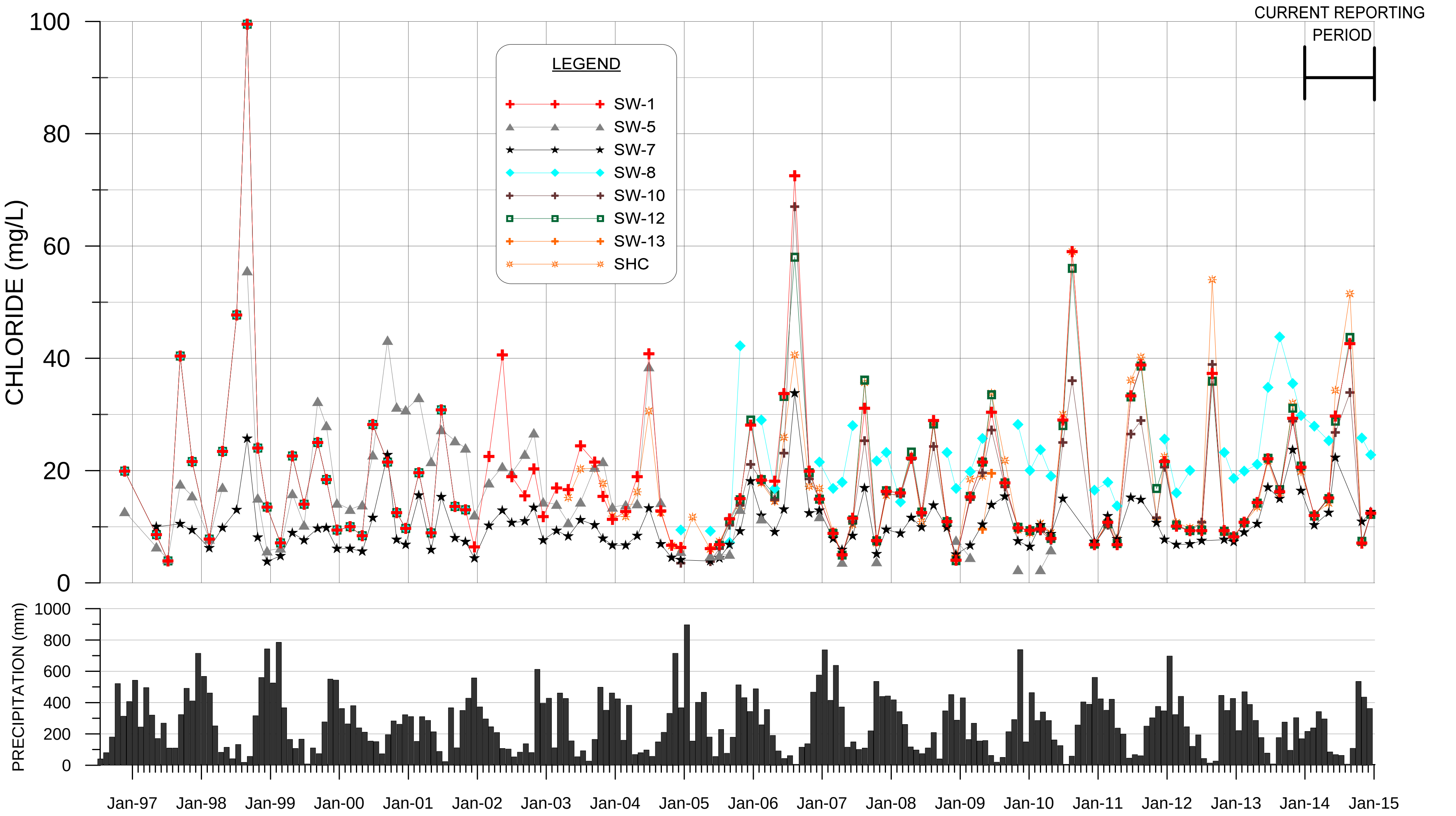
TOTAL DISSOLVED SOLIDS CONCENTRATION PLOT

BY: CAB	DATE: FEB 15
APPROVED: ATH	FIG: A-2



NOTES:
1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data unavailable).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. BC FWAL = 150 mg/L (30 Day Average)

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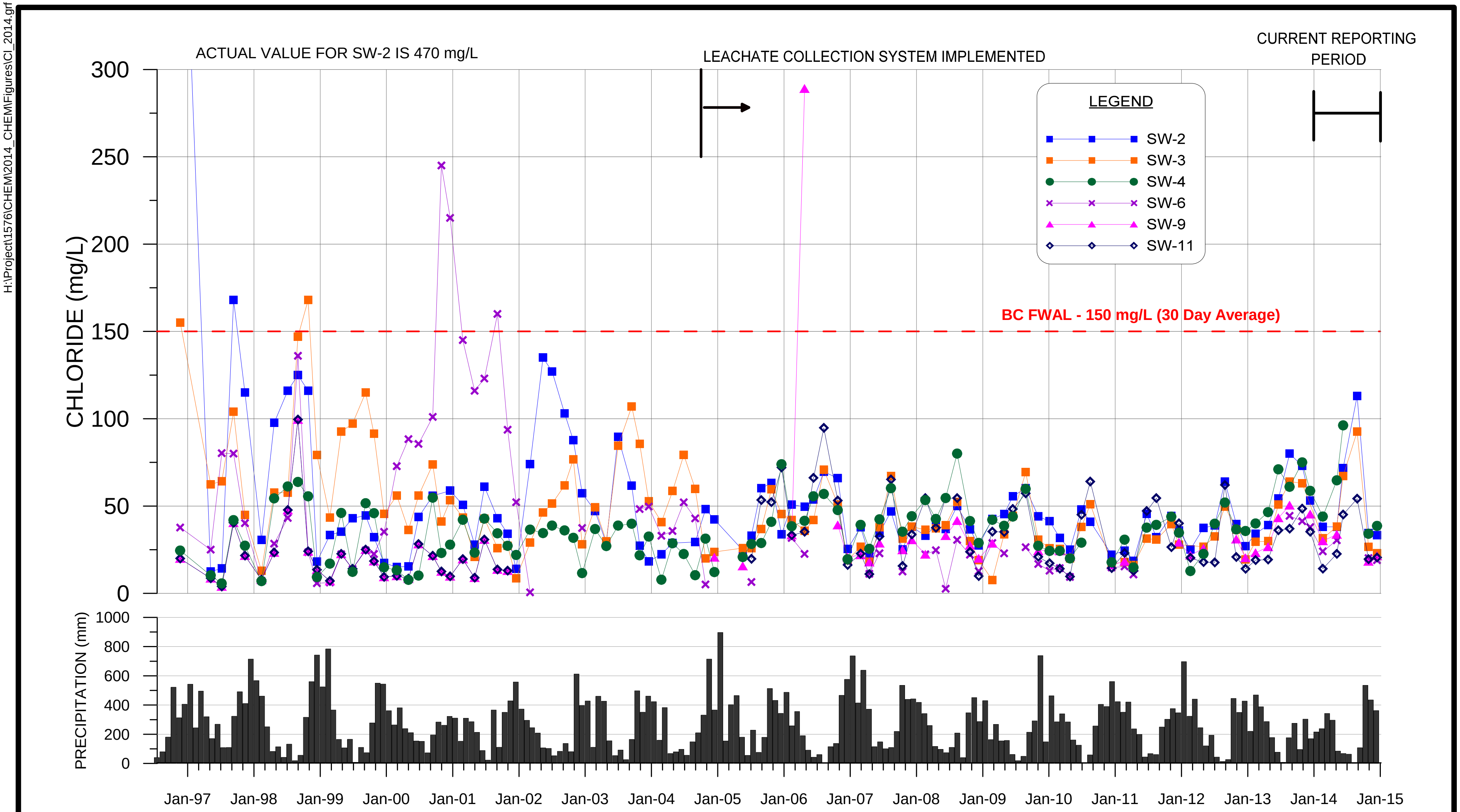
CHLORIDE CONCENTRATION PLOT LOWER RANGE VALUES

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A3



NOTES:
1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data not available).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. BC FWAL = 150 mg/L (30 Day Average)

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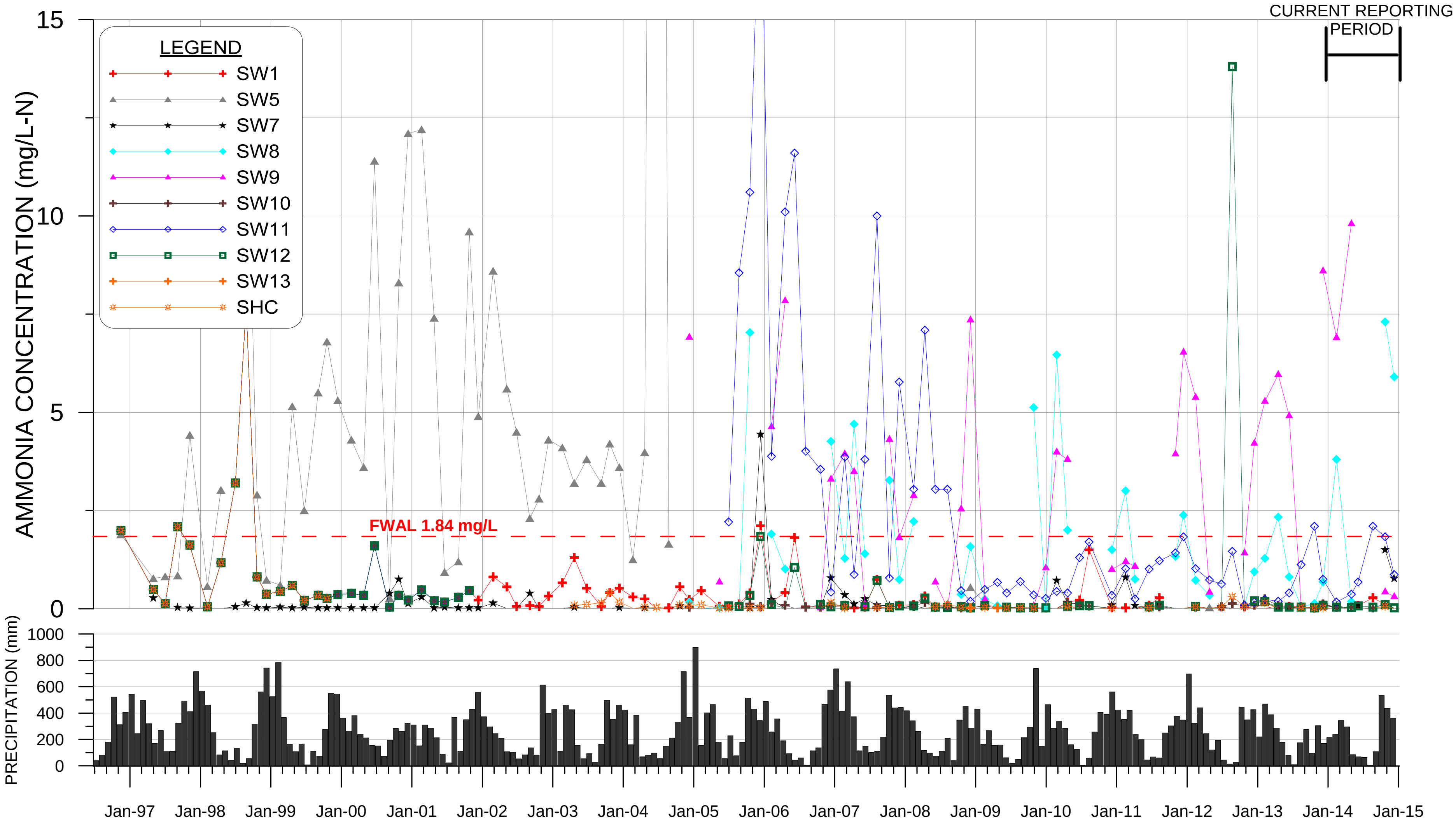
WEST COAST LANDFILL
UCLUELET, BC

CHLORIDE CONCENTRATION PLOT

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A-4



NOTES:
1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data unavailable).
2. BC FWAL = 1.84 mg/L (30 Day Average)

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WEST COAST LANDFILL
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AMMONIA NITROGEN CONCENTRATION PLOT LOWER RANGE VALUES

BY: CAB	DATE: FEB 15
APPROVED: ATH	FIG: A-5

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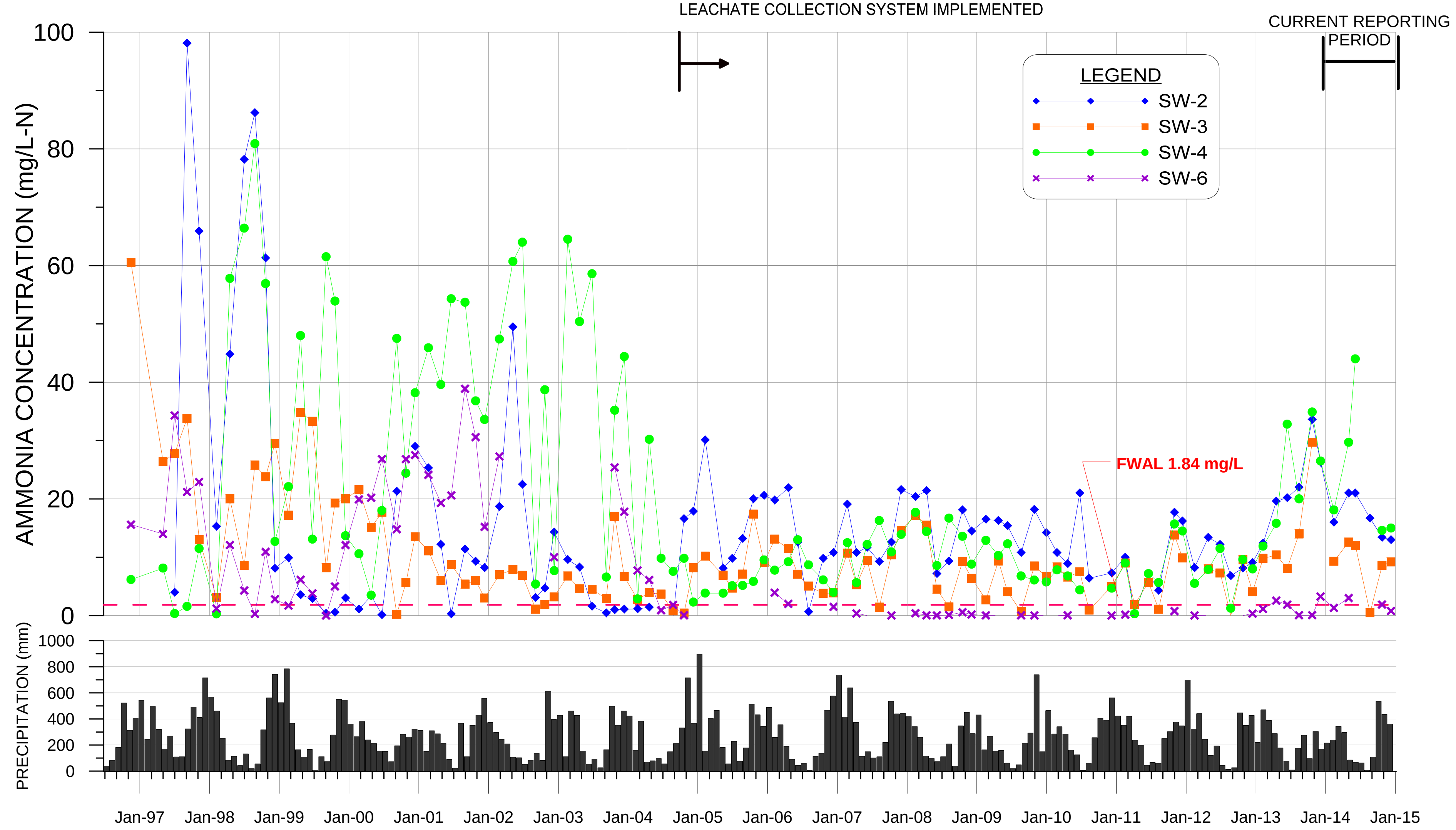

NOTES:

1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data unavailable).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. SW-3 samples are from leachate lagoon commissioned in October 2004, and represents average quality of entire leachate flow.
4. BC FWAL = 1.84 mg/L (30 Day Average)

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WEST COAST LANDFILL
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AMMONIA NITROGEN CONCENTRATION PLOT

BY:	DATE:
CAB	FEB 15
APPROVED:	FIG:
ATH	A-6

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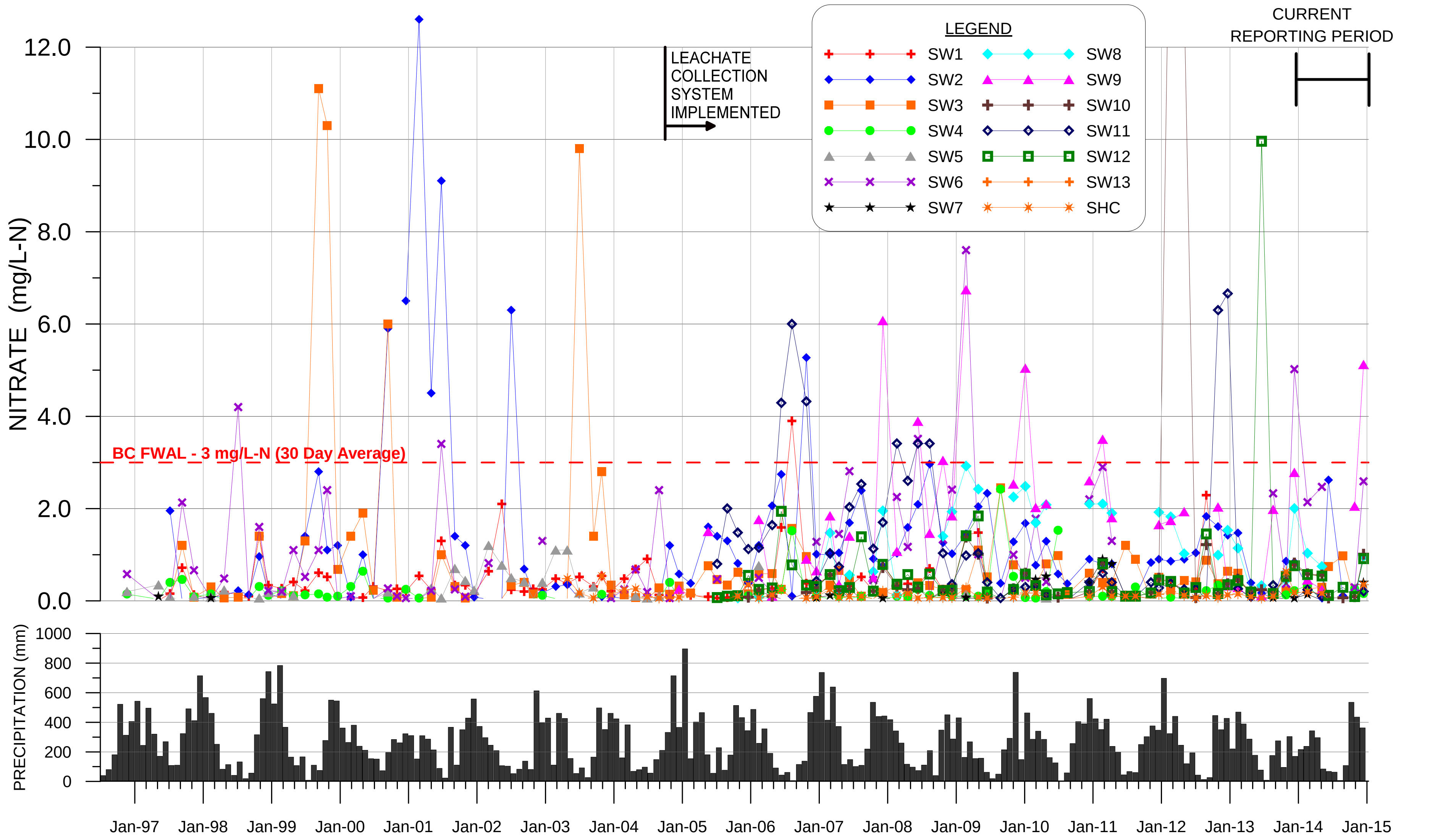

NOTES:

1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data unavailable).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. SW-3 samples are from leachate lagoon commissioned in October 2004, and represents average quality of entire leachate flow.
4. BC FWAL = 3 mg/L (30 Day Average)

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WEST COAST LANDFILL
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NITRATE (NITROGEN) CONCENTRATION PLOT

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A7

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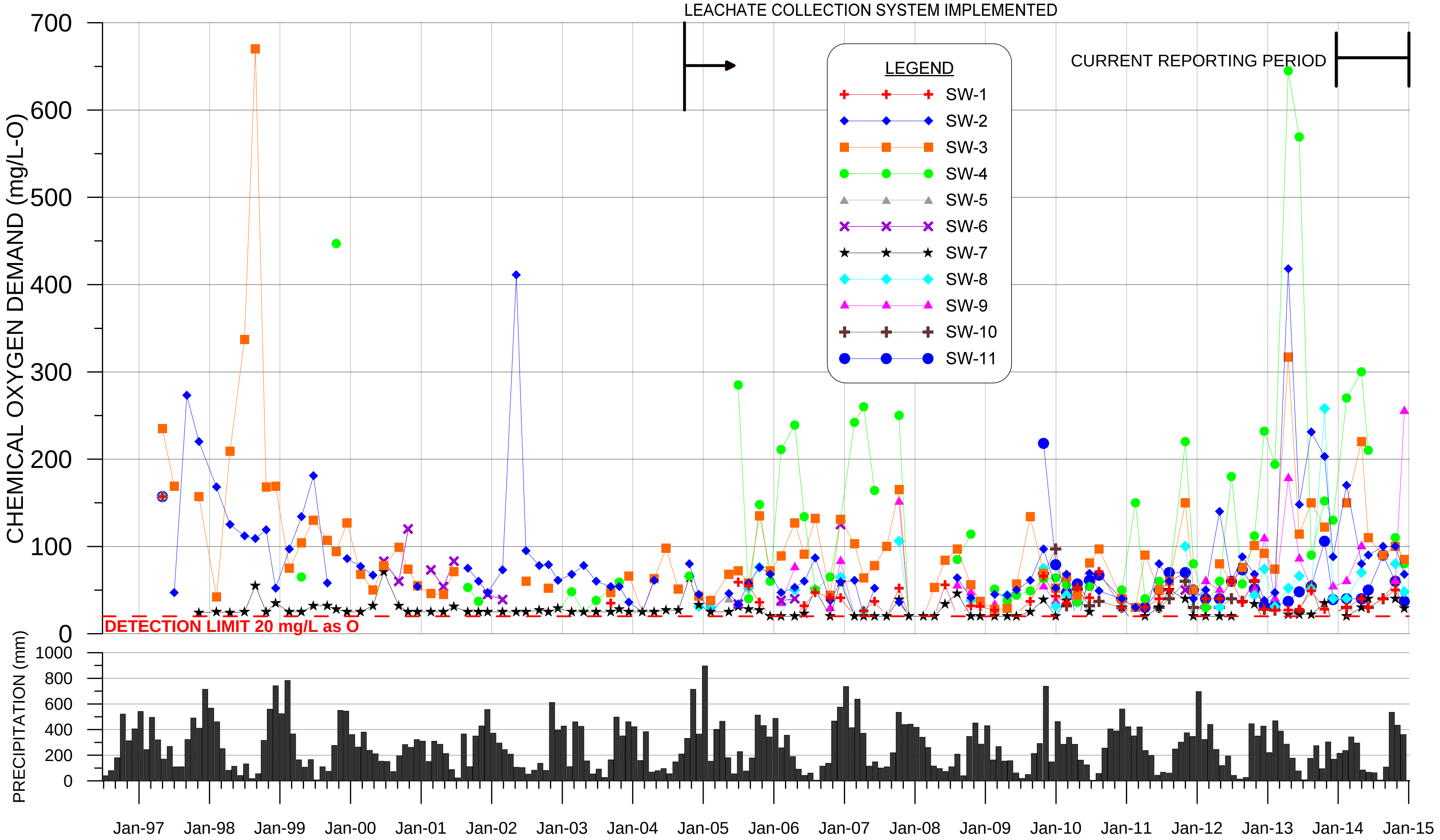

NOTES:

1. Monthly Tofino Airport climate data is plotted in bar chart (farmzon.com where Env Can data unavailable).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. SW-3 samples are from leachate lagoon commissioned in October 2004, and represents average quality of entire leachate flow.

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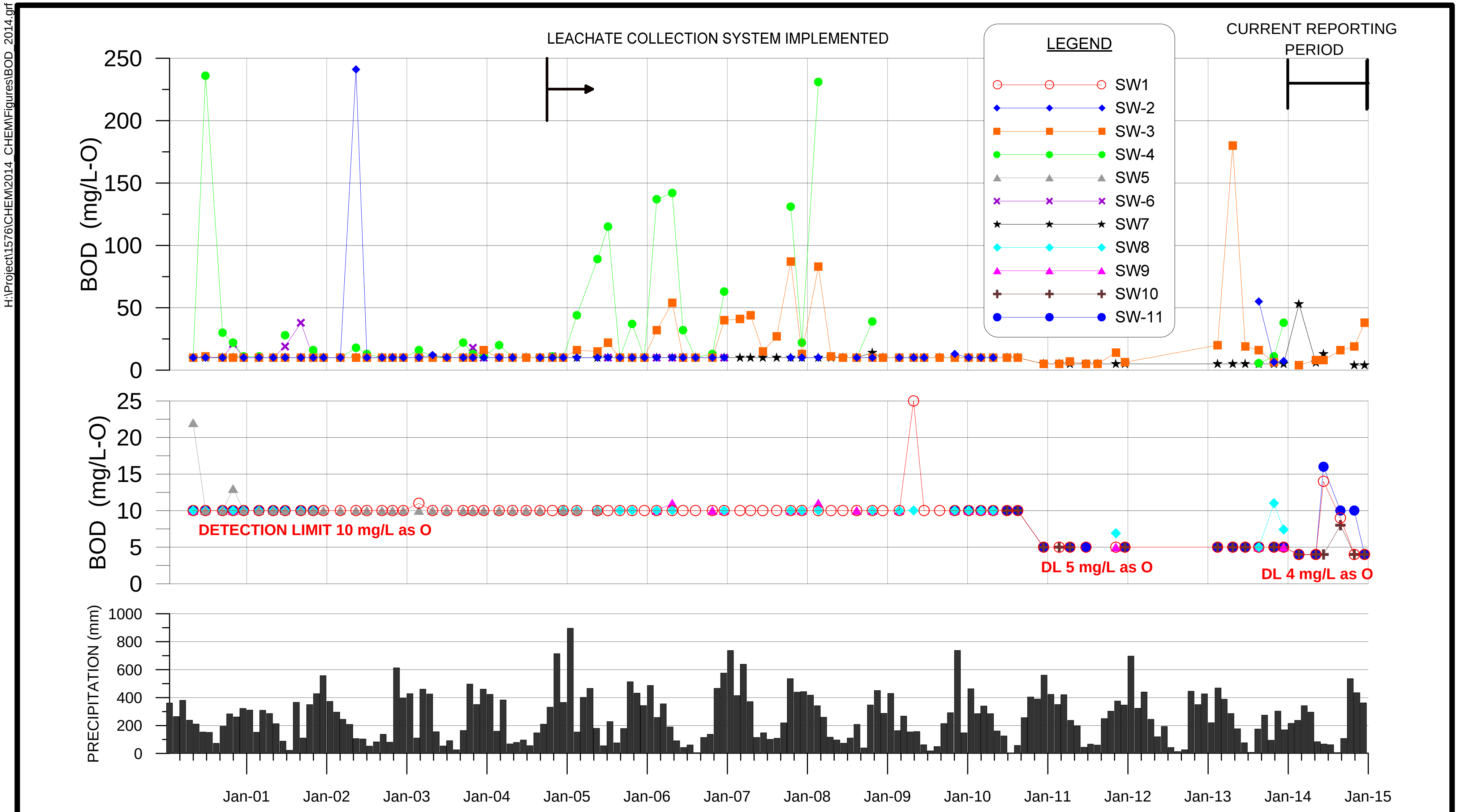
CHEMICAL OXYGEN DEMAND PLOT

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A-8



NOTES:
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2. SW-2 samples are from west leachate collector commissioned in October 2004.
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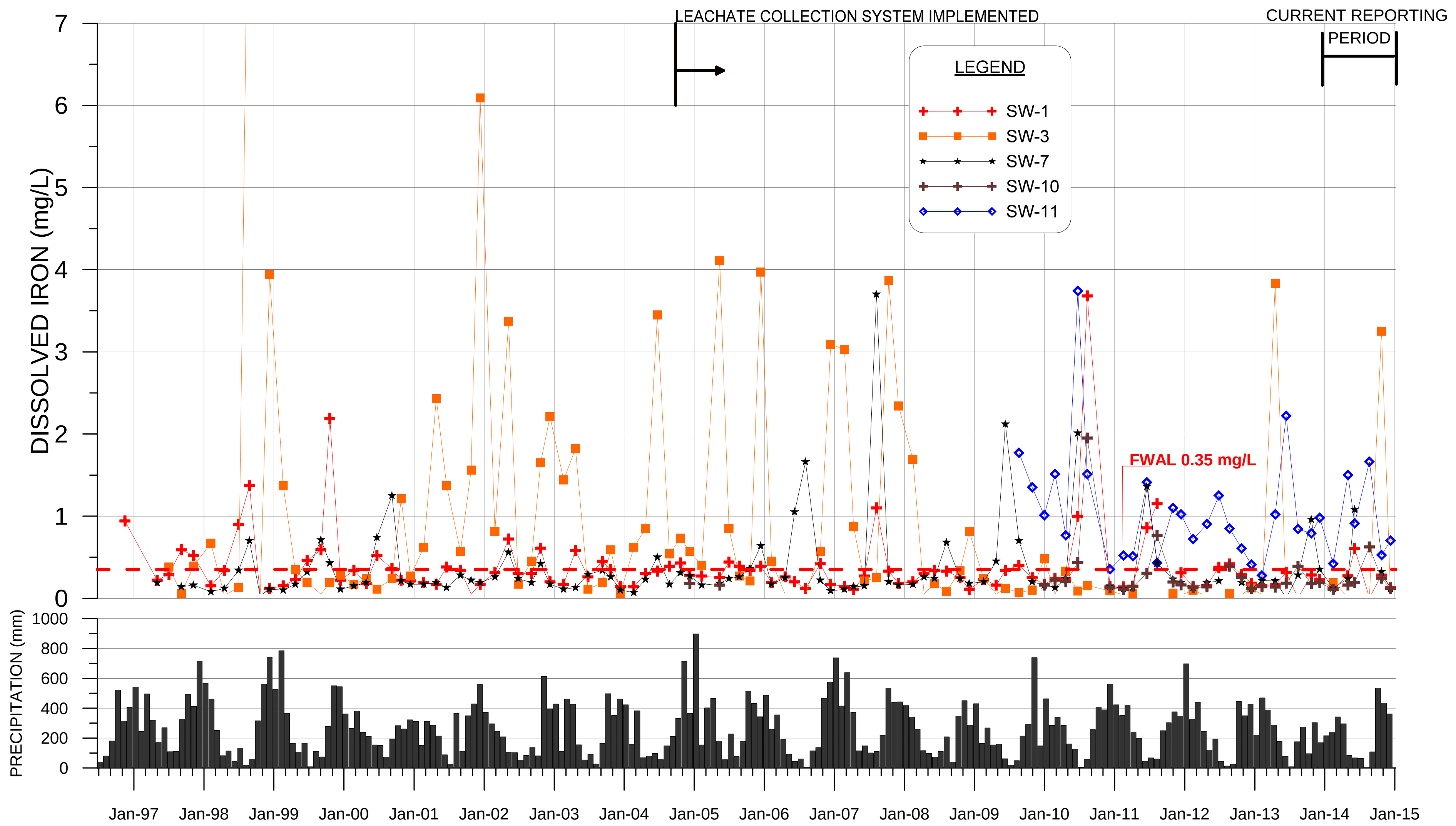
BIOLOGICAL OXYGEN DEMAND PLOT

BY:	DATE:
CAB	FEB 15
APPROVED:	FIG:
ATH	A9



NOTES:
1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data unavailable).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. SW-3 samples are from leachate lagoon commissioned in October 2004, and represents average quality of entire leachate flow.
4. BC FWAL = 0.35 mg/L

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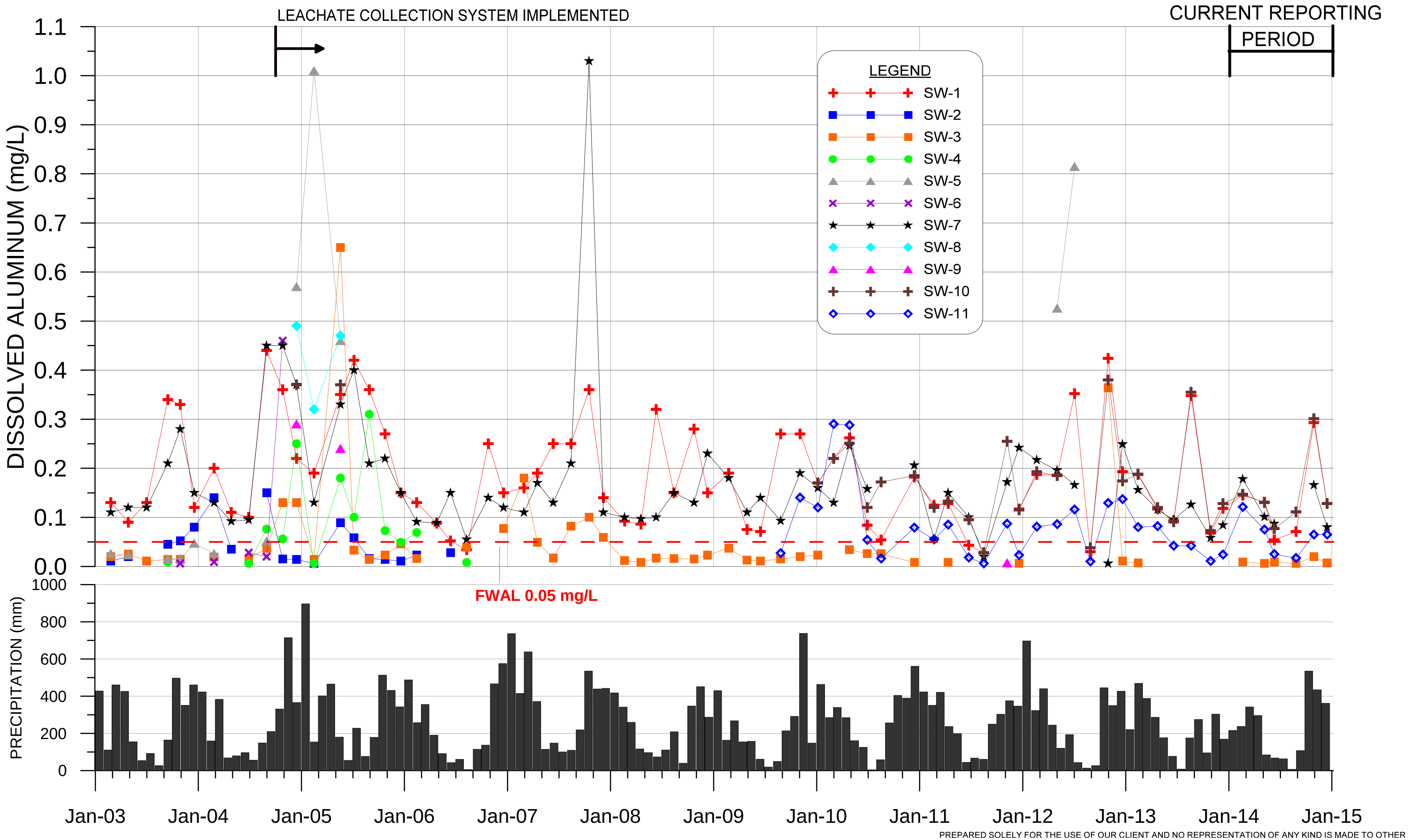
DISSOLVED IRON CONCENTRATION PLOT

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A-10



NOTES:

1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data unavailable).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. SW-3 samples are from leachate lagoon commissioned in October 2004, and represents average quality of entire leachate flow.

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DISSOLVED ALUMINUM CONCENTRATION PLOT

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A-11

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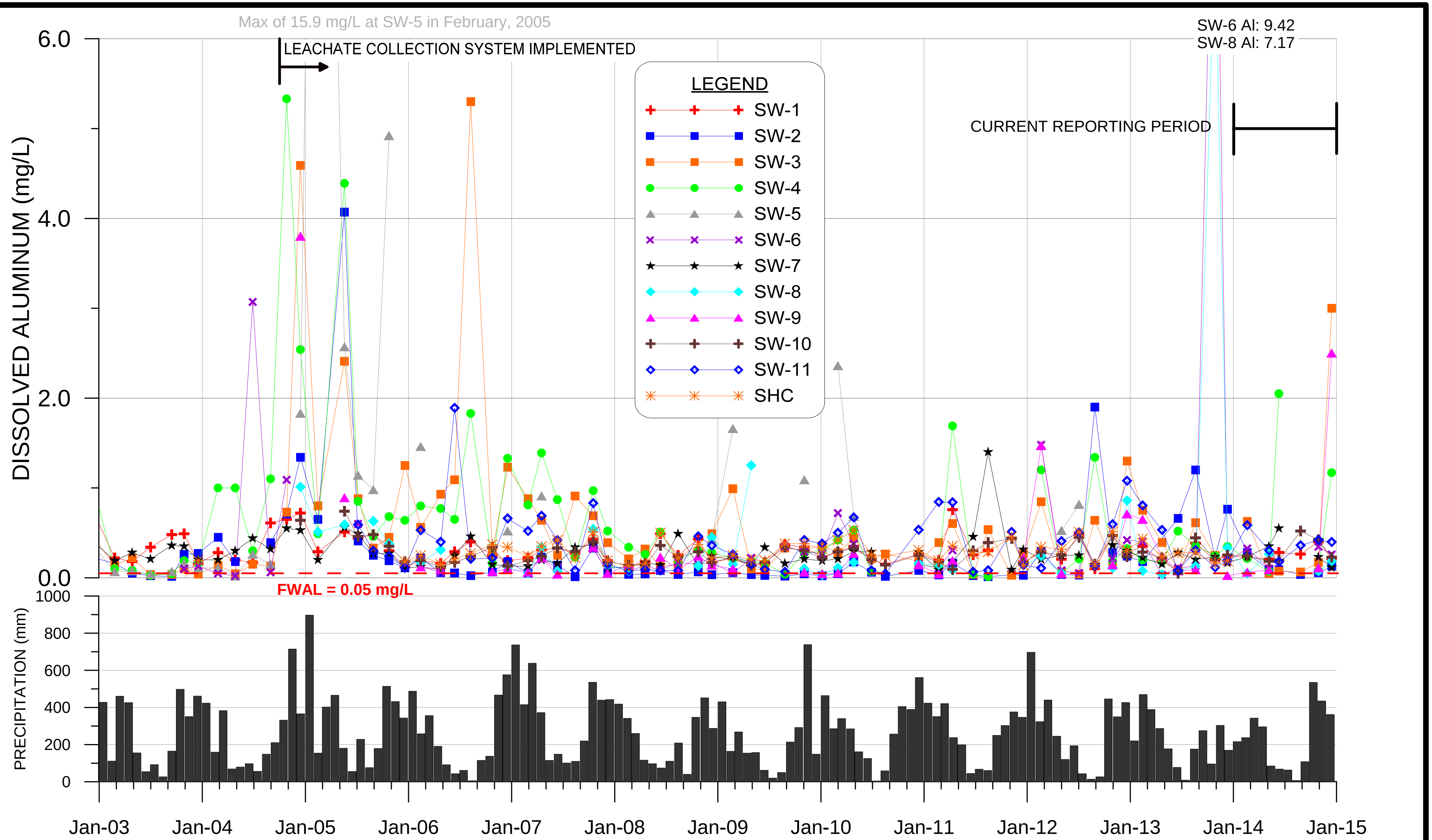

PREPARED SOLELY FOR THE USE OF OUR CLIENT AND NO REPRESENTATION OF ANY KIND IS MADE TO OTHER PARTIES WITH WHICH PITEAU ASSOCIATES ENGINEERING LTD. HAS NOT ENTERED INTO A CONTRACT.

NOTES:
1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data not available).
2. SW-2 samples are from west leachate collector commissioned in October 2004.
3. SW-3 samples are from leachate lagoon commissioned in October 2004, and represents average quality of entire leachate flow.
4. BC FWAL = 0.1 mg/L

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TOTAL ALUMINUM CONCENTRATION PLOT

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A-12

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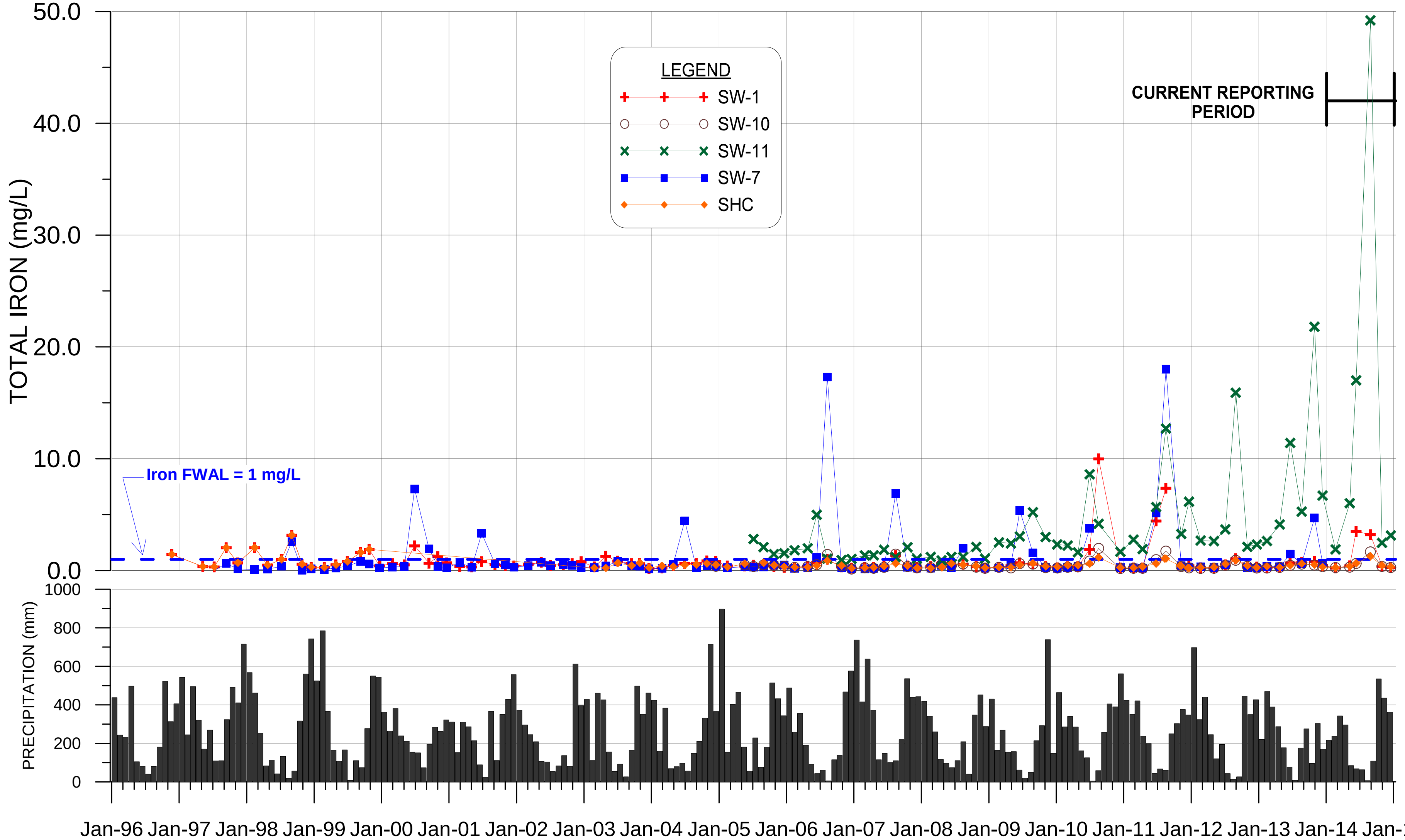

NOTES:

1. Monthly Tofino Airport climate data is plotted in bar chart (farmzone.com where Env Can data not available).
2. SW-1 concentrations much higher than SW-10 (upstream background) in summers of 2010 and 2011, indicating some leachate effect.

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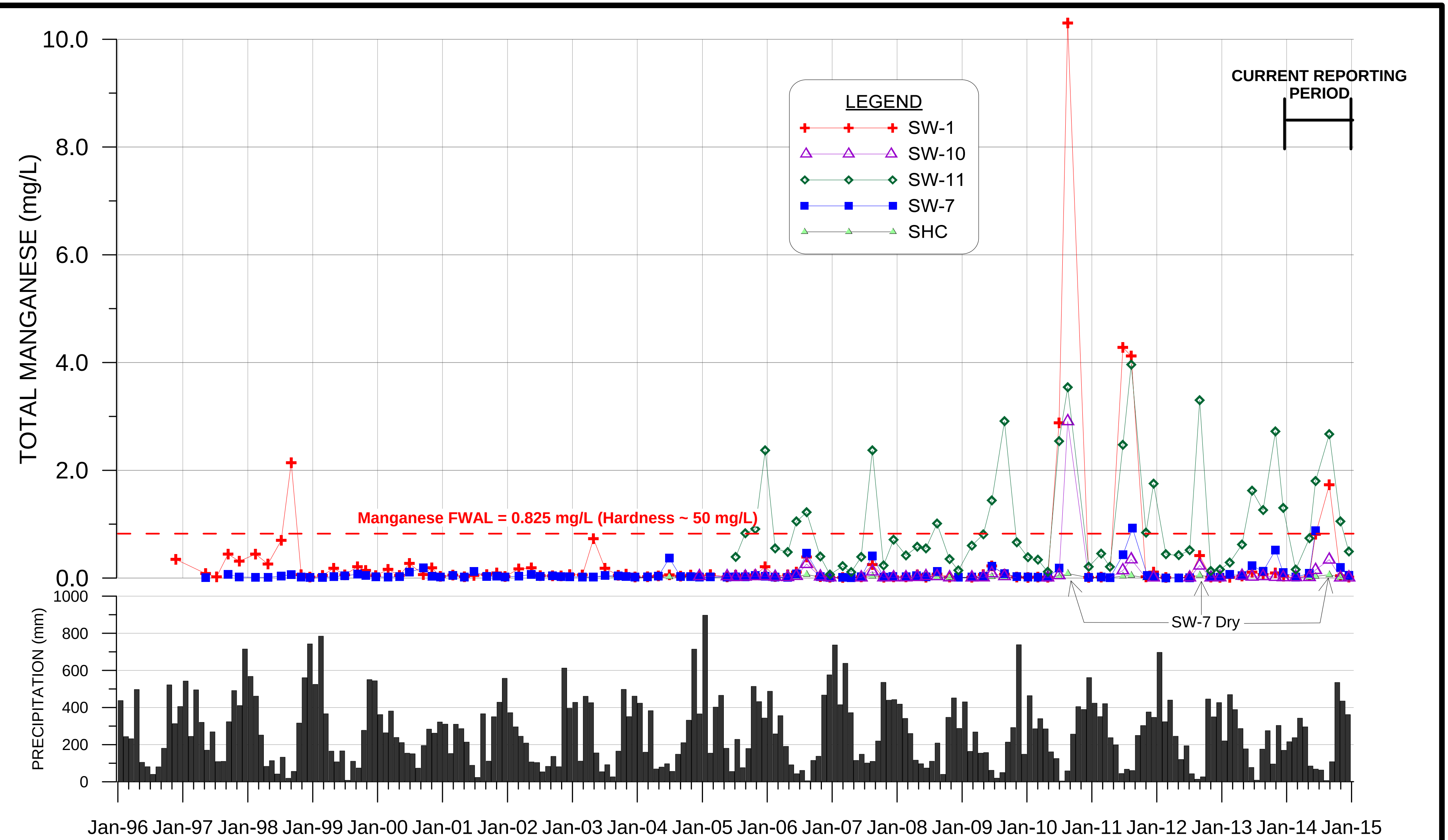
WEST COAST LANDFILL
UCLUELET, BC

TOTAL IRON CONCENTRATION PLOT
SW-1, SW-7, SW-10, SW-11 AND SHC

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A-13



NOTES:
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2. SW-1 concentrations much higher than SW-10 (upstream background) in summers of 2010 and 2011, indicating some leachate effect.

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UCLUELET, BC

TOTAL MANGANESE CONCENTRATION PLOT
SW-1, SW-7, SW-10, SW-11 AND SHC

BY:	DATE:
CAB	FEB 15
APPROVED: ATH	FIG: A-14

APPENDIX B

2014 MONITORING PROGRAM SAMPLING SUITE

TABLE B-1
SUMMARY OF WEST COAST LANDFILL SAMPLING SITES AND ANALYTICAL SUITES - 2014 PROGRAM

Site	Site Location	Field Parameters	LABORATORY								
			Physical Parameters	Anions	Nutrients	Total Metals	Dissolved Metals	BOD	COD	VOC Scan	LC_{50}
		temp, pH, conductance, colour	pH, conductance, TDS, total hardness	alkalinity, chloride, sulphate	ammonia, nitrate, total phosphate	ICP ICP/MS; FWAL detection limits	ICP ICP/MS; FWAL detection limits				
SW-1	Sandhill Creek near landfill	x	x	x	x	x	x	x	x		
SW-2	West leachate collector ditch	x	x	x	x	Al, Fe and Mn only		x	x		
SW-3	Leachate storage lagoon	x	x	x	x	x	x	x	x	x	
SW-4	West leachate collector ditch	x	x	x	x	Al, Fe and Mn only		x	x		
SW-5 [2]	South property line	Not sampled in 2014									
SW-6 [2]	West property line	x	x	x	x	Al, Fe and Mn only					
SW-7 [2]	Background at east property line	x	x	x	x	x	x	x	x		
SW-8 [2]	Irrigation area	x	x	x	x	Al, Fe and Mn only		x	x		
SW-9 [2]	Irrigation area	x	x	x	x	Al, Fe and Mn only		x	x		
SW-10	Sandhill Creek upstream of landfill	x	x	x	x	x	x	x	x		
SW-11	West drainage at property line	x	x	x	x	x	x	x	x		
SW-12	Sandhill Trib at south property line	x	x	x	x	Al, Fe and Mn only					
SW-13	Standing water along road to leachate lagoon	Not sampled in 2014									
Sandhill Creek d/s [1]	Sandhill Creek at Highway	x	x	x	x	Al, Fe and Mn only					

H:\Project\1576\SAMPLING\[SAMPLING-SITES.xls]Table B-1_2014

Notes:
1. Sandhill Creek d/s has not shown any impact to date.
2. SW-5, SW-6, SW-7, SW-8 and SW-9 not sampled during dry months, due to insufficient water.

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SUITE 300 - 788 COPPING STREET
NORTH VANCOUVER, B.C.
CANADA - V7M 3G6
TEL: (604) 986-8551 / FAX: (604) 985-7286
www.piteau.com

Our file: 1576

June 16, 2014

McGill & Associates Engineering Ltd.
3003 4th Avenue
Port Alberni, BC V9Y 2B8

Attention: Mr. Alan McGill, P.Eng.

Dear Sirs:

Re: 2014 Leachate Lagoon Overflow – West Coast Landfill – Alberni-Clayoquot Regional District

The leachate lagoon at the West Coast Landfill overflowed during an extreme storm event in April 2014. A total of 85mm of rain was recorded at the Tofino Airport on April 15 to 17, which caused the overflow. Decant from the lagoon was sampled on April 17.

The results of the overflow sampling from the lagoon are listed in Tables I and II, along with data from the 2013 bimonthly monitoring program of the water contained in the lagoon. As shown, most parameters were more dilute in the overflow sample than in the bimonthly samples, with the exceptions of total phosphorus, BOD and total aluminum. The former two parameters were within the envelope of the 2013 data, but the total aluminum was significantly higher. Relatively high concentrations for these three parameters are likely related to turbidity in the leachate lagoon during the overflow event.

The ammonia concentration of 7.8 mg/L-N exceeded the 30-day average FWAL guideline of 1.84 mg/L-N, but was less than 40% of the 20.5 mg/L-N maximum concentration. Total aluminum, chromium, copper and iron concentrations exceeded their respective FWAL criteria, but only copper has a maximum criteria defined. Hence, the other metals have been evaluated against their 30-day average criteria. The only dissolved metal to exceed FWAL guidelines was chromium, which was only 10% over the objective concentration.

With the exception of total aluminum, metal concentrations would all comply with their respective FWAL guidelines with less than about 5:1 dilution. Aluminum would require about 10:1 dilution. Considering the duration of the overflow event, the elevated aluminum background chemistry and the minimal dilution necessary to achieve compliance with FWAL objectives in Sandhill Creek, the effect of the overflow event is not considered significant.

If you have any questions regarding these results, or our assessment of same, please contact us.

Yours truly,

PITEAU ASSOCIATES ENGINEERING LTD.

PROFESSIONAL PROVINCE OF ANDREW T. HOLMES BRITISH COLUMBIA ENGINEER

June 16/2014

Andrew T. Holmes, P.Eng.

ATH/slc

Att.

c. Alan McGill, McGill & Associates (pdf)

TABLES

TABLE I
WATER CHEMISTRY DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-3

PARAMETERS	units	Aquatic Life (FWAL)[1] (30 day)	Aquatic Life (FWAL)[1] (Max)	SAMPLING DATE - CURRENT REPORTING PERIOD						OVERFLOW EVENT
				13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	17-Apr-14
PHYSICAL TESTS										
Colour	CU	-		-	-	-	-	-		
Total Hardness ($CaCO_3$)	mg/L	-		273	306	252	285	384	Not Sampled	181
Total Dissolved Solids	mg/L	-		376	502	482	574	626		
pH - Lab	pH	-		7.74	7.10	8.10	7.80	7.60		
pH - Field	pH	-		-	7.38	7.96	-	-		
ORP - Lab	mv	-		-	-	-	-	-		
ORP - Field	mv	-		-36.6	-112.4	8.0	-	-		
Conductivity - Lab	µS/cm	-		709	826	767	990	1205		
Conductivity - Field	µS/cm	-		640	769	755	-	-		
Temperature - Field	°C	-		8.3	17.3	20.7	-	-		
DISSOLVED ANIONS										
Alkalinity - Total	mg/L	-		290	350	350	360	500		
Chloride	mg/L	150	600	29.5	29.9	50.9	64	63		19.2
Sulphate	mg/L	309	309	23.4	10.7	4.9	36.4	19.3		13.7
DISSOLVED CATIONS										
Calcium	mg/L	-		90.1	105.0	77.7	89.8	123.0		62.6
Magnesium	mg/L	-		9.9	10.9	14.2	14.7	18.8		6.01
Potassium	mg/L	-		9.8	11.4	16.3	19.7	24.1		8.1
Sodium	mg/L	-		30.3	34.6	55.5	60.5	69.3		19.2
NUTRIENTS										
Ammonia Nitrogen	mg/L as N	1.84	20.5	**9.8**	**10.4**	**8.1**	**14.0**	**29.7**		**7.8**
Nitrate Nitrogen	mg/L as N	3.0	32.8	0.6	<0.05	<0.05	<0.05	0.22		<0.005
Total Phosphorus	mg/L as P	-		0.031	0.22	0.20	0.12	0.041		0.213
ORGANIC PARAMETERS										
Chemical Oxygen Demand	mg/L as O	-	-	74	317	114	150	122		106
Biological Oxygen Demand	mg/L as O	-		20	180	19	16	6.3		32.5

H:\Project\1576\CHEM\2014_CHEM\[SW3-2014.xlsx]NON-VOLATILES

Notes:

1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed May 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE II
METAL MONITORING DATA SUMMARY FOR SURFACE WATER SAMPLING SITE SW-3

		RECEIVING WATER CRITERIA		SAMPLING DATE - CURRENT REPORTING PERIOD						OVERFLOW EVENT
PARAMETERS	units	Aquatic Life (FWAL)[1] (30 day)	Aquatic Life (FWAL)[1] (Max)	13-Feb-13	23-Apr-13	19-Jun-13	20-Aug-13	28-Oct-13	11-Dec-13	17-Apr-14
TOTAL METALS										
Aluminum	mg/L	0.05	0.1	**0.751**	**0.393**	0.095	**0.613**	**0.248**	Not sampled	**1.18**
Arsenic	mg/L	0.005	0.005	0.00087	0.00109	0.0015	0.0029	0.0018		0.001
Barium	mg/L	1.0	5.0	0.0536	0.0872	0.054	0.081	0.087		0.04
Boron	mg/L	1.2	1.2	0.549	0.468	0.794	0.925	0.916		0.30
Cadmium	mg/L	0.00003	0.00005	0.00003	0.00003	0.00001	0.00003	0.00002		0.0001
Chromium	mg/L	0.001	0.001	**0.0016**	**0.0018**	**0.0011**	**0.0027**	**0.0017**		**0.0028**
Copper	mg/L	0.004	0.0072	0.002	0.0018	0.001	0.003	0.001		**0.01**
Iron	mg/L	1	1	**7.47**	**29.8**	**11.9**	**11.6**	**7.12**		**5.41**
Lead	mg/L	0.006	0.173	0.0008	0.0004	0.0003	0.0005	0.0002		0.001
Manganese	mg/L	1.05	2.52	**1.55**	**2.51**	**1.16**	**1.65**	**2.12**		0.89
Mercury	ug/L	0.02	n/a	<0.1	<0.1	<0.10	<0.010	<0.01		<0.000010
Nickel	mg/L	0.065	0.11	0.0037	0.0034	0.004	0.007	0.006		0.00320
Selenium	mg/L	0.002	n/a	0.0003	0.0002	<0.0006	**0.0028**	**0.0026**		0.0001
Zinc	mg/L	0.015	0.1005	**0.0224**	**0.0208**	0.007	**0.016**	0.007		0.0483
DISSOLVED METALS										
Aluminum	mg/L	0.05	0.1	0.007	<0.005	<0.005	<0.005	<0.005		0.0713
Arsenic	mg/L	0.005	0.005	0.0005	0.0007	0.0012	0.0022	0.0013		0.00053
Barium	mg/L	1.0	5.0	0.046	0.065	0.033	0.044	0.055		0.027
Boron	mg/L	1.2	1.2	0.522	0.602	0.724	0.953	0.963		0.3
Cadmium	mg/L	0.00003	0.00005	0.00002	<0.00001	<0.00001	<0.00001	<0.00001		0.000018
Chromium	mg/L	0.001	0.001	0.0007	0.0024	0.0008	0.0023	0.0042		**0.0011**
Copper	mg/L	0.004	0.0072	0.003	<0.001	0.007	0.002	<0.001		0.0011
Iron	mg/L	0.35	1	0.044	3.83	0.014	0.039	0.015		0.58
Lead	mg/L	0.006	0.173	<0.0001	<0.0001	0.0002	0.0002	<0.0001		<0.00050
Manganese	mg/L	1.05	2.52	**1.43**	**2.52**	0.756	0.0132	0.994		0.812
Mercury	ug/L	0.02	n/a	<0.1	0.01	<0.1	<0.01	<0.00001		<0.000010
Nickel	mg/L	0.025	0.11	0.0036	0.004	0.025	0.006	0.006		0.0021
Selenium	mg/L	0.002	n/a	<0.0002	<0.0006	<0.0006	0.0027	<0.0006		<0.00010
Zinc	mg/L	0.015	0.1005	0.006	<0.001	0.005	0.002	0.002		0.0093

H:\Project\1576\CHEM\2014_CHEM\[SW3-2014.xlsx]Metals

Notes:
1. Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. Available: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html#approved Accessed May 2014. Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown.
2. Bolding denotes parameters which exceed water quality criteria.
3. "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
4. FWAL guideline for Al changes with pH
5. FWAL guideline for Cd, Cu, Pb, Mn, and Z changes with hardness. Value shown appropriate for hardness of 100 mg/L-$CaCO_3$

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SUITE 300 - 788 COPPING STREET
NORTH VANCOUVER, B.C.
CANADA - V7M 3G6
TEL: (604) 986-8551 / FAX: (604) 985-7286
www.piteau.com

Our file: 1576

September 15, 2014

McGill & Associates Engineering Ltd.
3003 4th Avenue
Port Alberni, BC V9Y 2B8

Attention: Mr. Alan McGill, P.Eng.

Dear Sirs:

Re: 2014 Leachate Lagoon Overflow Sampling Recommendation – West Coast Landfill – Alberni-Clayoquot Regional District

The leachate lagoon at the West Coast Landfill has overflowed at an approximate annual frequency since it was commissioned in the fall of 2004. The last overflow event occurred following an extreme storm event in April 2014. A total of 85mm of rain was recorded at the Tofino Airport between April 15 and April 17, 2014, which caused the overflow. Decant from the lagoon was sampled on April 17, and a letter summarizing the results was prepared for McGill & Associates Engineering Ltd. on June 16, 2014.

Considering the frequency of the lagoon overflow events, a formal monitoring protocol should be in place to document these events when they occur. The following flow monitoring and sampling programs are recommended.

FLOW MONITORING

A method to measure the cumulative flow that decants from the pond over the period of an upset event should be established. A program to continuously monitor flows in the receiving Sandhill Creek should also be established.

Monitoring of flows through the decant pipe from the leachate storage lagoon could be achieved by attaching a sealed tube to the invert of the pipe, to transmit pressure to a data logger situated at a lower elevation than the pipe invert. The data logger would record the level in the pipe at 15-minute frequencies, and flow could be estimated with a Manning Equation calculation. The data logger could be in place from October 1 to May 1 each year, to record levels over this period.

Flow monitoring in Sandhill Creek could be achieved by standard stream gauging methods. A data logger and staff gauge should be installed near the SW-1 sampling site, and a series of flow gauging measurement conducted at various creek stage levels, to establish a stage-flow relationship. Staff gauge readings would be taken at the time of each sampling event to provide some calibration data for the data logger, and the data logger would be download twice per year.

Other flow monitoring data that would be useful for assessing the effects of the landfill on receiving water quality include the flow pumped from the leachate storage lagoon to the irrigation system, and the ambient flow in the natural gulley at SW-11. These two programs should be implemented at the same time as the leachate lagoon decant flow monitoring, above.

To measure flows that are discharged from the leachate lagoon during normal operation, a cumulative flow meter should be installed on the leachate irrigation system. Readings should be recorded weekly, to document the leachate quantity that is discharged via the irrigation system.

Flows in the small gulley at SW-11 should be monitored with a small weir constructed across the gulley, and a data logger and staff gauge to record levels. As with Sandhill Creek, the staff gauge should be read every time a sample is collected from SW-11, and the data logger should be downloaded twice per year. This data would be used to quantify the flow that enters Sandhill Creek along this pathway.

All data loggers used for the above monitoring should be 2m range instruments, to provide better than 2mm resolution in the head readings.

WATER CHEMISTRY MONITORING

Samples should be collected from the leachate lagoon decant flow and from the Sandhill Creek SW-1 site during overflow events. It would preferable to collect the samples near the mid-point of the event, but it could be at any convenient time, and sooner would be better than later if there is a chance the decant event would be of short duration.

Two coolers, each with the required bottles for one sampling suite, should be kept on site for this program. If the decant event continues for more than week, a second suite of samples should be collected. The landfill operator should collect the samples, and should be given instruction on sample collection and preservation methods.

A second sampling tube could be connected to the invert of the decant pipe, near the tube for the data logger. This tube should be run to the bottom of a five gallon container with a lid. A small hole near the top of the container would allow flow to decant from the container, such that the container would always hold the most recent water from the decant pipe, and would store this water in the event the decant flow were to stop. If active sampling of a decant flow was missed for any reason, a sample could be collected from the water in the container.

The sampling suite should include the list of analytes in Table I.

If you have any questions regarding the recommended leachate lagoon overflow event sampling program, please contact us.

Yours truly,

PITEAU ASSOCIATES ENGINEERING LTD.

Andrew T. Holmes, P.Eng.

ATH/slc

Att.

cc: John Thomas, ACRD (pdf)

TABLE

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PARAMETERS	units	RECEIVING WATER CRITERIA		
		GCDWQ MAC or AO[1]	Aquatic Life (FWAL)[1] (30 day)	Aquatic Life (FWAL)[1] (Max)
PHYSICAL TESTS				
Colour	CU	15		
Total Hardness ($CaCO_3$)	mg/L			
Total Dissolved Solids	mg/L	500		
pH - Lab	pH	6.5-8.5		
pH - Field	pH			
ORP - Lab	mv			
ORP - Field	mv			
Conductivity - Lab	µS/cm			
Conductivity - Field	µS/cm			
Temperature - Field	°C			
DISSOLVED ANIONS				
Alkalinity - Total	mg/L	-	-	
Chloride	mg/L	250	150	600
Sulphate	mg/L	500	309	309
DISSOLVED CATIONS				
Calcium	mg/L			
Magnesium	mg/L			
Potassium	mg/L			
Sodium	mg/L	200		
NUTRIENTS				
Ammonia Nitrogen	mg/L as N	-	1.84	20.5
Nitrate Nitrogen	mg/L as N	10.0	3.0	32.8
Total Phosphorus	mg/L as P			
ORGANIC PARAMETERS				
Chemical Oxygen Demand	mg/L as O			
Biological Oxygen Demand	mg/L as O			
TOTAL METALS				
Aluminum	mg/L	0.2	0.05	0.1
Arsenic	mg/L	0.01	0.005	0.005
Barium	mg/L	1.0	1.0	5.0
Boron	mg/L	-	1.2	1.2
Cadmium	mg/L	0.005	0.00003	0.00005
Chromium	mg/L	0.05	0.001	0.001
Copper	mg/L	1.0	0.004	0.0072
Iron	mg/L	0.3	1	1
Lead	mg/L	0.01	0.006	0.173
Manganese	mg/L	0.05	1.05	2.52
Mercury	ug/L	1.0	0.02	n/a
Nickel	mg/L	-	0.065	0.11
Selenium	mg/L	0.01	0.002	n/a
Zinc	mg/L	5.0	0.015	0.1005
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pH - Field	pH			
ORP - Lab	mv			
ORP - Field	mv			
Conductivity - Lab	µS/cm			
Conductivity - Field	µS/cm			
Temperature - Field	°C			
DISSOLVED ANIONS				
Alkalinity - Total	mg/L	-	-	
Chloride	mg/L	250	150	600
Sulphate	mg/L	500	309	309
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Magnesium	mg/L			
Potassium	mg/L			
Sodium	mg/L	200		
NUTRIENTS				
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Nitrate Nitrogen	mg/L as N	10.0	3.0	32.8
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ORGANIC PARAMETERS				
Chemical Oxygen Demand	mg/L as O			
Biological Oxygen Demand	mg/L as O			
TOTAL METALS				
Aluminum	mg/L	0.2	0.05	0.1
Arsenic	mg/L	0.01	0.005	0.005
Barium	mg/L	1.0	1.0	5.0
Boron	mg/L	-	1.2	1.2
Cadmium	mg/L	0.005	0.00003	0.00005
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APPENDIX E

WASTE CATEGORIZATION FROM 2009 TO 2014 &

ESTIMATED WASTE COMPOSITION FOR 2014

Table 1: Summary of WCL Scale Records 2009 to 2014

	Summary of Annual Weights (tonnes)					
Type of Waste	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Residential Mixed Waste	570	639	688	825	805	1108
Industrial, Commercial & Institutional Mixed Waste	3093	3220	2862	2865	2688	2819
Construction, Renovation & Demolition						
Roofing	n/a	n/a	32	47	66	90
Gyproc	8	14	24	33	41	34
Mixed Material	863	688	1092	1210	1239	802
Land Clearing	n/a	n/a	22	69	26	5
Septic Tank Pumpings	-	-	-	5	5	10
Animal Carcasses	3	5	13	0	1	1
Fish Feed Totes	n/a	n/a	2	1	2	0
Contaminated Soil	n/a	n/a	n/a	n/a	n/a	68
Compost	n/a	n/a	n/a	n/a	n/a	78
Total	**4537**	**4566**	**4735**	**5055**	**4873**	**5015**

Notes:

1. Based on records provided by the ACRD

Estimated Waste Composition - 2014

Waste Type	Mass (tonnes)	Mass (%)	Waste Category (tonnes)		
			Relatively Inert	Moderately Decomposable	Decomposable
1. Residential Mixed Waste	**1,108**	**-**			
Organics	531	47.9	-	-	531
Paper	208	18.8	-	208	-
Plastics	122	11.0	122	-	-
Multi-material	105	9.5	105	-	-
Textiles & Rubber	52	4.7	52	-	-
Other	22	2.0	-	22	-
Wood	4	0.4	-	4	-
Ferrous	25	2.3	25	-	-
Glass	21	1.9	21	-	-
Renovation	7	0.6	7	-	-
Non-ferrous	9	0.8	9	-	-
Haz-waste	1	0.1	1	-	-
		Subtotal =	342	235	531
2. Industrial, Commercial and Institutional Mixed Waste	**2,819**	**-**			
Organics	896	31.8	-	-	896
Paper	1,106	39.3	-	1,106	-
Plastics	260	9.2	260	-	-
Wood	166	5.9	-	166	-
Multi-material	10	0.4	10	-	-
Renovation	0	0.0	0	-	-
Textiles & Rubber	32	1.1	32	-	-
Ferrous	139	4.9	139	-	-
Glass	195	6.9	195	-	-
Other	0	0.0	-	0	-
Haz-waste	4	0.1	-	4	-
Non-ferrous	10	0.4	10	-	-
		Subtotal =	646	1,277	896
3. Construction, Renovation & Demolition	**926**	-			
Roofing	**90**		90	-	-
Gyproc	**34**		34	-	-
Mixed Demolition	**802**		-	-	-
Wood	243	30.3	-	243	-
Other	235	29.3	235	-	-
Concrete	136	17.0	136	-	-
Drywall	87	10.8	87	-	-
Asphalt	64	8.0	64	-	-
Non-ferrous	21	2.6	21	-	-
Paper product	10	1.2	-	10	-
Ferrous	6	0.8	6	-	-
		Subtotal =	673	253	0
4. Contaminated Soil	**68**	-	68	-	-
5. Land Clearing	**5**	-	-	-	5
6. Septic Tank Pumpings	**10**	-	-	10	-
7. Animal Carcasses	**1**	-	-	-	1
8. Compost	**78**	-	-	-	78
9. Fish Feed Totes	**0**	-	0	-	-
Total Waste (tonnes)=	**5,015**		**1,730**	**1,774**	**1,511**
Percentage (%) =	**100%**		**34%**	**35%**	**30%**

APPENDIX F

LANDFILL GAS GENERATION MODEL RESULTS

Year of Assessment	2015		LFG Management Regulation Referen
Annual Tonnage in Preceding Year	5,015	(tonnes/year)	4-2-a
Total waste in Place in the Preceding Y	105,975	(tonnes/year)	4-2-c
Methane generation in the Preceding Y	264	(tonnes CH4/year)	4-2-d

Next Five Years	Waste Tonnage (tonnes)	Methane Generation (tonnes CH4/year)	
2015	5,015	270	4-2-b & 4-2-e
2016	5,015	274	4-2-b & 4-2-e
2017	5,015	278	4-2-b & 4-2-e
2018	5,015	282	4-2-b & 4-2-e
2019	5,015	286	4-2-b & 4-2-e

ıce

	Relatively Inert	Moderately Decomposabl	Decomposable	
Gas Production potential, Lo =	20	120	160	m^3 CH4/tonne
lag time before start of gas production, lag =	1	years		
Historical Data Used (years)	30			
1st Year of Historical Data Used	1985			
4 Years after Reporting Year	2019			
methane (by volume)	50%			
carbon dioxide (by volume)	50%			
methane (density) - 1atm, 25C	0.6557	kg/m^3	(25C,SP)	
carbon dioxide (density)	1.7988	kg/m^3	(25C,SP)	

				Waste Tonnage			Methane Generation Rate, k			
Year	Year Number	Annual Tonnage (tonnes)	Cumulative Waste-in-place (tonnes)	Relatively Inert (tonnes)	Moderately Decomposable (tonnes)	Decomposable (tonnes)	Relatively Inert ($year^{-1}$)	Moderately Decomposable ($year^{-1}$)	Decomposable ($year^{-1}$)	Annual Methane Production (tonnes/yr)
1985	1	2,400	2,400	528	1,200	672	0.03	0.08	0.13	0.00
1986	2	2,400	4,800	528	1,200	672	0.03	0.08	0.13	16.14
1987	3	2,400	7,200	528	1,200	672	0.03	0.08	0.13	30.67
1988	4	2,400	9,600	528	1,200	672	0.03	0.08	0.13	43.74
1989	5	2,400	12,000	528	1,200	672	0.03	0.08	0.13	55.52
1990	6	2,520	14,520	554	1,260	706	0.03	0.08	0.13	66.13
1991	7	2,520	17,040	554	1,260	706	0.03	0.08	0.13	76.52
1992	8	2,520	19,560	554	1,260	706	0.03	0.08	0.13	85.89
1993	9	2,520	22,080	554	1,260	706	0.03	0.08	0.13	94.36
1994	10	2,520	24,600	554	1,260	706	0.03	0.08	0.13	102.01
1995	11	2,650	27,250	583	1,325	742	0.03	0.08	0.13	108.93
1996	12	2,650	29,900	583	1,325	742	0.03	0.08	0.13	116.07
1997	13	2,650	32,550	583	1,325	742	0.03	0.08	0.13	122.53
1998	14	2,650	35,200	583	1,325	742	0.03	0.08	0.13	128.38
1999	15	2,650	37,850	583	1,325	742	0.03	0.08	0.13	133.68
2000	16	3,536	41,386	778	1,768	990	0.03	0.08	0.13	138.49
2001	17	3,106	44,492	683	1,553	870	0.03	0.08	0.13	148.81
2002	18	3,678	48,170	809	1,839	1,030	0.03	0.08	0.13	155.24
2003	19	4,390	52,560	966	2,195	1,229	0.03	0.08	0.13	164.92
2004	20	4,348	56,908	957	2,174	1,217	0.03	0.08	0.13	178.45
2005	21	4,752	61,660	1,045	2,376	1,331	0.03	0.08	0.13	190.39
2006	22	4,686	66,346	1,031	2,343	1,312	0.03	0.08	0.13	203.89
2007	23	5,390	71,736	1,186	2,695	1,509	0.03	0.08	0.13	215.64
2008	24	5,456	77,192	1,200	2,728	1,528	0.03	0.08	0.13	230.99
2009	25	4,540	81,732	1,485	1,795	1,260	0.03	0.08	0.13	245.31
2010	26	4,560	86,292	1,419	1,808	1,333	0.03	0.08	0.13	249.24
2011	27	4,740	91,032	1,677	1,788	1,275	0.03	0.08	0.13	253.78
2012	28	5,055	96,087	1,822	1,859	1,375	0.03	0.08	0.13	257.09
2013	29	4,873	100,960	1,823	1,783	1,267	0.03	0.08	0.13	261.85
2014	30	5,015	105,975	1,730	1,774	1,511	0.03	0.08	0.13	264.30
2015	31	5,015	110,990	1,730	1,774	1,511	0.03	0.08	0.13	269.58
2016	32	5,015	116,005	1,730	1,774	1,511	0.03	0.08	0.13	274.28
2017	33	5,015	121,020	1,730	1,774	1,511	0.03	0.08	0.13	278.48
2018	34	5,015	126,035	1,730	1,774	1,511	0.03	0.08	0.13	282.23
2019	35	5,015	131,050	1,730	1,774	1,511	0.03	0.08	0.13	285.59

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

3008 Fifth Avenue, Port Alberni, B.C. CANADA V9Y 2E3 Telephone (250) 720-2700 FAX: (250) 723-1327

MEMORANDUM

To: West Coast Committee

From: Andrew McGifford, CPA, CGA Manager of Environmental Services

Meeting Date: June 14, 2017

Subject: Organic Processing Facility Feasibility Analysis and grant application update - WCLF

Summary:

The attached report was sourced by staff to provide a more focused feasibility study that could be undertaken at each landfill location in order to provide synergies by using the infrastructure that was already in place. The aim of the investigation was to provide a cost effective model specific for the west coast and have a project that would work with the limited volumes of waste.

Staff have been busy the past month sourcing information and analysis for the Strategic Priorities Fund - Consolidated Strategic Landfill Diversion Program application. The grant application covers 100% of the capital cost of the project up to 6 million dollars and these projects must be regional in scope. The submission for the grant application took all waste within the ACRD into consideration.

The grant application for the WCLF included the following, with Class "C" estimates:
1) Organic facility – similar to the Cumberland model - $600,000 estimated cost
2) Waterline on Highway into landfill site – firefighting capacity $406,000
3) Minor scale shack improvements. $60,000
4) Transfer Station expansion to allow additional diversion. $150,000

Submitted by: ______________________________
Andrew McGifford, CPA, CGA, Manager of Environmental Services

Approved by: ______________________________
Wendy Thomson, Acting Chief Administrative Officer

May 29th, 2017

Alberni-Clayoquot Regional District

Prepared for:
Alberni-Clayoquot Regional District
3008 5th Ave
Port Alberni, BC
V9Y 2E3

Submitted by:
Net Zero Waste Inc.
4283 Perry Street
Vancouver, B.C.
V5N-3X6

Alberni-Clayoquot Regional District
3008 5th Ave
Port Alberni, BC, V9Y 2E3
(250) 720-2717 (Phone)
(250) 723-1327 (Fax)

May 29th, 2017

Attention: Andrew McGifford, CPA, CGA; Manager of Environmental Services

Re: Preliminary Estimate and Organic Processing Facility Feasibility Analysis

Please find enclosed the preliminary report for the above mentioned project which outlines the results of our on-site investigation, as well as provides you with the necessary capital and operating cost information you require to evaluate your options moving forward. Few commercial facilities operate at a scale less than 10,000 TPA as the costs per tonne rise quickly below this capacity. An exception to this rule is when a composting facility is added to an existing waste management operations such as a Transfer Station, Landfill, MRF, or WWTP. For the purposes of this review, we have used information which previously demonstrated that the Gore Cover System represented the lowest risk option for implementation at the scale required by the ACRD.

An estimate of the costs associated with the construction and operation of a small scale model of this type of system has been provided in the following report. For the Western Landfill (Tofino) a suitable available area was identified. This site would utilize existing infrastructure and labour to be cost competitive with existing disposal options. Time would also be required to obtain necessary permitting and public approval before local facility siting could be considered as a possibility should this be the desire of the ACRD staff and council.

It has been demonstrated with our team at multiple locations across BC, that it is possible to sustainably and cost competitively divert additional organic materials from landfill at a smaller scale. The Gore Covers can be customized to any size and have no moving parts which facilitate a simpler lower maintenance operation suitable to smaller centers. The result of an implemented diversion will be a reduction in overall waste costs today with additional savings in the future as transportation and landfill costs continue to rise.

A curbside food and yard waste program will provide additional opportunities to divert commercial organics or expand the program to multi-family units or schools resulting in drastic improvements in waste diversion rates for the region. Following a more in depth detailed design and construction estimate you will be able to move forward with an understanding of the costs and responsibilities associated with a locally operated facility. We would be pleased to have the opportunity to work with you and your team again as you progress with the next phase of your project and remain at your service should you need support moving forward.

Very truly yours,

NET ZERO WASTE INC.
Per:

Mateo Ocejo, P.Eng.
Director

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1 Executive Summary

The Alberni-Clayoquot Regional District recently commissioned Net Zero Waste Inc. to evaluate options for the management of organic materials produced regionally. Representing the largest recyclable fraction of the waste stream, diverting organics from the waste, is expected to immediately lower disposal costs. Furthermore, development of a source-separated organics program will also limit exposure and long term liability associated with rising waste disposal rates in the future. Finally, source separating organics will significantly increase the environmental sustainability of the ACRD in terms of reducing greenhouse gas emissions and capturing valuable nutrition for agriculture and landscaping applications. It is important to recognize that while other initiatives such as backyard composting will continue to play a role for some people in the community, broad based support is likely only attainable through a curbside food waste collection program. Centralized processing will allow a higher quality end product to be manufactured than possible from the back yard and allow diversion of materials from meat and bones to commercial food waste and agricultural organics not possible with the much simpler systems designed for back yard use. Source separated organics at the curbside for Single Family Units is the first step to unlocking an integrated organics management and nutrient recovery strategy for the region.

NZW has worked with the project team to study the sites available and the capital cost / financial requirements or each of the two different site options for the future management of organics. Both of the two scenarios evaluated were at landfill sites owned by the ACRD which aided to lower the capital costs associated with development:

- The Alberni Clayoquot Regional District West Coast Landfill – Based on preliminary review of 2014 estimated waste composition assume a design which has the capacity to process 2,500 TPA and is a model similar to the Pigeon Lake Landfill CVRD Facility. Three Piles total (2 Covered with a Gore Cover)
- The ACRD Alberni Valley Landfill: Based on the Waste Composition study from 2016 it is estimated that a total design capacity for the compostable waste stream should commence at approximately 6,300 TPA. This would require a more substantial facility design of 7,500 TPA (allowing for regional waste streams) and a tipping building able to process more advanced and difficult to handle wastes including commercial waste streams. Allowances will be made to accommodate future expansions however the initial design will include 6 heaps and control systems (4 of them covered), and a mobile winder. It's recommended that remote regions (Bamfield / Ancala) are hauled to the Alberni Valley site for processing.

2 Financial Overview and Preliminary Study Goals

While the attached study can provide some preliminary capital costing, an expanded effort will be required so as to finalize design and associated implementation costs as well as outline expected operational costs. The alternative is to enter into a Public Private Partnership whereby the proponent provides the Design / Construction and Operation as part of a term contract. Not enough time was allowed for in this preliminary study to evaluate a cost analysis of the current waste management system to provide a baseline cost profile. A baseline review was completed of documentation provided by staff that allowed for preliminary design capacity sizing for a site operation. Further to the above, experience gained in the development of similarly sized facilities provides a realistic and achievable baseline for costs estimated in the attached report.

2.1 Project Rationale – Financial Clarifications

The current structure of the solid waste management system is straightforward; however with the rising cost of fuel and transportation, there is no guaranteed rate stability. It is estimated that the cost of fuel will more than double in the coming decade and this will likely have a negative impact on the cost of disposal for regional MSW due to the additional distance this material is required to travel. This has already become evident in larger markets including the Lower Mainland where tip fees have climbed from $65/T to more than $100/T over the past decade and are expected to exceed $200/T in the near future as existing landfills reach capacity. The weakening exchange rate with the United States has also drastically affected many communities who relied on exporting their waste to American disposal sites. Regarding the composting operation, rates will be optimized through the use of the Gore Cover System design and operational costs can be lowered further through the implementation of multi-year contract terms with fixed rates per household. Should the ACRD be able to capitalize on any infrastructure grants so as to cover the costs associated with construction this will further remove a large component of the tip fee an operator would be required to charge if these costs were to be covered over a short term contract. This is especially impactful on the smaller tonnages projected by the ACRD as the amortization of the debt will have a higher effect on each tonne disposed of. As a result the cost of capital was omitted from the operating cost estimate provided as it was assumed that part of all of this infrastructure capital would be provided by external sources.

Organic recycling is the lowest hanging fruit for significant diversion improvement for the ACRD. Organic diversion will minimize the impact of waste tip fee escalation risks while providing an immediately discounted tip fee for organics along with significantly lower transportation costs for disposal.

3 Regional and Additional Program Considerations

Capital costs associated with the two sites was estimated at an investment of $600,000 and $2,750,000 respectively for infrastructure and facility development costs. Despite where the waste is processed, additional costs associated with the implementation of an organics diversion program will also include the addition of modified collection routes and potentially the purchase and maintenance of a new split collection truck or a modified version of an existing truck out-fitted for organics collection. There is also the cost of organic curb side bins and kitchen catchers and the need for additional bylaw enforcement and community education until contamination is no longer an issue. Some of these costs can be offset by equivalent reductions in service for waste collection and or a higher tip fee for waste dropped off to subsidize the organic fraction and encourage participation.

Operational costing and an approximate price per tonne evaluation and comparison to the existing waste management program was not completed as part of this report due to the amount of time and the budget available at this phase in the project.

Finally, there is inherent risk to operating a publicly owned facility associated with public appeal and permitting. This report serves to outline the options available to the Regional District so that an educated and balanced approach can be utilized for implementation so as to optimize funding to areas that will provide the best value to residents and tax payers of the region.

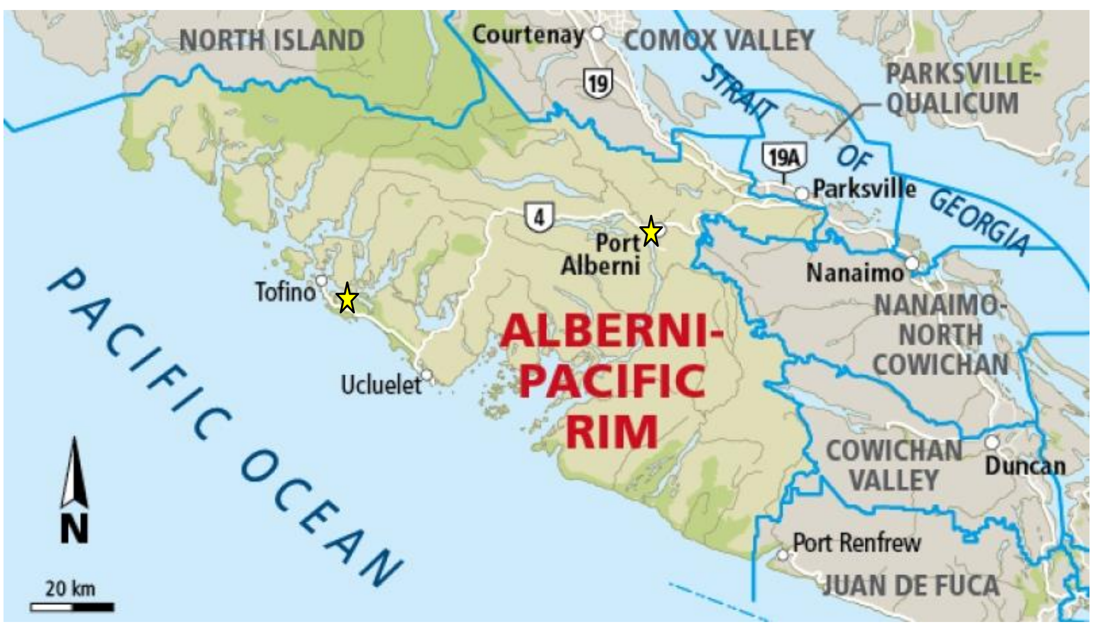


Figure 2…………..ACRD Map and Site Locations

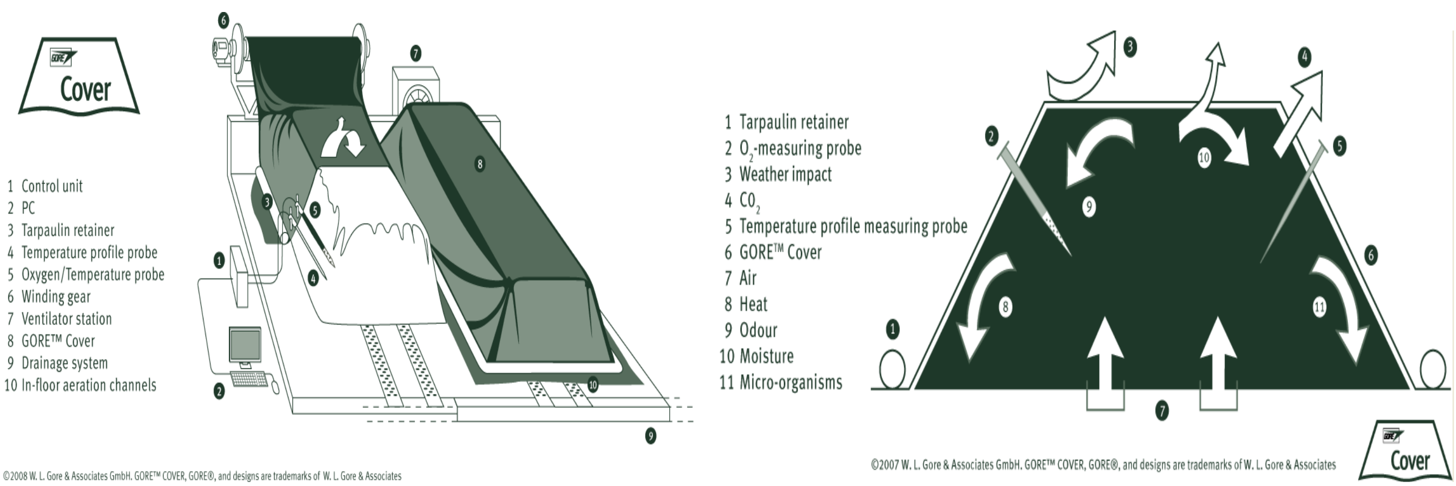
4 Technology Review

4.1 Gore Cover System Technology

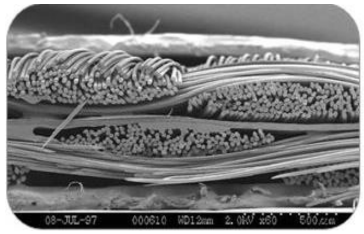
The GORE™ Cover System, manufactured by W. L. Gore & Associates, utilizes a specially designed cover to create an enclosed system that optimizes the composting process. Today, their enterprise is comprised of approximately 7,500 associates in 45 locations around the world. Annual revenues top $3 billion USD.

As the GORE™ Cover System composting process has no moving parts itself and is not very sensitive to contamination this system is flexible and can cope with widely differing waste streams. The GORE™ Cover System provides the environmental and odour control benefits of a typical "in-vessel" system without the cost of a permanent structure or the need for bio-filtration of process air. The typical components and equipment utilized in the GORE™ Cover System facilities is as follows.

- GORE™ Covers
- Aeration System: Trench/Pipes & Aeration Blowers (1 per heap)
- Control System complete with Oxygen and Temperature Sensors
- Control Units plus Computer and Software



Positive aeration drastically reduces utility operational costs (less than 1kWh of electricity per tonne of compost). The Gore Cover 2Hp blowers are on for approximately 2 minutes every 10. In comparison, "Negative Aeration Systems" must have their blowers on 24 hours a day 7 days a week to prevent negative odour events. Compact design results in a drastically reduced facility footprint and a 400% improvement in throughput from conventional windrow systems. Installed in more than 200 plants in 26 countries worldwide, the benefits of the Gore Cover System have been realized by a growing number of facilities.



4.2 Orca Drum In- Vessel Composting System

This system incorporates the use of an Orca drum technology (at 4 RPH) to mix and prepare the material prior to moving the compost outdoors for processing. Negative operating impacts associated with the drums can include pitting due to corrosion affects associated with the waste. There is also the maintenance of the drive shaft and motors that rotate the drums and regular oil changes and servicing that must accompany this system. Due to the experience seen at the facility in Nanaimo it is expected that the drums will need to be replaced every 6 - 8 years at a cost of up to ($250,000/drum).

Orca drums are manufactured to 10’ x 50’ and 15’ x 75’ lengths. The large drums can process 100 Tonnes per day, and the small drums 30 tonnes/day. Typically the drums hold the material for 3 – 5 days at the start of the composting process. The drums are held on saddles and use a friction reduction plastic (UHMW) to be rotated about their longitudinal axis. Polyurethane foam is then sprayed on the drum surface to help maintain the temperatures within. The Drum itself is driven by a 10 horse power variable speed motor. Maximum speed is four revolutions per hour (typical is 1/hour).

Material comes out of the drum and is deposited into a subsequent negatively aerated bay. This presents a potential bottleneck for the site as material coming out of the drum after only approximately 3 days at temperature will be odourous and will need to be managed under negative air to avoid fugitive odour emissions. Negative air systems need to be run continuously to minimize off gassing which can also represent a significant power draw on the overall facility. The exhaust system that is attached to the rear of the composter collects process gasses through suction which is then processed through a 15x40'x4'deep bio-filter. Following the negative air "finishing" phase material is moved to an outdoor, aerated static pile curing area. ICC uses a dual screw supreme 700 mixer for front end processing of commercial organics and a slow speed grinder for the pre-processing of green waste. This system has been successfully composting organic waste since 2004 and is currently being marketed to other communities around the world. While competitive on a larger scale, even a single small drum will far exceed the processing requirements of the ACRD. All material must travel through the drum where temperature controls and data can be logged to ensure compliance with the OMRR (Organic Matter Recycling Regulation of BC). It should also be noted that the separation of different waste types would not be possible which is also not ideal when evaluating the viability of a small market system.

4.3 In-Vessel - Christiaens Controls Group

While examples of this technology are difficult to locate on a small scale, one of the smallest has been constructed locally in Comox, BC and is successfully operating at capacity processing Comox Valley Regional District (CVRD) bio-solids and producing a soil product ('Sky Rocket') which is selling in high demand. On a larger scale the design and construction of a facility for Hamilton was completed for approximately $31.5 million CAD (60,000 TPA Capacity). This included over $5.2 million in Millennium funding from the Province of Ontario. Most systems of this kind will require 14 days in phase 1 and 14 days in phase 2. This process does not produce any wastewater and uses very little domestic cold water. Christiaens is able to process bio-solids (sewage sludge), household waste and yard and garden waste however as in the previous example all items would need to be comingled during processing for a small scale system.

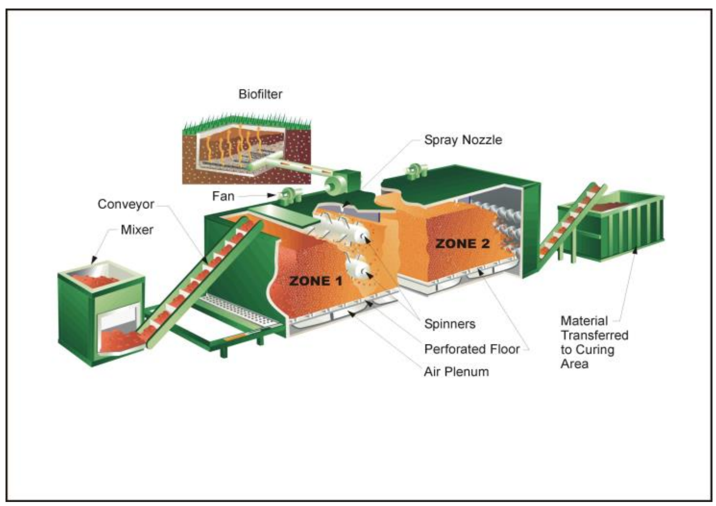
The technology utilizes a servomotor to control airflow, with exhaust air transported to the odour control system. The system measures and records oxygen consumption, water evaporation, total emitted energy, total circulated air and the water content of composting material. Water management systems are used to humidify the process air using an acid scrubber prior to sending it to the bio-filter. Process water is also used to moisturize the compost within the tunnels to ensure optimal decomposition.

4.4 Wright Environmental

While this technology was not visited during the site tours due to the logistics of travelling to the nearest BC facilities (located at the UBC Campus or near Whistler in the Callahan Valley). This technology remains one of the best systems available on the market for managing small volumes of waste in a controlled environment.

It is comprised of a fully enclosed flow-through tunnel system which is able to transform organic wastes such as meats, fish, dairy products, fruits, bio-solids, wood and paper wastes into a fine soil-like material in a 14-day period. (with 4 week minimum aerated curing post processing)

This system is considered In-vessel and is designed to be fed continuously. Each tunnel is lined with stainless steel and is comprised of nine sections; a loading section, three common sections, a spinner section with rotating spinners to blend materials, three more common areas and a discharge section with a series of breaker bars and an auger to remove materials from the tunnel onto a discharge conveyor (below). The exhaust fan is located right on top of zone 1 and the system is a negative air system. Air is always moving from the back to the front of the system (additional spore contamination control). This system comes complete with a fully automated control system, with air and water recirculation and data capture.



The stainless steel spinners are fast moving at up to 250 rpm and leave a void after the material passes. A hydraulic ram pushes one of 12 4'x8' perforated floor sections forward at 2"/min. The roof of the vessel has a sliding door, which is used to load incoming feedstock. Leachate drains through the floor sections allowing processing of rich waste streams. It is then pumped to the top of each respective zone to prevent cross contamination. This system also has the added benefit of being able to produce a bio-fuel through the use of an air to air heat exchanger. This additional end product is very effective in removing the seasonality of the compost market.

4.5 Technology Review Conclusions

A series of evaluation criteria were utilized to provide a comparison between each of the various systems which were either reviewed locally and or determined as proven technologies suitable for comparison in the below matrix. Each system was reviewed based on a qualitative approach and through experiences gained when visiting existing and operating facilities. It should be noted that there has been no weighting of any of the evaluation criteria and each line item carries the same potential of a maximum of +2 points and a minimum ranking of -2 points.

The first section of criteria is associated with costs related to the proposed technology. These costs have been separated into capital, operating and land based requirements which will impact either the size of lot required to be purchased or the lease rate of the future facility (based on number of acres required for processing). A range of operating costs for each type of technology was considered based at the desired capacities of 2,500 and 7,500 TPA respectively which is important to note as some systems have higher upfront infrastructure costs yet become cost competitive at higher capacities. Specifically, it was analyzed how the costs associated with each type of system compared to the other technologies being evaluated.

While each of the systems reviewed has been implemented on a commercial scale in North America, the likelihood of opposition to siting a waste management process within the community was considered. This includes the type and complexity of the equipment required for operation and the likelihood that skilled and qualified mechanical servicing is likely to be available in a remote location such as the ACRD. Any technology which contains a large number of moving parts will inherently require additional maintenance and servicing which adds a level of risk to the operation, especially over the medium to long term.

Most advanced and proven composting systems have either got experience with the feedstocks discussed in this report or would be able to handle them provided the appropriate porosity, C:N ratio and moisture content are maintained. Expansion must also be considered as it inevitably could occur at almost every successfully operating compost facility over time as populations, participation and capture groups increase. It must be possible to expand a system while maintaining the existing operation and process flow. This can be more difficult for “in-building” systems with fixed walls and usually results with an oversized design capacity at inception. This is often related to the minimum throughput required in order to make a system of this kind viable. The process simplicity and costs evaluation criteria should likely have held a higher weighting than some of the other categories as these areas would need to be a priority for the ACRD, however the end result would have remained the same with the Gore Cover System earning more points than any other technology.

NET ZERO WASTE

LEGEND	(no color = 0 points)		
(solid red)	2 points	(grey striped)	-1 point
(red striped)	1 point	(solid black)	-2 points

	Evaluation Criteria	Static Pile / Turned Windrow	Uncovered Aerated Static Pile	GORE[TM] Cover: Chemainus System	Concrete Bunker / Biofilter: Comox	ICC (Orca Drum Technology): Nanimo	Wright Environmental System: Whistler
Cost	Capital cost	2	1		-1	-1	-2
	Operating cost		1	1	-1	-1	-2
	Land base requirements	-2		1		2	1
Public Acceptance	Ease of Siting	-2	-2	1	1	1	1
	Reputation	-2	-1	2	2	1	
	Proven	2	2	2	2	2	2
Process Simplicity	Process Duration (To Sale)	-2		1	1	1	1
	Front end processing req'd	2	1	1	1		-1
Products	Process control		-1	2	1	1	1
	Product quality		1	2	2	2	2
	Market value of product		1	2	1	1	1
Feedstock Variability	Yard and Garden	2	2	2	2	2	2
	Food Waste	-2	1	2	2	2	1
	Bio-solids / Manure / Mortalities	-2	-2	2	2	1	2
	Mixed MSW	-2	-2	2	1		-2
Flexibility	Adaptable to seasonal variations	-2	-1		1	2	2
	Ability to expand	2	2	1		-1	
Environmental control	Leachate control	-1	-1	1	1		1
	Odour control	-2	-1	1	1		1
	Vector control	-2	-2	1	2	2	2
	Overall Rating	-2	-1	2	1	1	
	TOTAL POINTS SCORED	-11	-1	27	20	18	15

5 Site Review – Utilization Brownfield Landfill Infrastructure

Two sites were reviewed with staff of the ACRD and were used as the basis for the cost estimate provided. Significantly more work is still required before capital and operational costs can be finalized. The attached estimates are stated to within +- 25% and it should also be noted that costs can always be increased by requests for additional bells and whistles. Pricing provided is for a suitably serviced minimum level of equipment overlap and excess capacity.

5.1 Site A - The West Coast Landfill Site Location (2,500 TPA Capacity)

Advantages

This site has an open, level and available site area to provide adequate processing capacity (1 acre) with the added benefit of existing landfill leachate collection and diversion in place. Finding this type of existing infrastructure can drastically increase the viability of the implementation of a small scale facility by lowering the capital required for construction. As this location is remote and at landfill, provisions to enclose the entire system through the erection of a building with a biofilter are not assumed to be necessary. The installation of a small scale system at this location would be much more cost effective than at a “greenfield” site where no infrastructure exists. There appears to be power, which further limits infrastructure costs required for a facility to be constructed. Additional site advantages / synergies include; site security, fencing, office space, the use of an existing scale, loader and much more.

Disadvantages

There are limited disadvantages on this site as landfills present the most ideal location for organic recycling. The ACRD landfill is already operated with staff and a composting facility would not require significant additional staff, only training and support for existing staff on site. There is no water on site and there may be a need for a well and/or storm water pond.

Reference Facility – CVRD (Pigeon Lake Landfill / Cumberland) Location (2,500 TPA)

The CVRD site is an excellent comparable facility as it is also located at a landfill where it has been processing unground curbside food and yard waste for the past 4 years. The quality of the compost produced at the CVRD facility is of the highest level. The site has no odour and was constructed for far less than the amount estimated within this report for the West Coast Landfill.

5.2 Site #2: The Alberni Valley Landfill Site Location (7,500 TPA Capacity)

Advantages

This site appears to be of more than adequate size to house a composting facility of the capacity required. As outlined in the financial evaluation section of the proposal it was determined that approximately 2 acres would be required for processing and storage of finished compost. The site is ideally located on ACRD land with suitable buffers adjacent to the landfill. Synergy could present with the landfill operation and the use of the shared scale is possible.

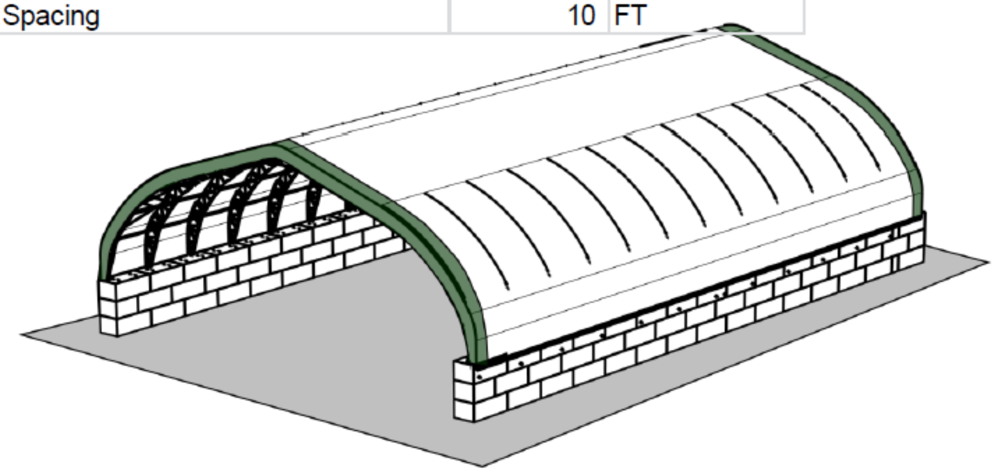
Disadvantages

While the site does present a centralized location with some natural buffers and vegetation, it is on rocky terrain and it will have a significant site development cost requirement. There is the potential for traffic impacts with the entrance of the landfill however as the compost facility is relatively small scale and significant traffic will only be present during the spring growing season, hopefully these impacts can be minimized through detailed design.

Reference Facility for West Coast Landfill Site: RDKS (Terrace) Location (2016-Present)

The RDKS is an excellent comparable facility for the ACRD. It is also located at a landfill where it has been processing unground curbside food and yard waste for the past year. We constructed this facility with the concrete side walls and in-ground aeration system estimated in the attached report. There is no bio-filter and the building only has 3 sides however there is no odour due to the lack of significant unprocessed feedstocks and a good seal with the Gore Cover System on the side walls.

Number of Buildings	1	BLDG(S)
Building Style	HHD	**HP**
Width	80	FT
Length	**120**	FT
Area	9,600	SF
Arch Spacing	10	FT



6 Financial Evaluation

Currently, the majority of organic material collected is yard waste, with only a very small amount of commercial organics being captured for recycling. The Regional District is considering enhancing the delivery of the organics program by providing kitchen and curbside bins for residents to use for depositing food waste and other household organics. This is expected to drastically boost participation and increase waste diversion from landfill. With some education and marketing, participation is expected to be approximately 65% from project inception.

Food waste typically has higher levels of contamination than yard waste, which typically consists of plastic film (bags) and other hard plastics. Metals can be removed relatively easily prior to or post-processing with a magnet on the conveyor prior to the grinder or after screening. Contamination levels are likely to increase significantly from what is seen currently in yard-waste, however are expected to average less than 1% of the total volume processed by weight annually. Food waste will also present a much higher vector attraction than yard waste and as a result provisions will need to be incorporated into the upstream handling of this waste prior to delivery at one of the regional facilities. This could include the provision of bear proof curbside bins which may add cost but could be considered as an option, or a bylaw to direct households not to place the bins outside prior to 7am on collection day. Once again, it is important to remember that this organic waste already exists in the waste stream and if bears are not currently a problem for residents they are unlikely to become a problem once an SSO program is implemented.

6.1 Overview of Conceptual Design

This section of the report outlines the proposed conceptual design for the facility which has been recommended to the ACRD. The scope of this report does not allow for detailed design; however our conceptual design for a facility of this scale will allow for an opinion of probable costs associated with the capital and operating expenses expected for an operation of this nature. This conceptual design was produced following a series of tours and investigations (technology evaluation) which helped determine the most suitable processing solution for this application. The conceptual design selected incorporates the use of an encapsulated aerated static pile composting system with leachate control and positive aeration so as to minimize capital cost while providing flexibility for expansion and growth into the future. This simple and cost-effective composting approach meets the needs of the region, while providing the necessary and appropriate environmental controls. The design description as outlined in this report also serves to identify facility requirements, the process flow for the system, as well as various recommendations for equipment and infrastructure. The recommended process will use forced aeration under automated temperature and oxygen control to minimize operator requirements and to ensure that hourly data is collected, documenting the history of the pile and demonstrating that the required vector and pathogen reduction limits have been met. This process control strategy will maintain an aerobic process and minimize the formation of fugitive gases. Leachate will be managed through a collection system and reused during the primary composting phase of the process. The entire composting process will be conducted under a covered building and only curing and product storage will take place entirely outdoors.

We have not elected for the use of a small bio-filter for exhaust process building air, however this could be allowed for as part of additional scope for as little as $100,000 including fans, and HVAC ducting. It would require enclosure of the entire building which may not be necessary as the facility is to be sited at the landfill and any small amount of odour around the building will not have any downstream impacts. The bio-filter can be upgraded at a later time if operations indicate this improvement is necessary. Where assumptions have been made to minimize the capital costs required, these assumptions have been listed so that should additional investigation into these management practices be deemed necessary, total potential capital required for the facility can be calculated. Further modifications can be made in the future to provide additional odour and process control at the facility if necessary however it is not expected that these additional features would be required.

6.2 Conceptual Design of Compost Facility

6.2.1 Proposed Feedstock

The feedstock for the proposed facility would be organics from residential sources, composed of yard and food waste, some commercial organics and some clean green waste used to supplement the other feedstocks and fill the capacity constructed. It is important to achieve a greater economy of scale, by accepting as many commercial sources of organics available however this waste stream can add complexity to the operation and challenges when handling slurry like wastes such as those from local fish farms. The evolution of the program could also include the inclusion of multi-family units, schools and other commercial sources (restaurants).

We have not considered the addition of bio-solids to the feedstocks accepted however should this be a consideration it would be very possible to compost bio-solids separately from the food waste and commercial organics collected. To process this waste separately, duplication and redundancy of infrastructure would be required which would not be as cost effective (at a small scale) so a great deal will depend on the current costs for disposal. While it is possible to make a high quality compost from bio-solids, the ACRD will need to determine if mixing these wastes and the soil produced still meets the needs of the community. There is often a stigma associated with bio-solids compost which often raises a host of issues when this material is considered for use in local food production.

Many communities feel that Organics must be looked at as part of a comprehensive system that connects the associated nutrients generated by a region to sustainable food production and improved food security. If the soil products manufactured from the food/yard waste are to be used in certified organic food production, they must meet all the compost guidelines set forth in the Organic Production Systems (OPS) - Permitted Substances List (CA.CGSB 32.311-2009). Please note that this will require that the compost products produced have not been mixed with or co-mingled with bio-solids or sewer sludge. Compost which includes these feedstocks will not qualify for use in “Certified Organic” food production in Canada.

Other possible (and permitted) commercial feedstocks which could be seen at a local facility in limited quantities include; Animal bedding, Brewery waste/ Winery waste, Hatchery waste, Manure, Milk processing waste (Solids), Poultry carcasses, Red meat carcasses (Excluding all SRM as outlined in Federal Regulations) and Whey.

6.3 Preferred Composting Technology and Design

While the development of an in-vessel system (such as the technology seen at ICC or Comox) may provide the highest degree of process and environmental control if managed properly, these types of systems are rarely developed for facilities with such small waste volumes due to the excessive costs associated with in ground infrastructure and development. They have also been proven historically to have the highest operating costs over time.

As a result, NZW has assumed a design for a facility which will meet the primary project parameters at the lowest possible cost. This is equivalent to what would normally be proposed as a pilot scale operation for larger municipalities. This flexible design will provide the necessary controls as dictated by the Organic Matter Recycling Regulation of BC (OMRR) as well as allow design improvements if so required in the future for additional odour and leachate controls. NZW operates a facility of a similar design as mentioned previously for the CVRD so we are aware of the most appropriate improvements and can thereby provide the highest cost benefit for the required design considerations.

The most suitable technology for a development of this nature would be the Gore Cover System. This type of facility would utilize an aerated encapsulated static pile / turned windrow system to compost the organic material. Either in ground aeration channels or above ground HDPE can be used to deliver the aeration to the pile. For the purposes of this report,the in-ground aeration system has been allowed for in the design for each site and the associated costs can be deducted at the request of ACRD staff moving forward should the above ground HDPE aerations system be preferred.

As the Gore Cover System turned windrows are readily scalable, and are able to operate at a very small capacity even the small scale design of approximately 2,500 tonnes/year can be managed through the use of 3 systems including 2 x 25m covers for the West Coast Landfill siste. Each cover will provide a Phase of the process with the final system providing aeration and curing prior to screening.

It is suggested that the Alberni Valley Landfill will have a combination of indoor and outdoor processing with three covered bays in-doors and three bays controlled outdoors. Only one of the three bays outdoors will have a cover on it as one pile will constantly be getting constructing while one pile will be getting over-aerated prior to screening. This more substantial facility will have better leachate controls and expanded and improved processing equipment including front end shredding, back end screening and a Gore Cover Mobile Winder. The Screening and Shredding equipment can provide a mobile solution that can be utilized at the West Coast Landfill site once or twice a year avoiding the need for additional capital costs. The covered processing building will provide complete diversion of storm water and a tight front end leachate separation and control area.

The scalability of the design will be important for the ACRD, because each facility can be constructed to manage current organics tonnages, as well as scaled up over time as more material is made available and or new organic waste streams begin to participate in the program (commercial organics / bio-solids / etc.).

6.3.1 Site Design and Equipment – West Coast Landfill Site

Based on the data provided and waste composition of the region, we have allowed for the construction of a facility able to process approximately 2,500 TPA of organics. The initial equipment purchased will be limited to the Gore Cover System as a suitably sized loader already exists at the landfill. We have assumed that at the West Coast site, it would be prudent to minimize any necessary capital costs for items such as screens and grinders (which can be rented as required or transferred from the Valley Landfill site). We recommend a flexible layout, with a minimal infrastructure investment to provide the lowest overall cost of capital which will ultimately be reflected in the tip fee / tonne paid by the residents. The facility however, will still be designed to process food waste or other difficult to handle wastes and will provide the necessary environmental and process controls to produce a top quality end product.

It is also always possible to complete additional design improvements if so required in the future to further enhance operations. We have placed a priority on a preliminary design which is straight-forward and cost-effective to operate, with a minimum amount of complex infrastructure. These priorities are a must if a facility of this size is to operate sustainably. Utilizing the Gore Cover System, we would recommend that the facility purchase no less than 2 covers with 3 control systems. The third control system would be uncovered and operate as an aerated static pile to minimize costs associated with the covers. Material would be removed and replaced into the next phase once/month. This would allow for a minimum of 8 weeks of processing for all materials through the facility. Additional covers could be purchased as required.

Table 6.3-1: Capital Cost Estimate for West Coast Landfill Gore Cover Facility (2,500 TPA)

• Concrete Lock Blocks for Rear Wall & Bunkers (100 Assumed)	$15,000
• Main Power Connection (2 Pole Allowance)	$20,000
• Gore Cover System for 2,500 TPA – 2 Covers / 3 Control Systems (Includes blowers, panels, probes, aeration trenches, etc.)	$250,000
• Electrical Connections / Communications	$20,000
• 1,500m^2 Site Prep. ($35/ m^2) and Paved Asphalt Surface ($35/m^2)	$105,000
• Building Concrete Channels (2/heap)	$50,000
• Site Work, Leachate Control (Minimum)	$40,000
• Storm-Water Pond / Well / Process Water Allowance	$35,000
• Office Supplies & Small Tools Allowance	$5,000
• Contingency	$60,000
• TOTAL	$600,000

* Loader / Scale / Fencing / Access Roads / Utilities / Fuel Storage / Storage and Staff Facilities assumed to be part of existing Landfill Infrastructure

6.3.2 Site Design and Equipment – Alberni Valley Landfill Site

For the purposes of this report we have made an allowance for a small pre-engineered building for this site location which will separate and isolate leachate which is typically produced during feedstock preparation and the primary composting phase. The most cost effective building is one which is constructed with a durable and corrosion resistant tube frame (hot-dip galvanized) and which has been pre-engineered for the snow and wind loads of the area. Facility staff will be able to travel freely into the building for material turning, and compost can by cycled through the covered forced air phase at a rate dependent upon the amount of new material delivered to site.

One piece of grinding equipment (shredding) has been recommended to improve front end material preparation, and to ensure the correct product mixture at the start of the process. Details associated with each option will be expanded on in the below estimate.

Additional provisions for odour control have been made in the design, beyond those inherent in the processing technology which include the use of a small bio-filter. This biofilter and exhaust fan can always be upgraded if necessary at a later date with relative ease or omitted from the baseline estimate and added later if necessary. The success of the facility, as well as the production of a quality end product will be possible under the existing design; however this will largely be dependent upon the operating procedures incorporated by the operator and staff. Most technologies (including the Gore Cover System) offer operator training at the facility and detailed process manuals as a component of their facility start-up, commissioning and preliminary operations package. This model has been implemented

A typical complaint of facilities of this nature is associated with the inability to control the process and the impacts of the environmental effects associated with atmospheric moisture. In order to provide control against these issues we have recommended a structure which will provide cover and a location to undertake the first and most critical phase of the composting process. A tube frame pre-engineered building will provide exceptional corrosion protection and is utilized frequently for composting. Welded arches are fabricated from tubular steel and hot dipped galvanized after fabrication and welding. This building includes a fire retardant rated Powershield woven polyethylene fabric which comes complete with a full warranty.

In order to optimize the size of the building and the compost action which occurs under it, we have suggested the addition of an air-floor system and concrete side walls. This system will apply positive forced air into the raw feedstock thereby accelerating the composting process and the breakdown of material. This air-floor system will double as a leachate collection system, with in-slab piping collecting and transporting leachate from below the piles when aeration is not on. Aeration will be controlled through software provided by the technology supplier. This forced aeration will also ensure that the material does not become anaerobic which can be an Occupational Health and Safety concern when operating in enclosed areas.

To add further security to this issue, an exhaust fan and small scale biofilter will ensure that air is constantly flowing through the building and minimizing condensation. This will help in keeping the work environment manageable as considerable steam and humidity will be released from the piles when the aeration system is turned on.

Should additional infrastructure such as an expanded exhaust fan and bio-filtration be required or desired at a later date, the design will facilitate the addition of such modifications. Please note that while some of the criteria associated with the slab design have been outlined in the design drawings, a detailed design effort would be required for the facility prior to the issuance of tender for the project. While it is understood that many facilities use large loaders for outdoor operations, the movement of material in the building should be confined to the use of a small skid steer loader (950 or smaller). This saves considerable costs on the thickness of the slab design, and given the size of the proposed building the use of large vehicles will not be required in order for successful operations.

Operations within the building will involve the rotation of a portion of the material on a daily or weekly basis so as to ensure that consolidation and the formation of air channels does not occur. It is expected that operations staff will see a vast improvement in the rate of decomposition using this design when compared to other open and negatively aerated designs. Slab grading will ensure that the collection and containment of all leachate generated within the system remains contained to the inside of the building while preventing the intrusion of atmospheric moisture. The leachate collection sump should be placed at one side of the receiving end of the building and include provisions for a coarse bubble diffuser to ensure this leachate remains aerobic. A small submersible pump can then be dropped into the leachate chamber when new feedstock is prepared on site and used to ensure the appropriate moisture content. This concentrated leachate will serve as an inoculant essentially kick-starting the composting process with a batch of active bacteria. A potential site layout and facility design from another facility is shown below as a basis for the attached cost estimate.

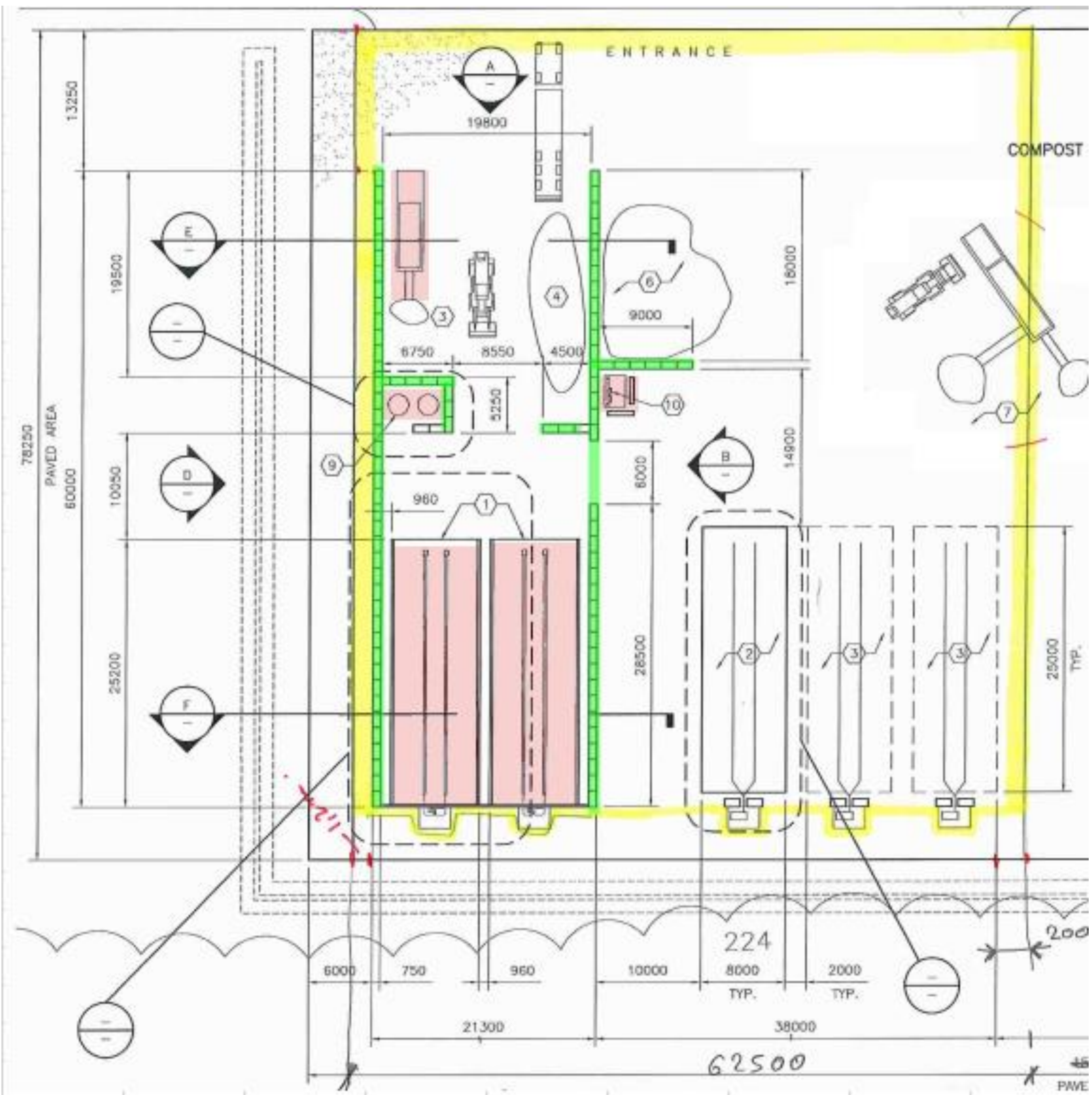


Table 6.3-2: Capital Cost Estimate: Alberni Valley Landfill Gore Cover Facility (7,500 TPA)

• Engineering Design Fee (Both Sites)	$60,000
• Concrete Lock Blocks for Rear Wall & Bunkers (200 Assumed)	$30,000
• Pre-Engineered Building (70'x120') on Lock Blocks (Installed)	$200,000
• Front End Loader Allowance (Lightly Used)	$150,000
• Shredder / Doppstadt DW3060 or equiv. (Pre-processing) Allow.	$350,000
• Trommel Screen with 5/8" sizing (SM720 or equiv)	$200,000
• Mobile Gore Cover Winder Unit	$80,000
• Pre-Eng Building Biofilter, HVAC and OH Doors	$70,000
• Main Power Connection (4 Pole Allowance)	$40,000
• Gore Cover System for 7,500 TPA – 4 Covers / 6 Control Systems (Includes blowers, panels, probes, aeration trenches, etc.)	$550,000
• Electrical Connections / Communications / Leachate Panel	$40,000
• 3,000m^2 Site Prep. ($35/ m^2) and Paved Asphalt Surface ($35/m^2)	$210,000
• Building Concrete Air Channels with Concrete Side Walls & Slab	$200,000
• Exterior 3 bays with Concrete Channels	$60,000
• Site Work, Leachate Control System (2 Tanks)	$100,000
• Lighting, Security, Fencing, Etc.	$80,000
• Storm-Water Pond / Well / Process Water / CB Allowance	$50,000
• Water Supply / Storm Water Solids Separation	$30,000
• Office Supplies & Small Tools Allowance	$5,000
• Operational Training / Commissioning of System	$35,000
• Contingency	$210,000
• TOTAL	$2,750,000

* Scale / Access Roads / Utilities / Fuel Storage / Communications and Staff Facilities assumed to be part of existing Landfill Infrastructure

As detailed information with regards to any existing equipment available to the facility was not available at the time of this report, we have assumed costs appropriate for a slab for the use of light weight traffic and earth moving equipment only. This significantly reduces the cost of the slab due to the thickness and reinforcing steel required. We have specified a 6" thick concrete slab with a concrete strength of 35MPa for the processing building. The slab is thickened to 12" at the edges and reinforcing bars have been used rather than structural admixtures so as to optimize construction cost and support around the in slab piping.

Lock block edge walls 2'-6" x 2'-6' (2 blocks high) have been specified for the perimeter of the slab which will tie into the building. This design works well and provides excellent value by utilizing the building walls as push walls for the material and a suitable mounting location for the blower's controllers and all electrical panels and distribution which will run along the outside of the building. The second layer of lock blocks will be required so as to provide adequate head room for vehicle traffic and equipment close to the wall due to the arched tube frame roof.

* Expansion of processing capacity can be completed with the purchase of additional covers which will be much easier to implement through conventional business financing following a successful start-up and operation. The remainder of the capital costs will not need to be increased for the expansion as the facility will experience improved optimization of existing infrastructure. Free cash flow from the operation generated as the facility exceeds the design capacity is typically used to finance the expansion and allow the provision of additional covers.

7 Conclusion

The ACRD has already demonstrated leadership by starting the process of evaluating the impacts associated with implementing a source separated organics collection program. As the region takes further steps to increase the levels of waste diversion from landfill, the composting of organic materials will be critical to achieving these targets. The decision as to whether to construct and operate its own composting facility should take into consideration the aspects discussed in this report and the assumptions which had to be made at this time.

While this report represents an important first step and provides a necessary tool for ACRD staff, additional and significant efforts are still required before a facility can be constructed without significant risk. This process is one which takes a considerable time to implement (particularly in smaller communities) and efforts and progress made thus far for organic diversion should be continued. Savings can be realized immediately through the implementation of a new SSO program. A competitive Request for Proposal is likely the best option to ensure all available disposal options are considered and the lowest priced and most qualified operating contract is obtained for the ACRD. Our team remains at your service should you require additional assistance in the months and years ahead as you continue to move organic recycling forward for the region.

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

3008 Fifth Avenue, Port Alberni, B.C. CANADA V9Y 2E3 Telephone (250) 720-2700 FAX: (250) 723-1327

MEMORANDUM

To: West Coast Committee

From: Wendy Thomson,
Acting Chief Administrative Officer

Date: June 9, 2017

Subject: Proposed Transit Service between Ucluelet, Long Beach and Tofino

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Following a recommendation from BC Transit, Regional District staff are working on some preliminary work for the proposed transit service for the west coast communities.

The ACRD Board of Directors approved $5,000 in the 2017 General Government Services budget in order to undertake some of this preliminary work. Attached, for your consideration, is a draft Request for Quotes (RFQ) to retain a consultant to undertake a feasibility study for the proposed transit service. The feasibility study would support possible funding through BC Transit, for consideration during their 2018/2019 expansion initiative opportunities.

The draft RFQ has also been sent to the Alberni-Clayoquot Health Network Transportation Committee for input. Staff request the WC Committee provide input to the RFQ prior to advertising.

Wendy Thomson

Wendy Thomson,
Acting CAO

ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

REQUEST FOR QUOTATION

The Alberni-Clayoquot Regional District will be accepting quotes from qualified consultants for the following:

Feasibility Study of a Transit Service between the communities of Ucluelet, Long Beach and Tofino on the West Coast of Vancouver Island.

1.0 Background

The Alberni-Clayoquot Regional District (ACRD) is working with BC Transit with respect to the possibility of creating a transit service on the West Coast between Ucluelet, Long Beach and Tofino. The ACRD requires a market/demand analysis for a proposed transit service. The analysis will not be limited to the Districts but will include First Nations communities on the west coast.

2.0 Objectives

The primary objectives for the feasibility study are outlined below:

a. Examine the demand for a transit service between Ucluelet, Long Beach and Tofino and outline options for its provision;
b. Review existing transportation options within the communities;
c. Review demographic data to identify potential transit markets within the service areas;
d. Identify the transportation needs of the communities;
e. Develop service concepts and outlined associated costs. Service concepts will be consistent with the area's population and geographic are, based on experience in similar B.C. Communities; and;
f. Consider all forms of transit including vanpools, taxis, buses, and subsidies for the service concepts outlined.

3.0 Scope of Work

It is expected that the successful Proponent will conduct a "hands-on" approach to the feasibility studies. This entails travelling to each of the communities to meet with the Regional contacts, where potential connections are to be assessed and other key Stakeholders, in addition to conducting public consultations in order to gather information and develop a comprehensive understanding of the local context and potential future transit needs.

4.0 Timeline

The suggested timeline for this work as presented above should be refined and confirmed within the Proponent's submission. The optimal target end date of work is ____________________

5.0 Key Deliverables

A study report which examines the demand for transit service and outlines options for its provision.

6.0 Budget

The budget for the scope as described herein is set at a maximum of $5,000 inclusive of all expenses and taxes.

7.0 Submission Requirements

Proponents are required to provide a submission, which includes:

a. Qualifications of the proponent.
b. Experience of the proponent detailing same or similar work.
c. Work plan, outlining a detailed scope of work to be conducted as part of the feasibility study and to include the approach to engagement.
d. Timeline and expected delivery date.
e. Total final fee including all disbursements and taxes.

8.0 Evaluation Criteria and Award

The ACRD reserves the right, at is sole discretion, to award a contract to the Proponent deemed to provide the best value to the ACRD. The ACRD shall not be bound, implied or otherwise, to award this contract to the lowest priced quote and/or most qualified Proponent. The ACRD will determine best value by evaluating submissions based on the following evaluation criteria:

Evaluation Criteria	Points
Proponent's understanding of the project	Pass/Fail
Overall flow and clarity of proposal	20
Experience and qualifications of proponent	20
Work Plan	20
Delivery Date	20
Price	20

Quotations will be accepted **no later than: 4:00 pm, ,2017**

Quotations may be email to :

Please note that the Regional District will not be held responsible for transmission problems or other errors that could occur.