



West Coast Committee Meeting

Wednesday, June 7, 2023

Zoom/Board Room (Hybrid) – 3008 5th Avenue, Port Alberni, BC

10:00 AM

Regular Agenda

Watch the meeting live at <https://www.acrd.bc.ca/events/7-6-2023/>

Register to participate via Zoom Webinar at:

https://portalberni.zoom.us/webinar/register/WN_wX7XiGsVTqmJKJwlrhlzrA

	PAGE #
1. <u>CALL TO ORDER</u>	
Recognition of Territories.	
Notice to attendees and delegates that this meeting is being recorded and livestreamed to YouTube on the Regional District Website.	
Introductions - Board Members and Staff present in the Boardroom.	
2. <u>APPROVAL OF AGENDA</u> <i>(motion to approve, including late items requires 2/3 majority vote)</i>	
3. <u>MINUTES</u>	
a. West Coast Committee Meeting – March 1, 2023	4-9
<i>THAT the minutes of the West Coast Committee meeting held on March 1, 2023 be received.</i>	
4. <u>REQUEST FOR DECISIONS</u>	
a. REQUEST FOR DECISION West Coast Transit	10-41

THAT the West Coast Committee recommends that the Alberni-Clayoquot Regional District Board of Directors award the West Coast Transit service provision contract to Pacific Western Transportation (PWT) up to a maximum amount of \$535,000 (excluding GST) and authorize the CAO to negotiate and execute the West Coast Transit service provision contract on behalf of the Regional District.

- b. **REQUEST FOR DECISION** **42-46**
Long Beach Airport Ha-Huulthii Memorandum of Understanding

THAT the West Coast Committee recommend that the ACRD Board of Directors authorize the CAO to enter into a Memorandum of Understanding regarding the Long Beach Airport between the Tla-o-qui-aht First Nation and the Alberni-Clayoquot Regional District, for a term commencing the 1st of July, 2023 and ending on the 31st of June, 2026.

- c. **REQUEST FOR DECISION** **47-50**
R1036-2 West Coast Waste Materials Regulation and Charges 2023 Amendment

THAT the West Coast Committee recommend that the ACRD Board of Directors give three readings and adoption to Bylaw R1036-2 West Coast Waste Materials Regulation and Charges 2023 Amendment.

- d. **REQUEST FOR DECISION** **51-56**
R1033-4 West Coast Landfill Tipping Fee Bylaw Amendment

THAT the West Coast Committee recommend that the ACRD Board of Directors give three readings and adoption to Bylaw R1033-4, West Coast Landfill Tipping Fee and Regulation Amendment, 2023.

5. **REPORTS**

- a. **Invitation for West Coast Landfill Upgrades Grand Opening Event** **57**
58-61
- b. **West Coast- Sort'nGo Three-Stream Waste Collection 6-Month Update** **62-169**
- c. **2022 West Coast Landfill Annual Operating and Environmental Reports**
- d. **How Recycling Works – Presentation – P. Eichelberger**
- e. **Ex-Officio Member Updates**
- Pacific Rim National Park Update
 - Ahousaht First Nation Update
 - Tla-o-qui-aht First Nation Update
 - Hesquiaht First Nation Update

THAT the West Coast Committee receive reports a-e.

6. **LATE BUSINESS**

7. **QUESTION PERIOD**

Questions/Comments from the public:

- Participating in Person in the Board Room
- Participating in the Zoom meeting
- Emailed to the ACRD at responses@acrd.bc.ca

8. **ADJOURN**



**ALBERNI-CLAYOQUOT
REGIONAL DISTRICT**

**MINUTES OF THE WEST COAST COMMITTEE MEETING
HELD ON WEDNESDAY, MARCH 1, 2023, 10:00 AM**

Hybrid - Zoom/Board Room, 3008 Fifth Avenue, Port Alberni, BC

MEMBERS

Tom Stere, Chairperson, Councillor, District of Tofino

PRESENT:

Marilyn McEwan, Vice-Chairperson, District of Ucluelet

Vaida Siga, Director, Electoral Area "C" (Long Beach)

Jenny Touchie, Member of the Legislature, Yuułu?it?ath Government

Kirsten Johnsen, Member of Council, Toquaht Nation

Jacinthe Amyot, Pacific Rim National Park

REGRETS:

Rob Bullock, Ahousaht First Nation

Jim Chisholm, Tla-o-qui-aht First Nation

Bob Anderson, Hesquiaht First Nation

STAFF PRESENT:

Daniel Sailland, Chief Administrative Officer

Jenny Brunn, General Manager of Community Services

Teri Fong, Chief Financial Officer

Wendy Thomson, General Manager of Administrative Services

Mark Fortune, Airport Manager

Eddie Kunderman, Operations Manager

Paulo Eichelberger, Public Works Manager

Heather Zenner, Protective Services Manager

Janice Hill, Executive Assistant

The meeting can be viewed on the Alberni-Clayoquot Regional District website

<https://www.acrd.bc.ca/events/1-3-2023/>

1. CALL TO ORDER

The CAO called the meeting to order at 10:01 am.

The CAO recognized this meeting is being held throughout the Nuuchahnulth territories.

The CAO reported this meeting is being recorded and livestreamed to YouTube on the Regional District website.

2. ELECTION OF CHAIRPERSON/VICE-CHAIRPERSON FOR 2023

ELECTION OF CHAIRPERSON

The General Manager of Administrative Services (GMAS) conducted the election for Chairperson of the West Coast Committee for 2023. The GMAS requested nominations three times.

The GMAS declared Director Stere to the position of Chairperson of the West Coast Committee for 2023.

ELECTION OF VICE-CHAIRPERSON

The GMAS conducted the election for Vice-Chairperson of the West Coast Committee for 2023. The GMAS requested nominations three times.

The GMAS declared Director McEwen, Vice-Chairperson of the West Coast Committee for 2023.

Director Stere assumed the Chair.

3. APPROVAL OF AGENDA

MOVED: Director McEwen

SECONDED: Director Johnsen

THAT the agenda be approved as circulated with the addition of the following late item for consideration under Section 7 Late Business: Developing a plan for advancing inclusive governance within the formal Board governance structures of the ACRD in 2023.

CARRIED

4. MINUTES

a. West Coast Committee Meeting – December 7, 2022

MOVED: Director Stere

SECONDED: Director Siga

THAT the minutes of the West Coast Committee meeting held on December 7, 2022 be received.

CARRIED

5. REQUESTS FOR DECISIONS

a. REQUEST FOR DECISION

Annual Review – West Coast Committee Terms of Reference, 2023

MOVED: Director Siga
SECONDED: Director Johnsen

THAT the West Coast Committee re-confirm their Terms of Reference for 2023 as presented.

CARRIED

b. REQUEST FOR DECISION
Re: 2023-2027 Draft Financial Plan – West Coast Services

MOVED: Director McEwen
SECONDED: Director Johnsen

THAT the West Coast Committee recommend the Long Beach Airport proposed budget, as presented, be included in the first reading of the 2023-2027 Alberni-Clayoquot Regional District Financial Plan bylaw.

CARRIED

MOVED: Director Siga
SECONDED: Director McEwen

THAT the West Coast Committee recommend the West Coast Emergency Coordination - proposed service budget, as presented, be included in the first reading of the 2023-2027 Alberni-Clayoquot Regional District Financial Plan bylaw.

CARRIED

MOVED: Director McEwen
SECONDED: Director Johnsen

THAT the West Coast Committee recommend the West Coast Multiplex Service proposed budget, as presented, be included in the first reading of the 2023-2027 Alberni-Clayoquot Regional District Financial Plan bylaw.

CARRIED

MOVED: Director Johnsen
SECONDED: Director McEwen

THAT the West Coast Committee recommend the West Coast Transit service proposed budget, as presented, be included in the first reading of the 2023-2027 Alberni-Clayoquot Regional District Financial Plan bylaw.

CARRIED

MOVED: Director McEwen
SECONDED: Director Siga

THAT the West Coast Committee recommend the West Coast Waste Management service proposed budget, as presented, be included in the first reading of the 2023-2027 Alberni-Clayoquot Regional District Financial Plan bylaw.

CARRIED

c. REQUEST FOR DECISION

Re: Long Beach Airport (CYAZ) Lease Preliminary Application File # 2023-002
– Source Holdings

MOVED: Director Stere

SECONDED: Director Siga

THAT the West Coast Committee defers the Preliminary Lease Application LBA-2023-002 from Chris Cowan (Source Holdings Ltd.) to a future Committee meeting following the completion of the Long Beach Airport Land Use and Development Plan.

CARRIED

d. REQUEST FOR DECISION

Re: Long Beach Airport (CYAZ) Lease Preliminary Application File # 2023-003
– Charlie Cornish

MOVED: Director McEwen

SECONDED: Director Siga

THAT the West Coast Committee supports the Preliminary Lease Application LBA-2023-003 from Charlie Cornish and recommend that the ACRD Board of Directors consider approval of the final application.

CARRIED

6. REPORTS

a. Ex-Officio Member Updates

- **Pacific Rim National Park** – Jacinthe Amyot provided an update on Pacific Rim National Park activities. The dog ban pilot project initiated last year on Combers Beach continues. All dogs are prohibited on Combers Beach between April 1st to October 1st in order to protect migrating shorebirds. The pilot project has been successful, with an increase in shorebirds by 32% since the start of the project. They have had 97% compliance by residents and visitors to Combers Beach.

MOVED: Director Stere

SECONDED: Director Siga

THAT the West Coast Committee receive the verbal report.

CARRIED

b. Reports for Information

- Expansion of ACRD Voyent Alert Emergency Notification System to Long Beach Electoral Area
- West Coast Sort'nGo Three Stream Waste Collection Service Update
- Recycle BC Expanded Product List

7. LATE BUSINESS

a. Late Business – Advancing Inclusive Governance

MOVED: Director Stere

SECONDED: Director McEwen

THAT the West Coast Committee recommend that the Alberni-Clayoquot Regional District (ACRD) Board of Directors direct staff to develop a plan for advancing inclusive governance within the formal Board governance structures of the ACRD in 2023.

CARRIED

8. QUESTION PERIOD

Questions/Comments from the public. The Corporate Officer advised there were no questions or comments respecting an agenda topic from public:

- Participating in Person in the ACRD Board Room
- Participating in the Zoom webinar
- Submissions received by email at responses@acrd.bc.ca.

9. IN-CAMERA

MOVED: Director Stere

SECONDED: Director McEwen

THAT the meeting be closed to the public as per the Community Charter, section(s):

- 90 (1) (j) information that is prohibited, or information that if it were presented in a document would be prohibited, from disclosure under section 21 of the Freedom of Information and Protection of Privacy Act;*
- 21 (1) (a) (ii) of FOIPPA: the head of a public body must refuse to disclose to an applicant information that would reveal commercial, financial, labour relations, scientific or technical information of or about a third party.*

iii. 21 (c) (i) of FOIPPA: the disclosure of which could reasonably be expected to harm significantly the competitive position or interfere significantly with the negotiating position of the third party

CARRIED

The meeting was closed to the public at 11:14 am.

The meeting was re-opened to the public at 11:33 am.

10. REPORT OUT – RECOMMENDATIONS FROM IN-CAMERA

11. ADJOURN

MOVED: Director Siga

SECONDED: Director Johnsen

THAT this meeting be adjourned 11:33 am.

CARRIED

Certified Correct:

Tom Stere

Tom Stere,
Chairperson

Wendy Thomson

Wendy Thomson,
General Manager of Administrative Services



REQUEST FOR DECISION

To: West Coast Committee

From: Eddie Kunderman, Operations Manager

Meeting Date: June 7, 2023

Subject: West Coast Transit

Recommendation:

THAT the West Coast Committee recommends that the Alberni-Clayoquot Regional District Board of Directors award the West Coast Transit service provision contract to Pacific Western Transportation (PWT) up to a maximum amount of \$535,000 (excluding GST) and authorize the CAO to negotiate and execute the West Coast Transit service provision contract on behalf of the Regional District.

Desired Outcome:

To implement an interim transit service for the residents of the West Coast as soon as possible that can be further expanded when a BC Transit service, with provincial funding, again becomes available.

Summary:

Staff have been working closely with WATT Consulting to conduct a feasibility study on interim transit options for the West Coast service, in lieu of the provincially supported model that had been worked on with BC Transit. WATT Consulting has completed the study, and the final report is attached for review.

At the December 7, 2022, West Coast Committee meeting, staff presented a report giving background on the steps that would be taken with the interim feasibility study. The West Coast Transportation working group, led by the Alberni-Clayoquot Health Network, hosted a kick-off meeting for the study on January 18, 2023, and WATT Consulting has been working to gather information and research since that meeting.

In communicating with local transportation options in the Region, WATT Consulting determined that there were enough interested transportation providers who could feasibly assist with the introduction of a service in a shorter time frame and had expressed interested in providing the service. It was decided at this point to undertake what was called a Guided Quote Process (GQP) with the potential providers and use this information to determine cost estimates with various levels of service. ACRD operations and procurement staff worked closely with WATT Consulting throughout this process, and determined it was necessary to make the expression of interest a public process, if the end goal was to ultimately enter into a partnership for the provision of transit.

Staff determined it would be best to post a Request for Expression of Interest (REI), which received four responses from parties interested in being a part of the GQP. WATT Consulting then worked with the interested parties, providing a publicly available document to each that detailed the Scope of Work. This process was communicated to the West Coast Transportation working group, who were supportive of the process.

An evaluation committee for potential responses, consisting of representatives from the District of Tofino, District of Ucluelet, ACRD, ʔaʔuukʔiʔaʔh (Tla-o-qui-aht) First Nation (TFN), and Yuuʔuʔiʔaʔh (Ucluelet) First Nation (UFN).

The GQP process ran from May 1, 2023, until May 19, 2023, at which point just one of the four interested parties submitted a completed questionnaire and costing spreadsheet. One potential provider was unable to provide year round service, and another cited labour shortages and challenges hiring drivers as their reason to withdraw their submission.

The one submission received was from Pacific Western Transportation (PWT). PWT currently operates transit services in Port Alberni, Comox Valley, Campbell River, and Mount Waddington on the Island, and is a very experienced and well regarded transportation provider. The proposal received was very thorough, detailed the ability to provide year-round service, the ability to be flexible with how and when service was delivered, and outlines the potential for future opportunities (inter-regional transit, charter services, local employer, and resort partnerships). The proposal also included a plan for personnel (all key personnel located on Vancouver Island) and included the proponent procuring three (3) new light-duty vehicles that will include a bike rack and some rear storage for items such as surfboards (size to be determined).

As mentioned earlier, it was deemed important to ensure that any interim options are able to be aligned with the longer-term goal of a provincially funded BC Transit service. As PWT currently operates BC Transit funded services on Vancouver Island, if provincial funding was made available, a transition to a BC Transit service would be as seamless as possible.

If successful, staff would work to finalize contract details with PWT and develop a detailed implementation timeline with WATT Consulting and PWT. The realistic goal is to have the service implemented and running in January 2024. The evaluation committee was unanimously in favour of moving forward with the submission received.

Background:

A pre-feasibility study was first conducted by BC Transit for the West Coast Transit service in 2011. The ACRD approached BC Transit in 2017 for the completion of a Market Demand Analysis and a feasibility study for the service was completed in 2018. Electoral assent was then gained through an alternative approval process in accordance with the Local Government Act for service establishment in 2019.

Since that time, ACRD staff, the West Coast Transportation group and BC Transit have been working towards service implementation. This has been delayed numerous times due to a lack of the provincial share of funding being made available. There have been issues with the ability to procure buses, a freeze on expansion funding due to Covid and then for the past two (2) years the province has asked BC Transit to use funds to streamline existing transit services, rather than allocate any money to the implementation of new services. In Fall of 2022, it was communicated to the ACRD and West Coast municipalities at UBCM that there again would not be any funding made available for the West Coast Transit service in the 2023-24 fiscal year and that any funding in the short-term should not be expected.

At this point, the ACRD Board directed staff to deviate from the plans to implement a BC Transit led service in favour of a, yet to be identified, alternative. Staff worked with a reinvigorated West Coast Transportation Working Group and WATT Consulting to discuss and identify alternate service options that could fit within the established service requisition levels. The recommended approach is the result of their collective work.

Time Requirements – Staff & Elected Officials:

The negotiation and implementation of the service will take approximately 100 hours of Community Services staff time and 20 hours of Finance staff time.

Financial:

The initial proposal submitted by PWT was \$522,424 to provide annual service and is under the maximum tax requisition of \$550,000 as per Establishing Bylaw No. E1062. Revenue received from fare collection will further offset the requisition necessary, making the proposal well within the financial restraints of the service. Estimated service revenue was anticipated at approximately \$105,000 by BC Transit, dependent on the fare structure. As a reference, the estimated annual costs for the BC Transit provided service was \$1,014,318 annually with the estimated municipal cost being \$588,295 before estimated revenue being factored in. The BC Transit shared services model shares the cost of the service at 53.31% Municipal funded and 46.69% Provincially funded. The recommendation of \$535,000 as a maximum allows for some room in negotiations to allow for service to adequately address the needs of West Coast residents.

There is no tax requisition in the current 2023-2027 Financial Plan, given the uncertainty surrounding the service. Prior to the tax requisition being removed in 2023, the requisition was anticipated to run from \$515,000 to \$539,000 from 2023-2026 in prior Financial Plans. The updated requisition will be added to the Financial Plan for the projected implementation date of January 2024.

The additional cost for implementation support, as budgeted would be approximately \$18,500. This has been budgeted and can be funded from the current West Coast Transit service operating account. This amount is within the current purchasing authority for staff and does not require a Board resolution to proceed.

Staff will also be identifying and applying for grants from the Rural Transit Solutions Fund to assist with the necessary infrastructure for the service.

Policy or Legislation:

As per Establishing Bylaw No. E1062

Submitted by: *Jenny Brunn*
Jenny Brunn, General Manager of Community Services

Reviewed by: *Wendy Thomson*
Wendy Thomson, General Manager of Administrative Services

Approved by: *Daniel Sailland*
Daniel Sailland, MBA, Chief Administrative Officer

MEMORANDUM

To: Eddie Kunderman –Alberni-Clayoquot Regional District
cc: Tania Wegwitz – WATT Consulting Group
From: Shilpa Panicker – WATT Consulting Group
Our File #: 3446.B01
Project: West Coast Transit Implementation Support
Date: May 31, 2023
RE: Phase I Progress Report

BACKGROUND

The purpose of the memorandum is to provide an overview of the work completed to date on the West Coast Transit Implementation project. This project was undertaken to confirm potential service delivery, pricing and service options for an interim transit solution connecting Tofino, Ucluelet and surrounding areas.

ACRD in collaboration with its West Coast Committee member First Nations, municipalities and agencies had been working with BC Transit to undertake planning and preparation for the implementation of transit service. However, implementation of the service has been delayed due to lack of the provincial share of funding. Given the current financial climate, BC Transit has also advised that the provincial government is unable to support expansion funding for new transit services in BC in the near term. As a result, the ACRD is keen on exploring other interim public transit options that can be implemented, until such time that the provincial government is able to contribute funding towards a BC Transit-administered service.

An interim transit service is envisioned to be one that can be locally funded and developed with the support and involvement of key community, transportation, health, and hospitality stakeholders in the area. It is anticipated that any interim solution recommended for implementation would be undertaken in such a way that its components (service design, service area / stops, name / branding, etc.) could then be further refined and expanded as needed into the envisioned permanent BC Transit service when provincial funding for transit again becomes

available. The West Coast Transit Implementation Project was proposed as a two-phase project. **This update is specific to Phase 1, which is almost 90% complete.**

Phase 1: Updating and Confirming Interim Approaches

This phase seeks to review and update any planning work and community-related information gathered to-date in order to confirm potential service model(s), operating structure and costs for an interim West Coast Transit option.

Phase 2: Preparing for and Supporting Implementation

This phase provides expertise and assistance to support the implementation of service. Together, both phases are intended to ensure planning and implementation of an interim service in the region.

PHASE I HIGHLIGHTS: BACKGROUND RESEARCH AND ENGAGEMENT

As part of Phase I, WATT undertook comprehensive background research and targeted stakeholder engagement to develop an understanding of travel needs, origins and destinations, and major players in transportation in the region. Guiding this process was a Steering Committee led by the ACRD and its West Coast Committee member First Nations, municipalities and agencies.

Background Research

Population

The two municipalities of Tofino and Ucluelet are the primary communities in the Alberni-Clayoquot Regional District (ACRD); in addition to these two communities, the ACRD Electoral Area C, and the 5 Nuu-Chah-Nulth Nations (Hesquiaht, Ahousaht, Tla-o-qui-aht, Yuu-thlu-ilth-aht and Toquaht) are also part of the ACRD. This study focuses on travel between the two communities of Tofino and Ucluelet along Highway 4 and Port Albion Road and includes adjacent communities of Hitacu, Esowista, Ty-Histanis and ACRD Electoral Area C.

The 2016 Census recorded a permanent population of approximately 5,340 residents in the west coast communities with over 3,228 square kilometres of diverse geography. In 2021, a minor increase in this permanent population was recorded at 5,483. There is a seasonal, temporary increase in the population given that the region is a major tourist destination on Vancouver Island. This study, however, focuses primarily on the needs of the local, permanent resident population of the area.

According to the Clayoquot Living Wage calculation, 40% of residents earn less than or close to minimum wage and 67% of residents earn less than the calculated living wage of \$20.11. This underscores the need for public transportation in the region. In addition, most employment opportunities are in the municipalities of Ucluelet and Tofino, with ongoing economic and community growth that amplify the need for housing and transportation services within and between communities.

Transportation Options

Transportation options in the region are limited. As with many rural communities, walking and cycling infrastructure can be limited in certain sections of each community; shoulders on highways are narrow if present at all. During the summer (May through September generally speaking), also the “tourist season” in the region, a few different transportation choices are available, but still provide limited connectivity.

The Tofino Free Shuttle is a service administered by the District of Tofino. It offers a free daytime shuttle from late June to early September through a contract with Wilson’s Transportation (Tofino Bus), funded by the province’s Resort Municipality Initiative (RMI). Service runs from Downtown Tofino to Cox Bay, from 8:00 AM to 8:00 PM, with half-hourly service between 10:00 AM – 6:00 PM and hourly service prior and afterward. This service caters largely to the visiting tourist population.

Vancouver Island Connector’s Tofino Bus is an inter-regional service that connects Tofino to Victoria. What used to be year-round service has recently been reduced to seasonal service with it now running only from May through October.

Wheels for Wellness used to operate in the region to provide rides for west coast residents to non-emergency medical appointments to Port Alberni, Parksville and other communities, but ceased operations earlier this year.

Wilson’s Transportation operates a school bus service to the elementary schools and high school during the school year; however, after school activities are not covered by this service.

In addition to these services, some ride-hailing and taxi services also exist in the region. Whistle! (Tofino) and Kabu (Ucluelet) are the two ride-hailing services in the region and local taxi services, such as Tiki Cab, Tofino Taxi and Ucluelet Taxi, provide an alternative transportation option, along with Pacific Rim Navigators that provides inter-city private car and shuttle service, as well as an airport shuttle service.

Overall, transportation choices for everyday activities like going to work, appointments, shopping, etc. are limited in the region and the options that are available can be very expensive for daily use and do not represent a sustainable choice for most people travelling to jobs, shopping and services in the region.

Engagement

With the above context and background, the project team spent some time trying to understand existing travel patterns in the region by reaching out to the transportation and community stakeholders identified by the Steering Committee. The stakeholders contacted included:

- Wilson's Transportation
- Pacific Rim Navigators
- Tiki Cab
- District of Tofino: Weagle Wagon and Tofino Free Shuttle
- Whistle!
- Tourism Tofino: Tofino Free Shuttle
- Pacific Rim Hospice

This outreach work confirmed general service levels for interim transit that could potentially be introduced within the available envelope of local funding. It also identified a few existing local service providers that:

- a) are currently operating in the area and who could therefore feasibly assist with the introduction of interim transit service in a relatively short time frame, and
- b) have expressed interest in potentially operating the service or supporting it otherwise.

As a way of gathering detailed service pricing and operating information in a fair manner, WATT, with the guidance of the ACRD and the Steering Committee, undertook a "Guided Quote Process" (GQP) with these potential service providers, with the objective of using the information gathered through this GQP to, expediently, refine cost estimates and proposed service levels. It could also then form the basis for contracting the service if it was approved to move forward by the West Coast Committee and ACRD Board.

GUIDED QUOTE PROCESS

This process builds from a Request for Expressions of Interest (REI) procurement process, which allows for more discussion and dialog with proponents (if required) than a more formal Request for Proposals. Instead, this proposed Guided Quote Process would aid proponents as required

as they develop and submit their quotes for service and thereby expedite the submittal process, while keeping the process within ACRD procurement guidelines.

The process had three distinct steps:

1) **Step 1: Posting a Request for Expression of Interest (REI)**

A publicly posted call for expression of interest in submitting for the Guided Quote Process.

2) **Step 2: Developing and Distributing a Guided Quote Process Document**

A confidential process of submitting information about qualifications, methodology and pricing by each proponent that had submitted an REI in step 1.

3) **Step 3: Evaluating Completed Guided Quote Process Documents**

An objective process of evaluating responses of each proponent to identify a successful candidate.

STEP 1: POSTING A REQUEST FOR EXPRESSION OF INTEREST (REI)

To support this process, WATT staff developed a short scope and submission guidelines Request for Expression of Interest (REI) document that:

- Outlined the desired transit service levels to be operated, noting that there is some flexibility in scheduling if proponents can present a way to optimize service.
- Outlined other supporting operational and administrative services that are desired in conjunction with service operation.
- Noted that a potential outcome of the process for the successful proponent(s) would be to enter contract negotiations with the ACRD to operate the service, if it is approved to move forward by the ACRD Board.
- In collaboration with ACRD Procurement, developed scoring criteria to be used in evaluation of the submissions, with the acknowledgement that further discussion may take place after their receipt to clarify and refine submissions and that the lowest cost quote may not necessarily rank highest.
- The above document and the list of intended recipients was reviewed with ACRD Operations and Procurement staff to ensure alignment with the Regional District's needs and practices.
- Once confirmed, this document was posted by ACRD Procurement publicly for a three-week period, resulting in interested candidates submitting an expression of interest form and requesting the Guided Quote Process Document and Costing Spreadsheet to fill out and submit.

At the end of the three-week period, the project team had received responses from four (4) interested proponents:

- Tofino Bus Services Inc. (Wilson’s Transportation)
- Pacific Rim Navigators (PRN)
- Pacific Western Transportation (PWT)
- Will Jenkins

STEP 2: DEVELOPING AND DISTRIBUTING A GUIDED QUOTE PROCESS DOCUMENT

Guided Quote Process Document

While the Guided Quote Process Document gave the proponents a publicly available document that provided details of the expected Scope of Work (SOW), its primary purpose was to:

- Gather details from the proponents on their experience and ability to complete the described scope of work, methodology and approach to successfully implement the service and provide an estimate of costs for the described scope of work.
- Provide any alternate suggestions on providing transportation services in the region.
- Understand challenges and opportunities of providing transportation services in the region, from the perspective of the proponent.

Appendix A has a copy of the document provided to the proponents, including a fillable Costing Spreadsheet that was sent to the interested parties. Proponents were given three weeks to fill out this document and submit it back to WATT and ACRD Procurement.

STEP 3: EVALUATING COMPLETED GUIDED QUOTE PROCESS DOCUMENTS

Evaluation Matrix

To complete an objective and fair in the evaluation of submittals, an Evaluation Matrix was developed with ACRD Operations and Procurement staff. The evaluation parameters were identified and weighted in alignment with typical ACRD Procurement practices.

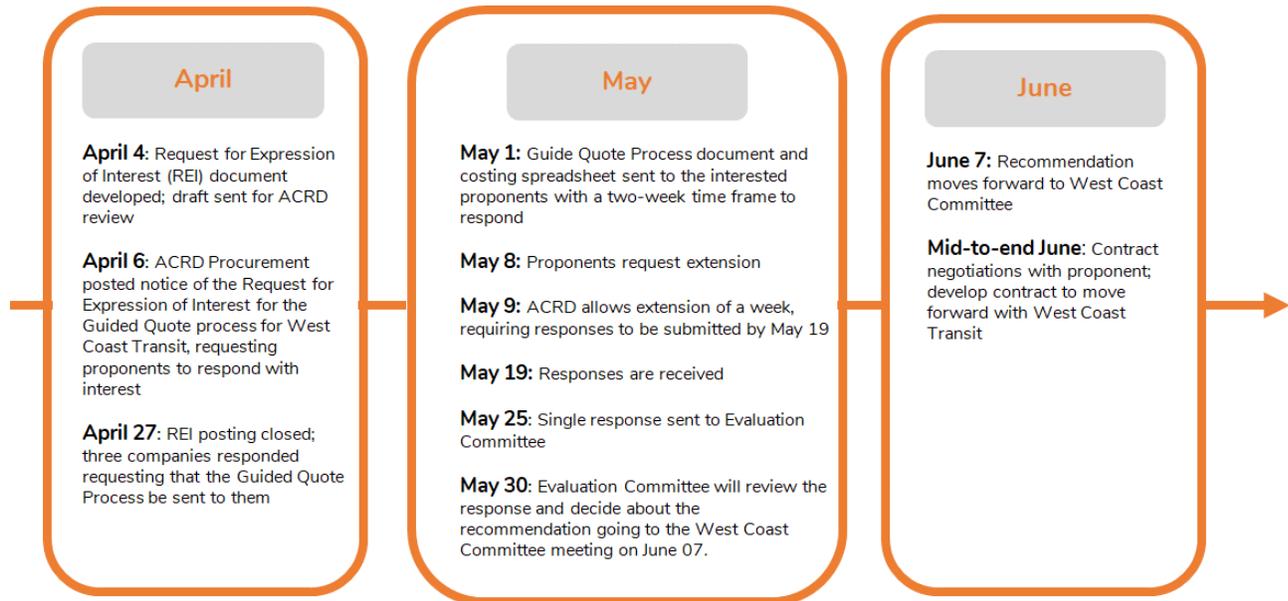
Evaluation Criteria	Points	Weighting	Max Score	Section
Service Reliability <ul style="list-style-type: none"> - Company profile - Capacity to deliver – staff, vehicles and expertise - Year-long availability of service - Company proposed plans and demonstrated experience with respect to ensuring optimal performance around the following: <ul style="list-style-type: none"> o Customer service o Safe and effective operations o Security and managing risk o Maintenance o Administration 	/30	3.0	30	1
Local Knowledge and Benefit <ul style="list-style-type: none"> - Local knowledge - Degree to which the service supports the local economy - Social Procurement questionnaire 	/20	2.0	20	2
Cost (Value for Money) <ul style="list-style-type: none"> - Level of service to be provided for the cost - Ability for service to meet local needs - Fleet and maintenance benefits 	/30	3.0	30	3
Ease of Implementation <ul style="list-style-type: none"> - Feasibility of starting the service within the desired timelines 	/20	2.0	20	4
Total	/100		100	

Evaluation Committee

To ensure representation from West Coast Committee member First Nations, municipalities and agencies, an Evaluation Committee was organized by ACRD Operations and Procurement staff. This Committee included representatives from the Districts of Tofino and Ucluelet, Ucluelet First Nation, Tla-o-qui-aht First Nation, and the ACRD. Tania Wegwitz from Watt Consulting Group was included as part of the Evaluation Committee given her extensive experience with starting up transit services across BC.

GUIDED QUOTE PROCESS: TIMELINE

Based on discussions with the ACRD, the following timeline was followed for the Guided Quote Process.



SUBMISSIONS

The Guided Quote Process submission deadline closed at 5:00 PM on Friday, May 19. The Project Team had initially received interest from four proponents, however only one provided a completed submission.

- **Pacific Rim Navigators (PRN):** did not submit a completed questionnaire, as they indicated an inability to provide year-round service. They notified the project team that they would be withdrawing from the process due to this deficiency on their end.
- **Pacific Western Transit (PWT):** submitted a completed questionnaire and costing spreadsheet.
- **Tofino Bus Services Inc. (Wilson’s Transportation):** submitted a withdrawal letter from the process citing labour shortages and challenges hiring drivers as their reason to withdraw their submittal.
- **Will Jenkins:** the project team received no response from this proponent.

The submission from PWT was complete and met all the requirements outlined in the Guided Quote Process Document. Highlights of the PWT submittal are as follows:

- 1) The firm has requisite experience in operating and administering transportation services. PWT has over 40 years of combined experience in bus transportation, between management, mechanics, and operations.
- 2) All key personnel are located on Vancouver Island – two in Comox Valley (GM and Director of Operations) and two in Port Alberni (Operations Supervisor and Lead Hand Mechanic).
- 3) Capable of providing year-round service with three new 24-passenger vehicles.
- 4) All vehicles and drivers will be fully available to West Coast Transit service year-round, with plans to store vehicles at Long Beach Airport.
- 5) The proposal provides daily trips from Monday to Friday during morning and evening peak hours and the mid-day.
- 6) The proposed recruitment, hiring and training practices meet industry standards.
- 7) Outlines potential for future opportunities: inter-city transit to larger centres (i.e. Port Alberni), charter services, partnerships with local employers, and partnerships with local resorts/hotels/inns.
- 8) The costs proposed for the service fall within the limits of the local funding.
- 9) PWT is able to start service as soon as possible but identifies January as a feasible timeframe, given the need to buy vehicles and the lag associated with this key activity.

The proposal outlines a feasible solution for interim service within the available envelope of local funding and has been forwarded to the Evaluation Committee for their consideration and deliberation.

FINAL OUTCOMES

The Evaluation Committee, after a lengthy discussion, has recommended continuing onto negotiations with Pacific Western Transportation, with the objective of finalizing a contract to provide fixed route transportation services in the region.

Appendix A

GUIDED QUOTE QUESTIONNAIRE

West Coast Transit



Alberni-Clayoquot
Regional District

Eddie Kunderman
Operations Manager
Alberni-Clayoquot Regional District

Shilpa Panicker, MUEP, B.Arch
Senior Transportation Planner & Transit Lead
WATT Consulting Group

WATT VICTORIA
302 – 740 Hillside Ave
Victoria, BC V8T 1Z4
250-388-9877

GUIDED QUOTE QUESTIONNAIRE

PROCESS OVERVIEW

This document provides the template that should be used to provide a quote for the provision of interim public transit service in the Alberni-Clayoquot Regional District.

- Proponents should use this template for their submission. It can be completed within the fillable fields of the PDF. A costing spreadsheet is also required for submission (see Excel attachment), which can be attached as a separate document. The costing spreadsheet calculates anticipated service hours and costs for providing the proposed service. If there are any issues with the PDF form template and/or the costing spreadsheet, please contact mlowes@wattconsultinggroup.com.
- The final PDF file and costing spreadsheet submission should be sent via email to mlowes@wattconsultinggroup.com and procurement@acrd.bc.ca. Paper copies will not be accepted.
- **Submissions must be received by 5:00 PM (Pacific Daylight Savings Time) on May 12, 2023.**
- If any questions on the form or to access up to three meetings with the WATT team to clarify your responses and proposed approach to service, please contact mlowes@wattconsultinggroup.com.
- Please refer to the Request for Expressions of Interest document for detailed project information and context.

ABOUT THIS QUOTE QUESTIONNAIRE

This form is broken into the following sections that align with the evaluation criteria. Evaluation sections and weighting are as follows:

Evaluation Criteria	Points	Weighting	Max Score	Section
Service Reliability <ul style="list-style-type: none"> - Company profile - Capacity to deliver – staff, vehicles and expertise - Year-long availability of service - Company proposed plans and demonstrated experience with respect to ensuring optimal performance around the following: <ul style="list-style-type: none"> o Customer service o Safe and effective operations o Security and managing risk o Maintenance o Administration 	/30	3.0	30	1
Local Knowledge and Benefit <ul style="list-style-type: none"> - Local knowledge - Degree to which the service supports the local economy - Social Procurement questionnaire 	/20	2.0	20	2
Cost (Value for Money) <ul style="list-style-type: none"> - Level of service to be provided for the cost - Ability for service to meet local needs - Fleet and maintenance benefits 	/30	3.0	30	3
Ease of Implementation <ul style="list-style-type: none"> - Feasibility of starting the service within the desired timelines 	/20	2.0	20	4
Total	/100		100	

Point Scoring /10	
0-3	Incomplete response Doesn't meet expectations Missing/mismatched attributes Poor level of details in response Unsupported claim(s)
4-7	Mostly complete response Partially meets expectations Partially fits desired attributes Medium level of detail in response Partially supported claim(s)
8-10	Meets or exceeds expectations Strongly fits desired attributes High level of detail in response Well-supported claim(s)

Section 3: Service Scope requests that respondents provide a description of the service levels and costs for one or more service scenarios. These scenarios reflect different potential options for the implementation of interim public transit service in the ACRD. These scenarios have been developed to take advantage of the existing transportation patterns in the Tofino-Ucluelet area as well as to offer local service providers an opportunity to support their community and improve business prospects while doing so.

Respondents should respond to at least one service scenario. They may respond to more than one if they choose and feel like they could operate the service in more than one way. However, respondents are not obligated to respond to more than one and can leave those sections blank if not responding (all other sections should be completed).

The service scenarios that may be responded to are as follows. Please see the respective scenario descriptions in Section 3.0 for further details on when, where and how each operates:

- **Service Scenario 1: Fixed Route Only** anticipates providing regularly scheduled service on a defined route with designated stops (stops would be implemented by the ACRD), with trips operating in the morning and afternoon peak commuter times, as well as some trips in the midday.¹
- **Service Scenario 2: Fixed Route Plus On-Demand Service** anticipates providing fixed-route schedule trips during the morning and afternoon peak commuter times, coupled with On-Demand service during middays.
- **Service Scenario 3: On-Demand Service Only** would consist of providing On-Demand service operating as requested by passengers between origins and destinations. The On-Demand service would be available during three time periods or trip windows: morning peak commuter period, a defined midday period, and an afternoon commuter period.

Additional information on the service requirements that apply to all scenarios is as follows:

- Service occurs year-round (January to December).
- Service occurs on weekdays only, no weekend service is planned for initially, with the opportunity to expand to weekend and holidays if ridership warrants it.
- ACRD will not be providing vehicles for this service. It is the expectation of the ACRD that service providers will provide vehicles, staff and all relevant equipment/items needed for service delivery.
- Any passenger information (such as website describing the service, printed maps and schedules for the service, etc.) as well as any physical infrastructure required to support the service (such as bus stop posts in the case of fixed route service) would be the responsibility of the ACRD, with the input of the selected proponent(s).
- Any dispatch or trip booking equipment or software required to support service would be the responsibility of the proponent.

¹ Peak times have been determined based on typical commuter hours in the morning and afternoon.

Section 1 – Service Reliability

1.1 Please describe your firm’s experience providing transportation services:

1.2 Please describe your team, roles and responsibilities of members of your team you expect will be involved with this service and their experience and qualifications as it relates to the scope identified in this Guided Quote Process:

1.3 Please describe the capacity of your team to provide year-round service for the service option(s) (option 1, 2, 3 or a combination of the three) you are submitting for:

1.4	Please describe the driver hiring and training practices that take place in your company.
1.5	How will you ensure that service is operated safely and reliably and offers good customer service?

Section 2 – Local Knowledge and Benefit

2.1

Please describe your firm's understanding of the transportation challenges and opportunities in the Tofino / Ucluelet area:

2.2

Please describe the benefit (supporting local economy, local travel needs, job creation etc.) your firm brings to the operation of this interim transit service:



2.3	Social Procurement Questionnaire
2.3.1	Does your company pay Fair Wages and/or Living Wages?
2.3.2	Does your company support gender equity?
2.3.3	Does your company participate in apprenticeships or any other employee training and development programs?
2.3.4	Does your company have an environmental and social governance policy?
2.3.5	Does your company work with employment support services within the communities you operate?
2.3.6	Does your company work with Social Enterprises in any manner?
2.3.7	Does your company provide other services which would support our social procurement values?
2.3.8	Does your company track diversity in its supply chain?

Section 3 – Service Scope & Cost (Value for Money)

Section 3.1 – Trip Information

Described below are three potentially feasible service scenarios for an interim transportation solution. Pick the scenario that most aligns with your experience and respond to all questions about that scenario. If a proponent believes that more than one scenario may be possible for them to operate, they can choose to submit more than one, however only one is required.

Service Scenario 1: Fixed Route Only

This option assumes that a fixed route service would operate on a regular schedule and route. This fixed route service will connect the communities of Tofino, Ty-Histanis, Ucluelet and Hitacu. Trips will have fixed drop-off and pick up stop locations (these will be finalized as part of the contract negotiations). Suggested trip times (see below) are based on existing transportation services and needs in the region. Suggested trips would include two round trips occurring in the morning commuter peak, two round trips in the afternoon peak, and one round trip in the mid-day. One-way trips may be considered if the proponent can show how these feasibly integrate around other services they may be providing.

This service scenario is intended to be year-round service that provides a stable connection between communities alongside current transportation services. Service occurs on weekdays only, no weekend service is planned for initially, with the opportunity to expand to weekend and holidays if ridership warrants it.

Suggested Trip Times:

- Two peak AM round trips to Tofino (approximately operating between 7:00 AM – 9:00 AM, exact time to be proposed by the proponent / TBD)
- Two peak PM round trips to Ucluelet (between approximately 2:30 PM – 4:30 PM, exact time to be proposed by the proponent / TBD)
- Midday service period between approximately 11:30 AM and 1:30 PM (exact time to be proposed by the proponent / TBD)

3.1.1A	Are you interested in responding to this option?		
	Yes		No

3.1.1B	If yes, which trips would your company be able to provide? Please select all that apply.		
High Season (June – September)		Low Season (January - May & October - December)	
	Morning Peak Round Trips (7 AM – 9 AM)		Morning Peak Round Trips (7 AM – 9 AM)
	Afternoon Peak Round Trips (2:30 PM – 4:30 PM)		Afternoon Peak Round Trips (2:30 PM – 4:30 PM)
	Mid-day Trips (11:30 AM – 1:30 PM)		Mid-day Trips (11:30 AM – 1:30 PM)
3.1.1C	Please describe any limitations/conditions associated with your selections:		
3.1.1D	If you have an alternate suggestion for how fixed route service can be provided in a more efficient and cost-effective manner, please describe below (i.e., trip times, trip direction, number of trips in the high or low season, etc.):		
3.1.1E	Any additional comments?		

Service Scenario 2: Fixed Route Plus On-Demand

The Fixed Route Plus On-Demand option assumes that a fixed route service would operate during morning and afternoon peak commuter times and On-Demand service will be provided during the mid-day time period. Both fixed route service and On-Demand service will connect the communities of Tofino, Ty-Histanis, Ucluelet and Hitacu. The On-Demand component would provide service from curb to curb (i.e., where the passenger requests a pick-up to where the passenger requests to be dropped off). The Fixed Route portion of service would operate on a defined schedule and route, with fixed drop-off and pick up stop locations (these will be finalized as part of the contract negotiations).

Suggested Trip Times:

- Two peak AM round trips to Tofino (approximately operating between 7:00 AM – 9:00 AM, exact time to be proposed by the proponent / TBD)
- Two peak PM round trips to Ucluelet (between approximately 2:30 PM – 4:30 PM, exact time to be proposed by the proponent / TBD)
- Midday service period between approximately 11:30 AM and 1:30 PM that would be serviced by On-Demand.

3.1.2A Are you interested in responding to this option?

Yes

No

3.1.2B If yes, which trips would your company be able to provide? Please select all that apply.

High Season (June – September)

Low Season (January - May & October - December)

Morning Peak Round Trips (7 AM – 9 AM)

Morning Peak Round Trips (7 AM – 9 AM)

Afternoon Peak Round Trips (2:30 PM – 4:30 PM)

Afternoon Peak Round Trips (2:30 PM – 4:30 PM)

Mid-day Trips (11:30 AM – 1:30 PM)

Mid-day Trips (11:30 AM – 1:30 PM)

3.1.2C Please describe any limitations/conditions associated with your selections:



3.1.2D	If you have an alternate suggestion for how this combination of Fixed Route service and On Demand service can be provided in a more efficient cost-effective manner, please describe below (i.e., trip times, trip direction, number of trips in the high or low season, etc.):
3.1.2E	Any additional comments?

Service Scenario 3: On-Demand Service Only

This option assumes that only an On-Demand service will be provided in the service area. The On-Demand service will connect the communities of Tofino, Ty-Histanis, Ucluelet and Hitacu. On-Demand service will operate curb to curb (i.e., where the passenger requests a pick-up to where the passenger requests to be dropped off). The service would use “Trip Windows” or periods of time when the service would be available for booking.

Three Trip Windows:

- AM Window (approximately operating between 7:00 AM – 9:00 AM, exact time to be proposed by the proponent / TBD)
- PM Window (approximately operating between 2:30 PM – 4:30 PM, exact time to be proposed by the proponent / TBD)
- Mid-day Window (approximately operating between 11:30 AM – 1:30 PM, exact times to be proposed by the proponent / TBD). All times between the AM and PM windows are considered the Mid-day Window

3.1.3A Are you interested in responding to this option?

Yes

No

3.1.3B If yes, which trips would your company be able to provide? Please select all that apply.

High Season (June – September)

Low Season (January - May & October - December)

Morning Peak Trips (7 AM – 9 AM)

Morning Peak Trips (7 AM – 9 AM)

Afternoon Peak Trips (2:30 PM – 4:30 PM)

Afternoon Peak Trips (2:30 PM – 4:30 PM)

Mid-day Trips (11:30 AM – 1:30 PM)

Mid-day Trips (11:30 AM – 1:30 PM)

3.1.3C Please describe any limitations/conditions associated with your selections.

3.1.3D If you have an alternate suggestion for how On-Demand service can be provided in a more efficient, cost-effective manner, please describe below:



3.1.3E	Any additional comments?

Section 3.2 – Vehicle Information

For the service scenario(s) and trips you have selected above, please describe the following:

3.2.1	Number of vehicles proposed to be used for service:	
3.2.2	Do you own or lease these vehicles?	
3.2.3	Please provide the year, make and model of the vehicles:	
3.2.4	What is the engine / propulsion type of the vehicle(s) (i.e. gas, diesel, electric, etc.)?	
3.2.5	Please describe the storage capacity in the vehicle(s). In other words, does it have anticipated space within or outside the vehicle for passenger items (parcels, bicycles, surfboards, etc.):	
3.2.6	Do the vehicle(s) have features making them accessible to passengers with mobility disabilities (i.e. ramp, lift, mobility aid securement or storage areas.)?	
3.2.7	Please describe where the vehicle(s) would be stored and maintained:	
3.2.8	Is fare collection possible in the vehicle(s)?	
3.2.8A	If yes, please provide details, including the end of day cash security operations:	



3.2.8B	If no, please describe your process for fare collection and your checks and balances process to ensure safety and security of fare collected:
3.2.9	What are your contingency plans in case of mechanical breakdown at the start of service or if a vehicle is in service? How would you address any maintenance issues? Is there an ability to notify the public of any potential service disruptions?
3.2.10	Do your buses undergo a set preventative maintenance program?
3.2.11	What insurance levels do your vehicles hold?

Section 3.3 – Cost Information

3.3.1	The separate costing spreadsheet calculates anticipated service hours and costs for providing the proposed service. Based on what was calculated in the spreadsheet, please note the total annual cost of service here. Please also ensure that the completed costing spreadsheet is attached to your submission	
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Section 3.4 – Dispatch, Trip Booking and Customer Service Information

For the service scenario(s) and trips you have selected above:

3.4.1 Please describe your firm’s ability to provide dispatch services:

--	--

3.4.2 Please describe your firm’s ability to provide trip booking or customer call taking services:

--	--

3.4.3 How would you accommodate customer enquiries (phone-in, online, email, etc.)? How would you handle any lost and found items that are turned in?

--	--

3.4.4 How would you handle any lost and found items that are turned in?

--	--

3.4.5 Please describe you company’s ability to respond to customer queries (fare, route, schedule, enquiries)?

--	--

3.4.6 If using an app for trip booking, please describe in detail the use of the app from a customer’s perspective:

--	--



3.4.7	What advantage would this app provide the interim service?
3.4.8	Please describe, very briefly, your company's policies for handling the following scenarios: <ul style="list-style-type: none">a. Passenger gets on the bus without paying fareb. Passenger requests a ride, but consistently does not show upc. Passenger does not have exact changed. Passenger on bus gets into an altercation with the drivere. Passenger on bus appears to be drunk and boisterous but not harmful to anyone else

Section 4 – Service Start-up

4.1	If chosen, are you able to start-up services by September 2023 including organizing operators, administrative staff and vehicles needed for this service?		
	Yes		No
4.2	If no, please provide a brief explanation for this as well as an alternate date for being able to start-up service:		

Please provide the required information below.	
Name:	Signature:
Name of Company:	Date:
Email:	Phone Number:

Thank you for the time you have taken to respond to this Guided Quote Process.



REQUEST FOR DECISION

To: West Coast Committee

From: Jenny Brunn, General Manager of Community Services

Meeting Date: June 7, 2023

Subject: Long Beach Airport Ha-Huulthii Memorandum of Understanding

Recommendation:

THAT the West Coast Committee recommend that the ACRD Board of Directors authorize the CAO to enter into a Memorandum of Understanding regarding the Long Beach Airport between the Tla-o-qui-aht First Nation and the Alberni-Clayoquot Regional District, for a term commencing the 1st of July, 2023 and ending on the 31st of June, 2026.

Desired Outcome:

To establish an agreement with Tla-o-qui-aht First Nation (TFN) for the Long Beach Airport (LBA) that will support reconciliation and partnering efforts and provide mutual benefit to both parties.

Summary:

Following a presentation to the West Coast Committee (WCC) by Saya Masso, TFN Natural Resource Manager and subsequent staff report in 2022 (attached), the WCC recommended that the ACRD Board direct staff to work towards setting up a 3-year Memorandum of Understanding (MOU) for the ACRD and TFN to work together collaboratively on airport development planning and initiatives. Subsequently, ACRD and TFN staff have met twice on the West Coast to discuss the objectives of the MOU, draft an agreement and review current lease applications and activities at the airport.

The resulting draft MOU agreement, as attached, has been reviewed and supported by both parties. It outlines the following key objectives:

To meet quarterly and work together on the following:

- The development of a long-term protocol agreement for the airport. The intention is to have a long-term agreement ready to enter into at the end of this 3-year MOU term.
- The development of a long-term land use and development plan for the airport.
- Review of long-term and short-term lease applications at the site.
- Development of a communications and signage plan to identify traditional territory and provide other cultural interpretative information. This may include road and terminal signage, website information and other communication mediums.

Time Requirements – Staff & Elected Officials:

There will be staff time from each party required to participate in regular meetings to review lease applications, work on signage and communications at the site and draft and finalize a formal protocol agreement. This is anticipated to be approximately 60 hours per year for each organization. Additional time for participation by TFN staff and leadership in the development of the LBA Land Use plan is estimated to be approximately 210 hrs.

Financial:

ACRD staff time and resources would be funded from the operating account within the long beach airport service. In order to ensure adequate resourcing is available for full and meaningful participation by the TFN in the activities planned under the MOU, the ACRD has increased passenger fees by \$2.50/passenger to generate funding to cover these resources. This funding will be based on revenue received during the year and will be passed along to TFN to support this project.

Strategic Plan Implications:

This aligns with strategy 5.2 - First Nation Protocol Agreements to support reconciliation and partnering efforts.

Submitted by: *Jenny Brunnn*
Jenny Brunnn, General Manager of Community Services

Reviewed by: *Wendy Thomson*
Wendy Thomson, General Manager of Administrative Services

Approved by: *Daniel Sailland*
Daniel Sailland, MBA, Chief Administrative Officer

Memorandum of Understanding

BETWEEN:

ALBERNI-CLAYOQUOT REGIONAL DISTRICT

3008 Fifth Avenue
Port Alberni, BC V9Y 2E3
Fax No. 250-723-1327

(hereinafter called the "ACRD")

OF THE FIRST PART

AND:

Tla-o-qui-aht First Nation
PO Box 18
Tofino, BC V0R 2Z0

(hereinafter called the "TFN")

OF THE SECOND PART

This Memorandum of Understanding (MOU) shall be known as the **"Long Beach Airport Ha-Huulthii MOU."**

WHEREAS:

The Ha-huulthii of the Tla-o-qui-aht Ha'wiih includes the Long Beach Airport (LBA) property.

The Alberni Clayoquot Regional District (ACRD) was transferred operation of the Long Beach Airport from the Federal Government in 2000.

The Tla-o-qui-aht First Nation (TFN) is pursuing a claim with the Federal Government of Canada for lands which include the LBA property.

The ACRD has increased passenger fees by \$2.50 to provide funding to cover staff and leadership time for TFN to participate in activities that will achieve the objectives of this MOU.

The TFN and ACRD wish to enter into a Memorandum of Understanding (MOU) to work together collaboratively on airport development planning and initiatives for the Long Beach Airport.

NOW THEREFORE:

The Parties enter into this MOU with the intention and desire to establish a cooperative government-to-government relationship for the purposes of facilitating communication, sharing information, exploring opportunities for land recognition, collaborative future land-use planning and identifying appropriate referral and approval of current land use lease requests regarding the Long Beach Airport.

This MOU is without prejudice to Tla-o-qui-aht Rights, Title and Interest.

Objectives:

To meet and work together on the following:

1. The development of a long-term protocol agreement for the airport. The intention is to have a long-term agreement ready to enter into at the end of this 3-year MOU term.
2. The development of a long-term land use and development plan for the airport.
3. Review of long-term and short-term lease applications at the site.
4. Development of a communications and signage plan to identify traditional territory and provide other cultural interpretative information. This may include road and terminal signage, website information and other communication mediums.

Principles of Cooperation:

The principle of respect (?iisaak) underlies the relationship between the parties.

The principle of taking care of (uu-a-thluk) will guide the approach to land use planning and management.

The principle that everything is one and connected (hisuk?is cawaak) will underpin all decision making.

Shared Values:

The parties share a respect for each other and for their respective cultures and traditional values.

The parties share respect for the land, the natural environment and community sustainability.

Working Group

Each party will provide 2 staff delegates and 2 alternative staff delegates to be part of the working group. Each party will report back on the progress of the working group to their perspective political bodies.

Timeline/schedule:

The working group will meet up to four times per year.

In addition, there will likely be separate meetings required for the development of the Long Beach Airport Land-Use Management Plan. TFN staff will be included as a partner in the development of this plan.

Term

This MOU shall come into effect as of the date of the signatures and will remain in effect for three years or as renegotiated in written agreement.

This MOU will be reviewed by June 30th, 2024 by all the parties involved.

IN WITNESS WHEREOF the parties have duly executed this MOU as of the date first written above.

THIS MOU IS WITHOUT PREJUDICE TO TLA-O-QUI-AHT RIGHTS, TITLE AND INTEREST

Executed on behalf of the ACRD by its authorized signatories on this ___ day of _____, ____.

_____ <i>Signature</i>	_____ <i>Signature</i>
_____ <i>Print Name</i>	_____ <i>Print Name</i>
_____ <i>Title</i>	_____ <i>Title</i>
_____ <i>Date</i>	_____ <i>Date</i>

Executed on behalf of the First Nation by its authorized signatories on this ___ day of _____, ____.

_____ <i>Signature</i>	_____ <i>Signature</i>
_____ <i>Print Name</i>	_____ <i>Print Name</i>
_____ <i>Title</i>	_____ <i>Title</i>
_____ <i>Date</i>	_____ <i>Date</i>



REQUEST FOR DECISION

To: West Coast Committee

From: Brenda Sauve – Solid Waste Coordinator

Meeting Date: June 7, 2023

Subject: R1036-2 West Coast Waste Materials Regulation and Charges 2023 Amendment

Recommendation:

THAT the West Coast Committee recommend that the ACRD Board of Directors give three readings and adoption to Bylaw R1036-2 West Coast Waste Materials Regulation and Charges 2023 Amendment.

Summary:

Staff are proposing an amendment to Bylaw R1036 to change the set-out time requirements of the Garbage, Recycling and Organic Carts for the West Coast 3-Stream collection program. This will allow collection drivers to start their routes earlier to allow them more time to drop off the materials at the West Coast Landfill prior to its closing at 4:00pm. The previous collection time began at 8 am and this amendment will allow a start time of 7 am. If supported by Committee and passed by the Board, staff will work with the collection contractor to communicate the change to the communities prior to implementation.

Background:

The attached amending bylaw will replace the previous set out schedule with the following:

SOLID WASTE SET-OUT REQUIREMENT

- 29. a. place Collection Carts with the lids in the closed position, no earlier than 5 AM and prior to 7 AM
- 29. b. ensure all latching devices on the Collection Carts, if any, are unlatched by 7 AM

Time Requirements – Staff & Elected Officials:

Minimal staff time will be required to implement the bylaw and communicate to the public.

Financial:

There is no financial implication to this amendment.

Strategic Plan Implications:

This initiative supports the ACRD's Strategic Objective 3.2 (Solid Waste Management Plan Implementation) to improve recycling and diversion programs throughout the region.

Policy or Legislation:

As per our Solid Waste Management Plan and Bylaw No. R1036-2 West Coast Waste Materials Regulation and Charges Amendment, 2023.

Submitted by: *Jenny Brunn*
Jenny Brunn, General Manager of Community Services

Reviewed by: *Wendy Thomson*
Wendy Thomson, General Manager of Administrative Services

Approved by: *Daniel Sailland*
Daniel Sailland, MBA, Chief Administrative Officer

Certified true and correct copy of “West Coast
Waste Materials **Regulation and Charges**
Bylaw No. R1036-2, 2023”

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

Wendy Thomson
General Manager of Administrative Services

John Jack
Chair



REQUEST FOR DECISION

To: West Coast Committee

From: Brenda Sauve – Solid Waste Coordinator
Paulo Eichelberger – Solid Waste Manager

Meeting Date: June 7, 2023

Subject: R1033-4 West Coast Landfill Tipping Fee Bylaw Amendment

Recommendation:

THAT the West Coast Committee recommend that the ACRD Board of Directors give three readings and adoption to Bylaw R1033-4, West Coast Landfill Tipping Fee and Regulation Amendment, 2023.

Desired Outcome:

To amend Bylaw R1033-4 to see an increase in Commercial Cardboard and Mattresses/Box springs. Furthermore, a new Schedule B containing Policies and Procedures is to be added to Bylaw R1033-4.

Summary:

The following amendments to Schedule A “Charges” are as followed:

Recyclable Materials	Current Tipping Fee	New Tipping Fee
Mattresses	\$20.00 each	\$23.00 each
Corrugated Cardboard	\$200/tonne \$15/min	\$350/tonne \$20/min

Schedule B has been amended to outline the collection process as it relates to credit accounts. Accounts that are ninety (90) days or more delinquent will result in account suspension and access to the landfill will be suspended until payments are received in full. If a customer receives an account suspension twice in a 12-month period, the customer will no longer have a landfill charge account and all amounts will need to be paid in full before accessing the landfill. The Board of Directors will be able to reverse a permanent suspension upon appeal for reinstatement. This section has been amended to provide finance staff a stronger mechanism for collection as there are a few accounts that frequently create collection issues.

Time Requirements – Staff & Elected Officials:

Minimal staff time will be required to implement the bylaw and implement the steps required in Schedule “B”.

Financial:

The increase in the Mattress fees is intended to cover the costs that are required for transporting and processing the mattresses at Recycle Matters.

Since January 1, 2022 to April 30, 2023 the total expense to collect the Corrugated Cardboard bin from the West Coast landfill is \$7,578.13. The revenue received for this material from tipping fees collected is \$2,277.40 a difference of \$5,300.73 that is not covered by the current tipping fees of \$200/tonne with a \$15/min.

Staff are recommending a dual pronged approach which includes a fee increase to \$350/tonne (which will align with the cardboard rate charged at the Alberni Valley Sort'nGo Centre) with a \$20 minimum charge, and reducing operational costs by adjusting the pick up schedule. Staff believe there is an opportunity to reduce cardboard pick-up frequency and this should help reduce overall costs for receiving this material at the site. We will review this approach (revenue/expenses) in one years' time to see if this has resulted in cost recovery for this material.

Options Considered:

1. Eliminate the Corrugated Cardboard bin from the West Coast Landfill as there are options for private collection on the West Coast. For context, the 16-month data shown above represents approximately 11 customer transactions per month (182 total).
2. Keep the service but increase the tipping fee to offset the cost difference noted above. In this scenario, it would be recommended to increase the tipping fee to \$700/tonne with a \$40 minimum charge.

Strategic Plan Implications:

This initiative supports the ACRD's Strategic Objective 3.2 (Solid Waste Management Plan Implementation) to improve recycling and diversion programs throughout the region.

Policy or Legislation:

As per our Solid Waste Management Plan and Bylaw No. R1033-4, West Coast Landfill Tipping Fee and Regulation Amendment, 2023.

Submitted by: *Jenny Brunn*
Jenny Brunn, General Manager of Community Services

Reviewed by: *Wendy Thomson*
Wendy Thomson, General Manager of Administrative Services

Approved by: *Daniel Sailland*
Daniel Sailland, MBA, Chief Administrative Officer

REGIONAL DISTRICT OF ALBERNI-CLAYOQUOT

BYLAW NO. R1033-4

A Bylaw to Provide for
the Regulation of Recycling, 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. Bylaw No. R1033, cited as “West Coast Landfill Tipping Fee and Regulation Bylaw No. R1033, 2019” is hereby amended as follows:
 - a) Replacing Schedule “A” with Schedule “A” attached to and forming part of this bylaw.
 - b) Adding Schedule “B” attached to and forming part of this bylaw.
1. This bylaw will come into effect on July 1, 2023.
2. This bylaw may be cited as “West Coast Landfill Tipping Fee and Regulation Amendment Bylaw No. R1033-4, 2023”.

Read a first time this	day of	2023.
Read a second time this	day of	2023.
Read a third time this	day of	2023.
ADOPTED this	day of	2023.

Certified true and correct copy of “**West Coast Landfill Tipping Fee and Regulation Bylaw No. R1033-4, 2023**”

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

Wendy Thomson,
General Manager of Administrative Services

John Jack,
Chairperson

**Schedule A
Charges**

Solid Waste	Tipping Fee	Other Charges
Loads of 83 kg or greater	\$140.00 per tonne	\$15.00 minimum
Loads under 83 kg (each garbage bag or can)	\$3.00 each	\$6.00 minimum \$15.00 maximum
Recreational Vehicle	\$240.00 per tonne	\$300.00 minimum
Surcharge for loads containing Recyclable Materials or Controlled Waste	Double the standard tipping fee	
Surcharge for Unsecured loads	\$240.00 per tonne	
Weighing service		\$10.00 each occurrence

Recyclable Materials	Tipping Fee	Other Charges
Corrugated Cardboard	\$350.00 per tonne	\$20.00 minimum
Metal, including appliances	No Charge	
Clean wood waste	\$120.00 per tonne	\$10.00 minimum
Car batteries	No Charge	
Tires	\$170 per tonne	\$2.00 each tire minimum
Residential Yard and Garden Waste	No charge	
Fish Nets and Rope	\$150.00 per tonne	\$15.00 minimum
Mattress or Box Spring	\$23.00 each	
Organics	\$115.00 per tonne	\$5.00 minimum
Residential Branches	\$5.00 per load	
Commercial Branches	\$120.00 per tonne	\$10.00 minimum
Grass and Leaves Material	No charge	
Dewatered Biosolids	\$175.00 per tonne	\$10.00 minimum

Controlled Waste	Tipping Fee	Other Charges
Construction/Demolition Waste	\$175.00 per tonne	\$15.00 minimum
Land clearing debris	\$240.00 per tonne	\$15.00 minimum
Pumpings from domestic septic tanks	\$160.00 per tonne	
Catch basin and manhole material	\$160.00 per tonne	\$150.00 minimum
Fish, shrimp shells, and animal carcasses	\$200.00 per tonne	\$100.00 minimum
Medical Facility 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 Alberni Landfill	\$50.00 per tonne	
Provided that the Ministry of Environment has approved of the treatment and disposal of the contaminated soil at the Alberni Landfill	\$100.00 per tonne	Plus estimated out-of-pocket treatment costs

Schedule B
Policies and Procedures

GENERAL

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 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.

CREDIT ACCOUNTS

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.
5. The Chief Financial Officer (CFO) may approve or deny a Credit Application in any of the following circumstances:
 - a. where the CFO has determined that the Applicant is not creditworthy; or
 - b. where the Applicant, or any principal, partner, director, or officer of the Applicant has had a Charge Account cancelled within the previous five (5) years.

COLLECTION PROCESS

6. If payment is not received by the due date the account will be considered in arrears and the customer will receive an invoice statement indicating their account is "Past Due,"
7. In order to reflect the additional administration costs associated with accounts in arrears, an overdue charge will be calculated monthly as the greater of:
 - c. \$2.00; or
 - d. Interest of 2% per month (effective interest rate of 26.824%) on the unpaid balance.
8. If a payment on an invoice is not received within sixty (60) days, the account will be considered delinquent and will result in a "Suspension Warning" being issued on the account statement; payment must be provided within thirty (30) days of this statement to avoid "Account Suspension".
9. If a payment on an invoice is not received within ninety (90) days, the delinquency will result in an "Account Suspension," this will be indicated on the account statement. Landfill staff will be notified to withhold access to the account holder until payment is received in full along with all interest charges.

10. If a customer receives an "Account Suspension" twice within a twelve (12) month period, the customer will no longer have a charge account with the Solid Waste Department. Their outstanding balance will need to be paid in full before accessing the landfill. All future charges will need to be paid at time of service.
11. Funds that are not recovered within six (6) months of the "Account Suspension" will be forwarded to a collection agency for recovery.
12. The Regional District reserves the right to cancel the credit offered herein for late payment, non-payment, or other justified cause.
13. Accounts under permanent suspension may appeal to the Board of Directors for reinstatement.



ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

JOIN US TO CELEBRATE WEST COAST LANDFILL UPGRADES

Through 2022, the Alberni-Clayoquot Regional District completed some important improvements to the West Coast Landfill, including a new, expanded public tipping area, and onsite composting facility



Sort'nGo

ACRD

RIBBON CUTTING + TOUR



WHERE: WEST COAST LANDFILL



WHEN: WED. JULY 5, 1-3 PM



WHO: ELECTED OFFICIALS,
ADMINISTRATORS, MEDIA AND
PUBLIC WORKS STAFF



REPORT FOR INFORMATION

To: West Coast Committee
From: Jodie Frank, Solid Waste Project Coordinator
Paulo Eichelberger, Solid Waste Manager
Meeting Date: June 7, 2023
Subject: West Coast- Sort'nGo Three-Stream Waste Collection 6-Month Update

Desired Outcome:

The purpose of this report is to provide the West Coast Committee with updates regarding the West Coast Sort'nGo three-stream automatic cart collection program after 6-months of implementation.

Summary:

As a follow up to the Report For Information, *West Coast- Sort'nGo Three-Stream Waste Collection Service Update* that was presented to the West Coast Committee March 1st 2023, this report summarizes the key results of the Sort'nGo program as we reach the 6-month milestone.

In early December 2022, the Alberni Clayoquot Regional District (ACRD) implemented a curbside three-stream (recycling, organics, and garbage) collection system to single-family households on the West Coast. Prior to the full West Coast launch, the Sort'nGo curbside service was introduced to ɫaʔuukʷiʔaḥ (Tla-o-qui-aht First Nation (TFN)), and Yuuluʔiiʔaḥ (Ucluelet First Nation (UFN)) in October 2022.

The recent implementation of this program has demonstrated successful results and already achieved an increase of waste diverted from the landfill. Over the first six months of the new curbside program – 368 tonnes of curbside material was collected. Of this total, 130 tonnes of organic waste was successfully diverted, representing a 30% reduction in curbside waste going to landfill from last year.

Background:

The Alberni-Clayoquot Regional District (ACRD) contracted AET Group Inc. (AET) to conduct a waste composition study for the West Coast that focused on single family residential curbside waste prior to and following the launch of the residential Sort'nGo program. Material from 100 residential households (hh) was sampled over a two-week period during the summer of 2022 (Aug 22-Sep 2, 2022) and the spring of 2023 (April 10-21, 2023). The recent Spring 2023 waste audit study included collecting and sorting curbside material from 100 households which represents the various collection areas and housing types across the West Coast community. Key findings from the recent post rollout audit are:

April 2023 Curbside Survey Highlights:

Garbage Stream –

- Garbage generation has reduced from 7.83kg/hh/wk to 4.03 kg/hh/wk
- This represents 48% of all waste put out at the curb
- An average of 9% of this is recyclable (same as pre-program implementation) but total amount is down
- An average of 40% of the material in the garbage stream is organic down from 55%
- an average of 0.66 carts were set out per household every other week, with a participation rate of 66% for the garbage stream.

Recycling Stream –

- Recycling generation has slightly decreased from 2.75 kg/hh/wk to 2.06 kg/hh/wk representing a 2.3% change.
- This represents 22% of all waste put out at the curb.
- an average of 0.70 recycling bins were set out per household every other week, with a participation rate of 70% for the recycling stream.

Organics Stream –

- the program is collecting 2.57 kg/hh/wk where a program did not exist previously.
- this represents 30% of all waste put out at the curb.
- an average of 0.40 organics bins were set out per household per week, with a participation rate of 40%.

The following chart includes the overall amount of organics and recycling being diverted as well as non divertible waste going to the landfill:

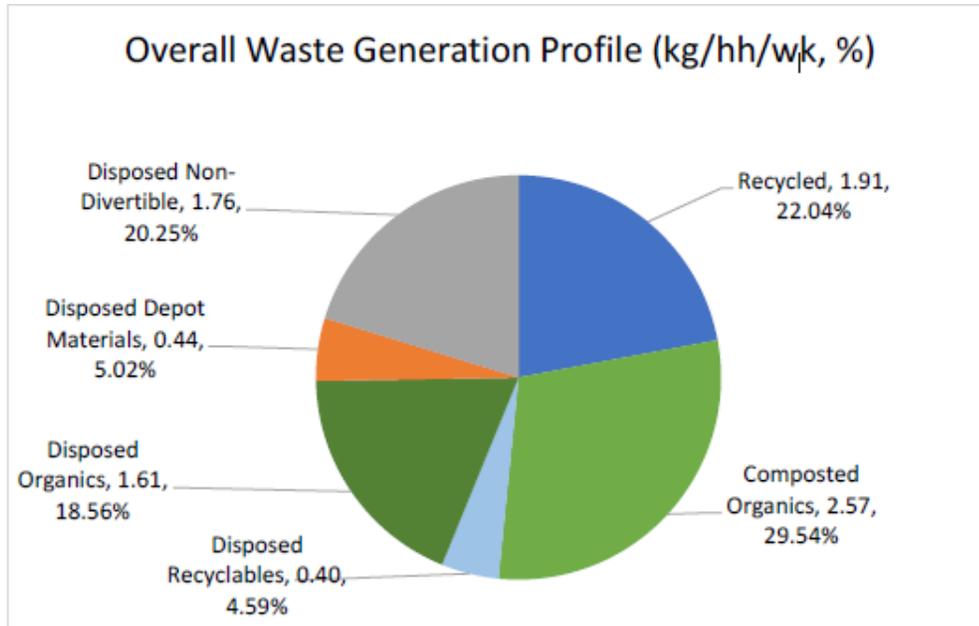


Figure 3.1 Overall Waste Generation Profile (kg/hh/wk, %)

Room for Improvement

Garbage Stream composition - the average quantity of material set out in the garbage stream by a single-family household (bi-weekly set-out normalized to weekly equivalent). The amount of recyclable materials found in the garbage stream represented 9.38%. Organic materials accounted for 39.88% and depot materials accounted for 9.34%. The remaining 41.40% of the garbage stream consisted of non-divertible materials.

	Spring 2023	Summer 2022
Garbage	4.03 kg/hh/wk 100%	7.83kg/hh/wk 100%
Recycling	0.38kg/hh/wk 9.38%	0.73kg/hh/wk 9.35%
Organics	1.16kg/hh/wk 39.88%	4.32kg/hh/wk 55.20%

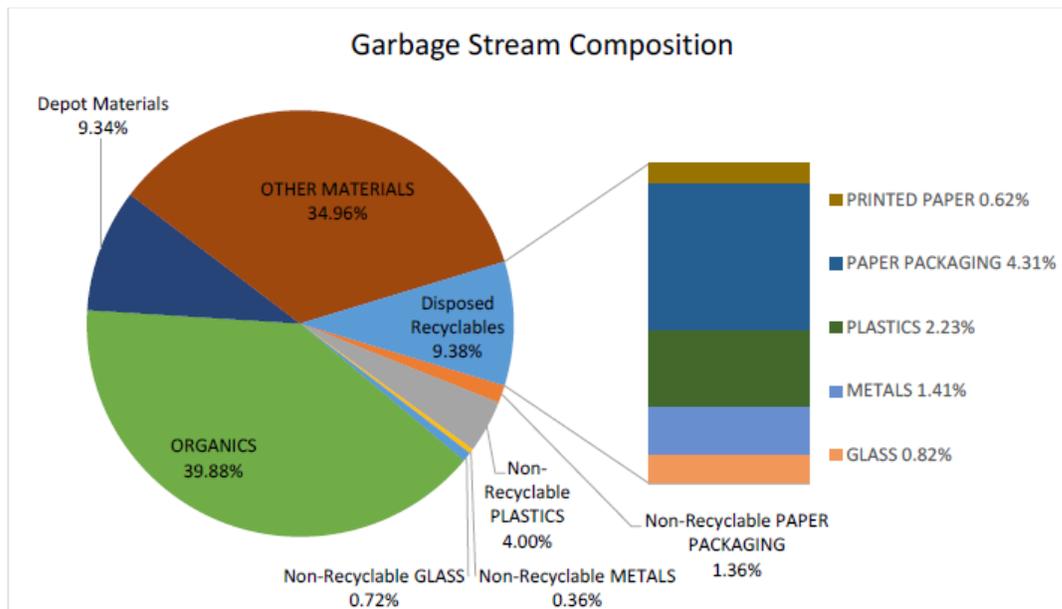


Figure 3.2 Garbage Stream Composition

Figures 3.3 and 3.4 provide examples of recyclable materials found in the garbage stream. Figures 3.5 and 3.6 provide examples of organic materials found in the garbage stream.

Diversion and Capture Rates:

Single family households generate an average of 8.69 kg/hh/wk of curbside waste. Of that, 1.91 kg/hh/wk is diverted from landfill through the curbside recycling program, 2.57 kg/hh/wk is diverted through the new organics program, for a **curbside diversion rate of 51.58%**.

Over the initial 6-month period of the Sort'nGo program the success of the program increasing diversion from just under 20% to 51% is a great feat thus far. However, there are still improvements to be made as 38% of organics material is still ending up in the garbage stream in some cases.

Engagement and Education

The ACRD, with the support of Zinc Strategies Inc. (Zinc), is currently drafting the Sort'nGo Education Strategy. This strategy will build upon existing approaches, such as residential waste audits and cart tagging programs. These initiatives help identify common contamination issues and provide valuable diversion data. They also support ongoing educational campaigns aimed at residents and the continual improvement of the service. Key findings will continue to be communicated to residents of the West Coast through social media, Westerly News articles, and other media outlets.

Other efforts related to community waste education and reduction will continue through info booths and presentations to community groups and schools. Zinc will also continue to work with both the TFN and UFN educators to communicate contamination or troublesome behavior that is being identified through Sort'nGo program mechanisms.

Next Steps:

The ACRD will continue to provide ongoing support to the West Coast communities as the three-stream program matures. As a key function of the ACRD, solid waste education services will continue to be provided throughout the region by way of continued collaboration with working group members to maximize effectiveness. ACRD staff will continue to monitor and report back on waste diversion rates, trends in contamination levels, customer feedback, and further optimization of the new program.

Submitted by: Jenny Brunn
Jenny Brunn, General Manager of Community Services

Reviewed by: Wendy Thomson
Wendy Thomson, General Manager of Administrative Services

Approved by: Daniel Sailland
Daniel Sailland, MBA, Chief Administrative Officer



REPORT FOR INFORMATION

To: West Coast Committee

From: Paulo Eichelberger, Solid Waste Manager
Brenda Sauvé, Solid Waste Coordinator
Jodie Frank, Solid Waste Project Coordinator
Jenny Brunn, General Manager of Community Services

Meeting Date: June 7, 2023

Subject: 2022 West Coast Landfill Annual Operating and Environmental Reports

Background:

As a condition of the West Coast Landfill (WCL) operating certificate, the ACRD is required to submit an annual report on landfill operations and monitoring to the Ministry of Environment and Climate Change Strategy (MOECCS). In recent years, staff have used this requirement as an opportunity to provide a more holistic report on landfill operations and the overall solid waste service for the waste-shed of the West Coast. This includes a review of how the goals and targets as established by the Solid Waste Management Plan are being met and developing an improvement plan to better meet those objectives. This report is created internally by staff and verified by an external Solid Waste Engineer as required by MOECCS. The ACRD's environmental consultants, Piteau and Associates, continue to oversee the environmental monitoring program and produce an annual report to summarize the technical analysis and recommendations based on the field monitoring undertaken by ACRD staff. These two reports are attached for your review with the key points summarized below.

Overview of Landfill Report:

Key Takeaways:

- Total amount of waste landfilled in 2022 was 7,268 tonnes, a 9.6 % increase from 2021, mostly due to an increase in construction and demolition waste with a small increase in the residential sector likely due to an uptick in private vacation rentals in the area.
- Revised population estimates, show an estimated population of 11,778 in 2022, resulting in a waste generation rate of 613 kg/capita, up 9% from 2021.
- Total diversion in 2022 was 22.2%.
 - Diversion Tonnage increased by 13% but so did waste disposal tonnage, offsetting this increase.
 - Part of this increased diversion was new data from commercial recycling haulers tracked that wasn't collected before.
 - There was a slight increase in some diversion streams (mattresses, compost pilot, new organics diversion, commercial cardboard, and ocean plastics).
 - There was a decrease in the larger volumes collected through the Recycle BC and metals recycling programs likely due to the changes in operating hours for the depots in Ucluelet and Tofino.
- The new Sort'nGo program for 3-stream curbside collection of garbage, organics and recyclables @ over 1,700

households rolled out in December 2022. This included expansion to ʔaʔuukʷiʔath (Tla-o-qui-aht First Nation (TFN)), and Yuuʔuʔiʔath (Ucluelet First Nation (UFN)) with specific education materials developed for these communities to include Nuuchahnulth language.

- Capital construction of a new tipping wall and organics processing capacity at the West Coast Landfill (WCL) commenced in fall 2022.
- The volume of space consumed in 2022 was 9,600 m³ resulting in an airspace consumption ratio of 757 kg/m³, surpassing the target of 750kg/m³ and boosting the 5-year average from 490 kg/m³ to 590 kg/m³.
- With the estimated 690,514 m³ of remaining airspace, there is approximately 40 years of landfill life remaining, and it will not reach its originally approved capacity until 2062 at current filling rates. This could be extended beyond well beyond this date with increased organics diversion and improved airspace utilization.
- Financial contributions for closure and capital upgrades were \$126,000 and \$3 million respectively. Capital expenditures are up due to construction of the organics facility and new waste tipping area, with the bulk of this funding coming from Strategic Priorities Grant funding.
- Landfill gas production is estimated at 339 tonnes of methane per year and is below the limit of 1,000 tonnes per year.
- The environmental monitoring program highlighted several overflow events of the existing leachate containment and treatment system, which was not effective at ensuring that all water leaving the property is meeting the Fresh Water Aquatic Life (FWAL) criteria.
- Follow-ups to address with the Ministry of Environment & Climate Change Strategy regarding future amendment of the operating certificate to include:
 - Completion of the new organics facility registration requirements;
 - Confirm requirements on soil disposal;
 - Additional monitoring and sampling, as recommended by ACRD's environmental consultants; and
 - Update documentation to include all recent infrastructure upgrades at the site.

Upcoming work includes, but is not limited to:

- Commissioning and operation of the Organics Composting Facility and Landfill Upgrades.
- Waste Reduction Education in line with the new 3-stream curbside collection system.
- Update of the Solid Waste Management Plan.
- Completion of a Waste Composition Study.
- Minor infrastructure upgrades to the existing leachate system.
- Exploration of alternative temporary cover.
- Design Operation and Closure Plan update.
- Undertaking a tipping fee review.

Communications:

The attached reports have been submitted to MOECCS as per our regulations and will be posted on our website once received by the Board of Directors.



Submitted by: _____

Jenny Brunn, GM of Community Services

Reviewed by: Wendy Thomson
Wendy Thomson, General Manager of Administrative Services

Approved by: Daniel Sailland
Daniel Sailland, MBA, Chief Administrative Officer



ALBERNI-CLAYOQUOT
REGIONAL DISTRICT

West Coast Landfill

2022 ANNUAL REPORT

Submitted to British Columbia Ministry of Environment and Climate
Change Strategy

Prepared by the ACRD Community Services Department

Reviewed by: Tetra Tech Canada Inc.

Paul Evans P.Eng.

Lauren Quan P.Eng.

PERMIT TO PRACTICE TETRA TECH CANADA INC. PERMIT NUMBER: 1001972
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May 2023

Report Summary

	Reporting Year 2022	Unit
Waste Tonnage Disposed at WCL	7,268	t
Landfill Airspace Consumed	12,130	m ³
Landfill Airspace Remaining	700,114	m ³
Anticipated Closure Date at Current Fill Rate/Density	Approx. 2070	
Waste in Place at Landfill	170,345	t
Leachate Generated & Treated	Not measured	m ³
Landfill Gas Management	none	
Closure Works Undertaken	none	
Inspection Works	Formal Inspection March 16, 2022	
Changes from Approved Plans	None	
Ministry Non-Compliances	Requirement for Active OMRR registration not met. MOE missing leachate overflow piping documentation and contaminated soil.	
Progress on Non-Compliances	From 2022: <ul style="list-style-type: none"> Registration submitted, acknowledged by MOECCS Aug. 29, 2022. Ops plan for organics outstanding. Leachate overflow documentation required. Confirmation of contaminated soil required. 	
WCL Waste Shed Projects Undertaken in 2022	Future Projects/Initiatives Proposed	
Organics/3-stream Curbside Collection	LF Upgrades/Organics Composting Facility (2023) Waste Reduction Education (2023)	
Expansion of Curbside to Tla-o-qui-aht First Nation and Yuułu?if?ath	Update of Solid Waste Management Plan (2023) Waste Composition Study (2023) Tipping Fee Review (2023)	
WC Solid Waste Collection Bylaw	Landfill Gas Supplementary Report (2023)	
LF Upgrades/Organics Composting Facility	Explore Temporary Cover Options (2023/2024) Installation of Flow Monitoring (2023/2024) Organics Ban (2023/2024)	
Waste Reduction Education	Construction and Demolition Waste Diversion (2023/2024)	
Landfill Environmental Monitoring Improvements	Landfill Ops Contract Extension (2023)/ RFP (2024) Design Operation and Closure Plan Update (2024) Operational Certificate Update (2025)	
Rope and Netting Project (begun in 2019)	Leachate Treatment Facility (2025/2026)	
	Target	Actual
1 - Waste Disposal Rate	< 400 kg/capita	613 kg/capita
2- Diversion of Waste	>50%	22%
3 - Airspace Consumption Ratio	>750 kg/m ³	757 kg/m ³
4 – Capital Contributions	>\$70,000/year	\$126,000
5 – Water Quality	Meet FWAL	Not met
6 – Landfill Gas Generation	<1,000 tonnes CH ₄ /year	Est. 339 tonnes CH ₄ /year

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Background

The Alberni-Clayoquot Regional District (ACRD) operates the West Coast Landfill (WCL) under the British Columbia Waste Management Act Operational Certificate Number OC-5634, issued April 12, 2005. The “waste shed” for municipal solid waste destined for the WCL includes the District of Tofino, District of Ucluelet, Parks Canada, ACRD Electoral District C - Long Beach, Millstream and Port Albion and the First Nations communities of the Toquaht, Yuułuʔiłʔatḥ, Ahousaht, Tla-o-qui-aht, and Hesquiaht. The WCL is located approximately 9 km northwest of the Tofino-Ucluelet junction, on the east side of the highway, along Alaska Pine Road. The WCL has been operational since 1980.

This report was prepared by staff at the ACRD to satisfy the annual reporting requirements for the WCL, as required by the Operational Certificate and the 2016 Landfill Criteria for Municipal Solid Waste published by BC Ministry of Environment and Climate Change Strategy (MOECCS). The report has been reviewed by solid waste engineers from Tetra Tech Canada Inc. that are familiar with the facility and operations. The content of the Annual Report and supporting materials were reviewed by Tetra Tech Canada Inc. in conjunction with the ACRD staff prior to the report being finalized.

Mission Statement

“To protect human health and the environment and maximize value of service by effectively managing the region’s solid waste in an environmentally, socially and economically responsible manner.”

Waste Quantification

Landfilled

In 2022, the WCL accepted 7,268 tonnes of municipal solid waste (MSW) and construction and demolition (C&D) waste as shown in Table 1. The cumulative waste in place at the WCL as of the end of 2022 is 170,345 tonnes.

Table 1 - Waste disposed in 2022

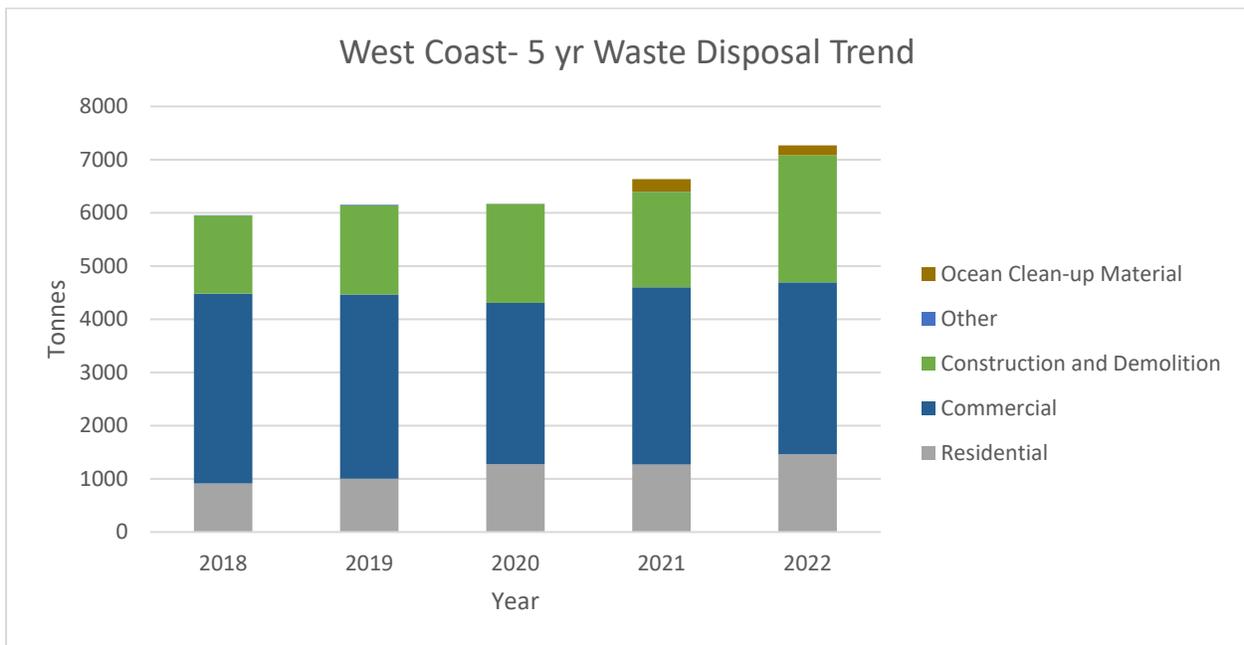
Waste Breakdown	Tonnes	Percentage
Residential Garbage	1,465	20%
Commercial Garbage	3,229	44%
Construction and Demolition	2,388	33%
Other Garbage	0	0%
Ocean Clean-up Material	185	3%
TOTAL	7,268	100%

The largest source of solid waste disposed on the West Coast is collected from the commercial sector. This sector includes resorts, hotels, restaurants, retail and other businesses; making up 44% of all waste that is landfilled. The residential sector produces 20% of the waste which includes materials collected at the curbside and materials self-hauled by residents to the landfill. Construction and demolition (C&D) waste makes up a relatively large portion of the waste stream at 33% (higher than the Alberni Valley Sort’nGo Centre rate of 25%) which includes roofing, drywall, and wood materials. A year over year

comparison of waste processed through the WCL was compiled over a five-year period (Chart 1 below). The key trends are:

- The quantity of residential waste disposed has increased slightly the last five years due to the uptick in private vacation rentals, including Airbnb’s.
- Commercial waste tonnages have reduced slightly compared to 5 years ago.
- Ocean Clean-up materials coming into the site decreased from the previous year.
- C&D Waste has increased in the five-year timeframe with a large increase noted in 2022, likely due to the demolition of an older school building in Ucluelet.

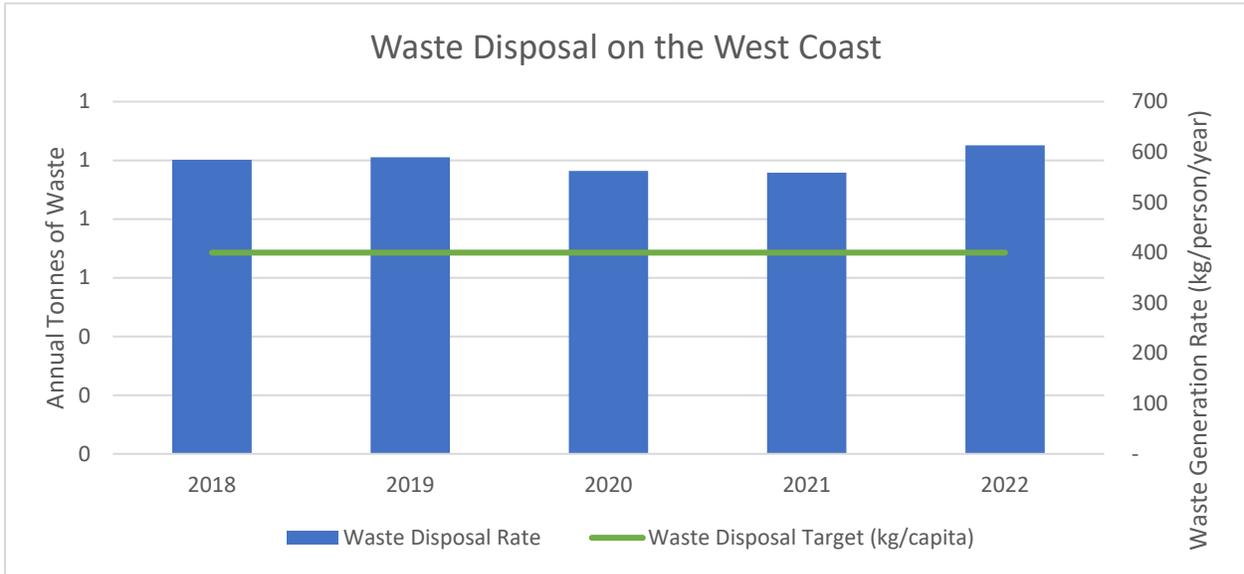
Chart 1 – 5 Year Waste Disposal Trend on the West Coast



The estimated permanent population served by the landfill in 2022 was 7,039. However, the West Coast has a significantly higher equivalent population due to the strong tourism sector. Equivalent population estimates put the total population to be 40% higher. With an average 3% increase in permanent population over the last 5 years¹, the revised equivalent population was 11,788 in 2022. This results in a disposal rate of 613 kg/capita per year which is greater than 2021 (560 kg/capita). This is still well in excess of the target of 400 kg/capital as shown in Chart 2.

¹ BC Population Statistics, Districts of Tofino & Ucluelet.

Chart 2- Waste Disposal 2022



Target-1 - Reduce waste disposal to less than 400 kg/capita

Several projects are planned or have been implemented to assist in the goal of reducing per capita waste disposal, including:

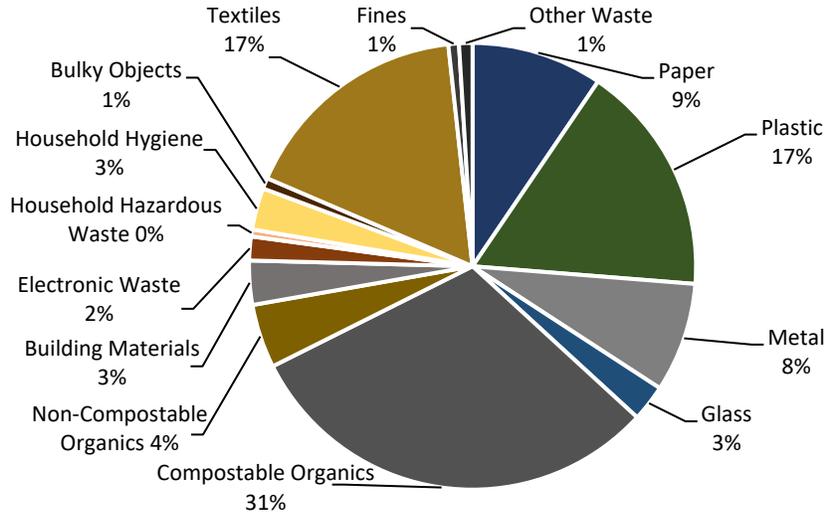
- The rollout of 3-stream curbside collection in December 2022;
- The recent installation of a new organics processing facility commissioned in Spring 2023;
- A waste composition audit slated for 2023; and
- The update of the Solid Waste Management Plan which will investigate other options, such as Construction and Demolition waste diversion

These projects are described later in this report.

Waste Composition Audits

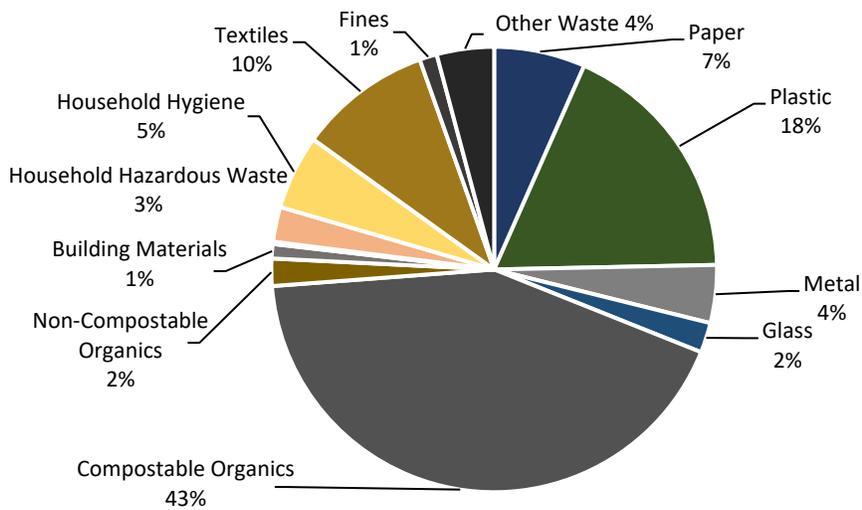
In 2019, the ACRD completed a Waste Composition Study to determine the make-up of materials in the garbage streams for curbside residential, self-haul and commercial waste. Charts 2 & 3 illustrate the weighted average material composition for commercial and residential curbside garbage with compostable organics as the single biggest contributor to landfill waste at the time of the study in 2019.

Chart 2 - WCL Commercial Waste Composition 2019



The commercial waste stream was found to have an average composition of 31% compostable materials and 29% recyclable materials.

Chart 3 - WCL Residential Curbside Waste Composition 2019



The residential curbside waste stream consisted of approximately 43% compostable and 21% recyclable materials. Garbage that was self-hauled by residents had a much lower percentage of organic material; this is because very few residents self-haul their waste to the West Coast Landfill unless they are also disposing of bulky items such as furniture.

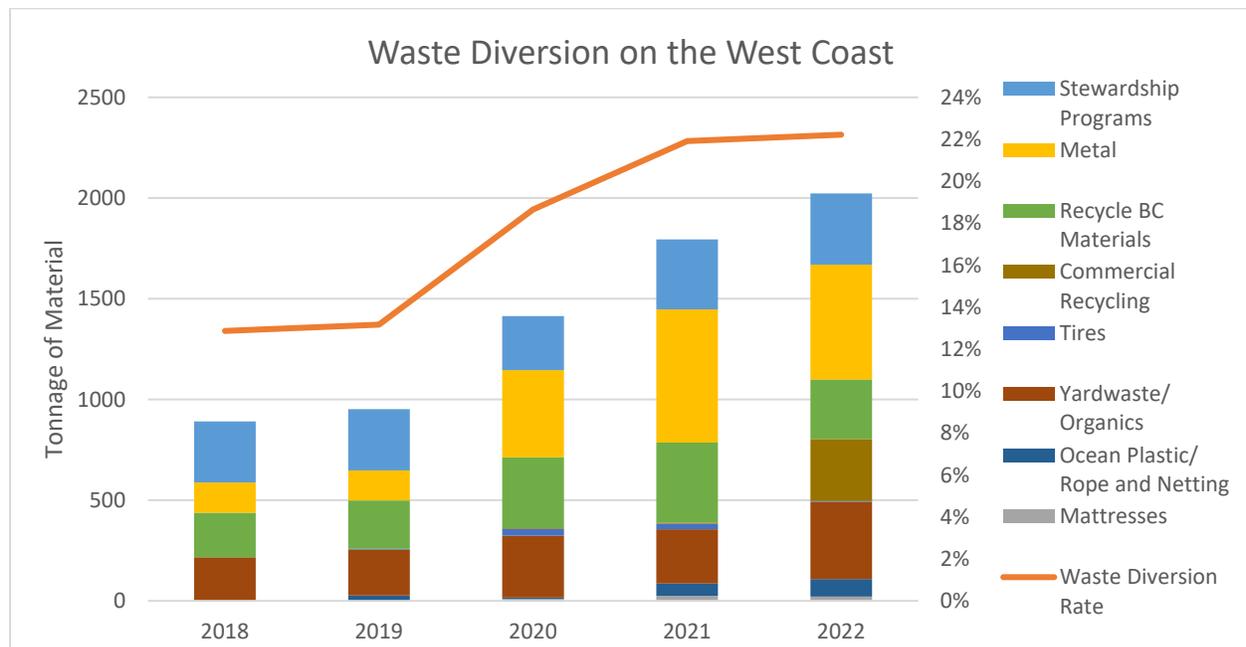
In 2021, the values from the original study were used to project an estimated 31 % of landfilled waste was available to be diverted (2,944 tonnes²). The onset of the new residential 3-stream curbside collection program and installation of a new organics facility at the WCL was created to address this issue and support Target 1. A new Waste Composition Audit is planned for 2023.

² 2021 WCL Annual Report

Diverted

In 2022 good progress was made in improving the collection of data on waste diverted from disposal. This progress was made largely outside of the EPR programs. The quantity of materials measured as being diverted from landfilling in 2022 was 2,023 tonnes of which 1,072 tonnes was collected directly at the landfill. The diversion rate is influenced by both the amount of materials collected through recycling programs and the amount of waste going to landfill, as shown in Chart 5, below.

Chart 5 - Annual Waste Diversion Rates 2022



Key takeaways include:

- Metal recycling remains high since 2019, though tonnage dropped from 2021-2022.
- There was a decrease in the Recycle BC material tonnages diverted in 2022. This was likely due to changes in operating hours for the private depots in Ucluelet and Tofino.
- There was a slight improvement overall in stewardship tonnages diverted from landfill.
- A new category of commercial recycling was noted, due to data not previously available from private haulers. ACRD staff has established connection with local haulers to track this data moving forward.
- An increase in organics waste, covered in the next section.

West Coast Sort'nGo - 3-Stream Curbside Collection and Organics

In 2022 staff put a significant amount of effort into the introduction of organics diversion on the West Coast through the ACRD's new Sort'nGo program (previously established in the Alberni Valley).

The new West Coast Sort'nGo program specifically targeted organics diversion by focusing on:

1. Adding organics collection to the existing residential curbside program; and,
2. Constructing a -new tipping wall and organics processing capacity at the WCL.

To support this work, the ACRD received a \$6-million grant through the Federal Strategic Priorities Gas Tax Fund. The funds paid for the bulk of the landfill upgrades as well as organics processing capacity at the West Coast landfill and the implementation of Phase 2 of the regional organics implementation project that was rollout out during the winter of 2022.

During the initial planning stages of the west coast project, the ACRD staff initiated a Sort'nGo working group that included regular meetings to vet decisions around the various policy and operational components of the service. The working group was made up of staff from Yuułu?it?ath (UFN) and Tla-o-qui-aht First Nation (TLFN) Public Works, District of Ucluelet, District of Tofino, Tofino Urban Farms, Surfrider and Zinc Strategies (Zinc). A large-scale strategy to develop the program, is defined by the following elements.

Engagement

The ACRD, with the support of Zinc Strategies, developed the public engagement strategy that focused on three phases: pre-implementation, implementation, and post implementation. The strategy included communication tools and program materials developed to support the changes to the upcoming waste services. Each phase of the strategy included promotion, education, and outreach tools designed to set residents up for success with the introduction and use of organics diversion and automated cart collection. Websites, videos, key messages, and FAQs were developed amongst other tools to support, educate, and help staff monitor the expanded waste service.

Post implementation engagement include residential waste audits and cart tagging that will identify common contamination issues and provide diversion data that will inform educational campaigns targeted at residents to assist with continued improvements of the service. Key findings from these tactics continue to be communicated to residents of the West Coast through social media, Westerly News articles, and other media outlets.

Ongoing Operations

Ozzard Environmental holds the current curbside recycling collection contract for households within the ACRD boundaries. As part of the transition to three-stream automatic waste collection, Ozzard has converted to automated collection trucks to complete the collection of organics (weekly), recycling (bi-weekly) and garbage (bi-weekly). The transition to fully automated collection has provided numerous benefits including, improved waste diversion, reduced neighborhood litter, dry recyclable materials, customer service improvements due to use of the collection carts, enhanced community aesthetics with the standardized carts, collection time efficiencies and the reduction of health and safety issues i.e., repetitive motion from manual collection from over 1,700 households.

Collection Trucks

Each truck has been outfitted with an on-board computer system, called "Prairie Robotics" with artificial intelligence technology capabilities that help track property-specific contamination issues and confirm missed collection inquires. This software has recently been installed and ACRD staff is undertaking training to ensure the functions can be maximized and used as a helpful tool to provide an important educational component to the service.

Carts

The default cart sizes for waste collection are 120 L for Garbage, 240 L for Recycling and 120L for organics with wildlife proof mechanisms included as a specification requirement. The size selection was

based on waste audits done in the community and ensuring enough room for the average home's recycling (since all materials need to fit inside the cart). However, given the high volume of vacation rentals, Airbnb's and staff accommodations, additional size options for garbage and organics were offered to homeowners at additional cost associated to the type and size of cart option.

Engagement for cart size options began in January 2022 asking residents to provide their preference of size options prior to the cart order being placed to guarantee their preferred cart size options. Since implementation of the Sort'nGo waste service, the ACRD has received request for larger capacity garbage carts and the ACRD is honoring these requests on a first come first served request basis while inventory lasts.

Cart Deliveries

ACRD staff collaborated with members from TLFN and UFN to assist with cart deliveries for both the First Nations pilot and the full West Coast rollout. Community members and additional volunteers delivered over 4,500 carts to 1,700 households over 10 days. Along with labor support, TFN also assisted with cart storage, equipment provisions and extended cart delivery services. The social procurement aspect of this project allowed the ACRD to support the first nations communities and also use community groups like the Wickaninnish Parent Advisory Committee (PAC) group for welcome package assembly.

Education

Surfrider Pacific Rim Chapter has played a key role in assisting with education and outreach efforts prior to the rollout of the Sort'nGo program. As the Sort'nGo service has expanded to organics, a more in-depth approach to the three-stream waste diversion and education will be required. This approach will include activities such as actively managing contamination and keeping abreast of the busy tourist season and waste fluctuation.

Additional Highlights

- Update of the ACRD Solid Waste Bylaw for the West Coast;
- Converting the existing curbside program in Districts of Ucluelet and Tofino to 3-stream automated cart collection;
- Introducing 3-stream collection into the First Nation communities of Hitačú, Esowista and TyHistanis;
- Development of the Sort'nGo brand and the "[letsconnectACRD](#)" online hub to host information to prepare residents for the new program;
- Retendering and redesign of capital works mid-year to meet our goals in direct response to inflated contractor and fuel costs which occurred due to the COVID-19 pandemic; extreme weather; and supply chain demand.
- Securing funding through the Strategic Priorities Grant for capital works at the landfill and purchase of automated collection carts; and
- Registering the new organics facility with the MOECCS.

This new program achieved many successes, including:

- Onboarding 1,730 homes with new carts (and counting);
- Working with language specialists in Yuułuʔiłʔatḥ (UFN) and Tla-o-qui-aht (TLFN) First Nations to develop new outreach material with traditional language terms for waste diversion; and
- Diverting 109 tonnes of organic material in the first month of roll-out.

See Chart 6 and Chart 7 below, which show preliminary data for December 2022 and the initial months of 2023.

Chart 6 –3-Stream Curbside Collection December 1, 2022 to March 31, 2023 (by weight)

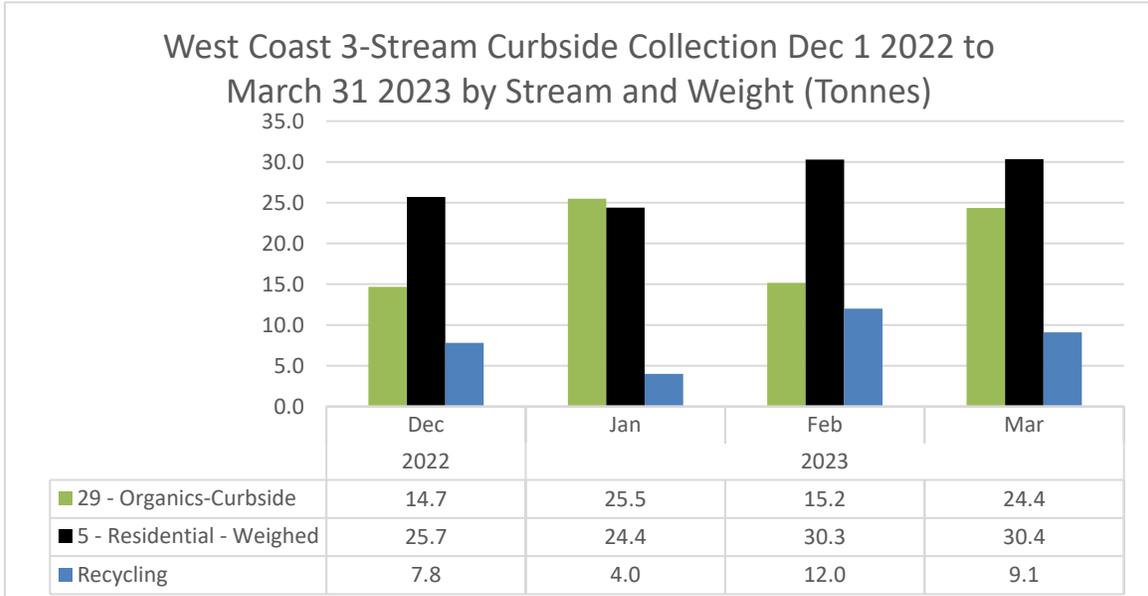
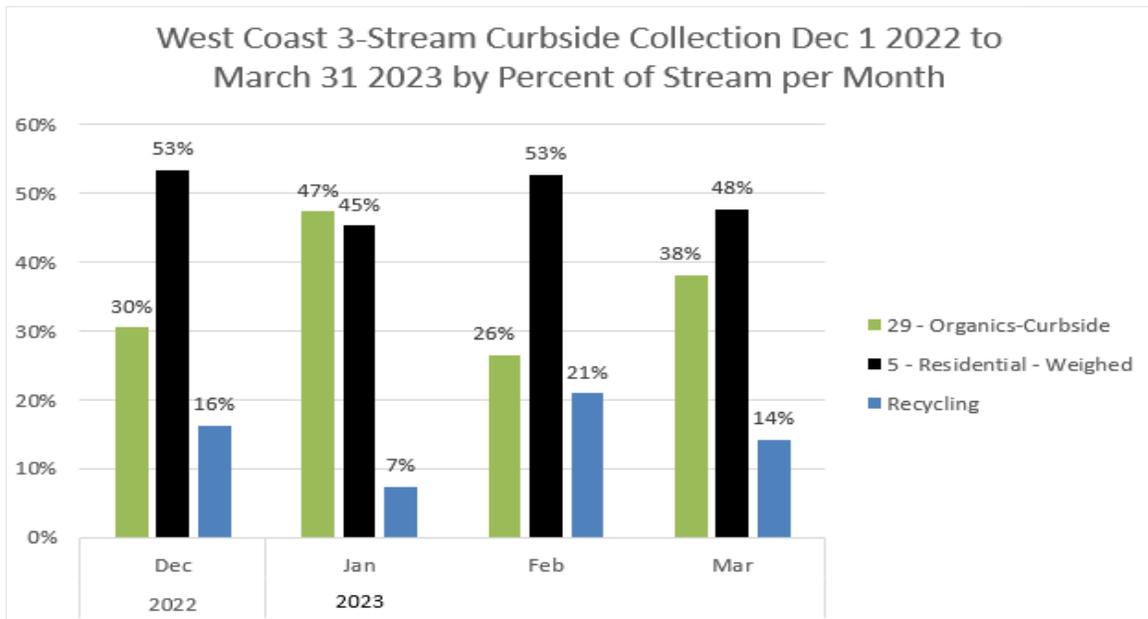


Chart 7 –3-Stream Curbside Collection December 1, 2022 to March 31, 2023 (by %)



Other expanded waste diversion programs also contributed to the trends shown above.

Recycling of ocean plastic debris, begun in 2021, continued in 2022 through partnerships between the ACRD and the Ocean Legacy Foundation as well as the ACRD and Surfrider Foundation. Surfrider spearheads ocean debris collection from coastline clean up events, feeding rope, netting and ocean plastics debris through the WCL for diversion to Ocean Legacy. From there, Ocean Legacy take diverted material and recycle it into feedstock for new products such as signboards. As a result of these efforts:

- 67.5 tonnes of ocean plastics were collected in 2022, compared to 13.7 tonnes in 2021;
- 19.4 tonnes of rope and netting were collected in 2022, compared to 47.5 tonnes in 2021

Mattress recycling, begun in mid-2021 in partnership with Recycle Matters, saw another 21.5 tonnes of mattresses diverted from landfilling in 2022, compared to 25 tonnes the previous year. This diversion is important not only for environmental reasons, but mattresses are also difficult to manage in disposal. To date, nearly 2,400 mattresses have been diverted from landfilling This is an important success in a region in with a strong hospitality industry.

Bicycles are also diverted for reuse. A dedicated storage shed is provided so that bikes may be reused whole or in part. The tonnages are small, but it is an important statement that they may be reused and are not disposable items.

The ACRD contracted the WCL waste reduction education services to Surfrider Pacific Rim Chapter which is present in both Tofino and Ucluelet. The waste reduction education program run by Surfrider has three main thrusts:

1. Eliminating single-use and unnecessary plastics;
2. Materializing a localized circular economy; and
3. Engaging youth, businesses, the public and all levels of government in ocean-friendly initiatives.

These additional diversion efforts have resulted in a diversion rate of approximately 22%, that is up slightly from 2021. However, this diversion rate is still low compared to the target set in the solid waste management plan of 50% and is artificially increased due to commercial recycling data that was not previously available. Staff continue to investigate additional diversion options and monitor the recent organics rollout in early December 2022, which is expected to contribute significantly to meeting this goal.

Target 2 - Increase Diversion of Waste to 50%

The two largest potential diversion opportunities on the West Coast are organics and improved commercial recycling. Other opportunities for diversion streams on the west coast could include residual drywall (demo projects), and other construction waste materials.

Landfill Capacity

Airspace Utilization

In 2022 the WCL consumed 9,600 m³ of airspace based on the annual topographical survey completed at year end. With a total tonnage disposed of 6,632 tonnes, that results in an airspace consumption ratio of 757 kg/m³, meeting our minimum target of 750 kg/m³, an important success. This is a large increase

compared to the five-year average of 560 kg/m³ and is comparable to neighboring landfills that average 730 kg/m³.

The volume of cover material used in 2022 was estimated at 2,662 m³, a significant reduction in airspace consumption from 2021 (4,381 m³). This increase in airspace consumption density was a result of both beneficial changes in operational methods for landfilling at the site as well as refinements in data calculations on cover utilization.

Target 3 – Minimum Airspace Consumption Ratio of 600 kg/m³

Remaining Life

Based on the airspace consumed in 2022, there is an estimated 690,514 m³ of airspace remaining at the WCL. Based on the current population growth rate of 3%, waste generation of 613 kg/capita and airspace consumption ratio of 757 kg/m³, the landfill will reach capacity near 2062. However, if the target for reducing waste disposal to 400 kg/person is met and minimum airspace consumption ratios continues to be met or exceeded, the landfill lifespan has the potential to extend to approximately 2070 and beyond.

Operations

Variations from DOCP

The last Design, Operations and Closure Plan (DOCP) was completed in 2012 by McGill and Associates Engineering and requires an update.

Exceptions from the 2012 plan include overflow (“decant”) events from the leachate holding lagoon. The current system was designed to capture the leachate generated on site. That leachate is then applied to an irrigation field. In 2015 Solinst Levelloggers were installed in the overflow pipes from the leachate lagoon to record overflow events. In 2022 there were 16 decant events as detailed in the Environmental Monitoring completed by Piteau and Associates. By comparison, there were 11 events in 2021 and 19 in 2020. The overflow events in all these years occurred during the winter months following winter storms. The pumping system has not had sufficient capacity to discharge the lagoon to accommodate the inflow of leachate coupled with extreme amounts of surface run-off that are experienced across the site and especially in the irrigation area.

Surface water discharged at the time of the decant events is typically sampled and analyzed as part of the environmental monitoring program. However due to safety concerns no samples were collected in 2022 as detailed in the 2022 Monitoring Report West Coast Landfill. Sample collection and analysis will resume in 2023.

Conformance to SWMP

The most recently adopted Solid Waste Management Plan (SWMP) from 2008³, listed several initiatives to meet the first two targets in the report; reduce per capita waste generation to 400 kg/person; and increase diversion to 50%. Most of these initiatives have been implemented, including the recent initiation of curbside organics diversion on the West Coast. However, organics diversion for the

³ Reviewed in 2014 and 2017.

commercial sector needs to be expanded from pilot stage and options for remote communities is still outstanding. The ACRD will be moving forward with the SWMP update in 2023 to review and update the targets and initiatives for this service (see projects section of this report).

Compliance Resolutions

The ACRD received an inspection on March 16, 2022. The WCL was shown to comply with the Hazardous Waste Regulation but did receive an advisory notice for 3 items:

- Registration with the Organic Matter Recycling Regulation (OMRR) for the time of the inspection. While minor, the MOECCS noted that small volume composting operations are required to have a registration on file, though these operations will not trigger a permit due to their size. A registration was submitted to capture the new organics facility and response was received from the MOECCS in August, 2022.
- Use of previously accepted soils that do not meet the Contaminated Sites Regulation standards for Industrial Land Use as interim cover materials. ACRD staff are communicating with MOECCS regarding correspondence on this topic that occurred in 2021 to confirm that the correct notifications were provided.
- Instances of leachate at the property boundary not meeting British Columbia Approved Water Quality Guidelines and Working Water Quality Guidelines. Continued monitoring of leachate lagoon overflow (decant) events including acute toxicity to fish will be completed as recommended in the 2022 Annual Environmental Monitoring Report. Design for an upgraded leachate treatment system will be completed in 2024/2025 with construction to follow.
- Documentation for leachate overflow piping not captured in MOECCS records including the WCL Operational Certificate No. 5634. Staff is working to establish a timeline and expectations for updating documentation and infrastructure upgrades. The Operational Certificate is expected to be amended if required following completion of the DOCP update in 2023/2024.

Complaints

The ACRD did not receive any documented community complaints regarding the operation of the landfill in 2022. It is beneficial that the landfill is located a significant distance from any residential communities, though staff engage with Parks Canada as the immediate neighbour to the landfill site. Typical complaints associated with other landfills are mainly due to odor and noise, but these are not an issue at the WCL. A formal complaint tracking system is in place to ensure that all complaints are documented and followed up on appropriately, should they occur.

Inspections

As detailed above, the MOECCS visited the site formally in March, 2022. Internally, the Solid Waste team began regular visits to the site in 2022, primarily for capital planning as well as oversight inspections to ensure compliance with the contract, operations certificate and ministry requirements. These internal site visits are conducted at least monthly.

Finances

Operating Expenses

In 2022, the operating expenses for the WCL were:

Table 3 - Operating Expenses

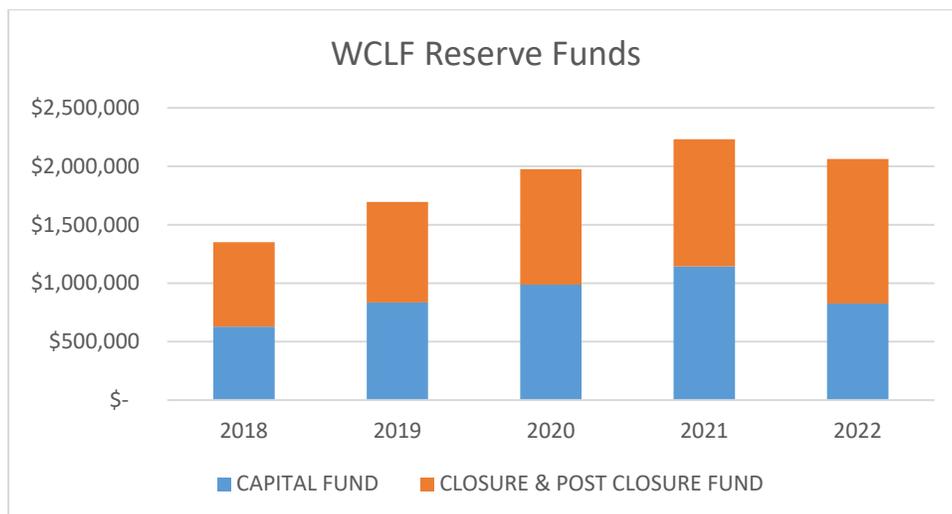
	2022
Landfill Operating Costs	\$829,287
Admin & Education Costs	\$228,560
Recycling	\$462,179
Total Costs	\$1,520,026
Recoveries	\$338,361
Net Cost	\$1,181,665
Reserve Funds Allocation	\$3,174,690

Capital and Closure Funding

Referencing Table 3, above, the allocation of \$3.2 million in reserves reflects the sum of \$3 million from the Strategic Priorities Grant and \$126,000 for the closure/post-closure fund. The Grant monies were expended specifically for the construction at the WCL as well as purchase of new curbside carts for the 3-stream collection program (reference earlier in the “West Coast Sort’nGo” section).

Regarding the closure/post-closure fund, the 2012 West Coast Landfill Design, Operations and Closure Plan (DOCP) identified the need for a fund of \$5,600,000 for closure and post-closure activities. There was \$1,236,228 in the closure and post closure reserve fund at the end of 2022. Contributions to this fund have exceeded the recommended minimum contribution of \$70,000 in each of the past four years. The capital fund shows a significant decrease from 2021 to reflect a capital contribution for the construction for the West Coast Organics Facility.

Chart 8 - Capital Reserve Funds



Target 4 – Annual Capital Contributions meet Funding Requirements

The 2012 DOCP assumed an estimated lifespan of 50 years and the potential to extend to 75-80 years with improved diversion and operation, the annual contribution should be between \$65,000 to \$115,000 per year. With the rollout of organics diversion being completed, the DOCP will need to be updated (see projects section). When the DOCP is updated, it will include a review of capital requirements and closure costs to provide an updated estimate of reserve fund requirements. Until the DOCP is finalized, the contribution to closure/post closure will be kept at least \$90,000 to continue building reserves.

Operational Efficiency

Chart 9 below drills down further into the total operating costs including contracts, administration, and support to manage solid waste on the west coast. It covers operation of the WCL, the curbside collection program and education programs. The costs are influenced by inflation and directly influenced by the volume of material landfilled and diverted.

Chart 9 - Annual Costs and Tonnages



Reserve funds jumped by approximately \$3 Million in 2022. This reflects the application of the Strategic Priorities Grant Fund in the West Coast 3-stream rollout and construction of the new organics facility. Additionally, cost increases for administration and waste education are also linked to those efforts. Finally, inflation from operating contracts and improving landfill operations to meet regulatory criteria have also contributed to increasing costs. Collectively these efforts have resulted in improved diversion of materials from the waste stream.

Environmental Monitoring

Leachate Monitoring

Leachate is generated when rain falls on the waste mound and comes in contact with the buried waste. The leachate is contained within the waste mound because of the low hydraulic conductivity of the marine clay foundation soils. The leachate is collected by ditches located at the perimeter of the waste mound. These ditches collect leachate that seeps from the edges of the landfill and transport it to a lagoon located on the southwest side of the property. The contents of the lagoon are pumped to the north of the landfill to a spray irrigation field. This field is designed to allow the leachate contaminants to attenuate prior to entering the eventual receiving waters of Sandhill Creek.

The ACRD monitors multiple sites in the leachate collection and irrigation field as well as background locations. The samples were analyzed by an independent laboratory for metals, VOCs, inorganic compounds, pH levels, conductivity, and other water quality parameters from the FWAL (Fresh-Water Aquatic Life) protection criteria. All monitoring data is directly reported to our environmental consultants, Piteau Associates Consulting, for their review and reporting to MOECCS. The Piteau report (2022 Monitoring Report West Coast Landfill) accompanies this report.

Leachate Pond Overflow Monitoring

The west coast of Vancouver Island receives some of the largest recorded annual rainfall in Canada. Much of this precipitation occurs during winter storms. The leachate pond is subject to overflowing (decant events) during, and immediately following, these intense winter storm events. When this occurs, the lagoon decants to the north through pipes installed for that purpose but bypassing the irrigation field. Information from dataloggers that are downloaded twice per year record the number of overflow events and the duration. The majority of the decant events in 2022 were due to above-average rainfall received in the 1st quarter (1,073 mm, nearly 40% of the year's precipitation of 2,800 mm). A future design project is planned for the proposed enhanced leachate management system and will build upon the previously executed feasibility study.

With the development of the Organics Processing Facility, the volume of leachate generated at the facility is expected to increase over the coming years. Conversely, the strength of the leachate generated is expected to decrease with the inclusion of contact water from the compost pad. This may result in additional overflow (decant) events throughout the winter months which will be monitored as discussed above.

Overview of the Monitoring Program

Target 5 – All water leaving the site meets the FWAL criteria

Detailed analysis of monitoring data (provided in the 2022 Monitoring Report West Coast Landfill, Piteau and Associates) concludes there is a continuing slight leachate effect to receiving waters in the vicinity of the West Coast Landfill. However, there are no long-term increasing trends apparent that would suggest the effects of the landfill are increasing over time. This means that the target for having all water leaving the site meet the FWAL criteria was not met. The report recommends continuing the environmental monitoring program with some minor adjustments, as described, and to continue the present approach to monitoring overflow events.

The design objective of the new leachate treatment project is that all water leaving the site meet the FWAL criteria. The recommendations of the monitoring report regarding flow gauging will be reviewed jointly with the project design team. The outcome of those discussions will be incorporated into the project which is being designed to ensure that this target will be met once the new system is commissioned.

The Piteau report also recommends the following:

- Continued decant event sampling to be conducted near the mid-point of the event with one set of samples completed for each week within an event.
- Partial capping of the landfill to reduce leachate quantity, the frequency of overflow events and impacts to the receiving waters.
- Temporary installation of a cumulative flowmeter on the leachate irrigation systems, as well as surveys of the culvert inlets, and continued records of leachate storage lagoon levels.

Until a new leachate treatment system is commissioned, staff are working with consultants to develop assess, plan, and implement operational and infrastructure changes to improve performance of the leachate management system. Additional monitoring and sampling will be completed per the recommendations of the 2022 Annual Environmental Monitoring Report to assist in the design of the new leachate treatment system.

Landfill Gas Monitoring

Target 6 - Landfill Gas Generation Less than 1,000 tonnes/year of methane

The engineering firm McGill and Associates completed a Landfill Gas Assessment Report in 2018. Using the required provincial model, the report estimated that the WCL would be producing 339 tonnes of methane in 2022. In the absence of the actual landfill composition data, this report used the average rural waste characterization data in the Landfill Gas Assessment Tool to calculate these volumes. A waste characterization study completed in the spring of 2019 showed that the WCL waste composition has a lower organic content than was assumed in the previous gas calculations. This predicted reduction will be updated and confirmed in the next Landfill Gas Supplementary Report which will be required in 2023 as per Section 15 of the Landfill Gas Management Regulation.

Other Greenhouse Gas Emissions

Landfilling operations require the use of motorized equipment including small machinery such as power washers, small utility vehicles (ATVs), and pickup trucks, as well as heavy duty machinery such as compactors, graders, and excavators. The fuel used for this equipment is primarily diesel. In 2022, the contractor burned approximately 12,213 liters of diesel in the operation of the landfill which produced the equivalent of 32.2 metric tonnes of CO₂.

Illegal Dumping

The west coast has experienced illegal dumping with many different types of wastes including yard waste such as leaves and branches as well as household wastes. These items are often found on logging roads surrounding the communities. In 2022 the WCL received 22.4 tonnes of illegally dumped wastes that were collected at community clean-up events. Community clean-up

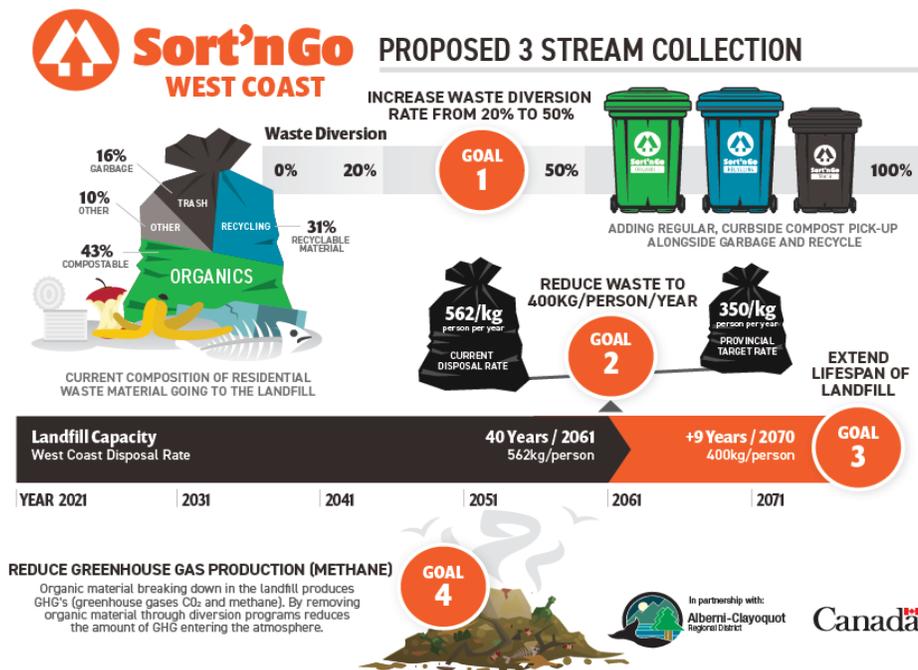
programs will continue to be supported with financial support from the ACRD and other community sponsors.

Projects Completed In 2022

Organics/3-stream Curbside Collection – staff completed public engagement to educate and prepare residents for three-stream curbside collection (garbage, recycling, and organics) via a new automated collection vehicle. As described in the “West Coast Sort’nGo” section earlier in this report, over 1,700 residents in Yuułu?it?ath (UFN), Tla-o-qui-aht (TLFN) First Nation, Tofino and Ucluelet were introduced to this exciting new program in December 2022. Nearly 40 tonnes of organics were diverted from landfilling with more to come.



Expansion of Curbside to Tla-o-qui-aht First Nation (TLFN) and Yuułu?it?ath (UFN) – As part of the organics working group engagement for 3-stream, the ACRD was successful in establishing service agreements with TLFN and UFN to introduce 3-stream curbside collection to 220 homes in the communities of Hitacu, Esowista and TyHistanis. Each nation recruited a member from their respective communities to provide education outreach for the new program. Additionally, language specialists were able to provide key language terms to help with literature to support education efforts.



WC Solid Waste Collection Bylaw – This update was completed to regulate three-stream (organics, recycling, and garbage) automatic cart collection system, on the West Coast. The new bylaw includes the existing collection service area, provides for service collection fees, additional language around securing waste to prevent human-wildlife conflicts and allows for the ability to expand collection where practicable. The bylaw also includes requirements for commercial businesses to establish a plan for managing and reducing their solid waste.

Landfill Upgrades/Organics Composting Facility – The ACRD tendered a contract for constructing a new and improved public drop area/tipping wall in conjunction with the new organics processing facility. Due to significant over pricing in the world economy as a result of the COVID pandemic, the scope of the project was adjusted to meet budget requirements. The new facility is being completed in 2023 in alignment with Ministry Regulations. With the rollout of three-stream collection on the West Coast in December 2022, organics material is collected on an inactive portion of the landfill to meet resident needs until the new facility can be completed.

Waste Reduction Education Program – As detailed above, a significant outreach and education campaign was undertaken with the assistance of Zinc, Surfrider and WildSafeBC to prepare for rollout of the new 3-stream program. Various methods of engaging residents were used, including social media campaigns, information hand-outs for residents and businesses, community events and school education.

Landfill Environmental Monitoring Improvements – Piteau and ACRD field staff continued to work together to sample surface water in various locations around the landfill. At least one sample location was relocated due to safety concerns resulting from fallen trees outside the site but within the neighbouring national park.



Rope and Netting Project – Continuation of a 5-year pilot project with Ocean Legacy to sort and ship out rope and netting for recycling. This project is intended to establish an effective diversion system for these materials that can be used as a template for other coastal landfills in BC. **45.63 tonnes** of Rope & Netting and 16.64 tonnes of Ocean Plastics have been collected by Ocean Legacy and utilized as plastic feedstock for manufacturing signboards.



Projects Upcoming

LF Upgrades/Organics Composting Facility (2023) – With facility upgrades wrapping up in Spring 2023, staff will be working with the landfill operator to transfer operations from the old tipping wall to the new transfer station area. Additionally, commissioning and testing of the new organics facility will take place early in 2023. Significant effort is being undertaken to finalize the operations manual for the new facility and satisfy regulatory requirements. A phased approach to receiving and processing organics will include residential curbside sources (completed), followed by commercial sources later in the summer.



Waste Reduction Education Program (2023) – A 3rd party will be contracted to provide waste education outreach with focus on the West Coast, the new 3-stream program, and waste diversion. Additionally, Staff and the new waste education contractor will be working with the Surfrider Foundation to continue to provide waste reduction education through social media campaigns, information hand-outs for residents and businesses, community events and school education. The program will also include conducting commercial waste audits at resorts and other businesses to assist in increasing the diversion of recyclable materials and organics.

Update of Solid Waste Management Plan (2023)- The current Solid Waste Management Plan is 13 years old. In British Columbia, Regional Districts are mandated by the Provincial Environmental Management Act to develop Solid Waste Management Plans that are long term visions of how each regional district would like to manage their solid waste, including waste diversion and disposal activities. A broad engagement plan will be rolled out in both waste sheds as a component of the Solid Waste Management Plan development.

Waste Composition Study (2023) - A study will be commissioned this year to gain an understanding of the quantity of organics, recyclables and Extended Producer Responsibility (EPR) materials in the garbage streams for curbside residential, self-haul and commercial waste. It is expected that the recent diversion of organics, upgrades at the landfill and onboarding of 3-stream collection will inform the next targets for waste reduction and diversion. Critical information from the study will be incorporated into the Solid Waste Management Plan update, also scheduled for 2023.



Tipping Fee Review (2023) – An in-depth review of tipping fees will be conducted to update self-haul rates, minimum fees, and assess cost coverage for diversion programs. The result of this review will be an updated bylaw to encourage and achieve the target of 50% waste diversion.

Landfill Gas Supplementary Report (2023)– Per the earlier section under landfill gas management, the regulation requires an updated assessment every 5 years. An update will be conducted this year.

Explore Temporary Cover Options (2023/2024) – Options and costs for temporary cover will be assessed in cooperation with Berry and Vale and in alignment with the 2024 Design Operation and Closure Plan Update. The goal of temporary cover would be to decrease leachate generation from portions of the site that will not be disturbed for several years. This work should be aligned with the plans for landfill development and progressive closure.

Landfill Contract Extension & Renewal (2023/2024) – The operating contract for Berry and Vale was originally slated to end on June 30, 2023. However, this took into consideration scheduled commissioning of the composting facility in Fall of 2022, to be followed by a 6-month initial operating period to assess the new scope of operations of the landfill site. After that period of time, a contract for the operation of landfill and compost facility would have been issued for competitive bid. Due to these delays, the contract has been extended for one additional year and will be retendered after costs of composting operations have been fully realized. This information will inform the scope of work for the new 2024 landfill operations contract and also be reflected in the 2024 financial plan.

Installation of Flow Monitoring (2023/2024)– As reference in the Environmental Monitoring section, until future upgrade of the leachate treatment facility can be completed, staff are working with ACRD’s environmental consultant to determine the best interim method of monitoring flow of the leachate discharge.

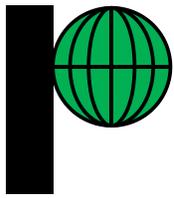
Organics Ban (2023/2024) – With the rollout and initial operations for organics diversion being completed in spring 2023, staff will follow-up thorough engage with commercial haulers, organics processors and area residents in order to move towards banning organics from landfilling. With that

goal in mind, commercial organics processing will be phased in, followed by an amendment to the Tipping Fee & Regulation Bylaw, tentatively planned for the beginning of 2024.

Construction and Demolition waste diversion (2023/2024) - As part of the Solid Waste Management Plan Update, there will be engagement with generators of this material to investigate options to divert as it makes up 30% of the waste stream on the West Coast.

Design Operation and Closure Plan Update (2024) – The current DOCP was created in 2012 and requires updating to address the leachate system operation, cover usage concerns and generally provide enhanced direction for the development of the landfill. The Province has created new landfill criteria and there are several areas identified that need to be improved to meet the new criteria. An important part of the new DOCP will look at runoff diversion with the completion of each stage of final cover as well as the addition of contact water from the Organics facility. The Water Balance Report estimates that the impact of precipitation on leachate generation will be significantly reduced when portions of the landfill are capped. The DOCP is scheduled for updating once the organics program has been completed, ideally in 2023-2024. This allows time to establish good baseline data for tonnage of organics received along with accurate costing of operating the organics program.

Leachate Treatment Facility (2025/2026)– 2023/2024 is dedicated to additional baseline sampling to inform potential design of a new enhanced facility, which will add treatment capacity for offsite discharge. This information will be incorporated into the conceptual design which is on file and be used to compile the detailed design of the leachate treatment facility in 2024/2025. This will be followed by tendering and construction over the 2025/2026 season.



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A TETRA TECH COMPANY

ALBERNI-CLAYOQUOT REGIONAL DISTRICT

2022 MONITORING REPORT

WEST COAST LANDFILL

Prepared for

ALBERNI-CLAYOQUOT REGIONAL DISTRICT

April 2023

Project 1576-R2022

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RECORD OF AMENDMENTS

This report has been issued and amended as follows:

Issue	Version	Date	Prepared by	Reviewed by
1	Draft	2023-03-22	Jennifer Mancner, P.Eng. Senior Hydrogeologist Judah Chen, GIT Junior Hydrogeologist	David Tiplady, P.Eng. Principal Hydrogeologist
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1 INTRODUCTION AND BACKGROUND

The West Coast Landfill (WCL) is situated 1 km north of the Pacific-Rim Highway, approximately 9 km northwest of the Tofino-Ucluelet junction, and 7 km southeast from the Tofino Airport. It is located in a previously clearcut area leased from Weyerhaeuser, and borders the Pacific Rim National Park to the south and west (Figure 1).

The WCL is owned by the Alberni-Clayoquot Regional District (ACRD) and operates under Operational Certificate MR-05634, issued by the Ministry of Water, Land and Air Protection on April 12, 2005. It accepts municipal solid waste from the surrounding area, including Ucluelet and Tofino. Berry & Vale Contracting Ltd. operated the landfill for the ACRD through 2022 and Piteau Associates Engineering Ltd. (Piteau) oversaw the water quality monitoring program. Water quality results from the 2022 sampling period, along with relevant results from previous years, have been compiled and are presented and assessed in this report.

A description of the landfill geology, the history of the landfill and water quality program, and descriptions of the monitoring wells and surface water sampling locations, are included in the 2019 monitoring report (Piteau, 2020).

2 MONITORING PROGRAM

2.1 DESCRIPTION OF 2022 MONITORING PROGRAM

The 2022 monitoring program included analysis of surface water samples collected at 17 sites at or close to the West Coast Landfill. The frequency of sample collection, and analyses performed, are summarized on Table 1.

The following changes recommended in the 2021 program (Piteau, 2022) were implemented in 2022:

- SW-5 was formally removed from the sampling program since it has been dry since 2012;
- SW-10 samples were collected at a safer site 20 m upstream due to a large tree across Sandhill Creek at the former SW-10 site;
- SW-15 was removed from the sampling program, as sampling results indicated it was local runoff with no leachate effect; and
- DOC and dissolved copper was removed from the sampling program. Dissolved copper guidelines were calculated with the 2020 and 2021 average DOC, and total copper was compared against the dissolved copper guidelines.

All samples were collected by ACRD personnel according to the field procedures for West Coast Landfill (Piteau, 2021). Electrical conductance (EC), pH, and temperature were measured at the time of sample collection, and water samples were collected using a low-flow peristaltic pump or by grab-sampling. Samples for ammonia were preserved with sulphuric acid (H_2SO_4) at the time of collection, and samples for total metals were preserved with nitric acid (HNO_3). All samples were stored with ice in a cooler and shipped to AGAT or ALS Laboratories in Burnaby, BC. All analyses were completed within acceptable holding times, unless noted in Appendix A.

Average concentrations of key leachate indicator parameters at each site in 2022 are presented in Table 2, along with working and approved guideline criteria for freshwater aquatic life (FWAL) in BC (MOE, 2021), and standards from the Contaminated Sites Regulation (CSR) for aquatic water (AW) and drinking water (DW). As the CSR AW standards are for groundwater, and assume 10 times dilution before entering surface water, analytic water quality data for natural surface watercourses have been compared to one tenth of the AW standard. Table 3 summarizes all sample locations with concentrations of one or more analytes exceed FWAL guidelines and/or the CSR standards on one or more occasions during 2022. With the exception of pH, these occurrences are discussed in Section 3.

Total phosphorus results were also compared to the May to September average phosphorus objective developed for Vancouver Island streams (MOE, 2014). This objective was developed to protect streams from the effects of development, and in particular sewage discharge. The focus of this objective is on southern and eastern Vancouver Island where development pressure is greatest.

Results of the field measurements and laboratory analyses for each of the sampling events in 2022 are summarized in Tables A-1 through A-15 in Appendix A. Key leachate indicator parameters are plotted spatially on Figure 1, and on time-series graphs on Figures B-1 through B-18 in Appendix B.

2.2 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control (QA/QC) processes incorporated in the monitoring program included measures by both the analytic laboratory and by field personnel collecting surface water and groundwater samples. The laboratory component includes analysis of quality control samples to define precision and accuracy, and to demonstrate contamination control for the type of samples and parameters under investigation. These measures include analysis of laboratory replicates, method blanks, and certified reference materials.

QA/QC inherent in the field program included the following measures to ensure sample integrity. Prevention of cross contamination or introduction of foreign contaminants during sampling included use of new latex or nitrile gloves and dedicated sampling equipment at each sample location, and use of unused sample containers provided by the project laboratory.

The field program also included collection and analysis of duplicate samples to verify analytical precision (i.e., repeatability). In 2022, 38 samples and three duplicate samples were collected for analysis. The relative percent difference (RPD) between the sample and the duplicate was calculated in accordance with the following equation:

$$RPD = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100\%$$

where:

- RPD is relative percent difference;
- C_1 is the larger of the two observed values; and
- C_2 is the smaller of the two observed values.

RPD values below about 35% are generally desirable, and values of up to about 65% are considered acceptable. For the three field duplicate samples collected in 2022, all calculated RPDs were below 35%, except for the 118% RPD calculated for total manganese at SW-6 in November 2022 (Appendix C). The maximum manganese concentration was 0.0285 mg/L and is well below the 1.05 mg/L FWAL guideline.

The elevated RPD is likely due to inclusion of sediment in the samples, which can lead to a higher degree of variability in analytical results. Due to the low reported concentrations that are well below the most stringent guideline, this high RPD is not considered to be of concern.

3 SAMPLING RESULTS

3.1 COLLECTED LEACHATE QUALITY

3.1.1 SW-2, SW-3 and SW-4

Sample collection sites SW-2 and SW-4 are located where Leachate Ditch #2 and Leachate Ditch #1 drain into the leachate storage lagoon. SW-3 is located at the pump intake in the leachate storage lagoon. Four samples were collected at SW-2 and SW-3 in 2022, but only three samples were collected from SW-4 due to dry conditions in September.

Analysis results for SW-2, SW-3, and SW-4 indicated elevated concentrations of total dissolved solids (TDS) and chloride (Tables A-2, A-3 and A-4, Figures B-1 and B-3), and are indicative of concentrated leachate. Hardness and alkalinity were also elevated, with 2022 average results for total hardness ranging from 304 to 399 mg/L as CaCO₃ and average alkalinity ranging from 381 to 508 mg/L as CaCO₃ (Table 2).

Long-term trends indicate that leachate indicator concentrations dropped after the implementation of the leachate interception measures in 2004, and began to rise in 2013 (Appendix B). The rise since 2013 is attributed to the drying trend seen in the local weather, and thus reduced dilution. Additionally this increase in concentrations, in some cases, may partially be attributed to waste composition or extent exposed to leaching. Although 2022 reported an unseasonably dry year, overall concentrations of analyzed parameters concentrations were within the range of values reported in the last seven years.

Seasonally, leachate indicator concentrations typically peak in the late summer/early fall when dilution is minimal. Due to the extended dry summer in 2022, concentrations reported in November were higher than for previous years (Tables A-2, A-3, and A-4, Figures B-1, B-3, and B-5). However, concentrations remained within the typical annual variation noted in data from the previous seven years.

In 2022, the SW-2 samples displayed higher leachate concentrations than SW-4. The difference was more pronounced during the summer (drier) months. This may indicate that as the region becomes drier, flows in Leachate Ditch #1 (east side) may potentially receive more dilution than that in Leachate Ditch #2 (west side).

Ammonia concentrations for SW-3 and SW-2 averaged 20.5 and 25.0 mg/L-N in 2022, respectively (Table 2). Average ammonia concentrations at SW-4 (37.5 mg/L-N) were significantly higher (Figure B-5). This indicates that some nitrification may be occurring in the leachate storage lagoon. All ammonia concentrations measured in leachate in 2022 were above the 1.84 mg/L-N FWAL guideline and the CSR AW standard (11.3 mg/L-N).

Nitrate concentrations in the leachate collection system were consistent with the previous seven years, with concentrations above the FWAL guideline (3 mg/L-N) measured at SW-2 for the summer and fall sampling events. The 2022 maximum concentration was 7.1 mg/L-N at SW-2 (Table A-2 and Figure B-7). Nitrate concentrations were generally lower at the other sites with no other FWAL exceedances.

Total phosphorus concentrations measured in the leachate system have remained within previously observed ranges. The average of May and September total phosphorus concentrations in samples collected at SW-2, SW-3, and SW-4 exceeded the May to September average Vancouver Island phosphorous objective for streams (0.005 mg/L; MOE, 2014) by multiples of three and six (Tables B-2, B-3, B-4 and 3).

Chemical oxygen demand (COD) concentrations have declined since the highs measured in 2013, with a maximum concentration of 81 mg/L measured at SW-4 in 2022 (Table A-4, Figure B-9). The relative concentrations of the three sampling sites reflect the mixing ratio of the SW-2 and SW-4 waters in the storage lagoon, evaporation in the summer months, and renovation from residence time in the leachate storage lagoon.

Historical five-day biochemical oxygen demand (BOD₅) concentrations at SW-2, SW-3 and SW-4 are typically less than 40 mg/L-O (Figure B-11), reflecting the low strength of the leachate. Levels in 2022 were lower compared to those measured in previous years, with the majority of the reported values close to or below the laboratory's detection limit of 2 mg/L-O. The highest BOD₅ (19 mg/L-O) was measured at SW-2 in September (Table A-2).

Total aluminum concentrations in leachate were lower than in previous years and only exceeded the FWAL guideline (0.05 mg/L) for dissolved aluminum at SW-2 in September (0.06 mg/L) and at SW-4 in May (0.09 mg/L) (Tables A-2, A-3, and A-4 and Figure B-13). Analysis of dissolved metals at SW-3 prior to 2017 indicated that while total aluminum regularly exceeded the FWAL guideline for dissolved aluminum, the concentration of dissolved aluminum was below the FWAL guideline in all samples (Piteau, 2018). The background concentration of total aluminum (at SW-7) also exceeded the FWAL guideline for all sampling events in 2022.

Since the implementation of the leachate collection system in 2004, total iron concentrations in the leachate have remained below 40 mg/L, with exceptions in 2013 and 2014. Concentrations in 2022 ranged from 0.275 mg/L to 16.4 mg/L, exceeding the FWAL guideline (1 mg/L) in eight of 11 samples. Total iron also exceeded the CSR DW standard in February and May at SW-2, and February at SW-4 (Tables 3, A-2, A-3, and A-4, and Figure B-15).

In 2022, total manganese concentrations in leachate were within the range of values measured since 2005 (Figure B-17). The highest concentration (4.7 mg/L) was recorded at SW-2 in May.

Three of 11 samples exceeded the hardness-dependent FWAL guideline (1.71 to 2.37 mg/L), and five samples exceeded the 1.5 mg/L CSR DW standard (Tables A-2, A-3, and A-4).

Samples from SW-3 were submitted for full metals analysis. Other than the total iron noted above, only cobalt had slight exceedances of FWAL guidelines or CSR standards in two of four samples (Tables 3 and A-3).

All samples collected from SW-3 in 2022 were analyzed for volatile organic compounds (VOCs). Results indicated concentrations of all analytes were below the applicable reporting limits (Table A-13). The September sample from SW-3 was also submitted for analysis of a broad spectrum of potential organic contaminants, including: light and heavy extractable petroleum hydrocarbons (LEPH & HEPH), organophosphate pesticides, organochlorine pesticides, polycyclic aromatic compounds (PAHs), and select phenols (Table A-14). Concentrations of all parameters analyzed were below reporting limits.

Although a sample was not submitted for per- and polyfluoroalkyl substances (PFAS) this year, analyzed parameters in 2021 had concentrations either below the laboratory's detection limit or far below application guidelines or standards.

3.1.2 SW-14

SW-14 is sampled where the pipe collecting the runoff from a trial composting facility discharges into Leachate Ditch #1 (Figure 1). It was first sampled in April 2020, shortly after composting commenced at the trial facility. As no discharge to Leachate Ditch #1 was observed during any of the 2022 sampling events no SW-14 samples were collected in 2022.

3.2 LEACHATE IRRIGATION WATER RECEIVING AREA AND WEST LANDFILL BOUNDARY

3.2.1 SW-8 and SW-9

SW-8 and SW-9 are located in the irrigation water receiving area in the northern part of the facility, and were sampled only three times in 2022. Both locations were noted to be dry during the September sampling event. The analytic results for these locations indicate significant leachate effect due to the upslope application of irrigation water. However, concentrations of TDS and chloride remained within previously observed bounds, with concentrations at SW-9 generally higher than at SW-8 (Table 2, Figures B-1 and B-3). Peak concentrations at SW-8 and SW-9 are typically observed in the summer months when conditions are driest. In 2022, peak concentrations occurred in November, which was after an extended dry summer.

Ammonia concentrations in 2022 ranged between 0.013 and 2.95 mg/L-N at SW-8 and SW-9, with the May sample at SW-8 and the February sample at SW-9 exceeding the 30-day average FWAL guideline of 1.84 mg/L-N (Tables A-8 and A-9, Figure B-5). Nitrate concentrations for 2022 were

within the previously observed range, except at SW-8 in November, where the 10.2 mg/L-N result exceeded both FWAL guidelines (3 mg/L-N) and CSR DW standard (10 mg/L-N). Samples from SW-9 exceeded the FWAL guidelines for nitrate in February (4.5 mg/L-N) and May (3.6 mg/L-N) (Figure B-7).

BOD₅ and COD concentrations in 2022 samples from SW-8 and SW-9 were at the lower end of the previously observed range (Figures B-8 and B-9).

All total aluminum results at SW-8 and SW-9 exceeded the dissolved aluminum guideline, except the SW-9 February sample (Figure B-13 and Tables B-8 and B-9). Total iron concentrations remained low compared to previous years, however reported concentrations for the SW-8 February (1.3 mg/L) and May (1.1 mg/L) samples slightly exceeded FWAL guideline (1 mg/L; Figure B-15). Total manganese concentrations were within the observed range of the previous several years (Figure B-17). Concentrations were higher in SW-8 compared to SW-9, and the February and May samples for SW-8 exceeded the FWAL guideline and the CSR DW standard.

The total phosphorus concentration exceeded the Vancouver Island May to September phosphorus objective for the May samples at both SW-8 and SW-9. No samples were collected at either location in September due to dry conditions.

The 2022 monitoring results for sites SW-8 and SW-9 continued to show varying leachate effect in response to the irrigation of water over the upland area. The sampling results also 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
- irrigation increases leachate dilution prior to discharge to Sandhill Creek in the winter months.

Overall, the results indicate the lagoon/irrigation system promotes oxidation and precipitation of iron. Some instances of higher total iron concentrations measured from 2013 to 2015 suggest this may not always be the case; however, 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. The irrigation system does appear to reduce iron and ammonia loading to Sandhill Creek, particularly during the growing season, when ammonia effects on Sandhill Creek are expected to be the most significant.

3.2.2 SW-6

SW-6 is located in an area of ephemeral ponding in the buffer zone along the west edge of the landfill (Figure 1) where water from the spray irrigation area passes before leaving the property. It was dry during the September sampling event and was thus sampled only three times in 2022.

Concentrations of TDS and chloride in 2022 samples from SW-6 were within the range of previously observed data, and were typically lower than concentrations measured at SW-8 and SW-9 (Figures B-1 and B-3). Ammonia concentrations in 2022 ranged from 0.006 to 0.09 mg/L-N, on the lower end of those measured in recent years (Table A-6 and Figure B-5). Lower ammonia concentrations are balanced by higher nitrate concentrations, with all exceeding the FWAL guideline (3 mg/L). An anomalously high nitrate concentration (28.4 mg/L-N) was measured in February (Figure B-7).

Total aluminum concentrations at SW-6 in 2022 were higher than those measured at SW-8 and SW-9, and above the FWAL guideline for all sampling events (Tables 2 and A-6, Figure B-13). Iron concentrations were below those measured at SW-8 except for the May sample (1.9 mg/L) when iron also exceeded the FWAL guideline (1 mg/L; Table 3 and Figure B-15). Total manganese concentrations remained below 0.4 mg/L in 2022, well below the 1.05 mg/L FWAL (Figure B-17).

Overall, historical TDS, chloride, ammonia and nitrate data suggest water quality at SW-6 shows a slight leachate effect. Compared to SW-8 and SW-9, samples from SW-6 generally show improvement for leachate indicators (Table 2). In 2022, relative concentrations of nitrate and ammonia indicated high nitrification rates. Chloride concentrations closely track those measured at SW-8 and SW-9 (Figure B-3), suggesting the reduced nutrient loading is not solely attributable to dilution.

3.3 SOUTHWEST AND SOUTH LANDFILL BOUNDARIES

3.3.1 SW-11

SW-11 is located west of the landfill in a natural gully that exhibits perennial flow and appears to be receiving leachate that seeps past Leachate Ditch #2 or overflows from the leachate pond after periods of heavy rain. This location was noted to be dry in September so only three samples were collected in 2022.

TDS and chloride have historically been elevated at SW-11. Concentrations measured in 2022 were typical of recent years, averaging 138 and 35 mg/L, respectively (Table 2, Figures B-2 and B-4).

Ammonia concentrations at SW-11 have dropped in the past three years, with all results for 2022 at or below 0.14 mg/L-N, which is well below the 1.84 mg/L-N FWAL guideline (Table A-11 and Figure B-6). Nitrate concentrations ranged between 0.1 and 2 mg/L-N in 2022 (Table A-11 and Figure B-8). The concentration trends for SW-11 do not correlate with results for SW-2 (the Leachate Ditch #2 sample). This suggests a localized source within the landfill, and hence a discrete seepage path beneath Leachate Ditch #2 (Piteau, 2020).

Summer phosphorus concentrations from SW-11 typically exceed the May to September average Vancouver Island phosphorous objective for streams (0.005 mg/L; MOE, 2014). The May sample exceeded the objective by a factor of seven (Tables A-11 and 3). No sample was collected in September due to dry conditions.

COD concentrations at SW-11 were relatively low in 2022, with all results below 20 mg/L-O (Table A-11 and Figure B-10). BOD₅ concentrations were all less than the 2 mg/L-O detection limit (Figure B-12).

Total aluminum concentrations ranged from 0.199 to 0.693 mg/L in 2022, with all samples exceeding the dissolved FWAL guideline of 0.05 mg/L (Table A-11 and B-14). The aluminum concentrations were historically similar to the background values (Section 3.4) but increased relative to background values between 2015 and 2021. Concentrations measured in 2022 were at background values.

In 2022 total iron concentrations at SW-11 varied from 0.958 to 2.1 mg/L and were lower than measured in previous years (Table A-11 and Figure B-16) but remained above the FWAL guideline at SW-11 for all but the November sample. The highest concentrations are typically observed in the summer months (Figure B-16). Summer peaks above 10 mg/L have not been recorded since sample collection with a low-flow peristaltic pump began in April 2018.

Manganese concentrations in all three samples from SW-11 in 2022 remained below the FWAL guideline (Table A-11; Figure B-18) and were consistent with results from previous years.

Also consistent with results from previous years, total chromium concentrations at SW-11 ranged between 0.00051 and 0.0014 mg/L in 2022. The results exceeded the Cr(VI) FWAL guideline of 0.001 mg/L for two of three sampling events (Table A-11).

Copper concentrations at SW-11 in 2022 were all below the sample-specific calculated dissolved copper guidelines (Table A-11).

Consistent with results from previous years, total zinc ranged from 0.006 to 0.02 mg/L, and exceeded the 0.0075 mg/L FWAL guideline for two of three sampling events (Table A-11). The only other metals exceedance at SW-11 was the November 2022 cobalt concentration (0.00115 mg/L), which was greater than the CSR DW standard (0.001 mg/L).

The monitoring results for SW-11 indicate the small gulley at SW-11 is a pathway for movement of leachate towards Sandhill Creek. Leachate effects (primarily nitrate and ammonia) appeared to drop in 2009, likely as a result of deepening of Leachate Ditch #2 (Piteau, 2010 and 2020). The ammonia results are highly variable, but overall, appear to correlate with concentrations in the

leachate. SW-11 continues to exhibit a moderate degree of effect from leachate, with iron and chromium concentrations regularly exceeding their respective 30-day FWAL guidelines.

3.3.2 SW-12

SW-12 is located near the park boundary in the southwest corner of the property, down gradient from the leachate lagoon, and represents the south landfill effect on Sandhill Creek. Three samples were collected in 2022. No sample was collected in September due to dry conditions.

TDS and chloride concentrations at SW-12 remained within previously observed bounds in 2022 (Figures B-2 and B-4). Both analytes vary seasonally, but to a much lesser extent than in leachate (Tables 2 and A-12).

Ammonia concentrations at SW-12 are relatively low, but since 2015 have increased slightly with exceedances of the FWAL guideline in 2015 and 2018 (Figure B-6). Ammonia was at or below 0.08 mg/L-N in all samples, far below the 1.84 mg/L-N FWAL guideline (Table A-12).

Nitrate concentrations at SW-12 ranged from 0.11 to 0.7 mg/L-N in 2022, consistent with results in previous years, and below the 3 mg/L-N 30-day average FWAL guideline (Table A-12 and Figure B-8).

Total phosphorus concentrations measured in the summer typically exceed the May to September average Vancouver Island phosphorous objective for streams (0.005 mg/L; MOE, 2014). In 2022, the May sample exceeded the objective by a factor of seven (Tables A-12 and 3).

Total aluminum concentrations in 2022 ranged from 0.68 to 1.09 mg/L, and exceeded the dissolved FWAL guideline of 0.05 mg/L at all sampling events (Table A-12 and Figure B-14). The aluminum concentrations were historically similar to the background values, but like those at SW-11, increased relative to background values starting in 2015.

Total iron concentrations at SW-12 up to May 2015 ranged between 0.19 and 2.9 mg/L, with approximately 10% of the results exceeding the current FWAL guideline (1 mg/L). Since 2015, total iron has routinely exceeded the FWAL guideline. All three 2022 samples exceeded the FWAL guideline (Table A-12 and Figure B-16).

Results for SW-12 suggest only a very slight leachate effect 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 effective containment is provided by Leachate Ditch #1 and the storage lagoon.

3.4 BACKGROUND CREEKS

3.4.1 SW-7

SW-7 drains the northeastern portion of the landfill property and is separated from the landfill area by a surface water divide. It is included in the monitoring program to provide background water quality data for the site. This location was sampled in May and November 2022. Water was observed to be stagnant in February, and was not sampled. SW-7 was dry in September.

Alkalinity and hardness are typically low at SW-7, with the sampling record to date exhibiting a typical range of 4 to 69 mg/L as CaCO₃ (Table A-7). Average alkalinity and hardness values were 23 and 43 mg/L as CaCO₃, respectively, in 2022.

Water quality for SW-7 during 2022 was characterized by a TDS range between 60 and 159 mg/L (Table A-7 and Figure B-2). Chloride concentrations in 2022 ranged between 19 and 38.9 mg/L (Figure B-4). Chloride concentrations in recent years have consistently been higher than in 2012, and likely reflect the drier-than-average summers and autumns of recent years.

All ammonia concentrations in samples collected at SW-7 in 2022 were below 0.2 mg/L-N, and are typical for this background site (Figure B-6). Corresponding nitrate concentrations ranged from below the laboratory detection limit (0.02) to 0.926 mg/L-N, and remained well below the FWAL guideline of 3 mg/L-N (Figure B-8).

Total phosphorus at SW-7 exceeded the May to September average Vancouver Island phosphorous objective for streams (0.005 mg/L; MOE, 2014) by a factor of four in the May sample. This is consistent with results from previous years (Tables A-7 and 3).

Prior to 2006, samples from SW-7 had pH typically ranging between 5 and 6.4. Both field and lab pH values have exhibited a slight increasing trend since 2006, with 2022 field and lab pH values averaging 7.2 and 6.41, respectively. Low pH is characteristic of peat bogs.

In 2022, COD at SW-7 ranged between 16 and 18 mg/L-O and BOD₅ remained below the detection limit of 2 mg/L-O (Table A-7). Elevated values measured in 2021 were not repeated in 2022 (Figures B-10 and B-12).

Background metal concentrations in 2022 were below the FWAL guidelines and CSR AW/10 standards for surface water, with the following exceptions (Tables 3 and A-7):

- Total aluminum is typically elevated at SW-7, with concentrations chronically exceeding the dissolved aluminum FWAL guideline of 0.05 mg/L by a considerable margin (Figure B-14). In 2022, concentrations ranged from 0.17 to 0.223 mg/L;
- Total copper was evaluated against sample-specific dissolved copper FWAL guidelines. The May (0.0019 mg/L) result slightly exceeded the calculated dissolved copper guidelines (0.0018 mg/L) but remained below the CSR AW/10 (0.002 mg/L);

- Total silver concentration measured in May (0.00006 mg/L) exceeded the hardness-dependent CSR AW/10 standard and FWAL guideline (0.00005 mg/L) in May; and
- Total zinc concentrations exceeded both the FWAL guideline and the CSR AW/10 standard (both 0.0075 mg/L) in the May (0.01 mg/L) and November (0.008 mg/L) samples.

Other metals that have exceeded FWAL guidelines at this background site in previous years include arsenic, chromium, manganese, and mercury. Most exceedances are attributed to low creek water levels leading to elevated amounts of sediment in the samples.

Since the leachate interception system was commissioned in 2004, elevated concentrations of iron and manganese have been encountered more frequently (Figures B-16 and B-18). As the elevated concentrations typically occur in the summer, they are at least partially attributed to the drier than average weather experienced over the past decade. However, although exceedances of nitrate and ammonia at SW-7 are rare, these nutrients have been detected more frequently at higher concentrations in recent years. In light of these results, it is possible that the SW-7 background site is receiving some landfill effect. However, as previously reported, no flow toward SW-7 from the Landfill or the irrigation area was visually observable in November 2020 after a period of significant rainfall (Piteau, 2021). This site will continue to be monitored for any indications of leachate effect.

3.4.2 SHC East Tributary

The SHC East Tributary site near the southeast corner of the facility was added to the landfill monitoring program in 2018 and is intended to further characterize background chemistry during summer low flow periods in a tributary of Sandhill Creek that is unlikely to receive any effect from the landfill. Due to dry conditions in 2022, no water was observed at the Sandhill Creek East Tributary location in September so no sample was collected

3.5 RECEIVING CREEKS

3.5.1 SW-10 Upstream (SW-10US)

SW-10-US is immediately upstream of a culvert that directs water under an old logging road (Figure 1) and is sampled annually.

Although samples from SW-10US have previously had slightly elevated TDS, chloride, alkalinity, ammonia and nitrate relative to samples from SW-10 (located 180 m downstream), concentrations measured in 2022 were similar to or lower than those at SW-10 (Figures A-2, A-4, A-6, and A-8; Table A-10). Total aluminum results exceeded the FWAL guideline for dissolved aluminum (0.05 mg/L) in 2022, which is consistent with results since 2015 and the background sampling sites. Total phosphorus also exceeded the May to September average Vancouver Island phosphorous objective for streams (0.005 mg/L; MOE, 2014) in the September sample by a factor of five (Tables A-10 and 3). This is also consistent with previous results and levels measured in background creeks. No other exceedances were identified for the SW-10US sample.

The leachate indicator chemistry results for the SW-10US samples show minimal leachate effect, and a slight improvement compared to the upgradient SW-6 site (Tables 2, A-6 and A-10).

3.5.2 SW-10

SW-10 samples are collected upstream of where flow at SW-11 enters the Sandhill Creek tributary. SW-10 was not sampled during the February and May sampling events due to safety concerns and accessibility. The sample location was therefore moved 20 m upstream for the September and November sampling events.

The chloride concentration at SW-10 in 2022 was 31.7 mg/L for both the September and November samples. Consistent with the historical record (Figure B-4), the elevated chloride concentrations are indicative of a drought condition, when groundwater discharge forms creek baseflows.

In 2022, ammonia concentrations ranged from <0.005 to 0.06 mg/L-N (Table A-10 and Figure B-6). Nitrate concentrations were slightly higher, ranging from 0.5 to 1.4 mg/L-N, but remained well below the 3 mg/L-N FWAL guideline (Figure B-8). Total phosphorus was typical of previous years and background creeks. It exceeded the May to September average Vancouver Island phosphorous objective for streams (0.005 mg/L; MOE, 2014) in the September sample by a factor of five (Tables A-10 and 3).

Consistent with previous years and other sites, total aluminum at SW-10 exceeded the dissolved aluminum FWAL guideline for both sampling events in 2022 (Table 3 and A-10). Total iron was measured at the FWAL guideline (1 mg/L) in September, but was only 0.283 mg/L for the November sample. One zinc exceedance (0.0094 mg/L) of the FWAL guideline and CSR AW/10 standard (0.0075 mg/L) occurred in November.

3.5.3 SW-1

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

Samples collected at SW-1 have historically displayed chloride concentrations up to 100 mg/L (Figure B-4). In 2022, chloride concentrations were mostly in the lower half of the historical range, with a peak value of 32.9 mg/L in the sample collected in September (Table A-1). TDS concentrations were also in the lower portion of the historical range, averaging 124 mg/L (Table 2 and Figure B-2). Hardness ranged between 32.1 and 51.7 mg/L as CaCO₃ during 2022, with the highest value occurring in November. Alkalinity ranged from 22.8 mg/L to 37 mg/L as CaCO₃.

Ammonia concentrations at SW-1 have ranged up to 7.7 mg/L-N (Figure B-6). The maximum concentration in 2022 (0.09 mg/L-N in September) was well below the FWAL guideline (1.84 mg/L-N).

Nitrate concentrations are typically low at SW-1. The February 2022 sample had a concentration of 3.9 mg/L-N (Table A-1), exceeding the FWAL guideline of 3 mg/L-N. The last exceedance of the FWAL guideline was in 2006 (Figure B-8).

Total phosphorus exceeded the May to September average Vancouver Island phosphorous objective for streams (0.005 mg/L; MOE, 2014) in the average of May and September samples by a factor of five (Tables A-1 and 3). Phosphorus concentrations are consistent with levels measured in previous years and at background creek sampling sites.

COD concentrations at SW-1 varied between 13 and 27 mg/L-O in 2022, and were comparable with the background concentrations recorded at SW-7 (Figure B-10). No BOD₅ concentrations were measured above the 2 mg/L-O detection limit at SW-1 in 2022 (Table A-1 and Figure B-12).

Consistent with previous years and the SW-7 and East Sandhill Creek background locations, total aluminum concentrations in all samples collected at SW-1 in 2022 exceeded the FWAL dissolved aluminum guideline of 0.05 mg/L (Figure B-14). The elevated aluminum concentrations are attributed to the low pH of the water in the natural peaty environment.

Total iron at SW-1 was measured at the 1.0 mg/L FWAL guideline in September (Table A-1). Concentrations at SW-1 typically exceed the SW-10 concentrations (Figure B-16). However in 2022, total iron concentrations at both locations were similar as iron loading previously attributed to the drainage course at SW-11 did not occur in the summer and fall months due to drier conditions.

Manganese concentrations in all 2022 samples from SW-1 were below 0.05 mg/L (Table A-1). These low concentrations are consistent with results since 2019 (Figure B-18).

The February and May 2022 zinc concentrations at SW-1 (0.02 and 0.008 mg/L, respectively) exceeded the FWAL guideline and CSR AW/10 standard of 0.0075 mg/L. These results are consistent with previous years and concentrations measured at the background sites.

VOC analyses were performed on the September and November samples from SW-1. All results were below the laboratory reporting limits (Table A-13).

Results for the creek sampling program indicate little to no leachate effect at SW-1 in relation to the SW-7 background data, based on similar concentrations of chloride, ammonia, nitrate, iron, and manganese. The alkalinity in the creek is greater than values recorded at SW-7, reflecting the contribution of natural groundwater to the SW-1 flow. Leachate effect 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 were measured in the summers during periods of very low baseflow from 2010 to 2018. There are no apparent increasing trends apparent, but the high variability of the peak concentrations makes it difficult to identify any slight trends.

3.5.4 SHC (Sandhill Creek Upstream of Highway 4)

The SHC site has been sampled since 2003. Chloride concentrations have been similar to those at SW-7 (background) during most of the year, but have been elevated during low-flow periods in summer (Figure B-4). During the extended dry period starting in 2007, the summer chloride concentrations at SHC have often been higher than at SW-1 and SW-10 on the same dates. These results indicate that during dry baseflow conditions, the lower reaches of Sandhill Creek receive a greater component of groundwater from the marine clay than in the upper reaches.

Total aluminum concentrations have chronically exceeded the dissolved aluminum FWAL guideline at the background and receiving creek sites, and have demonstrated similar behaviour throughout the period of record (Figure B-14 and Table A-5). Total iron concentrations have often exceeded the 1 mg/L FWAL guideline in the summers since 2010. The maximum iron concentration in 2022 (1.1 mg/L) was slightly above the guideline in September (Table A-5 and Figure B-16). Total manganese concentrations at SHC have always been less than the FWAL guideline (Figure B-18).

Consistent with results from previous years and background sites, total phosphorus in samples collected at the SHC site also exceeded the May to September average Vancouver Island phosphorous objective for streams (0.005 mg/L; MOE, 2014) in the May sample by a factor of three. All exceedances at this location were slight and remain within the envelope of background chemistry for the area.

The chemistry at SHC is comparable to background surface water at SW-7 and SW-10, and does not exhibit any leachate effects.

3.6 ADDITIONAL SAMPLING SITES

3.6.1 PW-SS (Scale Shack Tap)

The water at the Scale Shack Tap is supplied from a nearby shallow dug well for which no well log is available. It is not consumed as drinking water. Although this site is not part of the monitoring program to assess landfill effects, the ACRD plans to sample PW-SS annually.

A sample collected from the washroom tap in the scale shack in November 2022 was analyzed for physical parameters, anions, cations, nitrate, nitrite, selected total metals, and E.coli. All results were below GCDWQ, with the exception of the following (Table A-15):

- Total coliforms (>2420 MPN/100 mL) and e. coli (131 MPN/100mL) exceeded the maximum acceptable concentration of 0 MPN/100mL;
- Total iron (1.74 mg/L) exceeded the aesthetic objective of 0.3 mg/L; and
- Total manganese (0.147 mg/L) exceeded the aesthetic objective (0.02 mg/L) and maximum acceptable concentration (0.12 mg/L).

Groundwater from the scale shack tap also had a slightly low field pH (6.93) compared to the FWAL range (6.5-9.0), and exceeded FWAL guidelines for total aluminum, chromium, copper, iron, silver, and zinc. All measured parameters remained below CSR standards. No leachate effect is indicated at this site.

4 OVERFLOW EVENTS

Overflowing of the Leachate Storage Lagoon typically occurs after significant storm events in the winter months (October through April) when water decants through perforated overflow pipes at the northwest corner of the lagoon (Figure 1). The timing and duration of overflow events are inferred from the water levels measured in the overflow pipe and information provided by the landfill operator. The datalogger measuring water levels in the overflow pipe was not present between January, 26 and February 22, 2022 and no overflow events were measured during this interval. Twelve overflow events were recorded between January and May 2022, with durations ranging from 16 hours to seven days. Four additional overflow events were recorded in December 2022, ranging from one to 32 days, with the longest one extending into January 2023. Most overflow events followed precipitation events of over 60 mm. The December 2022 precipitation record was incomplete for the days leading up to the overflow events, but heavy snowfall was reported and likely contributed to the overflow event (Table D-1).

Water samples were not collected during the overflow events in 2022. Samples collected during overflow events in previous years indicate leachate indicator concentrations are typically diluted compared to water chemistry measured at routine sampling events (Figure D-1). Exceptions have included total aluminum, BOD₅ and total phosphorus, which are all likely associated with high turbidity in the lagoon during periods of high precipitation (Piteau, 2020). Dilution factors between SW-3 (the lagoon) and SW-1 (Sandhill Creek) averaged about six for metals results for 2021 overflow event samples. In 2021, analytical results for overflow samples collected at SW-1 were within all relevant FWAL guidelines except for aluminum, which was measured at typical SW-1 concentrations. Overflow samples collected at SW-3 and SW-11 in 2021 exceeded the short-term maximum FWAL guidelines for iron and chromium, and one sample had a toluene concentration at the FWAL guideline (0.5 µg/L).

5 CONCLUSIONS

Overall, the 2022 monitoring data indicate there is a continuing slight leachate effect to receiving waters in the vicinity of the West Coast Landfill. However, there are no long-term increasing trends apparent that would suggest the effects of the landfill are increasing over time.

5.1 LEACHATE COLLECTION SYSTEM

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.

In 2022, the parameters that exceeded receiving water guidelines (FWAL), the May to August average phosphorus objective for Vancouver Island streams, and/or CSR standards in the concentrated leachate were nitrate, ammonia, total phosphorus, total aluminum (dissolved aluminum guideline), iron, and manganese (Tables A-3 and 3). Over the history of the monitoring program, chloride, toluene, cadmium, chromium, cobalt, copper, and zinc exceedances have also occurred in leachate.

5.2 IRRIGATION RECEIVING AREA

Analysis results for sites SW-8 and SW-9, located on the overland flow pathway from the irrigation site towards 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 mitigates ammonia effects during the summer and early autumn months, when receiving water dilution is lowest and ammonia concentrations present the highest level of risk.

SW-6 is sampled from an area of ephemeral ponding in the buffer zone along the west edge of the landfill where water from the spray irrigation area passes before leaving the property. The results of sampling events available for the SW-6 site indicate some slight leachate effect at this site.

5.3 SOUTH AND SOUTHWEST BOUNDARIES

Sampling results at SW-11, located in a natural gully at the southwest corner of the site, exhibited a slight leachate effect, and indicate that leachate seepage past or around Leachate Ditch #2 is not entering the leachate storage lagoon. The most significant leachate effects at SW-11 are aluminum, chromium, iron, and zinc, with all concentrations regularly exceeding the FWAL guideline. Total manganese concentrations have remained relatively low since 2019, possibly due to a change to low-flow sample collection with a peristaltic pump.

SW-12 is located at the southwest corner of the landfill and represents the south landfill effect on Sandhill Creek. Sampling results indicate a slight leachate effect, with elevated aluminum and iron concentrations exceeding the FWAL guideline.

5.4 RECEIVING CREEK

Monitoring results for the receiving water monitoring site (SW-1) indicated only very slight effect during 2022. While several parameters exceeded FWAL and/or CSR AW standards for surface water on at least one occasion, the only parameter to chronically exceed FWAL guidelines was aluminum. Metals exceedances were isolated or only slightly exceeded the relevant guidelines/standards. Based on data from SW-10 and SW-11, it appears that elevated aluminum and iron concentrations at SW-1 that sometimes occur during the summer months may be due to background chemistry (Table 3) but could also include some effect from the landfill (Figures B-14 and B-16). Total phosphorus summer concentrations at SW-1 regularly exceed the May to August phosphorus objective for Vancouver Island streams (0.005 mg/L per MOE, 2014), but are similar to those measured at the SW-7 background site.

Water quality in Sandhill Creek at SW-1 has generally been within the allowable envelope defined by the FWAL guidelines, and/or typical background concentrations for the area. The potential for ammonia concentrations to increase in the future presents the most significant risk to Sandhill Creek. This risk was partially mitigated with the irrigation system that was fully commissioned in 2004. Chloride and ammonia concentrations in Sandhill Creek have not shown a significant increase in the past ten 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 continue to be properly monitored and managed to optimize its performance. At this time, consideration should also be given to completing portions of the landfill, and constructing final cap, to reduce leachate quantity.

Monitoring data for the lower reach of Sandhill Creek at Highway 4 (SHC) do not exhibit any indication of leachate effect. While chloride concentrations measured in the summer low flow period appear to have risen slightly compared with other sampling sites, other indicators (ammonia, nitrate, iron and manganese) have remained consistently low.

6 RECOMMENDATIONS

6.1 WATER SAMPLING PROGRAM

The current water sampling program (Table 1) should be continued through 2023 with the following recommendations:

- Samples should be collected from all sites when there is sufficient water for sampling. Instances of insufficient quantity of water should be documented.
- As has been the practice since 2010, bioassay analysis for samples from SW-1 can be omitted unless leachate effects to Sandhill Creek are noted to change.
- When the permanent composting facility is commissioned, the location of SW-14 should be adjusted to collect leachate from this facility where it enters the leachate collection channel.

6.2 FLOW GAUGING AT SW-1 AND SW-11

The water level record and spot flow measurements at the SW-1 gauging station have been used to build a level-discharge relationship. The data loggers at SW-1 should continue to be downloaded twice per year, and spot flow measurements should continue at least twice per year to verify the level-discharge relationship on an ongoing basis. Once flow data from the leachate collection system and SW-11 are available, these can be used with SW-1 flows to calculate loadings in the creek and relate those to leachate strengths and quantities.

A flow gauging site should be established on the drainage downstream of SW-11 to facilitate calculation of concentrations/loadings past the SW-11 sampling point, and comparison to the concentrations/loadings at SW-1. A small weir should be constructed across the gully, and a data logger and staff gauge installed to record levels. The water level on the staff gauge should be recorded at the same time that samples are collected at SW-11, and the data logger should be downloaded twice per year. This flow monitoring will provide some indication of whether the SW-11 drainage course is the primary source of the iron at SW-1. If the flow at SW-11 is determined to be a significant source of the iron at SW-1, further measures to mitigate leachate losses along this pathway could include diverting this flow into the leachate storage lagoon by pumping during low-flow periods.

The recommendation to monitor flows at SW-11 could be pre-empted if the flow excursion at SW-11 no longer leaves the site. If the proposed leachate treatment system is constructed, the SW-11 flow would be captured with the construction of a new leachate pond. Alternatively, a cut and fill sump/berm could be constructed across the SW-11 channel to impound the water, and a sump pump could be installed to relay any flow to the leachate lagoon. A cumulative flow meter on the sump pump would document the volume of flow diverted.

6.3 OPERATIONAL PUMPING AND MONITORING

Monitoring of water levels and flows in the leachate storage lagoon will provide information on the pumping system and assist with future planning. The ACRD should:

1. Install a cumulative flow meter on the leachate irrigation system to measure flows from the leachate lagoon during normal operation. Record readings monthly.
2. Survey the elevations of the staff gauge and culvert inlets in the leachate storage lagoon to correlate the water elevation measured in the pond with the overflow events.
3. Continue to record the leachate storage lagoon staff gauge level quarterly and download the leachate storage lagoon and overflow pipe loggers twice annually.

6.4 OVERFLOW EVENT SAMPLING

Water quality samples should continue to be collected from SW-3, SW-11 and SW-1 during overflow events. It would be preferable to collect the samples near the mid-point of the event. Samples from each location should be analyzed for the regular SW-1 sampling suite (Table 1). A VOC scan at all sites is recommended for one overflow event in 2023. Two coolers, each with the required bottles for one sampling suite, should be kept on hand for this purpose. If the decant event continues for more than week, a second suite of samples should be collected. Sample bottles and coolers should be restocked following each overflow event.

6.5 PARTIAL CAPPING

The frequency of overflow events documented since 2015 is a cause for concern. In addition, the very slight but apparent increase in some of the leachate concentrations should be addressed. As it is difficult to reduce the concentrations of metals and nutrients in the leachate, the only practicable method to reduce the contaminant loading that leachate conveys to Sandhill Creek is to reduce leachate quantity.

Partial capping of the landfill would allow diversion of runoff from some landfill areas away from the leachate lagoon. This would reduce the quantity of storm water that enters the leachate lagoon, and hence the frequency of overflow events. A partial cap would also reduce the total infiltration into the waste, in turn reducing leachate quantity.

Planning should include evaluation of possible phasing options that will allow a portion of the final landfill to be capped within the next three to five years. If this is not possible, an interim cap should be considered for inactive portions of the landfill. The goal of either approach should be to implement measures that would reduce leachate quantities and overflow events within the next three to five years.

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.

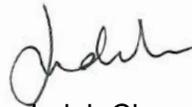
In preparing the recommendations contained herein, Piteau has relied on information and interpretations provided by others. Piteau is not responsible for any errors or omissions in this information. This report is comprised of text, figures, tables, and appendices, and all components must be read and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

8 CLOSURE

We trust this report adequately presents and discusses the leachate sampling data collected to date. If you wish to discuss the 2022 sampling results, please contact us.

Respectfully submitted,

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TABLES

**TABLE 1
SUMMARY OF WEST COAST LANDFILL SAMPLING SITES AND ANALYTICAL SUITES - 2022 PROGRAM**

Site	Site Location	Field Parameters	LABORATORY									
			Physical Parameters	Anions	Nutrients	Total Metals	BOD	COD	VOC Scan	Detailed Analysis	Routine Potability	
			temp, pH, conductance	pH, conductance, TDS, total hardness	alkalinity, chloride, sulphate	ammonia, nitrate, total phosphorus	ICP ICP/MS; FWAL detection limits					physical parameters, anions, cations, nitrate/nitrite, total Fe/Mn, total coliforms and e.coli
SW-1	Sandhill Creek near landfill	Q	Q	Q	Q	Q	Q	Q	Q	B		
SW-2	West leachate collector ditch	Q	Q	Q	Q	Q (Al, Fe, Mn only)	Q	Q				
SW-3	Leachate storage lagoon	Q	Q	Q	Q	Q	Q	Q	Q	A (Note 5)		
SW-4	East leachate collector ditch	Q	Q	Q	Q	Q (Al, Fe, Mn only)	Q	Q				
SW-6 ²	West property line	Q	Q	Q	Q	Q (Al, Fe, Mn only)						
SW-7	Background at east property line	Q	Q	Q	Q	Q	Q	Q				
SW-8 ²	Irrigation area	Q	Q	Q	Q	Q (Al, Fe, Mn only)	Q	Q				
SW-9 ²	Irrigation area	Q	Q	Q	Q	Q (Al, Fe, Mn only)	Q	Q				
SW-10	Sandhill Creek upstream of SW-11 discharge	Q	Q	Q	Q	Q	Q	Q				
SW-10U/S	Sandhill Creek upstream of SW-10	A	A	A	A	A	A	A				
SW-11	West drainage at property line	Q	Q	Q	Q	Q	Q	Q				
SW-12	Sandhill Creek trib at south property line	Q	Q	Q	Q	Q (Al, Fe, Mn only)						
SW-14 ²	Composting facility discharge	Q	Q	Q	Q	Q	Q	Q				
SW-15 ^{2,3}	Pond adjacent to composting facility access	Q	Q	Q	Q	Q	Q	Q				
Sandhill Creek d/s ⁴	Sandhill Creek at Highway	Q	Q	Q	Q	Q (Al, Fe, Mn only)						
Sandhill Creek East Tributary	East tributary to Sandhill Creek above Highway	A	A	A	A	A	A	A				
PW-SS ³	Tap in the scale shack fed by the pumping well	A										A

Notes:

H:\Project\1576\Chem\2022[Summary Tables.xlsx]Table1 summary Tables.xlsx]Table1

1. Q indicates sample is collected quarterly, B indicates sample collected biannually (1 winter high flow and 1 summer low flow), A indicates sample is collected annually (in the summer if water is present).
2. Sandhill Creek East Tributary, SW-4, SW-6, SW-7, SW-8, SW-9, SW-10, SW-11, SW-12, SW-14 were not sampled when there was insufficient water. SW-10 not sampled in February and May due to unsafe conditions. Samples were collected from a site 20 m upstream in September and November.
3. SW-15 added to monitoring program for 2021 only. PW-SS sampled by ACRD in 2021 for routine potability, not as part of landfill monitoring program.
4. Sandhill Creek d/s has not shown any impact to date.
5. Summer sample for SW-3 was submitted for analysis of a broad spectrum of potential contaminants: LEPH-HEPH, PAHs, VOCs, base neutrals and acid extractables, Organophosphate pesticides, GC-MS pesticide scan, and phenols. A sample for PFAS was not analyzed in 2022, but is recommended for the summer of 2023.

**TABLE 2
SUMMARY OF LEACHATE EFFECTS BASED ON MEAN 2022 CONCENTRATIONS**

MONITORING WELL units	Recommended Number of Samples	Number of samples	Laboratory pH	Laboratory Conductivity	Total Dissolved Solids	Chloride	Ammonia Nitrogen ⁶	Nitrate	Total Phosphorus ⁷	Sulphate ⁶	Total Hardness	Total Alkalinity	Total Aluminum ⁴	Total Iron	Total Manganese	Chemical Oxygen Demand
			(pH units)	(µS/cm)	(mg/L)	(mg/L)	(mg/L-N)	(mg/L-N)	(mg/L)	(mg/L)	(mg/L CaCO ₃)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
FWAL GUIDELINE ¹ CSR AW ⁵ CSR DW ⁵			6.5 - 9.0	-	-	150	1.84	3	0.005	128	-	-	0.05	1	0.69	-
			-	-	-	1500	18.4	400	-	1280	-	-	-	-	-	-
			-	-	-	250	-	10	-	500	-	-	9.5	6.5	1.5	-
LEACHATE COLLECTION SYSTEM																
SW-2	4	4	7.8	1256	702	93	25.0	3.7	0.05	24.7	399	456	0.04	5.0	2.10	50
SW-3	4	4	8.0	1001	540	72	20.5	<0.33	<0.06	19.3	304	381	<0.02	1.4	0.56	48
SW-4	4	3	7.8	1239	603	70	37.5	0.4	0.09	23.7	372	508	0.1	7.9	2.33	56
SW-14	4	0	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
LEACHATE IRRIGATION RECEIVING AREA AND WEST LANDFILL BOUNDARY																
SW-6	4	3	7.7	507	307	44	0.1	12.3	0.07	18.6	179	139.5	0.5	0.7	0.15	-
SW-8	4	3	7.6	466	257	39	1.5	<3.66	0.06	20.2	153	132	0.1	0.8	1.68	26
SW-9	4	3	7.7	571	332	46	1.3	3.4	0.10	22.3	194	182	0.1	0.1	0.07	24
SOUTHWEST AND SOUTH LANDFILL BOUNDARY																
SW-11	4	3	7.0	208	138	35	<0.08	0.9	<0.03	8.9	48	31	0.3	1.0	0.15	15
SW-12	4	3	7.0	122	90	23	<0.04	0.4	0.03	5.2	21	13.5	0.9	1.6	0.06	-
BACKGROUND CREEKS																
SHC East Tributary	1	0	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
SW-7	4	2	6.4	170	110	29	<0.02	<0.47	<0.02	14.0	43	23	0.2	0.4	0.08	17
RECEIVING CREEKS																
SW-10US	1	1	6.9	226	123	32	<0.05	0.43	0.03	11.8	46	25	0.3	0.9	0.06	21
SW-10	4	2	6.9	212	133	32	<0.03	1.0	<0.03	16.1	49	24.5	0.3	0.6	0.04	23
SW-1	4	4	7.0	184	124	27	<0.04	1.5	<0.03	10.8	42	26.0	0.4	0.9	0.08	20
SHC	4	4	6.9	142	96	29	<0.02	<0.39	0.03	4.7	21	9	0.3	0.6	0.02	-
SCALE SHACK																
PW-SS	1	1	7.3	206	143	20	0	<0.01	<0.05	3	64	70	1	1.7	0.15	-

H:\Project\1576\Chem\2022\Summary Tables.xlsx\Table2

Notes:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
 Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL").
 Lowest guidelines are shown.
- Bolding** denotes parameters which exceed water quality criteria.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
- FWAL guideline is for dissolved aluminum.
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10. https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- CSR AW guidelines for ammonia and sulphate change with pH and hardness. Value shown appropriate for pH<7 and hardness <30 mg/L.
- Phosphorus Objective for creeks from Phosphorus Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. Mean 2021 concentration compared against stringent guideline of 0.005 mg/L.

**TABLE 3
SUMMARY OF 2022 EXCEEDANCES OF BC FWAL GUIDELINES AND CSR STANDARDS**

Sampling Location	Number of samples	pH	Anions and Nutrients			Total Metals								
			Nitrate	Ammonia	Total Phosphorous ³	Aluminum ⁴	Arsenic	Chromium	Cobalt	Copper	Iron	Manganese	Mercury	Silver
Leachate Collection System														
SW-2	4			AW	P						DW	DW		
SW-3	4			AW	P				DW					
SW-4	3			AW	P						DW	DW		
SW-14	0	Dry												
Leachate Irrigation Receiving Area and West Landfill Boundary														
SW-6	3		DW		P									
SW-8	3		DW		P							DW		
SW-9	3				P									
Southwest and South Landfill Boundary														
SW-11	3								DW					
SW-12	3				P									
Background Creeks														
SHC East Tributary	0	Dry												
SW-7	2				P								AW/10	AW/10
Receiving Creeks														
SW-10US	1				P									
SW-10	2				P									AW/10
SW-1	4				P									AW/10
SHC	4				P									
Scale Shack														
PW-SS ⁶	1													

H:\Project\1576\Chem\2022\Summary Tables.xlsx|Table3

-  Orange shaded cells show sampling location has one or more exceedances of the BC FWAL¹
-  AW/DW Text indicates one or more exceedance of CSR² AW and/or DW or Vancouver Island Phosphorus Objective³ (P)
-  No shading indicates all sampling results were below all guidelines
-  Grey shaded cells show sampling location was not analyzed for the parameter indicated

Notes:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Quarterly sampling events compared to 30-day average guidelines.
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10. https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014.
Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. In 2021, May and September results compared against stringent guideline of 0.005 mg/L.
- Total aluminum compared against dissolved aluminum FWAL guideline.
- PW-SS also exceeded the Guidelines for Canadian Drinking Water Quality (Health Canada, 2022) for total coliforms, e. coli, total iron and total manganese <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html>

FIGURES

APPENDIX A
MONITORING DATA TABLES

APPENDIX A

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TABLE A-1
WATER CHEMISTRY DATA FOR SW-1

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	7.85	7.55	-	7.32
pH - Lab	pH	6.5 - 9.0	-	-	7.28	7.01	6.97	6.81
Conductivity - Field	µS/cm	-	-	-	98.7	104	165	120
Conductivity - Lab	µS/cm	-	-	-	146	141	241	208
Total Hardness (CaCO ₃)	mg/L	-	-	-	32.1	42.5	43.9	51.7
Total Dissolved Solids	mg/L	-	-	-	107	103	108	160
Temperature - Field	°C	-	-	-	3.4	8.9	-	4.0
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	24	37	24	22.8
Chloride	mg/L	150	1500	250	21.7	17.6	32.9	31.1
Sulphate ^{4,7}	mg/L	218	2180	500	3.9	3.5	15.0	20.7
TOTAL CATIONS								
Calcium	mg/L	-	-	-	8.4	12.4	12.4	13.7
Magnesium	mg/L	-	-	-	2.7	2.8	3.6	4.24
Potassium	mg/L	-	-	-	1.2	1.9	6.3	3.53
Sodium	mg/L	-	-	200	11.4	12.9	18.6	19.2
NUTRIENTS								
Ammonia Nitrogen ^{5,8}	mg/L as N	1.84	18.5	-	<0.02	<0.02	0.09	0.0062
Nitrate Nitrogen	mg/L as N	3	400	10	3.9	0.59	0.68	1.34
Total Phosphorus ³	mg/L as P	0.005	-	-	0.022	0.016	0.03	0.0072
POLLUTANT TESTS								
Chemical Oxygen Demand	mg/L as O	-	-	-	17	13	27	20
Biochemical Oxygen Demand	mg/L as O	-	-	-	<2	<2	<2	<2.0
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.214	0.254	0.266	0.29
Antimony	mg/L	0.01	0.09	0.006	<0.001	<0.001	<0.001	<0.00010
Arsenic	mg/L	0.005	0.05	0.01	<0.001	<0.001	<0.001	0.00016
Barium	mg/L	1	10	1	<0.05	<0.05	<0.05	0.00953
Beryllium	mg/L	0.00013	0.0015	0.008	<0.001	<0.0005	<0.0005	<0.000100
Boron	mg/L	1.2	12	5	0.06	0.1	0.14	0.104
Cadmium ^{4,7}	mg/L	0.00011	0.0015	0.005	<0.000016	<0.000016	<0.000016	0.0000069
Chromium	mg/L	0.001	0.01	0.05	<0.001	0.0006	0.0008	<0.00050
Cobalt	mg/L	0.004	0.04	0.001	<0.001	<0.0009	<0.0009	0.00025
Copper ⁷	mg/L	see below	0.02	1.5	0.001	0.0017	0.0017	0.00095
Iron	mg/L	1	-	6.5	0.2	0.4	1.0	0.298
Lead ^{4,7}	mg/L	0.004	0.16	0.01	<0.0001	0.0001	0.0002	0.000158
Lithium	mg/L	-	-	0.008	<0.001	<0.001	<0.001	<0.0010
Manganese ⁴	mg/L	0.79	-	1.5	0.008	0.017	0.121	0.0185
Mercury	µg/L	0.2	0.25	1	<0.000005	<0.000025	0.00001	<0.0000050
Molybdenum	mg/L	7.6	10	0.25	<0.001	<0.001	<0.001	<0.000050
Nickel ⁷	mg/L	0.03	0.25	0.08	<0.003	<0.003	<0.003	0.00111
Selenium	mg/L	0.002	0.02	0.01	0.0011	<0.0005	<0.0005	0.000059
Silver	mg/L	0.00005	0.0005	0.02	<0.00005	<0.00005	<0.00005	0.00003
Strontium	mg/L	-	-	2.5	0.044	0.065	0.073	0.0784
Thallium	mg/L	-	0.003	-	<0.0005	<0.0001	<0.0001	<0.000010
Tin	mg/L	-	-	2.5	<0.003	<0.0005	<0.0005	<0.00010
Titanium	mg/L	-	1	-	<0.003	0.008	0.012	0.01
Tungsten	mg/L	-	-	0.003	0.00013	<0.0001	<0.0001	<0.00010
Uranium	mg/L	-	0.09	0.02	<0.001	<0.001	<0.001	0.00001
Vanadium	mg/L	-	-	0.02	0.001	<0.001	0.001	0.001
Zinc ^{4,7}	mg/L	0.0075	0.075	3	0.02	0.008	<0.004	0.0068
DISSOLVED COPPER ASSESSMENT								
Dissolved Organic Carbon	mg/L	-	-	-	8	-	-	-
Dissolved Copper Guidelines ⁶	mg/L	varies	0.02	-	0.0024	0.0066	0.0073	0.0065

NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10. https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May and September results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 40 mg/L-CaCO₃. Cadmium guideline is for dissolved cadmium.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- Dissolved copper FWAL guideline is calculated for each sampling event using BC BLM software with sample-specific parameters except for humic acid ratio (assumed value of 10) and DOC values (estimated value of either 10 or 20 based on 2020 - 2021 data).
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 43 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 7.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- 11."-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

H:\Project\1576\Chem\2022\Tables-2022.xlsx|Table A-1

TABLE A-2
WATER CHEMISTRY DATA FOR SW-2

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	6.85	7.28	7.56	7.24
pH - Lab	pH	6.5 - 9.0	-	-	7.99	7.45	8.03	7.69
Conductivity - Field	µS/cm	-	-	-	731	814	1138	646
Conductivity - Lab	µS/cm	-	-	-	1290	1030	1603	1100
Total Hardness (CaCO ₃)	mg/L	-	-	-	363	387	444	366
Total Dissolved Solids	mg/L	-	-	-	557	570	824	629
Temperature - Field	°C	-	-	-	2.0	12.0	12.0	4.5
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	493	477	486	368
Chloride	mg/L	150	1500	250	76.2	57.6	138	99
Sulphate ^{4,6}	mg/L	429	4290	500	3.5	1.7	58	35.4
NUTRIENTS								
Ammonia Nitrogen ^{5,7}	mg/L as N	1.84	11.3	-	33.5	27	23.7	15.6
Nitrate Nitrogen	mg/L as N	3	400	10	0.63	0.79	6.46	7.08
Total Phosphorus ³	mg/L as P	0.005	-	-	0.17	0.007	0.027	0.0136
POLLUTANT TESTS								
Chemical Oxygen Demand	mg/L as O	-	-	-	41	48	54	55
Biochemical Oxygen Demand	mg/L as O	-	-	-	<2	<2	19	<2.0
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.043	0.039	0.064	0.0188
Iron	mg/L	1	-	6.5	10.6	8	1.2	0.275
Manganese ⁴	mg/L	2.32	-	1.5	3.11	4.71	0.39	0.185

H:\Project\1576\Chem\2022\Tables-2022.xlsx\Table A-2

NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
 Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March, 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf.
 BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May and September results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 400 mg/L-CaCO₃.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 390 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 7.8.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-3
WATER CHEMISTRY DATA FOR SW-3

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	7.5	7.63	-	7.52
pH - Lab	pH	6.5 - 9.0	-	-	8.25	7.85	8.03	7.73
Conductivity - Field	µS/cm	-	-	-	721	609	913	471.6
Conductivity - Lab	µS/cm	-	-	-	1140	760	1233	869
Total Hardness (CaCO ₃)	mg/L	-	-	-	348	299	273	295
Total Dissolved Solids	mg/L	-	-	-	523	430	592	487
Temperature - Field	°C	-	-	-	4.8	13.1	-	2.2
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	468	358	398	301
Chloride	mg/L	150	1500	250	67.3	40.8	109	69.4
Sulphate ^{4,8}	mg/L	429	4290	500	5.3	3.6	19.9	48.2
TOTAL CATIONS								
Calcium	mg/L	-	-	-	113	101	72.8	94.9
Magnesium	mg/L	-	-	-	15.9	11.3	23.7	14.2
Potassium	mg/L	-	-	-	17.3	12.8	26	16
Sodium	mg/L	-	-	200	57.1	40.7	106	57.2
NUTRIENTS								
Ammonia Nitrogen ^{5,8}	mg/L as N	1.84	11.3	-	29.5	17.4	22.8	12.1
Nitrate Nitrogen	mg/L as N	3	400	10	0.29	<0.02	<0.02	0.982
Total Phosphorus ³	mg/L as P	0.005	-	-	0.179	0.021	0.035	0.0193
POLLUTANT TESTS								
Chemical Oxygen Demand	mg/L as O	-	-	-	31	39	77	46
Biochemical Oxygen Demand	mg/L as O	-	-	-	3	<2	5	<2.0
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	<0.004	0.016	0.024	0.0219
Antimony	mg/L	0.01	0.09	0.006	<0.001	<0.001	<0.001	0.00014
Arsenic	mg/L	0.005	0.05	0.01	<0.001	<0.001	0.001	0.00044
Barium	mg/L	1	10	1	<0.05	<0.05	<0.05	0.0472
Beryllium	mg/L	0.00013	0.0015	0.008	<0.001	<0.0005	<0.0005	<0.000100
Boron	mg/L	1.2	12	5	0.75	0.59	1.14	0.624
Cadmium ^{4,7}	mg/L	0.00048	0.0040	0.005	<0.000016	<0.000016	<0.000080	0.0000113
Chromium	mg/L	0.001	0.01	0.05	<0.001	0.0008	0.0008	0.00066
Cobalt	mg/L	0.004	0.04	0.001	<i>0.001</i>	<i>0.0011</i>	<i>0.0013</i>	0.00066
Copper ⁷	mg/L	see below	0.09	1.5	<0.001	0.001	<0.0008	0.00114
Iron	mg/L	1	-	6.5	2.1	0.9	1.7	0.728
Lead ^{4,7}	mg/L	0.016	0.16	0.01	<0.0001	<0.0001	<0.0004	<0.000050
Lithium	mg/L	-	-	0.008	0.001	0.001	0.002	<0.0010
Manganese ⁴	mg/L	1.94	-	1.5	1.15	0.699	0.216	0.165
Mercury	µg/L	0.2	0.25	1	<0.000005	<0.000025	<0.05	<0.0000050
Molybdenum	mg/L	7.6	10	0.25	<0.001	<0.001	<0.001	0.000096
Nickel ⁷	mg/L	0.03	1.50	0.08	0.003	<0.003	0.003	0.00254
Selenium	mg/L	0.002	0.02	0.01	0.0008	<0.0005	<0.0025	0.000105
Silver	mg/L	0.00150	0.0150	0.02	<0.00005	<0.00005	<0.00005	<0.000010
Strontium	mg/L	-	-	2.5	0.592	0.493	0.553	0.469
Thallium	mg/L	-	0.003	-	<0.0005	<0.0001	<0.0001	<0.000010
Tin	mg/L	-	-	2.5	<0.003	<0.0005	<0.0005	0.0001
Titanium	mg/L	-	1	-	0.004	<0.001	<0.002	0.00118
Tungsten	mg/L	-	-	0.003	<0.00001	<0.0001	<0.0005	<0.00010
Uranium	mg/L	-	0.09	0.02	<0.001	<0.001	<0.001	0.000045
Vanadium	mg/L	-	-	0.02	<0.001	<0.001	<0.002	<0.00050
Zinc ^{4,7}	mg/L	0.1678	2.400	3	0.03	<0.004	<0.020	0.0057
DISSOLVED COPPER ASSESSMENT								
Dissolved Organic Carbon	mg/L	-	-	-	19	-	-	-
Dissolved Copper Guidelines ⁶	mg/L	varies	0.09	-	0.0201	0.0686	0.0826	0.0690

NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorus Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014.
Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May and September results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 250 mg/L-CaCO₃. Cadmium guideline is for dissolved cadmium.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- Dissolved copper FWAL guideline is calculated for each sampling event using BC BLM software with sample-specific parameters except for humic acid ratio (assumed value of 10) and DOC values (estimated value of either 10 or 20 based on 2020 - 2021 data).
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 304 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 8.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- 10."-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

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TABLE A-4
WATER CHEMISTRY DATA FOR SW-4

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	7.33	7.36	Dry	7.29
pH - Lab	pH	6.5 - 9.0	-	-	8.05	7.58		7.62
Conductivity - Field	µS/cm	-	-	-	831	701		796
Conductivity - Lab	µS/cm	-	-	-	1460	917		1340
Total Hardness (CaCO ₃)	mg/L	-	-	-	403	349		403
Total Dissolved Solids	mg/L	-	-	-	637	497		675
Temperature - Field	°C	-	-	-	4	11.1		5.6
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	571	421	532	
Chloride	mg/L	150	1500	250	79.8	43.2	86.2	
Sulphate ^{4,6}	mg/L	429	4290	500	5	20.5	45.5	
NUTRIENTS								
Ammonia Nitrogen ^{5,7}	mg/L as N	1.84	11.3	-	48.4	26.9	37.1	
Nitrate Nitrogen	mg/L as N	3	400	10	0.14	0.32	0.88	
Total Phosphorus ³	mg/L as P	0.005	-	-	0.197	0.028	0.0373	
POLLUTANT TESTS								
Chemical Oxygen Demand	mg/L as O	-	-	-	46	40	81	
Biochemical Oxygen Demand	mg/L as O	-	-	-	3	2	2.3	
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.044	0.088	0.0472	
Iron	mg/L	1	-	6.5	16.4	4.4	2.98	
Manganese ⁴	mg/L	2.30	-	1.5	3.2	1.85	1.93	

H:\Project\1576\Chem\2022\Tables-2022.xlsx\Table A-4

NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10. https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May and September results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 400 mg/L-CaCO₃.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 385 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 7.8.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-5
WATER CHEMISTRY DATA FOR SANDHILL CREEK SAMPLING SITE

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	6.21	8.7	-	7.84
pH - Lab	pH	6.5 - 9.0	-	-	7.01	7.08	6.58	6.73
Conductivity - Field	µS/cm	-	-	-	122.8	87.7	149	86
Conductivity - Lab	µS/cm	-	-	-	97	100	220	149
Total Hardness (CaCO ₃)	mg/L	-	-	-	13.3	17.6	24.7	23.4
Total Dissolved Solids	mg/L	-	-	-	77	60	93.2	108
Temperature - Field	°C	-	-	-	3.3	9	-	4.7
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	7	15	6	7.3
Chloride	mg/L	150	1500	250	19.1	19.6	45.5	31.6
Sulphate ^{4,6}	mg/L	128	1280	500	3	2.7	4.7	8.51
NUTRIENTS								
Ammonia Nitrogen ^{5,7}	mg/L as N	1.84	18.4	-	<0.02	<0.02	<0.05	<0.0050
Nitrate Nitrogen	mg/L as N	3	400	10	1.1	0.18	<0.02	0.256
Total Phosphorus ³	mg/L as P	0.005	-	-	0.034	0.017	0.047	0.006
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.365	0.256	0.296	0.237
Iron	mg/L	1	-	6.5	0.5	0.4	1.1	0.415
Manganese ⁴	mg/L	0.69	-	1.5	0.011	0.013	0.042	0.0188

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NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf.
BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May and September results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 30 mg/L-CaCO₃.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10° C.
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 20 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 6.9.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-6
WATER CHEMISTRY DATA FOR SW-6

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	7.27	7.3	Dry	7.07
pH - Lab	pH	6.5 - 9.0	-	-	8.06	7.57		7.6
Conductivity - Field	µS/cm	-	-	-	316	340.2		296.2
Conductivity - Lab	µS/cm	-	-	-	563	487		471
Total Hardness (CaCO ₃)	mg/L	-	-	-	163	182		180
Total Dissolved Solids	mg/L	-	-	-	313	287		321
Temperature - Field	°C	-	-	-	5.1	9.8		6.4
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	146	177	95.5	
Chloride	mg/L	150	1500	250	50.6	32	48	
Sulphate ^{4,6}	mg/L	309	3090	500	7.1	5.1	43.5	
NUTRIENTS								
Ammonia Nitrogen ^{5,7}	mg/L as N	1.84	11.3	-	0.07	0.09	0.0057	
Nitrate Nitrogen	mg/L as N	3	400	10	28.4	4.45	4.13	
Total Phosphorus ³	mg/L as P	0.005	-	-	0.15	0.042	0.0049	
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.085	1.17	0.116	
Iron	mg/L	1	-	6.5	0.2	1.9	0.084	
Manganese ⁴	mg/L	1.38	-	1.5	0.023	0.397	0.0285	

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NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
 Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May and September results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 175 mg/L-CaCO₃.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 175 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 7.7.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-7
WATER CHEMISTRY DATA FOR SW-7

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	Stagnant	7.4	Dry	7
pH - Lab	pH	6.5 - 9.0	-	-		6.53		6.28
Conductivity - Field	µS/cm	-	-	-		87.9		140.7
Conductivity - Lab	µS/cm	-	-	-		100		240
Total Hardness (CaCO ₃)	mg/L	-	-	-		30		56.2
Total Dissolved Solids	mg/L	-	-	-		60		159
Temperature - Field	°C	-	-	-		8.9		4.6
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	29	17.7		
Chloride	mg/L	150	1500	250	19	38.9		
Sulphate ^{4,7}	mg/L	218	2180	500	1.5	26.5		
TOTAL CATIONS								
Calcium	mg/L	-	-	-	8.4	14.5		
Magnesium	mg/L	-	-	-	2.2	4.85		
Potassium	mg/L	-	-	-	4.7	4.52		
Sodium	mg/L	-	-	200	10.7	23		
NUTRIENTS								
Ammonia Nitrogen ^{5,8}	mg/L as N	1.84	18.4	-	<0.02	0.0156		
Nitrate Nitrogen	mg/L as N	3	400	10	<0.02	0.926		
Total Phosphorus ³	mg/L as P	0.005	-	-	0.018	0.0066		
POLLUTANT TESTS								
Chemical Oxygen Demand	mg/L as O	-	-	-	16	18		
Biochemical Oxygen Demand	mg/L as O	-	-	-	<2	<2.0		
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.223	0.17		
Antimony	mg/L	0.01	0.09	0.006	<0.001	0.00019		
Arsenic	mg/L	0.005	0.05	0.01	<0.001	0.0002		
Barium	mg/L	1	10	1	<0.05	0.0129		
Beryllium	mg/L	0.00013	0.0015	0.008	<0.0005	<0.000100		
Boron	mg/L	1.2	12	5	0.09	0.171		
Cadmium ^{4,7}	mg/L	0.00011	0.0015	0.005	<0.000016	0.0000176		
Chromium	mg/L	0.001	0.01	0.05	0.0006	0.00053		
Cobalt	mg/L	0.004	0.04	0.001	<0.0009	0.00036		
Copper ⁷	mg/L	see below	0.02	1.5	0.0019	0.00118		
Iron	mg/L	1	-	6.5	0.5	0.387		
Lead ^{4,7}	mg/L	0.004	0.16	0.01	0.0002	0.000228		
Lithium	mg/L	-	-	0.008	<0.001	<0.0010		
Manganese ⁴	mg/L	0.79	-	1.5	0.061	0.0961		
Mercury	µg/L	0.2	0.25	1	<0.000025	<0.000050		
Molybdenum	mg/L	7.6	10	0.25	<0.001	<0.000050		
Nickel ⁷	mg/L	0.03	0.25	0.08	<0.003	0.00113		
Selenium	mg/L	0.002	0.02	0.01	<0.0005	<0.000050		
Silver	mg/L	0.00005	0.0005	0.02	0.00006	0.000034		
Strontium	mg/L	-	-	2.5	0.048	0.0849		
Thallium	mg/L	-	0.003	-	<0.0001	<0.000010		
Tin	mg/L	-	-	2.5	<0.0005	<0.00010		
Titanium	mg/L	-	1	-	0.007	0.00571		
Tungsten	mg/L	-	-	0.003	<0.0001	<0.00010		
Uranium	mg/L	-	0.09	0.02	<0.001	<0.000010		
Vanadium	mg/L	-	-	0.02	<0.001	0.00063		
Zinc ^{4,7}	mg/L	0.0075	0.075	3	0.01	0.008		
DISSOLVED COPPER ASSESSMENT								
Dissolved Copper Guidelines ⁶	mg/L	varies	0.02	-	0.0018	0.0023		

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NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014.
Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 20 mg/L-CaCO₃. Cadmium guideline is for dissolved cadmium.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10 °C.
- Dissolved copper FWAL guideline is calculated for each sampling event using BC BLM software with sample-specific parameters except for humic acid ratio (assumed value of 10) and DOC values (estimated value of either 10 or 20 based on 2020 - 2021 data).
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 43 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 6.4.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- 10.-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-8
WATER CHEMISTRY DATA FOR SW-8

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	7.5	7.29	Dry	6.98
pH - Lab	pH	6.5 - 9.0	-	-	7.98	7.46		7.26
Conductivity - Field	µS/cm	-	-	-	202.5	341.5		165.5
Conductivity - Lab	µS/cm	-	-	-	389	402		607
Total Hardness (CaCO ₃)	mg/L	-	-	-	108	151		201
Total Dissolved Solids	mg/L	-	-	-	153	227		391
Temperature - Field	°C	-	-	-	4.6	10.5		5.5
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	119	167	111	
Chloride	mg/L	150	1500	250	27.7	24.5	63.6	
Sulphate ^{4,6}	mg/L	309	3090	500	5.1	3.6	51.8	
NUTRIENTS								
Ammonia Nitrogen ^{5,7}	mg/L as N	1.84	11.3	-	1.55	2.95	0.0194	
Nitrate Nitrogen	mg/L as N	3	400	10	<0.02	0.75	10.2	
Total Phosphorus ³	mg/L as P	0.005	-	-	0.145	0.024	0.0065	
POLLUTANT TESTS								
Chemical Oxygen Demand	mg/L as O	-	-	-	20	28	29	
Biochemical Oxygen Demand	mg/L as O	-	-	-	<2	<2	<2.0	
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.14	0.085	0.0538	
Iron	mg/L	1	-	6.5	1.3	1.1	0.087	
Manganese ⁴	mg/L	1.28	-	1.5	2.83	2.1	0.0993	

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NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
 Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf.
 BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 125 mg/L-CaCO₃.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 153 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 7.6.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-9
WATER CHEMISTRY DATA FOR SW-9

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	7.84	7.39	Dry	7.13
pH - Lab	pH	6.5 - 9.0	-	-	8.17	7.56		7.42
Conductivity - Field	µS/cm	-	-	-	358.5	402.5		314.5
Conductivity - Lab	µS/cm	-	-	-	664	510		539
Total Hardness (CaCO ₃)	mg/L	-	-	-	198	214		156
Total Dissolved Solids	mg/L	-	-	-	307	350		339
Temperature - Field	°C	-	-	-	3.9	10		5.5
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	202	215		128
Chloride	mg/L	150	1500	250	53.5	32.7		51.9
Sulphate ^{4,6}	mg/L	429	4290	500	6.6	4.5		55.9
NUTRIENTS								
Ammonia Nitrogen ^{5,7}	mg/L as N	1.84	11.3	-	2.23	1.72		0.0136
Nitrate Nitrogen	mg/L as N	3	400	10	4.52	3.57		1.98
Total Phosphorus ³	mg/L as P	0.005	-	-	0.285	0.015		0.0067
POLLUTANT TESTS								
Chemical Oxygen Demand	mg/L as O	-	-	-	22	25		24
Biochemical Oxygen Demand	mg/L as O	-	-	-	<2	2		<2.0
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.044	0.068		0.112
Iron	mg/L	1	-	6.5	0.1	0.1		0.12
Manganese ⁴	mg/L	1.44	-	1.5	0.076	0.107		0.0252

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NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-and-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf.
BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 150 mg/L-CaCO₃.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 189 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 7.7.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-10
WATER CHEMISTRY DATA FOR SW-10 AND SW-10US

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE				
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	SW-10	SW-10	SW-10	SW-10	SW-10US
					22-Feb-22	25-May-22	07-Sep-22	21-Nov-22	07-Sep-22
PHYSICAL TESTS									
pH - Field	pH	6.5 - 9.0	-	-			7.3	7.05	7.51
pH - Lab	pH	6.5 - 9.0	-	-	Unsafe	Unsafe	7.05	6.79	6.91
Conductivity - Field	µS/cm	-	-	-	Conditions - Not Sampled	Conditions - Not Sampled	151	119.8	149
Conductivity - Lab	µS/cm	-	-	-			213	211	226
Total Hardness (CaCO ₃)	mg/L	-	-	-			46.4	51.6	46.4
Total Dissolved Solids	mg/L	-	-	-			104	162	103
Temperature - Field	°C	-	-	-			12.4	4	12.3
DISSOLVED ANIONS									
Alkalinity - Total	mg/L CaCO ₃	-	-	-			26	23	25
Chloride	mg/L	150	1500	250			31.7	31.7	31.8
Sulphate ^{4,7}	mg/L	218	2180	500			11.7	20.5	11.8
TOTAL CATIONS									
Calcium	mg/L	-	-	-			11.3	13.6	10.8
Magnesium	mg/L	-	-	-			3.4	4.28	3.2
Potassium	mg/L	-	-	-			5.9	3.98	5.5
Sodium	mg/L	-	-	200			18.3	18.7	17.1
NUTRIENTS									
Ammonia Nitrogen ^{5,8}	mg/L as N	1.84	18.4	-			0.06	<0.0050	<0.05
Nitrate Nitrogen	mg/L as N	3	400	10			0.5	1.4	0.43
Total Phosphorus ³	mg/L as P	0.005	-	-			0.027	0.0065	0.027
POLLUTANT TESTS									
Chemical Oxygen Demand	mg/L as O	-	-	-			20	26	21
Biochemical Oxygen Demand	mg/L as O	-	-	-			<2	<2.0	<2
TOTAL METALS									
Aluminum ⁵	mg/L	0.05	-	9.5			0.265	0.278	0.263
Antimony	mg/L	0.01	0.09	0.006			<0.001	<0.00010	<0.001
Arsenic	mg/L	0.005	0.05	0.01			<0.001	0.00016	<0.001
Barium	mg/L	1	10	1			<0.05	0.00921	<0.05
Beryllium	mg/L	0.00013	0.0015	0.008			<0.0005	<0.000100	<0.0005
Boron	mg/L	1.2	12	5			0.14	0.104	0.13
Cadmium ^{4,7}	mg/L	0.00013	0.0015	0.005			<0.000016	0.0000068	<0.000016
Chromium	mg/L	0.001	0.01	0.05			0.0008	<0.00050	0.0009
Cobalt	mg/L	0.004	0.04	0.001			<0.0009	0.00026	<0.0009
Copper ⁷	mg/L	see below	0.02	1.5			0.0015	0.00108	0.0017
Iron	mg/L	1	-	6.5			1	0.283	0.9
Lead ^{4,7}	mg/L	0.005	0.16	0.01			0.0001	0.000198	0.0002
Lithium	mg/L	-	-	0.008			<0.001	<0.0010	<0.001
Manganese ⁴	mg/L	0.82	-	1.5			0.065	0.0169	0.063
Mercury	µg/L	0.2	0.25	1			0.00001	<0.0000050	0.00001
Molybdenum	mg/L	7.6	10	0.25			<0.001	<0.000050	<0.001
Nickel ⁷	mg/L	0.03	0.25	0.08			<0.003	0.00115	<0.003
Selenium	mg/L	0.002	0.02	0.01			<0.0005	0.000071	<0.0005
Silver	mg/L	0.00005	0.0005	0.02			<0.00005	0.000029	<0.00005
Strontium	mg/L	-	-	2.5			0.068	0.0756	0.065
Thallium	mg/L	-	0.003	-			<0.0001	<0.000010	<0.0001
Tin	mg/L	-	-	2.5			<0.0005	<0.00010	<0.0005
Titanium	mg/L	-	1	-			0.012	0.00935	0.01
Tungsten	mg/L	-	-	0.003			<0.0001	<0.00010	<0.0001
Uranium	mg/L	-	0.09	0.02			<0.001	0.000014	<0.001
Vanadium	mg/L	-	-	0.02			0.001	0.0011	0.001
Zinc ^{4,7}	mg/L	0.0075	0.075	3			<0.004	0.0094	<0.004
DISSOLVED COPPER ASSESSMENT									
Dissolved Organic Carbon	mg/L	-	-	-			-	-	-
Dissolved Copper Guidelines ⁶	mg/L	varies	0.02	-			0.0088	0.0062	0.0068

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NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10. https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May and September results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 25 mg/L-CaCO₃. Cadmium guideline is for dissolved cadmium.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- Dissolved copper FWAL guideline is calculated for each sampling event using BC BLM software with sample-specific parameters except for humic acid ratio (assumed value of 10) and DOC values (estimated value of either 10 or 20 based on 2020 - 2021 data).
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 49 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 6.9.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-11
WATER CHEMISTRY DATA FOR SW-11

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	7.32	7.77		6.75
pH - Lab	pH	6.5 - 9.0	-	-	7.36	6.75		6.53
Conductivity - Field	µS/cm	-	-	-	115.8	101	Dry	161.4
Conductivity - Lab	µS/cm	-	-	-	214	142		268
Total Hardness (CaCO ₃)	mg/L	-	-	-	42.3	40.9		58.3
Total Dissolved Solids	mg/L	-	-	-	127	90		183
Temperature - Field	°C	-	-	-	4.4	8.5		5.3
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	30	33		25.5
Chloride	mg/L	150	1500	250	33.6	21		53.4
Sulphate ^{4,7}	mg/L	218	2180	500	6.5	3.4		16.7
TOTAL CATIONS								
Calcium	mg/L	-	-	-	11.5	11.6		16.3
Magnesium	mg/L	-	-	-	3.3	2.9		4.28
Potassium	mg/L	-	-	-	2.2	1.9		3.71
Sodium	mg/L	-	-	200	15.4	13.5		27.6
NUTRIENTS								
Ammonia Nitrogen ^{5,8}	mg/L as N	1.84	18.4	-	0.07	0.06		0.141
Nitrate Nitrogen	mg/L as N	3	400	10	2	0.2		0.111
Total Phosphorus ³	mg/L as P	0.005	-	-	0.046	0.033		0.0121
POLLUTANT TESTS								
Chemical Oxygen Demand	mg/L as O	-	-	-	15	17		18
Biochemical Oxygen Demand	mg/L as O	-	-	-	<2	<2		<2.0
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.389	0.693		0.199
Antimony	mg/L	0.01	0.09	0.006	<0.001	<0.001		<0.00010
Arsenic	mg/L	0.005	0.05	0.01	<0.001	<0.001		0.0003
Barium	mg/L	1	10	1	<0.05	<0.05		0.0145
Beryllium	mg/L	0.00013	0.0015	0.008	<0.001	<0.0005		<0.000100
Boron	mg/L	1.2	12	5	0.09	0.07		0.129
Cadmium ^{4,7}	mg/L	0.00012	0.0015	0.005	0.000017	0.000016		0.0000244
Chromium	mg/L	0.001	0.01	0.05	0.001	0.0014		0.00051
Cobalt	mg/L	0.004	0.04	0.001	<0.001	<0.0009		<i>0.00115</i>
Copper ⁷	mg/L	see below	0.02	1.5	0.002	0.0022		0.00108
Iron	mg/L	1	-	6.5	1.5	2.1		0.958
Lead ^{4,7}	mg/L	0.005	0.16	0.01	0.0002	0.0002		0.000124
Lithium	mg/L	-	-	0.008	<0.001	<0.001		<0.0010
Manganese ⁴	mg/L	0.81	-	1.5	0.119	0.19		0.311
Mercury	µg/L	0.2	0.25	1	<0.000005	<0.000025		<0.000050
Molybdenum	mg/L	7.6	10	0.25	<0.001	<0.001		<0.000050
Nickel ⁷	mg/L	0.03	0.25	0.08	<0.003	<0.003		0.00103
Selenium	mg/L	0.002	0.02	0.01	0.0013	<0.0005		0.000086
Silver	mg/L	0.00005	0.0005	0.02	<0.00005	<0.00005		0.000019
Strontium	mg/L	-	-	2.5	0.058	0.063		0.088
Thallium	mg/L	-	0.003	-	<0.0005	<0.0001		<0.00010
Tin	mg/L	-	-	2.5	<0.003	<0.0005		<0.00010
Titanium	mg/L	-	1	-	0.032	0.033		0.0111
Tungsten	mg/L	-	-	0.003	0.00013	<0.0001		<0.00010
Uranium	mg/L	-	0.09	0.02	<0.001	<0.001		<0.000010
Vanadium	mg/L	-	-	0.02	0.003	0.003		0.00119
Zinc ^{4,7}	mg/L	0.0075	0.075	3	0.02	0.006		0.0139
DISSOLVED COPPER ASSESSMENT								
Dissolved Organic Carbon	mg/L	-	-	-	6	-		-
Dissolved Copper Guidelines ⁶	mg/L	varies	0.02	-	0.0022	0.0041		0.0047

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NOTES:

- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcaaz2/161_2020_Sch3.2
- Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf. BC MOE, April 2014.
Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May and September results compared against stringent guideline of 0.005 mg/L.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 75 mg/L-CaCO₃. Cadmium guideline is for dissolved cadmium.
- FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10°C.
- Dissolved copper FWAL guideline is calculated for each sampling event using BC BLM software with sample-specific parameters except for humic acid ratio (assumed value of 10) and DOC values (estimated value of either 10 or 20 based on 2020 - 2021 data).
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 47 mg/L-CaCO₃.
- CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 6.9.
- Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *italics* denotes parameters which exceed CSR DW.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-12
WATER CHEMISTRY DATA FOR SW-12

PARAMETER	units	RECEIVING WATER CRITERIA			SAMPLING DATE			
		AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
PHYSICAL TESTS								
pH - Field	pH	6.5 - 9.0	-	-	8.65	8.09	Dry	7.84
pH - Lab	pH	6.5 - 9.0	-	-	7.25	6.71		6.91
Conductivity - Field	µS/cm	-	-	-	81.6	70.6		81.6
Conductivity - Lab	µS/cm	-	-	-	137	94		136
Total Hardness (CaCO ₃)	mg/L	-	-	-	19.3	17.2		27.8
Total Dissolved Solids	mg/L	-	-	-	83	83		104
Temperature - Field	°C	-	-	-	4.6	9.3		6.3
DISSOLVED ANIONS								
Alkalinity - Total	mg/L CaCO ₃	-	-	-	13	18		9.4
Chloride	mg/L	150	1500	250	25.9	16.7		26.2
Sulphate ^{4,6}	mg/L	128	1280	500	4.2	1.7		9.64
NUTRIENTS								
Ammonia Nitrogen ^{5,7}	mg/L as N	1.84	18.4	-	<0.02	0.08		0.0104
Nitrate Nitrogen	mg/L as N	3	400	10	0.7	0.34		0.11
Total Phosphorus ³	mg/L as P	0.005	-	-	0.032	0.035		0.0193
TOTAL METALS								
Aluminum ⁵	mg/L	0.05	-	9.5	0.68	0.928		1.09
Iron	mg/L	1	-	6.5	1	2.1		1.61
Manganese ⁴	mg/L	0.70	-	1.5	0.025	0.037		0.112

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- NOTES:
- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
 - Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021. AW standards assume minimum 1:10 dilution is available. As such, samples collected from background and receiving creeks are compared against CSR AW standards/10.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
 - Phosphorus Objective for creeks from Phosphorous Management in Vancouver Island Streams. Available: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-reference-documents/phosphorous_management_vi_streams_guidance_2014.pdf.
BC MOE, April 2014. Monthly average of May to September samples for total phosphorus should not exceed 0.005 mg/L, and maximum total phosphorus for this period should not exceed 0.01 mg/L in any one sample. May results compared against stringent guideline of 0.005 mg/L.
 - FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 100 mg/L-CaCO₃.
 - FWAL guideline for indicated parameter changes with pH. The aluminum guideline is for dissolved aluminum. Ammonia also changes with temperature. Value shown appropriate for pH<7 and temperature of 10° C.
 - CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 21 mg/L-CaCO₃.
 - CSR AW guideline for indicated parameter changes with pH. Value shown appropriate for pH 7.
 - Bolding** denotes parameters which exceed BC FWAL water quality criteria. Underline denotes parameters which exceed CSR AW criteria. *Italics* denotes parameters which exceed CSR DW.
 - "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-13

WATER CHEMISTRY DATA SUMMARY FOR VOCs

PARAMETER	units	RECEIVING WATER CRITERIA				SAMPLING DATE					
		GCDWQ MAC or AO ¹	AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	SW-1	SW-1	SW-3	SW-3	SW-3	SW-3
						07-Sep-22	21-Nov-22	22-Feb-22	25-May-22	07-Sep-22	21-Nov-22
HALOGENATED VOLATILES											
Bromodichloromethane	µg/L	-	-	-	100	-	<0.50	<1	-	-	<0.50
Bromoform	µg/L	-	-	-	100	<0.001	<0.50	<1	<1	<1	<0.50
Bromomethane	µg/L	-	-	-	5.5	<0.001	-	<1	<1	<1	-
Carbon Tetrachloride	µg/L	2	13.3	130	2	<0.0005	<0.50	<0.5	<0.5	<0.5	<0.50
Chlorobenzene	µg/L	80	1.3	13	80	<0.001	<0.50	<1	<1	<1	<0.50
Chloroethane	µg/L	30	-	-	-	<0.001	<0.50	<1	<1	<1	<0.50
Chloroform	µg/L	-	1.8	20	100	<0.001	<0.50	<1	<1	<1	<0.50
Chloromethane	µg/L	-	-	-	-	<0.001	<5.0	<1	<1	<1	<5.0
Dibromochloromethane	µg/L	3	-	-	100	<0.001	<0.50	<1	<1	<1	<0.50
1,2-Dibromoethane	µg/L	-	-	-	0.5	-	-	<1	-	-	-
1,2-Dichlorobenzene	µg/L	3	0.7	7	200	<0.0005	<0.50	<0.5	<0.5	<0.5	<0.50
1,3-Dichlorobenzene	µg/L	-	150	1.5	-	<0.0005	<0.50	<0.5	<0.5	<0.5	<0.50
1,4-Dichlorobenzene	µg/L	1	26	260	5	<0.0005	<0.50	<0.5	<0.5	<0.5	<0.50
1,1-Dichloroethane	µg/L	-	-	-	30	<0.001	<0.50	<1	<1	<1	<0.50
1,2-Dichloroethane	µg/L	5	100	1000	5	<0.001	<0.50	<1	<1	<1	<0.50
1,1-Dichloroethylene	µg/L	14	-	-	14	<0.001	<0.50	<1	<1	<1	<0.50
cis-1,2-Dichloroethylene	µg/L	-	-	-	8	<0.001	<0.50	<1	<1	<1	<0.50
trans-1,2-Dichloroethylene	µg/L	-	-	-	80	<0.001	<0.50	<1	<1	<1	<0.50
Dichloromethane	µg/L	50	98.1	980	50	-	<1.0	<1	-	-	<1.0
1,2-Dichloropropane	µg/L	-	-	-	4.5	<0.001	<0.50	<1	<1	<1	<0.50
1,1,2,2-Tetrachloroethane	µg/L	-	-	-	0.8	-	<0.50	<0.5	-	-	<0.50
Tetrachloroethylene	µg/L	10	110	1100	30	<0.001	<0.50	<1	<1	<1	<0.50
1,1,1-Trichloroethane	µg/L	-	-	-	8000	<0.001	<0.50	<1	<1	<1	<0.50
1,1,2-Trichloroethane	µg/L	-	-	-	3	-	<0.50	<1	-	-	<0.50
Trichloroethylene	µg/L	5	21	200	5	-	-	<1	-	-	-
Trichlorofluoromethane	µg/L	-	-	-	1000	<0.001	<0.50	<1	<1	<1	<0.50
Vinyl Chloride	µg/L	2	-	-	2	<0.0008	<0.40	<0.8	<0.8	<0.8	<0.40
NON-HALOGENATED VOLATILES											
Benzene	µg/L	5	40	400	5	<0.0005	<0.50	<0.5	<0.5	<0.5	<0.50
Ethylbenzene	µg/L	2	200	2000	140	<0.0005	<0.50	<0.5	<0.5	<0.5	<0.50
Styrene	µg/L	-	72	720	800	<0.001	<0.50	<1	<1	<1	<0.50
Toluene	µg/L	24	0.5	5	60	<0.0003	<0.40	<0.3	<0.3	<0.3	<0.40
Xylenes	µg/L	20	30	300	90	<0.0005	<0.50	<0.5	<0.5	<0.5	<0.50

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NOTES:

- GCDWQ = Guidelines for Canadian Drinking Water Quality (Health Canada, 2022)
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: <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Contaminated Sites Regulation (CSR) Schedule 3.2 guidelines are shown. Available: http://www.bclaws.ca/civix/document/id/complete/statreg/375_96_08#Schedule3.2
- Bolding denotes parameters which exceed water quality criteria.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

TABLE A-14
SUMMARY OF POTENTIAL CONTAMINANTS AT SW-3

PARAMETER	units	RECEIVING WATER CRITERIA				SAMPLING DATE
		GCDWQ MAC or AO ¹	AQUATIC LIFE (FWAL) ¹	CSR AQUATIC LIFE (AW) ²	CSR DRINKING WATER (DW) ²	
OP PESTICIDES						07-Sep-22
Phorate	µg/L	2	-	-	2	<0.5
Dimethoate	µg/L	20	-	62	20	<2.5
Terbufos	µg/L	1	-	-	1	<0.5
Diazinon	µg/L	20	-	0.03	20	<0.17
Malathion	µg/L	190	-	1	190	<0.1
Chlorpyrifos	µg/L	90	-	0.02	90	<0.002
POLYCYCLIC AROMATIC COMPOUNDS AND PHENOLS						
Naphthalene	µg/L	-	1	10	80	<0.30
Acenaphthylene	µg/L	-	-	-	-	<0.31
Acenaphthene	µg/L	-	6	60	250	<0.30
Fluorene	µg/L	-	12	120	150	<0.31
Phenanthrene	µg/L	-	0.3	3	-	<0.01
Anthracene	µg/L	-	4	1	1000	<0.30
Fluoranthene	µg/L	-	4	2	150	<0.27
Pyrene	µg/L	-	-	0.2	100	<0.01
Benz(a)anthracene	µg/L	-	0.1	1	0.07	<0.20
Chrysene	µg/L	-	-	1	7	<0.27
Benzo(b)fluoranthene	µg/L	-	-	-	0.07	<0.20
Benzo(k)fluoranthene	µg/L	-	-	-	-	<0.20
Benzo(a)pyrene	µg/L	0.04	0.01	0.1	0.01	<0.01
Dibenzo(a,h)anthracene	µg/L	-	-	-	0.01	<0.20
Benzo(g,h,i)perylene	µg/L	-	-	-	-	<0.20
Phenol	µg/L	-	-	2000	1000	<1.0
Bis(2-chloroethyl)ether	µg/L	-	-	-	0.15	<0.5
2-Chlorophenol	µg/L	-	-	19.5	45	<0.5
Bis(2-chloroisopropyl)ether	µg/L	-	-	-	-	<0.5
m&p-Cresol	µg/L	-	-	-	-	<0.5
Hexachloroethane	µg/L	-	-	-	3	<0.5
2,4-Dimethylphenol	µg/L	-	-	-	80	<0.5
2,4-Dichlorophenol	µg/L	-	4.3	3	900	<0.3
1,2,4-Trichlorobenzene	µg/L	-	-	240	5.5	<0.5
p-Chloroaniline	µg/L	-	-	-	0.8	<1.0
Hexachlorobutadiene	µg/L	-	-	15	2	<0.4
2-and 1-methyl Naphthalene	µg/L	-	-	-	5.5	<0.5
2,4,6-Trichlorophenol	µg/L	5	8.8	6	5	<0.2
2,4,5-Trichlorophenol	µg/L	-	3.3	2.5	400	<0.2
1,1-Biphenyl	µg/L	-	-	-	2000	<0.5
Dimethyl phthalate	µg/L	-	-	-	-	<0.5
2,6-Dinitrotoluene	µg/L	-	-	-	0.1	<0.5
2,4-Dinitrotoluene	µg/L	-	-	-	0.5	<0.5
2,3,4,6-Tetrachlorophenol	µg/L	100	8	5.5	100	<0.5
Diethyl phthalate	µg/L	-	-	-	3000	<0.5
Hexachlorobenzene	µg/L	-	-	-	0.1	<0.5
Pentachlorophenol	µg/L	30	-	1	60	<0.5
3,3'-dichlorobenzidine	µg/L	-	-	-	0.35	<0.5
Bis(2-Ethylhexyl)phthalate	µg/L	-	-	160	10	<0.5
2,4-Dinitrophenol	µg/L	-	-	2000	8	<10
Surrogate: Chrysene-d12	%	-	-	-	-	84
LEPH/HEPH						
Quinoline	µg/L	-	-	34	0.05	<0.04
Anthracene (Water)	µg/L	-	4	1	1000	<0.30
Acridine	µg/L	-	3	0.5	-	<0.05
OC PESTICIDES						
Heptachlor	µg/L	-	-	0.1	0.035	<0.01
Aldrin	µg/L	0.7	-	0.04	0.009	<0.01
Heptachlor Epoxide	µg/L	-	-	0.1	0.015	<0.01
Chlordane	µg/L	-	-	-	-	<0.04
Dieldrin	µg/L	0.7	-	0.04	0.01	<0.02
Endrin	µg/L	-	-	0.023	1	<0.05
Methoxychlor	µg/L	900	-	-	20	<0.03
Surrogate: TCMX	%	-	-	-	-	70
Surrogate: Decachlorobiphenyl	%	-	-	-	-	84

NOTES:

- GCDWQ = Guidelines for Canadian Drinking Water Quality (Health Canada, 2022)
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.
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines or those based on pH of 7.7 are shown.
- Contaminated Sites Regulation (CSR) Schedule 3.2 guidelines are shown.
Available: http://www.bclaws.ca/civix/document/id/complete/statreg/375_96_08#Schedule3.2
- Bolding** denotes parameters which exceed water quality criteria.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.

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TABLE A-15
WATER CHEMISTRY DATA FOR SCALE SHACK TAP

PARAMETER	units	RECEIVING WATER CRITERIA				SAMPLING DATE
		GCDWQ MAC or AO ¹	AQUATIC LIFE (FWAL) ²	CSR AQUATIC LIFE (AW) ⁶	CSR DRINKING WATER (DW) ⁶	21-Nov-22
PHYSICAL TESTS						
pH - Field	pH	7.0 - 10.5	6.5 - 9.0	-	-	6.93
pH - Lab	pH	7.0 - 10.5	6.5 - 9.0	-	-	7.3
Conductivity - Field	µS/cm	-	-	-	-	142.7
Conductivity - Lab	µS/cm	-	-	-	-	206
Total Hardness (CaCO ₃)	mg/L	-	-	-	-	63.8
Total Dissolved Solids	mg/L	500	-	-	-	143
Temperature - Field	°C	-	-	-	-	10.7
MICROBIOLOGY ⁸						
Total Coliforms	MPN/100mL	0	-	-	-	>2420
E. Coli	MPN/100mL	0	-	-	-	131
DISSOLVED ANIONS						
Alkalinity - Total	mg/L CaCO ₃	-	-	-	-	69.9
Chloride	mg/L	250	150	1500	250	19.6
Sulphate ^{5,7}	mg/L	500	218	2180	500	2.92
TOTAL CATIONS						
Calcium	mg/L	-	-	-	-	22.5
Magnesium	mg/L	-	-	-	-	1.86
Potassium	mg/L	-	-	-	-	4.32
Sodium	mg/L	200	-	-	200	12.5
NUTRIENTS						
Nitrate Nitrogen	mg/L as N	10	3	400	10	<0.0050
Nitrite Nitrogen ⁹	mg/L as N	1	0.2	2	1	<0.0010
TOTAL METALS						
Aluminum	mg/L	2.9	0.05	-	9.5	1.2
Antimony	mg/L	0.006	0.01	0.09	0.006	<0.00010
Arsenic	mg/L	0.01	0.005	0.05	0.01	0.00065
Barium	mg/L	2	1	10	1	0.017
Beryllium	mg/L	-	0.00013	0.0015	0.008	<0.000100
Boron	mg/L	5	1.2	12	5	0.025
Cadmium ^{5,7}	mg/L	0.007	0.00015	0.0015	0.005	0.0000178
Chromium	mg/L	0.05	0.001	0.01	0.05	0.00181
Cobalt	mg/L	-	0.004	0.04	0.001	0.00088
Copper ⁷	mg/L	1	see below	0.03	1.5	0.0164
Iron	mg/L	0.3	1	-	6.5	1.74
Lead ^{5,7}	mg/L	0.005	0.005	0.16	0.01	0.00368
Lithium	mg/L	-	-	-	0.008	<0.0010
Manganese ^{5,7}	mg/L	0.02	0.89	-	1.5	0.147
Mercury	µg/L	1	0.2	0.25	1	0.000007
Molybdenum	mg/L	-	7.6	10	0.25	0.000129
Nickel ⁷	mg/L	-	0.03	0.65	0.08	0.00168
Selenium	mg/L	0.05	0.002	0.02	0.01	<0.000050
Silver	mg/L	-	0.00005	0.0005	0.02	0.000057
Strontium	mg/L	7	-	-	2.5	0.134
Thallium	mg/L	-	-	0.003	-	<0.000010
Tin	mg/L	-	-	-	2.5	<0.00010
Titanium	mg/L	-	-	1	-	0.0512
Tungsten	mg/L	-	-	-	0.003	<0.00010
Uranium	mg/L	0.02	-	0.09	0.02	0.000035
Vanadium	mg/L	-	-	-	0.02	0.00384
Zinc ^{5,7}	mg/L	5	0.0075	0.075	3	0.0662
DISSOLVED COPPER ASSESSMENT						
Dissolved Copper Guidelines ¹⁰	mg/L	-	varies	0.02	-	0.0018

NOTES:

- GCDWQ = Guidelines for Canadian Drinking Water Quality (Health Canada, 2022)
MAC = Maximum acceptable concentration; AO = Aesthetic objective.
- Approved and Working Water Quality Guidelines, Science and Information Branch, Environmental Protection Division, BC Ministry of Environment.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines>
https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/bc_env_working_water_quality_guidelines.pdf
Guidelines for the Protection of Fresh-Water Aquatic Life ("FWAL"). Lowest guidelines are shown (ie. Long term average if applicable).
- Bolding** denotes parameters which exceed BC FWAL water quality criteria, underline denotes parameters which exceed CSR AW criteria, *italics* which exceed CSR DW criteria, and yellow highlight denotes parameters exceeding the GCDWQ.
- "-" denotes parameter was not analysed, or a receiving water criteria was not applicable.
- FWAL guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 60 mg/L-CaCO₃.
- Per Schedule 3.2 of Stage 13 Amendment to Contaminated Sites Regulation (CSR), March 2021.
https://www.bclaws.gov.bc.ca/civix/document/id/lc/bcgaz2/161_2020_Sch3.2
- CSR AW guideline for indicated parameter changes with hardness. Value shown appropriate for hardness of 60 mg/L-CaCO₃.
- Microbiology samples collected in November 2022 were analyzed past recommended hold time.
- FWAL guideline for indicated parameter changes with chloride. Value shown appropriate for chloride of 20 mg/L-CaCO₃.
- Dissolved copper FWAL guideline is calculated for each sampling event using BC BLM software with sample-specific parameters except for humic acid ratio (assumed value of 10) and DOC values (estimated value of 10 based on surrounding sampling locations).

H:\Project\1576\Chem\2022\Tables-2022.xlsx|Table A-15

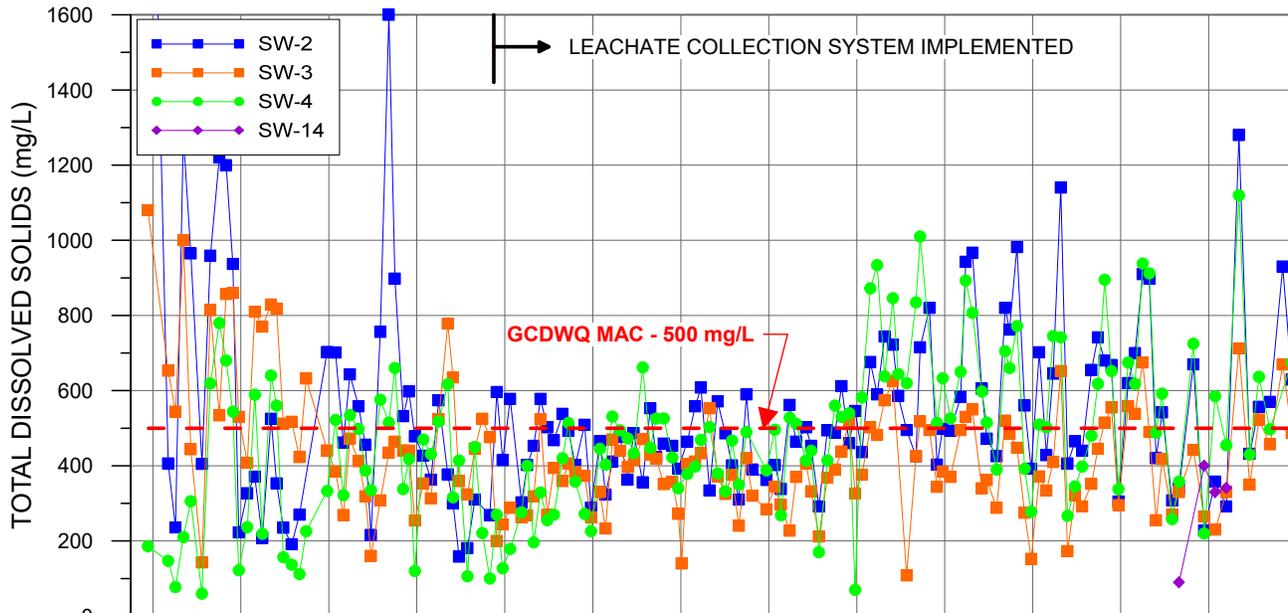
APPENDIX B
MONITORING DATA PLOTS

APPENDIX B

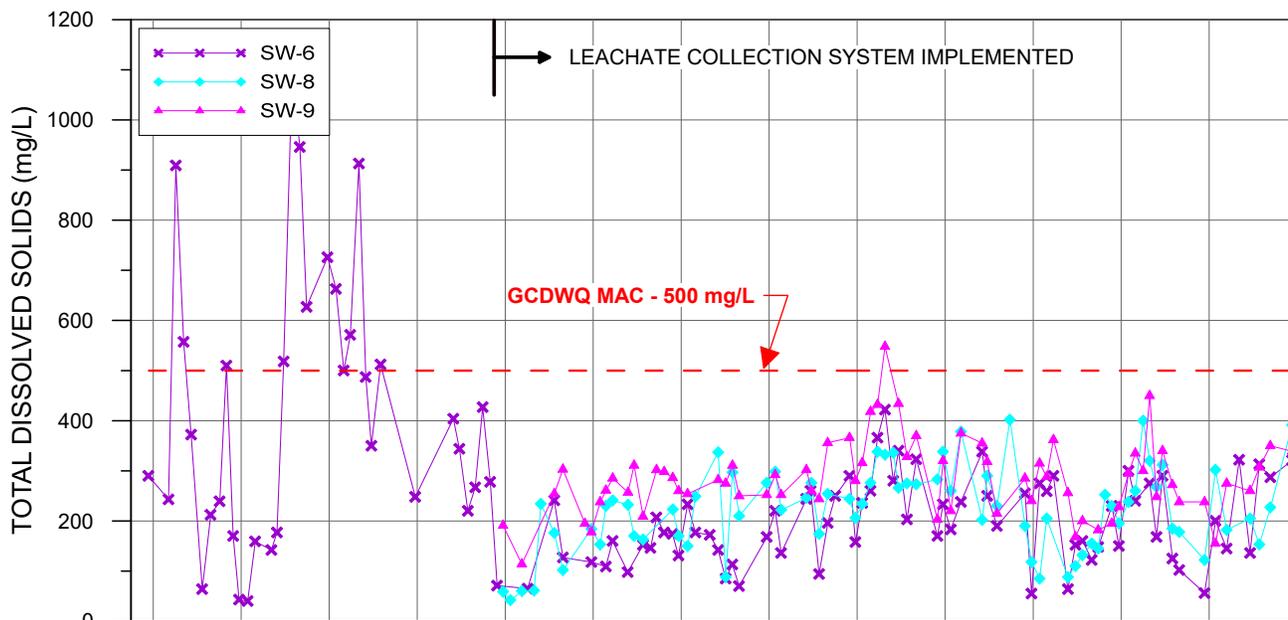
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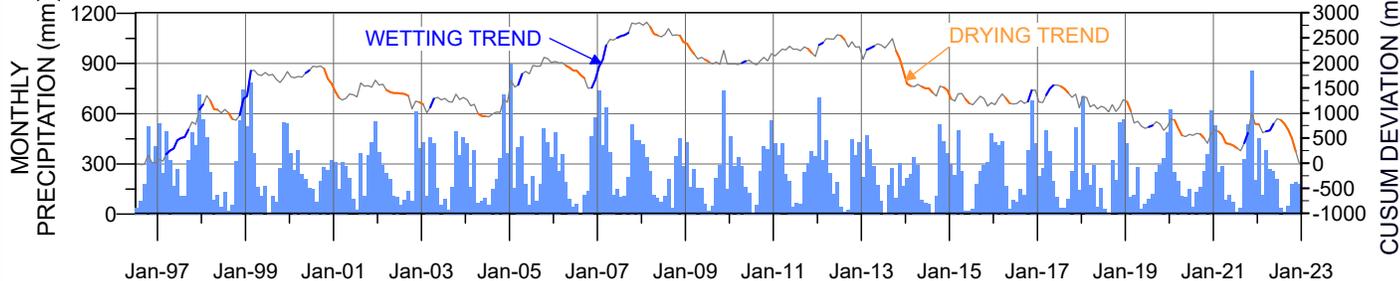
LEACHATE COLLECTION SYSTEM



LEACHATE IRRIGATION RECEIVING AREA



MONTHLY PRECIPITATION AND CUMULATIVE DEVIATION FROM MONTHLY PRECIPITATION



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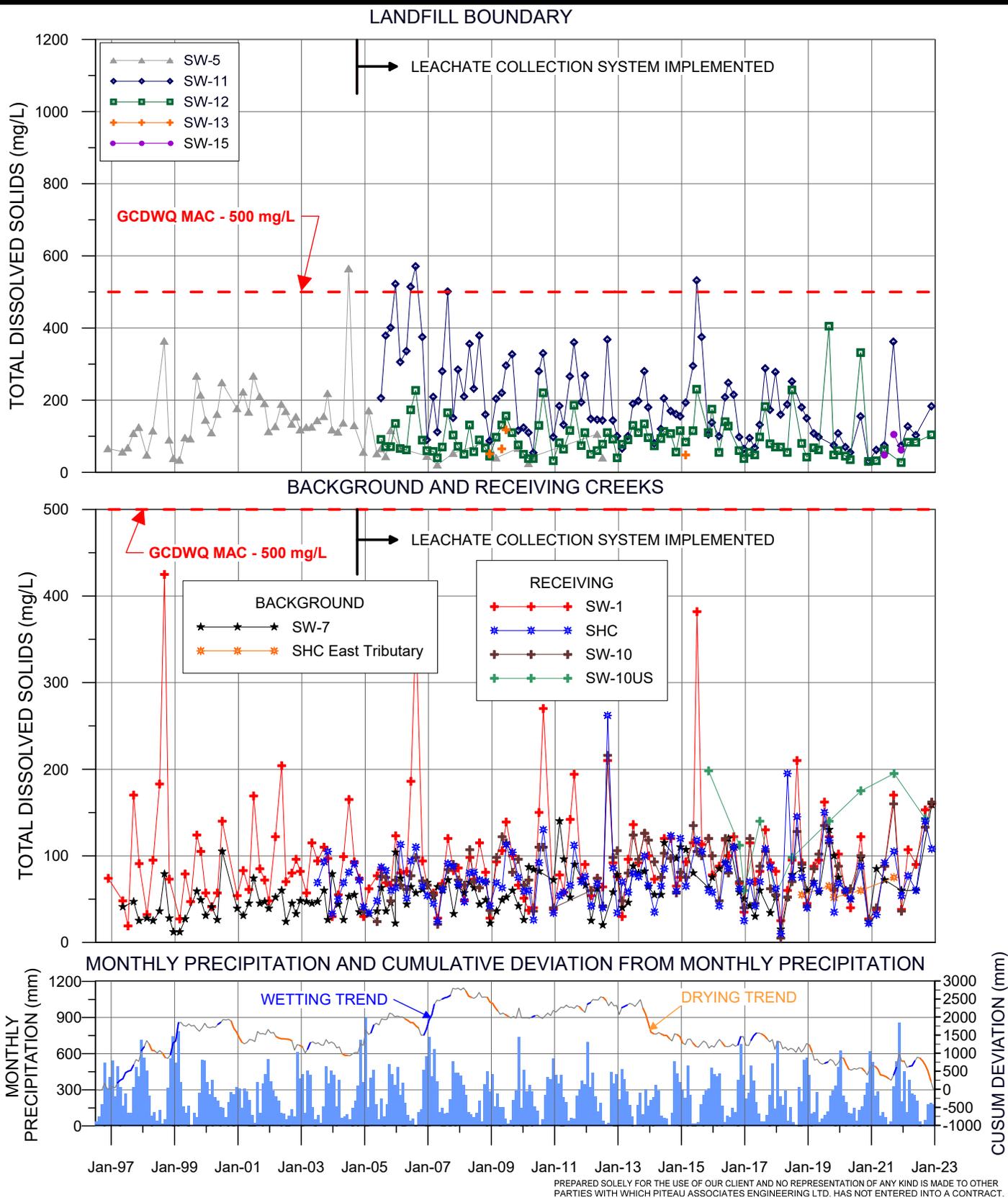
ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.



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TOTAL DISSOLVED SOLIDS CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-1



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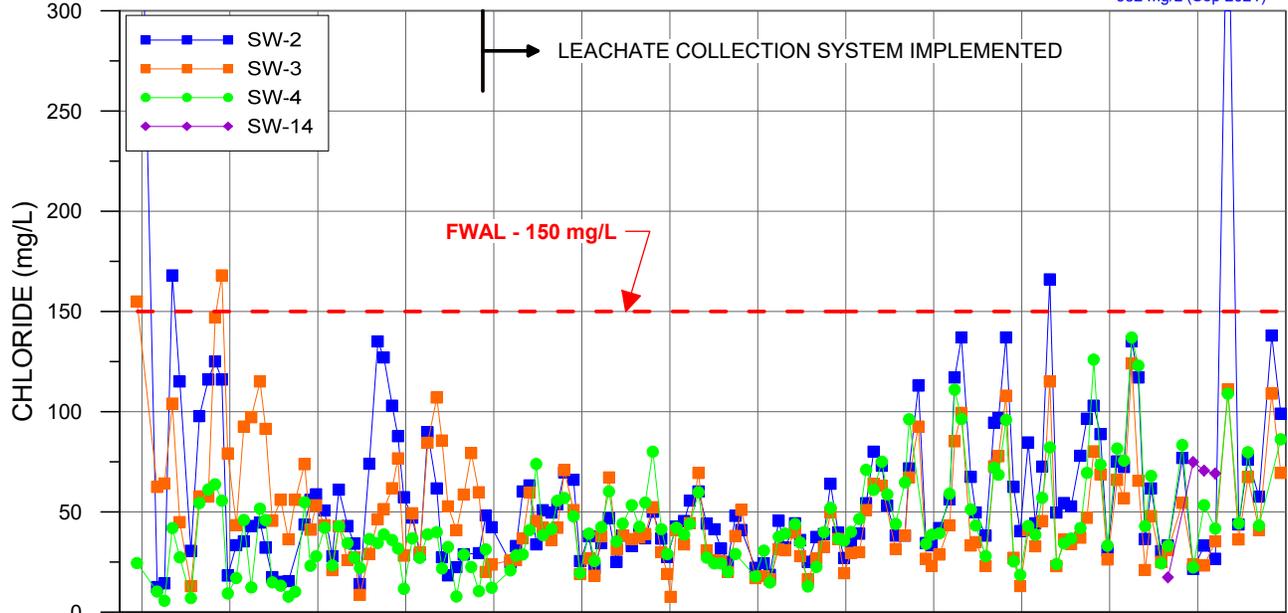
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TOTAL DISSOLVED SOLIDS CONCENTRATION
 TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
 AND BACKGROUND AND RECEIVING CREEKS

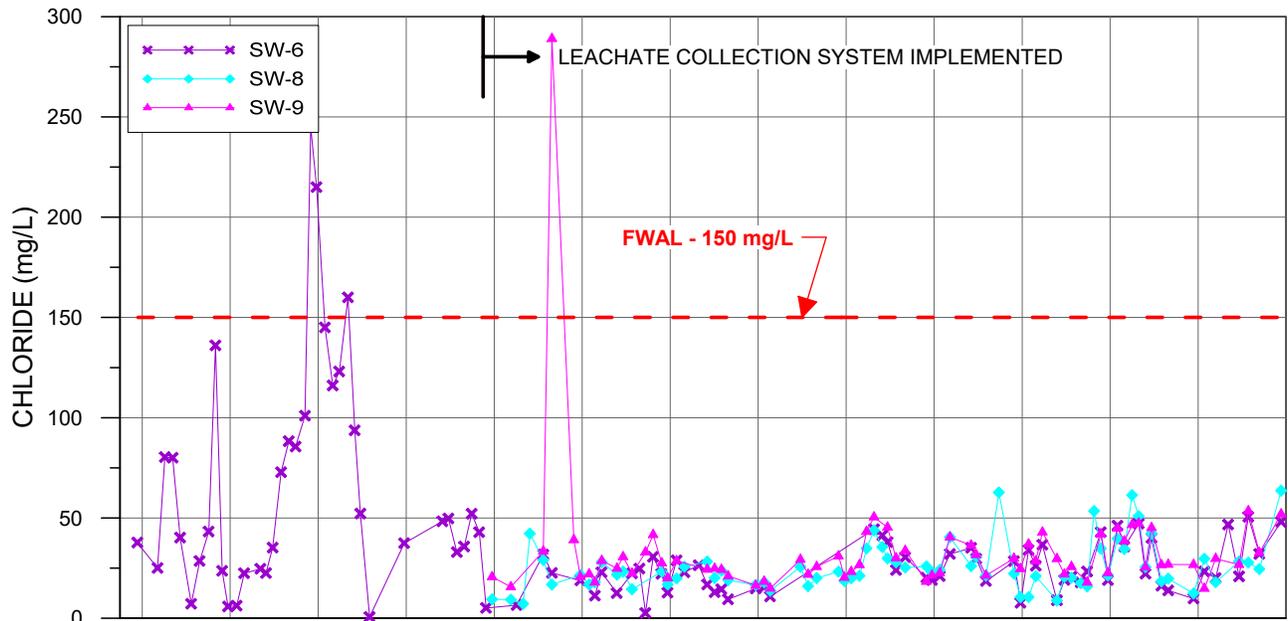
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LEACHATE COLLECTION SYSTEM

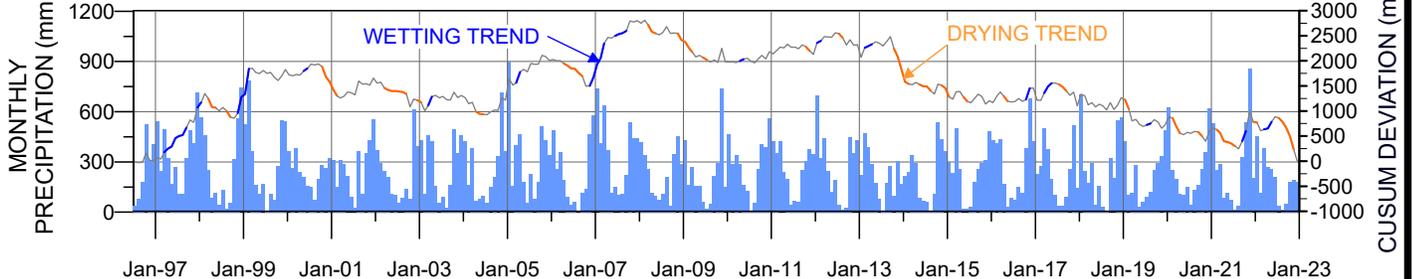
382 mg/L (Sep 2021)



LEACHATE IRRIGATION RECEIVING AREA



MONTHLY PRECIPITATION AND CUMULATIVE DEVIATION FROM MONTHLY PRECIPITATION



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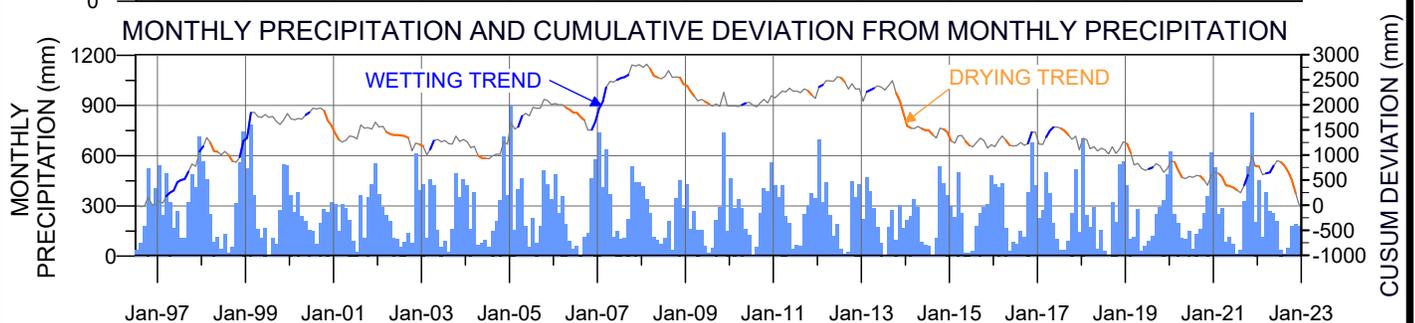
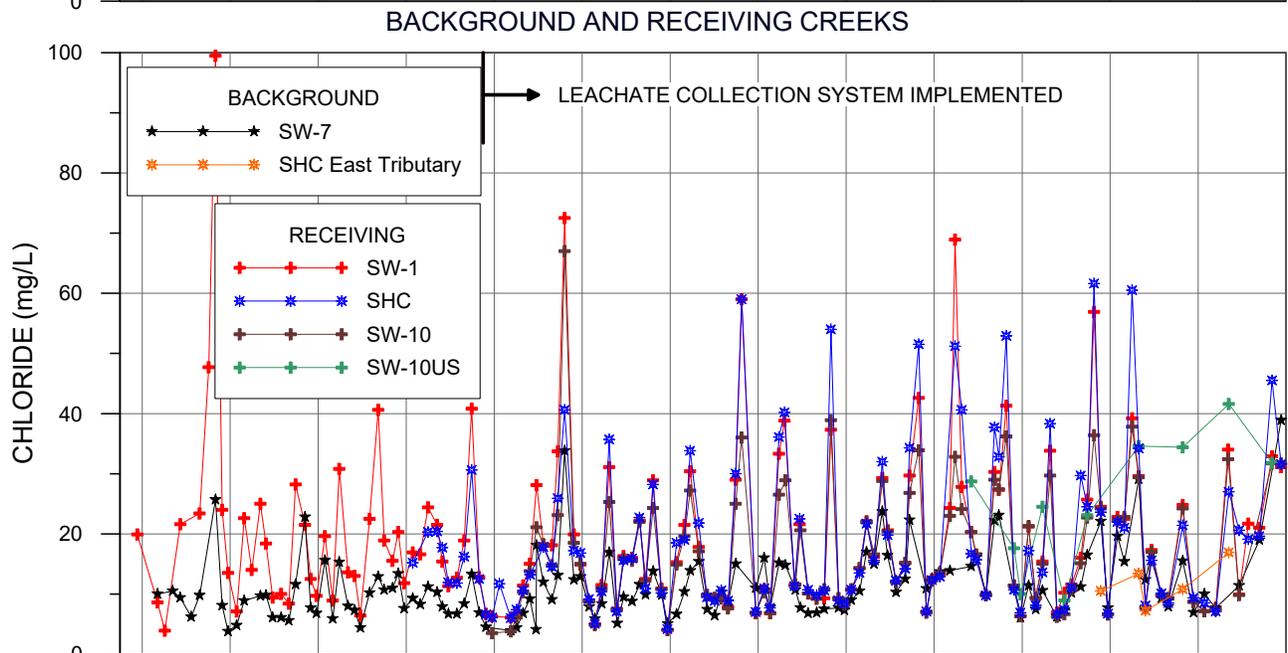
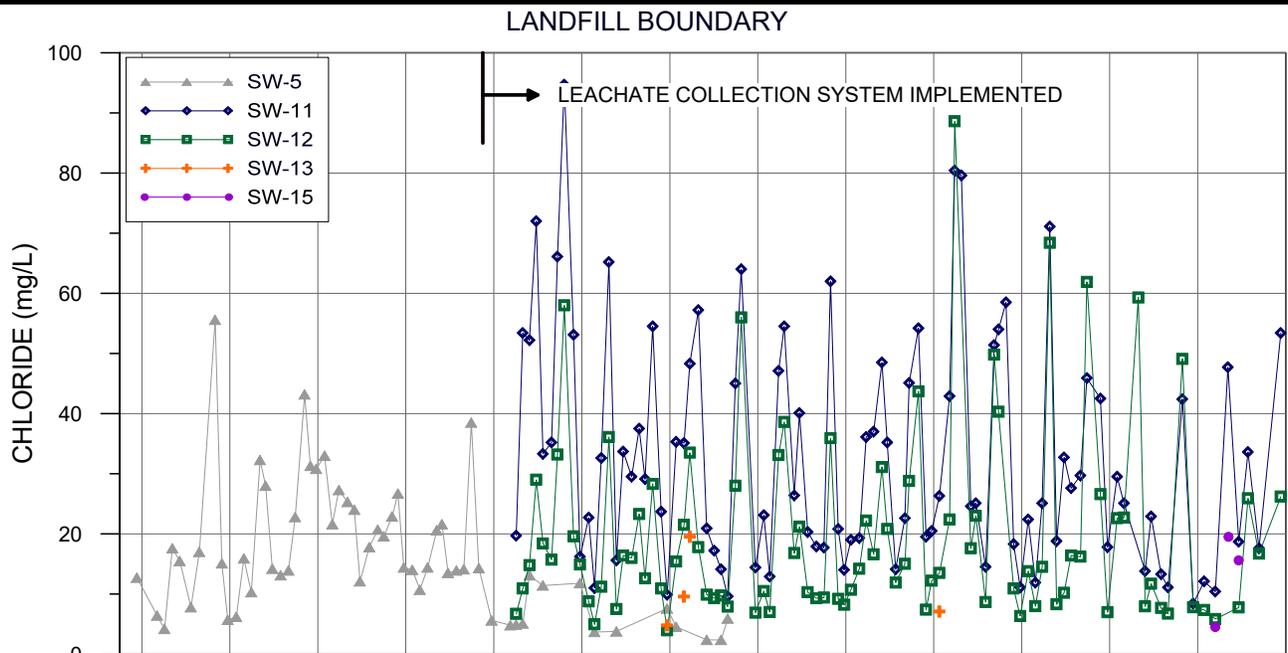
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CHLORIDE CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-3



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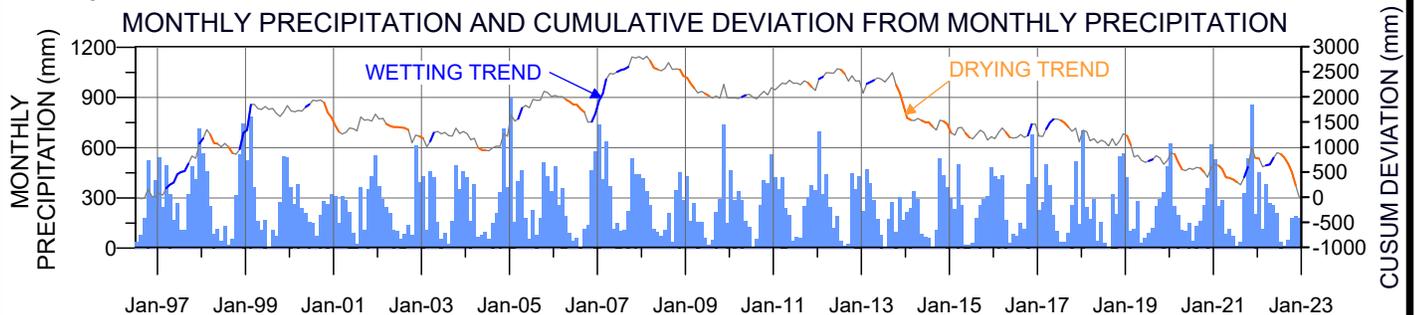
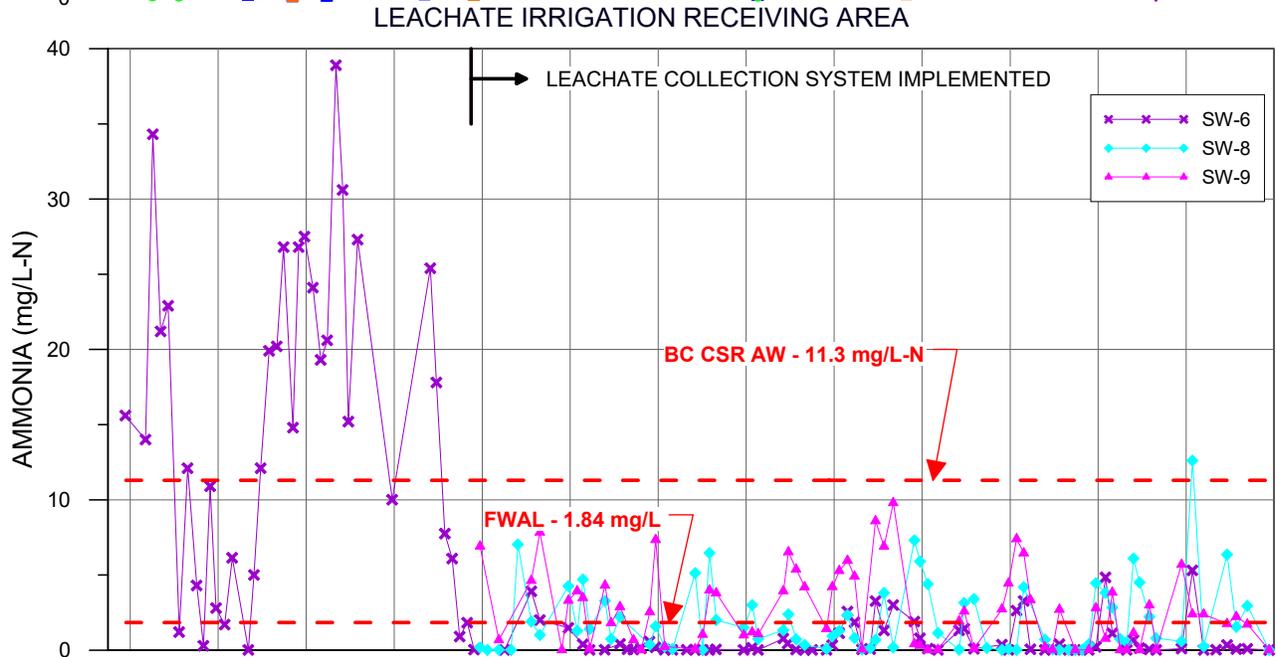
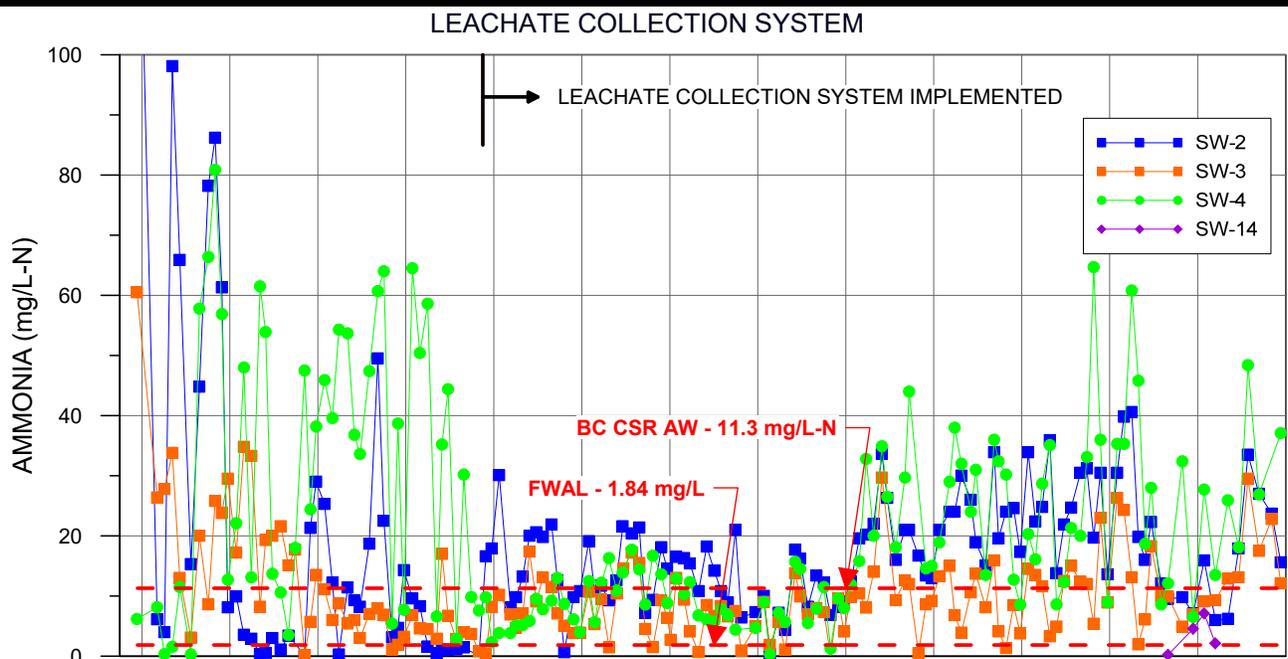
**ALBERNI-CLAYOQUOT REGIONAL DISTRICT
WATER QUALITY MONITORING PROGRAM
WEST COAST LANDFILL, UCLUELET, B.C.**



PITEAU ASSOCIATES
GEOTECHNICAL AND WATER MANAGEMENT CONSULTANTS
A TETRA TECH COMPANY

**CHLORIDE CONCENTRATION
TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
AND BACKGROUND AND RECEIVING CREEKS**

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-4



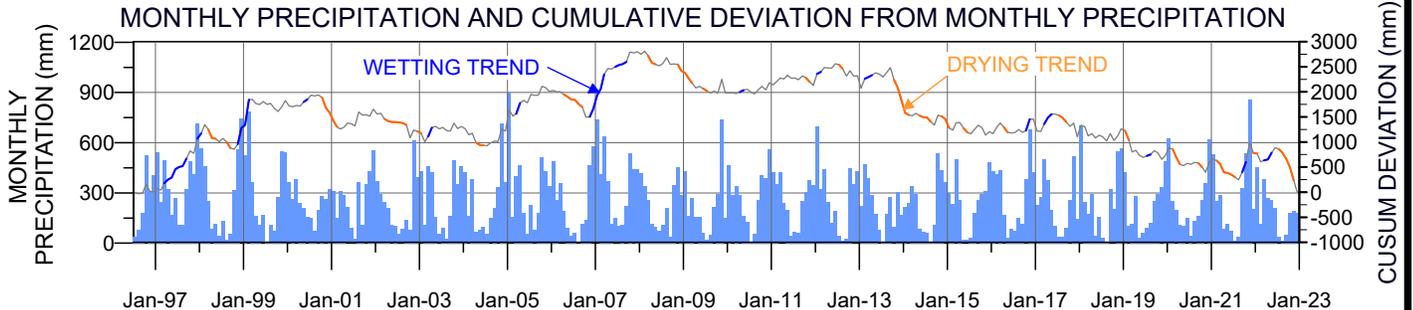
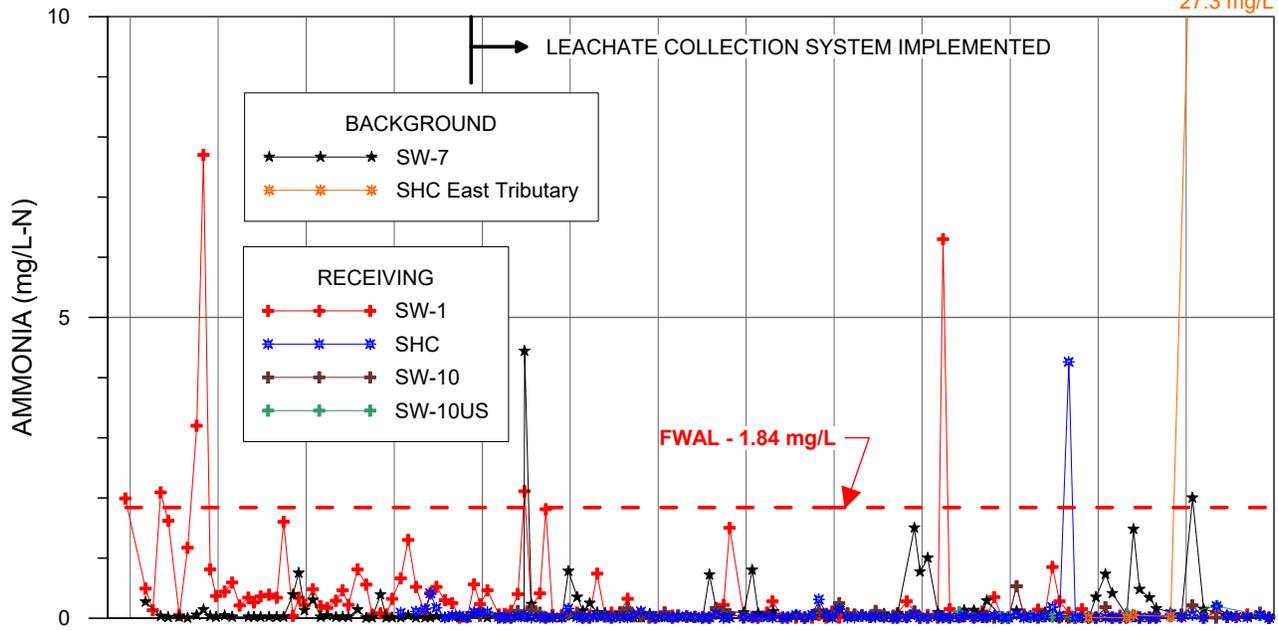
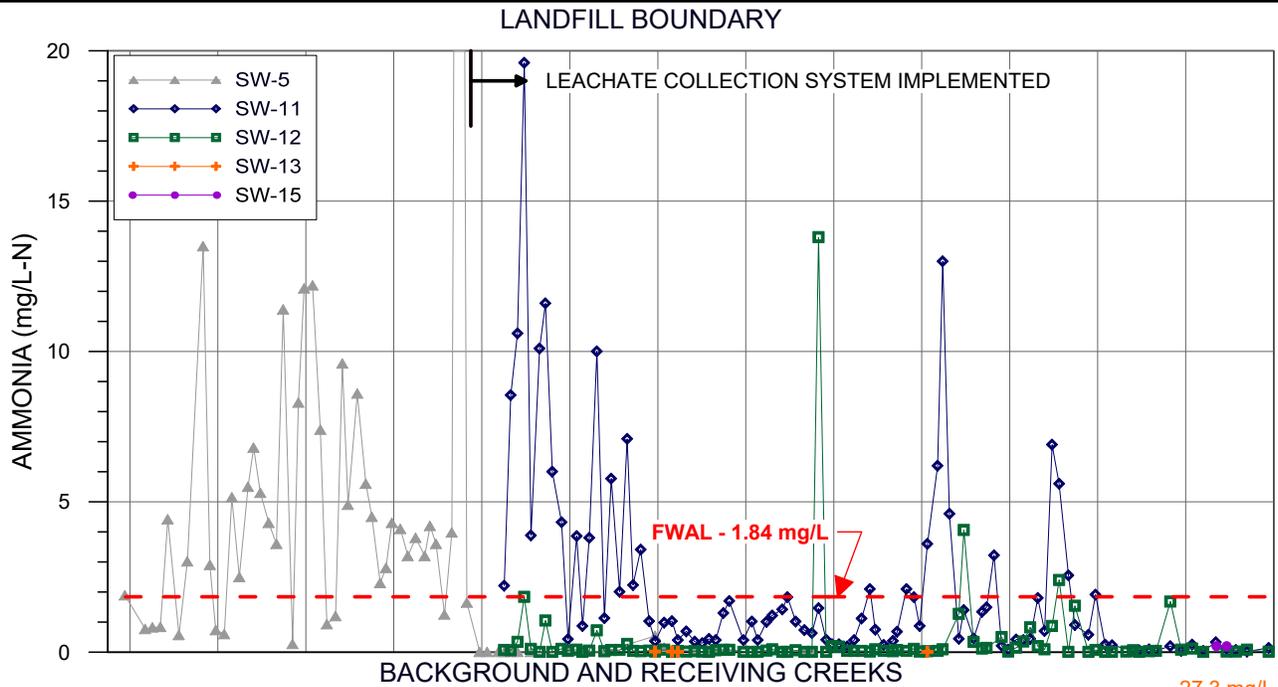
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 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.

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AMMONIA NITROGEN CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-5



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.

ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.

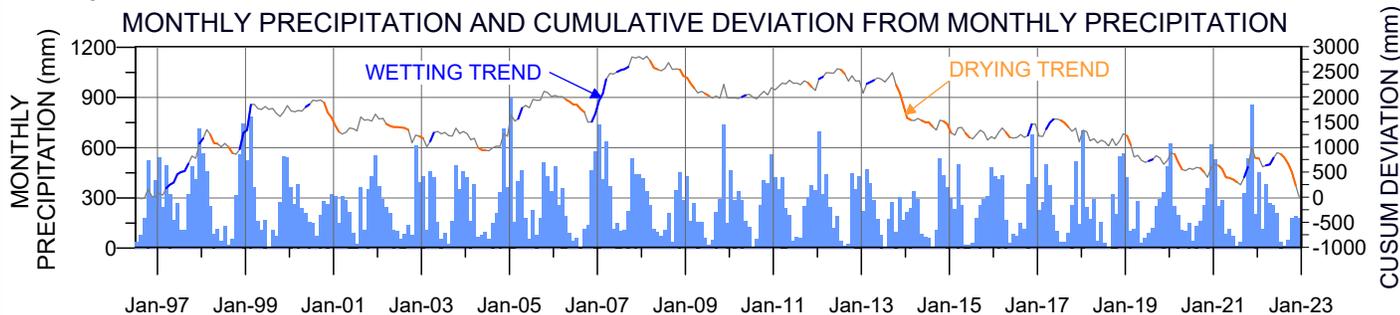
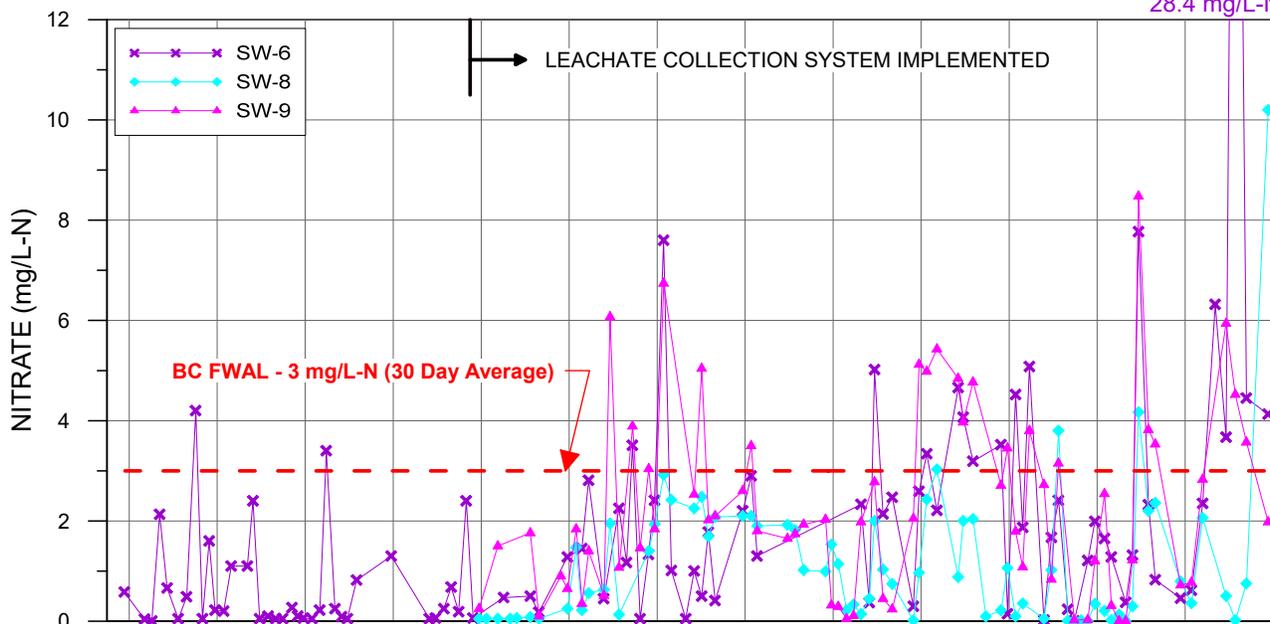
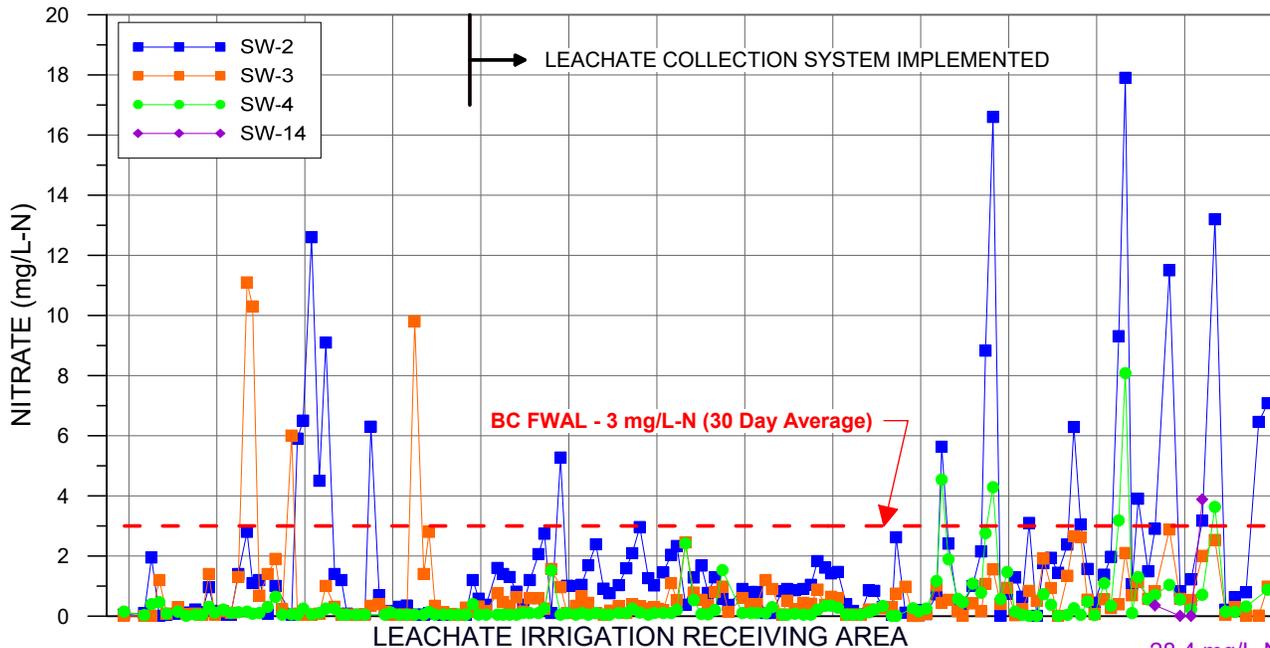


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AMMONIA NITROGEN CONCENTRATION
 TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
 AND BACKGROUND AND RECEIVING CREEKS

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-6

LEACHATE COLLECTION SYSTEM



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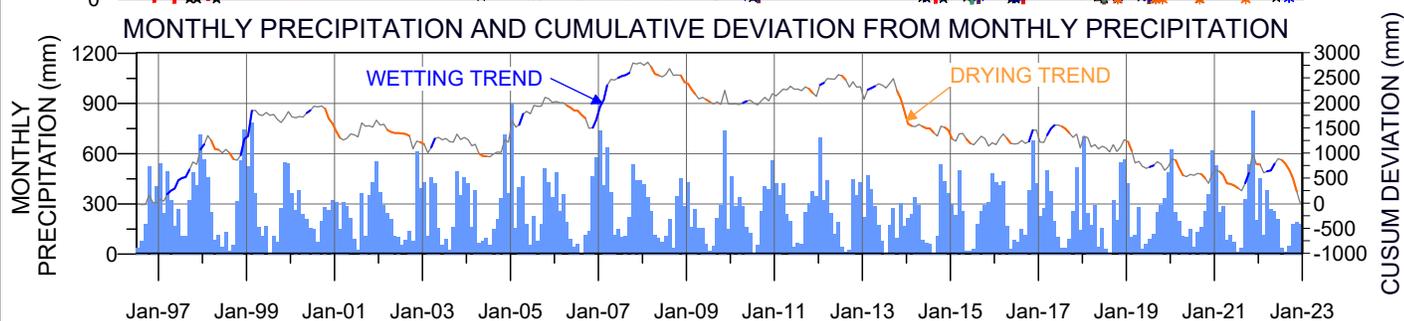
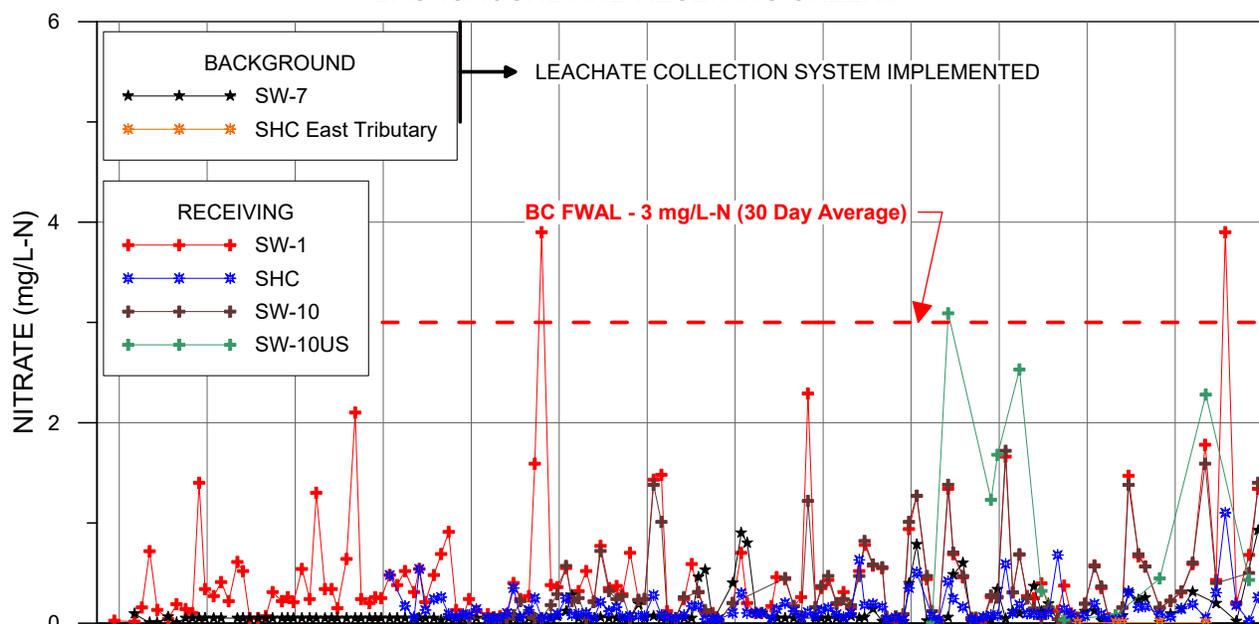
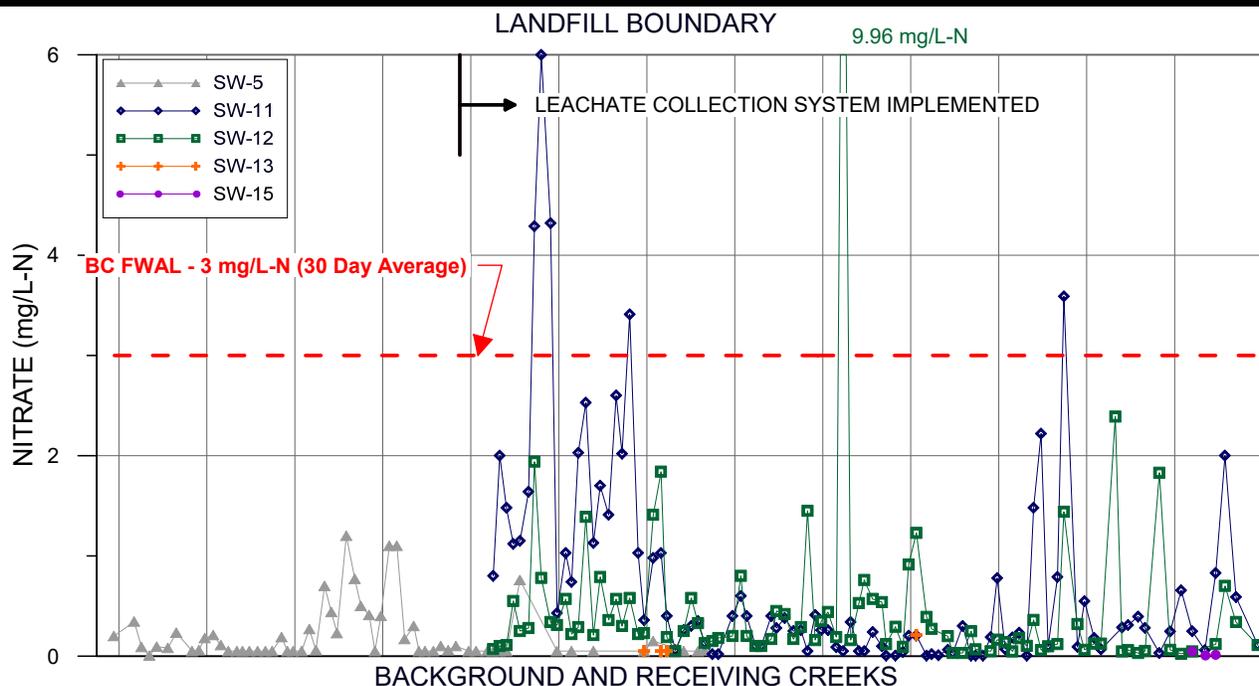
ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.



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NITRATE CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-7



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ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.

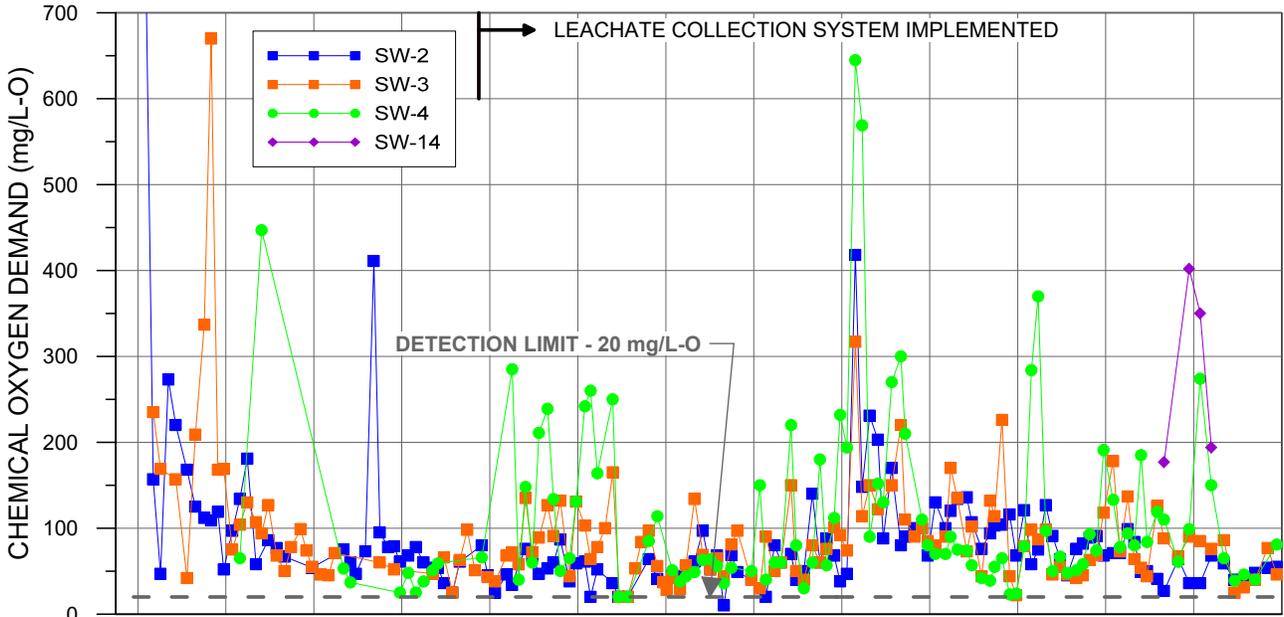


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 A TETRA TECH COMPANY

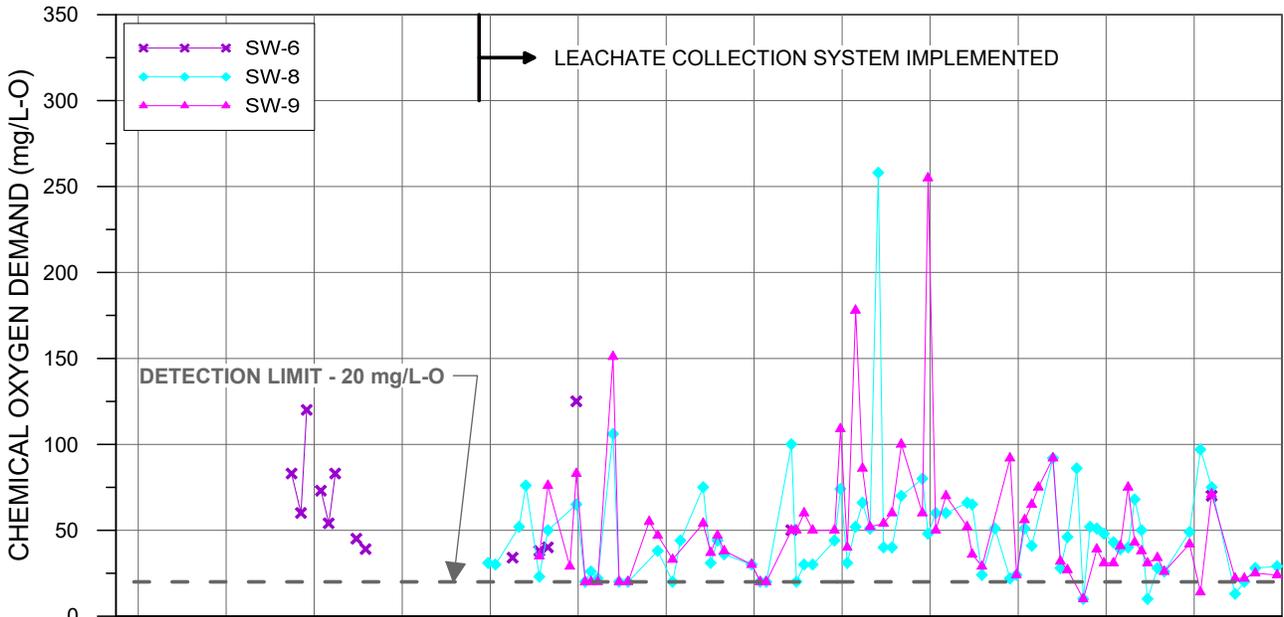
**NITRATE CONCENTRATION
 TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
 AND BACKGROUND AND RECEIVING CREEKS**

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-8

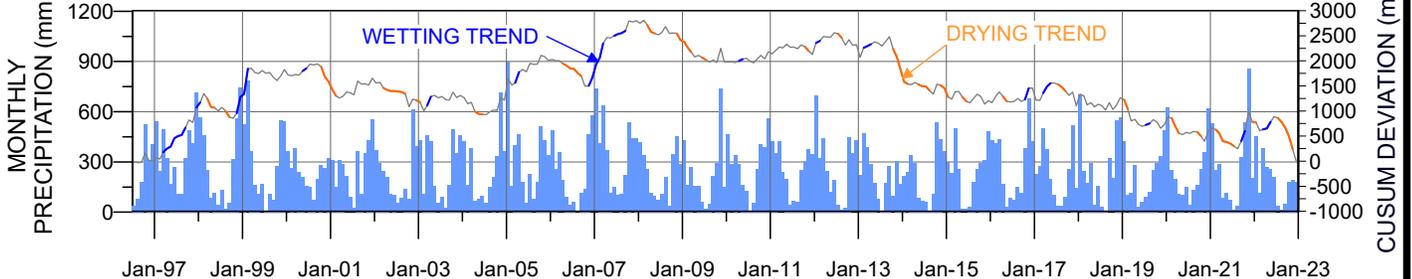
LEACHATE COLLECTION SYSTEM



LEACHATE IRRIGATION RECEIVING AREA



MONTHLY PRECIPITATION AND CUMULATIVE DEVIATION FROM MONTHLY PRECIPITATION



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.

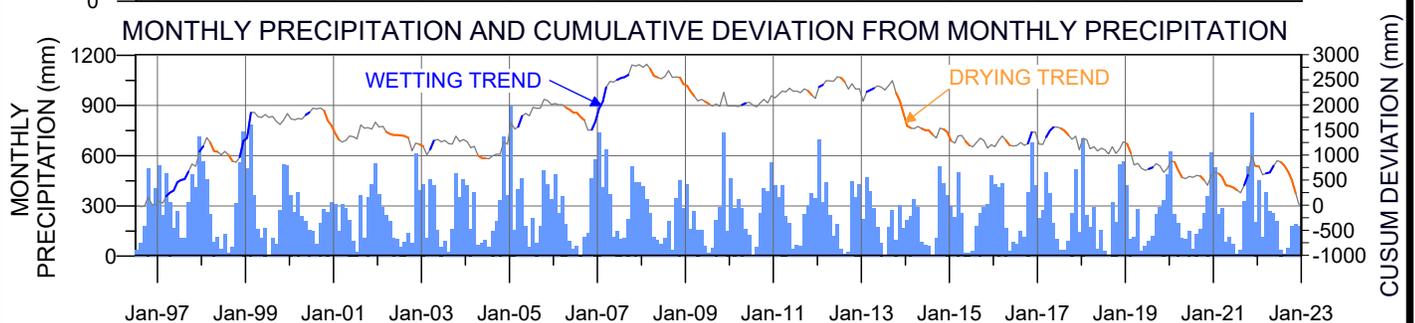
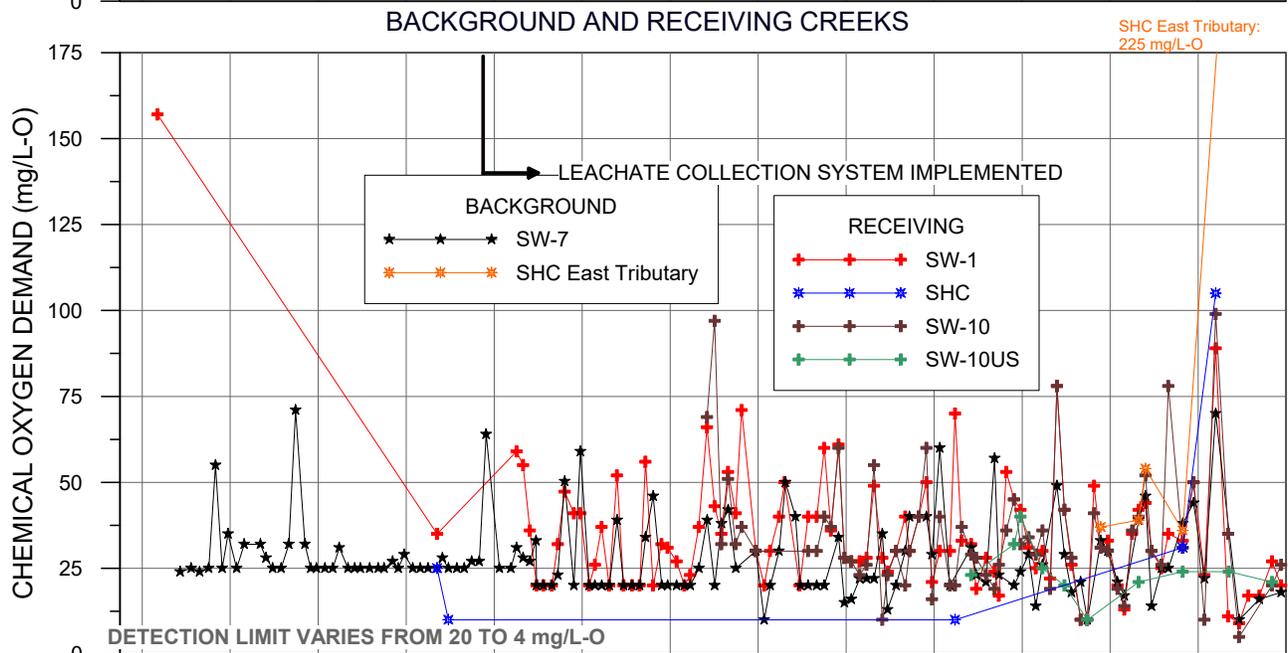
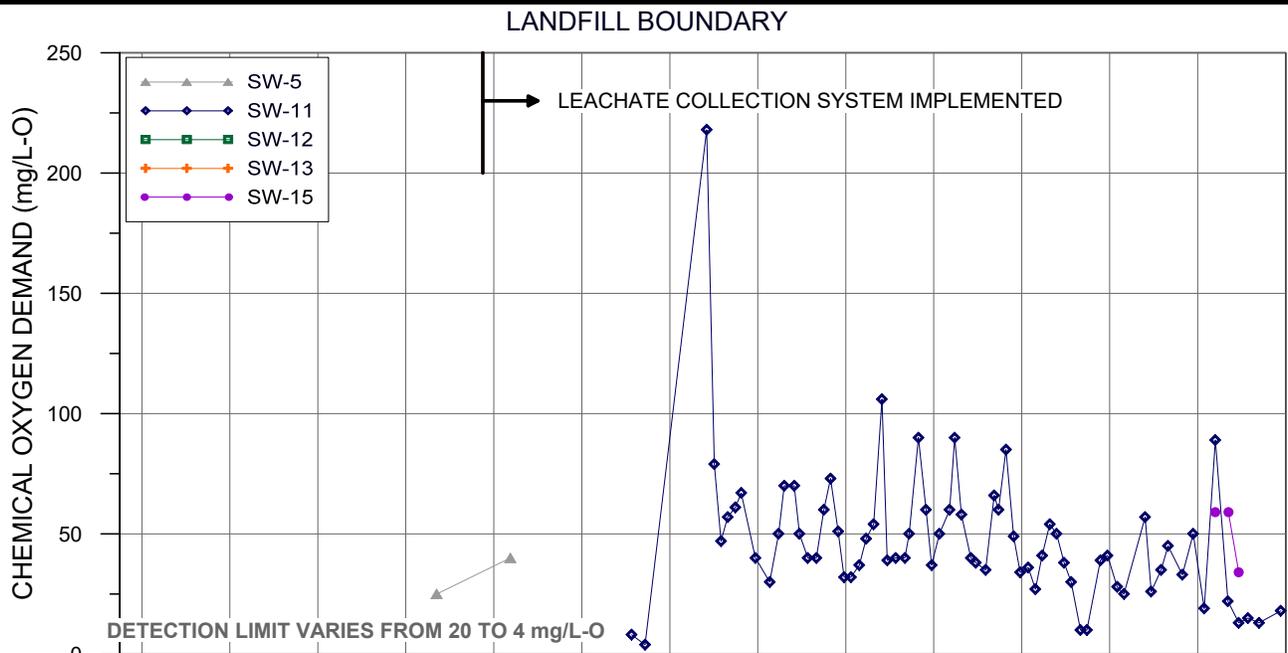
ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.



PITEAU ASSOCIATES
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CHEMICAL OXYGEN DEMAND CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-9



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.

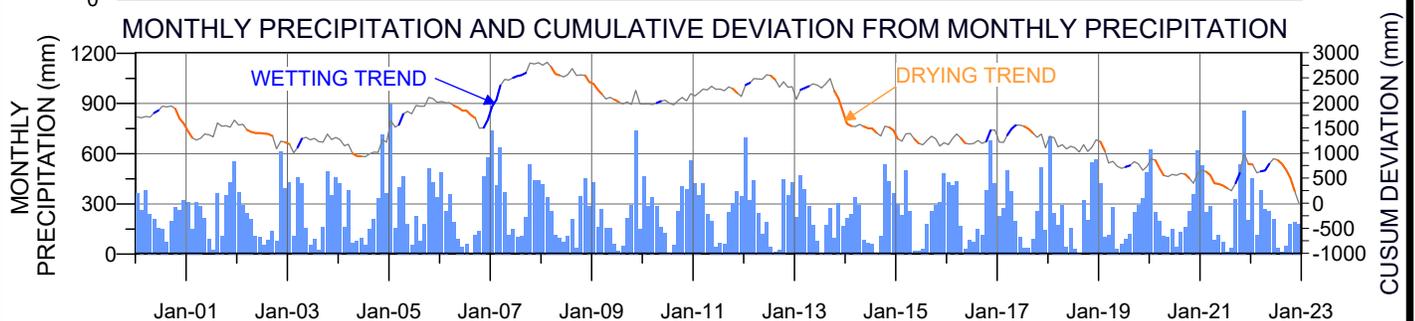
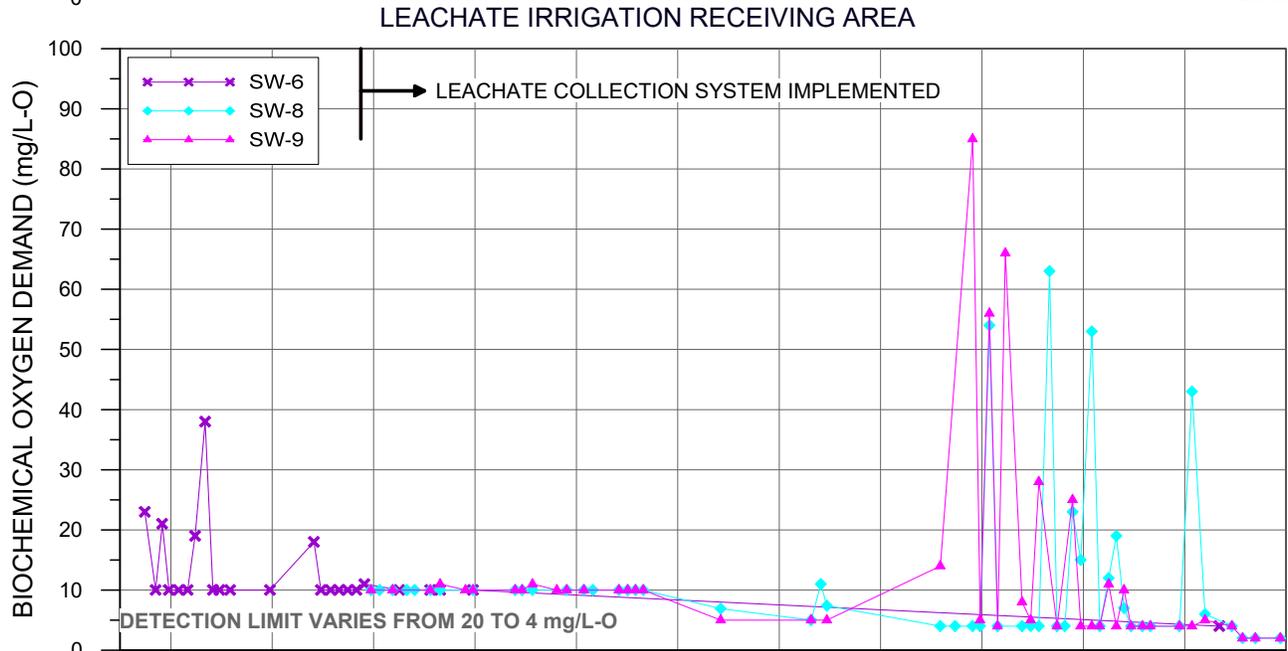
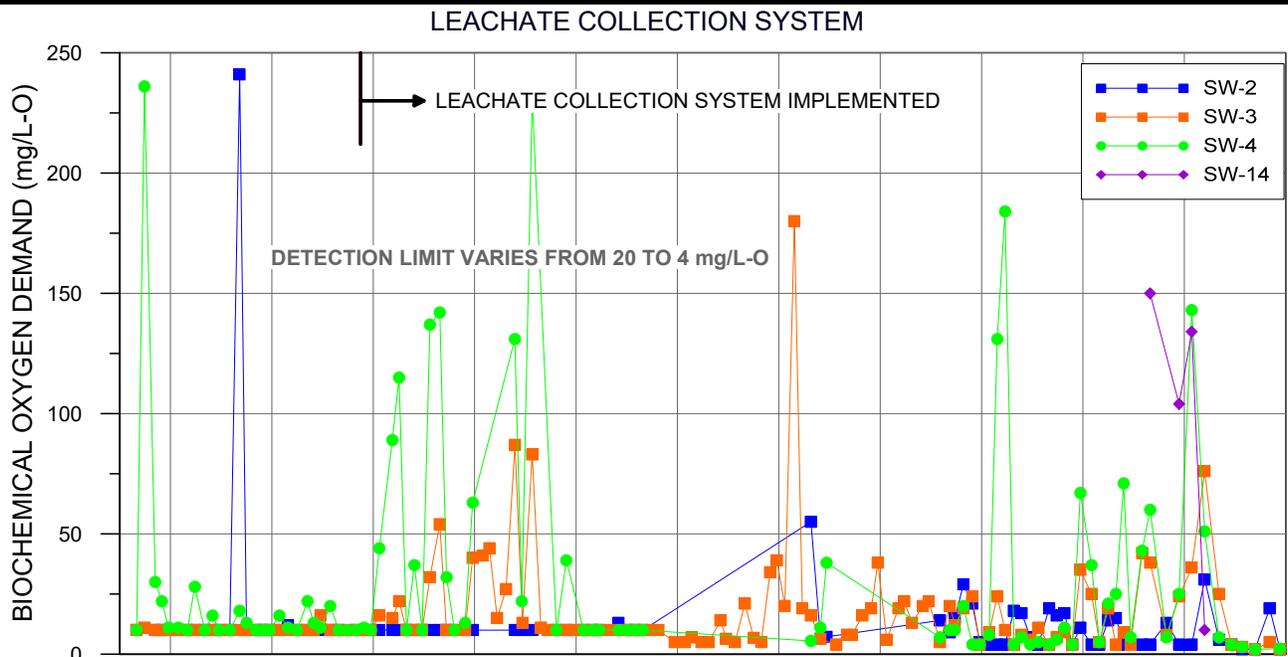
ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.



PITEAU ASSOCIATES
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CHEMICAL OXYGEN DEMAND CONCENTRATION
 TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
 AND BACKGROUND AND RECEIVING CREEKS

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-10



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ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.



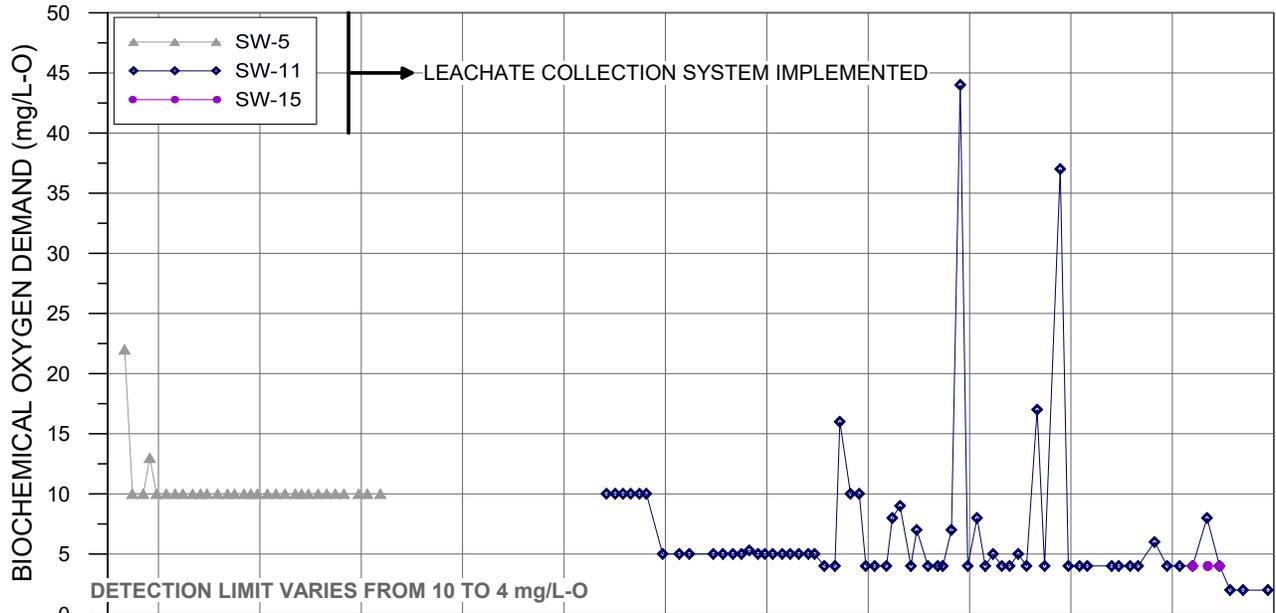
PITEAU ASSOCIATES
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A TETRA TECH COMPANY

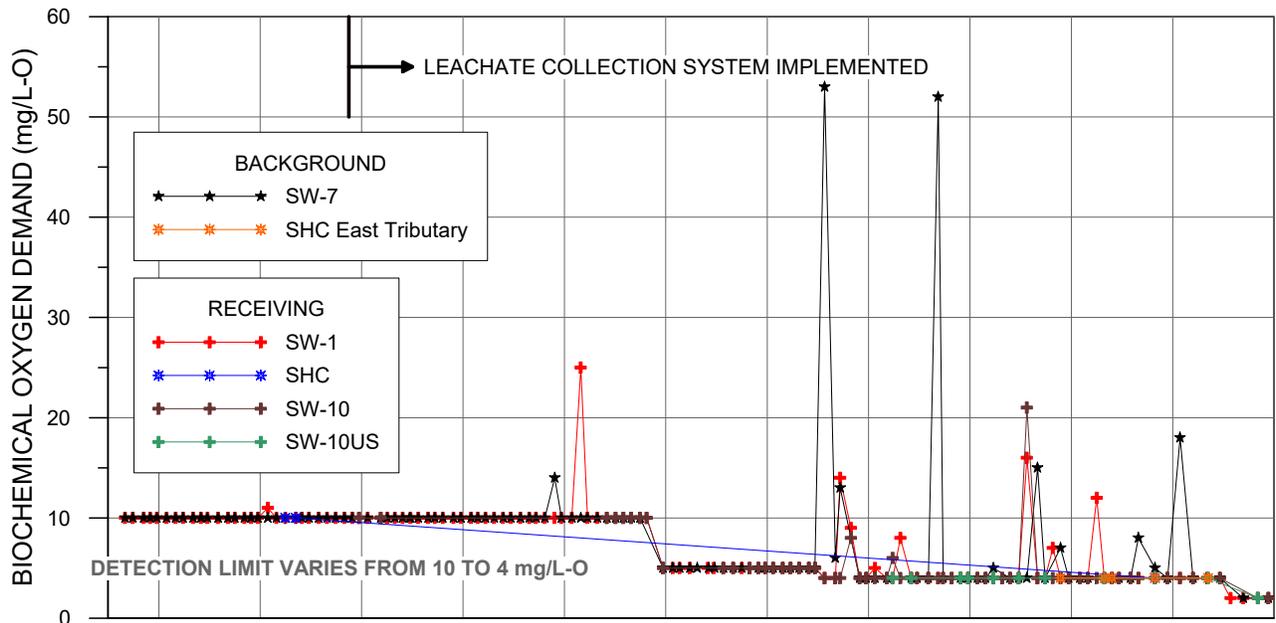
BIOCHEMICAL OXYGEN DEMAND CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-11

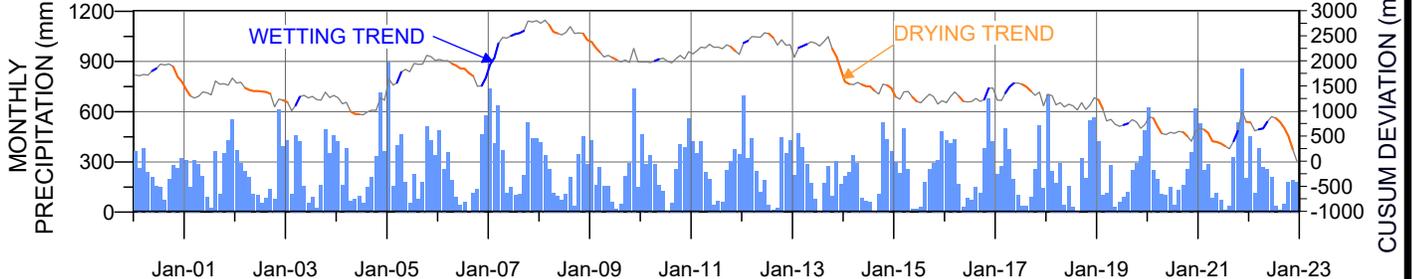
LANDFILL BOUNDARY



BACKGROUND AND RECEIVING CREEKS



MONTHLY PRECIPITATION AND CUMULATIVE DEVIATION FROM MONTHLY PRECIPITATION



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.

ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.

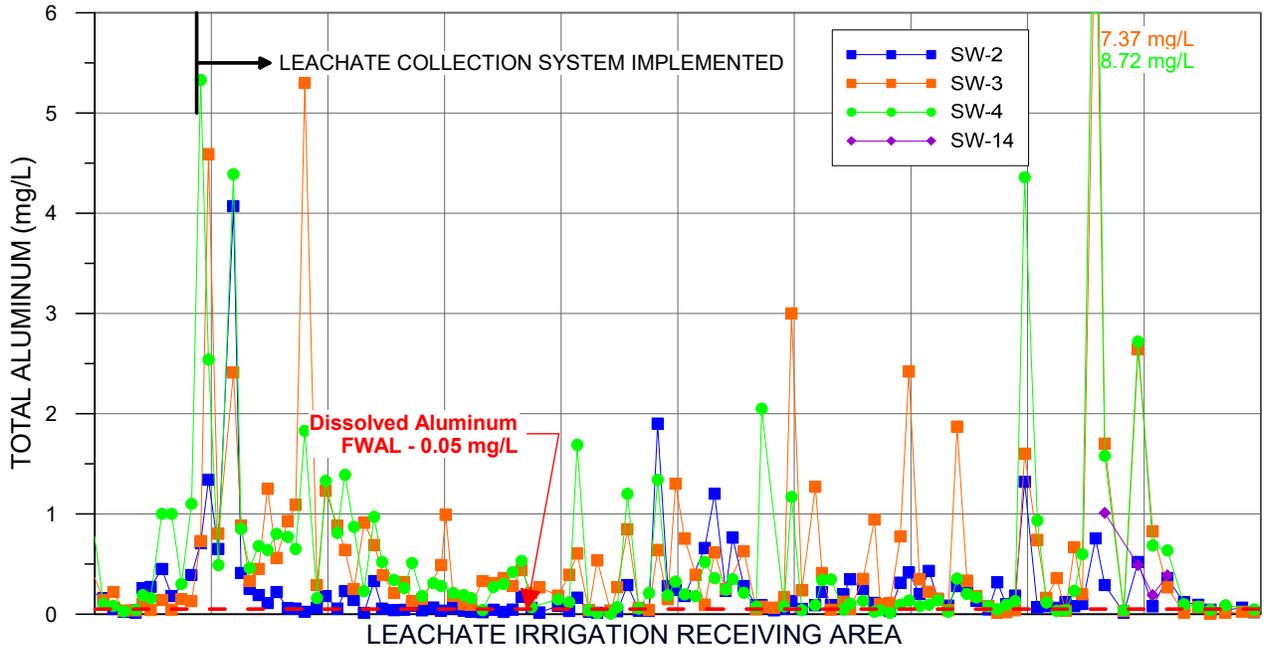


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 A TETRA TECH COMPANY

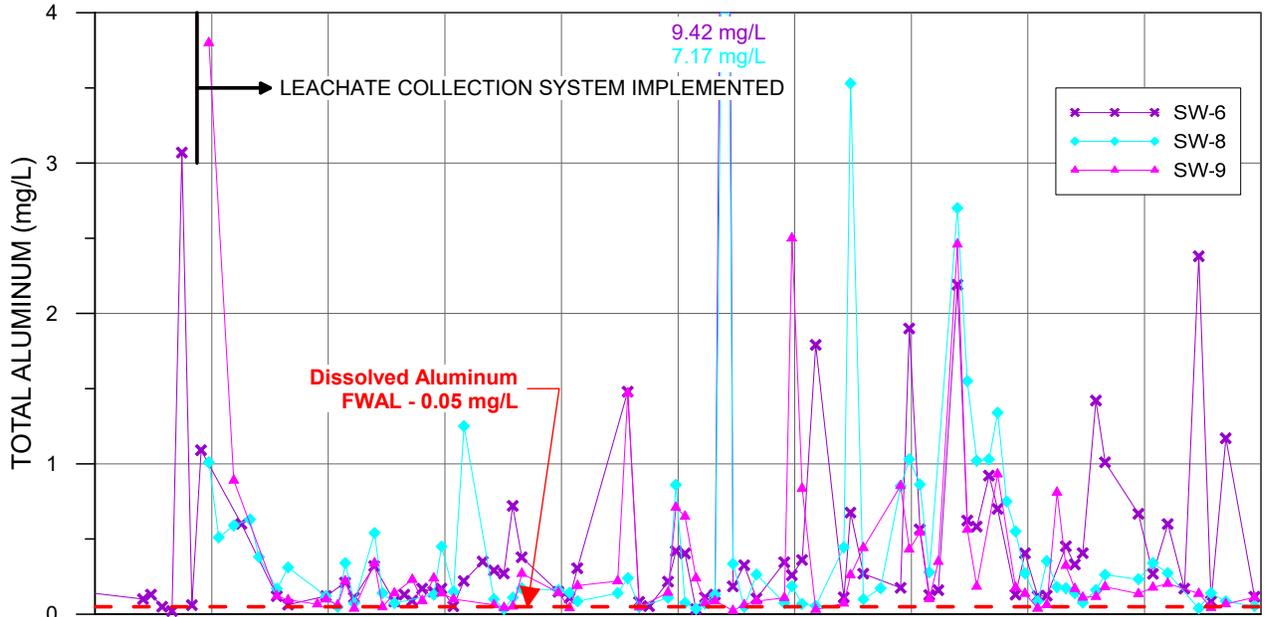
BIOCHEMICAL OXYGEN DEMAND CONCENTRATION
 TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
 AND BACKGROUND AND RECEIVING CREEKS

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-12

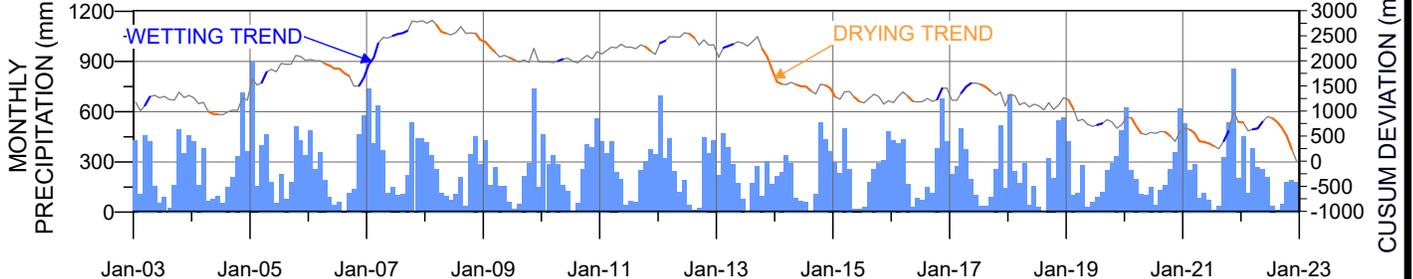
LEACHATE COLLECTION SYSTEM



LEACHATE IRRIGATION RECEIVING AREA



MONTHLY PRECIPITATION AND CUMULATIVE DEVIATION FROM MONTHLY PRECIPITATION



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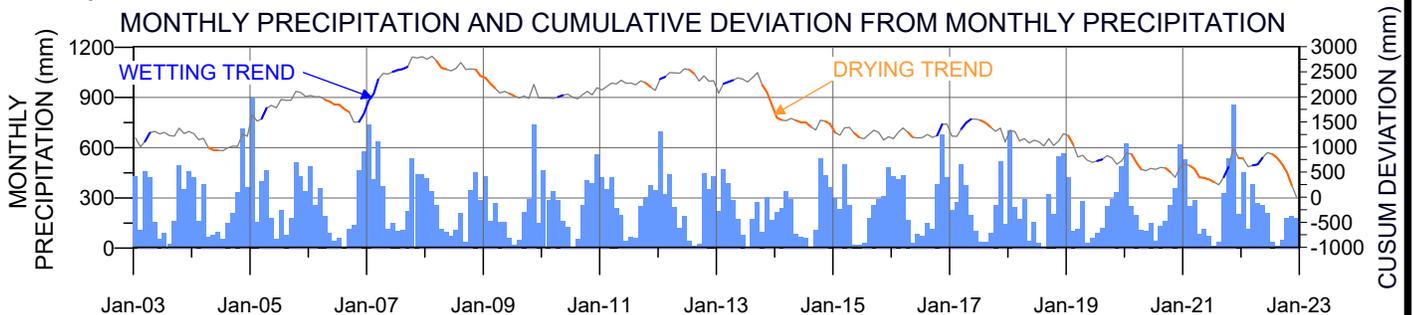
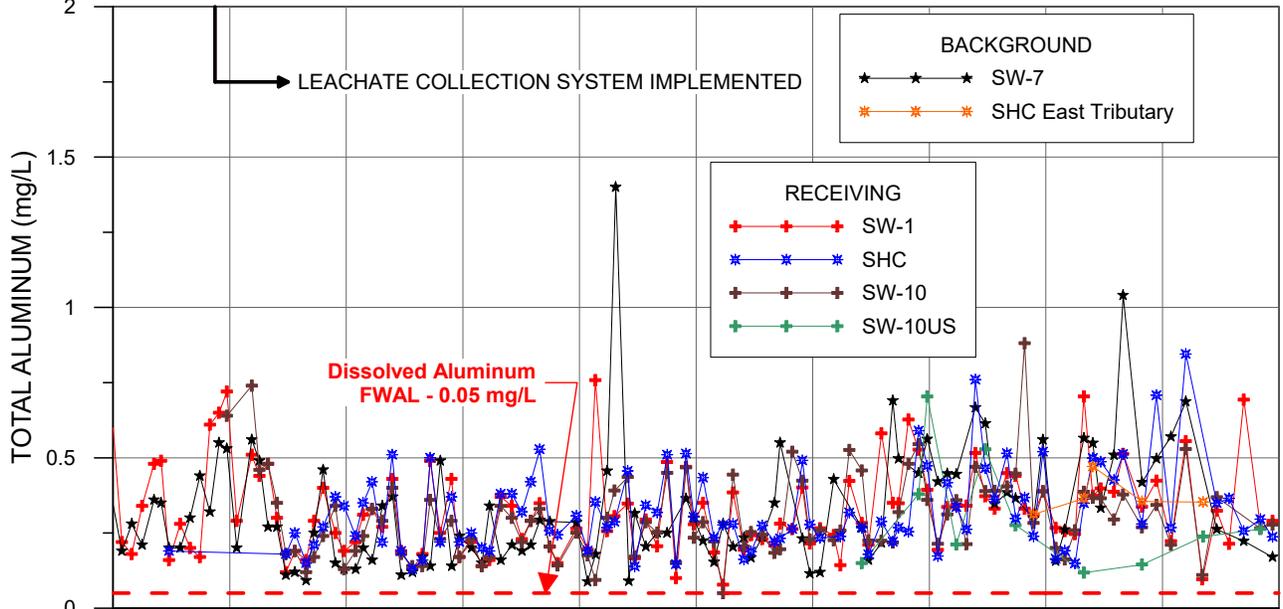
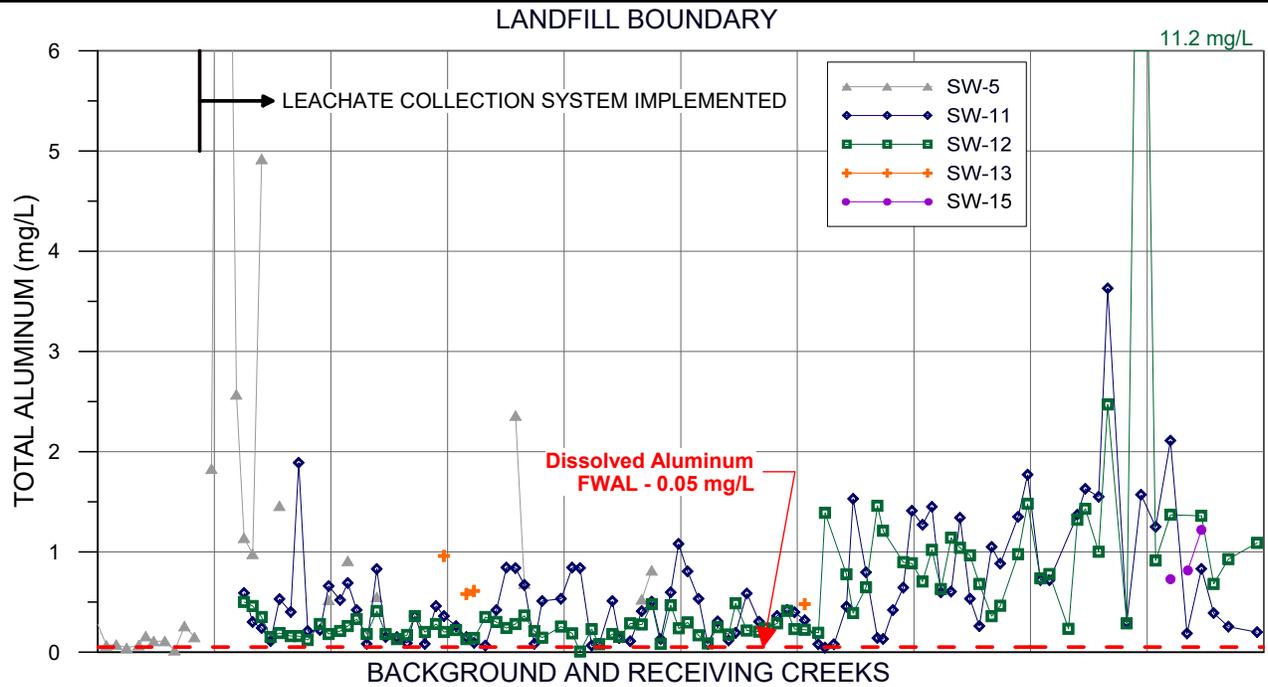
ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.



PITEAU ASSOCIATES
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 A TETRA TECH COMPANY

TOTAL ALUMINUM CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-13



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WATER QUALITY MONITORING PROGRAM
WEST COAST LANDFILL, UCLUELET, B.C.

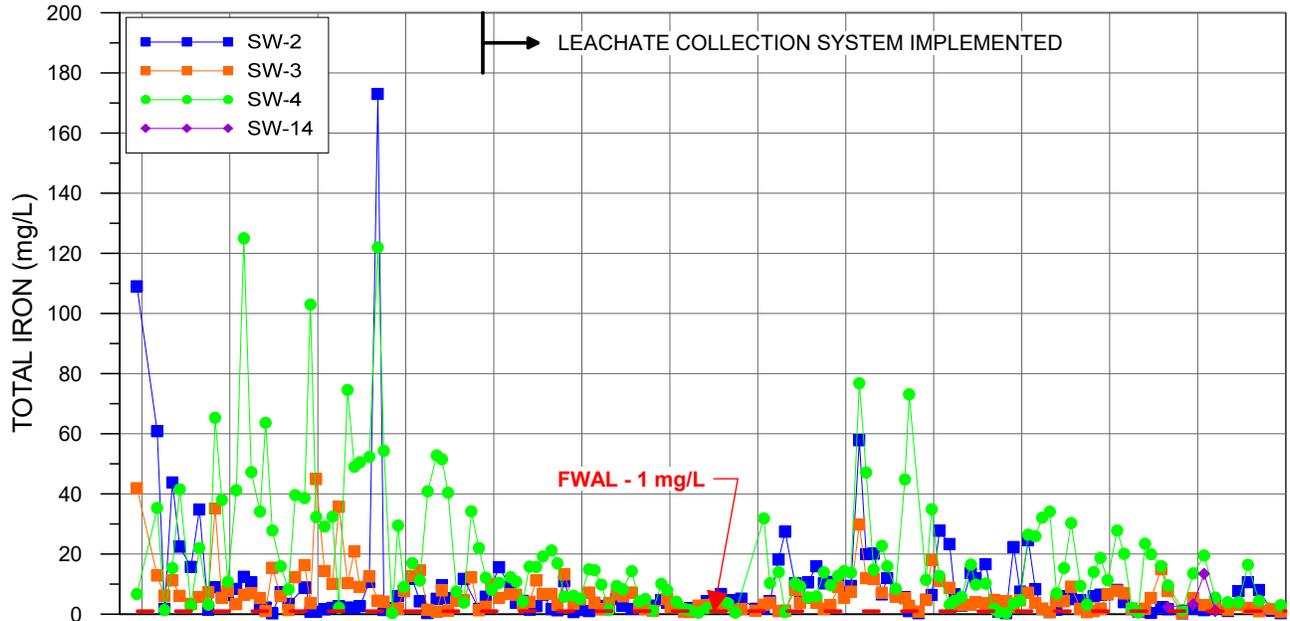


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A TETRA TECH COMPANY

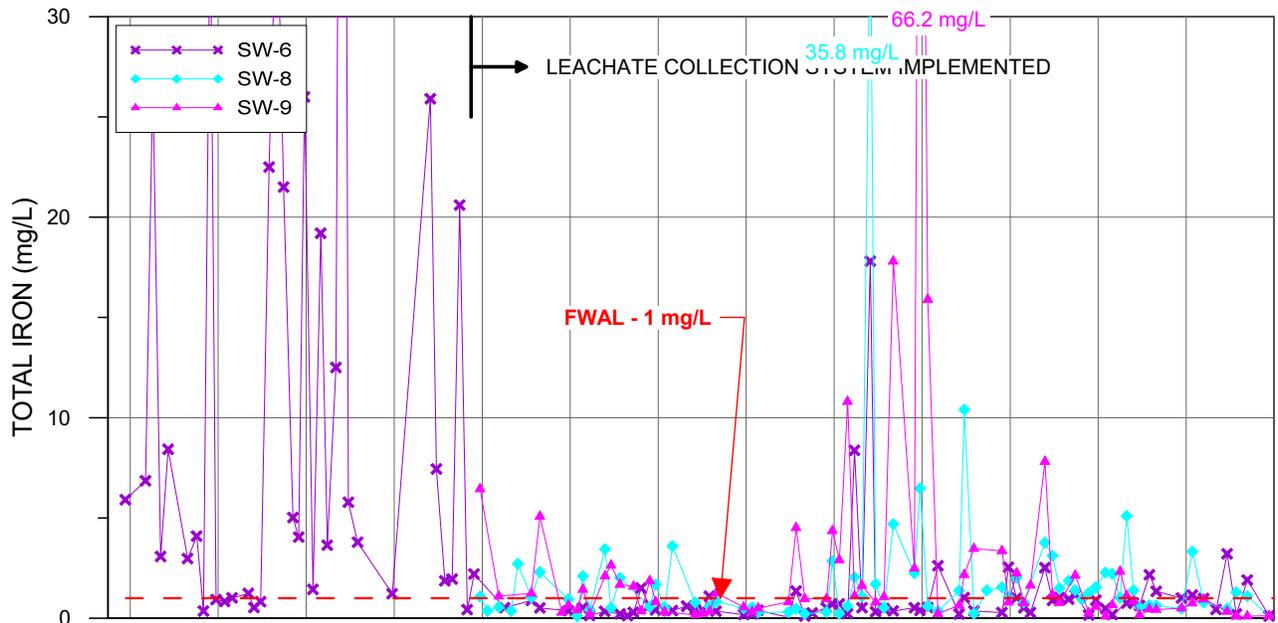
TOTAL ALUMINUM CONCENTRATION
TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
AND BACKGROUND AND RECEIVING CREEKS

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-14

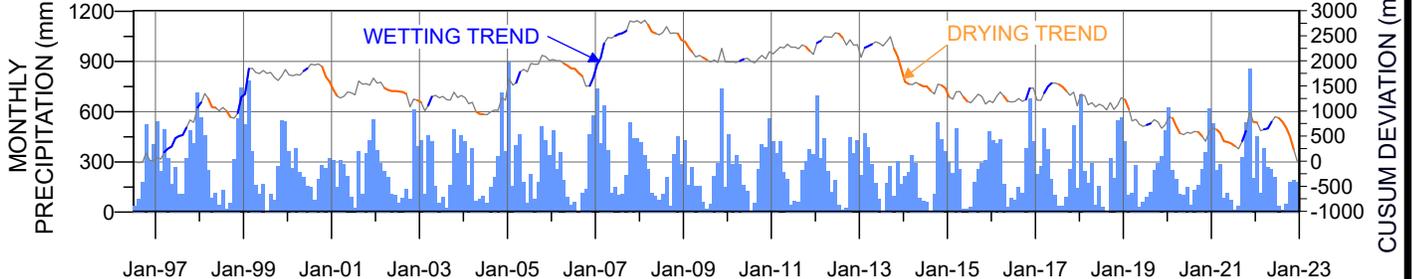
LEACHATE COLLECTION SYSTEM



LEACHATE IRRIGATION RECEIVING AREA



MONTHLY PRECIPITATION AND CUMULATIVE DEVIATION FROM MONTHLY PRECIPITATION



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.

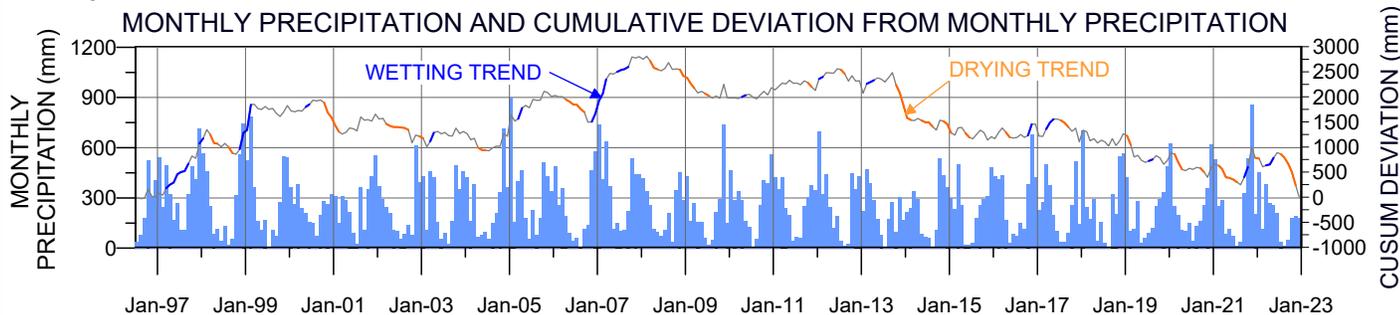
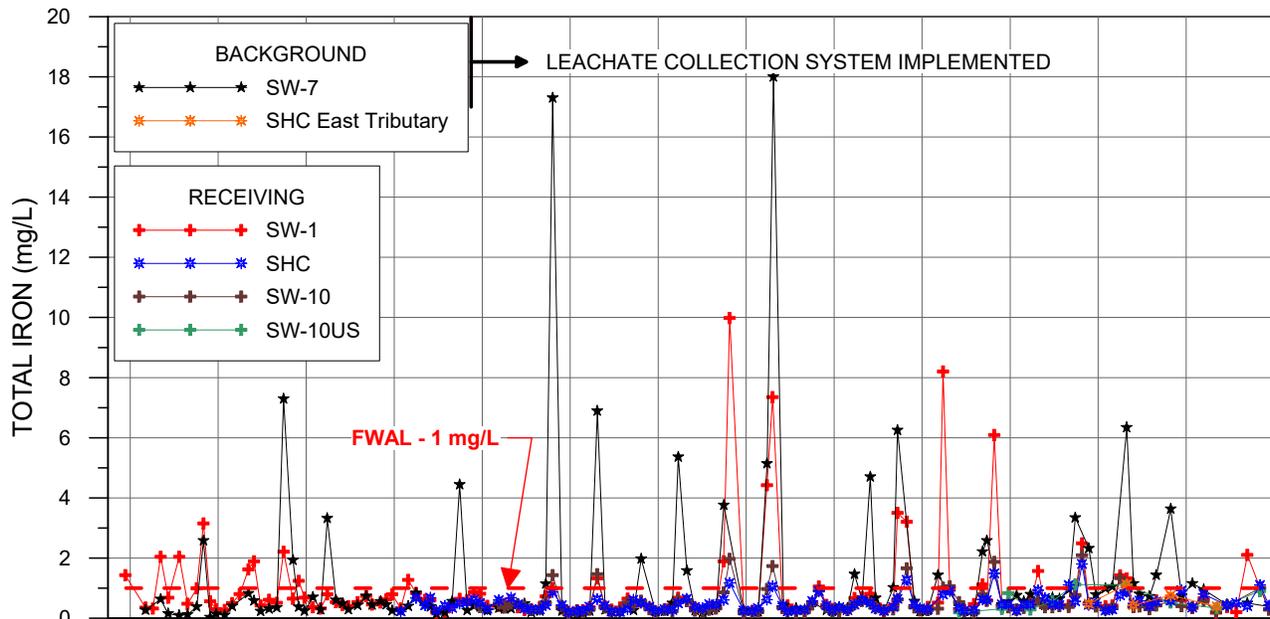
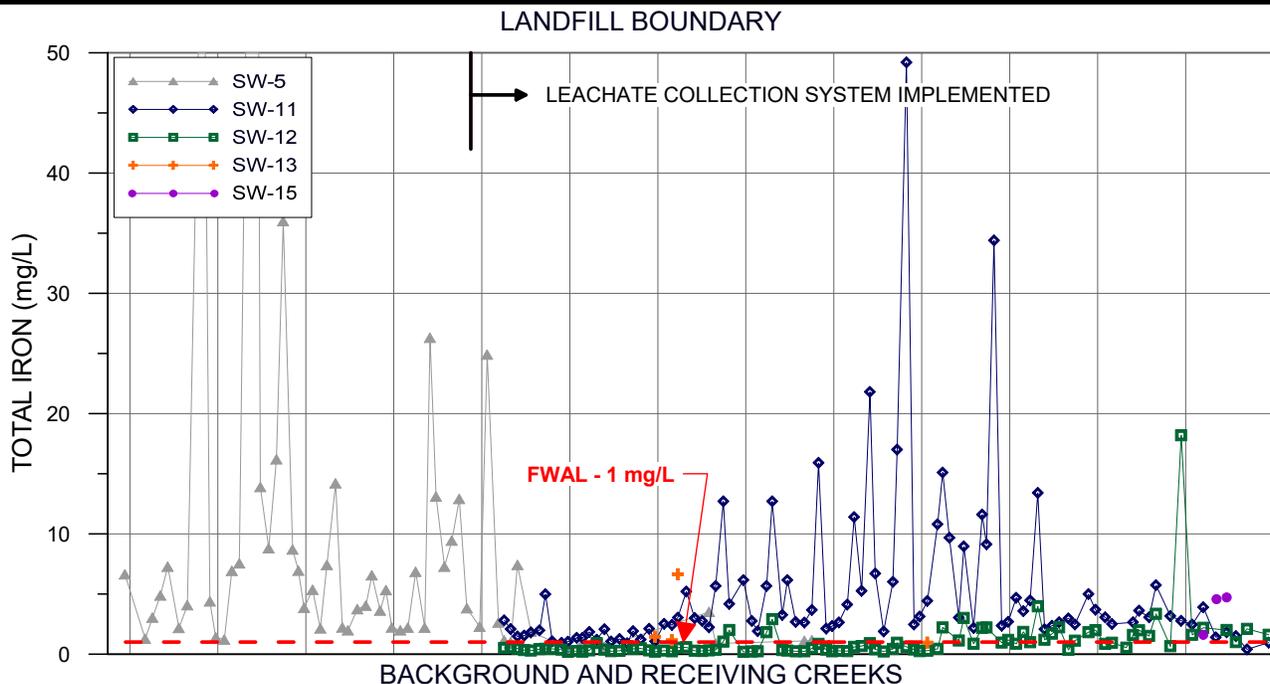
ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.



PITEAU ASSOCIATES
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TOTAL IRON CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-15



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.

ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.

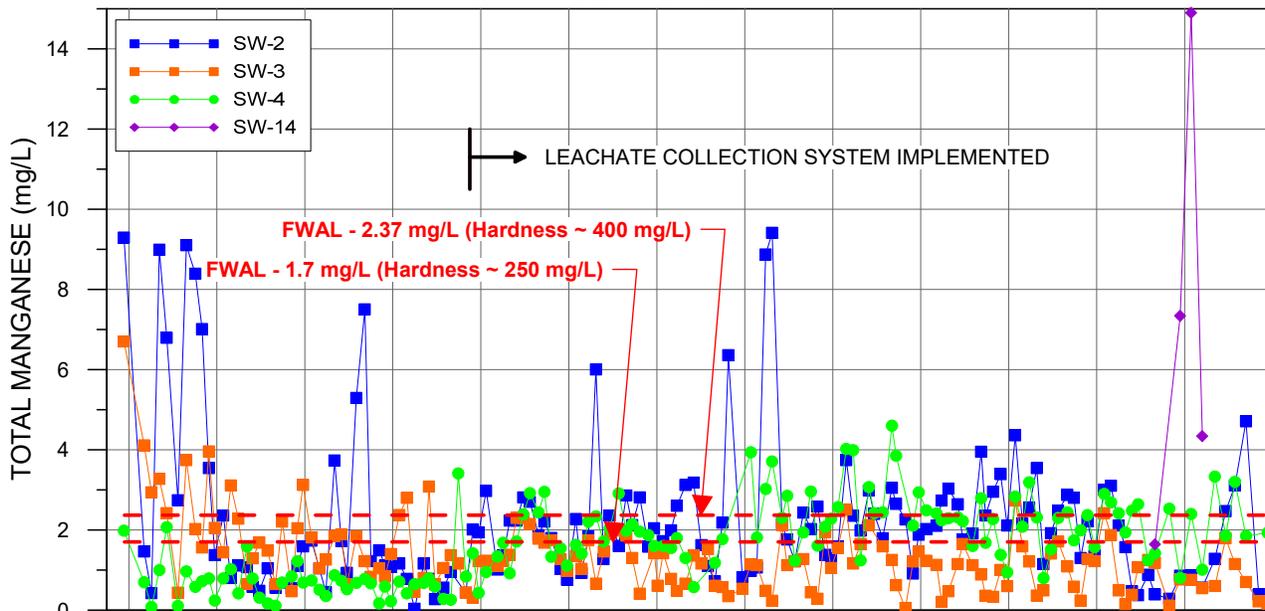


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 A TETRA TECH COMPANY

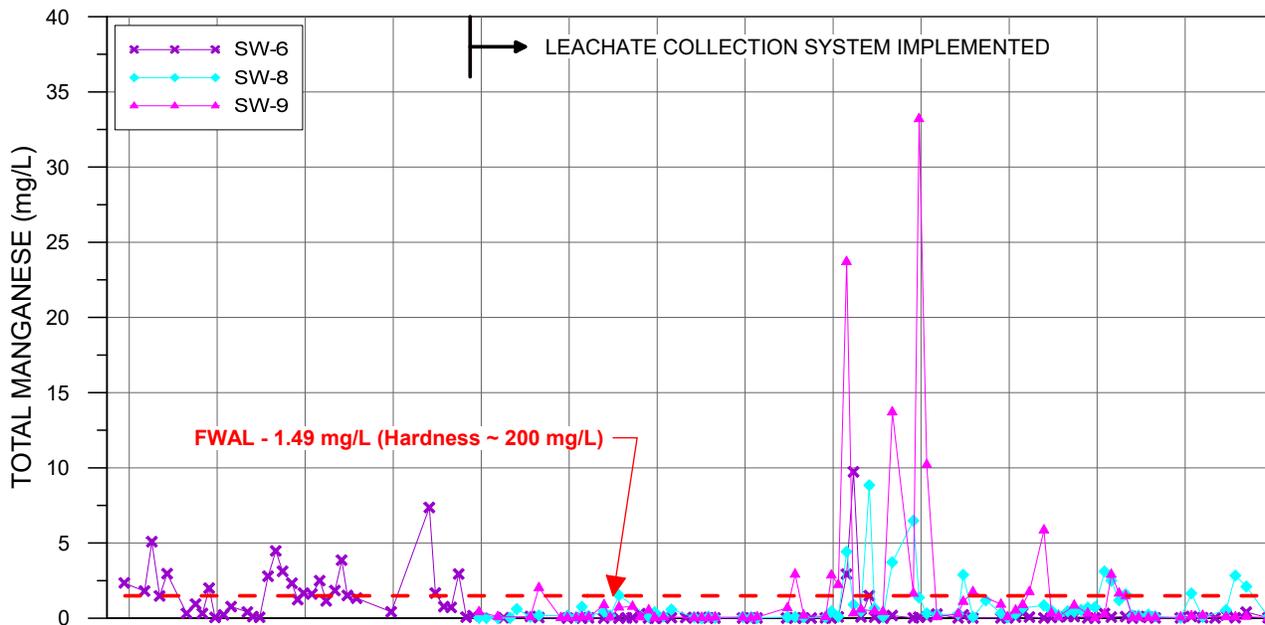
TOTAL IRON CONCENTRATION
 TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
 AND BACKGROUND AND RECEIVING CREEKS

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-16

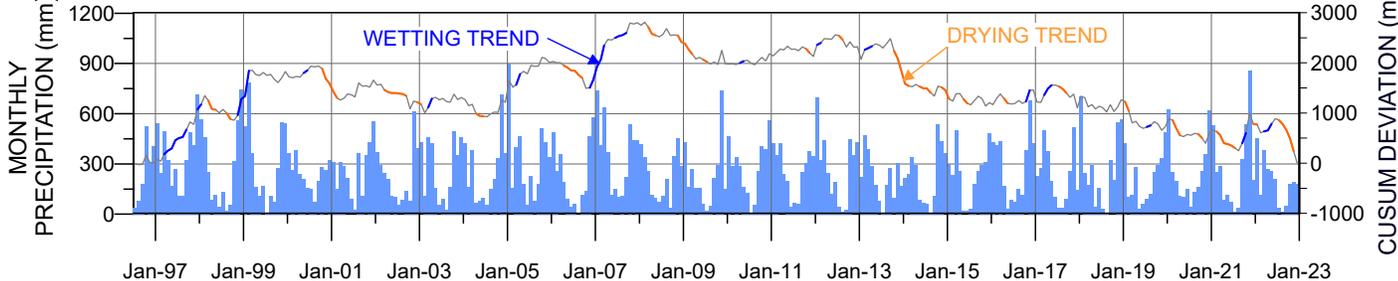
LEACHATE COLLECTION SYSTEM



LEACHATE IRRIGATION RECEIVING AREA



MONTHLY PRECIPITATION AND CUMULATIVE DEVIATION FROM MONTHLY PRECIPITATION



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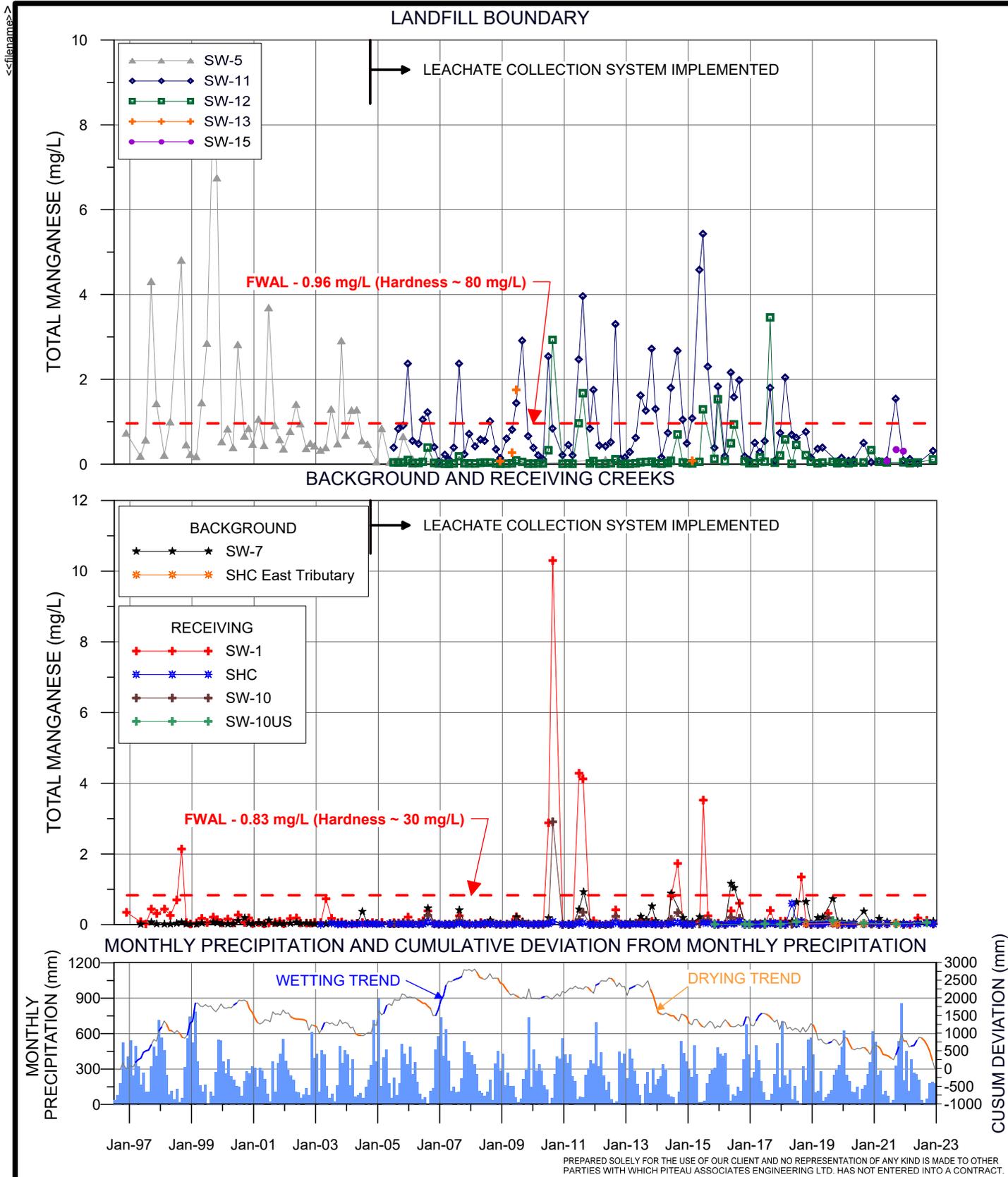
ALBERNI-CLAYOQUOT REGIONAL DISTRICT
 WATER QUALITY MONITORING PROGRAM
 WEST COAST LANDFILL, UCLUELET, B.C.



PITEAU ASSOCIATES
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 A TETRA TECH COMPANY

TOTAL MANGANESE CONCENTRATION
 TIME-SERIES PLOTS FOR LEACHATE COLLECTION SYSTEM
 AND LEACHATE IRRIGATION RECEIVING AREA

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-17



ALBERNI-CLAYOQUOT REGIONAL DISTRICT
WATER QUALITY MONITORING PROGRAM
WEST COAST LANDFILL, UCLUELET, B.C.



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TOTAL MANGANESE CONCENTRATION
TIME-SERIES PLOTS FOR LANDFILL BOUNDARY
AND BACKGROUND AND RECEIVING CREEKS

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	B-18

APPENDIX C
MONITORING DATA TABLE FOR 2021 DUPLICATE SAMPLES

APPENDIX C

LIST OF TABLES

Table C-1	Summary of Duplicate Sample Results 2022
Table C-2	Summary of Duplicate Sample Results: VOC Scan 2022

**TABLE C-1
SUMMARY OF DUPLICATE SAMPLE RESULTS
2022**

SAMPLE DATE SAMPLE TYPE LAB NAME	UNITS	SW-12			SW-3			SW-6		
		22-Feb-22 PR AGAT	22-Feb-22 DUP AGAT	RPD	25-May-22 PR AGAT	25-May-22 DUP AGAT	RPD	21-Nov-22 PR ALS	21-Nov-22 DUP ALS	RPD
PHYSICAL TESTS										
pH - Lab	pH	7.25	7.22	0	7.85	8.21	4	7.6	7.55	1
Conductivity - Lab	µS/cm	137	138	1	760	769	1	471	472	0
Total Hardness (CaCO ₃)	mg/L	19.3	19.6	2	299	286	-	180	153	16
Total Dissolved Solids	mg/L	83	83	0	430	457	6	321	287	11
DISSOLVED ANIONS										
Alkalinity - Total	mg/L CaCO ₃	13	12	8	358	338	-	95.5	97.1	2
Chloride	mg/L	25.9	25.7	1	40.8	41	0	48	47.9	0
Sulphate	mg/L	4.2	4.2	0	3.6	4.0	11	43.5	43.3	0
NUTRIENTS										
Ammonia Nitrogen	mg/L as N	<0.02	<0.02	-	17.4	17.5	1	0.0057	0.009	45
Nitrate Nitrogen	mg/L as N	0.7	0.7	0	<0.02	<0.02	-	4.13	4.11	0
Total Phosphorus	mg/L as P	0.032	0.024	29	0.021	0.027	25	0.0049	0.0048	2
POLLUTANT TESTS										
Chemical Oxygen Demand	mg/L as O	-	-	-	39	40	3	-	-	-
Biochemical Oxygen Demand	mg/L as O	-	-	-	<2	<2	-	-	-	-
TOTAL METALS										
Aluminum	mg/L	0.68	0.68	0	0.016	0.017	6	0.116	0.0924	23
Antimony	mg/L	-	-	-	<0.001	<0.001	-	-	-	-
Arsenic	mg/L	-	-	-	<0.001	<0.001	-	-	-	-
Barium	mg/L	-	-	-	<0.05	<0.05	-	-	-	-
Beryllium	mg/L	-	-	-	<0.0005	<0.0005	-	-	-	-
Boron	mg/L	-	-	-	0.59	0.55	7	-	-	-
Cadmium	mg/L	-	-	-	<0.000016	<0.000016	-	-	-	-
Chromium	mg/L	-	-	-	0.0008	0.0009	12	-	-	-
Cobalt	mg/L	-	-	-	0.0011	0.0011	0	-	-	-
Copper	mg/L	-	-	-	0.001	0.0009	11	-	-	-
Iron	mg/L	1	1	0	0.9	0.9	0	0.084	0.11	27
Lead	mg/L	-	-	-	<0.0001	<0.0001	-	-	-	-
Lithium	mg/L	-	-	-	0.001	<0.001	-	-	-	-
Manganese	mg/L	0.025	0.024	4	0.699	0.63	10	0.0285	0.00733	118
Mercury	µg/L	-	-	-	<0.000025	<0.000025	-	-	-	-
Molybdenum	mg/L	-	-	-	<0.001	<0.001	-	-	-	-
Nickel	mg/L	-	-	-	<0.003	<0.003	-	-	-	-
Selenium	mg/L	-	-	-	<0.0005	<0.0005	-	-	-	-
Silver	mg/L	-	-	-	<0.00005	<0.00005	-	-	-	-
Strontium	mg/L	-	-	-	0.493	0.489	1	-	-	-
Thallium	mg/L	-	-	-	<0.0001	<0.0001	-	-	-	-
Tin	mg/L	-	-	-	<0.0005	<0.0005	-	-	-	-
Titanium	mg/L	-	-	-	<0.001	<0.001	-	-	-	-
Tungsten	mg/L	-	-	-	<0.0001	<0.0001	-	-	-	-
Uranium	mg/L	-	-	-	<0.001	<0.001	-	-	-	-
Vanadium	mg/L	-	-	-	<0.001	<0.001	-	-	-	-
Zinc	mg/L	-	-	-	<0.004	<0.004	-	-	-	-
RPD Average				4			>6			19
RPD Min				0			0			>0
RPD Max				29			>25			118

H:\Project\1576\Chem\2022\QAQC Dups.xlsm|Table C-1

NOTES:

"-" denotes parameter was not analyzed.

PR = primary sample

DUP = duplicate sample

RPD = relative percent difference

TABLE C-2
SUMMARY OF DUPLICATE SAMPLE RESULTS: VOC SCAN
2022

SAMPLE DATE	UNITS	SW-3		
		25-May-22 PR AGAT	25-May-22 DUP AGAT	RPD
HALOGENATED VOLATILES				
Bromodichloromethane	µg/L	-	-	-
Bromoform	µg/L	<1	<1	-
Bromomethane	µg/L	<1	<1	-
Carbon Tetrachloride	µg/L	<0.5	<0.5	-
Chlorobenzene	µg/L	<1	<1	-
Chloroethane	µg/L	<1	<1	-
Chloroform	µg/L	<1	<1	-
Chloromethane	µg/L	<1	<1	-
Dibromochloromethane	µg/L	<1	<1	-
1,2-Dibromoethane	µg/L	-	-	-
1,2-Dichlorobenzene	µg/L	<0.5	<0.5	-
1,3-Dichlorobenzene	µg/L	<0.5	<0.5	-
1,4-Dichlorobenzene	µg/L	<0.5	<0.5	-
1,1-Dichloroethane	µg/L	<1	<1	-
1,2-Dichloroethane	µg/L	<1	<1	-
1,1-Dichloroethylene	µg/L	<1	<1	-
cis-1,2-Dichloroethylene	µg/L	<1	<1	-
trans-1,2-Dichloroethylene	µg/L	<1	<1	-
Dichloromethane	µg/L	-	-	-
1,2-Dichloropropane	µg/L	<1	<1	-
1,1,2,2-Tetrachloroethane	µg/L	-	-	-
Tetrachloroethylene	µg/L	<1	<1	-
1,1,1-Trichloroethane	µg/L	<1	<1	-
1,1,2-Trichloroethane	µg/L	-	-	-
Trichloroethylene	µg/L	-	-	-
Trichlorofluoromethane	µg/L	<1	<1	-
Vinyl Chloride	µg/L	<0.8	<0.8	-
NON-HALOGENATED VOLATILES				
Benzene	µg/L	<0.5	<0.5	-
Ethylbenzene	µg/L	<0.5	<0.5	-
Styrene	µg/L	<1	<1	-
Toluene	µg/L	<0.3	<0.3	-
Xylenes	µg/L	<0.5	<0.5	-
RPD Average				N/A
RPD Min				N/A
RPD Max				N/A

NOTES:

PR = primary sample

DUP = duplicate sample

RPD = relative percent difference

APPENDIX D
OVERFLOW EVENTS DATA

APPENDIX D

TABLE

Table D-1 Summary of 2022 Overflow Events

FIGURE

Figure D-1 Time Series Plot of Water Levels and Selected Leachate Indicator Concentrations
at SW-1, SW-3 and Leachate Pond Overflow

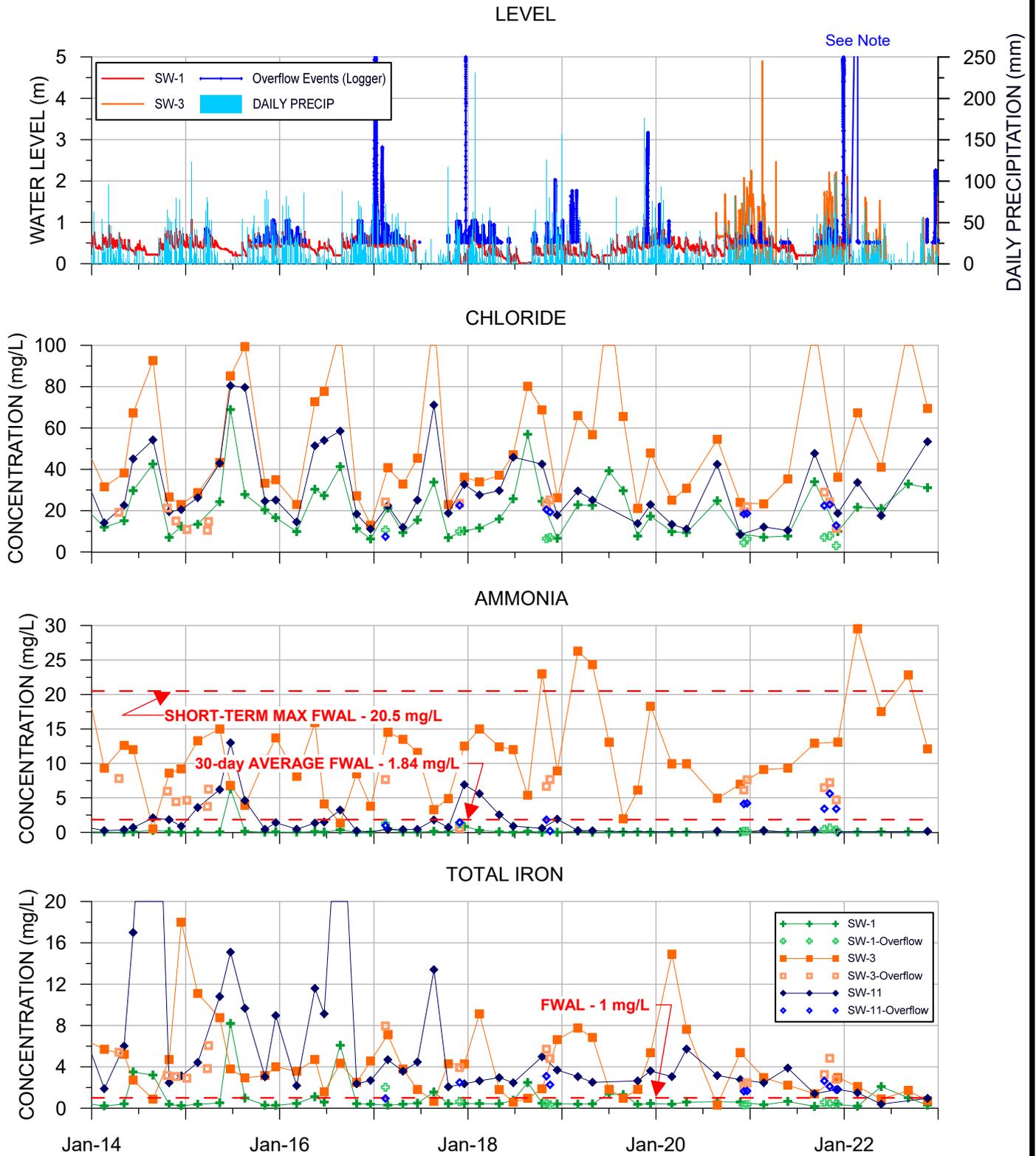
**TABLE D-1
SUMMARY OF 2022 OVERFLOW EVENTS**

Date Overflow Started	Duration of Event ¹	Precipitation over Preceding Five Days (mm)	Precipitation over Preceding Five Days and Period of Overflow Event (mm) ²
12-Jan-22	7.0 days	137.4	295.2
20-Jan-22	23 hrs	62	64
22-Feb-22 ⁴	4.0 days	9.4	25.4
27-Feb-22	18 hrs	34	34
21-Mar-22	1.7 days	145.2	189
23-Mar-22	2.6 days	164.2	178.8
03-Apr-22	1.8 days	57.8	80.6
06-Apr-22	16 hrs	65.8	65.8
10-Apr-22	21 hrs	23.2	23.2
25-Apr-22	1.7 days	61.6	77
05-May-22	2.8 days	72.6	72.6
16-May-22	1.1 days	95.6	128.4
08-Dec-22	1.5 days	25.9	52.9
10-Dec-22	1.4 days	45.1	51.9
18-Dec-22 ⁵	5.2 days	0	14
24-Dec-22 ⁵	32 days	8 ³	412.2 ³

Notes:

H:\Project\1576\WL_Monitoring\[Pond_Overflow_SW-1.xlsx]Overflow summary_2022

1. Duration of event estimated from water level in overflow pipe measured by Solinst Levellogger. No data available from 26 Jan 2022 to 22 Feb
2. Precipitation measured by Environment Canada at Tofino Airport Climate Station.
3. Missing precipitation data
4. No Leachate pond levels prior to 23 Mar 2022.
5. Event preceded by heavy snowfall.



Note: Datalogger not installed from January 26, 2022 to February 22, 2022.

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ALBERNI-CLAYOQUOT REGIONAL DISTRICT
WATER QUALITY MONITORING PROGRAM
WEST COAST LANDFILL, UCLUELET, B.C.



PITEAU ASSOCIATES
GEOTECHNICAL AND WATER MANAGEMENT CONSULTANTS
A TETRA TECH COMPANY

TIME SERIES PLOT OF WATER LEVELS AND
SELECTED LEACHATE INDICATOR CONCENTRATIONS
AT SW-1, SW-3 AND LEACHATE POND OVERFLOW

BY:	DATE:
JC	APR 23
APPROVED:	FIG:
JM	D-1