Regional Biosolids Composting Facility 2017 Annual Report

Prepared for: BC Ministry of Environment
Prepared by: City of Kelowna
Report Submitted: March 31, 2018

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Executive Summary

The Regional Biosolids Composting Facility (RBCF) is located at 551 Commonage Road (site reference #E307813) and is situated within the municipal boundary of Vernon, BC. The facility is jointly owned by the City of Kelowna (COK) and the City of Vernon (COV), but operated exclusively by COK staff. The facility receives biosolids originating from the Kelowna, Vernon, North Okanagan Regional District, and Lakecountry Wastewater Treatment Facilities (WWTF) and processes the material, along with wood hog fuel and ash product, to produce Class A compost as defined by the Organic Matter Recycling Regulation (OMRR). The facility is operated under condition of compliance of Air Discharge Permit #108537 (the Permit; Appendix A) issued under the provisions of the *Environmental Management Act*. This annual report covers the period between January 1 to December 31, 2017.

Received Biosolids

The total combined volume of stabilized sewage sludge (biosolids) received at the RBCF in 2017 was 30,368 wet tonnes, which is 83.4% of the 36,400 wet tonnes allowed by the Permit.

Finished Compost

Finished compost product was continuously produced and tested throughout 2017, with off-site transportation and product sale peaking May through September. A total of 89% of the finished product volume was removed from the site in 2017. The Permit requires the removal of 50% of the finished product from site (Table 1).

Table 1. Compost volume produced and stored at the RBCF

Finished Compost	Volume (m^3)
Stored on-site as of Jan 1, 2017	11,778
Produced on-site between Jan 1-Dec 31, 2017	57,258
Transported off-site between Jan 1-Dec 31, 2017	51,195
Stored on-site as of Dec 31, 2017	17,841

Introduction

The RBCF operates under Permit 108537, which mandates under Section 5.5, that annual reports be submitted to the Ministry of Environment (MOE) on or before March 31st of each year for the previous calendar year, and must include the following information at a minimum:

- The type and tonnage of compostable materials received for the preceding calendar year (page 5);
- The quantity of finished compost transported off-site and the amount stored on site at the end of each calendar year (page 1);
- The results of all monitoring programs as specified in this authorization. The Permittee must ensure that data interpretation and trend analysis, as well as an evaluation of the impacts of the discharges on the receiving environment in the previous calendar year must be carried out by a qualified professional (pages 8-10);
- A summary and analysis of all complaints received in the previous calendar year (page 8); and
- Any improvements made to the facility or operations to reduce and control odour (page 8).

This report addresses the above-noted items and provides an overview of the facility, processing volumes, odour and air emissions management, residual management, leachate management, sampling procedures, analytical testing results, staffing, and operational maintenance.

This annual report applies to the 2017 calendar year from January 1 to December 31.

Compost Facility Overview

The RBCF is situated in a rural area between Vernon and Kelowna and was officially opened in 2006 as a partnership between the two municipalities. The purpose of the facility is to process the biosolids produced at each of the respective wastewater treatment facilities, into a nutrient rich, high-quality Class A compost (as per OMRR) that is sold under the OgoGrow™ brand.

The site underwent a significant upgrade in 2010 to increase the receiving capacity of biosolids, expand the processing area, and increase the on-site storage capacity of the finished product

Site Plan

The infrastructure primarily consists of an administration building for staff, booster pump house that manages water flows, enclosed mixing building, maintenance shop, leachate collection system, aeration fan system, and two E-nose odour sensors strategically placed on the perimeter (Figure 1).

Each of the buildings, monitors, and collection systems are designed to provide efficient management, measurement, and containment of each of the compost production stages. This consists of initial mixing of biosolids, woody biomass and ash in the mixing building, primary and secondary aeration zones areas for curing, and finished product storage area.

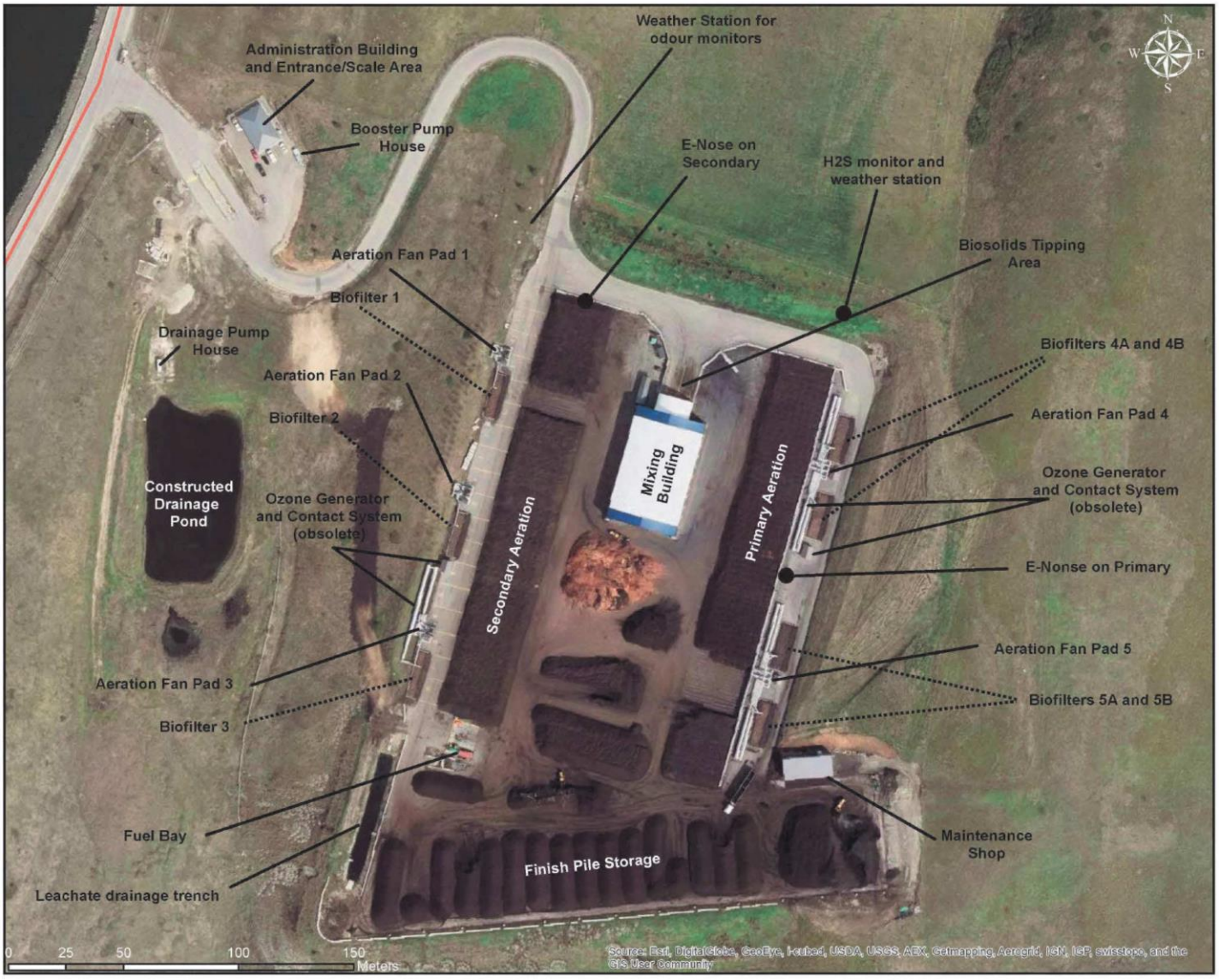

Figure 1. Regional Compost Facility Site Plan

Signage and Security

The compost facility has signage erected near the entrance that clearly identifies the site name, owner and operator, contact phone number for public, hours of operation, and prohibition of hazardous waste notification.

The site is secured from cattle and wildlife intrusion with a continuous perimeter fence that is gated at the entrance. The facility gate remains open during regular business hours and is monitored 24-hours a day by a surveillance camera.

Contracted haulers have access to the site after hours through use of proximity tags that open and close the gate automatically. Communication on site is through radio system control that staff and haulers are equipped with.

Residual Management

Feedstocks are generally very clean and do not contain litter or plastic debris. Any litter found on-site is collected and disposed of throughout the year as noticed. In addition, a coordinated clean-up effort is made each spring that consists of staff walking the north perimeter berm and field north of the berm to pick up any plastic fragments or residuals, and disposing of them off-site. All retained residual on premise is limited to less than 15 m^3.

Vehicles that make deliveries on and off-site drive on a dedicated paved surface that is frequently maintained and cleaned when needed. Biosolids are tipped into the mixing building, where they are mixed as soon as possible with the woody feedstocks, afterwhich the mix is transportedto the primary composting area. Any residual biosolids (i.e. dropped on the ground) are collected and added to the mix. Transport vehicles that come on site travel around the perimeter of the site and do not travel across areas where raw biosolids are stored or mixed. The roadways are cleared and kept as clean as possible to minimize tracking of compost by tires or undercarriages, which could be transported off-site.

Operations

The COK operates the RBCF in accordance with the current Commonage Biosolids Facility Operations Plan that was designed by MMM consulting group and approved by the MOE in 2010. As a condition on permit, the COK will obtain the professional services of a consulting firm to design and submit an updated operating plan to the MOE director by May 31, 2019. That plan will contain, but will not be limited to, the design, operations, acceptable materials, leachate management, monitoring program, reporting requirements and performance requirements for the RBCF.

Compostable Material

Activated sewage sludge is extracted from wastewater through a series of clarifiers, bioreactors, fermenters, and settling basins to physically remove solids from the waste stream at the various wastewater treatment facilities. The thickened sludge is further processed at a dewatering facility where it is centrifuged to get a consistency of 15-20 % solids.

The resulting biosolids, or cake, are mixed with Bioxide® calcium nitrate solution to reduce odours, and are transported to the RBCF for further processing into compost.

The amount of biosolids received at the RBCF in 2017 was 30,368 wet tonnes or 83.4% of the allowable permit limit of 36,400 wet tonnes. Over the past six years, the amount of biosolids received at the facility has increased by 11%, generally proportional to the increased volume contributed by Kelowna WWTF over the same time period (Figure 2).

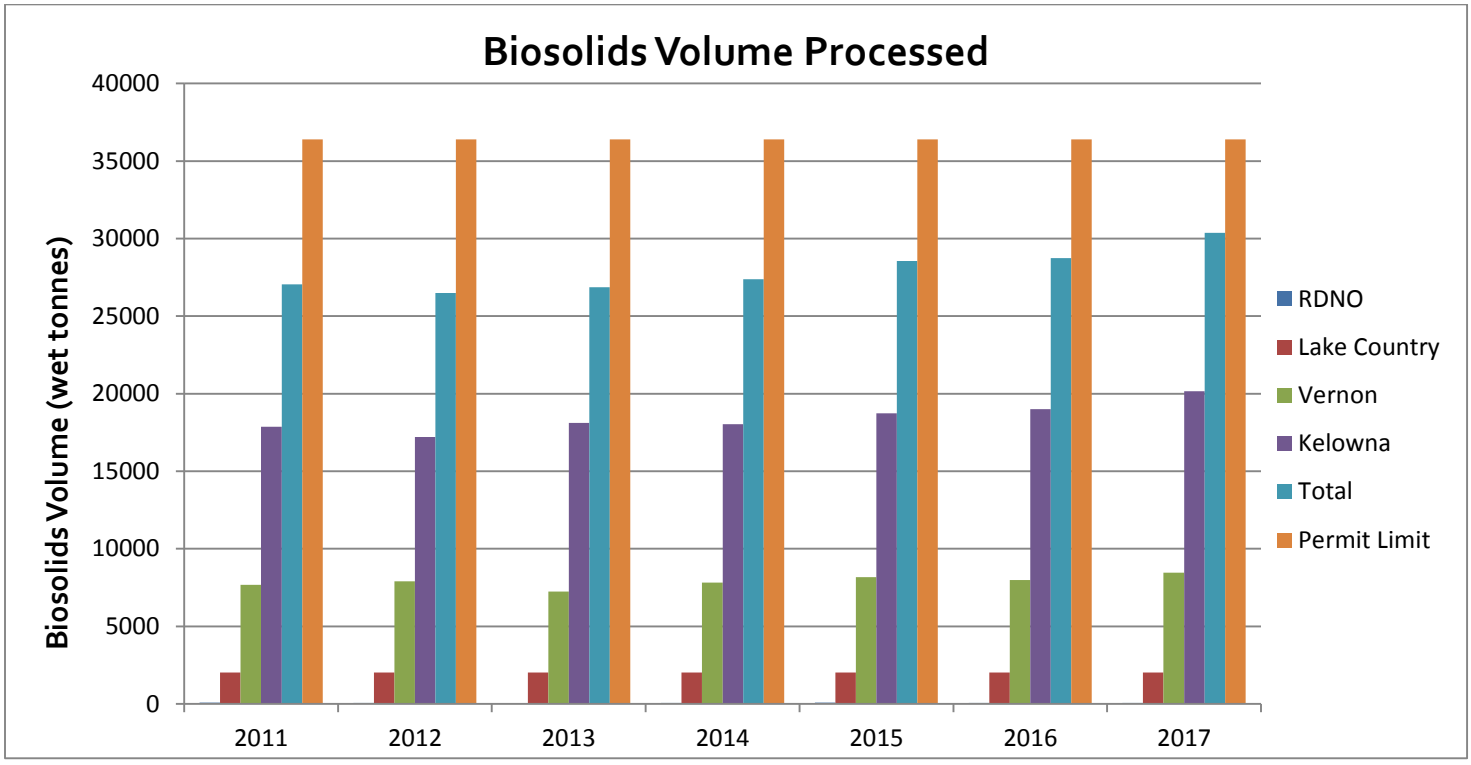

Figure 2. Volume of processed Biosolids at the RBCF year over year relative to permit

Table 2. Metal concentrations in biosolids accepted by RBCF in 2017

Parameter dw mg/kg	Kelowna WWTF	Vernon Water Reclamation Centre	Lake Country WWTF	NORD Septage receiving	Schedule 4 OMRR
Arsenic	1.65	1.62	2.26	2.90	75
Cadmium	0.61	0.87	1.43	1.69	20
Chromium	10.50	8.43	13.85	24.13	1 060
Cobalt	1.25	1.35	1.69	1.86	150
Copper	463	275	446	472	2 200
Lead	9.2	6.6	13.1	22.1	500
Mercury	0.36	0.40	0.61	0.69	15
Molybdenum	5.89	5.54	11.25	12.97	20
Nickel	8.02	7.33	11.33	16.20	180
Selenium	2.41	4.74	4.32	4.79	14
Zinc	257	293	692	1107	1 850

Table 3. Wood Feedstocks and Ash processed 2017

Hog fuel – m^3	42,400
Ground dimensional lumber – m^3	24,100
Ground Prunings - m^3	2,200
Oversize compost from screening (recycle estimate) – m^3	25,000
Ash - tonnes	4,780

Compost Blending Process

The raw materials used to blend with the biosolids include wood chips obtained from local forestry mills (hog fuel), ground dimensional lumber, oversized wood chips screened from previously composted material, and wood ash. Each of these materials are pre-mixed at a ratio of 3 parts hog fuel, 2 parts oversize screening, and 1-part ground dimensional lumber on-site. The pre-mix is then blended with the biosolids at a prescribed rate to optimize the nutrient balance of carbon to nitrogen to produce the OgoGrow mix (Table 4).

Table 4. Mixing ratio of material

Ogogrow mix
5000-5500 kg of pre-mix
3000 kg of biosolids
450 kg of ash

The RBCF utilizes an Extended Aerated Static Pile composting method to enhance the breakdown of biosolids and feedstock materials into compost. Following mixing, the blended material is built into rows on a primary aeration cell area where air is blown from the atmosphere through each pile in a positive (pushed through) or negative (pulled through) direction, to provide optimal aerobic and temperature conditions for organic material degradation and pathogen reduction. The internal temperature of each pile is electronically monitored to determine whether Process to Further Reduce Pathogens (PFRP) and Vector Attraction Reduction (VAR) targets are met. These targets are typically met within 25-28 days, after which the material is torn down and re-built into a new pile in the secondary aeration cell area where the process is repeated. The material is then screened to 5/8" inch in size and arranged into windrows in the final curing area prior to transportation.

Finished OgoGrow Product

The finished product is rigorously tested to ensure that it meets OMRR Class A compost criteria prior to approval for sale.
Market demand for OgoGrow product in 2017 increased 26.4% over 2016 and 45.2% since 2012 (Figure 2).

Table 5. Ogogrow Analytical Results 2017

mg/kg	Result	OMRR
Arsenic (As)	2.96	13
Cadmium (Cd)	1.12	3
Calcium (Ca)	24250	
Chromium (Cr)	10.14	100
Cobalt (Co)	1.83	34
Copper (Cu)	220	400
Iron (Fe)	4447	
Lead (Pb)	7.47	150
Lithium (Li)	2.39	
Magnesium (Mg)	4696	
Manganese (Mn)	981	
Mercury	0.20	2
Molybdenum (Mo)	2.2	5
Nickel (Ni)	7.02	62
Phosphorus (P)	12470	
Potassium (K)	7178	
Selenium (Se)	1.694	2
Silver (Ag)	1.002	
Sodium (Na)	921	
Tin (Sn)	9.96	
Titanium (Ti)	78.8	
Uranium (U)	4.20	
Vanadium (V)	7.78	
Zinc (Zn)	330	500
PCB's	Not detected	2
Conductivity (EC)	1.81	
Foreign Matter	0.1	<1
Foreign Matter - Sharps	<0.10	<1
Moisture %	50.9	35-60%
pH	7.8	
Organic Matter %	82.6	
Total Nitrogen by LECO %	2.15	
Phosphorus (Available P_2O_5) %	1.73	
Potassium (Soluble K_2O) %	<0.6	
Nitrate mg/kg	194	
Ammonia mg/kg	1148	
C:N Ratio	21	15-35

Fecal Coliform & Salmonella - Each 500 yard batch of Ogogrow is individually tested for pathogens. Compost is only released for sale when it has met the OMMR requirements of <3 MPN/4g salmonella and <1000 MPN/g coliform. Averages are calculated based on the results of monthly composite tests. Results are reported on a dry weight basis.

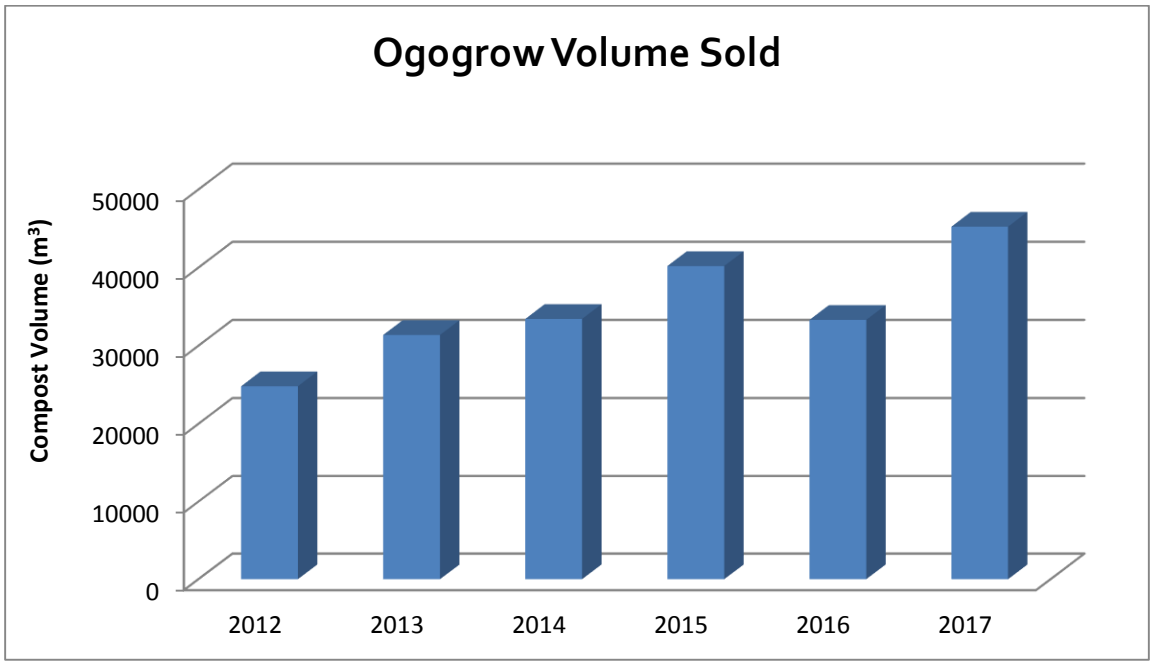

Figure 3. Volume of OgoGrow product sold year over year

Odour Management

The RBCF operates the facility in accordance with an Odour Management Plan (OMP), that employs best management practices to measure and mitigate both on-site and off-site odour generation. An updated OMP was submitted to the MOE November 31, 2017.

The facility utilizes an OdoWatch odour detection system, which consists of 2 odour detecting sensors (E-Noses) calibrated for the site, and a weather station. Data from these is used to model atmospheric dispersion of odours. Ten alert points, 4 at the property boundaries and 6 off site have been established. These have predetermined odour thresholds that when exceeded, may correlate to odour events reported by the public. The software has the ability to capture odour intensity, location, and duration and can provide alerts to notify staff in the event that odour thresholds have been exceeded (Figure 4). The OdoWatch system at the RBCF will be upgraded in the Spring of 2018.

As required by Section 4.4 of the Permit, the COK retained WSP consultants to produce an Air Emission Review Study that contains data interpretation, trend analysis, complaint summary, and impacts of emissions on the receiving environment (Appendix B).

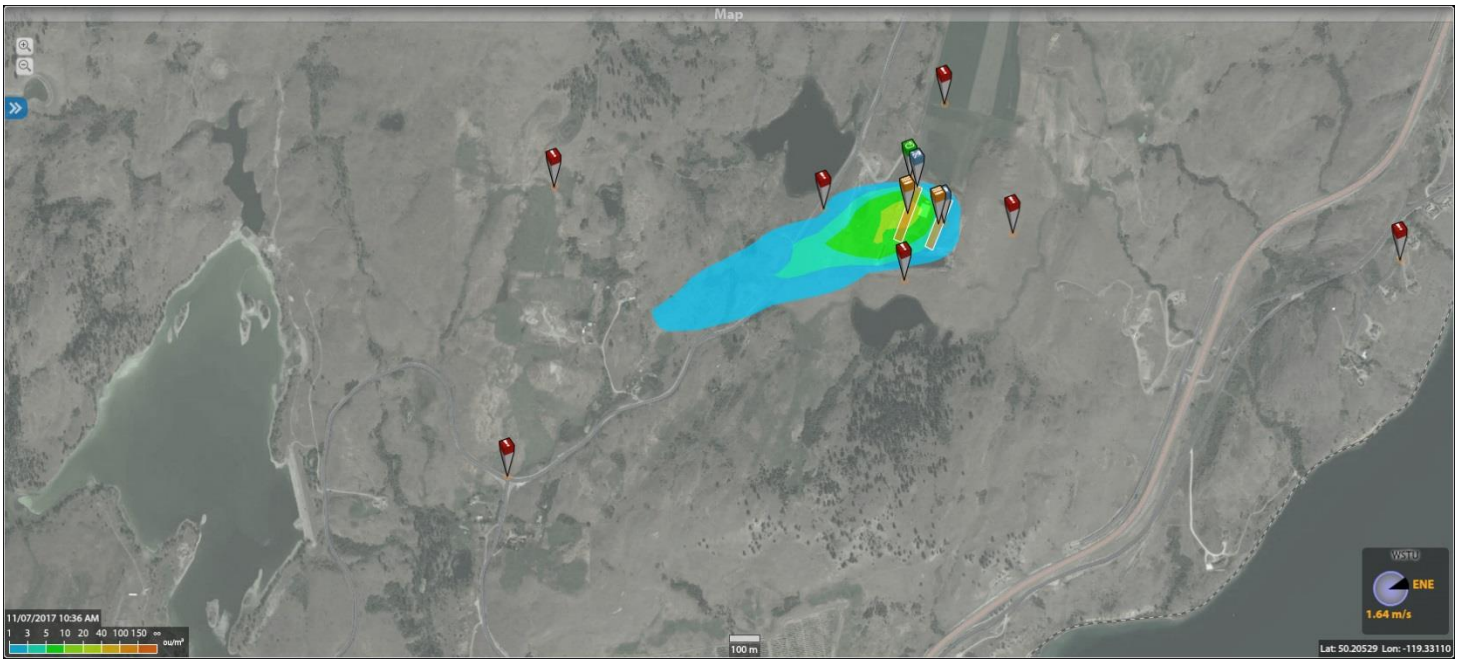

Figure 4. Odowatch odour profile showing location of E-noses, alert points, and predicted odour intensity contours

Primary Odour Control

To control the biosolids feedstock odour, an enclosed Coverall Building (mixing building) was erected in 2006, where the material is initially delivered on-site. The structure allows heavy machinery to mix and transport the initial compost mix without direct wind exposure and subsequent movement of odour to surrounding areas. Front end loaders used at the site have pressurized cabins to protect equipment operators from the dust and airborne material generated by the composting process.

Once the compost is blended and transferred to the primary aeration cell area, odour is managed through the use of a 0.3-m thick biofiltration cover that consists of a mixture of oversized material from the screening process and material from the secondary teardown piles. This top layer effectively absorbs much of the odour produced by the compost piles, particularly when the system is set to positive aeration.

There are 7 biofilters at the site; 3 to filter air from secondary composting and 4 to filter air from primary composting. When the aeration fans are working in negative to pull air down through the piles, the air exhausted from the bottom is directed through the biofilters. Data in the Air Emissions report supports the effectiveness of biofiltering as an odour control method. As part of the condition on permit, WSP engineering consultants have been retained to evaluate treatment methods for all primary compost piles to complement the existing biofilters. Based on WSP's recommendations, a technology will be selected for implementation. Approval for the implementation of this technology will be sought from the MOE Director by October 31, 2018 as required by the Permit.

Leachate Management

The RBCF operates the facility in accordance with a Leachate Management Plan (LMP) that employs best management practices for the collection and treatment of all leachate collected on-site.

Low-strength Leachate
All authorized works operate entirely on an impervious surface. Runoff is directed to a drainage trench along the site's south-western boundary and into the Drainage Pond (Figure 1). Water entering the drainage trench and pond consists primarily of stormwater that may contain leachate from the compost material and potentially process water runoff from irrigation that is applied regularly to the compost piles in the summer months.

High-strength Leachate
Leachate from the primary and secondary aeration cells drains through the aeration channels and is directed to a holding tank. This is regularly truck-hauled off-site for treatment at the North Okanagan Regional District's (NORD) septage facility in Vernon. A summary of the leachate volume produced and hauled off-site is summarized in Figure 5.

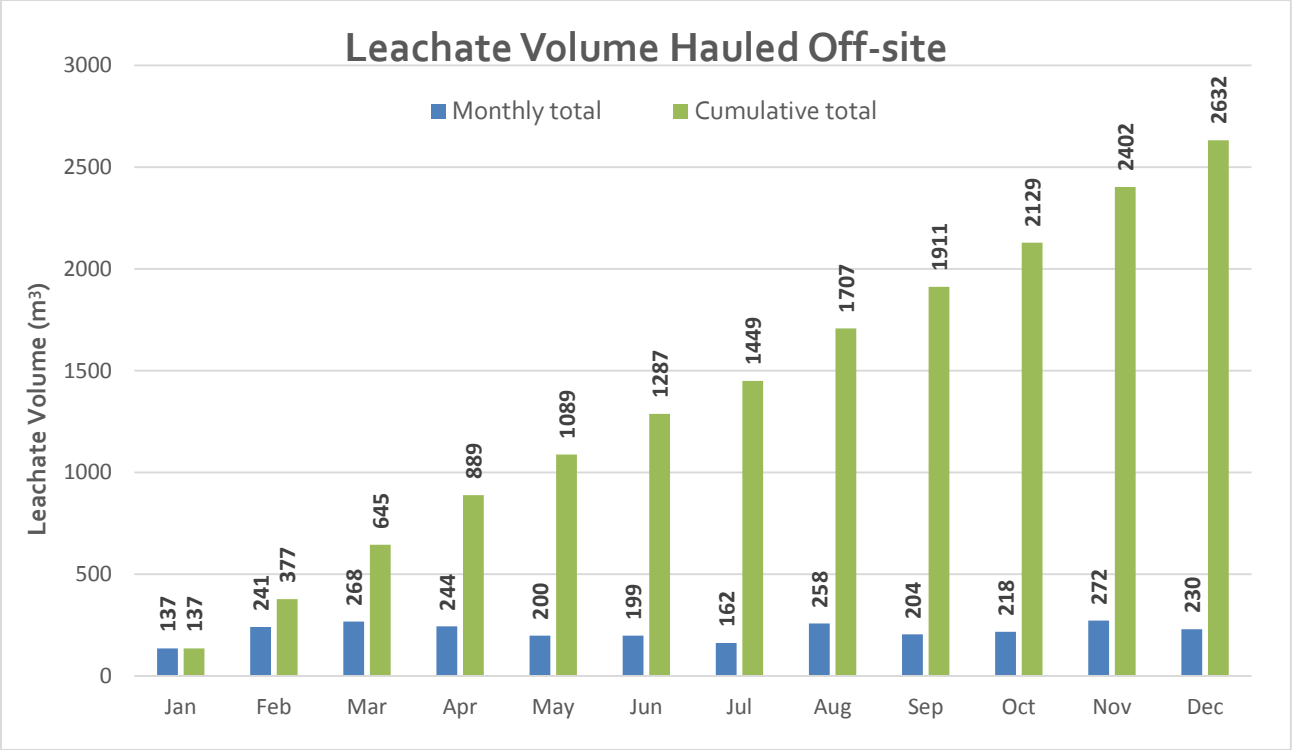

Figure 5. Leachate volume transported to the NORD septage facility for treatment in 2017

Analytical testing is carried out on the drainage trench water and surrounding water ponds to assess potential infiltration of leachate and impact to the surrounding area. As condition on permit, Golder Associates were contracted to review, report, and make recommendations on the water testing results from the 2017 calendar year (Appendix C).

As per Section 3.4 of the Permit, the COK will provide a new Leachate Management System Plan to the MOE by the amended date of March 31, 2018. It is the COK's intention to line the drainage trench and pond with an impermeable liner to manage low-strength leachate, and explore treatment and reuse technologies to manage high-strength leachate in the future. In the meantime, the hauling of high-strength leachate off-site to the NORD septage facility will continue.

Operational Maintenance

The COK regularly inspected all authorized works on-site and maintained them in good working order. The only significant maintenance event in 2017 involved the repair and replacement of several sections of asphalt surface to prevent leachate from infiltrating into the subsurface. Work was valued at $36,500 and was completed during a dry weather period to prevent surface run-off into the construction area.

All equipment was routinely serviced at the prescribed schedules or as needed at the on-site maintenance shop. All service records and activities are available upon request by the MOE.

Staffing

The RBCF operates with experienced personnel that includes; one Site Supervisor, one Equipment Level II Operator, five Equipment Level IV Operators, one Environmental Level I Technician, and one Environmental Level II Technician for a total of 9 staff. The RBCF staff is supported by a team of mechanics, millwrights and electricians based in Kelowna.

Monitoring and Testing

All sampling conducted on-site is carried out in accordance with the British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (2013).

Sample analysis is contracted to a third-party accredited laboratory that provides testing in accordance with OMRR and the BC Environmental Laboratory Manual (2015) analytical methods or equivalent. All reports are retained and available upon request by the MOE.

Environmental Impact Study

An initial Environmental Impact Study was completed by Golder Associates prior to the initial construction of the facility in 2006, and was further amended in 2010 by MMM Group to coincide with the operational expansion at that time. These two combined documents identify and address environmental impacts of the compost operation to the aquatic environment, terrestrial environment, atmospheric environment, and to vegetative and wildlife species in the surrounding areas. They provide recommendations as to biosolids diversion planning, best management practices, design capacity, leachate collection and treatment, and odour management as to minimize environmental consequences.

The resulting recommendations were addressed in the design and operation plan, carried out through the planning and actions of management and staff, and works inspected on site periodically by MOE staff. Copies of the Environmental Impact Studies are kept on site. An updated Environmental Impact Study will be commissioned prior to the construction of any significant site upgrades such as a secondary odour control technology if warranted.

Through consistent review of its practices and policies in place, the RBCF strives to reduce its environmental footprint, improve its relationships with surrounding landowners, and provide a safe and sustainable work environment.

Closure

This Annual Report has been prepared to comply with reporting requirements outlined in Section 5.5 of Air Discharge Permit #08537 for the City of Kelowna's Regional Biosolids Composting Facility located at 551 Commonage Road, Vernon, BC.

The City of Kelowna is committed to ensuring the facility meets all permitting requirements and minimizes its impact on the natural environment and the surrounding community, as it conducts an essential service for the Okanagan communities it serves.

For further details on the content of this report, please contact Kevin Van Vliet, Utility Services Manager at (250) 469-8826 or kvanvliet@kelowna.ca.

Appendix A

Air Discharge Permit

July 12, 2017

Tracking Number: 352392
Authorization Number: 108537

REGISTERED MAIL

CITY OF KELOWNA
1435 WATER STREET
KELOWNA, BC
V1Y 1J4

Dear Permittee:

Enclosed is Permit 108537 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the permit. An annual fee will be determined according to the Permit Fees Regulation.

This permit does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the permittee. This permit is issued pursuant to the provisions of the *Environmental Management Act* to ensure compliance with Section 120(3) of that statute, which makes it an offence to discharge waste, from a prescribed industry or activity, without proper authorization. It is also the responsibility of the permittee to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Environmental Protection Division
Ministry of Environment
1259 Dalhousie Dr.
Kamloops BC V2C 5Z5
Authorizations - South Region
Telephone: (250) 371-6200
Facsimile: (250) 828-4000

Administration of this permit will be carried out by staff from the Environmental Protection Division's Regional Operations Branch. Plans, data and reports pertinent to the permit are to be submitted by email or electronic transfer to the Director, designated Officer, or as further instructed.

Yours truly,

Luc Lachance, P.Eng
for Director, *Environmental Management Act*
Authorizations - South Region

Enclosure

cc: Environment Canada

**MINISTRY OF
ENVIRONMENT**

PERMIT

108537

Under the Provisions of the Environmental Management Act

**City of Kelowna
551 Commonage Road
Vernon, B.C. V1H 1G3**

is authorized to discharge contaminants to the air from a composting facility located at 551 Commonage Vernon, British Columbia subject to the requirements listed below. Contravention of any of these requirements is a violation of the *Environmental Management Act* and may lead to prosecution.

Unless otherwise defined in this authorization, terms used in this authorization have the same meaning as those defined in the *Environmental Management Act* and Organic Matter Recycling Regulation.

1. AUTHORIZED DISCHARGES

1.1. Authorized Source

This section applies to the discharge of air contaminants from various areas of the composting facility. The site reference number for this discharge is E307813.

1.1.1. The rate of the discharge is variable.

1.1.2. The authorized discharge period is continuous.

1.1.3. The characteristics of the discharge are that of typical emissions of a biosolids composting facility.

1.1.4. The authorized works are all paved surfaces, the aeration pads, one (1) primary receiving building, one (1) water supply pump house including the pumps, chlorination and filtration apparatus, one (1) drainage pump house, one (1) ECS Aerated Static Pile System comprised of 18 zones for primary composting and 18 zones for secondary composting, four (4) biofilters for primary composting area and

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three (3) biofilters for secondary composting area, related sumps, pipes, holding tanks and related appurtenances.

1.1.5. The Permittee must not operate under this authorization unless the authorized works are complete and fully operational.

1.1.6. The location of the authorized works approximately located as shown on Site Plan attached.

2. GENERAL REQUIREMENTS

2.1. Maintenance of Works and Emergency Procedures

The Permittee must regularly inspect the authorized works and maintain them in good working order. The Permittee must maintain all asphalt surfaces and must repair cracks and significant damages to prevent and avoid leachate infiltration. Records of inspection and maintenance activities must be kept and made available upon request.
In the event of an emergency or condition beyond the control of the Permittee including, but not limited to, unauthorized fires arising from spontaneous combustion or other causes, or the detection of leachate migration outside of onsite confinement, the Permittee must take remedial action to prevent any unauthorized discharges. The Permittee must immediately report the emergency or condition and the remedial action that has and will be taken to the RAPP line (1-877-952-7277, #7272 from mobile phone) or electronically at this link: http://www.env.gov.bc.ca/cos/rapp/form.htm.
The Director may require the Permittee to reduce or suspend operations until corrective steps have been taken to prevent unauthorized discharges.

2.2. Bypasses

The Permittee must not allow any discharge authorized by this authorization to bypass the authorized works, except with the prior written approval of the Director.

2.3. Signage

The Permittee must erect a sign at the main entrance to the site which identifies the following: site name, owner and operator, contact phone number and address, hours of operation, tipping fees (if applicable) and prohibition of hazardous wastes. The lettering on the sign must be such that it is clearly readable from a distance of 3 meters by the public when they approach the entrance of the site.

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2.4. Access Security

The Permittee must provide adequate security for the facility and restrict access to authorized personnel.

2.5. Qualified Professionals

The Permittee must cause a qualified professional to certify that all new works are constructed in accordance with submitted plans and specifications. All documents submitted to the Director by a qualified professional must be signed by the author(s).

2.6. Litter Control

The Permittee must use the best practical means available to prevent the scatter of litter at the site. The Permittee must clean up any litter that may have escaped the site and scattered into the neighbouring property, along access roads, in drainage ditches, along fences, into surrounding trees or elsewhere on the site. The Director may require the Permittee to implement a specified frequency of clean-up and other additional requirements for litter control.

2.7. Vehicle Leaving Site

The Permittee must ensure, before any vehicle transporting compostable materials leaves the site, that the wheels of the vehicle do not contain compostable materials. If tracking of compostable material outside of the facility becomes a problem the Director may require that a wheel rinsing station be installed at the facility.

2.8. Air Quality

The Permittee must suppress odours created within the compost area to the satisfaction of the Director. If air quality becomes a concern, the Director may require the Permittee to implement additional control measures on emission sources.

3. OPERATIONAL REQUIREMENTS

3.1. Compostable Materials

3.1.1. The Permittee is only authorized to process the stabilized municipal sewage sludge, unprocessed and untreated wood residuals and yard waste.

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3.1.2. The Permittee must not receive or process more than 36, 400 wet tonnes of stabilized sewage sludge per year.

3.1.3. Primary Composting Area

The Permittee must select and implement a secondary odour treatment for all primary composting piles to complement the biofilters for the period of May to October of each year. The Permittee must select a secondary odour treatment by October 31, 2018 and submit to the Director for approval. If the selected and approved secondary odour treatment is not implemented by June 30th, 2019, the Permittee will have to use a cover for all primary composting piles from May to October each year.

3.2. Biofiltration Cover

The Permittee must maintain at all times, for the purpose of odour control, a biofiltration cover for all compost piles located in the primary and secondary compost areas, consisting of:

- 0.3 m secondary teardown, or
- 0.3 m oversized material (overs), or
- A blend of secondary teardown and overs, or
- Another covering layer of a type and thickness that is acceptable to the Director.

The Permittee must account for the biofiltration cover when calculating the carbon to nitrogen ratio to ensure that optimal composting conditions are maintained throughout the process. In order for the biofiltration cover to be effective, the Permittee must maintain optimal moisture content in the biofileration material.

3.3. Design and Operating Plan

The Permittee must submit an updated design and operating plan by May 31, 2019. The plan must be prepared by a qualified professional. The plan must describe, but not be limited to, the design, operations, acceptable materials, leachate management, monitoring programs, reporting requirements and performance requirements. In addition, the operating plan must:

3.3.1. Demonstrate that the biofilters are of adequate size and capacity for the facility's design;

3.3.2. Establish a schedule of site-specific maintenance activities for the biofilters;

3.3.3. Describe how records are kept for all maintenance activities performed on site;

3.3.4. Explain how the biofiltration cover is integrated in the C:N ratio;

3.3.5. Include contingency plans in case of supply shortage (hog, ash) ; and,

3.3.6. Include an asphalt maintenance program, which describes inspection protocols and maintenance activities.

The Permittee must operate the facility in accordance with the design and operating plan. The Director may request additional information with respect to the design and operating plan and specifications that he or she considers necessary for the protection of human health and the environment, and may specify particular concerns or questions that the plans and specifications must address.

3.4. Leachate Management

The Permittee must ensure that all leachate generated from the composting operation, buildings, paved open surface areas, outdoor curing areas, finished compost storage areas, and truck marshalling area is collected and directed to the leachate collection system. The Permittee must maintain all collection channels and catch basins to ensure proper drainage.

The Permittee must select an impermeable containment system to store leachate, or the contact water from the curing areas or other water that may have come in contact with the organic waste or compost. The Permittee must submit the new Leachate Management System Plan to the Director for approval before November 30, 2017. The Permittee must cease to use the drainage trench or the drainage pond after October 31, 2018 to store leachate, or the contact water from the curing areas or other water that may have come in contact with the organic waste unless the drainage trench and the drainage pond are lined with an impermeable liner.

3.5. Odour Management

The Permittee must submit to the Director for approval an updated odour management plan by November 30, 2017. The plan must be prepared by a qualified professional and must do the following:

3.5.1. Identify all odour generating areas including, but not limited to: receiving, mixing, primary composting, curing or secondary composting, screening, leachate collection system, aeration systems, biofilters, grinding and storage.

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3.5.2. Identify appropriate mitigating strategies employed for each area and provide a summary table in the plan.

3.5.3. Identify all parameters and optimal ranges in the compost process needed to limit odour generation. Compost process parameters to be identified include, but are not limited to, feedstock type, bulking materials, bulk density, particle size, carbon to nitrogen ratios, moisture, temperature, oxygen, peak odour times (i.e. Day 3 or 7), pile turning schedules.

3.5.4. Outline all best management practices and emission control technologies aimed at reducing odour generation being employed at the facility.

3.5.5. Identify other best management practices and emission control technologies that could potentially be used on site to further reduce and control odour.

3.5.6. Include an odour monitoring program. The program must describe how odours are monitored on-site and off-site.

3.5.7. Include a complaint management process which includes a complaint form, any investigative actions to be taken and any mitigation actions to be taken.

The Permittee must operate the facility in accordance with the approved odour management plan, and any requirements which the Director may attach to the odour management plan as a condition of approval.

3.6. Change to Plans

The Permittee must keep the design and operating plan up to date and must notify the Director of any changes to the plan within 30 days of the change.

3.7. Closure of the Facility

Before closure of the facility, the Permittee must apply or distribute all compost in accordance with the Organic Matter Recycling Regulation, and all unprocessed organic matter must be removed from the facility and dealt with in accordance with the *Environmental Management Act*.
A final closure plan must be submitted 90 days prior to deactivation of the site to the Director for review and approval. The final closure plan and associated engineered closure works must be compatible with the planned end-use of the compost facility.

3.8. Additional Requirements

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The Permittee must ensure the following requirements are met:

3.8.1. Class A compost must meet the requirements of pathogen reduction processes, vector attraction reduction, pathogen reduction limits, quality criteria, sampling and analysis – protocols and frequency, and record keeping as outlined in the Organic Matter Recycling Regulation.

3.8.2. Biosolids used as feedstock for the production of Class A compost must not exceed the standards for Class B biosolids set out in Column 3 of Schedule 4.

3.8.3. At least half of the compost stored at 551Commonage Road, Vernon, BC must be removed annually from the facility.

3.8.4. The receiving, storage, processing and curing areas of the composting facility must be located on asphalt, concrete or another similar impermeable surface that is capable of withstanding wear and tear from normal operations and that will prevent the release of leachate into the environment.

3.8.5. Residuals from the composting process must be stored so as to prevent vector attraction, and be disposed of on a regular basis in accordance the *Environmental Management Act.*

3.8.6. Residuals that are stored at a composting facility must not at any time exceed 15 cubic meters in total.

4. MONITORING REQUIREMENTS

4.1. Odour emissions

The Permittee must continue to monitor air emissions at the facility and in the surrounding areas using existing e-noses and H2S monitors. The Permittee must monitor odour emissions in accordance with the approved odour management plan and results must be presented and interpreted in the annual report.

4.2. Surface Water Monitoring

The Permittee must continue to implement a surface water monitor program as required in writing by the Director and in accordance with recommendations from a Qualified Professional. The Director may request additional information or changes with respect to the monitoring program based on monitoring results and upon submission and review of the Leachate Management System Plan, required under Section 3.5.

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4.3. Environmental Impact Study

The Permittee must retain on site a copy of the most recently submitted environmental impact study for inspection. The Director may request additional information with respect to the environmental impact study that he or she considers necessary for the protection of human health and the environment, and may specify particular concerns or questions that the impact study must address.

4.4. Air Emissions Review Study

The Permittee must retain the services of a qualified professional to review and analyze all emissions data collected at the facility with e-noses, H_2S monitors and odorous gas measurements. The report must be submitted by March 31, 2018 and must:

4.4.1. Describe odour emissions on-site for each odour generating area;

4.4.2. Describe how odours are migrating off-site and identify all affected areas;

4.4.3. Use quantitative and qualitative units for descriptions;

4.4.4. Include daily, seasonal and annual trends;

4.4.5. Discuss how meteorological conditions effect odour generation and dispersion;

4.4.6. Provide a qualitative assessment of how odours have improved since 2010;

4.4.7. Report on the effectiveness of odour mitigation strategies used at the facility;

4.4.8. Discuss calibration schedule/requirements of the OdoWatch system; and

4.4.9. Make recommendations on how the facility could further reduce its odour emissions.

4.5. Foul Air Study

The Director may request the Permittee to conduct a foul air study or similar study to measure the effectiveness of the facility's odour management plan and to quantify the odours migrating off-site.

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4.6. Sampling Procedures

The Permittee must carry out sampling in accordance with the procedures described in the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2013", or the most recent edition, or by alternative procedures as authorized by the Director. A copy of the above manual is available on the Ministry web page at: http://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/sampling-methods-quality-assurance/bc-field-sampling-manual

4.7. Analytical Procedures

The Permittee must carry out analyses in accordance with the procedures described in the "British Columbia Laboratory Manual, 2015 ", or the most current edition, or by suitable alternative procedures as authorized by the Director.
A copy of the above manual is available on the Ministry web page at: http://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/sampling-methods-quality-assurance/bc-environmental-laboratory-manual

5. REPORTING REQUIREMENTS

5.1. Maintenance of Records

The Permittee must maintain all records and plans required by this authorization and produce them for inspection by an officer when requested.

5.2. Electronic Submission

The Permittee must submit all data required to be submitted under this permit by email to the Ministry's Routine Environmental Reporting Submission Mailbox (RERSM) at Envauthorizationsreporting@gov.bc.ca. For guidelines on how to properly name the files and email subject lines or for more information visit the Ministry website: http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/routine-environmental-reporting-submission-mailbox

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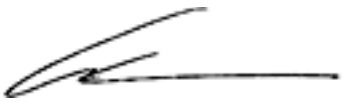

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5.3. Spill Reporting

The Permittee must immediately report all spills to the environment (as defined in the Spill Reporting Regulation) in accordance with the Spill Reporting Regulation, which among other things, requires notification to the Provincial Emergency Program at 1-800-663-3456.

5.4. Non-Compliance

The Permittee must immediately notify the Director or designate by email at EnvironmentalCompliance@gov.bc.ca of any non-compliance with the requirements of this authorization by the Permittee and take remedial action to remedy any effects of such non-compliance. The Permittee must immediately notify the Director or designate of any non-compliance with the requirements of this Permit and take appropriate remedial action. Written confirmation of all non-compliance events, including available test results is required within 24 hours of the original notification unless otherwise directed by the Director, Environmental Protection.

Within 30 days of the non-compliant event, the Permittee must submit to the Director, Environmental Protection, a written report including, but not necessarily limited to, the following:

(a) all relevant test results related to the noncompliance;
(b) an explanation of the most probable cause(s) of the noncompliance; and
(c) remedial action planned and/or taken to prevent similar noncompliance(s) in the future.

5.5. Annual Reporting

The Permittee must submit a comprehensive annual report to the Director, on or before March 31st of each year for the previous calendar year. The annual report must include but not be limited to:

5.5.1. The type and tonnage of compostable materials received for the preceding calendar year;

5.5.2. The quantity of finished compost transported off site and the amount stored on site at the end of each calendar year;

5.5.3. The results of all monitoring programs as specified in this authorization. The Permittee must ensure that data interpretation and trend analysis, as well as an

evaluation of the impacts of the discharges on the receiving environment in the previous calendar year must be carried out by a qualified professional;

5.5.4. A summary and analysis of all complaints received in the previous calendar year; and

5.5.5. Any improvements made to the facility or operations to reduce and control odour.

6. LICENCE TO PUBLISH DOCUMENTS

6.1. Subject to 6.2, the Permittee authorizes the Province to publish on the Ministry of Environment website the entirety of any Regulatory Document.

6.2. The Province will not publish any information that could not, if it were subject to a request under section 5 of the Freedom of Information and Protection of Privacy Act, be disclosed under that Act.

6.3. The Permittee will indemnify and save harmless the Province and the Province's employees and agents from any claim for infringement of copyright or other intellectual property rights that the Province or any of the Province's employees or agents may sustain, incur, suffer or be put to at any time that arise from the publication of a Regulatory Document.

GLOSSARY

"Foreign matter" means a contaminant that is not readily decomposed during the composting process, and includes demolition waste, metal, glass, plastic, rubber and leather, but does not include silt, sand, rocks or stones, or gravel less than 2.5 centimeters in diameter, or other similar mineral materials naturally found in soil;

"Oversized material" or "overs" means the product resulting from secondary teardown screening which removes the compost particles smaller than 19 mm.

"**Province**" means Her Majesty the Queen in right of British Columbia;

"**Regulatory Document**" means any document that the permittee is required to provide to the Director or the Province pursuant to:

(i) this authorization;

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(ii) any regulation made under the *Environmental Management Act* that regulates the facility described in this authorization or the discharge of waste from that facility; or,

(iii) any order issued under the *Environmental Management Act* directed against the Permittee that is related to the facility described in this authorization or the discharge of waste from that facility;

"Residuals" means material that can't be used in the composting process and includes organic material that can't be composted because it is unauthorized, or fails to meet OMRR standards, or is defined as foreign matter;

"**Secondary teardown"** means unscreened compost that has been processed for 24 to 28 days on the primary zone to achieve process to further reduce pathogens (PFRP) and vector attraction reduction (VAR) requirements, then moved to the secondary composting zone where aeration is continued for an additional 24 to 30 days of curing. The secondary teardown at the end of this process is approximately 56 days old and has met OMRR requirements;

"Stabilized municipal sewage sludge" means sludge resulting from a municipal waste water treatment process or septage treatment process which has been sufficiently treated through biological, thermal or chemical stabilization to allow the sludge to be beneficially recycled.

"Untreated and unprocessed wood residuals" means clean (non-contaminated and untreated) wood from lumber manufacture, including: shavings, sawdust, chips, hog fuel, ground mill ends and land clearing waste which has been ground with the majority of the greenery removed and no soil present but does not include construction and demolition debris;

"Yard waste" means clean and untreated wood waste or non-food vegetative matter resulting from gardening operations, landscaping, and land clearing; yard waste does not include wood waste derived from construction or demolition. Neither human or animal food waste that is diverted from residential, commercial or institutional sources, nor manure, is yard waste.

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SITE PLAN

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Authorizations – South Region
Permit Number: 108537

Appendix B

Air Emissions Report

CITY OF KELOWNA

AIR EMISSIONS REVIEW STUDY FOR THE COMMONAGE BIOSOLIDS FACILITY

MARCH 29, 2018

AIR EMISSIONS REVIEW STUDY FOR THE COMMONAGE BIOSOLIDS FACILITY

CITY OF KELOWNA

FINAL

PROJECT NO.: 181-01348-00
DATE: MARCH 28, 2018

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March 28, 2018

City of Kelowna
1435 Water Street
Kelowna BC, V1Y 1J4

Attention: Jose Garcia, Regional Compost Facility Supervisor

Dear Jose:

Subject: Air Emissions Review Study for the Commonage Biosolids Facility per the Air Discharge Permit 108537 Requirements

WSP Canada Inc. (WSP) is pleased to submit this Air Emissions Review Study (AERS) report to the City of Kelowna for the Regional Biosolids Composting Facility located at 551 Commonage Road, Vernon, BC, V1H 1G3. WSP completed this AERS in accordance to the monitoring requirements set out in the BC Ministry of Environment (MoE) Permit 108537.

If you have any questions or comments regarding the AERS report, please contact the undersigned.

Yours sincerely,

Curtis Wan, M.A.Sc., P.Eng.
Environmental Engineer

CW/sp

WSP ref.: 181-01348-00

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SIGNATURES

PREPARED BY

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REVIEWED BY

Curtis Wan, M.A.Sc., P.Eng
Environmental Engineer

This report was prepared by WSP Canada Inc. for the account of City of Kelowna, in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects WSP Canada Inc.'s best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

The original of the technology-based document sent herewith has been authenticated and will be retained by WSP for a minimum of ten years. Since the file transmitted is now out of WSP's control and its integrity can no longer be ensured, no guarantee may be given with regards to any modifications made to this document.

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1 INTRODUCTION

1.1 PURPOSE

The City of Kelowna's Regional Biosolids Composting Facility (RBCF) at 551 Commonage Road, Vernon, V1H 1G3, operates under the British Columbia Ministry of Environment's Permit Number 108537 (hereinafter referred to as "the Permit"), last dated on July 12th of 2017. As part of the Permit requirements, an Air Emissions Review Study (AERS) is required to be submitted to the Director by March 31, 2018 and must fulfill the specific requirements outlined in section 4.4 of the Permit as listed below:

- 4.4.1. Describe odour emissions on-site for each odour generating area;
- 4.4.2. Describe how odours are migrating off-site and identify all affected areas;
- 4.4.3. Use quantitative and qualitative units for descriptions;
- 4.4.4. Include daily, seasonal and annual trends;
- 4.4.5. Discuss how meteorological conditions effect odour generation and dispersion;
- 4.4.6. Provide a qualitative assessment of how odours have improved since 2010;
- 4.4.7. Report on the effectiveness of odour mitigation strategies used at the facility;
- 4.4.8. Discuss calibration schedule/requirements of the OdoWatch system;
- 4.4.9. Make recommendations on how the facility could further reduce its odour emissions.

The Permit also stipulates the AERS must be performed by qualified professionals in order to review and analyze all emissions data collected at the Facility with e-noses, H_2S monitors and odourous gas measurements. To that end, this AERS report has been prepared by WSP Canada Inc. (WSP) to meet this objective and address the aforementioned Permit requirements in the following sections of the report.

1.2 THE FACILITY

1.2.1 EMISSION SOURCES

There are many potential on-site odour sources at the RBCF. The relative odour significance of these potential sources are due to their size, such as the final storage piles, while some are due to their intensity, such as the biofilter surface. Table 1-1 below is a partial list of the odour sources and their relative significance, and Figure 1-1 illustrates each referenced location.

Table 1-1 List of potential on-site odour emission sources

Description	Figure Reference	Relative Significance	Type of Significance
Biosolid hauling		Low	Intensity
Fresh tipped biosolids area	A	Can be high	Intensity
Mixing building	B	Can be high	Size/Intensity
Wood waste storage areas	C	Low	Size
Primary composting zones		Can be high	Size
Building / breaking down primary composting piles		Low	Intensity
Paved working area	D	Low	Intensity
Secondary composting zones		Medium	Size
Building / breaking down secondary compositing piles		Medium	Size
Aeration floor trenches	E	Can be high	Intensity
Aeration system sumps	F	Can be high	Intensity
Primary / secondary leachate collection holding tanks	G	Can be high	Intensity
Curing piles		Low	Size
Overs (slightly disturbed)		Low	Intensity
Sedimentation pond (upper)	H	Can be high	Intensity
Biofilter surface	I	Can be high	Intensity
Constructed drainage pond	J	Can be high	Intensity
Screening operations	K	Medium	Intensity
Final storage piles	L	Low	Size
Site housekeeping		Low	Size
Biofilter floor cleaning		Low	Intensity
Lower drainage pond		Medium	Intensity

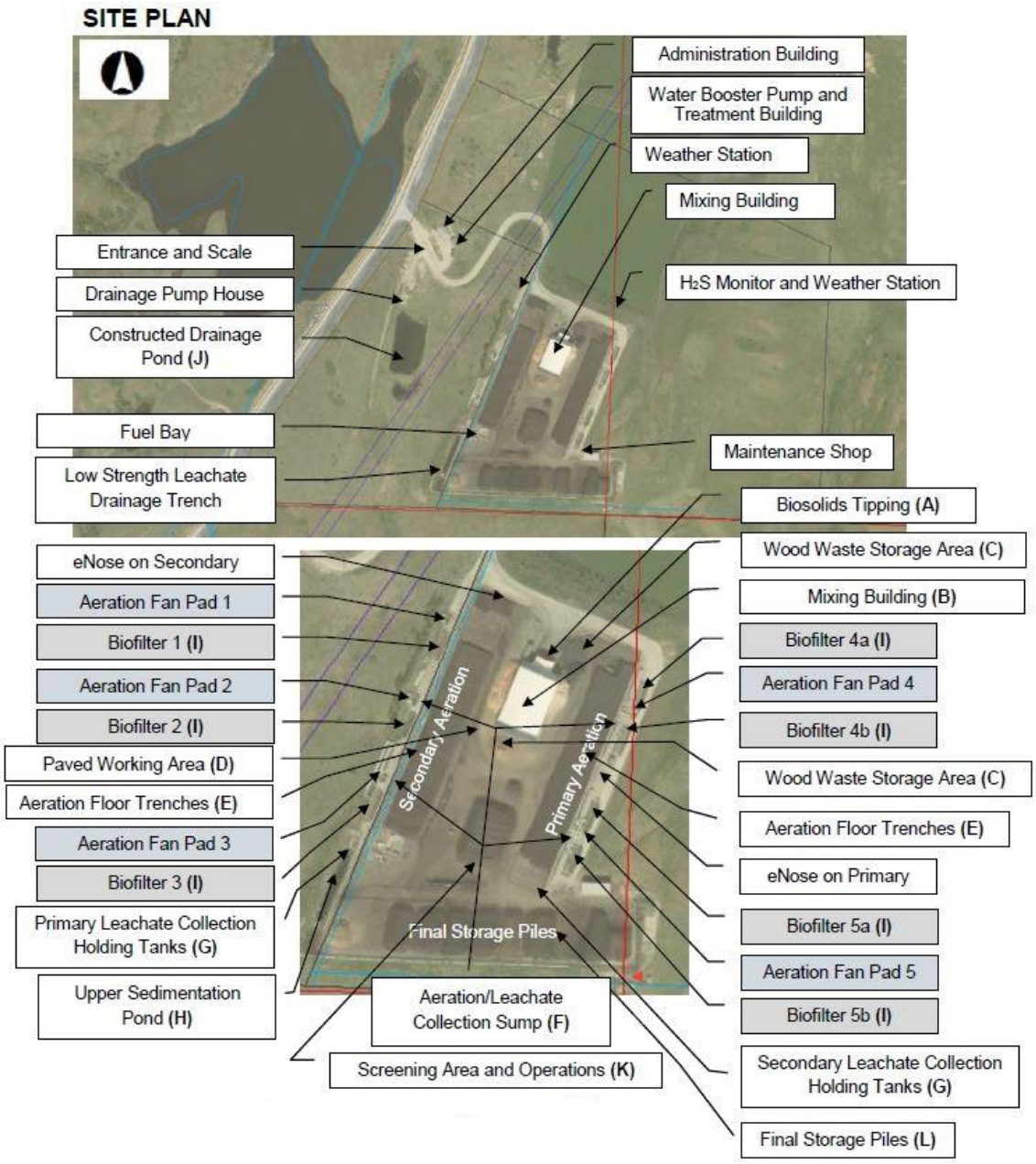


Figure 1-1 Site plan and odour emission sources

1.2.2 ON-SITE MONITORING PROGRAM

The odour monitoring program at the RBCF provides on-site data records of odour, gaseous contaminants and meteorological conditions as outlined in Table 1-2 below. Figure 1-2 also illustrates the locations of odour monitoring instruments and the four (4) property boundary alert points. In addition, the OdoWatch System's dispersion modelling also performs odour predictions at five (5) off-site alert points as shown in Figure 1-5. The alert points represent the receptor locations upon which odour dispersion modelling predictions would be performed.

Table 1-2 Instrumentation details

Monitoring Method	Equipment	Parameter(s) Measured	Data Interval	Start of Available Data
Continuous and Real-time	OdoWatch System – eNoses	Odour Units (OU/m^3)	4-Minute	June 2010
	OdoWatch System – odour dispersion modelling	Predicted Odour Concentration (OU/m^3)	4-Minute	August 2011
	OdoWatch System – weather towers	Wind Speed (m/s) Wind Direction (°) Temperature (°K) Solar Radiation (W/m^2) Pressure (mmHg) Relative Humidity (%)	4-Minute	April 2010
	Jerome hydrogen sulphide sensor	H_2S Concentration (ppm)	30-Minute	February 2014
Monthly Survey	Jerome hydrogen sulphide sensor	H_2S Concentration (ppm)	Monthly	July 2014
	Gastec sampling equipment	NH_3 Concentration (ppm) NH_2 Concentration (ppm)		

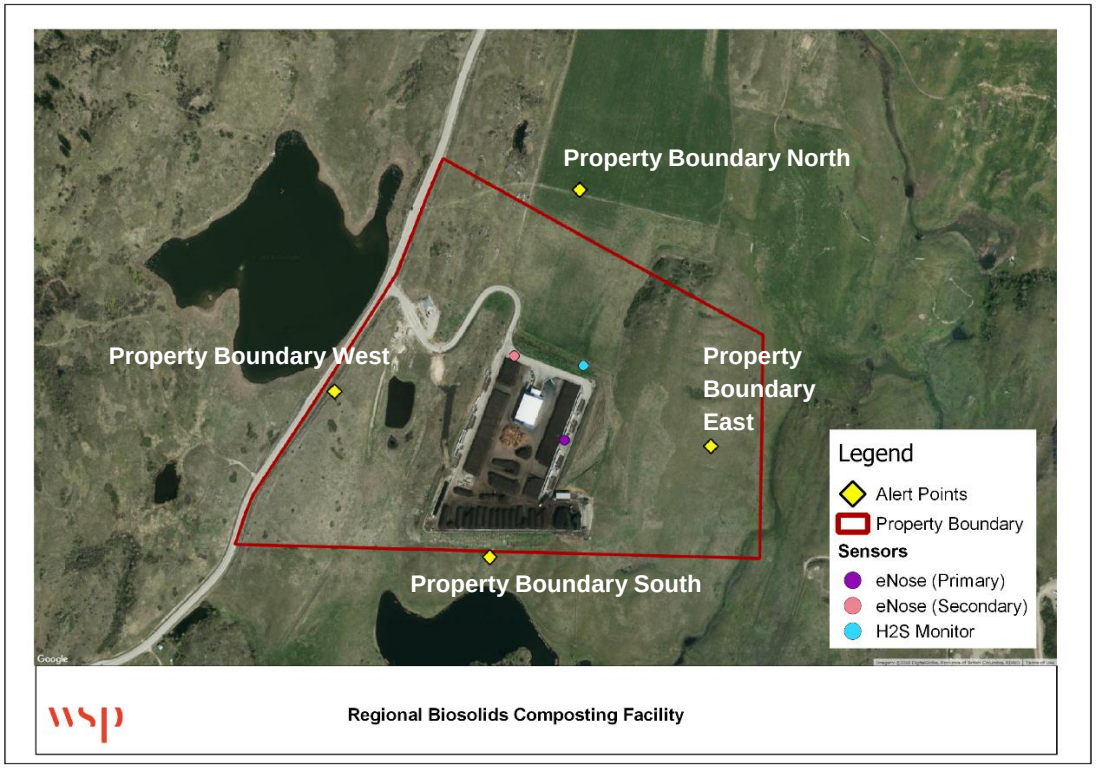


Figure 1-2 On-site property boundary alert points

CONTINUOUS ODOUR MEASUREMENT AND REAL-TIME MODELLING

The major triggers for the RBCF's monitoring plan are based on the continuous measurements of odour, using electronic noses (eNoses) developed by Odotech for the monitoring of odour, and a Jerome hydrogen sulphide monitor. eNoses are located at the middle of the primary aeration area and the north end of the secondary aeration area. The hydrogen sulphide monitor and a permanent weather station are also located at the north end of the site. The locations of the on-site continuous monitoring instruments are displayed on Figure 1-3 on the following page.

The eNoses are part of OdoWatch® continuous odour measurement and monitoring system (OdoWatch System). The OdoWatch® system integrates meteorological data received from the weather tower and odour data from the eNoses, and then the system computes an atmospheric dispersion of odours. It displays the odour dispersion plume, colour-coded according to the odour concentration (odour units), superimposed on a site aerial map. This enables the operator a visualized glance of the site's odour impacts. The major benefit of the OdoWatch® is to provide quantitative odour measurements allowing a scientific discussion with the facility's neighbours and regulatory authorities, when discussing potential odour issues from the site.

These devices continuously measure odour levels (in odour units) and hydrogen sulphide levels (in ppm) at 4-minute interval and 30-minute interval, respectively.

MONTHLY ODOUROUS GAS SAMPLES

The data from the continuous monitoring devices are supplemented by odorous gas measurements - which include H_2S (hydrogen sulphide), NH_2 (amines) and NH_3 (ammonia) - at several locations on-site, conducted on a monthly basis. The primary purpose of these measurements is to build up a database of information of typical odour levels throughout the site. Future grab sample odour measurements and odorous gas measurements can then be compared to these typical levels, and if there is a dramatic spike (or dip), action should be taken to determine the cause, and appropriate changes can be made.

The sample locations for the grab sample odour measurement and odorous gas measurements are shown on the site plan below and are as follows:

- Fresh tipped biosolids area, within 5 minutes of being tipped (A)
- Mixing building, while mixing (B)
- Primary zone, positive air (C)
- Primary zone, negative air (D)
- Primary zone, air off (E)
- Biofilter intakes (F)
- Primary biofilter surface (G)
- Secondary biofilter surface (H)
- Secondary zone, one mid aged zone, turned to closed (I)
- Final storage piles (J)

However, the only monthly odourous gas sampling data made readily available to WSP for analysis at the time of preparing this AERS is sampling data from the biofilters from 2014 to 2017.

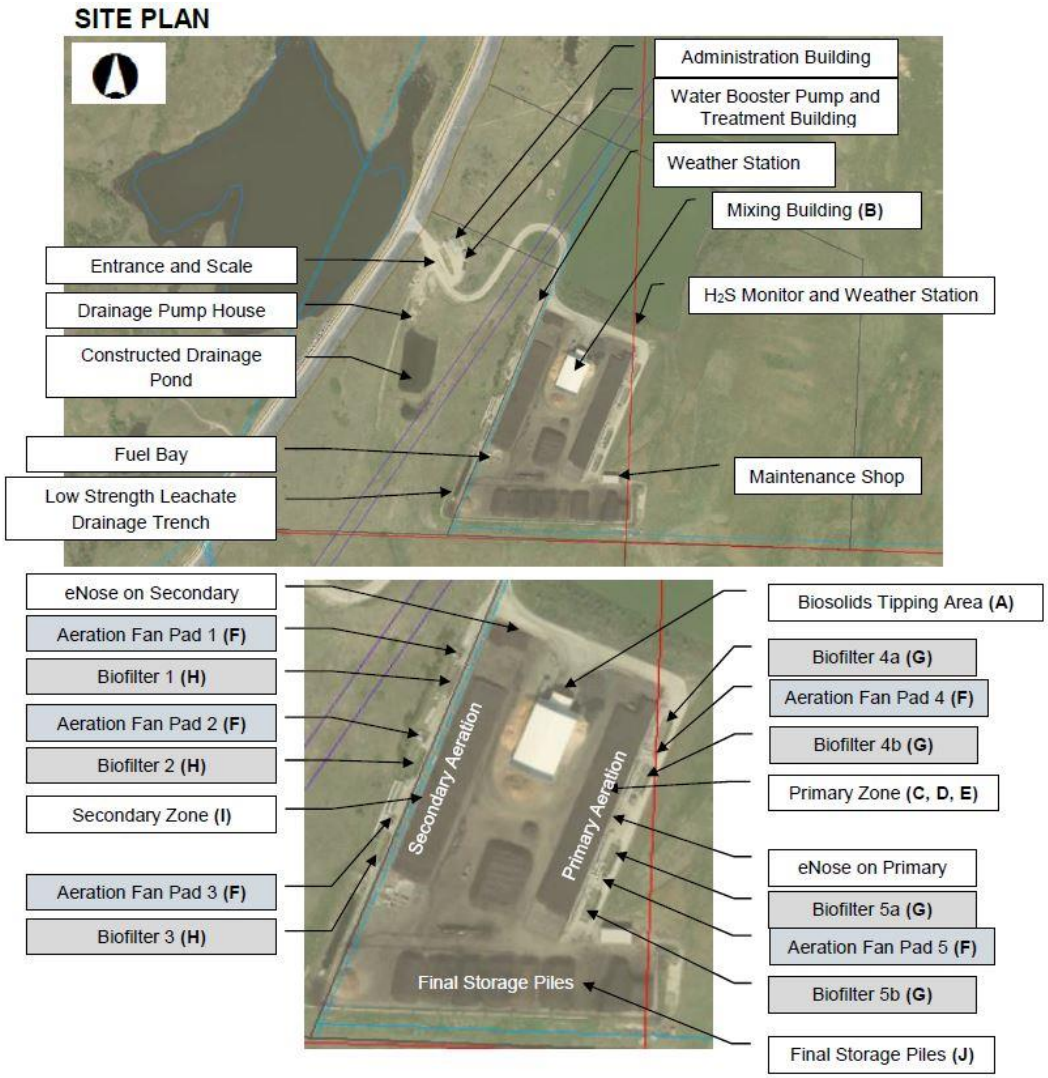


Figure 1-3 Site plan and locations of on-site sampling points and monitoring instruments

1.2.3 ODOUR LEVEL THRESHOLDS

Desirable, higher, and maximum levels of measured odour and H_2S determined as part of the Facility's Odour Management Plan (OMP, November 2010) and the corresponding action plans in response to each odour threshold level's exceedances were set forth in the OMP as follows:

- Stage 1 exceedance, triggered by exceeding the desirable levels of 0.001 ppm H_2S for a rolling 2-hour time period and/or projected odour intensity of 50 OU/m^3 at the property boundary for a rolling 2-hour time period, will result in a thorough site review;
- Stage 2 exceedance, triggered by exceeding the threshold of 0.003 ppm H_2S for a rolling 2-hour time period and/or projected odour intensity of 75 OU/m^3 at the property boundary for a rolling 2-hour time period, will result in a thorough composting process review and process adjustment;
- Stage 3 exceedance, triggered by exceeding the threshold of 0.005 ppm H_2S for a rolling 2-hour time period and/or projected odour intensity of 100 OU/m^3 at the property boundary for a rolling 2-hour time period, will result in an odour prevention activity.

Although the rolling averaging period for these odour level thresholds was changed from 2-hour to 1-hour resulting from an update made to the OMP in November of 2017, this AERS retains the use of a 2-hour rolling averaging time period considering that the monitoring period of interest is from 2010 to 2017.

1.3 OFF-SITE

As a way to evaluate the potential odour impacts on the surrounding area, a brief background odour survey was conducted in 2009 within the surrounding neighborhood, as well as the inclusion of select off-site receptors in the OdoWatch System's odour dispersion model. The OdoWatch System not only performs odour dispersion modelling for four (4) plant boundary alert points, but also for five (5) off-site alert points. Furthermore, the RBCF's monitoring plan also maintains a complaint management process such that any odour complaints lodged against the RBCF would be recorded and responded to with appropriate actions.

1.3.1 SURROUNDING AREA (BACKGROUND) ODOUR MEASUREMENT

In June of 2009, a sampling location at Kekuli Bay Estates (High Ridge Gate) was established. The purpose of this was to define the level of odour experienced in this area when the compost odour was present.

On September 30, 2009 background odour samples were taken at a number of locations around the site. The purpose of these samples is to establish the background odour levels surrounding the facility. The locations are as follows and are shown in Figure 1-4 below.

- Commonage Road
  - Driveway to 637 Commonage Road (#1)
  - Driveway to 585 Commonage Road (French residence) (#2)
  - Entrance to Composting Facility (#3)
  - Driveway to 520 Commonage Road (#4)
  - Intersection of Bailey and Commonage Road (#5)
- Kalamalka Lakeview Drive / High Ridge Road
  - Kalamalka Lake Lookout (A)
  - Gravel Pull Out on East Side of Road (1.0 km north of Kekuli Bay Estates sign) (B)
  - 315 Kalamalka Lakeview Drive driveway (High Ridge Gate) (C)
  - Driveway at 429 High Ridge Road (D)
  - Entrance to Kekuli Bay Provincial Park (E)

These background measurements indicated that odour is present at a variety of intensities around the site. As well, the tests indicated that the composting site is not the only odour source in the area.

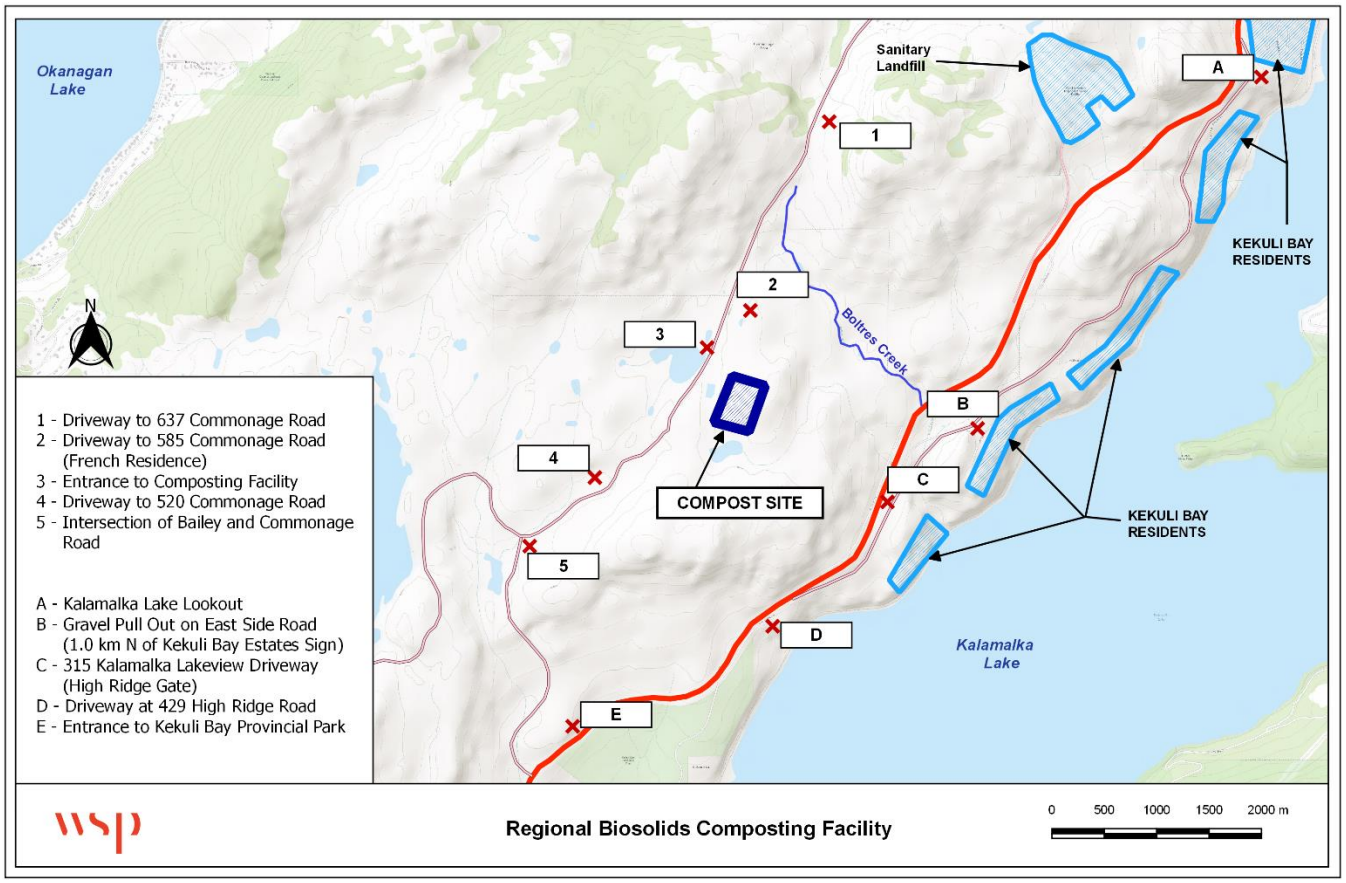


Figure 1-4 Background odour sample locations

1.3.2 OFF-SITE MONITORING PROGRAM

When a neighbourhood odour report (or complaint) is made, the following procedures are used:

- A comparison / evaluation of the on-site Odowatch system will be made. This will include:
  - Time of day
  - Temperature, wind direction and speed and solar radiation data
  - Predicted odour levels at each property boundary at the time of the report
- An evaluation of whether or not an unusual on-site activity that creates higher than usual odour potential was taking place.
- An evaluation of whether or not a Stage 1, Stage 2 or Stage 3 exceedance was taking place.
- For information, the projected odour intensity at a nearby neighbourhood alert point will be recorded. The following Figure 1-5 shows the neighbourhood alert point locations. Please note this project only allows for the impact of the biosolids facility and does not allow for any other odour source.
- A response will be prepared for the creator of the neighbourhood (or complaint) report.
- All responses and neighbourhood (or complaint) reports are available upon request.

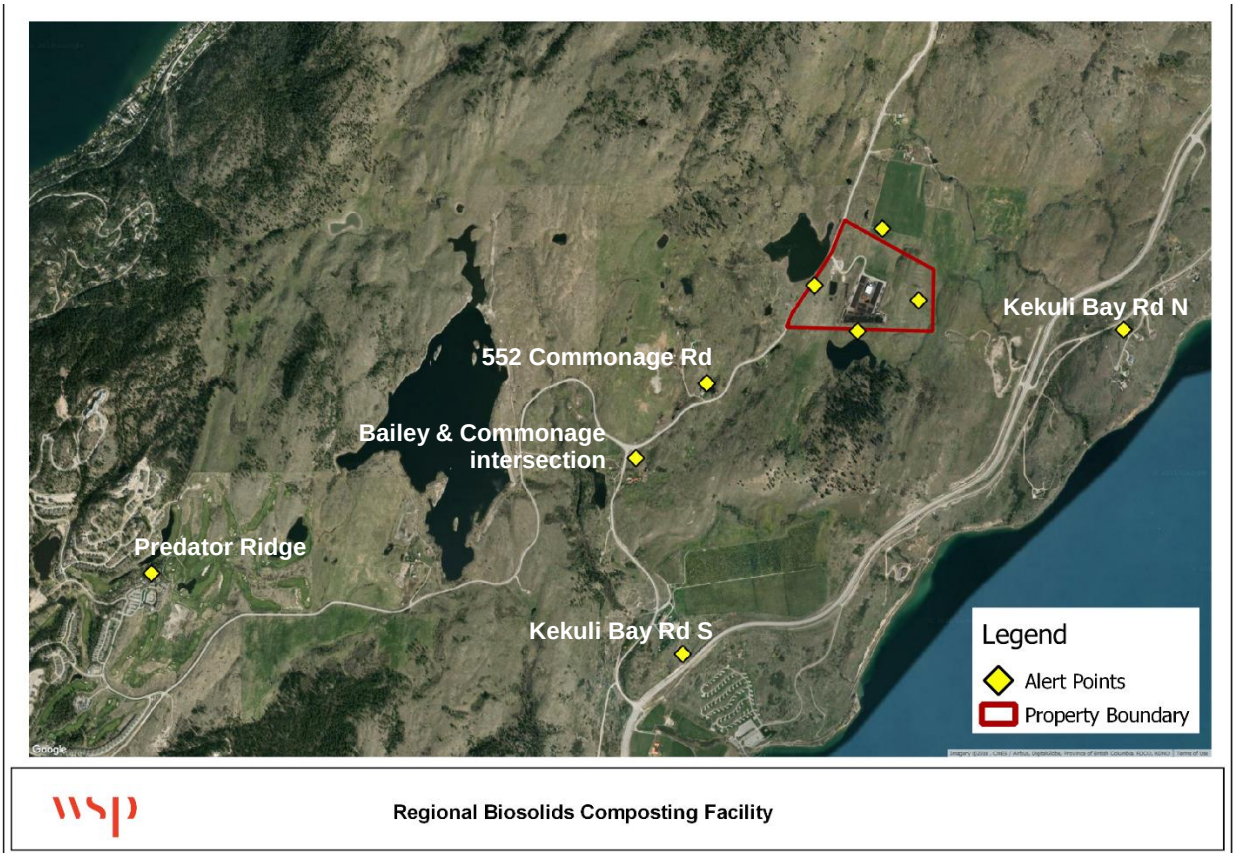


Figure 1-5 Off-site alert points

2 DATA ANALYSIS RESULTS

This section presents a summary of the data collected over the entire course of odour monitoring program established at the RBCF. Considering the commencement of RBCF's monitoring plan in 2010 and the submission date of this AERS, the monitoring period for data analysis of odour, gaseous contaminants and meteorological records was determined to be January 1, 2010 through December 31, 2017. However, it should be noted that not all of the monitoring instruments started operation in 2010.

As outlined in the previous section, the monitoring program established at the RBCF consists of continuous odour measurement from two on-site eNoses (primary and secondary); real-time odour dispersion modelling predictions for four (4) on-site property boundary alert points and five (5) off-site alert points; continuous measurements of on-site H_2S and meteorological conditions; on-site monthly sampling of H_2S, NH_2 and NH_3; and ongoing neighbourhood odour complaint tracking and inspection. Annual summary statistics for average, maximum and 98th percentile measures, as well as data completeness are tabulated for each parameter presented in tabular format. Diurnal, seasonal and annual trends are analyzed for both odour monitoring and modelling results as illustrated in figures.

2.1 ODOUR

2.1.1 CONTINUOUS ENOSE MEASUREMENTS

The continuous, 4-minute odour monitoring data collected at both primary and secondary eNoses were analyzed for 2010 to 2017. The summary statistics presented in Table 2-1 below demonstrates that overall, the average and maximum odour levels observed by the primary eNose are higher than that of the secondary eNose. By comparing the 98th percentile odour units (OU) or odour concentration analyzed for the entire monitoring period between the primary and secondary eNoses, a lower 98th percentile value from the primary eNose suggests that a small percentage of high odour concentrations increases the average primary eNose odour concentrations to be higher than that the average secondary eNose odour concentrations.

When examining the summary statistics by each year analyzed, the two eNoses exhibit different inter-annual variations as illustrated by Figure 2-1. The average odour concentrations for both eNoses show a decreasing trend from 2010 to 2013, following which the average odour level trends of both eNose starts to deviate from each other. From 2013 onwards, the primary eNose odour concentrations exhibits an increasing odour trend until a slight drop in 2017, whereas secondary eNose depicts an up and down pattern.

In addition to annual trends, the two eNoses exhibit similar behaviour in terms of diurnal and seasonal timescales as presented by Figure 2-2 and Figure 2-3. Overall, the measured odour levels from 2010 to 2017 are higher during the hottest time of the day in the early afternoon hours and in the warmest months of the year during the summer season. It is also evident from the diurnal and seasonal trends that primary eNose measures generally higher odour levels than secondary eNose.

Table 2-1 Summary statistics of eNose measurements (2010-2017)

Year	Primary eNose				Secondary eNose			
	Average (OU/m^3)	98th percentile (OU/m^3)	Maximum (OU/m^3)	Data Completeness (%)	Average (OU/m^3)	98th percentile (OU/m^3)	Maximum (OU/m^3)	Data Completeness (%)
2010	85	536	1877	60	74	322	1462	58
2011	53	82	15930	94	42	105	12092	94
2012	34	63	3415	96	36	150	1320	96
2013	26	62	293	88	30	281	880	89
2014	40	86	245	92	12	69	89	83
2015	48	83	233	98	37	171	531	86
2016	71	108	32751	96	16	91	583	80
2017	66	113	27479	98	27	94	950	95
Entire period	**51**	**96**	**32751**	**95**	**33**	**162**	**12092**	**90**

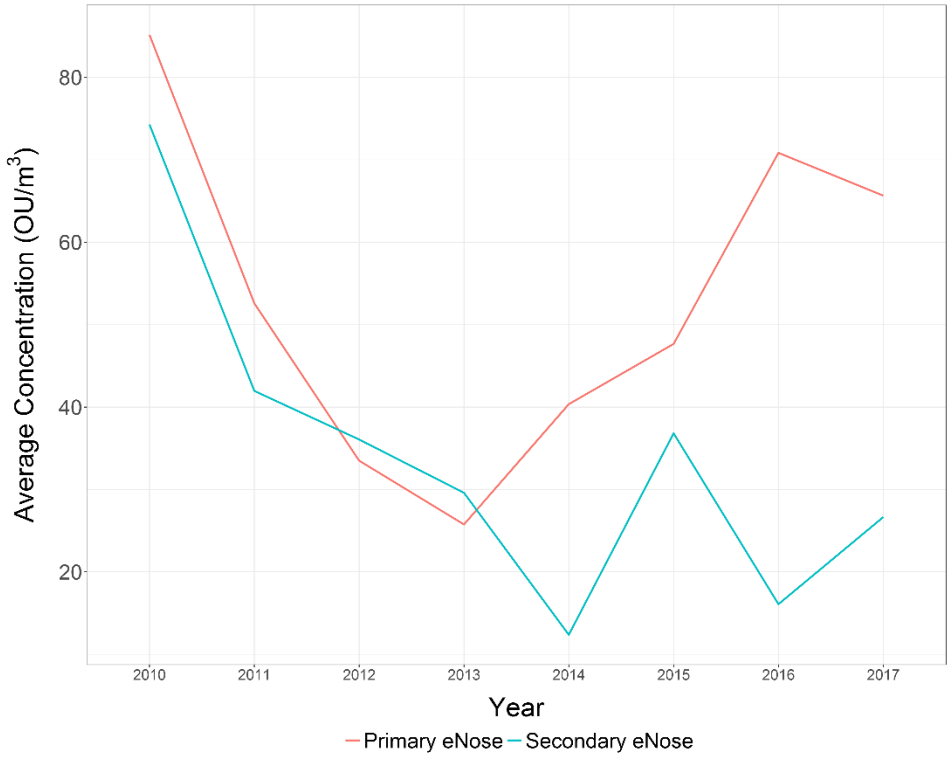


Figure 2-1 Annual trend of eNose odour measurements (2010-2017)

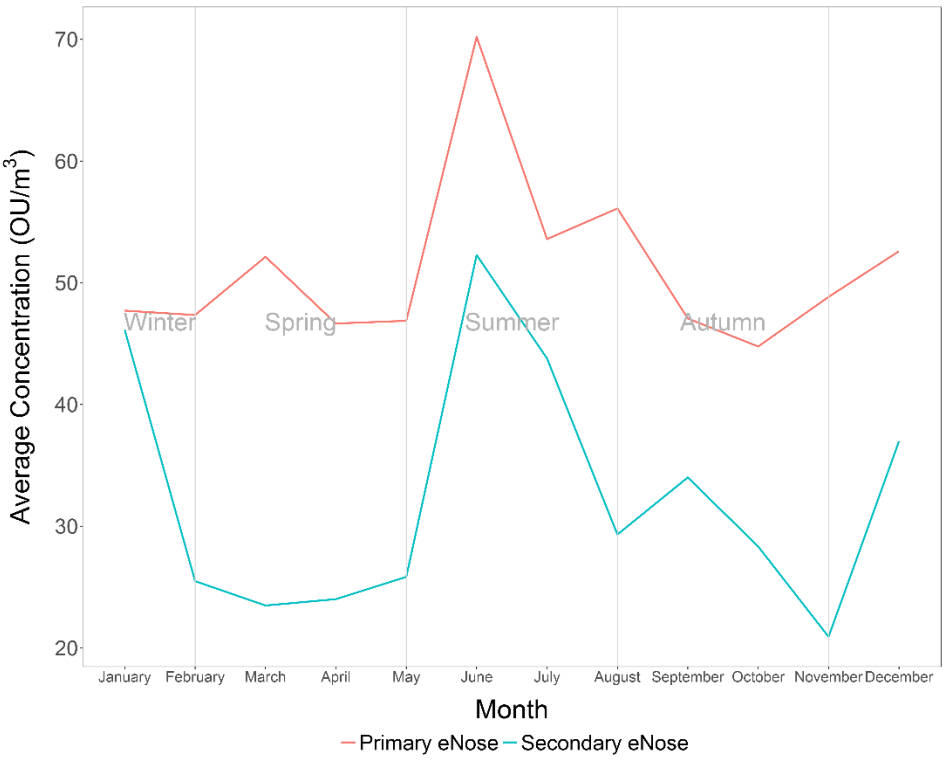


Figure 2-2 Seasonal trend of eNose odour measurements (2010-2017)

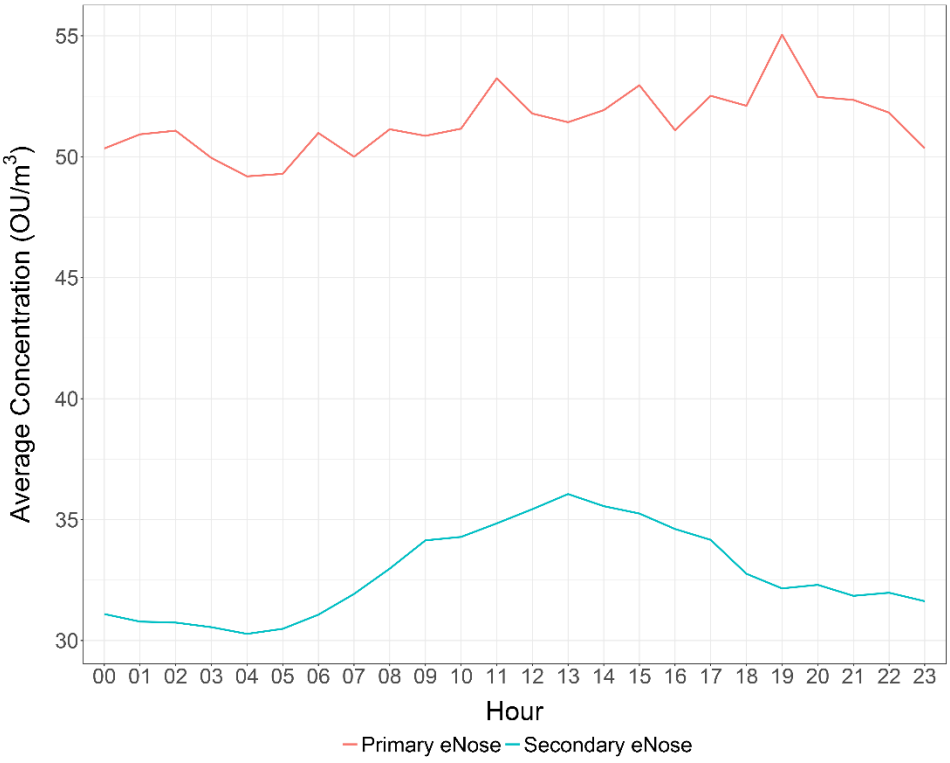


Figure 2-3 Diurnal trend of eNose odour measurements (2010-2017)

2.1.2 MODELLING PREDICTIONS

The continuous and real-time dispersion modelling by RBCF's OdoWatch system is conducted at 4-minute interval for four (4) on-site property boundary alert points or receptors and five (5) off-site receptors as listed in Table 1-2 below. Summary statistics and trend analysis are analyzed for each receptor using odour predictions from 2010 to 2017 tabulated as rolling 2-hour averages, such that the odour threshold levels can be compared and evaluated for exceedances. As shown by table below, none of the property boundary or off-site receptors exceeded any of the threshold levels during the 2010 to 2017 monitoring period.

Based on all measures of the summary statistics presented as well as the trend analysis charts below, the highest predicted odour levels are observed at the "Property Boundary South" receptor, possibly due to proximity to the RBCF's emission sources compared to the other receptors. The other property boundary receptors observe lower predicted odour levels in general. Similarly, the off-site receptors exhibit much lower odour predictions when compared with the on-site receptors. With respect to the annual variation, the year-by-year patterns shown by both on-site and off-site odour predictions as presented in Figure 2-4 below are significantly different than those of the eNose odour measurements. All of the receptors reveal a gradual increase of predicted odour levels from 2010, reach the peak in 2014, then decrease steadily thereafter. The diurnal and seasonal analysis of predicted average odour concentrations from Figure 2-5 to Figure 2-6 below indicate that all alert points experience higher odour levels at night, and in late morning hours to a lesser extent, during the winter season.

Table 2-2 Summary statistics of predicted odour concentrations for all model alert points (2010-2017)

Alert Point	Average (OU/m^3)	98th percentile (OU/m^3)	Maximum (OU/m^3)	Data Completeness (%)
Property Boundary East	0.82	6.53	35.09	76
Property Boundary North	0.79	4.53	17.67	76
Property Boundary South	2.60	15.30	49.96	76
Property Boundary West	0.99	6.03	19.14	76
552 Commonage Rd	0.09	0.65	1.71	73
Bailey & Commonage intersection	0.05	0.37	2.01	76
Kekuli Bay Rd N	0.03	0.27	2.58	76
Kekuli Bay Rd S	0.03	0.35	3.48	76
Predator Ridge	0.01	0.06	0.51	76

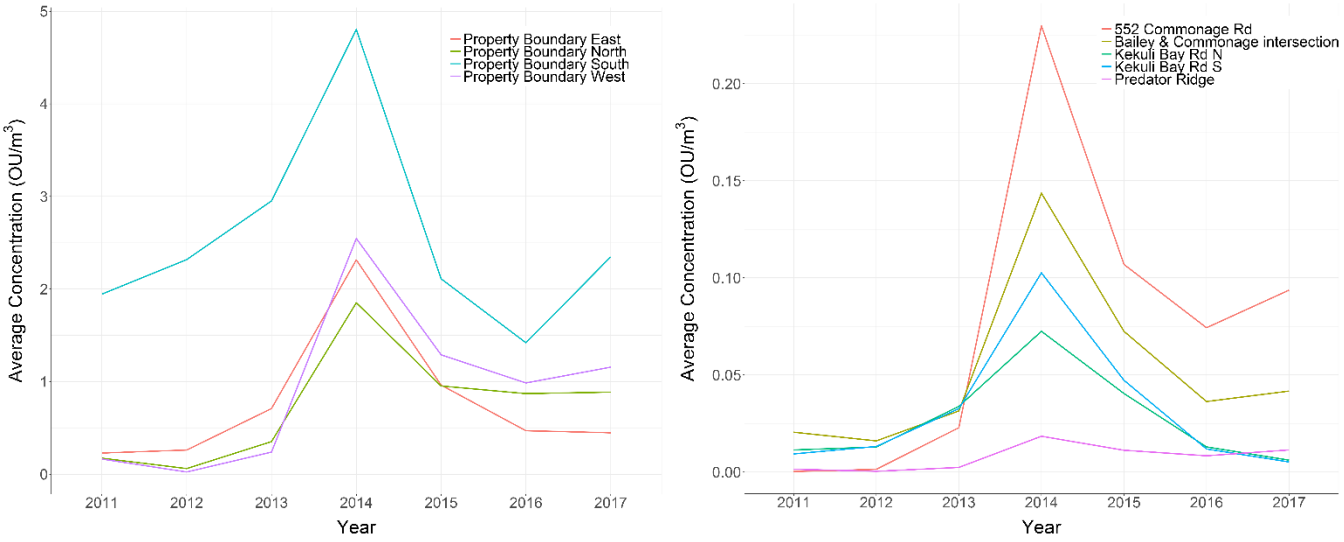


Figure 2-4 Annual trend of odour predictions for both on-site and off-site alert points (2010-2017)

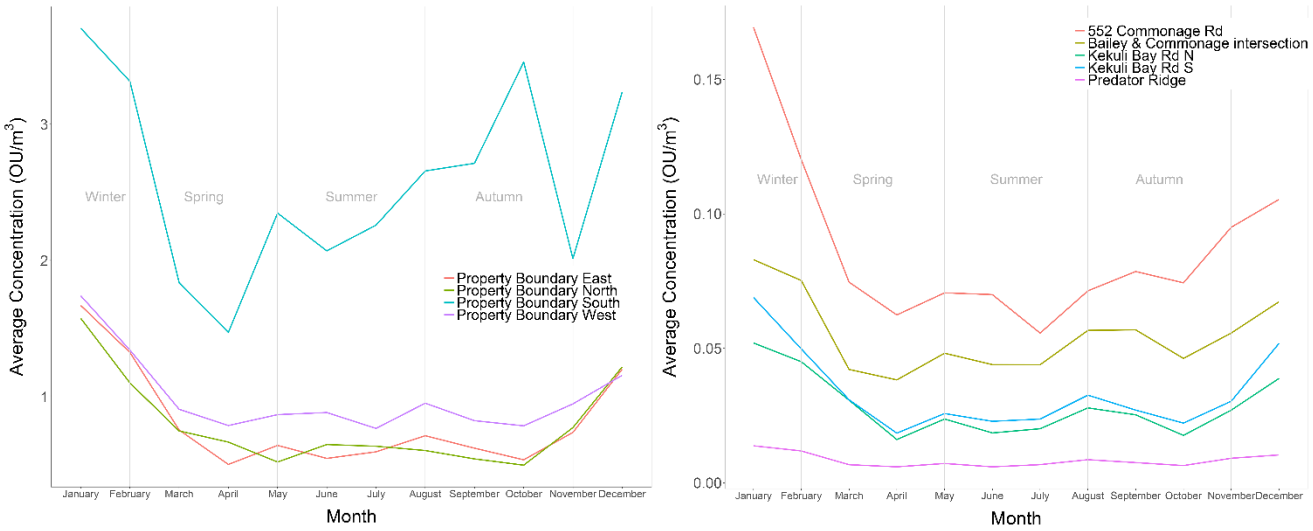


Figure 2-5 Seasonal trend of odour predictions for both on-site and off-site alert points (2010-2017)

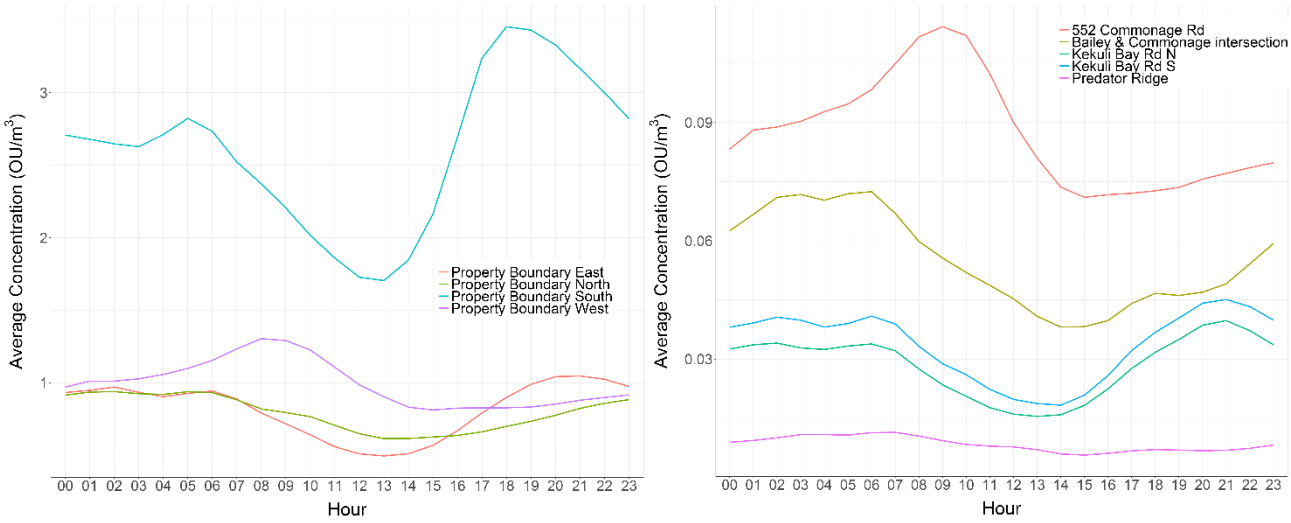


Figure 2-6 Diurnal trend of odour predictions for both on-site and off-site alert points (2010-2017)

2.2 METEOROLOGICAL CONDITIONS

The on-site weather station records various meteorological parameters at 4-minute interval by the OdoWatch system. The most relevant meteorological factors for odour dispersion modelling are wind speed and wind direction, from which the frequency of wind blowing from each direction over a specified period at the on-site weather tower are depicted in circular format as presented by the wind rose plots from Figure 2-7 to Figure 2-9 below. The wind roses also convey additional information, in that each spoke is broken down into discrete frequency categories, representing the percentage of time that winds blow from a particular direction and at certain speed ranges (shown by the coloured bands).

By comparing the annual wind roses from 2010 to 2017, the prevailing winds experienced at the on-site weather station are from the south-southwesterly and also north-easterly flows to a lesser degree, which reflect the influence of the valley alignment in channeling the wind flows. Considering that calm wind and stagnation conditions (consistent light to no winds occurring over a long duration) are frequent phenomena in the bowls and valleys of BC and are often responsible for poor atmospheric dispersion, the frequency of wind speeds under 0.3 m/s are tabulated

for each year and indicated within the wind rose plots of Figure 2-7. The 2014 year experienced the most calm wind conditions at 45.3%, followed closely by 41% in 2013 and 32.8% in 2012, while the rest of the years experienced much lower frequencies ranging from as low as 7% to 15%.

Judging from the seasonal wind roses for the entire monitoring period from 2010 to 2017 in Figure 2-8 below, the seasonal wind patterns at RBCF appear consistent with the valley-driven prevailing winds as seen from the annual wind roses, though the frequency of calm wind conditions is much higher during the winter months. Furthermore, a comparison of daytime (6AM to 6PM) and nighttime (6PM to 6AM) wind roses is presented for the entire monitoring period from 2010 to 2017 in Figure 2-9 below in order to examine the differences in diurnal wind pattern. Although the observed wind patterns are similar between daytime and nighttime, the frequencies of calm winds are higher during nighttime.

By linking the calm wind frequencies analyzed for various temporal timescales to those of the predicted odour concentrations, it could be inferred that calm wind conditions are responsible for the high odour predictions, such as the peak predicted odour concentrations in 2014 as seen from Figure 2-4. The OdoWatch Platform simulates odour dispersion for the RBCF using the AERMOD dispersion model, which is known for its incapability to handle calm winds and stagnate conditions where consistent light to no winds are observed over a long duration. According to the BC Air Quality Modelling Guideline (AQMG, 2015), calm wind conditions and stagnation can lead to unrealistically high concentrations as emissions can accumulate in a localized area due to minimal atmospheric mixing and impinge on the side of a hill, which is a common occurrence in BC valleys and may likely contribute to the high odour predictions during winter nighttime and particularly in 2012 to 2014.

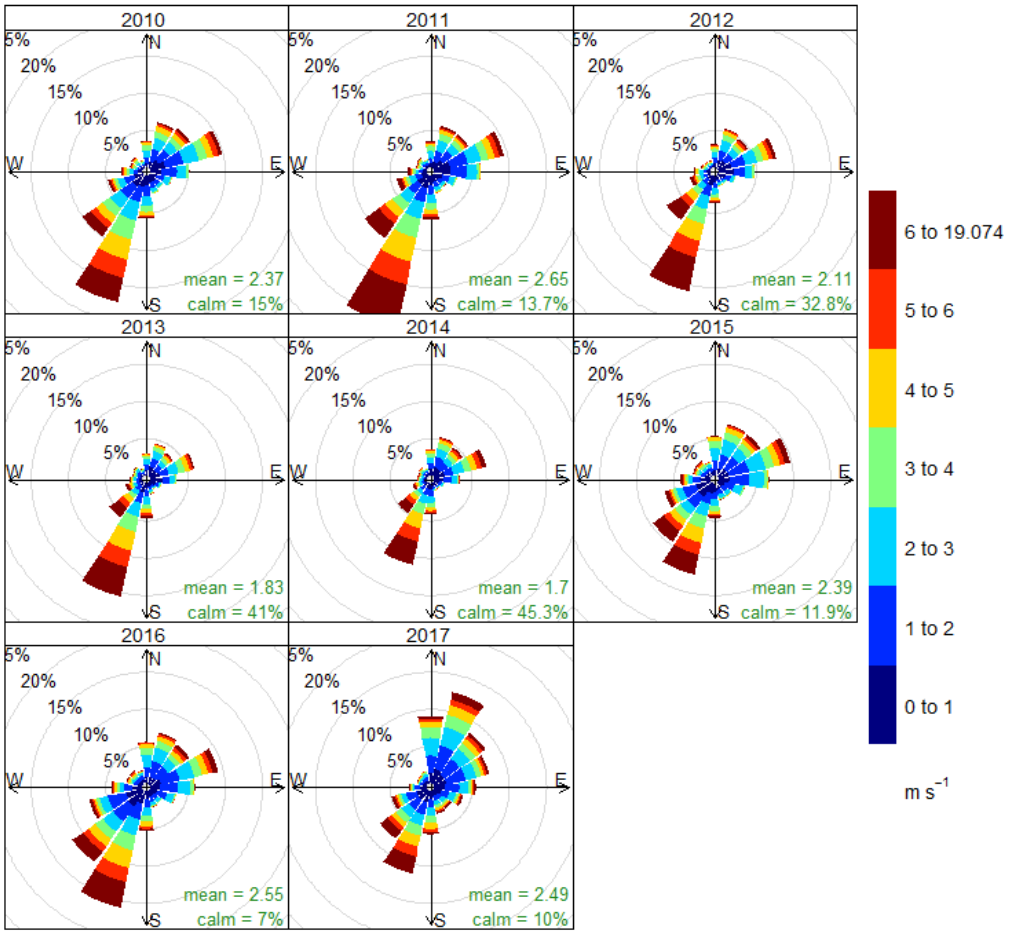
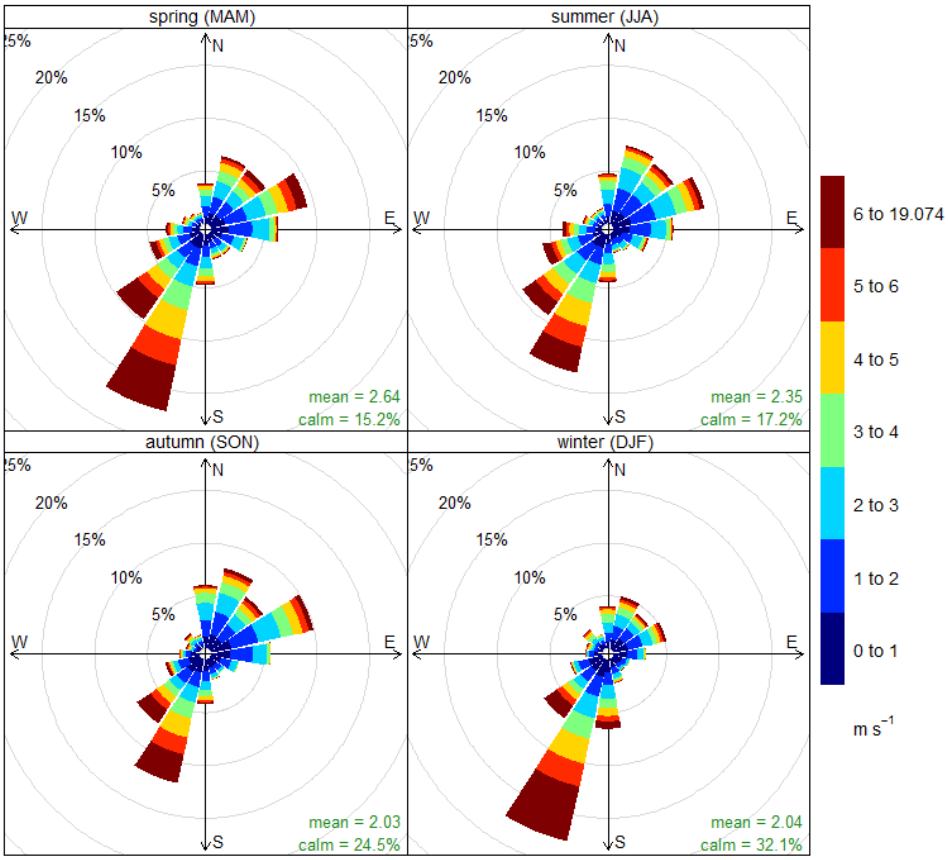


Figure 2-7 Annual wind roses with frequency of calm wind conditions (2010-2017)



Note: Spring (March-May); Summer (June-August); Autumn (September-November); and Winter (December-February)

Figure 2-8 Seasonal wind roses with frequency of calm wind conditions (2010-2017)

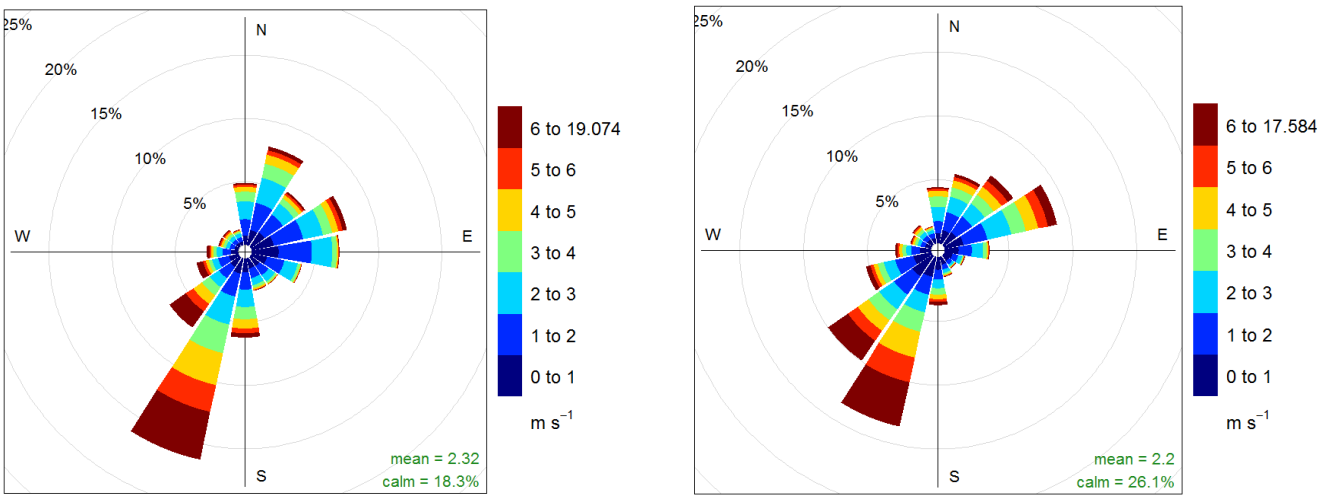


Figure 2-9 Daytime vs. nighttime wind roses with frequency of calm wind conditions (2010-2017)

Polar plots of the 4-minute odour measurements from 2010 to 2017 collected at the primary and secondary eNoses are presented in Figure 2-10. These polar plots visualize the distribution of odour concentrations by both wind speed and wind direction using polar coordinates, which provide directional information on the dispersion of emissions from the RBCF. The polar plot for the primary eNose shows that the highest odour measurements, as marked by the red colour shade, are generally associated with wind conditions from the southeast. Similarly for the secondary eNose, the higher odour measurements are observed with winds generally from the southerly and west-southwesterly directions.

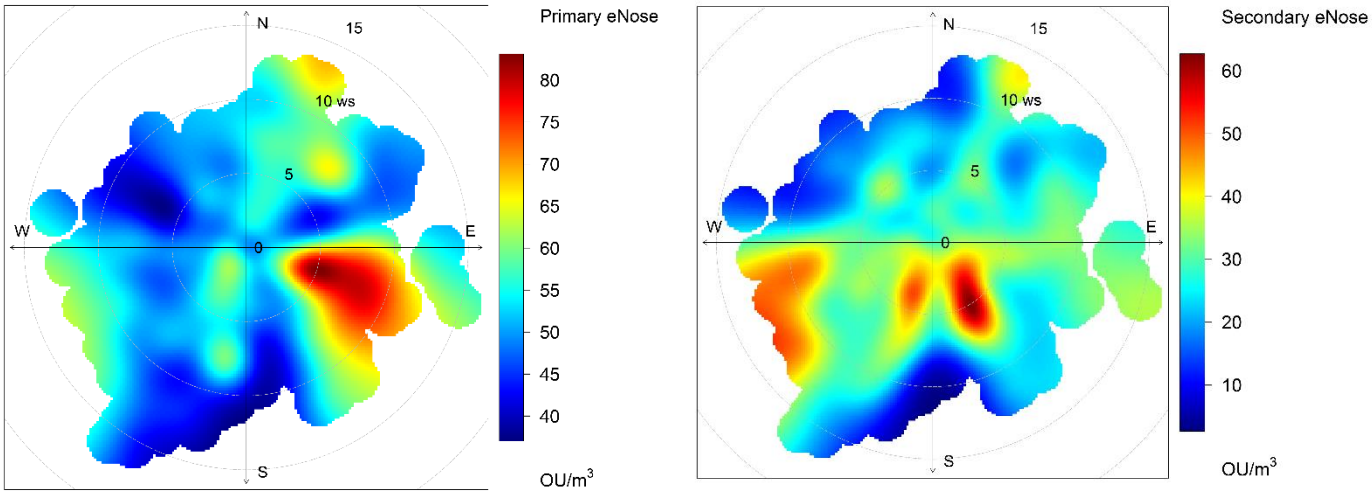


Figure 2-10 Polar chart of both primary and secondary eNose measurements (2010-2017)

2.3 ODOUR COMPLAINT REPORTS

The RBCF has recorded odour complaint reports lodged against the facility since 2009, and the total counts of odour complains received each year from 2009 to 2017 are presented in Figure 2-11 below. The greatest amount of odour complains filed against RBCF is 130 in 2014, followed closely by 124 in 2009, 121 in 2011 and 119 in 2015. In 2013, the RBCF received the least odour complaints with a total number of 46. From the most recent monitoring years in 2016 and 2017, the total number of odour complaints are 71 and 61 respectively, which dropped noticeably from the previous years with the exception of 2013. Despite the odour complaints, the RBCF monitoring program had not exceeded any of the odour threshold levels from 2010 to 2017. In order to provide more context to the odour complaints, the annual counts of odour complaints from 2010 to 2017 are broken down by residents as depicted in Figure 2-12, which shows that 3 residents constituted the majority of odour complaints against the RBCF.

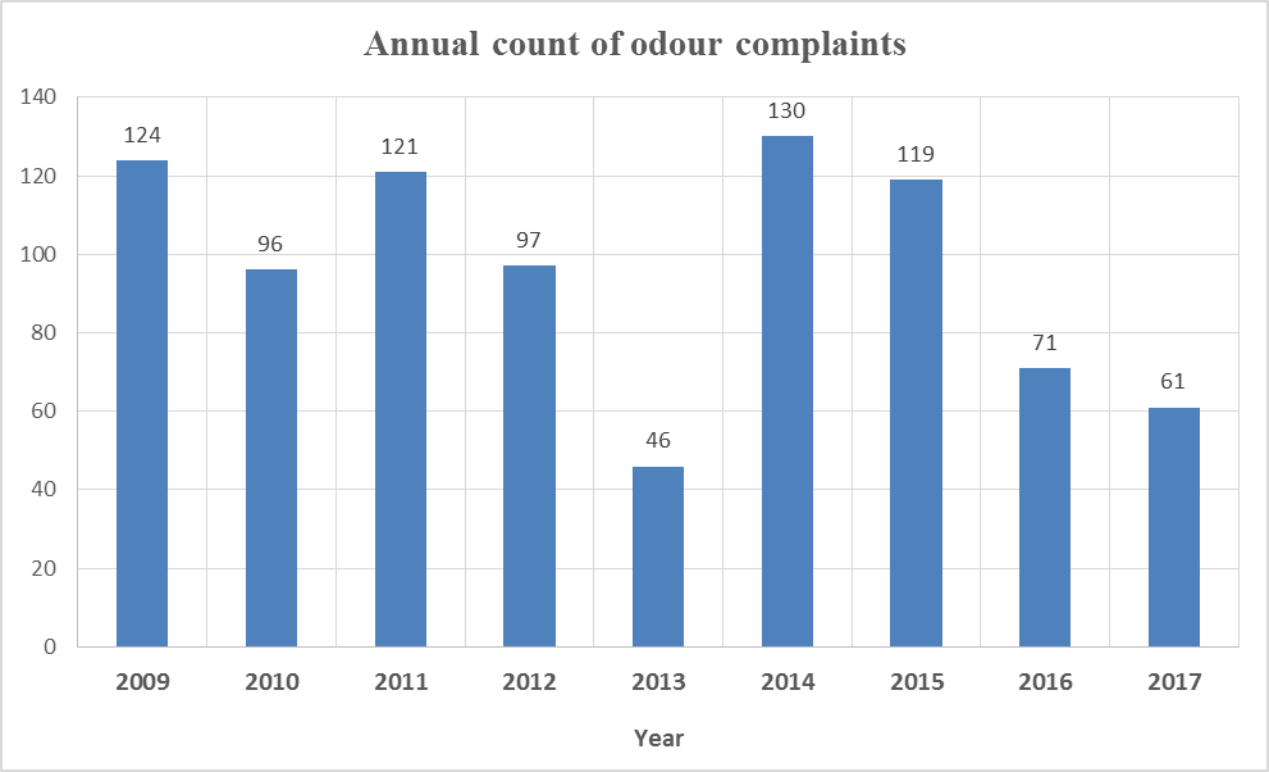


Figure 2-11 Annual count of odour complaints lodged against the RBCF (2009-2017)

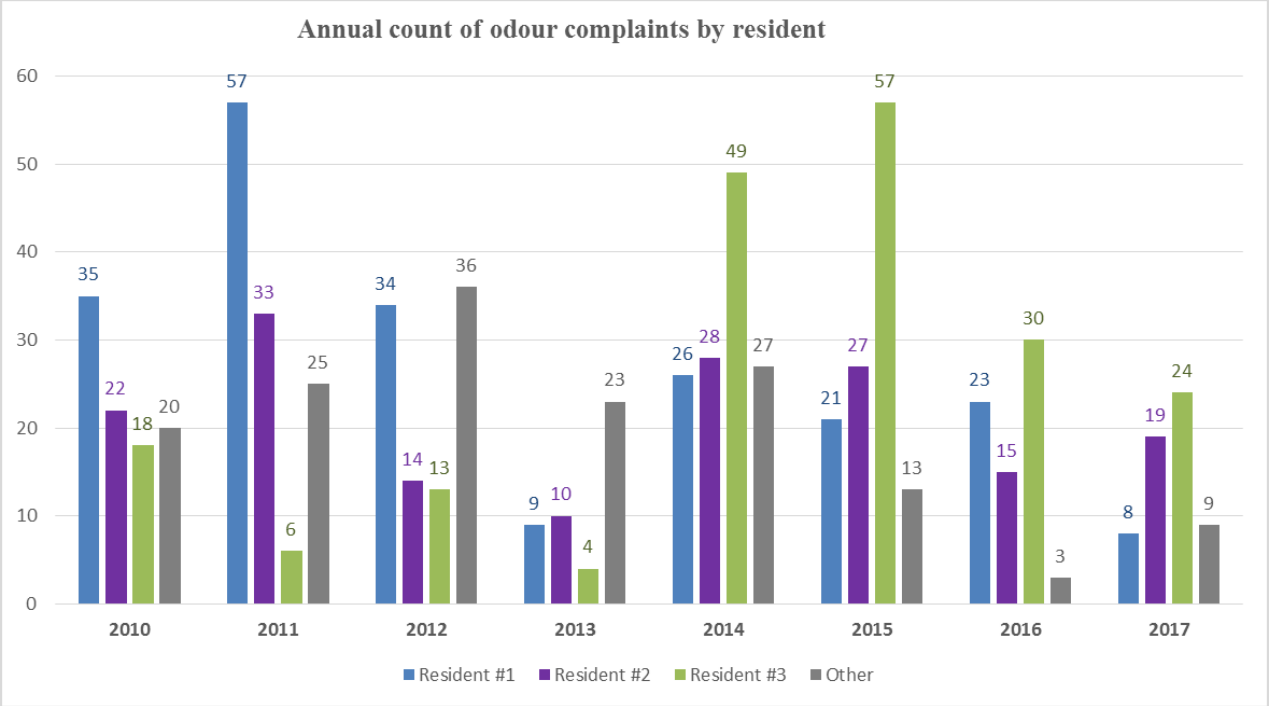


Figure 2-12 Annual count of odour complaints lodged against the RBCF by resident (2010-2017)

2.4 ODOUROUS GASES - H_2S, NH_3 AND NH_2

2.4.1 CONTINUOUS H_2S MEASUREMENTS

The on-site continuous Jerome hydrogen sulphide sensor started has operated since 2010 and collects H_2S measurements every 30 minutes. As a result of data loss from 2010 to 2014, the H_2S measurements are analyzed for 2014 to 2017 only; however, it was by noted by operational staff that there were no high episodes of H_2S observed during this missing time period. The summary statistics of rolling 2-hour H_2S averages tabulated for 2014 to 2017 are presented in Table 2-3. Due to the consistently low H_2S readings and the lack of non-zero values, temporal trend plots are not useful to describe the behaviour of on-site H_2S measurements. Instead, the frequencies of non-zero H_2S readings and H_2S exceedances are provided, which demonstrates low occurrences of H_2S detection, as well as low frequencies of rolling 2-hour H_2S averages exceeding the H_2S threshold levels.

Table 2-3 Summary statistics of H_2S measurements from 2014 to 2017

Year	Average (ppm)	98th percentile (ppm)	Maximum (ppm)	Frequency of non-zero H_2S detection (%)	Frequency of H_2S exceedances (%)	Data Completeness (%)
2014	2.12E-05	5.00E-04	0.00225	4.6	0.3%	92
2015	2.33E-06	0	0.001	0.8	0.0%	94
2016	1.16E-05	0.00025	0.00225	2.7	0.2%	92
2017	2.12E-05	0.00025	0.00075	4.4	0.0%	55
Entire period	**1.40E-05**	**0.00025**	**0.00225**	**1.7**	0.2%	**44**

2.4.2 MONTHLY SAMPLES OF H_2S, NH_3 AND NH_2

Based on the monthly odourous gas sampling data provided by RBCF to WSP at the time of preparing this AERS, only biofilter data had sufficient continuous data from 2014 to 2017 to be analyzed, although a few missing monthly records are observed from the dataset. Table 2-4 below presents the average and maximum measures tabulated for each of the odourous gases (H_2S, NH_3 and NH_2) sampled at each of the biofilters from 2014 to 2017, as well as compares the results analyzed for both untreated odourous gas samples and post-treatment gases exiting through the biofilers. As expected, the untreated odourous gases consistently recorded higher concentrations of all three gaseous contaminants sampled than those treated by the biofilters. Moreover, the biofilters used by the secondary aeration operations – which include biofilter numbers 4a, 4b, 5a and 5b – observed higher odourous gas concentrations than the primary aeration biofilters (biofilter numbers 1, 2 and 3).

Table 2-4 Summary statistics of H_2S, NH_3 and NH_2 monthly samples at the biofilters from 2014 to 2017

Biofilter Number	H_2S		NH_3		NH_2		H_2S		NH_3		NH_2		Count of monthly samples
	Average (ppm)						Maximum (ppm)						
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
1	0.49	0.28	18.09	0.00	30.47	0.00	5.9	4.2	200	0	200	0	35
2	0.26	0.17	15.36	0.00	20.59	0.00	3.6	3.4	200	0	200	0	35
3	0.24	0.09	22.03	0.00	33.76	0.00	2.3	0.5	200	0	200	0	35
4a	1.01	0.10	46.73	0.04	79.12	0.04	6.9	0.8	200	1	200	1	35
4b	1.01	0.18	46.73	0.26	79.12	0.27	6.9	1.7	200	6	200	3.5	35
5a	1.41	0.15	49.36	0.00	76.26	0.06	13.8	0.9	200	0	200	1	35
5b	1.41	0.07	49.36	0.01	76.26	0.00	13.8	0.5	200	0.5	200	0	35

Notes - "Pre" refers untreated odourous gases, and "Post" refers to treated odourous gases vented from the biofilters.

3 DISCUSSION AND CONCLUSION

3.1 ODOUR EMISSION TREND AND MITIGATION PERFORMANCE

Presented below are the trend analysis charts of odour measurements recorded at primary and secondary eNoses from 2010 to 2017. The Theil-Sen estimator in the Openair package of R programming is used to determine trends in measured odour concentrations over the entire course of RBCF's monitoring program. The Theil-Sen estimate analyzes the slope between all data points in the data set (in the case of long-term trends, monthly means are used) and takes the median of these slopes to estimate the trend. The solid line shows the trend estimate and the dashed lines represent the 95% confidence intervals. While the primary eNose shows small increasing trend in on-site odour measurements, the secondary eNose depicts a steady decreasing odour level over the entire monitoring period.

However, it should be noted that the odour dispersion modelling predictions never exceeded the odour thresholds prescribed for the RBCF over the entire course of the monitoring program (2010-2017). Despite a few occurrences of H_2S exceedances, the vast majority of H_2S readings are zero. Nevertheless, the RBCF consistently received odour complaints from the neighboring communities each year since the start of the monitoring program, though the total number of complaints filed against the facility decreased somewhat in the most recent years.

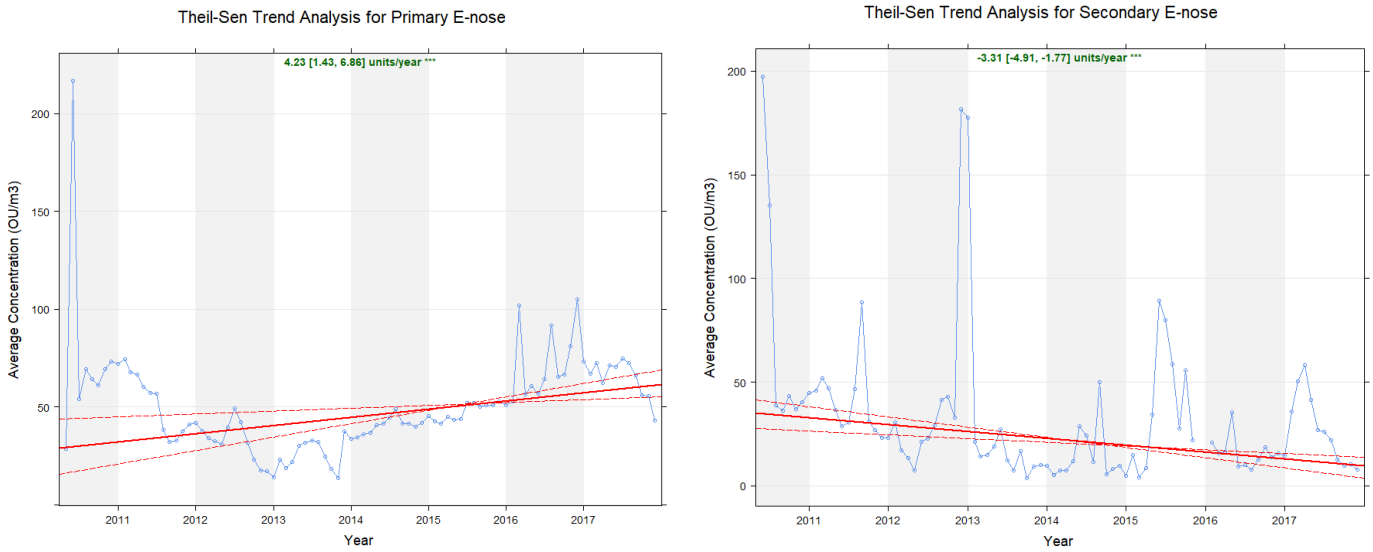


Figure 3-1 Theil-Sen trend analysis of both primary and secondary eNoses odour measurements (2010 to 2017)

3.2 ODOWATCH SYSTEM REQUIREMENTS

The eNoses undergo an annual maintenance and calibration, while the H_2S sensors undergo maintenance and calibration twice a year. There is also a preventative maintenance contract with Odotech for the eNoses, who routinely check on the instrumentation remotely to ensure proper performance. It is recommended that within the next 5 to 7 years, or earlier if there is a significant change in feedstock material, a recalibration of the eNoses be conducted to relate odour units to a greater variety of sources and account for potential new feedstocks, and to update the dispersion modelling parameters as required.

3.3 RECOMMENDATIONS

The RBCF is constantly looking towards ways to progressively reduce and control odours occurring on-site. In the near future, the facility will be implementing:

- An upgrade of the leachate management system through lining of the current drainage pond and trench system.

In addition, the facility will also be exploring options to treat and reuse the high strength leachate, and give consideration of adding aeration to the trench and pond to reduce chance of stagnation and septic conditions. This is expected to have a positive impact on potential off-site odour impacts.

Should there be a need to further reduce and control odours on-site, the following best management practices and emission control technologies will be explored:

- Reduce volumes of material processed through the composting facility
- Optimize existing odour treatment system to respond efficiently to season conditions.
- Use anerobically digested biosolids.
- Full enclosure of the receiving (tipping) operations.
- Full or partial enclosure of the primary aeration composting operations. Negative aeration inside enclosure and biofiltration of odorous air.
- Full or partial enclosure of the secondary aeration composting operations. Negative aeration inside enclosure and biofiltration of odorous air.
- Enclosure of the biofilters, including installing a stack to allow for greater dispersion of odour from the facility

A comprehensive review of the effectiveness and costing for each of these best management practices or emission control technologies would be the first step before implementation.

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Appendix C

Water Quality Report

REPORT

2017 WATER QUALITY MONITORING REPORT, REGIONAL BIOSOLIDS COMPOSTING FACILITY, 551 COMMONAGE ROAD, VERNON, BC

Submitted to:

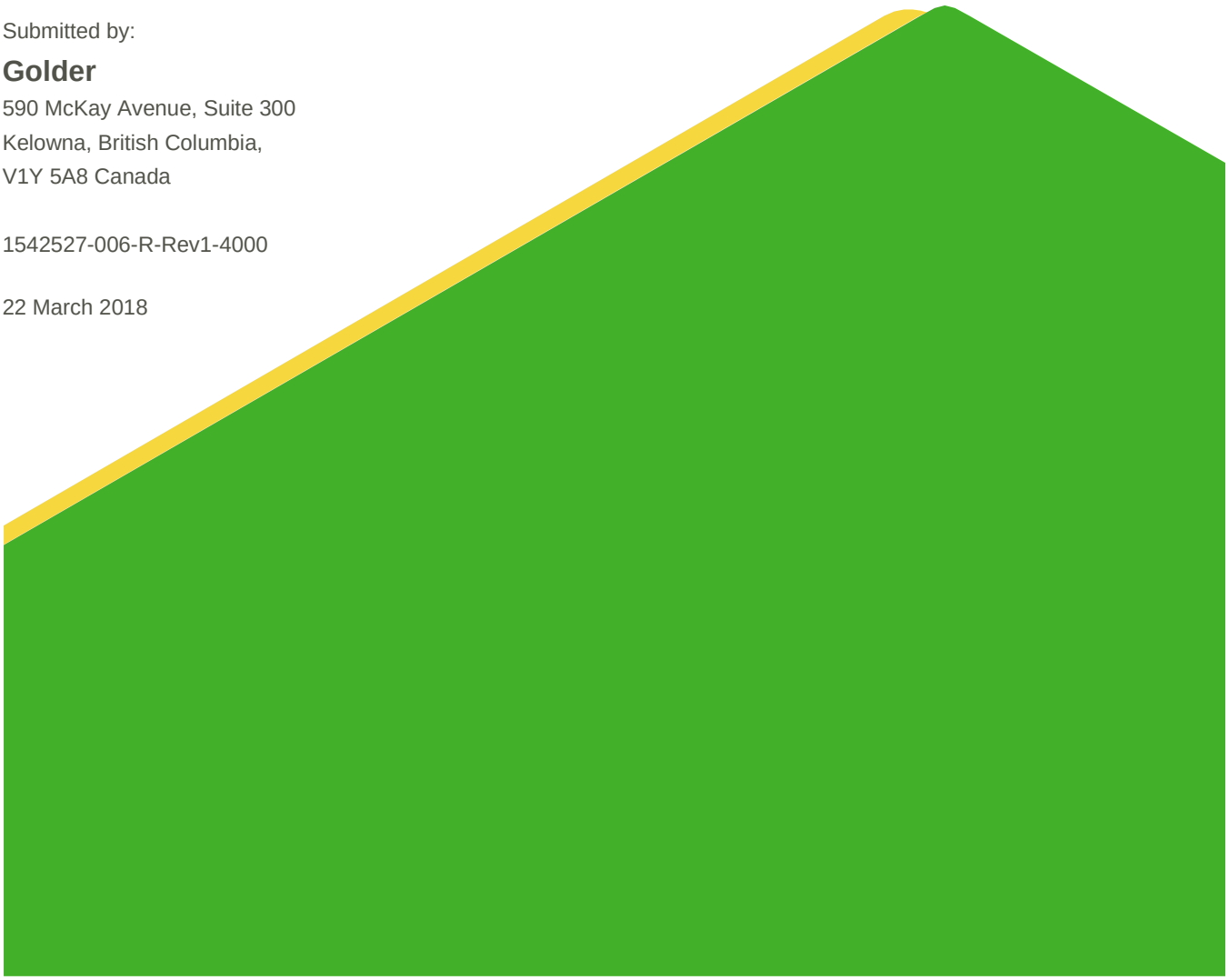
City of Kelowna
1435 Water Street
Kelowna, BC
V1Y 1J4

Submitted by:

Golder
590 McKay Avenue, Suite 300
Kelowna, British Columbia,
V1Y 5A8 Canada

1542527-006-R-Rev1-4000

22 March 2018



Distribution List

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1 eCopy - Golder Associates Ltd.

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FIGURES (AFTER TEXT)

APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) is pleased to provide the City of Kelowna (CoK) with this monitoring report that documents the results of water quality monitoring completed in 2017 at the Regional Biosolids Composting Facility (RBCF) located at 551 Commonage Road in Vernon, BC (hereafter referred to as the Site). The monitoring data were collected by CoK personnel and provided to Golder for compiling this report.

It is our understanding that the purpose of the monitoring program is to assess potential leachate infiltration of stormwater runoff and leachate that is generated at the Site. The monitoring program satisfies the requirements of Ministry of Environment (MoE) discharge Permit 108537 with regards to implementing a surface water monitoring program at the Site (Section 4.2 of Permit). The monitoring program also addresses recommendations made by the MoE in a letter to the CoK entitled "*Response to the Notice of Proposed Expansion of Biosolid Composting Facility*", dated 27 April 2010; and by Golder in subsequent letters and annual monitoring reports prepared for the CoK for submission to MoE.

This report satisfies the reporting requirements of Permit 108537, including data interpretation and trend analysis and an evaluation of the impacts of discharges on the receiving environment (Section 5.5.3 of Permit).

2.0 BACKGROUND

The RBCF was constructed in 2006 and is located on Commonage Road in Vernon, BC (Figures 1 and 2). The Site composts wastewater treatment plant biosolid material and currently consists of an administration building, sludge receiving building, a mixing building, primary and secondary aeration cells, and a compost curing area. An expansion of the facility and facility upgrades were completed in 2010, at which time the entire composting curing area was paved. Prior to the construction of the RBCF, a septage disposal facility was operated at the Site by the City of Vernon (CoV) and the North Okanagan Regional District (NORD).

The Site is surrounded primarily by undeveloped and agricultural land. Surface water bodies in close proximity to the Site include the following (refer to Figures 1 and 2):

- Drainage Pond: located approximately 100 m west of the RBFC, between the Site and Commonage Road, and used to store stormwater runoff generated at the Site.
- Rose's Pond: located approximately 200 m northwest of the RBFC (and approximately 100 m northwest of the Drainage Pond), on the northwest side of Commonage Road.
- Davidson Pond: a privately-owned pond on the Davidson Property, located approximately 100 m south of the RBFC (and approximately 200 m south and southwest of the Drainage Pond).

Our understanding of the Site operations is as follows: stormwater runoff generated at the Site is directed towards a drainage trench along the Site's south-western boundary, and then gravity-fed into the Drainage Pond (Figure 2). Water entering the drainage trench and Drainage Pond consists primarily of stormwater that may contain leachate from the compost material stored on the curing pads; and potentially process water runoff, as water is regularly added to the compost material, particularly in the hot summer months. Leachate from the primary and secondary aeration cells at the Site is directed to a holding tank and then truck-hauled for treatment at NORD's septage facility located at 1700 Polson Drive, Vernon BC, which then discharges into the COV's Water Reclamation Centre located at 2100 43rd Street, Vernon BC.

In the summer months, treated (chlorinated) effluent from the CoV's MacKay Reservoir (located approximately 2 km west-southwest of the Site) is periodically used to flush the drainage trench; in the winter months, effluent on route to the MacKay Reservoir from CoV's Water Reclamation Centre is diverted and treated (filtered and/or chlorinated) at the Site, then used to flush the drainage trench. When the water level at the Drainage Pond is near capacity, water is pumped to the MacKay Reservoir.

In 2009, the CoK retained Golder to complete an initial review of the Site, which was documented in the report titled "*Interim Report on Leachate Drainage Pond, Kelowna – Vernon Compost Facility*", dated 17 February 2010. The purpose of the report was to compile local and regional data on the hydrogeology in the area, monitor water quality, and monitor drainage and pond water levels to assess potential infiltration of leachate. The 2010 report indicated that the RBFC and the Drainage Pond are located on dense glacial tills that inhibit water infiltration into the groundwater aquifer located within the underlying bedrock. It was inferred that water infiltrating into the ground would likely migrate along the top of the glacial till and may eventually discharge into local ponds (i.e., Davidson Pond and Rose's Pond), with a small component of infiltration migrating vertically through the till into deeper bedrock fractures.

Between 2010 and 2017, the CoK conducted monitoring programs at the Drainage Pond, Davidson Pond and Rose's Pond (except in 2013 and 2016), to assess whether water at the Drainage Pond may be infiltrating into the ground and discharging into Rose's Pond and/or Davidson Pond. The results of these monitoring programs have been documented in various reports prepared by Golder and submitted to the CoK.

In July 2010, CoK personnel installed an evaporation pan at the Drainage Pond to monitor daily water levels in the pan, along with water levels at the Drainage Pond, as an indicator of water loss due to evaporation or potential infiltration. In 2010, it was found that the regular flushing of the one-inch and/or six-inch drainage lines, combined with the outflow pump operating intermittently, did not allow for a meaningful assessment of water loss at the Drainage Pond. For this reason, subsequent recommendations were to conduct observations on days when the drainage lines were not flushing and the pump was shut-off, and when no rainfall was expected.

Pursuant to the 9 June 2016 amendments to the Organic Matter Recycling Regulation, Permit 108537 was issued to the CoK on 12 July 2017 authorizing the discharge of contaminants to the air from the Site, and specifying surface water monitoring and reporting requirements at the Site.

3.0 2017 SCOPE OF WORK

The 2017 monitoring scope of work was based on Golder's recommendations outlined in our report entitled "*2016 Water Quality Monitoring Report, Vernon Compost Facility, 551 Commonage Road, Vernon, BC*", dated 7 June 2017, as follows. The field portion of the scope of work was completed by CoK personnel:

- Collect monthly samples between May and October of 2017 at the Drainage Pond, Rose's Pond and Davidson Pond for analysis of potential indicators of biosolids (i.e., septage) contaminants including:
  - Phosphorous, chloride, ammonia, nitrate, nitrite, total kjeldahl nitrogen and total nitrogen.
  - Biological oxygen demand (BOD) and chemical oxygen demand (COD).
  - Microbiological analyses (total coliforms and Escherichia coli [E. coli]).
  - Metals (total and dissolved; with lower detection limits for total beryllium and total selenium).
  - pH, conductivity, total suspended solids (TSS) and hardness.

- Field measurement of pH and temperature of water during sample collection.
- Review of analytical results.
- Conduct an observation period of Drainage Pond levels and evaporation pan readings.

It is noted that the recommendations for 2017 included that Drainage Pond level measurements and pan readings be recorded over three 48-hour periods; once in the spring months (i.e., May or June), once in the summer months (i.e., July or August) and again in the fall (i.e., September or October). Site operations did not allow for three monitoring periods in 2017; rather, only a limited set of data was obtained during the summer of 2017.

Based on the above scope of work, Golder has prepared this monitoring report for submission to MoE by the CoK. The monitoring report provides discussions on:

- Water quality results for the Drainage pond.
- Water quality results for Davidson Pond and Rose's Pond, including potential impacts from the Drainage Pond.
- The 2017 Drainage Pond levels in comparison to evaporation pan readings, as well as other published evapotranspiration rates.
- Recommendations for the 2018 water quality monitoring program.

4.0 SURFACE WATER ASSESSMENT CRITERIA

Pond water quality data were tabulated by Golder and compared to the following standards and/or criteria:

- Freshwater aquatic life (AW) standards in the BC Contaminated Sites Regulation (CSR) (B.C. Reg. 375/96; last amended 1 November 2017 by B.C. Reg. 253/2016, as amended by B.C. Reg. 196/2017).
- Drinking water (DW) standards in the CSR.
- "*British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture, Summary Report",* dated January 2017 (BCWQG) for freshwater aquatic life (AW) criteria. Where applicable, the most conservative of the long-term average and short-term maximum guidelines are referenced.
- "*Working Water Quality Guidelines for British Columbia (June 2017)"* for freshwater aquatic life (AW) criteria.

According to BC Technical Guidance Document 15: *Concentration Limits for the Protection of Aquatic Receiving Environments* (Version 2.0; 1 November 2017):

- For maintained watercourses, the CSR AW standards are applicable to surface water, porewater and groundwater.
- Surface water in aquatic receiving environments other than maintained watercourses should be evaluated against the BCWQG.

For the purposes of this assessment, the Drainage Pond is considered to be a maintained watercourse; and as there is no overland flow from the Drainage Pond, and potential contaminants can only migrate through groundwater to other surface water bodies or drinking water wells, the water quality data from the Drainage Pond has been compared to the CSR AW and DW standards. Rose's Pond and Davidson Pond are considered to be aquatic receiving environments, and water quality data for these two ponds have been compared to the BCWQG, and conservatively against the CSR AW and DW standards.

As of 1 November 2017, Stage 11 amendments to the CSR have been brought into force, resulting in updated standards for groundwater parameters. This report was prepared based on the new CSR regulations and associated standards. In addition, re-screening of the water quality data from 2014 through 2016 was completed and the results of re-screening are included in this report where applicable.

For the comparison of ammonia concentrations, the BCWQG AW guideline for ammonia is pH and temperature dependent and was derived using the pH and temperature measured in the field during collection of each water sample. The CSR AW standard for ammonia is pH dependant and assumes a temperature of 10 degrees Celsius; the CSR AW standard for ammonia was derived using the field pH.

For the comparison of metals concentrations, the total metals (unfiltered) concentrations in the samples were used for comparison to the CSR standards and the BCWQG AW guidelines, in accordance with standard practice for surface water samples. Total metals parameter exceedances of the applicable criteria are shown in tables and discussed in the body of this report. For inclusiveness, the dissolved metals (filtered) concentrations were also compared to the CSR standards and the BCWQG AW guidelines; however, while dissolved metals parameter exceedances are shown in applicable tables, they are not further discussed in the body of this report.

5.0 FIELD MONITORING

5.1 Field Monitoring

Field monitoring in 2017 was conducted between May and October 2017 and included the following tasks:

- Sampling of the Drainage Pond monthly in May through October 2017 (for a total of six samples) and analysis of samples for septage contaminants listed under Section 3.0.
- Sampling of Davidson Pond and Rose's Pond monthly in May through October 2017 (for a total of six samples) and analysis of samples for septage contaminants listed under Section 3.0.
- Measuring the pH and temperature (in degrees Celsius) of pond water during sample collection.
- In the month of July (between 4 and 7 July 2017), without stormwater discharge occurring, pond levels were measured during a 69-hour observation period. Within the 69-hour period, Drainage Pond level measurements and evaporation pan measurements were collected at the same time each day.

5.2 Field Sampling Methods

CoK staff collected all water levels and water samples described in this report. Grab samples were collected from below the water surface near the shoreline of each pond and placed in bottles supplied by ALS Environmental Laboratory (ALS) of Burnaby, BC. The sample bottles were placed in chilled coolers and transported via overnight courier. The ALS laboratory analytical reports were provided to Golder by the CoK. During each sampling event, CoK staff measured pH and temperature of the pond water.

Golder tabulated the 2017 data to allow for an assessment of the water quality results; tabulated data are provided in this report along with the 2014, 2015, and 2016 data.

6.0 RESULTS

6.1 Drainage Pond Quality

A summary of the analytical results for water samples collected from the Drainage Pond in 2017 is presented in Table 1, attached. The ALS laboratory analytical reports (laboratory report numbers L1924064-1, L1946645-1, L1965494-1, L1984896-1, L1994913-1, and L2016326-1) are included in Appendix A.

The following is a summary of the 2017 analytical results. Results were compared to the CSR AW and DW standards, where applicable.

- Ammonia (as N) concentrations exceeded the applicable CSR AW standard during the June, September, and October sampling events (there is no CSR DW standard for ammonia as N).
- Total lithium concentrations exceeded the CSR DW standard during the May, June, July, and August sampling events (there is no CSR AW standard for lithium). Although total lithium concentrations in September and October 2017 were below the laboratory reporting limit (<0.050 mg/L), but above the applicable standard (0.008 mg/L), they were not flagged as exceedances at this time. As part of the Stage 11 amendments to the CSR, the CSR DW standard for lithium was lowered to 0.008 mg/L from 0.73 mg/L, the latter of which was used in previous reports.
- As part of the Stage 11 amendments to the CSR, the CSR AW standard for beryllium was lowered to 0.0015 mg/L from 0.053 mg/L, the latter of which was used in previous reports. The laboratory reported detection limits for beryllium in September and October 2017 (and in 2014 through 2016) (i.e., 0.005 mg/L) were greater than the current CSR AW standard of 0.0015 mg/L; however, as beryllium concentrations in the May through August 2017 samples were less than the current CSR AW standard, beryllium is not inferred to be a parameter of concern at the Site.
- All other concentrations of nutrients parameters, chloride and total metals in the Drainage Pond were below the applicable CSR AW and DW standards.
- Nitrate (as N) concentrations were elevated in May, June and October as compared to those in July, August, and September, but still well below standards.
- Concentrations of total coliforms and E. coli in the samples collected from the Drainage Pond were the lowest in May, with most probable number (mpn) per 100 mL of 980 for total coliforms and 23 mpn/100 mL for E. coli. The highest concentrations were measured in June with total coliforms of 90,000 mpn/100mL and <10,000 mpn/100mL of E. coli.

- Dissolved metals parameter concentrations (including hardness) were significantly lower in October 2017, compared to the total metals parameter concentrations in October 2017 and to the remaining results at the Drainage Pond. The cause of the lower concentrations in October 2017 is not known at this time; however, it may be due to sample collection, preservation and/or filtration methods.

The following is a summary of notable trends observed between 2014 and 2017.

- Parameters concentrations were variable between 2014 and 2017, with elevated concentrations generally apparent during the spring sampling events. Ammonia (as N) concentration trends at the Drainage Pond are shown in Figure A below.
- Parameter concentrations measured in 2017 were generally within the range of concentrations measured in 2014, 2015, and 2016, except for the chloride concentration in June 2017 (132 mg/L), which was higher than those measured in 2014, 2015, 2016, and the remainder of 2017 monitoring events. Chloride concentration trends at the Drainage Pond are shown in Figure A below.
- In previous years (2014 – 2016), the reported analytical detection limit for lithium (0.05 mg/L) was greater than the current CSR DW standard of 0.008 mg/L, and thus, it is not known whether the previous parameter concentrations would have exceeded the current CSR DW standard of 0.008 mg/L at that time.

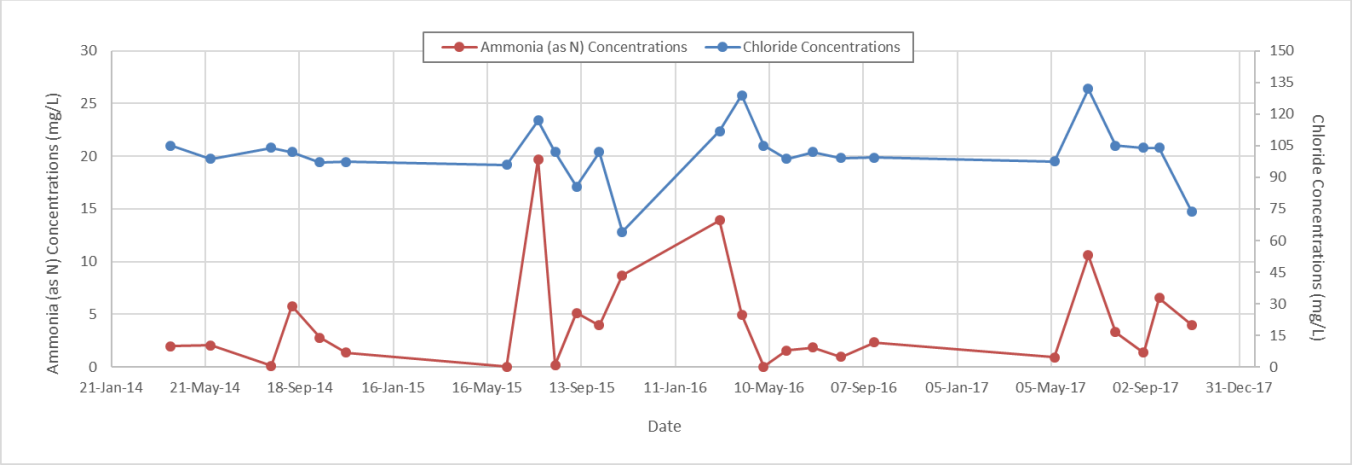

Figure A. Ammonia (as N) and chloride concentration trends in water at the Drainage Pond (2014 - 2017 data).

6.2 Davidson Pond and Rose's Pond Quality

A summary of the analytical results for water samples collected from the neighbouring Davidson and Rose's Ponds in 2017 is presented in Table 2, attached. The ALS laboratory analytical reports (laboratory report numbers for Davidson Pond: L1924064-2, L1946645-2, L1965494-2, L1984896-2, L1994913-2, and L2016326-2; and for Rose's Pond: L1924064-3, L1946645-3, L1965494-3, L1984896-3, L1994913-3, and L2016326-3) are included in Appendix A.

The following is a summary of the 2017 analytical results. Results were compared to the BCWQG AW guidelines and the CSR AW and DW standards, where applicable.

6.2.1 Davidson Pond

Concentrations of most parameters were less than the BCWQG AW guidelines and CSR AW and DW standards during the six sampling events in 2017, except for the following parameters:

- Chloride concentrations exceeded the long-term average BCWQG AW guideline and the CSR DW standard, but were less than the short-term maximum BCWQG AW guideline and the CSR AW standard, during all sampling events.
- Total lithium concentrations exceeded the CSR DW standard during all sampling events.
- Total sodium concentrations exceeded the CSR DW standard during all sampling events. There are no BCWQG AW or CSR AW criteria for sodium.
- The reported analytical detection limit for total beryllium exceeded the applicable BCWQG AW guideline during all sampling events (with the exception of the August 2017 event).
- The reported analytical detection limit for total phosphorus exceeded the BCWQG AW guideline during all sampling events.
- As per the CSR Stage 11 amendments, there is no longer a CSR DW standard for magnesium; thus, total magnesium concentrations that were reported as exceedances in the 2015 and 2016 monitoring events are no longer considered exceedances. There is no CSR AW standard or BCWQG AW guideline for magnesium.
- Dissolved metals parameter concentrations (including hardness) were significantly lower in October 2017 compared to the total metals parameter concentrations in October 2017 and to the remaining results at Davidson Pond. The cause of the lower concentrations in October 2017 is not known at this time; however, it may be due to sample collection, preservation and/or filtration.
- Total coliform and E.coli counts at Davidson Pond were variable, but within the range of 2014 – 2016 results. The highest total coliform and E. coli counts were measured in July 2017 (24,200 mpn/100mL) and May 2017 (1000 mpn/100mL), respectively.

Parameter concentrations measured in 2017 at Davidson Pond were generally within the range of concentrations measured in 2014, 2015, and 2016. Ammonia (as N), chloride and total sodium concentration trends are provided in Figure B below. A slight decreasing trend is noted in ammonia (as N) concentrations, and a very slight decreasing trend is noted in sodium concentrations.

6.2.2 Rose's Pond

Concentrations of most parameters were less than the BCWQG AW guidelines and CSR AW and DW standards during the six sampling events in 2017, except for the following parameters:

- Chloride concentrations exceeded the long-term average BCWQG AW guideline and the CSR DW standard, but were less than the short-term maximum BCWQG AW guideline and the CSR AW standard, during all sampling events.
- Total lithium and total sodium concentrations exceeded the CSR DW standard during all sampling events.

- The BCWQG for arsenic has been removed in 2017, and as such, there were no exceedances of total arsenic concentrations in 2017, which had previously (2014, 2015, and summer of 2016) been identified to exceed the guideline.
- As there is no longer a CSR DW standard for magnesium; total magnesium concentrations that were reported as exceedances in the 2015 and 2016 monitoring events are no longer considered exceedances.
- The reported detection limits for total beryllium and total phosphorus exceeded the applicable BCWQG AW guidelines during most sampling events.
- Dissolved metals parameter concentrations (including hardness) were significantly lower in October 2017 compared to the total metals parameter concentrations in October 2017 and to the remaining results at Rose's Pond. The cause of the lower concentrations in October 2017 is not known at this time; however, it may be due to sample collection, preservation and/or filtration methods.
- Total coliform and E. coli counts at Rose's Pond were variable, but within the 2014 – 2016 results. The highest total coliform and E. coli counts were measured in July 2017 (29,900 mpn/100mL) and June 2017 (12 mpn/100mL), respectively.

Some parameter concentrations measured in 2017 at Rose's Pond appear to be on a decreasing trend (including chloride, arsenic, lithium, magnesium and sodium); while other parameter concentrations appear to be on an increasing trend (including calcium, manganese, molybdenum, potassium, silicon, strontium and uranium). Ammonia (as N), chloride and total sodium concentration trends are provided in Figure B below.

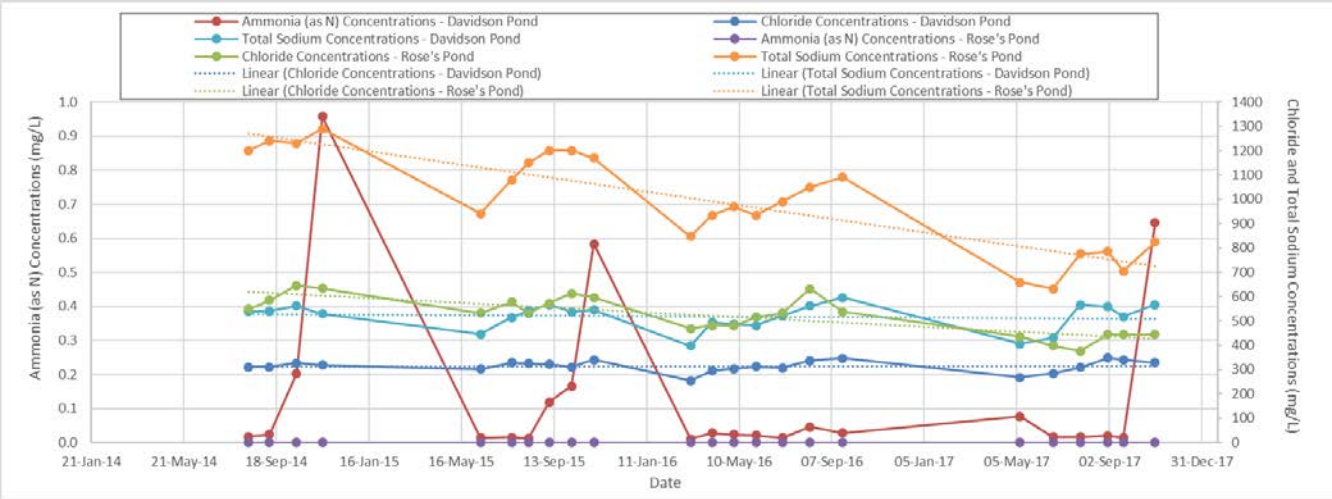

Figure B. Ammonia (as N), chloride and total sodium concentration trends in water at Davidson's Pond and Rose's Pond (2014 - 2017 data).

6.3 Evaporation Pan Monitoring

In 2017, a 69-hour observation period was conducted between 4 and 7 July 2017. The days selected were during times of no rainfall, and when the one-inch and six-inch drainage lines were not flushed and the pump was shut-off. The results for the observation period are presented in Table 3 below.

Table 3: Evaporation Pan and Drainage Pond Levels - 2017

Date	Time	Pan Reading (mm)	Drainage Pond (mm)	Daily Temperature (^{0}C) (low – high)
4-Jul-17	2:00 pm	252	532	12.4 – 31.7
5-Jul-17	2:00 pm	244	530	13.3 – 34.3
6-Jul-17	2:00 pm	234	526	16.2 – 36.9
7-Jul-17	11:00 am	230	522	17.2 – 33.8
Total Decrease (mm)		**22**	**10**	-
Daily Average Decrease (mm)*		**7**	**3**	-

Note:

Temperature data are for the Kelowna UBCO Station (Environment Canada)

*Approximate

The following summarizes the results of each observation period:

- Evaporation Pan: The total decline of water levels in the evaporation pan based on the evaporation pan measurements, was 22 mm over the observation period of 69 hours; and,
- Drainage Pond: The total decline of water levels at the Drainage Pond based on measurements collected from the staff gauge at the Drainage Pond was 10 mm over the observation period of 69 hours.

The evaporation pan and Drainage Pond measurement data provided above, as well as previous measurements, supports the inference that evaporation from the Drainage Pond accounts for most of the losses within the Drainage Pond (compared to infiltration).

7.0 DISCUSSION

The concentrations of typical septage contaminants (ammonia as N, BOD, nitrate, nitrite, total nitrogen and orthophosphate and microbiological parameters) at the Drainage Pond, Davidson Pond and Rose's Pond were generally within the range of concentrations previously measured in 2014, 2015, and 2016, and generally within the range of analysis from month to month during the sampling events in 2017 (except concentrations of ammonia, BOD, total coliforms and E. coli, which exhibited variability between the 2017 sampling events).

The ammonia (as N) concentrations at the Drainage Pond exceeded the CSR AW standard on three occasions in 2017. The ammonia (as N) concentrations at the Drainage Pond were much greater than the nitrate (as N) and

nitrite (as N) concentrations (as in 2014, 2015, and 2016), indicative that little nitrification is occurring. The total nitrogen concentrations at the Drainage Pond were greater than the combined ammonia, nitrate and nitrite concentrations (as in 2014, 2015, and 2016), indicative that a portion of the total nitrogen in the water samples was organic nitrogen.

CoK personnel have observed waterfowl at the Drainage Pond, Davidson Pond and Rose's Pond; and have noted that cattle have access to Davidson's Pond. It is likely that wildlife using these ponds have contributed to the elevated total coliform and E. coli counts measured at the ponds. As these parameters were generally higher at the Drainage Pond than at Davidson Pond and Rose's Pond, it is possible that elevated total coliform and E. coli counts at the Drainage Pond may also be due to Site runoff into the Drainage Pond.

As in 2014 – 2016, samples collected during the 2017 sampling events indicated that biosolids (i.e., septage) parameter concentrations were higher at the Drainage Pond than at Davidson Pond and Rose's Pond, as follows:

- Total nitrogen concentrations were more than approximately 2 times greater at the Drainage Pond than at Davidson Pond and Rose's Pond.
- BOD concentrations were generally higher (up to approximately 7 times greater) at the Drainage Pond than at Davidson Pond and Rose's Pond.
- Orthophosphate concentrations were approximately 1 to 3 orders of magnitude greater at the Drainage Pond than at Davidson Pond and Rose's Pond.
- Certain metals parameters were higher at the Drainage Pond than at Davidson Pond and Rose's Pond (including: aluminum, barium, boron, copper, iron, magnesium, manganese, molybdenum, phosphorus, silicon and zinc).

As in 2014 – 2016, samples collected during the 2017 sampling events indicated that certain inorganic and metals parameters were higher at Davidson Pond and Rose's Pond relative to the Drainage Pond, as follows:

- Chloride concentrations were approximately 2 to 3 times higher at Davidson Pond, and approximately 3 to 6 times higher at Rose's Pond, than at the Drainage Pond.
- Sodium concentrations were approximately 3 to 7 times higher at Davidson Pond, and approximately 5 to 10 times higher than at Rose's Pond, than at the Drainage Pond.
- Arsenic concentrations were slightly higher at Rose's Pond than at Davidson Pond; arsenic concentrations at both ponds were higher than at the Drainage Pond.
- Lithium concentrations were on average approximately 2 to 4 times higher at Davidson Pond and Rose's Pond than at the Drainage Pond.
- Potassium concentrations were on average approximately 2 times higher at Davidson Pond, and approximately 2 to 4 times higher at Rose's Pond, than at the Drainage Pond.

The cause of the suspect dissolved metals parameter concentrations in October 2017 is not known and may have been due to errors in sample collection, preservation and/or filtration. However, as only total metals exceedances are discussed in this report, the October 2017 total metals data can be relied upon for this annual monitoring report. Implementation of a quality assurance/quality control (QA/QC) program may help to address these issues in the future, should they occur again.

8.0 CONCLUSIONS

Water potentially infiltrating from the Drainage Pond may be considered a source of contamination for groundwater, particularly with respect to ammonia, which exceeded applicable standards on three occasions in 2017; however, as it has previously been assessed that evaporation from the Drainage Pond is inferred to account for most of the losses within the Drainage Pond (compared to infiltration) and as exceedances noted at one pond(s) were not noted at the other pond(s), the water quality at Davidson Pond and Rose's Pond does not appear to be adversely impacted by water that may be infiltrating and migrating from the Drainage Pond.

The City of Kelowna should confirm that the quality of the water pumped from the Drainage Pond to the CoV's Mackay Reservoir is acceptable, particularly with respect to ammonia and orthophosphate concentrations.

9.0 RECOMMENDATIONS FOR 2018

As per Section 4.2. *Surface Water Monitoring* of discharge Permit 108537, the City is required to continue to implement a surface water monitoring program at the Site, in accordance with recommendations from a Qualified Professional.

Golder proposes monthly monitoring at the Drainage Pond and at the neighbouring Davidson Pond and Rose's Pond between April and November (or, when the pond is not frozen) in 2018, as follows:

- Collecting and analyzing samples for potential septage contaminants including:
  - Phosphorous (ortho-phosphate), chloride, ammonia, nitrate, nitrite, and total kjeldahl nitrogen.
  - BOD and COD.
  - Metals (total and dissolved).
  - pH, total dissolved solids (TDS), total suspended solids (TSS) and hardness.
- The City of Kelowna should request that the laboratory use lower analytical detection limits for beryllium (i.e., <0.0001 mg/L), lithium (i.e., <0.008 mg/L), and phosphorus (i.e., <0.005 mg/L) for reasonable comparison of results with the applicable guidelines.
- Compile an annual report to the City of Kelowna with comparison of surface water sample results to applicable criteria.
- Continue to obtain evaporation pan readings and staff gauge measurement at the Drainage Pond. In order to have a meaningful interpretation of pond evaporation versus infiltration, it is recommended that these readings/measurements be taken over three long-term (i.e., 48-hour) periods in 2018; once in the spring (i.e., May or June), once in the summer (i.e., July or August) and again in the fall (i.e., September or October). *The spring and fall periods will be important for assessing potentially smaller differences between evaporation and infiltration, as lower evaporation rates are expected during spring/fall compared to summer*. Consideration should be given to collecting this evaporation pan and water level data with pressure transducers to capture the small level changes.
- The field pH and temperature of the water samples should be measured with a properly-calibrated meter by CoK personnel during the collection of pond water samples, so that the suitability of the ammonia guidelines can be assessed. Often laboratory-measured pH can be slightly different than field pH, due to geochemical changes in the sample bottle during transport. The field pH and temperature will be used in the assessment of pond water quality and in determining the appropriate criteria to use in the comparison of analytical ammonia results.

- Implement a QA/QC program to minimize errors in the field and obtain accurate monitoring results. This may include: i) collection of a field duplicate sample from a select pond during each sampling event; ii) use of dedicated monitoring and sampling sheets during the collection of water samples (refer to next bullet); iii) review of analytical results soon after receipt; and iv) contacting analytical laboratory should anomalous analytical results be identified to determine whether anomalous results are laboratory-related.
- Dedicated monitoring and sampling sheets should be completed during sampling events at each location and reviewed in conjunction with the analytical water quality data. Field notes on the sheets should include: sample location, date and time of sample collection, weather, surface water conditions, approximate pond levels at the time of sample collection, the approximate depth that each sample is collected (from top of water surface), equipment used for sampling, field (pH and temperature) parameter measurements, apparent sample turbidity, type and size of bottles used, and whether the sample was preserved (including preservative type) and/or field filtered.
- Samples should be taken such that minimal to no suspended particles or disturbed sediment are collected in the sampling bottles, and that no surface matter (i.e., algae) is inadvertently collected.

10.0 LIMITATIONS AND USE OF REPORT

This report was prepared for the exclusive use of the City of Kelowna and MoE. The findings, interpretations and conclusions are based solely on the Site conditions during the sampling events. The data presented in this report represent the leachate quality conditions at the sampling locations tested. Leachate conditions may vary with location, depth, sampling, methodology, analytical techniques and other factors.

Except where specifically stated to the contrary, the information contained in this report (including reports, information and data) was provided to Golder by others and has not been independently verified or otherwise examined by Golder to determine its accuracy of completeness. Golder has relied in good faith on this information and does not accept responsibility of any deficiency, misstatements or inaccuracies contained in the report as a result of omissions, misinterpretation and/or fraudulent acts of the persons interviewed or contacted, or errors or omissions in the reviewed documentation.

Golder makes no warranty, expressed or implied, and assumes no liability with respect to the use of the information contained in this report at the subject site, or at any other site, for other than its intended purpose.

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

The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

If new information is discovered during future work, including excavations, borings or other studies, Golder should be requested to re-evaluate the conclusions presented in this report and to provide amendments as required.

11.0 CLOSURE

We trust that this report provides the information you require at this time. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Yours very truly,

Golder Associates Ltd.

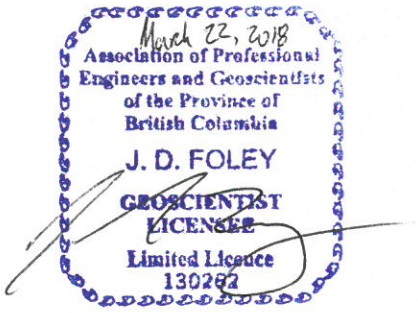

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Table 1: 2014 - 2017 Results of Water Analyses - Drainage Pond
City of Kelowna-Vernon Biosolids Facility
511 Commonage Road, Vernon, BC

Location					Drainage Pond																					
ALS Laboratory ID	Aquatic Life CSR-AW[1] (freshwater)	Notes	Drinking Water CSR-DW[1]	Notes	L1440745-1	L1462088-1	L1502217-1	L1515479-1	L1532630-1	L1547862-3	L1625288-1	L1645255-1	L1656492-1	L1669705-1	L1684336-1	L1698669-1	L1742616-1	L1752610-1	L1763882-1	L1777367-1	L1794599-1	L1811981-1	L1832582-1	L1924064-1	L1946645-1	L1965494-1	L1984896-1	L1994913-1	L2016326-1
Date					7-Apr-14	28-May-14	13-Aug-14	9-Sep-14	14-Oct-14	17-Nov-14	10-Jun-15	20-Jul-15	11-Aug-15	7-Sep-15	6-Oct-15	4-Nov-15	8-Mar-16	5-Apr-16	3-May-16	1-Jun-16	5-Jul-16	10-Aug-16	21-Sep-16	9-May-17	21-Jun-17	26-Jul-17	31-Aug-17	20-Sep-17	31-Oct-17
General Parameters																												
Temperature (field)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.0	20.0	24.0	19.0	13.0	3.0
pH (field)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	8.0	8.0	8.0	8.1	8.7
pH (laboratory)					9.13	8.15	9.21	8.25	8.50	8.11	9.44	8.12	8.67	8.22	8.19	7.57	7.82	8.19	9.11	8.17	8.03	8.19	8.24	8.00	8.23	8.20	8.20	8.19	8.68
conductivity (laboratory)					1460	949	922	977	928	918	883	1250	944	847	987	769	1670	1710	1050	992	919	961	962	899	1590	1070	913	1020	784
total suspended solids (TSS)					43.9	4.6	46.9	9.2	35.7	7.4	37.8	31.0	27.6	34.0	16.0	52.4	21.5	32.1	22.4	7.5	24.8	5.0	<3.0	3.6	19.2	4.9	9.1	11.6	31.3
biochemical oxygen demand (5-day BOD)					25.9	3.8	27.7	6.0	13.5	<2.0	13.1	41.1	13.2	13.1	6.1	15.5	12.8	13.6	7.3	3.7	10.8	<2.0	6.2	<2.0	13.4	<2.0	3.9	3.0	15.0
chemical oxygen demand					118	59	155	92	93	57	109	430	92	88	102	195	158	86	60	37	102	55	75	28	261	61	49	121	117
hardness as CaCO3					576	247	233	246	242	217	239	260	232	199	227	157	575	592	305	247	225	234	222	217	484	279	226	254	107
Inorganics																												
ammonia (total; as N)	1.31 - 18.4	pH/T			**1.97***	2.06	0.0990	**5.76***	**2.79***	1.35	0.0265	**19.7***	0.192	**5.13***	**3.94***	8.68	**13.9***	**4.98***	0.0232	1.55	1.84	0.965	2.33	0.915	**10.6**	3.29	1.38	**6.55**	**3.99**
nitrate (as N)	400		10		1.35	0.540	0.068	0.118	0.997	2.75	<0.010	<0.025	0.568	0.172	0.090	0.222	6.84	5.82	0.029	0.521	0.408	0.533	0.336	1.21	1.72	0.356	0.314	0.150	1.04
nitrite (as N)	0.2 - 2	Cl	1		0.127	0.032	0.034	0.094	0.085	0.077	<0.0020	<0.0050	0.226	0.109	0.0160	0.678	0.513	0.229	0.0886	0.0606	0.159	0.127	0.211	0.0156	0.287	0.106	0.0230	0.106	0.104
total nitrogen					8.76	4.31	7.02	8.56	7.43	5.54	4.68	36.6	5.02	9.70	7.75	17.5	25.1	15.6	2.98	3.66	3.38	3.26	4.71	3.26	25.5	5.63	3.17	12.0	10.3
chloride	1500		250		105	98.7	104	102	97.2	97.4	96	117	102	85.6	102	64.1	112	129	105	98.7	102	99.2	99.4	97.6	132	105	104	104	73.8
ortho-phosphate (dissolved; as P)					0.455	1.42	1.84	2.02	1.02	0.683	0.450	4.92	1.03	2.68	1.60	3.99	2.98	1.19	0.464	0.968	2.01	1.21	1.36	0.647	1.65	2.05	0.929	1.69	2.51
Total Kjeldahl Nitrogen					-	-	-	-	-	-	-	-	-	-	-	-	-	9.06	2.39	3.08	2.81	2.77	4.16	2.03	23.5	5.17	2.83	11.7	9.20
Microbiological Analyses																												
total coliforms (mpn/100mL)					236	3650	10500	242000	38700	5790	12000	92100	1180	>241960	41100	>241960	37200	1780	100	>24196	64900	>241960	1660	980	90000	24200	>24196	3260	24200
Escherichia coli (mpn/100mL)					1	107	4	14100	980	62	7	13000	12	19900	2420	19900	2000	30	<10	70	411	130000	<10	23	<10000	120	480	70	290
Total Metals																												
aluminum			9.5		0.074	0.065	0.038	0.069	0.130	0.021	0.068	0.198	0.066	0.258	0.166	0.705	0.225	0.182	0.066	0.116	0.080	0.088	0.116	0.0282	0.215	0.047	0.108	0.026	0.069
antimony	0.09		0.006		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0007	<0.00050	<0.00050	<0.00050	<0.00050
arsenic	0.05		0.01		0.0019	0.0012	0.0016	0.0017	0.0014	<0.0010	0.0013	0.0050	0.0013	0.0022	0.0016	0.0029	0.0033	0.0019	0.0013	0.0011	0.0023	0.0011	0.00136	0.00086	0.00447	0.0015	0.00130	0.0020	0.0024
barium	10		1		0.028	0.022	0.025	0.030	0.023	<0.020	0.025	0.036	0.023	0.034	0.030	0.050	0.048	0.039	0.027	0.029	0.027	0.033	0.034	0.029	0.056	0.035	0.035	0.030	0.023
beryllium	0.0015		0.008		***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	<0.0010	<0.0010	<0.0010	<0.00010	<0.00010	***<0.0050***	***<0.0050***
bismuth					<0.20	<0.20	<0.20	-	-	-	-	<0.20	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
boron	12		5		0.14	0.16	0.17	0.20	0.17	0.17	0.17	0.21	0.16	0.16	0.17	0.14	0.13	0.14	0.15	0.16	0.17	0.14	0.16	0.15	0.17	0.14	0.15	0.16	0.16
cadmium	0.0005 - > 0.004	H	0.005		<0.000050	<0.000050	0.000087	<0.000050	<0.000050	<0.000050	<0.000050	0.000467	<0.000050	0.000095	0.000063	0.000272	0.000146	0.000071	<0.000050	<0.000050	<0.000050	<0.000050	0.0000468	0.0000125	0.000285	<0.000050	0.0000249	<0.000050	0.000063
calcium					117	58.1	55.5	64.3	55.3	50.9	57.0	62.6	55.0	48.9	54.7	41.5	123	122	65.5	58.9	54.4	54.5	53.1	56.2	105	72.1	55.6	57.7	41.1
chromium	0.010[VI], 0.090[III]	V	0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00098	<0.00050	0.00066	<0.00050	0.00168	0.00104	0.00090	<0.00050	<0.00050	<0.00050	0.00177	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	0.00063
cobalt	0.04		0.001		0.00064	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00081	<0.00050	<0.00050	<0.00050	0.00074	0.00076	0.00076	<0.00050	<0.00050	<0.00050	<0.00050	0.00042	0.00030	0.00081	<0.00050	0.00033	<0.00050	<0.00050
copper	0.020 - 0.090	H	1.5		0.0056	0.0061	0.0090	0.0066	0.0051	0.0071	0.0045	0.0531	0.0051	0.0148	0.0092	0.0373	0.0234	0.0118	0.0039	0.0036	0.0070	0.0047	0.0117	0.0032	0.0544	0.0043	0.0039	0.0062	0.0130
iron			6.5		0.205	0.154	0.094	0.162	0.238	0.057	0.142	0.384	0.114	0.272	0.238	0.893	0.472	0.409	0.130	0.225	0.179	0.141	0.206	0.061	0.484	0.205	0.170	0.108	0.237
lead	0.040 - 0.160	H	0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0034	<0.0010	0.0013	<0.0010	0.0031	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	0.00123	<0.0010	<0.00050	<0.0010	<0.0010
lithium			0.008		***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	**0.0107**	**0.0102**	**0.0178**	**0.0131**	**0.0105**	***<0.050***	***<0.050***
magnesium					64.8	25.2	23.2	27.0	23.8	21.9	23.6	25.2	22.1	19.8	22.3	16.1	66.1	68.6	30.4	23.8	22.1	21.2	22.0	23.3	54.8	28.4	23.1	23.6	18.4
manganese			1.5		0.221	0.143	0.087	0.159	0.122	<0.010	0.123	0.193	0.104	0.140	0.130	0.276	0.265	0.208	0.109	0.158	0.124	0.126	0.147	0.0980	0.272	0.183	0.117	0.095	0.137
mercury	0.00025		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.0000050	<0.0000050	0.000062	<0.0000050	0.0000135	<0.00020	<0.00020
molybdenum	10		0.25		0.0057	0.0066	0.0075	0.0065	0.0048	0.0043	0.0057	0.0069	0.0053	0.0057	0.0060	0.0042	0.0067	0.0056	0.0052	0.0045	0.0055	0.0045	0.0044	0.0043	0.0119	0.0044	0.0043	0.0042	0.0039
nickel	0.250 - 1.5	H	0.08		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	0.0017	0.0044	<0.0050	0.0019	<0.0050	<0.0050
phosphorus					1.35	1.67	2.52	-	-	-	-	6.10	-	-	1.90	5.73	3.85	1.88	0.93	1.20	2.99	1.53	1.66	0.85	2.59	2.31	1.22	1.84	3.33
potassium					24.4	21.0	28.4	-	-	-	-	72.7	-	-	24.7	27.2	33.3	26.7	19.9	22.0	25.5	19.9	22.1	19.5	44.5	22.6	20.8	28.9	25.2
selenium	0.02		0.01		0.0025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0042	0.0035	<0.0010	<0.0010	<0.0010	<0.0010	0.000534	0.000512	0.00187	<0.0010	0.000622	<0.0010	<0.0010
silicon					5.41	3.61	2.84	-	-	-	-	4.47	-	-	4.28	4.16	5.98	5.81	3.56	3.54	3.75	3.46	3.96	2.96	4.76	4.11	3.68	3.92	0.49
silver	0.0005 - 0.015	H	0.02		0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000279	<0.000050	0.000111	0.000098	0.000215	0.000093	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000063	<0.000020	0.000227	<0.000050	0.000036	<0.000050	<0.000050
sodium			200		125	104	105	116	95.4	101	93.1	106	98.2	90.0	93.9	73.3	131	146	110	103	99.8	101	108	103	135	103	103	109	81.4
strontium			2.5		1.18	0.583	0.535	-	-	-	-	0.566	-	-	0.545	0.359	1.16	1.23	0.642	0.566	0.549	0.527	0.558	0.541	1.10	0.647	0.551	0.569	0.376
thallium	0.003				<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000010	<0.00020	<0.00020
titanium	1				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050	<0.050
tin			2.5		<0.030	<0.030	<0.030	-	-	-	-	<0.030	-	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.00050	<0.00050	0.00080	<0.00050	<0.00050	<0.030	<0.030
uranium	0.085		0.02		0.00444	0.00197	0.00209	0.00180	0.00178	0.00100	0.00223	0.00250	0.00202	0.00214	0.00241	0.00116	0.00615	0.00592	0.00265	0.00204	0.00224	0.00210	0.00193	0.00241	0.00984	0.00306	0.00275	0.00262	0.00134
vanadium					<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.00126	0.00088	0.00193	0.00071	0.00136	<0.030	<0.030
zinc	0.075 - > 2.4	H	3		0.0267	0.0266	0.0282	0.0180	0.0238	0.0385	0.0196	0.0866	0.0198	0.0310	0.0188	0.0822	0.0715	0.0539	0.0240	0.0229	0.0191	0.0237	0.0284	0.0270	0.0574	0.0130	0.0226	0.0177	0.0418

Table 1: 2014 - 2017 Results of Water Analyses - Drainage Pond
City of Kelowna-Vernon Biosolids Facility
511 Commonage Road, Vernon, BC

Location					Drainage Pond																					
ALS Laboratory ID	Aquatic Life CSR-AW[1] (freshwater)	Notes	Drinking Water CSR-DW[1]	Notes	L1440745-1	L1462088-1	L1502217-1	L1515479-1	L1532630-1	L1547862-3	L1625288-1	L1645255-1	L1656492-1	L1669705-1	L1684336-1	L1698669-1	L1742616-1	L1752610-1	L1763882-1	L1777367-1	L1794599-1	L1811981-1	L1832582-1	L1924064-1	L1946645-1	L1965494-1	L1984896-1	L1994913-1	L2016326-1
Date					7-Apr-14	28-May-14	13-Aug-14	9-Sep-14	14-Oct-14	17-Nov-14	10-Jun-15	20-Jul-15	11-Aug-15	7-Sep-15	6-Oct-15	4-Nov-15	8-Mar-16	5-Apr-16	3-May-16	1-Jun-16	5-Jul-16	10-Aug-16	21-Sep-16	9-May-17	21-Jun-17	26-Jul-17	31-Aug-17	20-Sep-17	31-Oct-17
Dissolved Metals																												
aluminum			9.5		0.036	0.013	0.014	0.017	0.021	0.072	0.017	0.067	0.018	0.063	0.033	0.104	0.045	0.025	0.015	0.013	0.030	0.010	0.0185	0.0056	0.0818	0.020	0.0136	0.031	<0.010
antimony	0.09		0.006		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00054	<0.00050	<0.00050	<0.00050	<0.00050
arsenic	0.05		0.01		0.0016	0.0012	0.0015	0.0016	0.0013	<0.0010	0.0011	0.0046	0.0012	0.0020	0.0016	0.0026	0.0031	0.0018	0.0012	0.0010	0.0021	0.0012	0.00114	0.00081	0.00449	0.0015	0.00120	0.0021	<0.0010
barium	10		1		<0.020	<0.020	<0.020	0.023	<0.020	<0.020	<0.020	0.028	0.020	<0.020	0.024	<0.020	0.032	0.032	0.026	0.026	0.020	0.033	0.030	0.027	0.043	0.036	0.030	0.031	0.023
beryllium	0.0015		0.008		***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	<0.0010	<0.0010	<0.0010	<0.00010	<0.00010	***<0.0050***	***<0.0050***
bismuth					<0.20	<0.20	<0.20	-	-	-	-	<0.20	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
boron	12		5		0.14	0.16	0.17	0.17	0.18	0.16	0.17	0.20	0.16	0.16	0.17	0.13	0.13	0.14	0.15	0.16	0.16	0.16	0.17	0.13	0.16	0.15	0.14	0.18	<0.10
cadmium	0.0005 - > 0.004	H	0.005		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000154	<0.000050	<0.000050	<0.000050	0.000126	0.000088	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.0000229	0.0000102	0.000159	<0.000050	0.0000150	0.000059	<0.000050
calcium					121	57.5	54.7	58.3	56.6	50.0	56.8	62.4	55.7	47.5	54.9	37.9	120	123	70.2	59.7	53.8	57.2	53.9	51.0	99.5	65.0	53.9	61.3	28.3
chromium	0.010[VI], 0.090[III]	V	0.05		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00064	<0.00050	0.00066	<0.00050	<0.00050	<0.00050	0.00064	0.00058	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050
cobalt	0.04		0.001		0.00055	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00064	<0.00050	<0.00050	<0.00050	<0.00050	0.00067	0.00069	<0.00050	<0.00050	<0.00050	<0.00050	0.00032	<0.00030	0.00059	<0.00050	<0.00030	<0.00050	<0.00050
copper	0.020 - 0.090	H	1.5		0.0025	0.0036	0.0059	0.0037	0.0025	0.0096	0.0030	0.0219	0.0030	0.0065	0.0045	0.0174	0.0147	0.0057	0.0024	0.0021	0.0048	0.0031	0.0036	0.0025	0.0142	0.0020	0.0024	0.0085	0.0025
iron			6.5		<0.030	0.056	<0.030	0.046	<0.030	0.174	<0.030	0.210	<0.030	0.034	0.041	0.177	0.162	0.064	<0.030	0.053	0.072	0.037	0.043	<0.030	0.144	0.104	<0.030	0.112	0.121
lead	0.040 - 0.160	H	0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.0010	<0.0010
lithium			0.008		***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	0.0095	0.0098	0.0172	0.0120	0.0101	***<0.050***	***<0.050***
magnesium					66.4	25.1	23.3	24.4	24.4	21.7	23.6	25.2	22.4	19.4	21.9	15.2	66.8	69.0	31.4	23.9	22.1	22.1	21.2	21.8	57.2	28.3	22.2	24.6	8.79
manganese			1.5		0.026	0.062	0.010	<0.010	<0.010	0.074	<0.010	0.023	<0.010	<0.010	<0.010	0.128	0.144	0.102	<0.010	0.139	0.050	0.102	0.0596	0.0835	0.211	0.171	0.0413	<0.010	<0.010
mercury	0.00025		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000025	<0.0000050	<0.000025	<0.0000050	<0.0000050	<0.00020	<0.00020
molybdenum	10		0.25		0.0060	0.0065	0.0072	0.0065	0.0049	0.0050	0.0057	0.0063	0.0053	0.0056	0.0057	0.0041	0.0065	0.0056	0.0049	0.0041	0.0052	0.0042	0.0040	0.0041	0.0055	0.0042	0.0040	0.0041	<0.0010
nickel	0.250 - 1.5	H	0.08		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0016	0.0015	0.0035	<0.0050	0.0017	<0.0050	<0.0050
phosphorus					0.81	1.51	1.42	-	-	-	-	5.32	-	-	1.74	4.37	3.31	1.34	0.64	1.15	2.58	1.48	1.49	0.76	2.09	2.45	1.08	1.94	3.44
potassium					24.6	20.9	28.6	-	-	-	-	76.4	-	-	24.3	25.6	31.3	24.9	21.1	21.7	25.4	20.5	20.3	18.3	44.3	25.4	19.7	30.3	2.2
selenium	0.02		0.01		0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0039	0.0034	<0.0010	<0.0010	<0.0010	<0.0010	0.000507	0.000579	0.00137	<0.0010	0.000572	<0.0010	<0.0010
silicon					5.44	3.43	2.87	-	-	-	-	3.63	-	-	4.08	3.30	5.50	5.73	3.61	3.35	3.62	3.45	3.71	2.71	4.56	4.17	3.33	3.91	0.273
silver	0.0005 - 0.015	H	0.02		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000071	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	<0.000020	<0.000020	<0.000050	<0.000020	<0.000050	<0.000050
sodium			200		126	103	107	106	98.2	99.2	93.9	110	100	86.9	94.8	71.2	125	148	118	103	99.5	105	101	96.0	136	108	97.3	108	7.3
strontium			2.5		1.16	0.578	0.522	-	-	-	-	0.557	-	-	0.546	0.316	1.10	1.27	0.682	0.568	0.542	0.549	0.539	0.515	1.09	0.639	0.544	0.572	0.133
thallium	0.003				<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.000014	<0.00020	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000010	<0.000010
tin			2.5		<0.030	<0.030	<0.030	-	-	-	-	<0.030	-	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.030	<0.030
titanium	1				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.050	<0.050
uranium	3		0.02		0.00478	0.00195	0.00197	0.00182	0.00179	-	0.00217	0.00246	0.00208	0.00198	0.00233	0.00079	0.00602	0.00606	0.00185	0.00173	0.00210	0.00194	0.00173	0.00202	0.00620	0.00275	0.00246	0.00254	<0.00020
vanadium					<0.030	<0.030	<0.030	<0.030	<0.030	0.00122	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.00097	0.00077	0.00161	0.00062	0.00096	<0.030	<0.030
zinc	0.075 - > 2.4	H	3		0.0118	0.0254	0.0146	0.0134	0.0169	<0.030	0.0072	0.0508	0.0144	0.0137	0.0119	0.0448	0.0549	0.0423	0.0194	0.0248	0.0181	0.0238	0.0212	0.0242	0.0394	0.0103	0.0145	0.0206	0.0233

Notes:
All concentrations in milligrams per litre (mg/L), unless otherwise noted.
(1) Standards from the Contaminated Sites Regulation (CSR), updated to 1 November 2017.
Land Use abbreviations: AW (Aquatic Life); and DW (Drinking Water).
H = standard is Hardness dependent; pH = standard is pH dependent; Cl = standard is chloride dependent; V = standard is valence dependent, VI=chromium VI and III=chromium III; T = standard varies with temperature (10 deg C assumed for ammonia criteria).
19.7 indicates parameter concentration exceeds applicable CSR AW or DW standards
*Exceedance based on laboratory pH

Table 2: 2014 - 2017 Results of Water Analyses at Davidson Pond and Rose's Pond
City of Kelowna-Vernon Biosolids Facility
511 Commonage Road, Vernon, BC

Location							Davidson Pond																	
ALS Laboratory ID	Aquatic Life CSR-AW (freshwater)	Notes	Drinking Water CSR-DW	Notes	BC Water Quality Aquatic Life (freshwater)	Notes	L1502217-2	L1515479-2	L1532630-2	L1547862-2	L1625288-2	L1645255-2	L1656492-2	L1669705-2	L1684336-2	L1698669-2	L1742616-2	L1752610-2	L1763882-2	L1777367-2	L1794599-2	L1811981-2	L1832582-2	L1924064-2	L1946645-2	L1965494-2	L1984896-2	L1994913-2	L2016326-2
Date							13-Aug-14	9-Sep-14	14-Oct-14	17-Nov-14	10-Jun-15	20-Jul-15	11-Aug-15	7-Sep-15	6-Oct-15	4-Nov-15	8-Mar-16	5-Apr-16	3-May-16	1-Jun-16	5-Jul-16	10-Aug-16	21-Sep-16	9-May-17	21-Jun-17	26-Jul-17	31-Aug-17	20-Sep-17	31-Oct-17
Parameters																												
Temperature (field)							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	21	23.5	24	15	5
pH (field)					6.5 - 9.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.8	9.1	8.8	9.3	9.2	7.8
pH (laboratory)					6.5 - 9.0		8.68	8.77	8.49	8.31	8.70	8.67	8.71	8.64	8.46	8.35	8.75	8.73	8.81	8.66	8.77	8.82	8.62	8.76	8.89	8.74	8.96	8.78	8.36
conductivity (laboratory)							3140	3110	3160	3210	2870	3250	3350	3230	3500	3480	2480	2980	3100	3250	3140	3470	3550	2500	2720	3010	3150	3290	3510
total suspended solids (TSS)							<3.0	6.6	8.9	19.0	5.5	4.6	3.0	10.2	23.3	16.3	12.8	<3.0	3.4	<3.0	6.0	3.4	<3.0	22.8	24.2	6.1	4.1	6.6	16.7
biochemical oxygen demand (5-day BOD)							<2.0	<2.0	<2.0	<2.0	<2.0	2.9	<2.0	<2.0	4.9	4.1	5.7	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	<2.0	<2.0	<2.0	<2.0	<2.0	2.9
chemical oxygen demand (COD)							56	63	70	90	64	64	63	58	79	63	1050	57	56	61	58	101	75	49	68	64	71	72	65
hardness as CaCO3							532	526	531	545	539	527	525	544	549	564	461	533	566	561	540	563	565	482	514	560	556	535	139
Inorganics																												
ammonia (total; as N)	1.31 - 18.4	pH/T			0.131 - 1.84*	pH/T	0.0176	0.0235	0.203	0.957*	0.0142	0.0149	0.0114	0.119	0.166	0.583*	0.0111	0.0283	0.0238	0.0208	0.0143	0.0455	0.0278	0.0768	0.0161	0.0160	0.0198	0.0140	0.645
nitrate (as N)	400		10		3.0		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.79	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
nitrite (as N)	0.2 - 2	Cl	1		0.02 - 0.20*	Cl	<0.020	<0.020	<0.020	0.050	<0.020	<0.020	<0.020	<0.020	<0.020	0.030	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.13
total nitrogen							1.60	467	1.82	2.79	1.60	1.69	1.71	1.90	2.47	2.62	1.69	1.70	1.55	2.49	1.72	1.81	1.72	1.52	1.75	1.76	2.24	1.88	2.42
chloride	1500		250		150*, 600*		310	311	327	319	303	329	326	322	311	340	254	296	304	312	307	336	347	268	285	309	348	340	328
ortho-phosphate (dissolved; as P)					0.005 to 0.015	see note 1	0.011	0.0022	0.0085	0.0883	<0.0010	<0.0010	<0.0010	<0.0010	0.0027	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	0.0087	<0.0010	<0.0010	0.0010	<0.0010	0.0363
Total Kjeldahl Nitrogen							-	-	-	-	-	-	-	-	-	-	-	1.66	1.54	2.49	1.72	1.73	1.72	1.52	1.75	1.76	2.24	1.88	2.42
Microbiological Analyses																												
total coliforms (mpn/100mL)							173000	13000	2910	411	11200	92100	24200	1730	1530	248	88	71	365	387	>2419.6	>241960	488000	1000	4610	24200	9800	2420	37
Escherichia coli (mpn/100mL)							261	61	17	2	3	17	3	6	22	12	48	6	1	<1	<1	21	2720	1000	5	6	<10	1	9
Total Metals																												
aluminum			9.5		See Dissolved Metals		<0.010	0.166	0.038	0.053	0.027	<0.010	<0.010	0.012	0.122	0.034	0.056	0.0107	<0.0060	0.0063	<0.0060	0.0435	<0.015	0.0256	0.174	0.0122	0.0174	<0.0060	0.0143
antimony	0.09		0.006		0.009	W	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00052	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
arsenic	0.05		0.01		0.005		0.0031	0.0034	0.0035	0.0032	0.0032	0.0028	0.0028	0.0036	0.0046	0.0038	0.0026	0.00312	0.00298	0.00317	0.00358	0.00347	0.00358	0.00273	0.00314	0.00386	0.00342	0.00321	0.00408
barium	10		1		1	W	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
beryllium	0.0015		0.008		0.00013	W	***<0.0050***	***<0.010***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0020***	<0.00010	***<0.00020***	***<0.00020***
bismuth							<0.20	-	-	-	-	<0.20	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
boron	12		5		1.2		<0.10	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
cadmium	0.0005 - > 0.004	H	0.005		See Dissolved Metals		<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000025	<0.000010	0.00001	<0.000010	0.0000052	<0.000010	<0.000010
calcium							59.9	62.2	61.7	61.0	64.6	58.2	57.0	58.7	61.5	60.5	61.7	67.5	66.4	64.1	59.9	54.9	52.4	64.5	58.1	54.9	50.2	47.0	59.3
chromium	0.010[VI], 0.090[III]	V	0.05		0.001[VI], 0.0089[III]	W	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
cobalt	0.04		0.001		0.004		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
copper	0.020 - 0.090	H	1.5		calculation	H	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0025	0.0017	<0.0010	<0.0010	0.0012	0.0010	<0.0010	<0.0010	<0.0025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
iron			6.5		1*		<0.030	0.083	0.069	0.111	0.043	<0.030	<0.030	<0.030	0.153	0.053	0.094	<0.030	<0.030	<0.030	<0.030	0.054	<0.030	0.043	0.233	0.033	0.041	<0.030	0.043
lead	0.040 - 0.160	H	0.01		calculation	H	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
lithium			0.008				***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	0.0392	0.0402	0.0423	0.0474	0.0495	0.0501	0.0323	0.0348	0.0485	0.0447	0.0427	0.0472
magnesium							91.6	93.9	99.1	97.2	88.5	88.3	96.7	98.7	101	98.9	75.9	91.1	89.8	93.1	97.7	104	110	82.6	90.1	108	110	97.2	119
manganese			1.5		calculation	H	0.029	0.032	0.125	0.103	0.032	0.022	0.012	0.129	0.161	0.158	0.111	0.0340	0.0405	0.0415	0.0110	0.0149	0.0841	0.0358	0.0326	0.0245	0.0222	0.0306	0.157
mercury	0.00025		0.001				<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000089	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
molybdenum	10		0.25		<1		<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0013	<0.0010	<0.0010	0.0011	0.0017	<0.0010	<0.0010	0.0011	<0.0010	0.0011	0.0012	<0.0010	<0.0010	<0.0010	<0.0010
nickel	0.250 - 1.5	H	0.08		0.15	H ≥ 180 mg/L CaCO3; W	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0016	0.0019	0.0014	0.0017	0.0021	<0.0025	0.0014	0.0020	0.0018	0.0018	0.0017	0.0018
phosphorus					0.005 to 0.015	see note 1	***<0.30***	-	-	-	-	***<0.30***	-	-	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***
potassium							41.7	-	-	-	-	40.9	-	-	46.6	43.6	32.6	39.2	37.7	40.4	41.1	44.5	46.2	32.5	35.9	44.0	43.2	40.1	44.3
selenium	0.02		0.01		0.002	see note 2	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00020	0.00011	<0.00010	<0.00010	0.00016	<0.00025	0.00013	0.00015	0.00031	0.000116	0.00010	<0.00010
silicon							2.24	-	-	-	-	3.80	-	-	4.69	1.76	1.25	0.461	0.340	1.05	1.46	1.61	1.63	0.76	0.57	1.42	1.11	1.48	2.56
silver	0.0005 - 0.015	H	0.02		0.0015	H > 100 mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000050	<0.000020	<0.000020	0.000486	<0.000020	<0.000020	<0.000020
sodium			200				539	540	561	529	446	514	542	567	537	546	397	494	487	481	520	561	596	405	431	567	559	518	566
strontium			2.5				0.664	-	-	-	-	0.690	-	-	0.797	0.775	0.648	0.773	0.779	0.783	0.832	0.772	0.784	0.775	0.766	0.753	0.734	0.706	0.874
thallium	0.003				0.0008	W	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	***<0.0020***	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000010	<0.00020	<0.00020
titanium	1						<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
tin			2.5				<0.030	-	-	-	-	<0.030	-	-	<0.030	<0.030	<0.030	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
uranium	0.085		0.02		0.0085	W	0.00396	0.00415	0.00462	0.00527	0.00564	0.00505	0.00492	0.00498	0.00640	0.00585	0.00516	0.00590	0.00611	0.00540	0.00583	0.00623	0.00481	0.00545	0.00525	0.00493	0.00551	0.00502	0.00548
vanadium							<0.030	<0.060	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0025	<0.0010	0.0011	<0.0010	0.00082	<0.0010	<0.0010
zinc	0.075 - > 2.4	H	3		calculation	H; H > 90 mg/L	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0060	<0.0060	<0.0060	<0.0050	<0.0060	<0.0060

Table 2: 2014 - 2017 Results of Water Analyses at Davidson Pond and Rose's Pond
City of Kelowna-Vernon Biosolids Facility
511 Commonage Road, Vernon, BC

Location							Davidson Pond																	
ALS Laboratory ID	Aquatic Life CSR-AW (freshwater)	Notes	Drinking Water CSR-DW	Notes	BC Water Quality Aquatic Life (freshwater)	Notes	L1502217-2	L1515479-2	L1532630-2	L1547862-2	L1625288-2	L1645255-2	L1656492-2	L1669705-2	L1684336-2	L1698669-2	L1742616-2	L1752610-2	L1763882-2	L1777367-2	L1794599-2	L1811981-2	L1832582-2	L1924064-2	L1946645-2	L1965494-2	L1984896-2	L1994913-2	L2016326-2
Date							13-Aug-14	9-Sep-14	14-Oct-14	17-Nov-14	10-Jun-15	20-Jul-15	11-Aug-15	7-Sep-15	6-Oct-15	4-Nov-15	8-Mar-16	5-Apr-16	3-May-16	1-Jun-16	5-Jul-16	10-Aug-16	21-Sep-16	9-May-17	21-Jun-17	26-Jul-17	31-Aug-17	20-Sep-17	31-Oct-17
Dissolved Metals																												
aluminum			9.5		0.05˜ (dis)	pH >6.5	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0059	<0.0050	<0.0050
antimony	0.09		0.006				<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
arsenic	0.05		0.01				0.0031	0.0031	0.0028	0.0031	0.0032	0.0029	0.0028	0.0032	0.0039	0.0037	0.0024	0.00289	0.00328	0.00333	0.00316	0.00340	0.00338	0.00269	0.00308	0.00339	0.00337	0.00318	<0.00050
barium	10		1				<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
beryllium	0.0015		0.008				***<0.0050***	***<0.010***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	***<0.0050***	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00020	<0.00010	<0.00020	<0.00020
bismuth							<0.20	-	-	-	-	<0.20	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
boron	12		5				<0.10	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
cadmium	0.0005 - > 0.004	H	0.005		calculation (dis)	H	<0.00010	<0.00010	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.0000050	<0.000010	<0.000010
calcium							60.0	60.5	58.7	60.1	65.9	60.4	55.1	58.2	60.0	60.9	61.0	66.9	70.6	66.5	58.3	54.2	53.6	60.5	55.8	53.6	50.3	52.3	35.5
chromium	0.010[VI], 0.090[III]	V	0.05				<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cobalt	0.04		0.001				<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
copper	0.020 - 0.090	H	1.5			H	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0022
iron			6.5		0.35* (dis)		<0.030	<0.060	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
lead	0.040 - 0.160	H	0.01				<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
lithium			0.008				***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	0.0386	0.0427	0.0444	0.0453	0.0467	0.0434	0.0325	0.0353	0.0487	0.0453	0.0482	<0.0020
magnesium							92.8	91.1	93.3	95.9	90.9	91.4	94.1	96.7	97.0	100	75.0	89.0	94.6	95.8	95.8	104	105	80.3	90.9	103	105	98.2	12.3
manganese			1.5				<0.010	<0.010	0.094	0.089	<0.010	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	0.00123	0.0343	0.0302	0.00362	0.00863	0.0273	0.0267	0.0137	0.0147	0.0137	0.0077	0.00267
mercury	0.00025		0.001				<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
molybdenum	10		0.25				<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0011	0.001	<0.0010	<0.0010	<0.0010	<0.0010
nickel	0.250 - 1.5	H	0.08				<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0017	0.0016	0.0013	0.0016	0.0021	0.0012	0.0014	0.0015	0.0016	0.0016	0.0015	0.0035
phosphorus							<0.30	-	-	-	-	<0.30	-	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
potassium							41.3	-	-	-	-	42.8	-	-	44.3	43.2	31.6	35.9	39.1	40.4	40.1	43.3	43.9	30.4	34.7	43.1	41.0	41.6	<2.0
selenium	0.02		0.01				<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00019	0.00012	0.00012	0.00012	<0.00010	0.00016	0.00012	0.00010	0.00019	0.000122	<0.00010	0.00011
silicon							2.22	-	-	-	-	3.93	-	-	4.28	1.40	0.437	0.417	0.261	1.06	1.40	1.50	1.51	0.67	0.23	1.32	1.00	1.49	2.54
silver	0.0005 - 0.015	H	0.02				<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020	0.000025	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
sodium			200				**536**	**524**	**532**	**531**	**449**	**537**	**530**	**561**	**524**	**546**	**392**	**464**	**510**	**488**	**506**	**551**	**560**	**386**	**431**	**543**	**529**	**527**	10.7
strontium			2.5				0.660	-	-	-	-	0.717	-	-	0.775	0.775	0.636	0.730	0.820	0.803	0.808	0.764	0.761	0.752	0.807	0.712	0.728	0.770	0.183
thallium	0.003						<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000020	<0.00020	<0.00020	<0.000050	<0.000020	<0.000020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
tin			2.5				<0.030	-	-	-	-	<0.030	-	-	<0.030	<0.030	<0.030	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
titanium	1						<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
uranium	0.085		0.02				0.00374	0.00421	0.00427	0.00516	0.00593	0.00534	0.00499	0.00485	0.00641	0.00572	0.00516	0.00588	0.00627	0.00537	0.00538	0.00553	0.00526	0.00574	0.00552	0.00453	0.00524	0.00541	<0.00020
vanadium							<0.030	<0.060	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00059	<0.0010	<0.0010
zinc	0.075 - > 2.4	H	3				<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0134

Notes:
All concentrations in milligrams per litre (mg/L), unless otherwise noted.
Standards from the Contaminated Sites Regulation (CSR), updated 1 November 2017. Land Use abbreviations: AW (Aquatic Life); and DW (Drinking Water).
BCWQG = British Columbia Approved (updated January 2017) and Working (updated June 2017) Water Quality Guidelines. Approved WQG provided, unless otherwise noted (as W: Working WQG).
H = standard is Hardness dependent; pH = standard is pH dependent; Cl = standard is chloride dependent; V = standard is valence dependent,
VI=chromium VI and III=chromium III; T = standard varies with temperature (10 deg C assumed for ammonia criteria).
Note 1: the guidelines provided for ortho-phosphate are the BCWQG for total phosphorus (as P), and are applicable for lakes where salmonids are the predominant fish species. Guidelines are for reference only, and may not be applicable to Davidson Pond or Rose's Pond.
+ = long-term average BCWQG AW guideline; * = short-term maximum BCWQG AW guideline. Long-term average BCWQG provided, unless otherwise noted.
(dis) = BCWQG AW guideline is for dissolved concentration.
calcuation = indicates that a calculation is required to determine BCWQG. No exceedences were identified for those parameters where BCWQG was calculated.
Note 2: the guideline of 0.001 mg/L is an alert concentration; the guideline of 0.002 mg/L is the BCWQG.

310	indicates parameter concentration exceeds applicable CSR AW or DW standards
0.957	indcates parameter concentration exceeds applicable BCWQG guideline
340	indicates parameter concentration exceeds applicable CSR DW standard and long-term average BCWQG guideline
645	indicates parameter concentration exceeds applicable CSR DW standard and short-term maximum BCWQG guideline
<0.0050	indicates that the reported detection limit is greater than the applicable criteria

*Exceedance based on laboratory pH

Table 2: 2014 - 2017 Results of Water Analyses at Davidson Pond and Rose's Pond
City of Kelowna-Vernon Biosolids Facility
511 Commonage Road, Vernon, BC

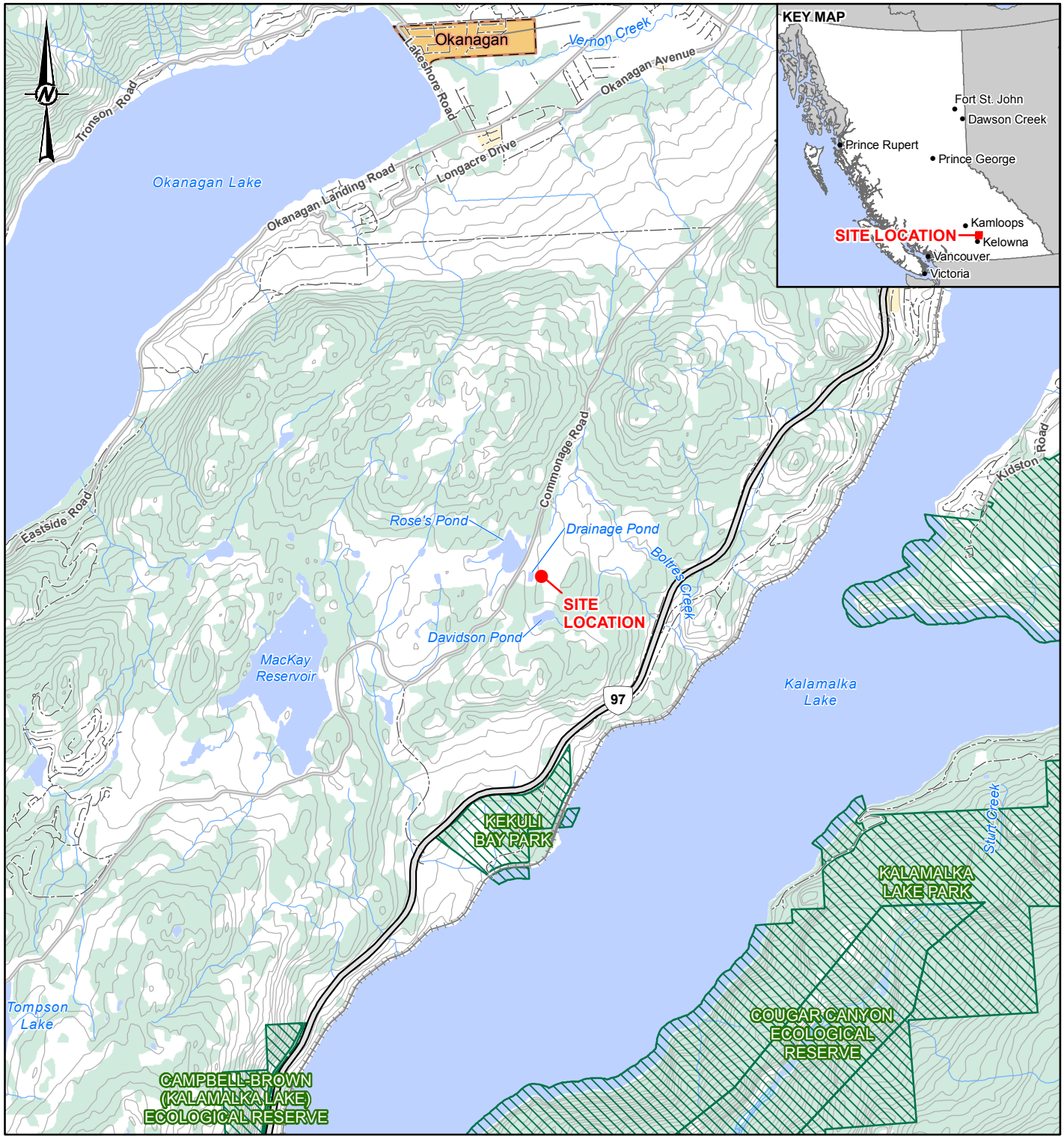
Location							Rose's Pond																		
ALS Laboratory ID	Aquatic Life CSR-AW (freshwater)	Notes	Drinking Water CSR-DW	Notes	BC Water Quality Aquatic Life (freshwater)	Notes	L1502217-3	L1515479-3	L1532630-3	L1547862-1	L1625288-3	L1645255-3	L1656492-3	L1669705-3	L1684336-3	L1698669-3	L1742616-3	L1752610-3	L1763882-3	L1777367-3	L1794599-3	L1811981-3	L1832582-3	L1924064-3	L1946645-3	L1965494-3	L1984896-3	L1994913-3	L2016326-3
Date							13-Aug-14	9-Sep-14	14-Oct-14	17-Nov-14	10-Jun-15	20-Jul-15	11-Aug-15	7-Sep-15	6-Oct-15	4-Nov-15	8-Mar-16	5-Apr-16	3-May-16	1-Jun-16	5-Jul-16	10-Aug-16	21-Sep-16	9-May-17	21-Jun-17	26-Jul-17	31-Aug-17	20-Sep-17	31-Oct-17
Parameters																												
Temperature (field)							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	19	23	21	16	5
pH (field)					6.5 - 9.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.4	8.5	8.5	9.1	8.9	8.4
pH (laboratory)					6.5 - 9.0		8.94	8.86	8.75	8.58	8.80	8.71	8.88	8.85	8.82	8.55	8.47	8.60	8.62	8.57	8.72	8.76	8.56	8.45	8.44	8.43	8.72	8.67	8.49
conductivity (laboratory)							7350	7310	7270	7350	6030	6860	7240	6990	7520	7400	5490	5790	5940	6350	6050	6800	7030	4330	4380	4930	4890	5130	5440
total suspended solids (TSS)							10.2	9.4	27.3	17.3	9.5	8.0	6.7	<3.0	6.9	9.4	10.4	7.6	5.8	5.5	4.6	3.8	4.8	8.8	6.8	9.3	9.7	15.2	6.1
biochemical oxygen demand (5-day BOD)							<2.0	<2.0	<2.0	2.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4.9	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.2	2.1	<2.0
chemical oxygen demand (COD)							70	78	83	91	71	75	71	66	78	69	58	66	56	61	59	69	76	46	54	63	75	80	62
hardness as CaCO3							1790	1780	1830	1840	1550	1680	1690	1750	1650	1700	1310	1410	1440	1460	1440	1570	1620	1070	1130	1220	1230	1080	18.8
Inorganics																													
ammonia (total; as N)	1.31 - 18.4	pH/T			0.131 - 1.84[+]	pH/T	0.0188	0.0231	0.0181	0.0132	0.0131	0.0266	0.0089	0.0194	0.0167	0.0441	0.0117	0.0129	0.0321	0.0210	0.0184	0.0520	0.0237	0.0771	0.0228	0.0104	0.0117	0.0097	0.0187
nitrate (as N)	400		10		3.0[*]		0.28	<0.25	<0.25	<0.25	<0.25	<0.25	0.31	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.57	<0.10	<0.10	<0.10	<0.10	0.12
nitrite (as N)	0.2 - 2	Cl	1		0.02 - 0.20[+]	Cl	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	***<0.050***	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
total nitrogen							1.79	1.91	1.77	2.04	1.70	1.72	1.67	1.74	1.85	1.99	1.67	1.78	1.55	1.54	1.64	1.66	1.55	1.77	1.43	1.58	1.64	1.85	1.81
chloride	1500		250		150[~], 600*		549	584	645	634	532	578	530	573	613	596	468	482	479	515	533	632	537	436	397	377	444	443	443
ortho-phosphate (dissolved; as P)					0.005 to 0.015	see note 1	0.010	0.0013	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	0.0023	<0.0010	0.0011	<0.0010	<0.0010	0.0020	<0.0010	0.0114	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen							-	-	-	-	-	-	-	-	-	-	-	1.74	1.53	1.54	1.64	1.61	1.55	1.20	1.43	1.58	1.64	1.85	1.70
Microbiological Analyses																													
total coliforms (mpn/100mL)							43500	29900	1960	57	24200	41100	19900	7270	236	225	65	205	387	921	>2419.6	<1	2480	225	19900	29900	17300	2480	25
Escherichia coli (mpn/100mL)							7	<1	1	<1	6	82	16	52	5	<1	3	43	42	11	326	<1	<10	4	12	1	10	2	<1
Total Metals																													
aluminum			9.5		See Dissolved Metals		<0.015	0.029	<0.015	<0.030	0.021	0.016	<0.015	<0.015	<0.015	0.080	0.022	0.030	<0.015	<0.015	0.021	0.024	0.015	0.021	<0.015	0.024	0.0218	<0.015	0.0090
antimony	0.09		0.006		0.009	W	0.00071	0.00086	0.00082	<0.0010	0.00066	0.00074	0.00070	0.00079	0.00085	0.00074	0.00059	0.00060	0.00071	0.00054	0.00063	0.00060	0.00063	<0.00050	<0.00050	<0.00050	0.00057	0.00056	0.00053
arsenic	0.05		0.01		0.005		0.0058	0.0063	0.0067	0.0058	0.0068	0.0060	0.0056	0.0061	0.0062	0.0058	0.0045	0.00405	0.00475	0.00441	0.00519	0.00501	0.00525	0.00332	0.00382	0.00419	0.00483	0.00422	0.00442
barium	10		1		1	W	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.024	0.025	0.02	0.021	<0.020	<0.020
beryllium	0.0015		0.008		0.00013	W	***<0.010***	***<0.010***	***<0.010***	***<0.010***	***<0.0050***	***<0.010***	***<0.010***	***<0.010***	***<0.010***	***<0.010***	***<0.0050***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0010***	***<0.0050***	<0.00010	***<0.00050***	***<0.00020***
bismuth							<0.40	-	-	-	-	<0.40	-	-	<0.40	<0.40	<0.20	<0.40	<0.20	<0.20	<0.20	<0.40	<0.40	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
boron	12		5		1.2		<0.20	<0.20	<0.20	<0.20	0.10	<0.20	<0.20	<0.20	<0.20	<0.20	<0.10	<0.20	<0.10	<0.10	<0.10	<0.20	<0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
cadmium	0.0005 - > 0.004	H	0.005		See Dissolved Metals		<0.00025	<0.00025	<0.00025	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.0000050	<0.000025	<0.000010
calcium							36.9	48.7	41.5	44.4	57.2	53.3	46.1	47.6	47.2	47.8	65.4	71.6	70.9	62.2	59.1	52.8	52.5	84.8	80.9	85.4	81.3	71.3	79.7
chromium	0.010[VI], 0.090[III]	V	0.05		0.001[VI], 0.0089[III]	W	***<0.0025***	***<0.0025***	***<0.0025***	***<0.0050***	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cobalt	0.04		0.001		0.004		<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00030	<0.00050	<0.00030
copper	0.020 - 0.090	H	1.5		calculation	H	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0010	<0.0025	<0.0010
iron			6.5		1*		<0.060	<0.060	<0.060	<0.060	<0.030	<0.060	<0.060	<0.060	<0.060	0.130	0.039	<0.060	<0.030	<0.030	<0.030	<0.060	<0.060	<0.050	<0.050	<0.050	<0.030	<0.050	<0.030
lead	0.040 - 0.160	H	0.01		calculation	H	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
lithium			0.008				0.073	0.078	0.076	0.076	0.063	0.066	0.068	0.073	0.073	0.073	0.054	0.0540	0.0592	0.0601	0.0647	0.0622	0.0752	0.0410	0.0398	0.0547	0.0471	0.0503	0.0558
magnesium							393	403	422	419	336	377	389	392	393	384	280	306	308	300	314	354	370	231	226	255	277	231	288
manganese			1.5		calculation	H	0.030	0.043	0.015	<0.010	0.036	0.096	0.012	0.035	0.026	0.063	0.201	0.113	0.0511	0.0312	0.0355	0.0356	0.0426	0.0789	0.0449	0.0527	0.102	0.0169	0.0514
mercury	0.00025		0.001				<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
molybdenum	10		0.25		<1		<0.0010	0.0012	<0.0010	0.0012	0.0013	0.0012	0.0012	0.0011	0.0011	<0.0010	0.0016	0.0017	0.0019	0.0014	0.0014	0.0011	<0.0010	0.0025	0.0023	0.0022	0.0023	0.0020	0.0019
nickel	0.250 - 1.5	H	0.08		0.15	H ≥ 180 mg/L CaCO3; W	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	0.0026	<0.0025	<0.0025	<0.0025	<0.0025	0.0012	<0.0025	0.0011
phosphorus					0.005 to 0.015	see note 1	***<0.60***	-	-	-	-	***<0.60***	-	-	***<0.60***	***<0.60***	***<0.30***	***<0.60***	***<0.30***	***<0.30***	***<0.30***	***<0.60***	***<0.60***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***	***<0.30***
potassium							119	-	-	-	-	108	-	-	118	115	84.6	89.9	91.6	83.8	92.7	103	105	70.3	69.1	79.8	82.2	70.4	85.2
selenium	0.02		0.01		0.002	see note 2	***<0.0050***	***<0.0050***	***<0.0050***	***<0.010***	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00051	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00057	<0.00025	0.00030	0.000267	0.00027	0.00022
silicon							0.24	-	-	-	-	0.32	-	-	0.12	0.26	1.49	0.15	0.253	0.129	0.348	0.38	0.43	1.49	0.54	1.06	1.07	0.96	1.17
silver	0.0005 - 0.015	H	0.02		0.0015	H > 100 mg/L	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000134	<0.000020	<0.000050	<0.000020
sodium			200				1200	1240	1230	1290	942	1080	1150	1200	1200	1170	847	935	969	935	991	1050	1090	659	632	776	786	704	825
strontium			2.5				0.293	-	-	-	-	0.485	-	-	0.410	0.434	0.620	0.711	0.693	0.600	0.580	0.480	0.483	0.802	0.785	0.777	0.770	0.686	0.737
thallium	0.003				0.0008	W	<0.00050	<0.00050	<0.00050	***<0.0010***	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000050	<0.000010	<0.000050	<0.000020
titanium	1						<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.030	<0.020	0.013	<0.010	<0.010	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
tin			2.5				<0.060	<0.060	-	-	-	<0.060	-	-	<0.060	<0.060	<.050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
uranium	0.085		0.02		0.0085	W	0.00403	0.00462	0.00461	0.00481	0.00486	0.00485	0.00459	0.00452	0.00495	0.00456	0.00466	0.00514	0.00574	0.00486	0.00518	0.00483	0.00434	0.00607	0.00562	0.00553	0.00591	0.00560	0.00637
vanadium							<0.060	<0.060	<0.060	<0.060	<0.030	<0.060	<0.060	<0.060	<0.060	<0.060	<0.030	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.00099	<0.0025	<0.0010
zinc	0.075 - > 2.4	H	3		calculation	H; H > 90 mg/L	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.015	<0.015	<0.015	<0.0050	<0.015	<0.0060

Table 2: 2014 - 2017 Results of Water Analyses at Davidson Pond and Rose's Pond
City of Kelowna-Vernon Biosolids Facility
511 Commonage Road, Vernon, BC

Location							Rose's Pond																		
ALS Laboratory ID	Aquatic Life CSR-AW (freshwater)	Notes	Drinking Water CSR-DW	Notes	BC Water Quality Aquatic Life (freshwater)	Notes	L1502217-3	L1515479-3	L1532630-3	L1547862-1	L1625288-3	L1645255-3	L1656492-3	L1669705-3	L1684336-3	L1698669-3	L1742616-3	L1752610-3	L1763882-3	L1777367-3	L1794599-3	L1811981-3	L1832582-3	L1924064-3	L1946645-3	L1965494-3	L1984896-3	L1994913-3	L2016326-3
Date							13-Aug-14	9-Sep-14	14-Oct-14	17-Nov-14	10-Jun-15	20-Jul-15	11-Aug-15	7-Sep-15	6-Oct-15	4-Nov-15	8-Mar-16	5-Apr-16	3-May-16	1-Jun-16	5-Jul-16	10-Aug-16	21-Sep-16	9-May-17	21-Jun-17	26-Jul-17	31-Aug-17	20-Sep-17	31-Oct-17
Dissolved Metals																												
aluminum			9.5		0.05+ (dis)	pH >6.5	<0.015	<0.015	<0.015	<0.030	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	0.0086	0.0073	<0.0050	<0.0050	<0.0050	0.0051	<0.0050	<0.0050
antimony	0.09		0.006				0.00070	0.00078	0.00075	<0.0010	0.00070	0.00074	0.00072	0.00075	0.00077	0.00075	0.00053	0.00052	0.00062	0.00051	0.00057	0.00062	0.00066	<0.00050	<0.00050	<0.00050	<0.00050	0.0005	<0.00050
arsenic	0.05		0.01				0.0057	0.0058	0.0063	0.0062	0.0068	0.0056	0.0055	0.0060	0.0060	0.0057	0.0046	0.00416	0.00463	0.00442	0.00502	0.00523	0.00521	0.00310	0.00372	0.00410	0.00440	0.00377	<0.00050
barium	10		1				<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	0.023	<0.020	<0.020	<0.020	<0.020
beryllium	0.0015		0.008				***<0.010***	***<0.010***	***<0.010***	***<0.010***	***<0.0050***	***<0.010***	***<0.010***	***<0.010***	***<0.010***	***<0.010***	***<0.0050***	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.00020
bismuth							<0.40	-	-	-	-	<0.40	-	-	<0.40	<0.40	<0.20	<0.40	<0.20	<0.20	<0.20	<0.40	<0.40	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
boron	12		5				<0.20	<0.20	<0.20	<0.20	0.12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.10	<0.20	<0.10	<0.10	0.11	<0.20	<0.20	<0.10	<0.10	<0.10	0.11	<0.10	<0.10
cadmium	0.0005 - > 0.004	H	0.005		calculation (dis)	H	<0.00025	<0.00025	<0.00025	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000025	<0.000010
calcium							37.5	47.0	41.9	43.0	58.2	53.7	45.6	45.9	44.6	47.7	65.6	70.6	72.5	65.9	59.0	51.8	51.1	76.2	81.6	83.1	78.9	71.3	6.54
chromium	0.010[VI], 0.090[III]	V	0.05				<0.0025	<0.0025	<0.0025	<0.0050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cobalt	0.04		0.001				<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00030
copper	0.020 - 0.090	H	1.5			H	<0.0025	<0.0025	<0.0025	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
iron			6.5		0.35* (dis)		<0.060	<0.060	<0.060	<0.060	<0.030	<0.060	<0.060	<0.060	<0.060	<0.060	<0.030	<0.060	<0.030	<0.030	<0.030	<0.060	<0.060	<0.050	<0.050	<0.050	<0.050	<0.050	<0.030
lead	0.040 - 0.160	H	0.01				<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
lithium			0.008				**0.072**	**0.076**	**0.076**	**0.077**	**0.062**	**0.066**	**0.064**	**0.072**	**0.071**	**0.072**	**0.052**	**0.0530**	**0.0614**	**0.0615**	**0.0625**	**0.0648**	**0.0645**	**0.0382**	**0.0404**	**0.0531**	**0.0491**	**0.0497**	<0.0020
magnesium							411	403	418	419	342	376	382	398	372	383	278	300	307	315	314	349	362	214	224	246	250	220	0.61
manganese			1.5				0.027	<0.010	<0.010	0.021	<0.010	0.079	<0.010	<0.010	<0.010	<0.010	0.168	0.0464	0.0373	0.00671	0.0208	0.00583	0.0257	0.0689	0.0354	0.00622	0.0316	0.00138	0.0161
mercury	0.00025		0.001				<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
molybdenum	10		0.25				<0.0010	0.0011	<0.0010	0.0012	0.0014	0.0014	0.0011	<0.0010	0.0011	0.0011	0.0011	0.0014	0.0018	0.0014	0.0014	0.0012	<0.0010	0.0023	0.0024	0.0020	0.0021	0.0020	<0.0010
nickel	0.250 - 1.5	H	0.08				<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	0.0028	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0010
phosphorus							<0.60	-	-	-	-	<0.60	-	-	<0.60	<0.60	<0.30	<0.60	<0.30	<0.30	<0.30	<0.60	<0.60	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
potassium							122	-	-	-	-	107	-	-	110	114	83.0	85.9	92.7	86.7	92.9	99.4	108	62.5	65.5	78.2	78.7	68.4	<2.0
selenium	0.02		0.01				<0.0050	<0.0050	<0.0050	<0.010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.00033	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00054	0.00026	0.00026	0.00025	<0.00025	<0.00010
silicon							0.25	-	-	-	-	0.33	-	-	<0.10	<0.10	1.41	<0.10	0.248	0.104	0.301	0.34	0.39	1.21	0.48	0.92	0.86	0.97	0.37
silver	0.0005 - 0.015	H	0.02				<0.000050	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000020
sodium			200				**1220**	**1200**	**1240**	**1250**	**950**	**1070**	**1120**	**1150**	**1130**	**1170**	**841**	**908**	**983**	**968**	**990**	**1020**	**1140**	**599**	**615**	**748**	**721**	**675**	6.7
strontium			2.5				0.301	-	-	-	-	0.487	-	-	0.388	0.429	0.615	0.691	0.707	0.623	0.578	0.469	0.521	0.742	0.814	0.747	0.751	0.672	0.0291
thallium	0.003						<0.00050	<0.00050	<0.00050	<0.0010	<0.00020	<0.000050	<0.00020	<0.00020	<0.000050	<0.000050	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
tin			2.5				<0.060	-	-	-	-	<0.060	-	-	<0.060	<0.060	<0.030	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
titanium	1						<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.020	0.012	<0.010	<0.010	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
uranium	0.085		0.02				0.00426	0.00443	0.00445	0.00478	0.00512	0.00478	0.00468	0.00438	0.00479	0.00455	0.00472	0.00510	0.00586	0.00483	0.00505	0.00490	0.00436	0.00597	0.00597	0.00520	0.00545	0.00557	<0.00020
vanadium							<0.060	<0.060	<0.060	<0.060	<0.030	<0.060	<0.060	<0.060	<0.060	<0.060	<0.030	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
zinc	0.075 - > 2.4	H	3				<0.010	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0125

Notes:
All concentrations in milligrams per litre (mg/L), unless otherwise noted.
Standards from the Contaminated Sites Regulation (CSR), updated 1 November 2017. Land Use abbreviations: AW (Aquatic Life); and DW (Drinking Water).
BCWQG = British Columbia Approved (updated January 2017) and Working (updated January 2017) Water Quality Guidelines. Approved WQG provided, unless otherwise noted (as W: Working WQG).
H = standard is Hardness dependent; pH = standard is pH dependent; Cl = standard is chloride dependent; S = refer to CSR Schedule 10; V = standard is valence dependent, VI=chromium VI and III=chromium III; T = standard varies with temperature (10 deg C assumed for ammonia criteria).
Note 1: the guidelines provided for ortho-phosphate are the BCWQG for total phosphorus (as P), and are applicable for lakes where salmonids are the predominant fish species. Guidelines are for reference only, and may not be applicable to Davidson Pond or Rose's Pond.
+ = long-term average BCWQG AW guideline; * = short-term maximum BCWQG AW guideline. Long-term average BCWQG provided, unless otherwise noted.
(dis) = BCWQG AW guideline is for dissolved concentration.
calcuation = indicates that a calculation is required to determine BCWQG. No exceedences were identified for those parameters where BCWQG was calculated.
Note 2: the guideline of 0.001 mg/L is an alert concentration; the guideline of 0.002 mg/L is the BCWQG.

310	indicates parameter concentration exceeds applicable CSR AW or DW standards
0.957	indcates parameter concentration exceeds applicable BCWQG guideline
340	indicates parameter concentration exceeds applicable CSR DW standard and long-term average BCWQG guideline
645	indicates parameter concentration exceeds applicable CSR DW standard and short-term maximum BCWQG guideline
<0.0050	indicates that the reported detection limit is greater than the applicable criteria



LEGEND

- SITE LOCATION
- AIRFIELD
- INDIAN RESERVE
- PARK / PROTECTED AREA
- RESIDENTIAL AREA
- WETLAND
- WATERBODY
- WOODED AREA
- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY
- WATERCOURSE
- CONTOUR (20m)

0 1,000 2,000

1:50,000 METRES

REFERENCES

1. ROAD, CONTOUR, WOODED AREA, HYDROLOGY, RESIDENTIAL AREAS AND AIRFIELD DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. INDIAN RESERVES, PARK / PROTECTED AREAS, RAILWAY AND TOWN DATA CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – BRITISH COLUMBIA.
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N

CLIENT
CITY OF KELOWNA

PROJECT
2017 ANNUAL MONITORING REPORT
BIOSOLID COMPOSTING FACILITY, VERNON, BC.

TITLE
KEY PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-02-07
DESIGNED	HH
PREPARED	JP
REVIEWED	HH
APPROVED	PA

PROJECT NO.	PHASE	REV.	FIGURE
1542527	4000	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25mm

0

PATH: Y:\burnaby\CAD-GIS\Client\City_of_Kelowna\Vernon\99_PROJECTS\1542527_2014_2015_ANNUAL_MONITORING_REPORT\02_PRODUCTION\ANNUAL_REPORT\MXD\Report\1542527_FIG1_KEY_PLAN_2017.mxd

LEGEND

MAJOR ROAD

0 150 300

1:6,000 METRES

REFERENCES

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3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N

CLIENT
CITY OF KELOWNA

PROJECT
2017 ANNUAL MONITORING REPORT
BIOSOLID COMPOSTING FACILITY, VERNON, BC.

TITLE
SITE PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-02-07
DESIGNED	HH
PREPARED	JP
REVIEWED	HH
APPROVED	PA

PROJECT NO.	PHASE	REV.	FIGURE
1542527	4000	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

25mm

0

PATH: Y:\burnaby\CAD-GIS\Client\City_of_Kelowna\Vernon\99_PROJECTS\1542527_2014_2015_ANNUAL_MONITORING_REPORT\02_PRODUCTION\ANNUAL_REPORT\MXD\Report\1542527_FIG2_SITE_PLAN_2017.mxd

APPENDIX A

ALS Laboratory Certificates of Analysis (2017)

CITY OF KELOWNA
ATTN: Marcia Browne
Glenmore Landfill
2720 John Hindle Drive
Kelowna BC V1V 2C5

Date Received: 10-MAY-17
Report Date: 18-MAY-17 18:06 (MT)
Version: FINAL

Client Phone: 250-469-8796

Certificate of Analysis

Lab Work Order #: L1924064

Project P.O. #: 520747
Job Reference: 1186-202 POND
C of C Numbers:
Legal Site Desc:

Dean Watt, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1924064-1	L1924064-2	L1924064-3		
	Description	SURFACE WATE	SURFACE WATE	SURFACE WATE		
	Sampled Date	09-MAY-17	09-MAY-17	09-MAY-17		
	Sampled Time	11:00	10:30	10:05		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	899	2500	4330		
	Hardness (as CaCO3) (mg/L)	217	482	1070		
	pH (pH)	8.00	8.76	8.45		
	Total Suspended Solids (mg/L)	3.6	22.8	8.8		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.915	0.0768	0.0771		
	Chloride (Cl) (mg/L)	97.6	268	436		
	Nitrate (as N) (mg/L)	1.21	<0.10 DLDS	0.57		
	Nitrite (as N) (mg/L)	0.0156	<0.020 DLDS	<0.020 DLDS		
	Total Kjeldahl Nitrogen (mg/L)	2.03	1.52	1.20		
	Total Nitrogen (mg/L)	3.26	1.52	1.77		
	Orthophosphate-Dissolved (as P) (mg/L)	0.647	0.0087	0.0114		
Bacteriological Tests	E. coli (MPN/100mL)	23	1000	4		
	Coliform Bacteria - Total (MPN/100mL)	980	1000	225		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0282	0.0256	0.021		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Total (mg/L)	0.00086	0.00273	0.00332		
	Barium (Ba)-Total (mg/L)	0.029	<0.020	0.024		
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Total (mg/L)	0.15	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	0.0000125	<0.000010 DLA	<0.000025 DLA		
	Calcium (Ca)-Total (mg/L)	56.2	64.5	84.8		
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Total (mg/L)	0.00030	<0.00030	<0.00050 DLA		
	Copper (Cu)-Total (mg/L)	0.0032	<0.0010	<0.0025 DLA		
	Iron (Fe)-Total (mg/L)	0.061	0.043	<0.050 DLA		
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Lithium (Li)-Total (mg/L)	0.0102	0.0323	0.0410		
	Magnesium (Mg)-Total (mg/L)	23.3	82.6	231		
	Manganese (Mn)-Total (mg/L)	0.0980	0.0358	0.0789		
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.0043	0.0011	0.0025		
	Nickel (Ni)-Total (mg/L)	0.0017	0.0014	<0.0025 DLA		
	Phosphorus (P)-Total (mg/L)	0.85	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	19.5	32.5	70.3		
	Selenium (Se)-Total (mg/L)	0.000512	0.00013	0.00057		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1924064-1	L1924064-2	L1924064-3		
	Description	SURFACE WATE	SURFACE WATE	SURFACE WATE		
	Sampled Date	09-MAY-17	09-MAY-17	09-MAY-17		
	Sampled Time	11:00	10:30	10:05		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Total Metals	Silicon (Si)-Total (mg/L)	2.96	0.76	1.49		
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020	<0.000050 DLA		
	Sodium (Na)-Total (mg/L)	103	405	659		
	Strontium (Sr)-Total (mg/L)	0.541	0.775	0.802		
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	0.00241	0.00545	0.00607		
	Vanadium (V)-Total (mg/L)	0.00088	<0.0010 DLA	<0.0025 DLA		
	Zinc (Zn)-Total (mg/L)	0.0270	<0.0060 DLA	<0.015 DLA		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0056	<0.0050	<0.0050		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Dissolved (mg/L)	0.00081	0.00269	0.00310		
	Barium (Ba)-Dissolved (mg/L)	0.027	<0.020	0.021		
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Dissolved (mg/L)	0.13	<0.10	<0.10		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000102	<0.000010 DLA	<0.000025 DLA		
	Calcium (Ca)-Dissolved (mg/L)	51.0	60.5	76.2		
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00050 DLA		
	Copper (Cu)-Dissolved (mg/L)	0.0025	<0.0010	<0.0010		
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.050 DLA		
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Lithium (Li)-Dissolved (mg/L)	0.0098	0.0325	0.0382		
	Magnesium (Mg)-Dissolved (mg/L)	21.8	80.3	214		
	Manganese (Mn)-Dissolved (mg/L)	0.0835	0.0267	0.0689		
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0041	0.0011	0.0023		
	Nickel (Ni)-Dissolved (mg/L)	0.0015	0.0014	<0.0025 DLA		
	Phosphorus (P)-Dissolved (mg/L)	0.76	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	18.3	30.4	62.5		
	Selenium (Se)-Dissolved (mg/L)	0.000579	0.00012	0.00054		
	Silicon (Si)-Dissolved (mg/L)	2.71	0.67	1.21		
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000050 DLA		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1924064-1	L1924064-2	L1924064-3		
	Description	SURFACE WATE	SURFACE WATE	SURFACE WATE		
	Sampled Date	09-MAY-17	09-MAY-17	09-MAY-17		
	Sampled Time	11:00	10:30	10:05		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Sodium (Na)-Dissolved (mg/L)	96.0	386	599		
	Strontium (Sr)-Dissolved (mg/L)	0.515	0.752	0.742		
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.00202	0.00574	0.00597		
	Vanadium (V)-Dissolved (mg/L)	0.00077	<0.0010 DLA	<0.0025 DLA		
	Zinc (Zn)-Dissolved (mg/L)	0.0242	<0.0050	<0.0050		
Aggregate Organics	BOD (mg/L)	<2.0	<2.0	<2.0		
	COD (mg/L)	28	49	46		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	COD	MS-B	L1924064-1, -2, -3
Matrix Spike	Barium (Ba)-Total	MS-B	L1924064-1, -2, -3
Matrix Spike	Boron (B)-Total	MS-B	L1924064-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L1924064-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1924064-1, -2, -3
Matrix Spike	Manganese (Mn)-Total	MS-B	L1924064-1, -2, -3
Matrix Spike	Potassium (K)-Total	MS-B	L1924064-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L1924064-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L1924064-1, -2, -3
Matrix Spike	Total Nitrogen	MS-B	L1924064-1, -2, -3
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1924064-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD5-VA	Water	Biochemical Oxygen Demand- 5 day	APHA 5210 B- BIOCHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5210 B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

Reference Information

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

TCOLI-COLI-ENV-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Enul

Short Holding Time

Rush Processing

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page ___ of ___

Report To				**Report Format / Distribution**				**Service Requested** (Rush for routine analysis subject to availability)
Company:	City of Kelowna			☐ Standard	☐ Other			◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Marcia Browne			☑ PDF	☑ Excel	☐ Digital	☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	2720 John Hindle Drive. Kelowna BC V1V2C5			Email 1:	mbrowne@kelowna.ca			○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
				Email 2:	mlewis@kelowna.ca			○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	250-469-8796	Fax:	250-862-3342	Email 3:				**Analysis Request**
Invoice To	Same as Report ?	☑ Yes	☐ No	**Client / Project Information**				Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?		☐ Yes	☑ No	Job #:	1186-202 POND			
Company:				PO / AFE:	520747			
Contact:				LSD:				
Address:								
Phone:		Fax:		Quote #:				
[redacted]				**ALS Contact:**	Dean Watt	**Sampler:**		

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total metals	Dissolved metals	BOD,COD	T. Coliform, E. Coli	TSS, Ammonia	O-PO4-P	Total Nitrogen, TKN	NO2-N, NO3-N	Total hardness	EC	Chloride	pH	Number of Containers
[redacted]	Commonage Drainage Pond	MAY 9/17	11:00	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
[redacted]	Davidson Pond	09/05/17	10:30	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
[redacted]	Rose's Pond	09/05/17	10:05am	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
[redacted]																	
[redacted]																	
[redacted]	Please return cooler and icepacks with replacement bottles [redacted]																
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please use CCME/ BC WQG guidelines for both Davidson Pond and Rose's Pond for Total Metals Analysis and continue using BC CSR guidelines for Commonage Drainage Pond. Please return cooler , ice packs and replacment bottles and preservatives. Thank you

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

[redacted] SHIPMENT RELEASE (client use) [redacted]			[redacted] SHIPMENT RECEPTION (lab use only) [redacted]				[redacted] SHIPMENT VERIFICATION (lab use only) [redacted]			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
			JC	MAY 10 2017	8:30	0.6 °C				

GENF 20.00 Front

CITY OF KELOWNA
ATTN: Marcia Browne
Glenmore Landfill
2720 John Hindle Drive
Kelowna BC V1V 2C5

Date Received: 22-JUN-17
Report Date: 29-JUN-17 18:49 (MT)
Version: FINAL

Client Phone: 250-469-8796

Certificate of Analysis

Lab Work Order #: L1946645

Project P.O. #: 520747
Job Reference: 1186-202 POND
C of C Numbers:
Legal Site Desc:

Dean Watt, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1946645-1	L1946645-2	L1946645-3		
Description	Surface Water	Surface Water	Surface Water		
Sampled Date	21-JUN-17	21-JUN-17	21-JUN-17		
Sampled Time	11:15	11:15	11:15		
Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**				
WATER					
Physical Tests	Conductivity (uS/cm)	1590	2720	4380		
	Hardness (as CaCO3) (mg/L)	484	514	1130		
	pH (pH)	8.23	8.89	8.44		
	Total Suspended Solids (mg/L)	19.2	24.2	6.8		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	10.6	0.0161	0.0228		
	Chloride (Cl) (mg/L)	132	285	397		
	Nitrate (as N) (mg/L)	1.72	<0.10 DLDS	<0.10 DLDS		
	Nitrite (as N) (mg/L)	0.287	<0.020 DLDS	<0.020 DLDS		
	Total Kjeldahl Nitrogen (mg/L)	23.5	1.75	1.43		
	Total Nitrogen (mg/L)	25.5	1.75	1.43		
	Orthophosphate-Dissolved (as P) (mg/L)	1.65	<0.0010	<0.0010		
Bacteriological Tests	E. coli (MPN/100mL)	<10000	5	12		
	Coliform Bacteria - Total (MPN/100mL)	90000	4610	19900		
Total Metals	Aluminum (Al)-Total (mg/L)	0.215	0.174	<0.015 DLA		
	Antimony (Sb)-Total (mg/L)	0.00070	<0.00050	<0.00050		
	Arsenic (As)-Total (mg/L)	0.00447	0.00314	0.00382		
	Barium (Ba)-Total (mg/L)	0.056	<0.020	0.025		
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Total (mg/L)	0.17	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	0.000285	0.000010	<0.000025 DLA		
	Calcium (Ca)-Total (mg/L)	105	58.1	80.9		
	Chromium (Cr)-Total (mg/L)	<0.0010	0.0011	<0.0010		
	Cobalt (Co)-Total (mg/L)	0.00081	<0.00030	<0.00050 DLA		
	Copper (Cu)-Total (mg/L)	0.0544	<0.0010	<0.0025 DLA		
	Iron (Fe)-Total (mg/L)	0.484	0.233	<0.050 DLA		
	Lead (Pb)-Total (mg/L)	0.00123	<0.00050	<0.00050		
	Lithium (Li)-Total (mg/L)	0.0178	0.0348	0.0398		
	Magnesium (Mg)-Total (mg/L)	54.8	90.1	226		
	Manganese (Mn)-Total (mg/L)	0.272	0.0326	0.0449		
	Mercury (Hg)-Total (mg/L)	0.000062	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.0119	0.0012	0.0023		
	Nickel (Ni)-Total (mg/L)	0.0044	0.0020	<0.0025 DLA		
	Phosphorus (P)-Total (mg/L)	2.59	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	44.5	35.9	69.1		
	Selenium (Se)-Total (mg/L)	0.00187	0.00015	<0.00025 DLA		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1946645-1	L1946645-2	L1946645-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	21-JUN-17	21-JUN-17	21-JUN-17		
	Sampled Time	11:15	11:15	11:15		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Total Metals	Silicon (Si)-Total (mg/L)	4.76	0.57	0.54		
	Silver (Ag)-Total (mg/L)	0.000227	<0.000020	<0.000050 DLA		
	Sodium (Na)-Total (mg/L)	135	431	632		
	Strontium (Sr)-Total (mg/L)	1.10	0.766	0.785		
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Total (mg/L)	0.00080	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	0.00984	0.00525	0.00562		
	Vanadium (V)-Total (mg/L)	0.00193	0.0011	<0.0025 DLA		
	Zinc (Zn)-Total (mg/L)	0.0574	<0.0060 DLA	<0.015 DLA		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0818	<0.0050	<0.0050		
	Antimony (Sb)-Dissolved (mg/L)	0.00054	<0.00050	<0.00050		
	Arsenic (As)-Dissolved (mg/L)	0.00449	0.00308	0.00372		
	Barium (Ba)-Dissolved (mg/L)	0.043	<0.020	0.023		
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Dissolved (mg/L)	0.16	<0.10	<0.10		
	Cadmium (Cd)-Dissolved (mg/L)	0.000159	<0.000010 DLA	<0.000025 DLA		
	Calcium (Ca)-Dissolved (mg/L)	99.5	55.8	81.6		
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	0.00059	<0.00030	<0.00050 DLA		
	Copper (Cu)-Dissolved (mg/L)	0.0142	<0.0010	<0.0010		
	Iron (Fe)-Dissolved (mg/L)	0.144	<0.030	<0.050 DLA		
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Lithium (Li)-Dissolved (mg/L)	0.0172	0.0353	0.0404		
	Magnesium (Mg)-Dissolved (mg/L)	57.2	90.9	224		
	Manganese (Mn)-Dissolved (mg/L)	0.211	0.0137	0.0354		
	Mercury (Hg)-Dissolved (mg/L)	<0.000025 DLM	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0055	0.0010	0.0024		
	Nickel (Ni)-Dissolved (mg/L)	0.0035	0.0015	<0.0025 DLA		
	Phosphorus (P)-Dissolved (mg/L)	2.09	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	44.3	34.7	65.5		
	Selenium (Se)-Dissolved (mg/L)	0.00137	0.00010	0.00026		
	Silicon (Si)-Dissolved (mg/L)	4.56	0.23	0.48		
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000050 DLA		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1946645-1	L1946645-2	L1946645-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	21-JUN-17	21-JUN-17	21-JUN-17		
	Sampled Time	11:15	11:15	11:15		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Sodium (Na)-Dissolved (mg/L)	136	431	615		
	Strontium (Sr)-Dissolved (mg/L)	1.09	0.807	0.814		
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.00620	0.00552	0.00597		
	Vanadium (V)-Dissolved (mg/L)	0.00161	<0.0010 DLA	<0.0025 DLA		
	Zinc (Zn)-Dissolved (mg/L)	0.0394	<0.0050	<0.0050		
Aggregate Organics	BOD (mg/L)	13.4	<2.0	<2.0		
	COD (mg/L)	261	68	54		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1946645-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1946645-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1946645-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1946645-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1946645-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1946645-1, -2, -3
Matrix Spike	Barium (Ba)-Total	MS-B	L1946645-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L1946645-1, -2, -3
Matrix Spike	Copper (Cu)-Total	MS-B	L1946645-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1946645-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L1946645-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L1946645-1, -2, -3
Matrix Spike	Total Nitrogen	MS-B	L1946645-2, -3
Matrix Spike	Total Nitrogen	MS-B	L1946645-2, -3
Matrix Spike	Total Nitrogen	MS-B	L1946645-2, -3
Matrix Spike	Total Nitrogen	MS-B	L1946645-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD5-VA	Water	Biochemical Oxygen Demand- 5 day	APHA 5210 B- BIOCHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5210 B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

TCOLI-COLI-ENV-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

L1946645-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page ____ of ____

Report To		**Report Format / Distribution**	**Service Requested** (Rush for routine analysis subject to availability)
Company:	City of Kelowna	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Marcia Browne	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	2720 John Hindle Drive. Kelowna BC V1V2C5	Email 1: mbrowne@kelowna.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
		Email 2: mlewis@kelowna.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	250-469-8796 Fax: 250-862-3342	Email 3:	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: 1186-202 POND	
Company:		PO / AFE: 520747	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)	[redacted]	ALS Contact: Dean Watt	Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total metals	Dissolved metals	BOD,COD	T. Coliform, E. Coli	TSS, TDS, Ammonia	O-PO4-P	Total Nitrogen, TKN	NO2-N, NO3-N	Total hardness	EC	Chloride	pH	Number of Containers
[redacted]	Commonage Drainage Pond	21/06/17	11:15	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
[redacted]	Davidson Pond	21/06/17	10:30	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
[redacted]	Rose's Pond	21/06/17	10:00	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
[redacted]																	
[redacted]																	
[redacted]	Please return cooler and icepacks with replacement bottles ~~and preservatives~~																
[redacted]	+ 40 mL - 6 pack holder (styro.) please.																
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please use CCME/ BC WQG guidelines for both Davidson Pond and Rose's Pond for Total Metals Analysis and continue using BC CSR guidelines for Commonage Drainage Pond. Please return cooler , ice packs and replacment bottles and preservatives. Thank you TSD has been added to the list of parameters. Please use lower detection limit for Beryllium <0.0001 mg/L

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by: (C) IP	Date: JUN 22 2017	Time: 8:45 AM	Temperature: 1 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

GENF 20.00 Front

L1946645

Dean Watt, B.Sc.

CITY OF KELOWNA

KEL400

CITY OF KELOWNA
ATTN: Marcia Browne
Glenmore Landfill
2720 John Hindle Drive
Kelowna BC V1V 2C5

Date Received: 27-JUL-17
Report Date: 10-AUG-17 14:10 (MT)
Version: FINAL

Client Phone: 250-469-8796

Certificate of Analysis

Lab Work Order #: L1965494

Project P.O. #: 520747
Job Reference: 1186-202 POND
C of C Numbers:
Legal Site Desc:

Dean Watt, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1965494-1	L1965494-2	L1965494-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	26-JUL-17	26-JUL-17	26-JUL-17		
	Sampled Time	11:00	10:20	10:40		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1070	3010	4930		
	Hardness (as CaCO3) (mg/L)	279	560	1220		
	pH (pH)	8.20	8.74	8.43		
	Total Suspended Solids (mg/L)	4.9	6.1	9.3		
	Total Dissolved Solids (mg/L)	679	2120	3600		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.29	0.0160	0.0104		
	Chloride (Cl) (mg/L)	105	309	377		
	Nitrate (as N) (mg/L)	0.356	<0.10 DLDS	<0.10 DLDS		
	Nitrite (as N) (mg/L)	0.106	<0.020 DLDS	<0.020 DLDS		
	Total Kjeldahl Nitrogen (mg/L)	5.17	1.76	1.58		
	Total Nitrogen (mg/L)	5.63	1.76	1.58		
	Orthophosphate-Dissolved (as P) (mg/L)	2.05	<0.0010	<0.0010		
Bacteriological Tests	E. coli (MPN/100mL)	120	6	1		
	Coliform Bacteria - Total (MPN/100mL)	24200	24200	29900		
Total Metals	Aluminum (Al)-Total (mg/L)	0.047	0.0122	0.024		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Total (mg/L)	0.0015	0.00386	0.00419		
	Barium (Ba)-Total (mg/L)	0.035	<0.020	0.020		
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00020 DLA	<0.00050 DLA		
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Total (mg/L)	0.14	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	<0.000050	<0.000010 DLA	<0.000025 DLA		
	Calcium (Ca)-Total (mg/L)	72.1	54.9	85.4		
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00030	<0.00050 DLA		
	Copper (Cu)-Total (mg/L)	0.0043	<0.0010	<0.0025 DLA		
	Iron (Fe)-Total (mg/L)	0.205	0.033	<0.050 DLA		
	Lead (Pb)-Total (mg/L)	<0.0010	<0.00050	<0.00050		
	Lithium (Li)-Total (mg/L)	0.0131	0.0485	0.0547		
	Magnesium (Mg)-Total (mg/L)	28.4	108	255		
	Manganese (Mn)-Total (mg/L)	0.183	0.0245	0.0527		
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.0044	<0.0010	0.0022		
	Nickel (Ni)-Total (mg/L)	<0.0050	0.0018	<0.0025 DLA		
	Phosphorus (P)-Total (mg/L)	2.31	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	22.6	44.0	79.8		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1965494-1	L1965494-2	L1965494-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	26-JUL-17	26-JUL-17	26-JUL-17		
	Sampled Time	11:00	10:20	10:40		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0010	0.00031	0.00030		
	Silicon (Si)-Total (mg/L)	4.11	1.42	1.06		
	Silver (Ag)-Total (mg/L)	<0.000050	0.000486	0.000134		
	Sodium (Na)-Total (mg/L)	103	567	776		
	Strontium (Sr)-Total (mg/L)	0.647	0.753	0.777		
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.000020 DLA	<0.000050 DLA		
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	0.00306	0.00493	0.00553		
	Vanadium (V)-Total (mg/L)	0.00071	<0.0010 DLA	<0.0025 DLA		
	Zinc (Zn)-Total (mg/L)	0.0130	<0.0060 DLA	<0.015 DLA		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.020	<0.0050	<0.0050		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Dissolved (mg/L)	0.0015	0.00339	0.00410		
	Barium (Ba)-Dissolved (mg/L)	0.036	<0.020	<0.020		
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00050 DLA		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Dissolved (mg/L)	0.15	<0.10	<0.10		
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000010 DLA	<0.000025 DLA		
	Calcium (Ca)-Dissolved (mg/L)	65.0	53.6	83.1		
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00050	<0.00030	<0.00050 DLA		
	Copper (Cu)-Dissolved (mg/L)	0.0020	<0.0010	<0.0010		
	Iron (Fe)-Dissolved (mg/L)	0.104	<0.030	<0.050 DLA		
	Lead (Pb)-Dissolved (mg/L)	<0.0010	<0.00050	<0.00050		
	Lithium (Li)-Dissolved (mg/L)	0.0120	0.0487	0.0531		
	Magnesium (Mg)-Dissolved (mg/L)	28.3	103	246		
	Manganese (Mn)-Dissolved (mg/L)	0.171	0.0147	0.00622		
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0042	<0.0010	0.0020		
	Nickel (Ni)-Dissolved (mg/L)	<0.0050	0.0016	<0.0025 DLA		
	Phosphorus (P)-Dissolved (mg/L)	2.45	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	25.4	43.1	78.2		
	Selenium (Se)-Dissolved (mg/L)	<0.0010	0.00019	0.00026		
	Silicon (Si)-Dissolved (mg/L)	4.17	1.32	0.92		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1965494-1	L1965494-2	L1965494-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	26-JUL-17	26-JUL-17	26-JUL-17		
	Sampled Time	11:00	10:20	10:40		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000050	<0.000020	<0.000050 DLA		
	Sodium (Na)-Dissolved (mg/L)	108	543	748		
	Strontium (Sr)-Dissolved (mg/L)	0.639	0.712	0.747		
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.00275	0.00453	0.00520		
	Vanadium (V)-Dissolved (mg/L)	0.00062	<0.0010 DLA	<0.0025 DLA		
	Zinc (Zn)-Dissolved (mg/L)	0.0103	<0.0050	<0.0050		
Aggregate Organics	BOD (mg/L)	<2.0	<2.0	<2.0		
	COD (mg/L)	61	64	63		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

Qualifiers for Individual Samples Listed:

Sample Numbe	Client Sample ID	Qualifier	Description
L1965494-1	COMMONAGE DRAINAGE F	WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Total	MS-B	L1965494-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L1965494-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1965494-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L1965494-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L1965494-1, -2, -3
Matrix Spike	Uranium (U)-Total	MS-B	L1965494-1, -2, -3
Matrix Spike	Total Nitrogen	MS-B	L1965494-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD5-VA	Water	Biochemical Oxygen Demand- 5 day	APHA 5210 B- BIOCHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5210 B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

TCOLI-COLI-ENV-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1965494-COFC

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Page ____ of ____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	City of Kelowna	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Marcia Browne	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	2720 John Hindle Drive. Kelowna BC V1V2C5	Email 1: mbrowne@kelowna.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
		Email 2: mlewis@kelowna.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	250-469-8796 Fax: 250-862-3342	Email 3:	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: 1186-202 POND	
Company:		PO / AFE: 520747	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)		ALS Contact: Dean Watt	Sampler:

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total metals	Dissolved metals	BOD,COD	T. Coliform, E. Coli	TSS, TDS, Ammonia	O-PO4-P	Total Nitrogen, TKN	NO2-N, NO3-N	Total hardness	EC	Chloride	pH	Number of Containers
	Commonage Drainage Pond	26/07/17	10:00	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Davidson Pond	26/07/17	10:20	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Rose's Pond	26/07/17	10:40	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Please return cooler and icepacks with replacement bottles ~~and preservative~~ & Syringes.																

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please use CCME/ BC WQG guidelines for both Davidson Pond and Rose's Pond for Total Metals Analysis and continue using BC CSR guidelines for Commonage Drainage Pond. Please return cooler , ice packs and replacment bottles and preservatives. Thank you TSD has been added to the list of parameters. Please use lower detection limit for Beryllium <0.0001 mg/L

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by: AMANPR1	Date: 27-07-17	Time: 9.50	Temperature: 3 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

GENF 20.00 Front

CITY OF KELOWNA
ATTN: Marcia Browne
Glenmore Landfill
2720 John Hindle Drive
Kelowna BC V1V 2C5

Date Received: 01-SEP-17
Report Date: 11-SEP-17 18:00 (MT)
Version: FINAL

Client Phone: 250-469-8796

Certificate of Analysis

Lab Work Order #: L1984896

Project P.O. #: 520747
Job Reference: 1186-202 POND
C of C Numbers:
Legal Site Desc:

Dean Watt, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1984896-1	L1984896-2	L1984896-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	31-AUG-17	31-AUG-17	31-AUG-17		
	Sampled Time	11:23	12:25	11:10		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	913	3150	4890		
	Hardness (as CaCO3) (mg/L)	226	556	1230		
	pH (pH)	8.20	8.96	8.72		
	Total Suspended Solids (mg/L)	9.1	4.1	9.7		
	Total Dissolved Solids (mg/L)	600	2250	3910		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	1.38	0.0198	0.0117		
	Chloride (Cl) (mg/L)	104	348	444		
	Nitrate (as N) (mg/L)	0.314	<0.10 DLDS	<0.10 DLDS		
	Nitrite (as N) (mg/L)	0.0230	<0.020 DLDS	<0.020 DLDS		
	Total Kjeldahl Nitrogen (mg/L)	2.83	2.24	1.64		
	Total Nitrogen (mg/L)	3.17	2.24	1.64		
	Orthophosphate-Dissolved (as P) (mg/L)	0.929	0.0010	<0.0010		
Bacteriological Tests	E. coli (MPN/100mL)	480	<10	10		
	Coliform Bacteria - Total (MPN/100mL)	>24196	9800	17300		
Total Metals	Aluminum (Al)-Total (mg/L)	0.108	0.0174	0.0218		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	0.00057		
	Arsenic (As)-Total (mg/L)	0.00130	0.00342	0.00483		
	Barium (Ba)-Total (mg/L)	0.035	<0.020	0.021		
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Total (mg/L)	0.15	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	0.0000249	0.0000052	<0.0000050		
	Calcium (Ca)-Total (mg/L)	55.6	50.2	81.3		
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Total (mg/L)	0.00033	<0.00030	<0.00030		
	Copper (Cu)-Total (mg/L)	0.0039	<0.0010	<0.0010		
	Iron (Fe)-Total (mg/L)	0.170	0.041	<0.030		
	Lead (Pb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Lithium (Li)-Total (mg/L)	0.0105	0.0447	0.0471		
	Magnesium (Mg)-Total (mg/L)	23.1	110	277		
	Manganese (Mn)-Total (mg/L)	0.117	0.0222	0.102		
	Mercury (Hg)-Total (mg/L)	0.0000135	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.0043	<0.0010	0.0023		
	Nickel (Ni)-Total (mg/L)	0.0019	0.0018	0.0012		
	Phosphorus (P)-Total (mg/L)	1.22	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	20.8	43.2	82.2		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1984896-1	L1984896-2	L1984896-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	31-AUG-17	31-AUG-17	31-AUG-17		
	Sampled Time	11:23	12:25	11:10		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	0.000622	0.000116	0.000267		
	Silicon (Si)-Total (mg/L)	3.68	1.11	1.07		
	Silver (Ag)-Total (mg/L)	0.000036	<0.000020	<0.000020		
	Sodium (Na)-Total (mg/L)	103	559	786		
	Strontium (Sr)-Total (mg/L)	0.551	0.734	0.770		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	0.00275	0.00551	0.00591		
	Vanadium (V)-Total (mg/L)	0.00136	0.00082	0.00099		
	Zinc (Zn)-Total (mg/L)	0.0226	<0.0050	<0.0050		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0136	0.0059	0.0051		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Dissolved (mg/L)	0.00120	0.00337	0.00440		
	Barium (Ba)-Dissolved (mg/L)	0.030	<0.020	<0.020		
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00050 DLA		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Dissolved (mg/L)	0.14	<0.10	0.11		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000150	<0.0000050	<0.000025 DLA		
	Calcium (Ca)-Dissolved (mg/L)	53.9	50.3	78.9		
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00050 DLA		
	Copper (Cu)-Dissolved (mg/L)	0.0024	<0.0010	<0.0010		
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.050 DLA		
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Lithium (Li)-Dissolved (mg/L)	0.0101	0.0453	0.0491		
	Magnesium (Mg)-Dissolved (mg/L)	22.2	105	250		
	Manganese (Mn)-Dissolved (mg/L)	0.0413	0.0137	0.0316		
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0040	<0.0010	0.0021		
	Nickel (Ni)-Dissolved (mg/L)	0.0017	0.0016	<0.0025 DLA		
	Phosphorus (P)-Dissolved (mg/L)	1.08	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	19.7	41.0	78.7		
	Selenium (Se)-Dissolved (mg/L)	0.000572	0.000122	0.00025		
	Silicon (Si)-Dissolved (mg/L)	3.33	1.00	0.86		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1984896-1	L1984896-2	L1984896-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	31-AUG-17	31-AUG-17	31-AUG-17		
	Sampled Time	11:23	12:25	11:10		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000050 DLA		
	Sodium (Na)-Dissolved (mg/L)	97.3	529	721		
	Strontium (Sr)-Dissolved (mg/L)	0.544	0.728	0.751		
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.00246	0.00524	0.00545		
	Vanadium (V)-Dissolved (mg/L)	0.00096	0.00059	<0.0025 DLA		
	Zinc (Zn)-Dissolved (mg/L)	0.0145	<0.0050	<0.0050		
Aggregate Organics	BOD (mg/L)	3.9	<2.0	2.2		
	COD (mg/L)	49	71	75		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1984896-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1984896-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1984896-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1984896-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1984896-1, -2, -3
Matrix Spike	Total Nitrogen	MS-B	L1984896-2, -3
Matrix Spike	Total Nitrogen	MS-B	L1984896-1
Matrix Spike	Total Nitrogen	MS-B	L1984896-1
Matrix Spike	Total Nitrogen	MS-B	L1984896-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD5-VA	Water	Biochemical Oxygen Demand- 5 day	APHA 5210 B- BIOCHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5210 B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA	Water	Total Nitrogen in water by Colour	APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

TCOLI-COLI-ENV-VA	Water	Total coliform by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

L1984896-COFC

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Page ____ of ____

Report To			
Company:	City of Kelowna		
Contact:	Marcia Browne		
Address:	2720 John Hindle Drive. Kelowna BC V1V2C5		
Phone:	250-469-8796	Fax:	250-862-3342
Invoice To	Same as Report ? ☑ Yes ☐ No		
Hardcopy of Invoice with Report?	☐ Yes ☑ No		
Company:			
Contact:			
Address:			
Phone:		Fax:	

Report Format / Distribution			
☐ Standard	☐ Other		
☑ PDF	☑ Excel	☐ Digital	☐ Fax
Email 1:	mbrowne@kelowna.ca		
Email 2:	mlewis@kelowna.ca		
Email 3:			

Client / Project Information	
Job #:	1186-202 POND
PO / AFE:	520747
LSD:	
Quote #:	

Service Requested (Rush for routine analysis subject to availability)

- ◉ Regular (Standard Turnaround Times - Business Days)
- ○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
- ○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
- ○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT

Lab Work Order # (lab use only)		ALS Contact:	Dean Watt	Sampler:	

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total metals	Dissolved metals	BOD,COD	T. Coliform, E. Coli	TSS, TDS, Ammonia	O-PO4-P	Total Nitrogen, TKN	NO2-N, NO3-N	Total hardness	EC	Chloride	pH	Number of Containers
	Commonage Drainage Pond	31/0817	11:23	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Davidson Pond	31/08/17	12:25	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Rose's Pond	31/08/17	11:10	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Please return cooler and icepacks with replacement bottles																
	and preservatives. Thank you.																

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please use CCME/ BC WQG guidelines for both Davidson Pond and Rose's Pond for Total Metals Analysis and continue using BC CSR guidelines for Commonage Drainage Pond. Please return cooler , ice packs and replacment bottles and preservatives. Thank you TSD has been added to the list of parameters. Please use lower detection limit for Beryllium <0.0001 mg/L

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
			PAUL	SEP 1	08:45	7.7, 10.4 °C 5.6 8.4				

GENF 20.00 Front

CITY OF KELOWNA
ATTN: Marcia Browne
Glenmore Landfill
2720 John Hindle Drive
Kelowna BC V1V 2C5

Date Received: 21-SEP-17
Report Date: 28-SEP-17 16:13 (MT)
Version: FINAL

Client Phone: 250-469-8796

Certificate of Analysis

Lab Work Order #: L1994913

Project P.O. #: 520747
Job Reference: 1186-202 POND
C of C Numbers:
Legal Site Desc:

Comments: ADDITIONAL 27-SEP-17 17:36

Dean Watt, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994913-1	L1994913-2	L1994913-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	20-SEP-17	20-SEP-17	20-SEP-17		
	Sampled Time	11:00	10:45	10:30		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSONN POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1020	3290	5130		
	Hardness (as CaCO3) (mg/L)	254	535	1080		
	pH (pH)	8.19	8.78	8.67		
	Total Suspended Solids (mg/L)	11.6	6.6	15.2		
	Total Dissolved Solids (mg/L)	668	2320	4020		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	6.55	0.0140	0.0097		
	Chloride (Cl) (mg/L)	104	340	443		
	Nitrate (as N) (mg/L)	0.150	<0.10 DLDS	<0.10 DLDS		
	Nitrite (as N) (mg/L)	0.106	<0.020 HTD	<0.020 DLDS		
	Total Kjeldahl Nitrogen (mg/L)	11.7	1.88	1.85		
	Total Nitrogen (mg/L)	12.0	1.88	1.85		
	Orthophosphate-Dissolved (as P) (mg/L)	1.69	<0.0010	<0.0010		
Bacteriological Tests	E. coli (MPN/100mL)	70	1	2		
	Coliform Bacteria - Total (MPN/100mL)	3260	2420	2480		
Total Metals	Aluminum (Al)-Total (mg/L)	0.026	<0.0060 DLA	<0.015 DLA		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	0.00056		
	Arsenic (As)-Total (mg/L)	0.0020	0.00321	0.00422		
	Barium (Ba)-Total (mg/L)	0.030	<0.020	<0.020		
	Beryllium (Be)-Total (mg/L)	<0.0050	<0.00020 DLA	<0.00050 DLA		
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Total (mg/L)	0.16	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	<0.000050	<0.000010 DLA	<0.000025 DLA		
	Calcium (Ca)-Total (mg/L)	57.7	47.0	71.3		
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.0010	<0.0010		
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00030	<0.00050 DLA		
	Copper (Cu)-Total (mg/L)	0.0062	<0.0010	<0.0025 DLA		
	Iron (Fe)-Total (mg/L)	0.108	<0.030	<0.050 DLA		
	Lead (Pb)-Total (mg/L)	<0.0010	<0.00050	<0.00050		
	Lithium (Li)-Total (mg/L)	<0.050	0.0427	0.0503		
	Magnesium (Mg)-Total (mg/L)	23.6	97.2	231		
	Manganese (Mn)-Total (mg/L)	0.095	0.0306	0.0169		
	Mercury (Hg)-Total (mg/L)	<0.00020	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.0042	<0.0010	0.0020		
	Nickel (Ni)-Total (mg/L)	<0.0050	0.0017	<0.0025 DLA		
	Phosphorus (P)-Total (mg/L)	1.84	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	28.9	40.1	70.4		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994913-1	L1994913-2	L1994913-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	20-SEP-17	20-SEP-17	20-SEP-17		
	Sampled Time	11:00	10:45	10:30		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSONN POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0010	0.00010	0.00027		
	Silicon (Si)-Total (mg/L)	3.92	1.48	0.96		
	Silver (Ag)-Total (mg/L)	<0.000050	<0.000020	<0.000050 DLA		
	Sodium (Na)-Total (mg/L)	109	518	704		
	Strontium (Sr)-Total (mg/L)	0.569	0.706	0.686		
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.000020 DLA	<0.000050 DLA		
	Tin (Sn)-Total (mg/L)	<0.030	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	<0.050	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	0.00262	0.00502	0.00560		
	Vanadium (V)-Total (mg/L)	<0.030	<0.0010 DLA	<0.0025 DLA		
	Zinc (Zn)-Total (mg/L)	0.0177	<0.0060 DLA	<0.015 DLA		
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB		
	Dissolved Metals Filtration Location	LAB	LAB	LAB		
	Aluminum (Al)-Dissolved (mg/L)	0.031	<0.0050	<0.0050		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	0.00050		
	Arsenic (As)-Dissolved (mg/L)	0.0021	0.00318	0.00377		
	Barium (Ba)-Dissolved (mg/L)	0.031	<0.020	<0.020		
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.00020 DLA	<0.00050 DLA		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Dissolved (mg/L)	0.18	<0.10	<0.10		
	Cadmium (Cd)-Dissolved (mg/L)	0.000059	<0.000010 DLA	<0.000025 DLA		
	Calcium (Ca)-Dissolved (mg/L)	61.3	52.3	71.3		
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.0010	<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00050	<0.00030	<0.00050 DLA		
	Copper (Cu)-Dissolved (mg/L)	0.0085 DTC	<0.0010	<0.0010		
	Iron (Fe)-Dissolved (mg/L)	0.112	<0.030	<0.050 DLA		
	Lead (Pb)-Dissolved (mg/L)	<0.0010	<0.00050	<0.00050		
	Lithium (Li)-Dissolved (mg/L)	<0.050	0.0482	0.0497		
	Magnesium (Mg)-Dissolved (mg/L)	24.6	98.2	220		
	Manganese (Mn)-Dissolved (mg/L)	<0.010	0.00770	0.00138		
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0041	<0.0010	0.0020		
	Nickel (Ni)-Dissolved (mg/L)	<0.0050	0.0015	<0.0025 DLA		
	Phosphorus (P)-Dissolved (mg/L)	1.94	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	30.3	41.6	68.4		
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.00010 DLA	<0.00025 DLA		
	Silicon (Si)-Dissolved (mg/L)	3.91	1.49	0.97		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1994913-1	L1994913-2	L1994913-3		
	Description	Surface Water	Surface Water	Surface Water		
	Sampled Date	20-SEP-17	20-SEP-17	20-SEP-17		
	Sampled Time	11:00	10:45	10:30		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSONN POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000050	<0.000020	<0.000050 DLA		
	Sodium (Na)-Dissolved (mg/L)	108	527	675		
	Strontium (Sr)-Dissolved (mg/L)	0.572	0.770	0.672		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.00020	<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.00050	<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.050	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.00254	0.00541	0.00557		
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.0010 DLA	<0.0025 DLA		
	Zinc (Zn)-Dissolved (mg/L)	0.0206	<0.0050	<0.0050		
Aggregate Organics	BOD (mg/L)	3.0	<2.0	2.1		
	COD (mg/L)	121	72	80		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Molybdenum (Mo)-Dissolved	MB-LOR	L1994913-1, -2, -3
Method Blank	Aluminum (Al)-Total	MB-LOR	L1994913-1, -2, -3
Method Blank	Barium (Ba)-Total	MB-LOR	L1994913-1, -2, -3
Method Blank	Calcium (Ca)-Total	MB-LOR	L1994913-1, -2, -3
Method Blank	Lead (Pb)-Total	MB-LOR	L1994913-1, -2, -3
Method Blank	Magnesium (Mg)-Total	MB-LOR	L1994913-1, -2, -3
Method Blank	Manganese (Mn)-Total	MB-LOR	L1994913-1, -2, -3
Method Blank	Sodium (Na)-Total	MB-LOR	L1994913-1, -2, -3
Matrix Spike	Mercury (Hg)-Total	MS-B	L1994913-2, -3
Matrix Spike	Mercury (Hg)-Total	MS-B	L1994913-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1994913-1
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1994913-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1994913-1
Matrix Spike	Total Nitrogen	MS-B	L1994913-1
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1994913-1, -2, -3
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1994913-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD5-VA	Water	Biochemical Oxygen Demand- 5 day	APHA 5210 B- BIOCHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5210 B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-DIS-CVAFS-VA Water Dissolved Hg in Water by CVAFS LOR=50ppt APHA 3030B/EPA 1631E (mod)

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-TOT-CVAFS-VA Water Total Hg in Water by CVAFS LOR=50ppt EPA 1631E (mod)

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence APHA 4500 NH3-NITROGEN (AMMONIA)

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

Reference Information

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

TCOLI-COLI-ENV-VA	Water	Total coliform by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Page ____ of ____

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	City of Kelowna	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Marcia Browne	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	2720 John Hindle Drive. Kelowna BC V1V2C5	Email 1: mbrowne@kelowna.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
		Email 2: mlewis@kelowna.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	250-469-8796 Fax: 250-862-3342	Email 3:	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: 1186-202 POND	
Company:		PO / AFE: 520747	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	

Lab Work Order # (lab use only)	ALS Contact: Dean Watt	Sampler:

Sample # (lab use only)	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total metals	Dissolved metals	BOD,COD	T. Coliform, E. Coli	TSS, TDS, Ammonia	O-PO4-P	Total Nitrogen, TKN	NO2-N, NO3-N	Total hardness	EC	Chloride	pH	Number of Containers
	Commonage Drainage Pond	20-09-17	11:00	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Davidson Pond	20-09-17	10:45	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Rose's Pond	20-09-17	10:30	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Please return cooler and icepacks with replacement bottles.																

L1994913-COFC

B

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please use CCME/ BC WQG guidelines for both Davidson Pond and Rose's Pond for Total Metals Analysis and continue using BC CSR guidelines for Commonage Drainage Pond. Please return cooler , ice packs and replacment bottles and preservatives. Thank you TSD has been added to the list of parameters. Please use lower detection limit for Beryllium <0.0001 mg/L

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
			PAUL	SEP 21	08:40	3-9 °C				

7.6°C

7.4°C.

GENF 20.00 Front

CITY OF KELOWNA
ATTN: Marcia Browne
Glenmore Landfill
2720 John Hindle Drive
Kelowna BC V1V 2C5

Date Received: 01-NOV-17
Report Date: 17-NOV-17 19:06 (MT)
Version: FINAL

Client Phone: 250-469-8796

Certificate of Analysis

Lab Work Order #: L2016326

Project P.O. #: 520747
Job Reference: 1186-202 POND
C of C Numbers:
Legal Site Desc:

Dean Watt, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016326-1	L2016326-2	L2016326-3		
	Description	SURFACE WATE	SURFACE WATE	SURFACE WATE		
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17		
	Sampled Time	10:27	11:15	10:10		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	784	3510	5440		
	Hardness (as CaCO3) (mg/L)	107	139	18.8		
	pH (pH)	8.68	8.36	8.49		
	Total Suspended Solids (mg/L)	31.3	16.7	6.1		
	Total Dissolved Solids (mg/L)	481	2270	4080		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	3.99	0.645	0.0187		
	Chloride (Cl) (mg/L)	73.8	328	443		
	Nitrate (as N) (mg/L)	1.04	<0.10 DLDS	0.12		
	Nitrite (as N) (mg/L)	0.104	<0.13 DLM	<0.020 DLDS		
	Total Kjeldahl Nitrogen (mg/L)	9.20	2.42	1.70		
	Total Nitrogen (mg/L)	10.3	2.42	1.81		
	Orthophosphate-Dissolved (as P) (mg/L)	2.51	0.0363	<0.0010		
Bacteriological Tests	E. coli (MPN/100mL)	290	9	<1		
	Coliform Bacteria - Total (MPN/100mL)	24200	37	25		
Total Metals	Aluminum (Al)-Total (mg/L)	0.069	0.0143	0.0090		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	0.00053		
	Arsenic (As)-Total (mg/L)	0.0024	0.00408	0.00442		
	Barium (Ba)-Total (mg/L)	0.023	<0.020	<0.020		
	Beryllium (Be)-Total (mg/L)	<0.0050	<0.00020 DLA	<0.00020 DLA		
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Total (mg/L)	0.16	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	0.000063	<0.000010 DLA	<0.000010 DLA		
	Calcium (Ca)-Total (mg/L)	41.1	59.3	79.7		
	Chromium (Cr)-Total (mg/L)	0.00063	<0.0010	<0.0010		
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00030	<0.00030		
	Copper (Cu)-Total (mg/L)	0.0130	<0.0010	<0.0010		
	Iron (Fe)-Total (mg/L)	0.237	0.043	<0.030		
	Lead (Pb)-Total (mg/L)	<0.0010	<0.00050	<0.00050		
	Lithium (Li)-Total (mg/L)	<0.050	0.0472	0.0558		
	Magnesium (Mg)-Total (mg/L)	18.4	119	288		
	Manganese (Mn)-Total (mg/L)	0.137	0.157	0.0514		
	Mercury (Hg)-Total (mg/L)	<0.00020	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.0039	<0.0010	0.0019		
	Nickel (Ni)-Total (mg/L)	<0.0050	0.0018	0.0011		
	Phosphorus (P)-Total (mg/L)	3.33	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	25.2	44.3	85.2		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016326-1	L2016326-2	L2016326-3		
	Description	SURFACE WATE	SURFACE WATE	SURFACE WATE		
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17		
	Sampled Time	10:27	11:15	10:10		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0010	<0.00010 DLA	0.00022		
	Silicon (Si)-Total (mg/L)	0.49	2.56	1.17		
	Silver (Ag)-Total (mg/L)	<0.000050	<0.000020	<0.000020		
	Sodium (Na)-Total (mg/L)	81.4	566	825		
	Strontium (Sr)-Total (mg/L)	0.376	0.874	0.737		
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.000020 DLA	<0.000020 DLA		
	Tin (Sn)-Total (mg/L)	<0.030	<0.00050	<0.00050		
	Titanium (Ti)-Total (mg/L)	<0.050	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	0.00134	0.00548	0.00637		
	Vanadium (V)-Total (mg/L)	<0.030	<0.0010 DLA	<0.0010 DLA		
	Zinc (Zn)-Total (mg/L)	0.0418	<0.0060 DLA	<0.0060 DLA		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	<0.010	<0.0050	<0.0050		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Dissolved (mg/L)	<0.0010	<0.00050	<0.00050		
	Barium (Ba)-Dissolved (mg/L)	0.023	<0.020	<0.020		
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.00020 DLA	<0.00020 DLA		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	<0.10		
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000010 DLA	<0.000010 DLA		
	Calcium (Ca)-Dissolved (mg/L)	28.3	35.5	6.54		
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.0010	<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00050	<0.00030	<0.00030		
	Copper (Cu)-Dissolved (mg/L)	0.0025	0.0022	<0.0010		
	Iron (Fe)-Dissolved (mg/L)	0.121	<0.030	<0.030		
	Lead (Pb)-Dissolved (mg/L)	<0.0010	<0.00050	<0.00050		
	Lithium (Li)-Dissolved (mg/L)	<0.050	<0.0020 DLA	<0.0020 DLA		
	Magnesium (Mg)-Dissolved (mg/L)	8.79	12.3	0.61		
	Manganese (Mn)-Dissolved (mg/L)	<0.010	0.00267	0.0161		
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Nickel (Ni)-Dissolved (mg/L)	<0.0050	0.0035	<0.0010		
	Phosphorus (P)-Dissolved (mg/L)	3.44	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	2.2	<2.0	<2.0		
	Selenium (Se)-Dissolved (mg/L)	<0.0010	0.00011	<0.00010 DLA		
	Silicon (Si)-Dissolved (mg/L)	0.273	2.54	0.37		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2016326-1	L2016326-2	L2016326-3		
	Description	SURFACE WATE	SURFACE WATE	SURFACE WATE		
	Sampled Date	31-OCT-17	31-OCT-17	31-OCT-17		
	Sampled Time	10:27	11:15	10:10		
	Client ID	COMMONAGE DRAINAGE POND	DAVIDSON POND	ROSE'S POND		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000050	<0.000020	<0.000020		
	Sodium (Na)-Dissolved (mg/L)	7.3	10.7	6.7		
	Strontium (Sr)-Dissolved (mg/L)	0.133	0.183	0.0291		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.00020	<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.00050	<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.050	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.0010 DLA	<0.0010 DLA		
	Zinc (Zn)-Dissolved (mg/L)	0.0233	0.0134	0.0125		
Aggregate Organics	BOD (mg/L)	15.0	2.9	<2.0		
	COD (mg/L)	117	65	62		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2016326-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2016326-1, -2, -3
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L2016326-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2016326-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2016326-1, -2, -3
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2016326-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2016326-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2016326-1, -2, -3
Matrix Spike	Barium (Ba)-Total	MS-B	L2016326-1, -2, -3
Matrix Spike	Boron (B)-Total	MS-B	L2016326-1, -2, -3
Matrix Spike	Calcium (Ca)-Total	MS-B	L2016326-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2016326-1, -2, -3
Matrix Spike	Manganese (Mn)-Total	MS-B	L2016326-1, -2, -3
Matrix Spike	Sodium (Na)-Total	MS-B	L2016326-1, -2, -3
Matrix Spike	Strontium (Sr)-Total	MS-B	L2016326-1, -2, -3
Matrix Spike	Total Nitrogen	MS-B	L2016326-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD5-VA	Water	Biochemical Oxygen Demand- 5 day	APHA 5210 B- BIOCHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5210 B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

ECOLI-COLI-ENV-VA	Water	E.coli by Colilert	APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-DIS-CVAFS-VA	Water	Dissolved Hg in Water by CVAFS LOR=50ppt	APHA 3030B/EPA 1631E (mod)

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-TOT-CVAFS-VA Water Total Hg in Water by CVAFS LOR=50ppt EPA 1631E (mod)

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

N-T-COL-VA Water Total Nitrogen in water by Colour APHA4500-P(J)/NEMI9171/USGS03-4174

This analysis is carried out using procedures adapted from APHA Method 4500-P (J) "Persulphate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus" and National Environmental Methods Index - Nemi method 5735.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

TCOLI-COLI-ENV-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

Reference Information

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # _____

Page 1 of 2

Report To		Report Format / Distribution	Service Requested (Rush for routine analysis subject to availability)
Company:	City of Kelowna	☐ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Marcia Browne	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	2720 John Hindle Drive. Kelowna BC V1V2C5	Email 1: mbrowne@kelowna.ca	○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
		Email 2: mlewis@kelowna.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	250-469-8796 Fax: 250-862-3342	Email 3:	
Invoice To	Same as Report ? ☑ Yes ☐ No	Client / Project Information	Analysis Request
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: 1186-202 POND	Please indicate below Filtered, Preserved or both (F, P, F/P)
Company:		PO / AFE: 520747	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)		ALS Contact: Dean Watt	Sampler:

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Total metals	Dissolved metals	BOD,COD	T. Coliform, E. Coli	TSS, TDS, Ammonia	O-PO4-P	Total Nitrogen, TKN	NO2-N, NO3-N	Total hardness	EC	Chloride	pH	Number of Containers
	Commonage Drainage Pond	31/10/17	10:27	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Davidson Pond	31/10/17	11:15	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Rose's Pond	31/10/17	10:10	Surface Water	X	X	X	X	X	X	X	X	X	X	X	X	
	Please return cooler and icepacks with replacement bottles																
	Thank you.																
	[redacted]																
	[redacted]																
	[redacted]																
	[redacted]																
	[redacted]																

60mL only please!

No preservatives this time, thanks. We have lots [redacted] Thanks! Trying to use up supplies :)

L2016326-COFC

B

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

Please use CCME/ BC WQG guidelines for both Davidson Pond and Rose's Pond for Total Metals Analysis and continue using BC CSR guidelines for Commonage Drainage Pond. Please return cooler , ice packs and replacment bottles and preservatives. Thank you TSD has been added to the list of parameters. Please use lower detection limit for Beryllium <0.0001 mg/L

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
			PAUL	NOV 1	08:35	1.5 °C				

GENF 20.00 Front

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