DISTRICT OF SUMMERLAND

Wastewater Treatment Plant

2023 Annual Report

British Columbia Ministry of Environment

Operational Certificate PE# 13627

Issued June 16, 1998

Environmental Operators Certification Program

Certificate #516 Class IV Municipal Wastewater Treatment Plant

Issued March 12, 1999

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The Corporation of the District of Summerland

Wastewater Treatment Plant – 2023 Annual Report

List of Appendices

1.0 PURPOSE

This report is submitted in accordance to the requirements of the Summerland Wastewater Treatment Plant (SWWTP) Operational Certificate # 13627. A copy of the Operational Certificate is attached in **Appendix A.**

2.0 INTRODUCTION

The Summerland WWTP was commissioned in 1998 by Reid Crowther & Partners Ltd. The plant process is based on a 3-stage Biological Nutrient Removal (BNR) facility; it is used to remove both nitrogen and phosphorus as its primary objective. Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) are also removed by the longer retention times of a BNR facility. The biological reactions can be controlled by manipulation of the physical environment in which the active organisms work.

Process control elements include:

- Hydraulic retention in each type of zone.
- Presence or absence of dissolved oxygen.
- Presence or absence of nitrate nitrogen.
- Retention time of active organisms.
- Presence of simple organics, in particular volatile fatty acids (VFA).

The biological systems are accompanied by settling, filtration, and ultraviolet disinfection systems. The Class IV tertiary treatment plant is owned and operated by the District of Summerland and staffed in accordance with the operational certificate.

3.0 SPECIFIC AUTHORIZED DISCHARGES AND RELATED REQUIREMENTS

The SWWTP has a deep lake outfall for the wastewater effluent, located approximately 310m offshore and 44m deep in Okanagan Lake. The discharge of effluent to Okanagan Lake is at 49° 35' 00" N Latitude and 119° 37' 55" W Longitude. The location of the treatment system from which the effluent is legally discharged is described as: Lot 1, DL 508, Plan KAP57829 ODYD. The site reference number for this discharge is Environmental Monitoring System (EMS), E230437. The SWWTP discharges effluent to the

lake under the provisions of the Operational Certificate PE 13627, issued June 16, 1998. The annual report will address each section of the current Operational Certificate.

3.1 Authorized Rate of Discharge (m3/d)

The maximum authorized rate of effluent discharge for 2023 was 4,000m^3/day, based on a monthly average. A magnetic flow meter is located on the influent pipe and monitors all incoming flows 24 hr/day. The average effluent discharge for 2023 was 2147 m^3/day, maximum daily flow was 2671 m3. Important to note that from April 21- September 20 the regular flow meter was out of service and a back-up flow meter used, which reads approximately 20% lower. **See Appendix F, *Table 1.0, Table 1.1 & Graph 1.0.***

3.2 Effluent Quality (Discharge to Okanagan Lake)

Effluent characteristics of the treatment plant to the outfall shall be equivalent to or better than:

- 5 Day Biochemical Oxygen Demand - 10 mg/L
- Total Suspended Solids - 10 mg/L
- Total Phosphorus as P:
  - Not to exceed - 2.0 mg/L
- Total Nitrogen - 6.0 mg/L as N
- Fecal coliform - 50 MPN

Detailed effluent discharge requirements are attached in **Appendix G, *Table 2.0.***

4.0 GENERAL REQUIREMENTS

4.1 Maintenance of Works and Emergency Procedures

The Summerland WWTP continues to work with Antero maintenance software. The program prints out weekly work orders that direct operators to perform maintenance on specific pieces of equipment. Every piece of equipment at the plant and lift stations listed in the database. Complete manufacturer's manuals and literature for all the equipment is catalogued and readily available to all staff at the SWWTP.

Manufacturers' recommended service requirements performed in 2023. Material Safety Data Sheets (MSDS) are on file at the SWWTP and updated as required. **Appendix B\C**

4.2 Bypasses

The District of Summerland wastewater treatment plant required no bypasses in 2023.

4.3 Process Modifications

No major process modifications in 2023, however piping repairs in Return Activated Sludge tank improved return sludge process to the Bioreactor as well as improved pumping to the Dissolved Air Flotation tank via the Scum tank.

4.4 Emergency Response Plan

The Emergency Response plan is up to date with new contact information. There were no spills to report in 2023. **See Appendix B.**

4.5 Odour Control

Odour from the treatment plant are contained in the buildings and tanks, then treated on-site in the bio filter. Air is pulled from the old head works room, new grit building, centrifuge room, equalization tank, sludge storage vault, and primary clarifier/fermenter and forced up through two compost beds. The buildings that produce dangerous gases have exhaust fans that are controlled by the continuous gas monitoring (H2S and LEL) that rapidly change out the air if gasses are detected.

The bio filter media is used to grow beneficial bacteria used to remove offensive odors that would otherwise be released to atmosphere. The bio filter is sprinkled with reclaimed water during the summer months to keep the media moist so that Sulphur reducing bacteria can grow and consume hydrogen sulfide.

Our lift stations contain odor control scrubbers that use carbon particles to remove odorous chemicals. Air is pulled out of the wet wells and filtered through the scrubber's which then release into the atmosphere. All lift stations except Landry kiosk have the scrubbers installed but only Peach Orchard lift station requires it to be running at all times. The rest are for backup incase odors occur. Ongoing monitoring of odor challenges are always part of the treatment process and we will continue to explore new ways to improve current systems and we also look forward to capital projects in the future.

4.6 Disinfection – Ultraviolet

Ultraviolet (UV) radiation is used for the sterilization of effluent wastewater and ensures a safe effluent discharge to Okanagan Lake. Multiple banks of lamps are maintained such that one bank may be taken out of service for cleaning/maintenance and the effluent shall still meet the fecal coliform effluent quality discharge limit. The staff cleans the UV banks on a regular basis according to manufacturer's specifications.

Along with UV disinfection, staff also uses a 12% sodium hypochlorite solution to further reduce pathogens in the reclaimed water. This secondary step increases the pathogen removal to a 4 log reduction (99.99%). Filters, UV, and hypo-chlorination produces safe water that we use onsite to make polymer, wash equipment, pump cooling and onsite irrigation of grass and shrubs. Treated effluent is not used off-site of the Summerland WWTP.

4.7 Facility Classification and Operator Certification

The British Columbia Environmental Operators Certification Program has classified the Summerland Wastewater Treatment Plant as a Level IV facility.

There are four full time staff members at the SWWTP and all are EOCP certified.

Employee	Position	EOCP #	Certification
Ryan Cleverdon	WWTP Chief Operator	1000746	WWT-III
Mathew Perdue	WWTP Operator	8443	WWT-IV
Jason Wright	WWTP Operator	7034	WWT-II WD-I
Kendell Wilson	WWTP Operator	1000613	WWT-I

4.8 Water Conservation

Summerland provides matching funds to the Okanagan Basin Water Board annually and is active in the creation and delivery of the "Make Water Work" campaign. This campaign provides Okanagan Valley-wide promotion of water conservation with items such as: billboards; bus signage; bus shelter signage; water-smart plants list; radio ads; digital ads; social media posts; contests; and other promotional material to encourage the conservation of water throughout the Okanagan.

Summerland has consumption-based water metering and billing and continue to work with irrigation and domestic customers in identifying issues with excessive water use. In 2023, there were 285 domestic meters, 2 commercial meters, 68 seasonal water service meters, and 10 agricultural irrigation meters replaced that had operational issues such as leakage or non-reads.

There were no amendments made to Bylaw 98-002.

4.9 Sewage Collection System – Infiltration, Inflow, and Cross Connections

The District of Summerland Public Works department is responsible for infrastructure repair and maintenance to the sewage collection system. The system currently has over 3400 connections, fed primarily by eight lift stations located throughout the municipality. Summerland has approximately 80 kilometers of sewer lines and over 700 manhole covers. As part of the preventative maintenance schedule, the collection system is flushed annually, and monitored for issues and blockages during the cleaning process.

The Wastewater Treatment Plant staff provide monitoring/maintenance to eight lift stations. Regular maintenance includes daily SCADA checks for each lift station and weekly equipment checks. There were no significant equipment failures at the lift stations this year. The District mechanics provide monthly maintenance and test runs to all the lift station generators. This test increases the dependability of the generators should standby power be required in the event of a power outage.

There was no evidence of infiltration, inflow, or cross-connections in the sewer system in 2023 as flows entering the plant were normal.

4.10 Influent Wastes By-Law(s)

In 2023, the District of Summerland had six (6) concerns raised regarding the Sewage Regulation Bylaw 98-002. Investigations showed that none of the concerns identified impacted the District sanitary sewer system. There were no changes made to the District of Summerland Sewage Regulation Bylaw 98-002 during 2023. **Appendix E**

5.0 RECLAIMED WATER IRRIGATION OPERATIONAL REQUIREMENTS

Although authorized in the Operating Certificate, no effluent irrigation has been applied beyond the SWWTP boundary on area's designated **Restricted or Unrestricted Public Access**.

Effluent irrigation water is applied within the treatment plant boundary on the odor control filter and for irrigation purposes. The effluent is chlorinated prior to any applications to further destroy fecal coliforms and to be within the required Restricted Public Access standard of 200 MPN/100ml.

6.0 INFLUENT MONITORING REQUIREMENTS

6.1 INFLUENT SAMPLING PROGRAM

Once per month samples are sent to an accredited lab for the following:

- 5 day biochemical oxygen demand, mg/L;
- Total Phosphorus expressed as mg/L P;
- Total nitrogen expressed as mg/L N;
- pH

Monthly grab sample data and yearly averages for these parameters are attached in **Appendix H, *Table 3.0, Graph 3.0, 3.1, 3.2.*** In addition, influent sampling is done daily in-house to monitor the influent waste stream **Appendix I, *Table 4.0.***

7.0 EFFLUENT – MONITORING REQUIREMENTS

7.1 Effluent Sampling

In-house Grab samples are taken daily and analyzed for the following:

- Ortho phosphorus expressed as mg/L P;
- Ammonia nitrogen expressed as mg/L N;
- Nitrate nitrogen expressed as mg/L N and;
- pH.

Attached in **Appendix K, *Table 6.0, Graph 6.0, 6.1, 6.2*** are the monthly averages for these effluent parameters.

7.2 Effluent Quality Excursions

The accredited lab-sampling program during 2023 recorded six excursions. Each event was recorded and reported to the Ministry of Environment. ***Table 5.0***

7.3 Additional Effluent Sampling Program

Monthly grab samples are sent to an external accredited lab for the following:

- Total suspended solids
- 5 day biochemical oxygen demand
- Total and Ortho phosphorus as mg/L P
- Total nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, organic nitrogen, and total kjeldahl nitrogen, all expressed as mg/L N
- pH
- Total and Fecal coliforms MPN

Monthly/Yearly averages are attached in **Appendix J, *Table 5.0, 5.1, 5.2 and Graph 5.0, 5.1, 5.2, and 5.3***

8.0 SLUDGE MONITORING REQUIREMENTS

8.1 Sludge Mass Measurement

Appendix N, *Table 7.0, Table 7.1 & Graph 7.0* attached shows the total amount of primary sludge and secondary waste activated sludge hauled to the composting site at the District of Summerland landfill. In

2023 the total amount of sludge hauled was 1,009,630 kg. (Note: OC13627 states "volume" but it is assumed that this is a colloquialism because volume of dry solids are not easily measured so mass is provided. Also the density of the sludge is extremely close to 1kg/L so you may interchange kg with L)

8.2 Sludge Sampling Program

Waste Activated Sludge samples were sent to accredited lab – CARO Analytical Services test samples as per the Operational Certificate requirements. The sludge analysis is summarized in the attached **Appendix N, *Table 7.2.***

8.3 Sludge Management Plan

Dewatered sludge from the process is transported to the District of Summerland landfill in liquid-tight containers. The sludge is then composted and offered to the public for beneficial reuses (soil conditioning), following Organic Matter Recycling Regulations (OMAR).

Attached in **Appendix N (**Sludge Management Plan)

9.0 LAKE SAMPLING AND MONITORING PROGRAM

9.1 Lake Sampling

The British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) in partnership with local municipalities, commissioned an annual collaborative monitoring program to sample water quality in Okanagan Lake every year since 2011. Now operated by the Okanagan Basin Water Board (OBWB). **Appendix L**

10.0 CONCLUSION

The Summerland Wastewater Treatment Plant (WWTP) is classified a Level IV facility with four full time staff. The operations team is knowledgeable and determined to provide the best service and environmental protection possible for the community. Emphasis on budget, funding, maintenance, pro-active upgrades and day-to-day operations will continue to be essential moving forward.

Ryan Cleverdon
Wastewater Treatment Plant Chief Operator
District of Summerland
Ph: 250-494-0619 Fax: 250-494-0620
rcleverdon@summerland.ca

APPENDIX A

OPERATIONAL CERTIFICATE

POLLUTION
PREVENTION

BRITISH COLUMBIA

Suite 201
3547 Skaha Lake Road
Penticton
British Columbia V2A 7K2
Telephone: (250) 490-8200
Fax: (250) 492-1314

MINISTRY OF ENVIRONMENT,
LANDS AND PARKS

OPERATIONAL CERTIFICATE

PE 13627

Under the Provisions of the Waste Management Act

The Corporation of the District of Summerland

PO Box 159

Summerland, British Columbia

V0H 1Z0

Hereinafter referred to as "the District"

is authorized to discharge effluent from a municipal sewage collection and treatment system located at Summerland, British Columbia, to Okanagan Lake, and to the ground by irrigation, and is further authorized to discharge sludge from this same system to an authorized compost facility, subject to the conditions listed below. Contravention of any of these conditions is a violation of the Waste Management Act and may result in prosecution.

1. SPECIFIC AUTHORIZED DISCHARGES AND RELATED REQUIREMENTS

1.1. Discharge of effluent to which this section is applicable is from a municipal sewage treatment plant to an effluent outfall located approximately as shown on the attached Appendix A. The site Environmental Monitoring System (EMS) reference number for this discharge is E230437.

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Assistant Regional Waste Manager

1.2. The maximum authorized rate of effluent discharged from the sewage treatment plant averaged on a monthly basis:

1998	1,750 m3/day
1999	2,750 m3/day
2000	2,800 m3/day
2001	3,000 m3/day
2002	3,100 m3/day
2003	3,300 m3/day
2004	3,400 m3/day
2005	3,600 m3/day
2006	3,800 m3/day
2007	3,900 m3/day
2008	4,000 m3/day

1.3. Effluent Quality (Discharge to Okanagan Lake)

The characteristics of the effluent discharged from the sewage treatment plant to the outfall shall be equivalent to or better than:

(a) 5 Day Biochemical Oxygen Demand - 10 mg/L

(b) Total Suspended Solids - 10 mg/L

(c) Total Phosphorus as P:

Not to exceed -	2.0 mg/L
99 percentile -	1.5 mg/L
90 percentile -	1.0 mg/L
Annual Average -	0.25 mg/L
Level to strive for -	0.01 mg/L

The level to strive for is the lake background level. The percentile values given relate to the daily values. e.g.: 99 percentile means that 99 percent of all daily values throughout the year are not to exceed 1.5 mg/L Total Phosphorus as P.

(d) Total Nitrogen - 6.0 mg/L as N

(e) Faecal coliform - 50 CFU /100ml

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Assistant Regional Waste Manager

3. RECLAIMED WATER IRRIGATION OPERATIONAL REQUIREMENTS

3.1. BUFFER ZONES

3.1.1. The requirement for formal buffer zones surrounding reclaimed water irrigated lands is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager. The reclaimed water irrigation system shall be managed in such a fashion as to preclude spray drift from leaving the irrigated lands in accordance with the "Health and Safety Criteria for Use of Reclaimed Wastewater" published by the Ministry of Health.

Reclaimed water applied by effluent irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.

3.2. SURFACE RUNOFF

There shall be no surface runoff of irrigated reclaimed water from the irrigated lands.

3.3. SURFACING TAIL WATER

Irrigation shall be managed in such a fashion as to preclude surfacing of irrigation tail water down slope of the point of irrigation.

3.4. HIGH WINDS -

The following strategy shall be followed to minimize the necessity to shut down the irrigation system or portions thereof during windy conditions.

Devices utilized in the spray irrigation of reclaimed water shall be operated in such fashion as to preclude aerosol drift from leaving the irrigated lands.

3.5. IRRIGATION RATES

Irrigation rates shall not exceed the rates given in "The Irrigation Design Manual for Farm Systems in British Columbia", dated 1989, published by the British Columbia Ministry of Agriculture and Food, except land that slopes in excess of 20% shall not be irrigated, without the written consent of the Regional Waste Manager.

Soils of the irrigated lands shall be monitored periodically to prevent saturation, erosion, and instability.

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Soils of the irrigated lands shall be monitored periodically to prevent saturation, erosion, and instability.

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Assistant Regional Waste Manager

3.6. CATTLE LAG TIME

A three day lag time is required before un-inspected beef cattle are permitted on areas sprayed with reclaimed water. No lag time is required if beef cattle are subjected to the federal meat inspection program.

A six day lag time is required before dairy cattle are permitted in areas irrigated with reclaimed water.

A three day lag time, after irrigation has ceased, is required before a crop intended for animal feed is harvested.

3.7. SIGNAGE

Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed water, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language readily comprehensible by the general public. e.g. "NO TRESPASSING - RECLAIMED WATER - DO NOT DRINK".

Signage at the gate of the plant site and any irrigated areas shall have the appropriate emergency contact person(s) and phone numbers for use by the general public and others.

3.8. FENCING

Generally, fencing is required for spray irrigation systems, but is not required for trickle irrigation systems, however, fencing may be specified for trickle irrigation systems, by the Regional Waste Manager.

4. INFLUENT - MONITORING REQUIREMENTS

4.1. INFLUENT - SAMPLING PROGRAM

The District shall install and maintain a suitable sampling facility (EMS site number E230439) and obtain a grab sample of the plant influent once each month for analysis by a suitably accredited independent laboratory. A proportional continuous sampler may be used, provided that prior written approval has been obtained from the Regional Waste Manager. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

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4.2. INFLUENT - ANALYSES

Obtain analyses of the influent sample for the following:

(a) 5-day biochemical oxygen demand, mg/L;

(b) total phosphorus expressed as mg/L P;

(c) total nitrogen, expressed as mg/L N; and

(d) pH.

5. EFFLUENT - MONITORING REQUIREMENTS

5.1. EFFLUENT - SAMPLING PROGRAM

The District shall install and maintain a suitable sampling facility (EMS Site Number E230437) and obtain a grab sample of the effluent once daily during the period of maximum daily flow for subsequent in-house analysis, and once each month for check by a suitably accredited independent laboratory. A proportional continuous sampler may be used, provided that prior written approval has been obtained from the Regional Waste Manager. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

5.2. EFFLUENT - ANALYSES

Obtain analyses of the effluent sample for the following:

5.2.1. Daily Analyses, (in house)

(a) ortho phosphorus expressed as mg/L P
(b) ammonia nitrogen and nitrate nitrogen, expressed as mg/L N; and
(c) pH,

5.2.2. Monthly Analyses (accredited lab)

(a) total suspended solids (non-filterable residue), mg/L;
(b) 5-day biochemical oxygen demand, mg/L;
(c) total and faecal coliforms CFU/100 ML;
(d) total and ortho phosphorus, all expressed as mg/L P;
(e) total nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, organic nitrogen, and total Kjeldahl nitrogen, , all expressed as mg/L N; and
(f) pH.

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5.2.3. Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

5.3. EFFLUENT - FLOW MEASUREMENT

Provide and maintain a suitable flow measuring device and record once per day the effluent volume discharged over a 24-hour period. Record the flows for each calendar month and for each calendar year. For the purposes of this section, effluent flows may be considered equivalent to influent measured flows.

6. SLUDGE - MONITORING REQUIREMENTS

6.1. SLUDGE - VOLUME MEASUREMENT

Install and maintain a system for measuring and recording the volumes of sludge produced, the location where the sludge was discharged, and the amount of sludge discharged at each location.

6.2. SLUDGE - SAMPLING PROGRAM

Obtain a representative sample of the sludge being produced at the treatment plant at least once every 6 months (EMS Site Number E230440).

6.3. SLUDGE - ANALYSES

Obtain analyses of the sludge sample for the following:

(a) Total solids (T.S.), g/L;
(b) Moisture content, %;
(c) Volatile suspended solids (V.S.S.), g/L;
(d) Total Kjeldahl Nitrogen (T.K.N.), g/L and g/kg dry solids;
(e) Aluminum, mg/kg;
(f) Arsenic, mg/kg;
(g) Cadmium, mg/kg;
(h) Calcium, mg/kg;
(i) Chromium, mg/kg;
(j) Cobalt, mg/kg;
(k) Copper, mg/kg;
(l) Iron, mg/kg;
(m) Manganese, mg/kg;
(n) Mercury, mg/kg;
(o) Molybdenum, mg/kg;
(p) Nickel, mg/kg;

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(q) Lead, mg/kg;
(r) Silver, mg/kg;
(s) Sodium, mg/kg; and
(t) Zinc, mg/kg.

Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

7. GROUNDWATER MONITORING PROGRAM - MONITORING REQUIREMENTS

A Groundwater Monitoring Program, shall be submitted to the Regional Waste Manager, and his written approval obtained prior to the commencement of irrigation of any lands other than the plant grounds. The program shall be designed by a Professional Engineer or a Hydrogeological Technologist licensed to practice in the Province of British Columbia, to establish with acceptable scientific accuracy, the groundwater flow pattern and nutrient removal capability of the soil, to ensure reasonable notice of impending high phosphorus or nitrate levels that may adversely affect the shoreline waters of Okanagan Lake system or domestic water wells. The sampling, measurement frequency and analyses shall be conducted in accordance with the Groundwater Monitoring Program upon it's written approval by the Regional Waste Manager.

8. LAKE SAMPLING AND MONITORING PROGRAM

A Lake Monitoring Program shall be initiated by the District consisting of the following components:

8.1. LAKE SAMPLING

Establish two sampling sites, one downcurrent of the effluent diffuser within the initial dilution zone (EMS Site Number E227650) and the other in an appropriate location for background sampling (EMS Site Number 0500454), each acceptable to the Regional Manager. At each site collect discrete samples at depths of one meter, five meters and ten meters, then at each ten meter interval including twenty, thirty and forty meter depths, during March and September of each year.

Have the samples at 1, 5 and 10 meter depths analyzed (accredited lab) for the following:

(a) total and ortho phosphorus , expressed as mg/L P;
(b) total nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, organic nitrogen, and total Kjeldahl nitrogen, all expressed as mg/L N;

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(c) faecal coliform bacteria, expressed as CFU/100 ML;
(d) chlorophyll a, expressed as ug/L;
(e) sodium and chloride expressed in mg/l;
(f) dissolved oxygen, expressed in mg/l;
(g) temperature, expressed in degrees centigrade; and
(d) pH;

Have the samples at 20, 30 and 40 meter depths analyzed (accredited lab) for the following:

(a) total and ortho phosphorus , expressed as mg/L P;
(b) total nitrogen, ammonia nitrogen, nitrate/nitrite nitrogen, organic nitrogen, and total Kjeldahl nitrogen, all expressed as mg/L N;
(c) faecal coliform bacteria, expressed as CFU/100 ML;
(d) sodium and chloride expressed in mg/l;
(e) dissolved oxygen, expressed in mg/l;
(f) temperature, expressed in degrees centigrade; and
(g) pH;

Measure and record water clarity using a secchi disk and underwater viewing box at each of the above sites.

The District must submit the proposed method of determining the location of the downcurrent sampling site to the Regional Manager for approval prior to the commencement of sampling.

Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

Results of the analyses shall be forwarded to the Regional Manager within 30 days following receipt of the results by the district. The results and trend analysis shall also be included in the year-end report

9. ENVIRONMENTAL IMPACT ASSESSMENT

In the year 2003, an Environmental Impact Assessment consisting of dye dispersion and limnology studies will be required to determine the changes in contaminant concentrations in water and sediments with distance from the diffuser. When required, the dye tests shall be carried out in conjunction with a basic physical limnology description of the discharge site (temperature profile, surface and subsurface current description, sediment chemistry and benthos including scans for organic compounds and analysis of benthic invertebrate populations etc.) and shall be supplemented with a chemical limnology program to verify the dye study findings.

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Assistant Regional Waste Manager

The limnology and dye dispersion studies shall be carried out by qualified consultants, licensed to practice in the Province of BC. In the year prior to the study being carried out, a proposal for this assessment shall be provided to the Regional Manager. The Regional Managers may at his discretion require additional monitoring if deemed necessary.

10. SOIL ASSESSMENT AND IRRIGATION PLAN

For lands other than the treatment plant site that are irrigated with reclaimed water, retain a Professional Agrologist to once per year conduct a soil assessment of the irrigated lands. Maintain records of crop production and nutrient content. Maintain records of soil, water and nutrient balances and assessments of any changes in the soil, surface or groundwater regimes. Maintain records of groundwater monitoring data. Annually submit the data and Soil Assessment as part of the Annual Report.

11. SAMPLING AND ANALYTICAL PROCEDURES

The sampling, flow and monitoring requirements above shall be carried out in accordance with the appropriate procedures listed in the table below. Alternative test methods may be used provided that the alternative test methods are authorized by the Regional Waste Manager prior to performing the actual source testing. Test methods for parameters not listed below require the consent of the Regional Waste Manager.

LIQUID EFFLUENTS, SURFACE WATER, GROUND WATER, SOILS, SEDIMENTS, VEGETATIVE MATTER:		
Parameter	**Source Testing Procedure**	**Analytical Procedure**
Metals Nutrients Organics Toxicity	British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 1996 Permittee Edition	British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials, March, 1994, Permittee Edition

The above manuals are available from Queen's Printer Publications Centre, P.O. Box 9452, Stn. Prov. Govt, Victoria, BC, V8W 9V7 (1-800-663-6105 or (250)387-4609). The above manuals are also available for inspection at all Pollution Prevention offices.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

12. REPORTING

12.1. GENERAL REPORTING

The influent, effluent, reclaimed water and sludge quality, groundwater and lake monitoring analyses and related flow data is to be submitted to the Regional Waste Manager such that they are received by the Regional Waste Manager within 30 days of the results being received, or produced, by the District.

Monitoring data shall be entered into EMS electronically and submitted in electronic and printed format satisfactory to the Regional Waste Manager.

12.2. ANNUAL REPORTING

Annually submitted data, as detailed below, is to be combined into a single report, suitably tabulated and indexed and forwarded to the Regional Waste Manager, such that it is received by the Regional Waste Manager, on, or before March 31, each year for the previous year's monitoring. Raw data are to be attached as appendices to the report. The report shall include graphical trend analysis of amenable data, an evaluation of those trends and discussion of any points of action which may arise from the data. A copy of the Annual Report shall also be placed in the local library for public access.

12.3. EFFLUENT

Maintain records of effluent analyses and flow measurements for inspection by the Regional Waste Manager or his designate, and annually submit the data, suitably tabulated, to the Regional Waste Manager.

12.4. INFLUENT

Maintain records of influent analyses for inspection by the Regional Waste Manager or his designate, and annually submit the data, suitably tabulated, to the Regional Waste Manager.

12.5. LAKE MONITORING

Maintain records of lake monitoring for inspection by the Regional Waste Manager or his designate, and annually submit the data, suitably tabulated, to the Regional Waste Manager.

12.6. IRRIGATION

Maintain effluent water balance records. Maintain records of the duration, intensity, acreage, location and type of effluent irrigation. For lands other than the treatment plant site: Maintain records of crop production and nutrient content. Maintain records of soil, water and nutrient balances and assessments of any changes in the soil,

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surface or groundwater regimes. Maintain records of groundwater monitoring data. Annually submit the data as part of an Irrigation Plan and Soil Assessment.

12.7. SLUDGE

Maintain records of sludge analysis, sludge volumes and application sites for inspection by the Regional Waste Manager or his designate, and annually submit the data, suitably tabulated, to the Regional Waste Manager, prior to the end of the month of March, for the previous year's monitoring.

12.8. I&I

Maintain records of efforts to reduce infiltration, inflow and cross connections and annually submit the data, suitably tabulated, to the Regional Waste Manager.

12.9. INFLUENT WASTES BY-LAW(S)

Maintain records of efforts to administer the influent wastes by-law(s) and annually submit the data, suitably tabulated, to the Regional Waste Manager. Include as an attachment, any amendments to the influent wastes by-law(s) that have been made during the past year.

12.10. WATER CONSERVATION

Maintain records of efforts to implement water conservation initiatives and annually submit the data, suitably tabulated, to the Regional Waste Manager. Include as an attachment, any amendments to the influent wastes by-law(s) that have been made during the past year.

With prior written authorization from the Regional Waste Manager, data may be submitted, suitably formatted, on computer storage media such as a floppy disk or another similar device.

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APPENDIX A

Requirements of Reclaimed water Users

The holder of this Operational Certificate (The reclaimed water supplier) shall be responsible for ensuring that contractual agreement(s) with each Reclaimed water User are in accordance with the Operational Certificate.

A copy of this Appendix is to be provided to EACH USER prior to the commencement of irrigation EACH YEAR. Documentation, indicating that Reclaimed water Users were provided a copy of this Appendix, is to be included in the Annual Report each year.

13. GENERAL REQUIREMENTS

13.1. PLANS - NEW WORKS

13.1.1. Plans for modifications and/or extensions to the existing reclaimed water irrigation system shall be approved by a person qualified in the design of irrigation systems and the Irrigation Plan and the Soils Assessment is to be submitted to the Regional Waste Manager for authorization prior to the commencement of irrigation on the subject property.

13.1.2. Design and construct the irrigation works in accordance with best current agricultural practice and the "Pollution Control Guidelines for Municipal Effluent Application to Land", dated January 1983, and any amendments thereto, issued by the Ministry of Environment of British Columbia, and also in accordance with the "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries or the "B.C. Trickle Irrigation Manual", dated 1987, prepared by the B.C. Ministry of Agriculture and Fisheries.

13.2. CONSTRUCTION CRITERIA

13.2.1. All reclaimed water user valves, shall be of a type, or secured in a manner, that permits operation by only personnel authorized by each wastewater user. All piping, valves and outlets should be clearly marked to differentiate reclaimed water from domestic water. All reclaimed water controllers, valves, etc., shall be affixed with reclaimed water warning signs. It is recommended that, where possible purple coloured pipe and fixtures be utilized to facilitate identification of reclaimed water piping and fixtures.

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13.2.2. Use or installation of hose-bibs on any irrigation system presently operating, or designated to operate with reclaimed water, regardless of the hose-bib construction or identification, is not permitted.

13.2.3. There shall be at least a 3 metre horizontal and a 0.3 metre vertical separation (with domestic water pipeline above the reclaimed water pipeline) between all pipelines transporting reclaimed water and those transporting domestic water.

13.2.4. There shall be no connection between a potable water supply, irrigation water or industrial well, and piping containing reclaimed water, except through an air gap separation or reduced pressure principle device.

13.3. FENCING

The reclaimed water user **may be** required by the Regional Waste Manager to erect a fence around the reclaimed water irrigation area to restrict public access. The height and type of fencing shall meet the approval of the Regional Waste Manager.

13.4. SIGNAGE

13.4.1. Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed water, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language or symbols readily comprehensible by the general public. e.g. "NO TRESPASSING - RECLAIMED WATER - DO NOT DRINK"

13.4.2. Warning signs shall be posted in sufficient numbers and size and at strategic locations to advise the public that reclaimed water is being used. Additional signage may be required as directed by the Regional Waste Manager.

14. GENERAL REQUIREMENTS - RECLAIMED WATER IRRIGATION

14.1. BUFFER ZONES

14.1.1. The requirement for formal buffer zones surrounding lands irrigated with reclaimed water is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager.

14.1.2. Reclaimed water applied by irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.

14.1.3. There shall be no reclaimed water irrigated within 30 metres of any well or in-ground reservoir for domestic supply.

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14.2. SURFACE RUNOFF

14.2.1. There shall be no surface runoff of irrigated reclaimed water from the irrigated lands.

14.2.2. The maximum ground slope shall not exceed 20% without the written consent of the Regional Waste Manager.

14.3. SURFACING RECLAIMED WATER

14.3.1. Irrigation shall be managed in such a fashion as to preclude surfacing of irrigation tail water down slope of the point of irrigation.

14.3.2. Irrigation shall be managed as to prevent ponding.

14.4. SPRAY IRRIGATION DRIFT

14.4.1. Reclaimed water shall be confined to the area designated and approved for irrigation with reclaimed water. The reclaimed water irrigation system shall be managed in such a fashion as to prevent aerosol drift from leaving the irrigated lands.

14.4.2. Precautions shall be taken to ensure that reclaimed water will not have contact with any facility or area not designated for reclamation, such as passing vehicles, buildings, domestic water facilities, fruit and vegetable gardens, or food handling facilities.

14.4.3. Drinking water facilities shall be protected from direct or wind blown reclaimed water spray.

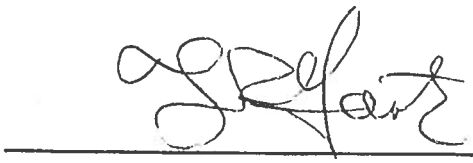
14.5. IRRIGATION RATES

14.5.1. Irrigation rates for spray irrigation shall not exceed the rates given in "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries and irrigation rates for trickle irrigation shall not exceed the rates given in those given in "B.C. Trickle Irrigation Manual", dated 1987, prepared by the B.C. Ministry of Agriculture and Fisheries.

14.5.2. Soils of the irrigated lands will be monitored periodically or as otherwise directed by the Regional Waste Manager or the District, to prevent saturation, erosion, and instability.

14.6. AGRICULTURAL PRODUCTS LAG TIME

14.6.1. A three day lag time is required before un-inspected livestock intended for human consumption are permitted on areas irrigated with reclaimed water. No lag time is required if livestock are subjected to the federal meat inspection program.



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14.6.2. A six day lag time is required before dairy cattle are permitted in areas irrigated with reclaimed water.

14.6.3. A three day lag time, after irrigation has ceased, is required before a crop intended for animal feed is harvested.

14.7. INSECT AND VECTOR CONTROL

Adequate measures shall be taken to prevent the breeding of insects and other vectors of health significance, and the creation of odours, slimes or unsightly deposits.

14.8. IRRIGATION OF PUBLIC AREAS

14.8.1. Irrigation on golf courses, parks or cemeteries shall only be practised when the public are not present.

14.8.2. Golf score cards shall indicate that reclaimed water is used for irrigation on the golf course lands.

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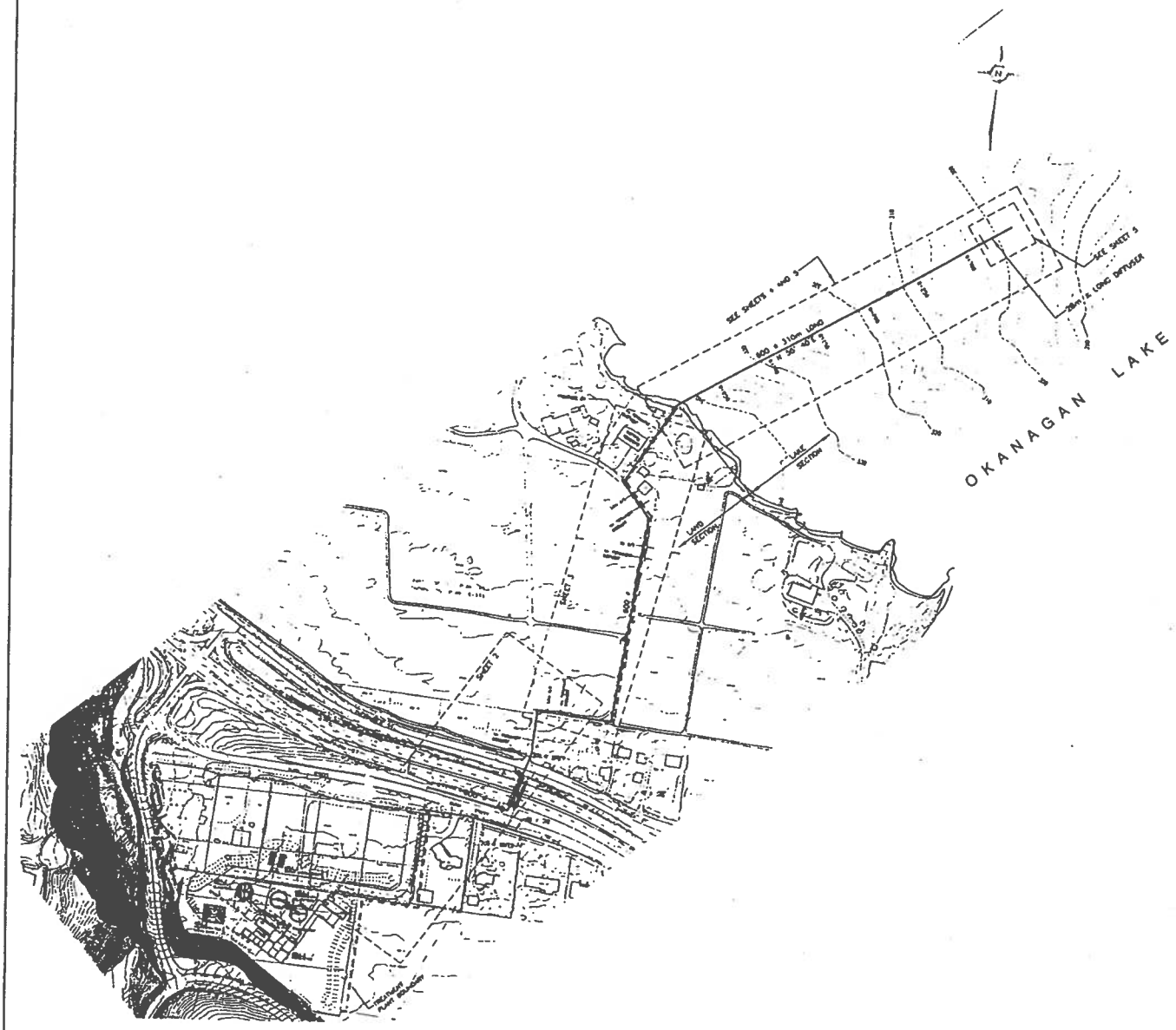
PROVINCE OF
BRITISH COLUMBIA

Pollution Prevention

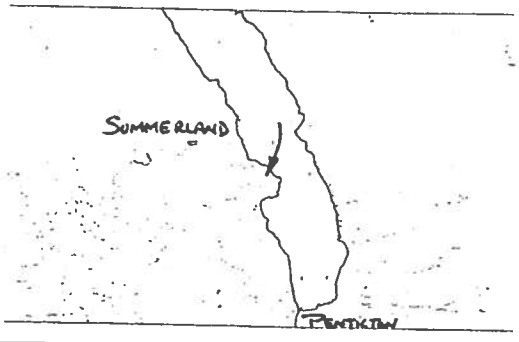
SITE PLAN A

N



Location Map

N



Scale: NTS

Permit No.: PE13627(01)

Date: June 16, 1998

T. R. Forty, P.Eng.
Assistant Regional Waste Manager

APPENDIX B

EMERGENCY RESPONSE PLAN

DISTRICT OF SUMMERLAND

Engineering & Public Works Department
Wastewater Division

District of Summerland Wastewater Treatment Plant Emergency Response Manual 2023

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APPENDIX A Wastewater Section Emergency Response Report

APPENDIX B Wastewater Section Spill Incident Report

APPENDIX C Wastewater Section Contaminated Soil or Groundwater Report

APPENDIX D Wastewater Section Personal Injury Report

1.0 EXECUTIVE SUMMARY

The Summerland Wastewater Treatment plant is responsible for providing final wastewater effluent that meets all regulatory requirements. Disruption to these services whether routine or as a result of an emergency is inevitable. The Utility's challenge is to reduce risk and the overall effects of these emergencies.

The Treatment plant personnel must consider themselves responsible for providing wastewater treatment services under emergency conditions. The best way to do this is through preparation. This manual represents the wastewater plant's principles, practices and guidelines for the treatment plant's emergency planning and is intended to be used by all section employees.

The manual provides guidelines and a sufficient level of detail to complete the emergency planning process for most systems.

The content of this emergency response manual will be periodically updated and revised as the Utility grows and changes. New emergency procedures will be added and existing procedures revised, as utility operators or management identifies the need. The procedures laid out will be revised as equipment and processes utilized by the section are phased out, upgraded or expanded.

2.0 PLAN INTRODUCTION

2.1 How and When to Use the Plan

This emergency response plan is intended to be distributed to all wastewater operations staff. It is to be used as a guide for dealing with emergencies as they arise within any operating area and must be available for reference by all staff at all times. It is the responsibility of each staff member to familiarize themselves with the response plan and to refer to the specific area that applies during emergency situations. It is also the responsibility of each staff member to bring to the attention of their Supervisor the need to make changes, additions or modifications as they arise within their specific area. The Supervisor must ensure any and all of these additions or modifications are included in the plan and that it is updated on an annual basis.

2.2 Treatment Plant Organizational Chart

<table>
<tr><td colspan="2">Jeremy Storvold
Director of Utilities
Devon van der Meulen
Manager of Water Utilities</td></tr>
<tr><td>Lift Station Operators:
1. Ryan Cleverdon
2. Jason Wright
3. Matthew Perdue
4. Kendell Wilson</td><td>WWTP Operators:
1. Ryan Cleverdon
2. Jason Wright
3. Matthew Perdue
4. Kendell Wilson</td></tr>
</table>

3.0 PLAN ACTIVATION PROCEDURES

3.1 First Response

All staff members must immediately report any emergency to their Supervisor and use the plan as a guide to assist in first response. **In an emergency, the most senior staff in the vicinity shall assume the responsibility of initiating the emergency response plan and assume the role of "Senior Operator" as described in the emergency response procedures that follow**. The first line Management Supervisor within each unit, or his / her designate, is responsible to ensure the plan is properly coordinated and implemented in a timely fashion. The Supervisor is also responsible to notify the section head or his / her designate immediately.

3.2 Senior Staff Notification Procedure

All emergencies involving risk to the health and safety of staff members or to the general public are to be reported to Senior Management immediately. The Senior Operator or his / her designate must ensure that Senior Management is notified immediately prior to public notification. Within 48 hours of the emergency, complete the Emergency Response Report found in Appendix A and forward it to the Supervisor and the Director of Engineering and Public Works along with any additional relevant documentation.

3.3 Public Notification Procedure

Once the Senior Operator and Senior Management have been notified of an emergency, Senior Management will notify the customers that may be affected. Depending on the severity of the emergency, senior management will determine what form notification to the public will take.

3.4 Environment and Regulatory Notification Procedure

All emergencies that may have an effect on water, sewer, or air quality are to be reported immediately to the Senior Operator and Senior Management is responsible to ensure staff know and can implement the PEP first response procedure. Refer to Section 3.4.1 - Spill Reporting Procedures.

3.4.1 Spill Reporting Procedures

.1 In these procedures, as defined by the Environmental Management Act (BC Reg. 263/90):

"Act" means the Waste Management Act;

"PEP" means the Provincial Emergency Program;

"Spill" means a release or discharge except as authorized or allowed by:

a) Section 3 of the Act,

b) A waste management plan approved by the minister or under the Act, or

c) A permit, approval or order under the Act.

into the environment of a substance in an amount equal to or greater than the amount listed in Table 1.

"Substance" means a substance, product, material or other thing listed in Table 1.

"Federal Regulations" means The Transportation of Dangerous Goods Regulations made under the Transportation of Dangerous Goods Act (Canada).

"Special Waste Regulations" means BC Reg. 63/88.

.2 **Spill Reporting Requirements**

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

.1 **A primary containment facility leaks a substance of reportable quantity** (*see Table 1*):

a) If the substance is discharged to the environment then the leak must be reported to the Immediate Supervisor

b) If the substance is not discharged to the environment then the leak must be reported to the immediate Supervisor;

c) If the leak is to a secondary containment the leak must be reported to the Immediate Supervisor. If failure of the secondary containment would result in discharge to the environment the Immediate Supervisor must also be notified.

.2 **A primary containment facility leaks a substance of less than reportable quantity** *(see Table 1):*

a) If no discharge to the environment occurs then, at the discretion of staff, this leak should be reported to the Immediate Supervisor at the time of the incident or within 12 hours;

b) If discharge to the environment does occur this leak should be reported to the Immediate Supervisor at the time of the incident or within 12 hours.

.3 **Use the Wastewater Section Spill Incident Report found in Appendix B to document spills by filling out the appropriate sections and forwarding as indicated on the form.**

Table 1
Summary of Reportable Spills by Quantity
(From: Environmental Management Act Reporting Schedule)

Item	Column 1 Substance spilled	Column 2 Specified amount
1	Class 1, Explosives as defined in section 2.9 of the Federal Regulations	Any quantity that could pose a danger to public safety or 50 kg
2	Class 2.1, Flammable Gases, other than natural gas, as defined in section 2.14 (a) of the Federal Regulations	10 kg
3	Class 2.2 Non-Flammable and Non-Toxic Gases as defined in section 2.14 (b) of the Federal Regulations	10 kg
4	Class 2.3, Toxic Gases as defined in section 2.14 (c) of the Federal Regulations	5 kg
5	Class 3, Flammable Liquids as defined in section 2.18 of the Federal Regulations	100 L
6	Class 4, Flammable Solids as defined in section 2.20 of the Federal Regulations	25 kg
7	Class 5.1, Oxidizing Substances as defined in section 2.24 (a) of the Federal Regulations	50 kg or 50 L
8	Class 5.2, Organic Peroxides as defined in section 2.24 (b) of the Federal Regulations	1 kg or 1 L
9	Class 6.1, Toxic Substances as defined in section 2.27 (a) of the Federal Regulations	5 kg or 5 L
10	Class 6.2, Infectious Substances as defined in section 2.27 (b) of the Federal Regulations	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
11	Class 7, Radioactive Materials as defined in section 2.37 of the Federal Regulations	Any quantity that could pose a danger to public safety and an emission level greater than the emission level established in section 20 of the "Packaging and Transport of Nuclear Substances Regulations"
12	Class 8, Corrosives as defined in section 2.40 of the Federal Regulations	5 kg or 5 L
13	Class 9, Miscellaneous Products, Substances or Organisms as defined in section 2.43 of the Federal Regulations	25 kg or 25 L
14	waste containing dioxin as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
15	leachable toxic waste as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
16	waste containing polycyclic aromatic hydrocarbons as defined in section 1 of the hazardous Waste Regulation	5 kg or 5 L
17	waste asbestos as defined in section 1 of the Hazardous Waste Regulation	50 kg
18	waste oil as defined in section 1 of the Hazardous Waste Regulation	100 L
19	waste containing a pest control product as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
20	PCB Wastes as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
21	waste containing tetrachloroethylene as defined in section 1 of the Hazardous Waste Regulation	50 kg or 50 L
22	biomedical waste as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
23	A hazardous waste as defined in section 1 of the Hazardous Waste Regulation and not covered under items 1 – 22	25 kg or 25 L
24	A substance, not covered by items 1 to 23, that can cause pollution	200 kg or 200 L
25	Natural gas	10 kg, if there is a breakage in a pipeline or fitting operated above 100 psi that results in a sudden and uncontrolled release of natural gas

3.5 Section and Inter Division Primary Contact Lists

Table 2
Inter Section Primary Contact List

Position	Name	Work No.	Cell No.
Administrators			
Director of Utilities	Jeremy Storvold	250-494-0431	250-460-6610
Manager of Water Utilities	D. van der Meulen	250-404-4075	250-462-0493
Manager of Public Works	Shawn Goodsell	250-404-4082	250-485-6216
Operations			
Wastewater Chief Operator	Ryan Cleverdon	250-494-0619	250-490-7242
Wastewater Operator	Kendell Wilson	250-494-0619	250-809-7141
Wastewater Operator	Jason Wright	250-494-0619	250-809-7141
Wastewater Operator	Mathew Perdue	250-494-0619	250-809-7141

3.5.1 Wastewater Treatment Plant Contact Procedures

To Contact Standby Personnel (24 hour) call:

- Ryan Cleverdon, Cell 250-490-7242
- Stand-By Operator, Cell 250-809-7141

If unable to reach the standby person call:

- Devon van der Meulen, Manager of Utilities 250-462-0493

3.5.2 Lift Station Contact Procedures

To Contact Standby Personnel call direct to:
After hours call:

- Ryan Cleverdon, Cell 250-490-7242
- Stand-By Operator, Cell 250-809-7141

If unable to reach standby person call:

- Devon van der Meulen, Manager of Utilities 250-462-0493

4.0 RESPONSE PROCEDURES BY UNIT

The following section is a summary of response procedures for selected emergency conditions. This is by no means exhaustive, and will be expanded and revised periodically or as the need arises. In an emergency, the most senior staff in the vicinity will assume the responsibilities designated to the *Senior Operator* in the response procedure. Following each response procedure is a list of the appropriate contact personnel or agencies and the contact's phone number. Within 48 hours of the emergency, complete the Emergency Response Report

found in Appendix A and forward it to your Immediate Supervisor along with any additional relevant documentation.

4.1 Lift Station Emergency Response

4.1.1 Staff Injury

A member of the staff has been seriously injured.

Objective: Prevent further injury and provide medical attention as quickly as possible.

Response Action	Responsibility
1. If working in confined space and the attending worker cannot retrieve the injured person with a harness: • If the attending worker sees that the worker(s) inside the space are in trouble, or if he cannot contact the worker(s) inside, he shall immediately call **911**. He shall provide information such as: location, type of accident and condition of patient. Under no circumstances shall the attending worker enter the confined space to give aid until help arrives.	• Senior Operator
2. Once the injured person is retrieved, or if confined space is not involved, then protect the injured person from further danger. If severely injured, do not move the person unless threatened by nearby hazard.	• Senior Operator
3. Establish and maintain the injured persons breathing.	• Senior Operator
4. Control all major bleeding.	• Senior Operator
5. As soon as possible, report the accident to the Assistant Superintendent.	• Senior Operator
6. Accompany the injured employee to the Doctor's office or place of residence upon receiving approval from a Supervisor.	• Senior Operator
7. Prepare a detailed accident report within 24 hours of the incident and submit it to your Supervisor (*See Appendix D*).	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.1.2 Lift Station Power Failure

A collection system lift station has ceased operation due to prolonged power failure. A prolonged power failure is one which lasts more than 10 minutes and can not be restored for 30 minutes or more.

Objective: Prevent flooding and damage to property and the environment.

Response Action	Responsibility
Contact the Manager of Utilities and inform him of the problem.	• Senior Operator
1. If possible, call Electrical Dept. and determine the nature of the problem and how long the power will be out.	• Senior Operator
2. Butler Street, Dale Meadows, Trout Creek, Cresent Beach, Landry #1, Landry #2, Peach Orchard and Hunters Hill Lift Stations are equipped with standby generators and will automatically start if power is disrupted.	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Corp. Electrical Dept	250-494-0431	250-494-6818
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.1.3 Chemical Spill Response

A chemical spill that has occurred within the lift station and may impact the environment.

Objective: Prevent injury or loss of life to staff and the public. Contain and clean-up the spill as soon as possible.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Response Procedure	Responsibility
1. When possible, the person finding a leak should stop the flow of the chemical immediately. Follow all safety procedures.	• Senior Operator
2. Upon discovery of a spill, notify the following people: • Manager of Utilities • Director of Works and Utilities; • Provincial Emergency Program (PEP).	• Senior Operator
3. If public safety is at risk, notify and if necessary evacuate residence in the affected area.	• Senior Operator
4. Spills of reportable quantities must be documented by filling out the Water / Wastewater Spill Incident Report found in Appendix B (*Refer to Table 1 Reportable Spill Quantities*).	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493
Provincial Emergency Program (PEP)	1-800-663-3456	
Ministry of Environment	1-800-461-1127	
Summerland PEP Coordinator	250-494-7211	250-488-1220
Assistant PEP Coordinator	250-494-7211	250-488-0960
Dispatch (for Duty Officer)	911	

4.1.1.1 Spill Response and Counter Measures Plan for *Ferric Chloride*

.1 A spill of Ferric Chloride has occurred. This product is classified under Item 75 as Class 9.2 (Environmentally Hazardous) according to the Spill Reporting Regulations. Any spill to the environment of more than 1 kg or 1 litre must be reported using the Spill Incident Report (*see Appendix B*).

.2 For spills less than reportable quantities (at the discretion of the operator) notify your Immediate Supervisor at the time of the incident or within 12 hours of the spill.

.3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.

.4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the SDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

.5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Water hose	Maintenance Shop

.6 Utilize the containment and clean-up equipment as follows:

.1 While wearing the above safety equipment, secure the area and contain the spill. Recover as much product as possible with absorbent material and place in a rubber or plastic container. Wash down contaminated area thoroughly.

.2 A major failure of the Ferric Chloride storage tank will be contained by the secondary containment but would result in contamination of a large area. The operator should not attempt to contain or clean-up a spill of this magnitude.

.3 In the event of a major spill event the Fire Hall should be contacted immediately and the first response unit dispatched to the scene.

MINISTRY

4.2 Summerland Wastewater Treatment Plant Emergency Response

4.2.1 Staff Injury

A member of the staff has been seriously injured.

Objective: Prevent further injury and provide medical attention as quickly as possible.

Response Action	Responsibility
8. If working in confined space and the attending worker can not retrieve the injured person with a harness: • If the attending worker sees that the worker(s) inside the space are in trouble, or if he cannot contact the worker(s) inside, he shall immediately call **911**. He shall provide information such as: location, type of accident and condition of patient. • Under no circumstances shall the attending worker enter the confined space to give aid until help arrives.	• Senior Operator
9. Once the injured person is retrieved, or if confined space is not involved, then protect the injured person from further danger. If severely injured, do not move the person unless threatened by nearby hazard.	• Senior Operator
10. Establish and maintain the injured persons breathing.	• Senior Operator
11. Control all major bleeding.	• Senior Operator
12. As soon as possible, report the accident to the Manager of Utilities.	• Senior Operator
13. Accompany the injured employee to the Doctor's office or place of residence upon receiving approval from a Supervisor.	• Senior Operator
14. Prepare a detailed accident report within 24 hours of the incident and submit it to your Supervisor (*see Appendix D*).	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.2.2 Wastewater Treatment Plant Permit Violation

The Summerland Wastewater Treatment Plant may potentially violate the operating permit.

Objective: To correct the problem as soon as possible.

WWTP Operator: On discovery of effluent flowing to Okanagan Lake with **any** parameter that has reached or exceeded permit requirements:

Response Procedure	Responsibility
1. Advise Senior Operator.	• Lab Technician
2. Collect a 500 ml grab sample of effluent from the filter building, filter a 100 ml portion from this sample, label both the filtered portion and the unfiltered portion of the sample with the type of sample, date, time collected, and the name of the person that collected the sample. Seal the lids with masking tape and store in the refrigerator.	• Lab Technician
3. Collect a 500 ml sample from the effluent composite sampler and handle and label as in Step 2.	• Lab Technician

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493
Ministry of Environment	250-490-8200	

4.2.3 Major Component or Tankage Failure Response

A major process component has failed. This may include anything from mechanical failure to failed containment walls in the bioreactor, primary and secondary clarifiers, etc.

Objective: Prevent damage to public and private property, injury to staff and the public, and restore the plant to operation as soon as possible.

Response Procedure	Responsibility
1. Alert the first available of: • Manager of Water Utilities • Director of Utilities.	• Senior Operator
2. If there is danger of fire or explosion call 911.	• Senior Operator
3. If the component failure results in a chemical spill then refer to section.	• Senior Operator
4. Divert flows to any undamaged tanks that are not in use and isolate the failed component.	• Senior Operator
5. Set up temporary controls if the main control system has also failed.	• Senior Operator
6. Secure the necessary pumps, staff and equipment to repair the damage.	• Senior Operator
7. Notify PEP and Ministry of Environment if volume of spill exceeds reportable quantities (*see Table 1 Reportable Spill Quantity).*	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493
Ministry of Environment	1-800-461-1127	
Provincial Emergency Program (PEP)	1-800-663-3456	

4.2.4 Outfall Pipe Failure

A major failure of the outfall pipe has occurred.

Objective: Prevent flooding of private property due to WWTP effluent overflow.

Response Procedure	Responsibility
Notify the Manager of Utilities and the Director of Works and Utilities. 1. Of the outfall pipe failure.	• Senior Operator
2. Notify the Ministry of Environment of the emergency and the departure from normal operating procedures.	• Senior Operator
3. Secure necessary equipment to make repairs to the outfall pipe.	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610

Manager of Water Utilities	250-404-4075	250-462-0493
Ministry of Environment		1-800-461-1127

4.2.4.1 Chemical Spill

A chemical spill has occurred within the plant and may impact the environment.

Objective: Prevent injury or loss of life to staff and the public. Contain and clean-up the spill as soon as possible.

All staff must be acquainted with the nature of chemicals used on-site (refer to the SDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Response Procedure	Responsibility
1. When possible, the person finding a leak should stop the flow of the chemical immediately. Follow all safety procedures.	• Senior Operator
2. Upon discovery of a spill, notify the following people. • Manager of Engineering; • Director of Engineering and Public Works; • Provincial Emergency Program (PEP).	• Senior Operator
3. If public safety is at risk, notify and if necessary evacuate residence in the affected area.	• Senior Operator
4. Spills of reportable quantities must be documented by filling out the Water / Wastewater spill Incident Report found in Appendix B (*Refer to Table 1 Reportable Spill Quantities*).	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493
Provincial Emergency Program (PEP)	1-800-663-3456	
Ministry of Environment	1-800-461-1127	

4.2.4.2 Spill Response and Counter Measures Plan for *Aluminum Sulfate (Alum)*

.1 A spill of Alum has occurred. This product is classified under Item 15 as Class 9.2 (Environmentally Hazardous) according to the Spill Reporting Regulations. Any spill to the environment of more than 1 kg or 1 litre must be reported using the Spill Incident Report (see *Appendix B*).

.2 For spills less than reportable quantities, (at the discretion of the operator) notify your immediate supervisor at the time of the incident or within 12 hours of the spill.

.3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.

.4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

.5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Water hose	Maintenance Shop

.6 Utilize the containment and clean-up equipment as follows:

.1 While wearing the above safety equipment, secure the area and contain the spill. Spills of less than 5 litres from the day tanks or the main tanks are unlikely to have an environmental impact so need not be reported to PEP. Spilled material will run into the containment area. Attempt to pump clean alum back into the tanks. If containment is breached the sump will send it to the headworks of the plant.

.2 Wash down contaminated areas thoroughly with water and employ absorbent materials for areas that may not be accessed with water.

.3 A major failure of the main alum storage tanks will be partially contained by the secondary containment but would result in contamination of a large area. The operator should not attempt to contain or clean up a spill of this magnitude.

.4 In the event of a major spill event the fire hall should be contacted immediately and the HAZMAT response unit dispatched to the scene.

4.2.4.3 Spill Response and Counter Measures Plan for *Polymer*

.1 A spill of Polymer has occurred. This product is classified according under Item 20 of the Spill Reporting Regulations and therefore spills of greater than 200 kg have to be reported using the Spill Incident Report.

.2 Spills of less than reportable quantities, at the discretion of staff, notify your Immediate Supervisor of the spill at the time of the incident or within 12 hours of the spill.

.3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.

.4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Approved dust mask	Maintenance Shop
Rubber gloves	Maintenance Shop
Safety goggles and face shield	Maintenance Shop
Coveralls	Administration Building
Footwear with closed tops	Standard Equipment

.5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Scoop shovel and broom	Maintenance Shop
Water-tight storage containers	Maintenance Shop

.6 Utilize the containment and clean-up equipment as follows:

.1 While wearing the above safety equipment, secure the area, remove all sources of ignition and contain the spill.

.2 Recover as much of spilled dry product as possible and place in water-tight containers for storage until the product can be used or disposed of.

.3 Wash down spills of dilute solutions or residual dry product with large quantities of water into internal plant sewer system.

.4 Upon completion of clean-up procedures, remove contaminated safety equipment and clean or service as required. Remove contaminated clothing and wash thoroughly.

4.2.4.4 Spill Response and Counter Measures Plan for *Oil*

.1 A spill of oil has occurred. This product is classified under Item 20 according to the Spill Reporting Regulations and therefore spills to the environment of more than 205 liters must be reported using the Spill Incident Report.

.2 For spills of less than reportable quantities, notify your Immediate Supervisor of the spill at the time of the incident or within 12 hours of the spill.

.3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.

.4 Obtain the following safety equipment.

Safety Equipment	Location
Gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop
Coveralls	Administration Building

.5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Scoop shovel and broom	Maintenance Shop
Absorbent materials	Maintenance Shop

.6 Utilize the containment and clean-up equipment as follows:

.1 Employ absorbent materials to soak up any oil on the floor. Place the used absorbent materials in plastic bags or barrels for storage until it can be properly disposed of.

.2 Obtain a tank large enough to store the quantity of oil spilled into the secondary containment. Store the oil until the permanent tank can be repaired or replaced if need be.

4.2.4.5 Spill Response and Counter Measures Plan for *Diesel Fuel*

.1 A spill of Diesel fuel has occurred. This product is classified under Item 6 as Class 3.3 (Flammable Liquid) according to the Spill Reporting Regulations. Any spills of more than 100 litres to the environment must be reported using the Spill Incident Report.

.2 For spills less than reportable quantities, notify your Immediate Supervisor at the time of the incident or within 12 hours of the spill.

.3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.

.4 Obtain the following safety equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

.5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Containers	Maintenance Shop

.6 Utilize the containment and clean-up equipment as follows:

.1 While wearing the above safety equipment, secure the area and eliminate all sources of ignition.

.2 Use absorbent materials to clean-up spilled diesel.

.3 Place contaminated absorbent materials in containers for storage until they can be disposed of.

.4 Transfer any diesel left in the tank into a temporary container until the permanent tank can be repaired or replaced.

.5 Upon completion of clean-up procedures, remove contaminated safety equipment and clean or service as required. Remove contaminated clothing and wash thoroughly.

4.2.4.6 Spill Response and Counter Measures Plan for *Sodium Hypochlorite*

.1 A spill of sodium hypochlorite has occurred. This product is classified under Item 15 as Class 9.2 (Environmentally Hazardous) according to the Spill Reporting Regulations. Any spill to the environment of more than 1 kg must be reported using the Spill Incident Report.

.2 For spills less than reportable quantities, (at the discretion of staff) notify your Immediate Supervisor at the time of the incident or within 12 hours of the spill.

.3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.

.4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

.5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Shovels, brooms, containers	Maintenance Shop

.6 Utilize the containment and clean-up equipment as follows:

.1 While wearing the above safety equipment, secure the area.

.2 Attempt to control or stop the leak by repositioning containers.

.3 Wash spilled material into the drains or contain with absorbent materials.

.4 Recover any contaminated absorbent material and deposit in water-tight containers for disposal.

.5 Upon completion of clean-up procedures, remove contaminated safety equipment and clean or service as required. Remove contaminated clothing and wash thoroughly.

4.2.4.6 Spill Response and Counter Measures Plan for *Ferric Chloride*

.1 A spill of Ferric Chloride has occurred. This product is classified under Item 75 as Class 9.2 (Environmentally Hazardous) according to the Spill Reporting Regulations. Any spill to the environment of more than 1 kg or 1 litre must be reported using the Spill Incident Report (See Appendix B).

.2 For spills less than reportable quantities, (at the discretion of the operator) notify your Immediate Supervisor at the time of the incident or within 12 hours of the spill.

.3 Spills that do not put staff, the environment, or the public in serious danger in an attempt to contain or clean-up should be handled as follows.

.4 Obtain the following safety equipment.

All staff must be acquainted with the nature of chemicals used on-site (refer to the MSDS Sheets) and the protective clothing and equipment required to handle these chemicals.

All staff must be informed of the location of safety equipment including fire extinguishers and spill clean-up equipment and how to operate that equipment.

Safety Equipment	Location
Rubber boots, apron and gloves	Maintenance Shop
Safety glasses and face shield	Maintenance Shop

.5 Obtain the following containment and clean-up materials:

Containment and Clean-up Equipment	Location
Absorbent materials	Maintenance Shop
Water hose	Maintenance Shop

.6 Utilize the containment and clean-up equipment as follows:

.1 While wearing the above safety equipment, secure the area and contain the spill. Recover as much product as possible with absorbent material and place in a rubber or plastic container. Wash down contaminated area thoroughly.

.2 A major failure of the Ferric Chloride storage tank will be contained by the secondary containment but would result in contamination of a large area. The operator should not attempt to contain or clean-up a spill of this magnitude.

.3 In the event of a major spill event the fire hall should be contacted immediately and the HAZMAT response unit dispatched to the scene.

4.2.5 Major Power Failure

Power to the plant has been interrupted and will remain off for an undetermined amount of time.

Scenario:

The power has gone out at the plant, the generator will automatically start and all the essential equipment will stagger start.

Response Procedure	Responsibility
Check the stand-by generator to see if it is running, check the oil pressure, amps, rpm, etc. on the diesel.	Senior Operator
When the power returns to normal do a complete walk through to insure all plant equipment has restarted. Check the SCADA System to see that all alarms have been cleared.	Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.2.6 Fire Emergency Response

All staff must be acquainted with the nature of chemicals used on-site (refer to the SDS Sheets) and the potential for fire and explosion.

All staff must be informed of the location of safety equipment including fire extinguishers and first aid equipment and how to operate that equipment.

Response Procedure	Responsibility
1. Preserve life at all times, including your own	• Senior Operator
2. When approaching a fire or leaving a fire site, face the fire location at all times	• Senior Operator
3. **Call 911 and provide information about the potential for chemical fires**	• Senior Operator
4. Alert all staff, the Manager of Water Utilities (Devon van der Meulen) and the Director of Utilities (Jeremy Storvold)	• Senior Operator
5. Extinguish or attempt to control small fires, but at no time risk life or injury by fighting a large fire; close doors; have all personnel leave the area	• Senior Operator
6. Meet the fire trucks at the main gate and assist the first firefighters by directing them, if possible, to the main fire	• Senior Operator

7. Assist in post investigation procedures	• Senior Operator

Notify:

Contact / Agency	Contact Phone Number	
	Office	Cellular
Director of Utilities	250-494-0431	250-460-6610
Manager of Water Utilities	250-404-4075	250-462-0493

4.3 Community Contact List

4.3.1 EMERGENCY SERVICES AND VOLUNTEER FIRE DEPARTMENT

POLICE DEPARTMENT 911

AMBULANCE SERVICE 911

Summerland Fire Department (*call fire department and leave message*) Hall: 250-494-7211
Rob Robinson, Fire Chief 250-404-4088
Summerland BC V0H 1Z8

4.3.2 Utilities

CORP. ELECTRICAL DEPT 250-494-0431

BC HYDRO 1-800-224-9376

FORTIS BC NATURAL GAS 1-800-663-9911

TELUS (24 HOURS) 611

4.3.3 Additional Emergency Numbers

BC PEP
(HAZARDOUS MATERIAL SPILLS) 1-800-663-3456

DICK'S SEPTIC (SEPTAGE HAULING) 250-494-9864

INTERIOR INSTRUMENT 250-717-8813

SOUTH OKANAGAN HEALTH UNIT 250-868-7700

WORKSAFE BC 1-888-922-3700

4.3.4 RENTAL AGENCIES

SUMMERLAND RENTAL CENTRE 250-494-9864

WESTMINSTER RENTALS 250-492-7551

4.3.5 Pump Repair Services

EMPS	1-250-765-4998
EMERGENCY	1-250-717-0025

Appendix A
Wastewater Emergency Response Report

Staff Reporting or Receiving Report of an Emergency:

Name:	Date:	Time: a.m.☐ p.m.☐

Person Reporting Emergency (if other than Regional Staff)

Name:	Telephone No.:
Address:	

Emergency Details

Location:

Type of Emergency (i.e. fire, flood etc.):

Surroundings:

Agencies Contacted:

Forward To: _____
(Immediate Supervisor)

Action Taken:

Comments:

Immediate Supervisor's Signature _____
Date _____

Forward to: _____
(Department Supervisor)

Action Taken:

Comments:

Submitted:
Personal Injury Report ☐
Spill Incident Report ☐
Emergency Response Report ☐
Notice of Contamination ☐

Dept. Supervisor's Signature _____
Date _____

Appendix B
Wastewater Spill Incident Report

Staff Reporting or Receiving Report of a Spill:

Name:	Date:	Time: a.m.☐ p.m.☐

Person Reporting Spill (if other than Regional Staff)

Name:	Telephone No.:
Address:	

Incident Details

Location:

Substance (i.e. oil, acid, etc.):

Reportable Quantity? Yes ☐ No ☐

Discharge to Secondary Containment? Yes ☐ No ☐ N/A ☐

Discharge to Environment? Yes ☐ No ☐

Affected Areas:

Agencies Contacted:

Forward To: _____
(Immediate Supervisor)

Action Taken:

Comments:

Immediate Supervisor's Signature _____

Date _____

Forward to: _____
(Department Supervisor)

Action Taken:

Comments:

Submitted:

Personal Injury Report ☐

Spill Incident Report ☐

Emergency Response Report ☐

Notice of Contamination ☐

Dept. Supervisor's Signature _____

Date _____

Appendix C
Wastewater Contaminated Soil or Groundwater Report

Staff Reporting or Receiving Report of Contaminated Soil or Groundwater:

Name:	Date:	Time: a.m.☐ p.m.☐

Person Reporting Contamination (if other than Regional Staff)

Name:	Telephone No.:
Address:	

Contamination Details

Location:

Description of Work Being Performed:

Type of Contamination: (i.e. septic, toxic substance)

Approximate Quantity of Contamination:

Agencies Contacted:

Forward To: _____
(Immediate Supervisor)

Action Taken:

Comments:

Immediate Supervisor's Signature _____
Date _____

Forward to: _____
(Department Supervisor)

Action Taken:

Comments:

Submitted:
Personal Injury Report ☐
Spill Incident Report ☐
Emergency Response Report ☐
Notice of Contamination ☐

Dept. Supervisor's Signature _____
Date _____

Appendix D
Wastewater Section Injury Report

Staff Injured:

Name:	Date:	Time: a.m.☐ p.m.☐

Staff Reporting the Injury:

Name:	Telephone No.:
Address:	

Accident Details

Location:

Injury (i.e. broken bone, abrasion, etc.):

Actions Taken (First Aid Applied):

Forward To: _____
(Immediate Supervisor)

Action Taken:

Comments:

Immediate Supervisor's Signature _____
Date

Forward to: _____
(Department Supervisor)

Action Taken:

Comments:

Submitted:
Personal Injury Report ☐
Spill Incident Report ☐
Emergency Response Report ☐
Notice of Contamination ☐

Dept. Supervisor's Signature _____
Date _____

APPENDIX C

EMERGENCY CONTACT LIST

EMERGENCY CONTACT LIST

District of Summerland

	Office	Cell
Municipal Hall	250-494-6451	
Engineering and Public Works	250-494-0431	
Devon van der Meulen	250-404-4075	250-462-0493
Shawn Goodsell	250-404-4082	250-485-6216
Ryan Cleverdon	250-494-0619	250-490-7242
Kendell Wilson	250-494-0619	250-809-7924
Jason Wright	250-494-0619	250-488-2244
Matthew Perdue	250-494-0619	250-809-7986
WWTP EMERGENCY CELL PHONE		**250-809-7141**
ENGINEERING AND PUBLIC WORKS (After Hours)		**250-493-0005**

Electrical Services

Centrix	250-717-8813	
Electrical Utility Division	250-494-0431	
EMERGENCY (After Hours)		**250-490-6818**

FIRE DEPARTMENT

Fire Hall	250-494-7211	
Rob Robinson (FC)	250-494-7211	250-404-4088
Dispatch (24 hr)	250-490-2305	
EMERGENCY	**911**	

POLICE DEPARTMENT

RCMP Non-Emergency	250-494-7416
EMERGENCY	**911**

MINISTRY OF ENVIRONMENT

EMERGENCY	**1-800-663-3456**

Hazardous Spills

Dangerous Goods – Spills	1-800-663-3456

CHEMICAL SUPPLIERS

Cleartech	1-800-387-7503
Alumichem	1-888-921-3317
EMERGENCY	**306-664-2522**

WORKSAFE BC

EMERGENCY	**604-273-7711**

SLUDGE HAULING

Dick's Septic Service	250-494-9864
Superior Septic Services	250-493-1865

APPENDIX D

ODOUR INVESTIGATION & COMPLAINT FORM

District of Summerland
Odor Questionnaire Form

Questionnaire Form

Location: _____

Person: _____ Phone: _____

Address: _____

Date: _____ Time: _____

Concerns: _____

Strength of Odor

- ☐ Undetectable
- ☐ Slight
- ☐ Definite
- ☐ Strong
- ☐ Intense

Description of Odor

- ☐ Ammonia
- ☐ Decayed Cabbage
- ☐ Fecal
- ☐ Fishy
- ☐ Garlic
- ☐ Medicinal
- ☐ Rotten Egg
- ☐ Skunk
- ☐ Other_____

Wind Direction

- ☐ North
- ☐ South
- ☐ East
- ☐ West
- ☐ None

Wind Velocity

- ☐ Calm
- ☐ Mild Breeze
- ☐ Gusty
- ☐ Strong
- ☐ Very Strong

Participants Comments: _____

_____

_____

_____

_____

_____

_____

Investigator Information

Name of Investigator: _____

Date of Investigation: _____ Time of Investigation: _____

Investigators Comments: _____

_____

_____

_____

_____

Reviewed by: _____ Date: _____

APPENDIX E

SANITARY SEWER SYSTEM REGULATION BYLAW

THE CORPORATION OF THE DISTRICT OF SUMMERLAND

BYLAW NUMBER 98-002

SANITARY SEWER SYSTEM REGULATION BYLAW

WHEREAS it is expedient that all real property that has shared in sewer extension costs and is capable of being served by a sanitary sewer, should so be served and connected;

AND WHEREAS there are possible components of sewage in various concentrations which are detrimental or costly to the operation and maintenance of the sanitary sewage system and must be prohibited;

AND WHEREAS it is deemed necessary and expedient to regulate the operation and use of the sanitary sewer system of the District;

AND WHEREAS pursuant to Section 574 of the Municipal Act, being Chapter 323 of the R.S.B.C.1996 and amendments thereto, the Municipal Council may by bylaw provide for the establishment of a system of sanitary sewer works and regulate the design of said works by persons other than the municipality and require connection to said works;

NOW THEREFORE, the Municipal Council of the district of Summerland, in Open Meeting Assembled, enacts as follows:

SECTION

1.0 TITLE

1.1 This bylaw may be cited as "District of Summerland Sewer Regulation Bylaw Number 98-002.

2.0 APPLICABILITY

2.1 This bylaw applies to all lands shown in Schedule "A" attached to Bylaw Number 95-014.

3.0 SEVERABILITY

3.1 If any section, subsection, clauses, sub-clause or phrase of this bylaw is for any reason held to be invalid by the decision of any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions of this bylaw.

4.0 SANITARY SEWER SYSTEM REGULATIONS

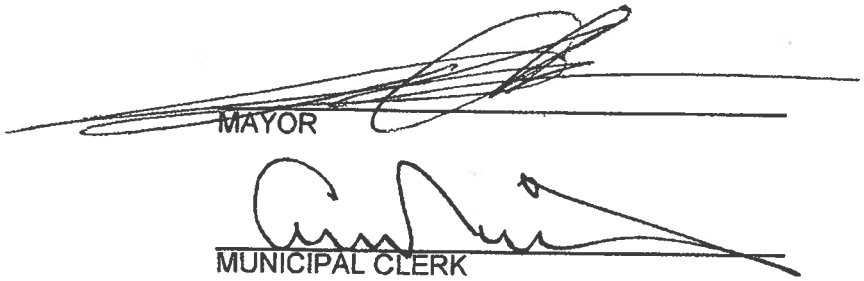
4.1 This section provides for the regulation and use of sanitary sewers for all properties that have shared in sewer extension costs and are capable of being served by a sanitary sewer system.

5.0 FORCE AND EFFECT

5.1 This bylaw shall come into force and effect on the date of its adoption by the Municipal Council of the Corporation of the District of Summerland.

READ A FIRST, SECOND AND THIRD TIMES by the Municipal Council this 22nd day of June, 1998.

RECONSIDERED, FINALLY PASSED AND ADOPTED BY THE MUNICIPAL COUNCIL OF THE CORPORATION OF THE DISTRICT OF SUMMERLAND THIS 13th DAY OF JULY, 1998.



MAYOR

MUNICIPAL CLERK

SECTION 1 - ADMINISTRATION AND GENERAL REQUIREMENTS

1.1 SCOPE

1.1.1 This section provides for the regulation and use of sanitary sewers .

1.1.2 The provisions of this section shall apply to all direct or indirect discharges to any part of the public sanitary sewerage system.

1.1.3 This section, among other things, regulates the quantity and quality of discharged wastes and the degree of pre-treatment required; and provides for the approval of plans for waste treatment.

1.1.4 Nothing in this section relieves any person or organization from complying with any provision of any Federal or Provincial legislation, or any other bylaw of the District of Summerland.

1.2 DEFINITIONS

1.2.1 In this section, unless the context otherwise requires, the following words and terms shall have the meanings hereinafter assigned to them:

B.O.D. or "biochemical oxygen demand" means the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory conditions in five (5) days at 20°C, expressed in milligrams per litre as determined by the appropriate procedure in "Standard Methods".

Building Drain means the horizontal piping, including any vertical offset that conducts sewage, or clear water waste to a building sewer.

Building Inspector means the District's Building Inspector as appointed by resolution of the Municipal Council or his duly appointed representative.

Building Sewer (also called a "service connection")means a pipe that is connected to a building drain one (1) metre outside a wall of a building and that leads to a public sewer (sewer connection) or a private sewage disposal system.

District Engineer means the District's Engineer as appointed by resolution of the Municipal Council or his duly appointed representative. The range of authority of the District Engineer is intended to be, but not limited to, items involving Capital Works and expenditures, sewer infrastructure integrity and when other bylaws are involved.

C.O.D. or "chemical oxygen demand" means the measure of the oxygen consuming capacity of inorganic and organic matter present in domestic or industrial wastewater as determined by the appropriate procedure described in "Standard Methods".

Cooling Water means untreated water originating from heat exchangers or similar type units.

Director of Works & Utilities means the person appointed by the Municipal Council as the head of the District's Works & Utilities Department and includes employees of the Works & Utilities Department of the District when acting under the direction of the Director of Works & Utilities.

Domestic means resulting from natural processes and not produced by commercial or industrial activities.

Domestic Wastewater means the water carried wastes produced from non-commercial or non-industrial activities and which result from normal human living processes.

Effluent means the liquid outflow of any facility designed to treat or convey wastewater.

Flammable liquid means any liquid having a flash point below 38°C and having a vapour pressure not exceeding 280 kPa at 38°C.

Garbage means solid wastes from domestic and commercial preparation, cooking, and dispensing of food, and from the handling, storage and sale of produce.

Grab Sample means an aliquot of a sampled stream or discharge collected at one particular time and place.

Grease means an organic substance recoverable by procedures set forth in "Standard Methods" and includes but is not limited to hydrocarbons, esters, fats, oils, waxes and high molecular carboxylic acids.

Industrial wastewater means all water carried wastes and waste-water excluding domestic wastewater and uncontaminated water, and includes all wastewater from any processing, institutional, commercial, or other operation where the wastewater discharged includes wastes of non-human origin.

Municipal/Municipality means the District of Summerland.

Municipal Council means the duly elected Officials of the District of Summerland.

Offal means waste portions of food, animals, fowl or fish.

One-operating-day Composite Sample (one day sample) means a composite sample discharge consisting of flow proportioned samples collected at consecutive one-hour intervals over the duration of one operating day as outlined in Schedule "E", attached to and forming part of this bylaw.

Person includes any person, a corporation, partnership or party, and the personal or other legal representative of a person to whom the context can apply according to law.

Pesticide means an organism or material that is represented, sold, used or intended to be used to prevent, destroy, repel or mitigate a pest and includes:

(a) a plant growth regulator, plant defoliator or plant desiccant; and

(b) a control product, other than a device that is a control product under the Pest Control Products Act (Canada).

pH means logarithm, to the base 10, of the reciprocal of the concentration of Hydrogen ions in moles per litre of solution.

Plumbing Code means any regulation made by the Lieutenant Governor of the Province of British Columbia, in accordance with Section 692 of the Municipal Act.

Plumbing fixture means a receptacle, appliance, apparatus or other device that discharges sewage or clear-water waste, and includes a floor drain.

Regional District means the Regional District of Okanagan Similkameen.

Sanitary Sewer Specified Area means an area of land within the District, defined by bylaw adopted by the Municipal Council, which is designated to receive works or service from the municipality.

Sanitary Sewer System means all sewer works and all appurtenances thereto, including sewer mains, connections, pumping stations, treatment plants, lagoons and sewer outfalls laid within any highways, municipal right-of-way or easement and owned and operated by the Municipality and installed for the purpose of conveying, treating and disposing of domestic municipal wastes and industrial wastes.

Septic Tank means any device or structure designed for the temporary storage of wastewater.

Service Connection (also called "Building Sewer") means a pipe connecting a building drain to a sanitary sewer connection at the property line or to a private sewage disposal system.

Sewer means a pipe, including manholes and other appurtenances other than a service connection, in the sewer system.

Sewer Connection means a sewer pipe extending from a public sanitary sewer to the property line of the property being served or to be served or to a Statutory Right of Way or easement in favour of the property to be served.

Special Waste means a substance that is defined as "Special Waste" as interpreted by the Waste Management Act.

Standard Methods means the Standard Methods of Water and Wastewater Analysis (19th Edition, 1995, or current edition at the time of testing) as published by the American Public Health Association, the American Water Works Association, the Canadian Standards Association, and the Water Pollution Control Federation.

Total Suspended Solids means the solid matter according to particle size, expressed in milligrams per litre, in a liquid as determined according to "Standard Methods".

Two-Hour Composite Sample means a composite sample consisting of equal portions of 8 Grab Samples collected at consecutive 15-minute intervals.

Uncontaminated Wastewater means water such as spent cooling water, de-chlorinated water discharged from a swimming pool, water used in street cleaning.

Wastewater means the water-borne wastes of the municipality derived from human or industrial sources including domestic wastewater and industrial wastewater, but does not include rain water, ground water, or drainage of uncontaminated water.

Wastewater treatment plant means any arrangement of devices and structures used for treating wastewater.

Watercourse means:

(i) the bed and shore of a river, stream, lake, creek, lagoon, swamp, marsh or other natural body of water; or

(ii) a channel, ditch, reservoir or other man-made surface feature;

whether they contain or convey water continuously or intermittently.

1.3 CONNECTION REQUIREMENT

1.3.1 The owner of every parcel of real property within a Sanitary Sewer Specified Area, for which a service connection to the sanitary sewer system can be, or has been made, and upon which a building or structure containing a plumbing fixture is situate, shall connect such building or structure to the service connection.

1.3.2 In the event of any owner failing to make the required connection within sixty (60) days of being notified in writing by the District to do so, the Director of Works & Utilities may order the required connection be made by District workmen or others at the Owner's expense and the expenses incurred shall become a lien on the land or real property on or for which the charge is imposed, done or provided and the District may recover the expenses in a similar manner to municipal taxes and the expenses shall be subject to the same penalty and interest additions as municipal taxes.

1.3.3 The Director of Works & Utilities may allow any owner of real property outside of an existing Sanitary Sewer Specified Area to connect into the existing sanitary sewer system on the basis of the following:

(a) the owner paying all costs of extending the District's sanitary sewer system including sewer development charges;

(b) the owner paying a share of an existing or future proposed specified area cost including administration and bylaw amendment costs. In either case, approval must be granted by Municipal Council.

1.4 APPLICATION FOR SANITARY SEWER CONNECTION

1.4.1 (a) No person shall connect any building sewer or storm building sewer to the sanitary sewer system until he has completed an application and an agreement in the form of Schedule "4.A" of this bylaw and paid the connection fee as applicable. The applicant shall, in completing such form of application and agreement, provide true and accurate information as to all details called for therein.

(b) The applicant or an agent on his behalf must also obtain a plumbing permit and pay a sewer development charge unless such charge has been collected under the Development Cost Charge Bylaw requirements.

1.5 SEWER CONNECTIONS STANDARDS

1.5.1 Every sewer connection shall be installed in accordance with the standards contained in the District's Subdivision and Development Bylaw, as amended or revised and shall be installed prior to the installation of every building sewer . The District shall not be responsible to meet the elevation or connect to an existing building sewer installed by the owner prior to installation of the sewer connection. Building owners shall be required to meet the sewer connection elevation.

1.6 BUILDING SEWER (Service Connection) AND INSPECTION

1.6.1 Every building sewer shall be constructed at the cost of the owner in accordance with the standards contained in the District's Subdivision and Development Bylaw as amended or revised, and to the requirements of the British Columbia Plumbing Code. The Director of Works & Utilities may require conformity with the District's Subdivision and Development Bylaw in the case of differing standards relative to the B.C. Plumbing Code or unique site or special situations.

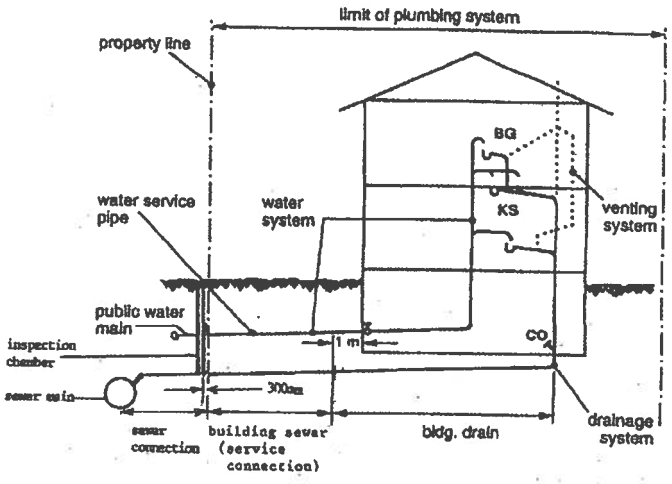
1.6.2 The owner shall notify the District's Building Inspector as soon as the work for which a connection permit has been issued is ready for inspection and no building sewer work shall be covered until it has been inspected and approved.

1.6.3 If upon inspection it is determined that any building sewer work is defective, or that such work was not ready for inspection after notification as required by Article 1.6.2, the owner shall file a further Notice of Inspection, together with the required fee to cover the cost of such extra inspection.

1.6.4 The building sewer shall be repaired and maintained by the property owner or occupant at their expense.

1.6.5 Where any building sewer is abandoned, the owner or occupant shall notify the District's Building Inspector, and, upon receiving proper authorization, the owner or occupant shall block and/or seal the service connection. The service connection shall be blocked at the property line, or at the sewer main, as specified by the Director of Works & Utilities, and the costs of such work shall be borne by the property owner or occupant.

1.6.6 **Plumbing System**



1.7 **INTERFERENCE WITH SANITARY SEWER SYSTEM**

1.7.1 No person shall do any work upon, or interfere in any way with the sanitary sewer system without the written permission of the Director of Works & Utilities.

1.7.2 No person shall enter or work upon the sewer system without meeting the applicable confined space entry, street regulations or other safety requirements, required by the Workers' Compensation Act, being Chapter 437 of the R.S.B.C. 1979 and amendments thereto.

1.8 **SANITARY SEWER RATES**

1.8.1 All sanitary sewer rates and charges are levied and administered by the District's Fees and Charges Bylaw.

1.9 **SEPTIC TANKS-HOLDING TANKS-R.V. DUMPING OUTLET**

1.9.1 No septic tank shall be connected to the sanitary sewer system without the express written approval of the Director of Works & Utilities or the District's Building Inspector.

1.9.2 No person shall permit any sludge or deposit contained in any septic tank, holding tank or sewage field to enter into the sanitary sewer system. With the approval of the Director of Works and Utilities all sludge or septic tank deposits shall be disposed of at the District's disposal facility located at the District's sanitary landfill.

1.9.3 All existing septic tanks and holding tanks must be pumped out, removed or filled with clean sand or gravel within thirty (30) days after completion of the installation and final inspection of the sanitary sewer connection.

1.9.4 No person shall install a Recreation Vehicle dumping outlet on a residential lot sewer service line entering into the sanitary sewer system.

1.10 RIGHT OF ENTRY

1.10.1 The Director of Works & Utilities or the Building Inspector and anyone authorized by them are hereby authorized to enter upon any property or premises at any reasonable time in order to ascertain whether or not the regulations contained in this bylaw have been complied with.

10.2 Any person interfering with or obstructing the entry of the Director of Works & Utilities or the Building Inspector or their duly authorized representative into any premises, after that person has identified himself, shall be guilty of an offense under this bylaw and shall be liable to the penalties provided herein.

1.10.3 No person shall hinder or prevent the Director of Works & Utilities or the Building Inspector or their duly authorized representative from entering and making reasonable inspection of any building or premises whenever necessary to secure compliance with, or prevent a violation of any provisions of this bylaw.

SECTION 2 - WASTE DISCHARGE

2.1 PROHIBITED WASTES

2.1.1 No person shall discharge or permit to be discharged into any pipe, main, conduit, manhole, street inlet, gutter or aperture draining into the sanitary sewer system system:

(a) Any gasoline, benzene, naphtha, alcohol, fuel, oil, solvents, acetone or flammable or explosive liquid, solid or gas.

(b) Any pesticides, insecticides, herbicides or fungicides save and except chemicals contained in storm water emanating from trees or vegetation treated in accordance with the Pesticide Control Act, R.S.B.C., 1979 C. 322 and regulations.

(c) Any corrosive, noxious or malodorous gas, liquid, or substance which either singly or by interaction with other wastes, is capable of:

(i) creating a public nuisance or hazard to life;

(ii) preventing human entry into a sewer or pump station; or

(iii) causing damage to the sewerage system.

(d) Radioactive material - except within such limits as are permitted by license issued by the Atomic Energy Control Board of Canada.

(e) Any material from a cesspool.

(f) Any solid or viscous substance capable of obstructing wastewater flow or interfering with the operation of the sewerage system or treatment facilities. These substances include but are not limited to ashes, cinders, grit sand, mud, straw, grass clippings, insoluble shavings, metal, glass, rags, feathers, tar, asphalt, creosote, plastics, wood, animal paunch contents, offal, blood, bones, meat trimmings and waste, fish or fowl head, shrimp, crab or clam shells, fish scales, entrails, lard, mushrooms, tallow, baking dough, chemical residues, cannery or wine waste, bulk solids, hair and fleshings, spent grain and hops, whole or ground food or beverage containers, garbage, paint residues, cat box litter, slurries of concrete, cement, lime or mortar.

(g) Any storm water or uncontaminated wastewater into the sanitary sewer system.

(h) Any waste, liquid or material classified as a 'Special Waste' pursuant to the provisions of the WASTE MANAGEMENT ACT, R.S.B.C., 1979, C. 428.5 and amendments thereto.

(i) Any material from a septic tank, holding tank or sewage disposal field, except sewage material taken from motor boats or recreational vehciles where the disposal facilities are located at public facilities such as service stations, Recreation Vehicle dealerships or marinas.

2.2 STANDARDS FOR RESTRICTED WASTES

2.2.1 Sanitary Sewer System

No person shall discharge or permit to be discharged into any pipe, main, conduit, manhole, street inlet, gutter, or aperture draining into the sanitary sewer system:

(a) any non-domestic waste having a B.O.D. in excess of 500 milligrams per litre as analyzed in a one-operating day Composite Sample, 1000 milligrams per litre as analyzed in a 2-hour Composite Sample, and 2000 milligrams per litre as analyzed in a Grab Sample;

(b) any non-domestic waste having a C.O.D. in excess of 750 milligrams per litre as analyzed in a one-operating-day Composite sample, 1500 milligrams per litre as analyzed in a 2-hour Composite sample, and 3000 milligrams per litre as analyzed in a Grab sample.

(c) any non-domestic waste which contains suspended solids in a concentration that is in excess of 600 milligrams per litre as analyzed in a one-operating-day Composite Sample, 1200 milligrams per litre as analyzed in a 2-hour Composite Sample, and 2400 milligrams per litre as analyzed in a Grab Sample;

(d) any garbage that has been ground, comminuted or shredded by a garbage disposal unit;

(e) any non-domestic liquid or vapour having a temperature higher than 65° Celsius;

(f) any non-domestic waste which contains oil and grease in a concentration that is in excess of 150 milligrams per litre as analyzed in a

a one-operating day Composite Sample, 300 milligrams per litre as analyzed in a 2-hour Composite Sample, and 600 milligrams per litre as analyzed in a Grab Sample, and any non-domestic waste which contains oil and grease derived from a petroleum source in a concentration that is in excess of 15 milligrams per litre as analyzed in a one-operating-day Composite Sample, 30 milligrams per litre as analyzed in a 2-hour Composite Sample, and 60 milligrams per litre as analyzed in a Grab Sample;

(g) any substance which may solidify or become viscous at temperatures above 0° Celsius;

(h) any non-domestic waste which has a pH lower than 5.0 or higher than 11.0 as determined by a Grab Sample of the discharge, or less than 5.5 or higher than 10.5 as determined by a two-hour Composite Sample.

(i) any water or waste that will by itself or with other water or wastes in the sewerage system, release noxious gases, or create any other condition deleterious to the pipe, gaskets, structures or treatment processes;

(j) any water or waste containing dyes or colouring materials which pass through a sewage works and discolour the sewage works effluent, with the exception of dyes used by the District for testing purposes;

(k) any water or waste containing a hazardous or a toxic or poisonous substance in sufficient quantity to injure or interfere with any sewer, sewage treatment equipment and sewage treatment process, to constitute a hazard to humans or animals, or to create any hazard in the receiving waters or the effluent of the sewage treatment plant.

(l) any material which exerts or causes:
  (i) unusual concentrations of inert suspended solids, such as, but not limited to, fuller's earth;

  (ii) unusual concentrations of dissolved solids such as but not limited to sodium chloride, calcium chloride or sodium sulphate;

(m) any water or waste added for the purpose of diluting wastes which would otherwise exceed applicable maximum concentrations;

(n) any non-domestic waste which, at the point of discharge into a sewer, contains any substance, in a combined or uncombined form, with a concentration in excess of the levels set out below. All concentrations are expressed as total concentrations, which include both the dissolved and undissolved substances.

Substance	Expressed as	Concentration in milligrams per litre		
		One Day Composite Sample	Two Hour Composite Sample	Grab Sample
Aluminum	A1	50.0	100.0	200.0
Arsenic	As	1.0	2.0	4.0
Boron	B	50.0	100.0	200.0
Cadmium	Cd	0.2	0.4	0.8
Chromium	Cr	4.0	8.0	16.0
Cobalt	Co	5.0	10.0	20.0
Copper	Cu	2.0	4.0	8.0
Cyanide	Cn	1.0	2.0	4.0
Iron	Fe	10.0	20.0	40.0
Lead	Pb	1.0	2.0	4.0
Manganese	Mn	5.0	10.0	20.0
Mercury	Hg	0.05	0.1	0.2
Molybdenum	Mo	1.0	2.0	4.0
Nickel	Ni	2.0	4.0	8.0
Phenols	-	1.0	2.0	4.0
Phosphorus	P	12.5	25.0	50.0
Silver	Ag	1.0	2.0	4.0
Sulphate	SO^4	1500.0	3000.0	6000.0
Sulphide	S	1.0	2.0	4.0
Tin	Sn	5.0	10.0	20.0
Zinc	Zn	3.0	6.0	12.0

Note: More restrictive guidelines may be required by the Director of Works & Utilities if he considers there is some detrimental effect on the District's treatment plant, infrastructure or workmen.

(o) any water or waste containing substances in such concentrations that are not amenable to treatment or reduction by the sewage treatment process employed, or are amenable to treatment only to such a degree that the sewage treatment plant effluent cannot, during normal operation, meet the requirement of any other agency having jurisdiction over discharges to the receiving waters.

(p) any material or substance (e.g. enzymes and/or bacteria) that alters the structure of the waste(s) but does not reduce the loading (C.O.D.).

2.3 ACCIDENTAL DISCHARGES

2.3.1 Every person responsible for, or aware of, the accidental discharge of prohibited substances into the sanitary sewer system shall report the same forthwith to the Director of Works & Utilities in order that the necessary precautions can be taken to minimize the deleterious effects of the discharge.

SECTION 3 - ADDITIONAL REQUIREMENTS FOR CONNECTION TO THE SANITARY SEWER SYSTEM

3.1 WASTEWATER TREATMENT FACILITIES

3.1.1 Any industrial wastewaters likely to damage or increase maintenance costs on the sewer system or which may detrimentally affect the sewage treatment plant; or contaminate surface or sub-surface waters, shall be pre-treated to render them innocuous prior to discharge into a public sewer.

3.1.2 Discharges of liquid wastes exceeding the strength, nature, quantity or quality permitted by this bylaw, shall be pre-treated in a facility designed, constructed and operated by the discharger so as to fulfill all of the requirements of this bylaw. The Director of Works & Utilities may waive this requirement in lieu of surcharge billings for waste discharge with issuance of Waste Discharge Permits and the payment of the fees as outlined in Schedule "4.B", attached to and forming part of this bylaw.

3.1.3 All details pertaining to the treatment process or processes, capacity, location, materials, equipment, methods of construction and all operational procedures and methods of process control of treatment facilities shall be approved by the Director of Works & Utilities before any portion of such facilities is installed. The approval of such plans and devices shall not imply that the treatment process or processes will comply with the regulations and/or restrictions contained in this bylaw.

3.1.4 All wastewater treatment facilities must be kept clear of obstructions so as to provide immediate access for inspection and servicing.

3.2 DESIGN REQUIREMENTS FOR NON-RESIDENTIAL USES CONNECTING TO THE SANITARY SEWERAGE SYSTEM

3.2.1 Where an owner or occupier of premises upon which an industrial or commercial activity is proposed or is carried on wishes to connect these premises to the sewerage system he shall comply with Article 3.2.3 herein.

3.2.2 Where an owner or occupier intends to expand an industrial or commercial activity so that the quantity, biochemical oxygen demand, chemical oxygen demand, suspended solids concentration or grease concentration of the sewage will be increased, he shall comply with Article 3.2.3 herein.

3.2.3 Except as provided in Article 3.2.4, the owner shall supply to the Director of Works & Utilities plans and reports certified by a professional engineer registered in the Province of British Columbia indicating:

(a) the proposed or existing development or addition, including flow schematic drawing,

(b) the daily volumes and peak discharges,

(c) the type of waste to be processed or discharged,

(d) the anticipated biochemical oxygen demand and the amount of suspended solids or grease,

(e) the pH factor and temperature of the wastewater,

(f) toxic chemicals contained in the wastewater,

(g) the proposed pre-treatment, including dimensions of the proposed facility,

(h) flow equalizing or mixing facilities,

(i) the location of sampling manhole,

(j) the monitoring equipment,

(k) any other information deemed necessary by the Director of Works & Utilities.

3.2.4 The Director of Works & Utilities may deal with the application and make a decision thereon without the above information if in his opinion the nature of the application is such that a decision can be properly made without such information.

3.2.5 Grease and oil interceptors shall be installed as close to the source of the material as practical and provided upstream of the service connection on private property for all food preparation facilities including restaurants, canning operations, killing and processing facilities. Such interceptors shall be so located as to be readily and easily accessible for cleaning and inspection. All interceptors shall be maintained by the owner at his expense in continuously efficient operation such that all provisions of this bylaw are complied with at all times.

3.2.6 Grease, oil and sand interceptors shall be installed as close to the source of the material as practical and provided upstream of the service connection on private property for all vehicle repair and maintenance establishments and service stations. Interceptors will be required for other types of industries or commercial establishments as appropriate for the proper handling of liquid waste containing grease in excessive amounts or any flammable wastes, sand, grit or other harmful ingredients. Such interceptors shall be so located as to be readily and easily accessible for cleaning and inspection. All interceptors shall be maintained by the owner at his expense in continuously efficient operation at all times. These types of building services shall be connected to the sanitary sewer where available.

3.2.7 Separate sand traps and oil and grease interceptors shall be provided upstream of the service connection on private property for all establishments which provide car, vehicle, or equipment washing facilities. Sand traps shall be located upstream from the oil and grease interceptors, and shall have a minimum liquid depth of 1 metre and a maximum overflow rate of 8 L/m/m_2 under peak flow conditions. Sand and silt shall be removed from sand traps before these materials occupy 25 percent of the liquid depth. Accumulated oil and grease shall be skimmed off the surface of the interceptors and other sumps often enough to prevent these materials from escaping to the sewer.

3.3 VOLUME CONTROL

3.3.1 Where wastewater is discharged into the sewerage system in volumes which are highly variable or unusual, the owner or occupier shall ensure that discharges do not exceed the limits established by the Director of Works & Utilities. The owner or occupier of the premises shall take such measures, as required by the Director of Works & Utilities, to equalize the discharge volumes and strengths.

3.3.2 Equipment necessary to comply with clause 3.3.1 shall be provided, maintained and operated by the owner or occupier of such premises in a manner satisfactory to the Director of Works & Utilities.

SECTION 4 - CONTROL OF INDUSTRIAL WASTES

4.1 SPECIAL CONTROL MANHOLES

4.1.1 Any property owner or occupier discharging or likely to discharge wastewater to the public sewer which may exceed the STANDARDS FOR RESTRICTED WASTES, as deemed by the Director of Works & Utilities, shall have installed a control manhole at an accessible location and suitable for the inspection and sampling of the discharged waters.

4.1.2 The design and location of the control manhole shall be approved by the Director of Works & Utilities. Construction shall comply with the approved design.

4.1.3 The control manhole shall be installed and maintained at the sole expense of the owner of the premises and shall be accessible at all times to the District's Inspector.

4.1.4 All industrial wastewater discharged to public sewers shall first pass through the control manholes.

4.1.5 The control manhole shall conform with the District's standard sewer manhole STD-200 except that the barrel diameter shall be 1200 mm instead of 1050 mm. The standard cast iron frame and cover will be acceptable.

The control manhole shall be located on a straight run of service extending from 3 metres upstream of the manhole to 2 metres downstream. The section of service on which the manhole is located shall have a gradient not exceeding 2 percent.

A permanent style Palmer Bowlus flume flow meter shall be installed as an integral part of the control manhole, and shall be sized to suit the peak design flows.

4.1.6 Where installation of a control manhole is not possible, an alternative device or facility may be substituted for approval by the Director of Works & Utilities.

4.2 MONITORING OF WASTEWATER

4.2.1 Should any testing of wastewater show that it is not in compliance with this bylaw, the Director of Works & Utilities, in addition to any other provision of this bylaw may direct the owner to so comply with the bylaw and may, in addition, direct the owner at his expense to install such monitoring and recording equipment as the Director of Works & Utilities deems necessary and supply the results of such monitoring to the Director of Works & Utilities, as required.

4.2.2 All tests, measurements, analyses and examinations of wastewater, its characteristics or contents shall be carried out in accordance with "Standard Methods." Initial testing shall be arranged and paid for by the discharger. Additional testing or re-testing of wastewater, made necessary by non-compliance with this bylaw, or at the request of the Director of Works & Utilities, shall be carried out at the cost of the discharger.

4.2.3 Sampling shall be carried out by methods acceptable to the Director of Works & Utilities. Normally the analyses will be performed on samples composited by volume as per Schedule "4.E" attached to and forming part of this bylaw. Values for pH will be determined from samples composited over a short period of time.

4.3 CONTROL OF WASTE DISPOSAL

4.3.1 The Director of Works & Utilities may at any time require a person who intends to dispose of wastes of liquid, semi-liquid or solid nature to show proof that these wastes are being stored and subsequently disposed of in a place and

manner which is acceptable to the Director of Works & Utilities the information must also include method of packaging, storing and transporting of the waste.

4.3.2 The Director of Works & Utilities may require a person to provide an analysis, prepared by a qualified chemist, of the waste referred to in Article 4.3.1.

SECTION 5 PROTECTION OF PUBLIC SANITARY SEWER SYSTEM

5.1 DISCONNECTION OF SANITARY SEWER

5.1.1 Where any wastewater which:

(a) creates an immediate danger to any person, or

(b) endangers or interferes with the operation of the sewerage system discharged to the sewer system.

The Director of Works & Utilities may, in addition to any action provided for in this bylaw, disconnect, plug or seal off the sewer line discharging the unacceptable wastewater into the sewer system or take such other action as is necessary to prevent such wastewater from entering the sewerage system.

In addition or as an alternate action, the Director of Works & Utilities may order the shut-off of water service to the subject property.

5.1.2 The unacceptable wastewater described in article 5.1.1 may be physically prevented from being discharged into the sewer system until evidence satisfactory to the Director of Works & Utilities has been produced to ensure that no further discharge of hazardous wastewater will be made to the sewer system.

5.1.3 The owner or occupier of the land from which the wastewater, described in Article 5.1.2 herein, is being discharged shall pay the costs incurred by the District in taking all necessary action relative to the sewer disconnection and/or re-connection.

5.1.4 The costs incurred in Article 5.1.3 shall be in addition to and not in substitution for any fine or other penalty to which the owner or occupier of the premises in question may be subject pursuant to the provisions of this bylaw.

5.1.5 The sewer or drain shall not be reconnected until the costs in Article 5.1.3 are paid.

5.2 RECOVERY OF COSTS FOR DAMAGE TO THE PUBLIC SANITARY SEWER SYSTEM

5.2.1 Where any person contravenes any provision of this bylaw and thereby causes damage to the sewer system, such person shall be liable to the District for all costs incurred in making repairs or taking remedial action.

5.2.2 If such costs are not paid forthwith after demand, the District may recover the same by action in any court of competent jurisdiction.

SECTION 6 - PENALTIES

6.1 PENALTIES

6.1.1 Every person who violates any of the provisions of this bylaw or who suffers or permits any act or thing to be done in contravention of or in violation of any of the provisions of this bylaw or who neglects to do or refrains from doing anything required to be done pursuant to any of the provisions of this bylaw, or who does any act which violates any of the provisions of this bylaw shall be guilty of an offence and each day during which such violation occurs or is allowed to continue shall constitute a separate offence.

6.1.2 Every person guilty of an offence against this bylaw shall be liable under summary conviction to a penalty of up to $2,000.00 for each offence.

SECTION 7 - MASCULINE/SINGULAR

7.1 Wherever the masculine is used throughout this bylaw, it shall also mean the feminine; and wherever the singular is used throughout this bylaw, it shall also mean the plural.

SCHEDULE 4.A

APPLICATION FOR SANITARY SEWER

Job #_____

THE DISTRICT OF SUMMERLAND
UTILITY SERVICE REQUEST FORM

Date: _____ Roll Number: _____

Name: _____ Phone Number: _____
Full Name of Owner(s)

Mailing Address: _____
Street or Box Number

_____
City Province Postal Code

Legal Description of Property: Lot(s): _____ Block: _____ District Lot: _____ Plan Number: _____

Street Address: _____ Phone Number: _____

Type of Development: _____

REQUESTED SERVICES

Sanitary Sewer	☐	Driveway access *	☐	Electrical: New	☐
Domestic Water	☐	Other _____	☐	Service Change	☐
				Amperage	☐
				Voltage	☐

* A sketch plan showing the driveway design, location and associated grades must be provided with this type of requested service as per Bylaw 92-047.

☐ Check here if there is a preferred location for any of the other requested services other than a driveway access. (If checked, a map or sketch should be attached to this utility service request form which identifies the preferred location.)

OFFICE USE ONLY

Sanitary Sewer:	_____ Connection size	_____ Service line cost	_____ Main extension cost	Cost Estimate _____
Water:	_____ Connection size	_____ Service line cost	_____ Main extension cost	Cost Estimate _____
Electrical:	_____ Temporary service	_____ New service	_____ Electrical surcharge	Cost Estimate _____
Other:	_____			Cost Estimate _____
				Total Costs _____

Date _____ Amount Received _____ Signature _____

I/We agree to be governed by the bylaws of the Corporation of the District of Summerland relative to the above requested services. **Should the actual cost of service installation exceed the above noted cost estimates, the owner(s)/agent will be responsible for the balance owing.**

Signature of owner(s)/agent: _____ Date: _____

SCHEDULE "4.B"

SANITARY SEWER REGULATIONS

1. The Waste Discharge Permit fees required under this by-law shall be paid to the District of Summerland.

2. The holder of a validated "Temporary Waste Discharge Permit" (Schedule "4.C" attached to and forming part of this bylaw) or "Waste Discharge Permit" (Schedule "4.D" attached to and forming part of this bylaw) is required to notify the issuing authority when the discharge period has terminated. If the discharge needs to continue, then an application for a new "Temporary Waste Discharge Permit" or "Waste Discharge Permit" must be submitted together with the application fee.

3. Waste Discharge Permit Fees:

   3.1 A Waste Discharge Application Fee as established in the District's Fees and Charges Bylaw shall be paid upon application for a "Temporary Waste Discharge Permit" or "Waste Discharge Permit".

   3.2 For authorized discharges to the sanitary sewer there will be a surcharge to cover the costs of treatment, plus G.S.T. The surcharge is based upon flow and load.

   3.3 The surcharge for authorized discharge to the sanitary sewer shall be based on the District of Summerland Fees and Charges Bylaw and amendments thereto.

SCHEDULE "4.C"
Sanitary Sewer Regulations

Temporary Waste Discharge Permit Assessment/Application Form

Mailing Address: Director of Works & Utilities, Box 159, Summerland, B.C. V0H 1Z0
Phone: (250) 494-6451
FAX: (250) 494-1415

Date: _____

PLEASE ANSWER ALL QUESTIONS COMPLETELY. PRINT NEATLY OR TYPE.
NOTE THAT ADDITIONAL INFORMATION MAY BE REQUIRED.

1. Company Name: _____

2. Site Address: _____

3. Mailing Address: _____

4. Person to call regarding this form:

_____ _____ _____
Name Title Phone No.

5. Nature or type of business (brief description): _____

_____

_____

6. Estimate the average daily wastewater discharge:
To Sanitary Sewer _____ m^3/day No. of days _____
To Storm Sewer _____ m^3/day No. of days _____
How was this estimated? _____

_____

7. Surcharge Fee Calculation (if applicable):

_____ x _____ x _____ + $100 App Fee x 1.07 GST = _____ Total
m^3/day no. of days $/$m^3$

8. Expiration date or period of discharge, if applicable:

_____

9. Check (ü) the contaminants expected to be present in the discharge.

a)	¨	Acids	b)	¨	Aluminium
c)	¨	Ammonia	d)	¨	Boron
e)	¨	Arsenic	f)	¨	Cadmium

g)	"	Caustics & Bases	h)	"	Chromium
i)	"	Chemical Oxygen Demand	j)	"	Cobalt
k)	"	Cyanide	l)	"	Copper
m)	"	Five-day Biochemical Oxygen Demand	n)	"	Iron
o)	"	Fluoride	p)	"	Lead
q)	"	Fuels/Flammable	r)	"	Manganese
s)	"	Oil & Grease (Non-Petroleum)	t)	"	Mercury
u)	"	Oil & Grease (Petroleum)	v)	"	Molybdenum
w)	"	Organic Solvents	x)	"	Nickel
y)	"	Pesticides	z)	"	**Other** _____
aa)	"	Phenols (total)	bb)	"	Selenium
cc)	"	Phenols(chlorinated)	dd)	"	Silver
ee)	"	Sulphate	gg)	"	Tin
ff)					
hh)	"	Sulphide	*ii)*	"	Zinc

10. Attach concentrations and corresponding volumes of substances checked in Question 9.

11. Does your operation discharge Special Waste as defined under the Special Waste Regulation of the Waste Management Act of British Columbia?

a) " Yes " No " To be determined

I, _____

declare that the information given on this form is correct and accurate to the best of my knowledge.

_____ _____
Date Signature

Approved

_____ _____ _____
Paid by receipt No: Date Environmental Section

NOTE: Personal information collected on this form is collected for the purpose of processing this application and for administration and enforcement of the Sanitary Sewer Regulation Bylaw No. 97-006. The information is collected under the authority of Bylaw 97-006 and the Municipal Act. If you have any questions about this collection, please contact the Municipal Treasurer @ 1-250--494-6451.

SCHEDULE "4.D"

DISTRICT OF SUMMERLAND
WASTE DISCHARGE PERMIT

Under the provisions of the

District of Summerland

Sanitary Sewer Regulation Bylaw No. 98-002

hereinafter referred to as the Permittee,

is authorized to discharge Non-Domestic Waste to SANITARY SEWER

located at _____

This WASTE DISCHARGE PERMIT has been issued under

the terms and conditions, including definitions,

prescribed in the District of Summerland's

Sanitary Sewer Regulation Bylaw No. 98-002

hereinafter referred to as the BYLAW

and in the attached Appendices A, B, C, D and E for discharge sources

and works existing or planned on _____

This Appendix sets out the standard conditions, engineering units, and the requirements for emergency procedures.

A. STANDARD CONDITIONS

1. Except as otherwise provided in this WASTE DISCHARGE PERMIT, hereinafter referred to as the "Permit", all terms and conditions stipulated in the Bylaw shall apply to this Permit.

2. The terms and conditions of this Permit may be amended, by the Director of Works & Utilities pursuant to the Bylaw.

3. Definitions contained within Bylaw Number 98-002 apply to this Permit.

B. ENGINEERING UNITS

The engineering units specified in this Permit are in accordance with the Metric System of measure. Approximately equivalent values for the British System can be calculated using the following conversion factors:

IGPD	divided by	220	=	M3/day
IGPM	divided by	0.22	=	l/min
cfs	divided by	35.31	=	m3/s

ppm	divided by	1	=	mg/L
lb	divided by	2.205	=	kg

Where:

m^3	= cubic metres	IGPD	= Imperial gallons per day
L	= litres	IGPM	= imperial gallons per minute
mg	= milligrams	cfs	= cubic feet per second
kg	= kilograms	ppm	= parts per million
min	= minutes	lb	= pounds
s	= seconds		

C. MAINTENANCE AND OPERATION OF WORKS AND PROCEDURES

Pollution control works and procedures associated with maintaining the discharge criteria and/or the monitoring requirements specified in the Permit shall be employed at all times during the discharge of industrial/commercial wastes to sewer. All such works and procedures shall be inspected regularly and maintained in good working condition.

D. EMERGENCY PROCEDURES

In the event of an emergency or condition which prevents the continuing operation of any pollution control works or procedures designated by this Permit or results, or may result in a violation of any discharge criteria specified in this Permit, the Permittee shall notify the District of Summerland at 494-0431 regular hours or 493-0005 after hours at the first available opportunity, and shall undertake appropriate remedial action as soon as possible.

E. BY-PASSES

The discharge of wastes which by-pass any pollution control works or are not in accordance with procedures designated by the Permit is prohibited, unless prior approval of the Director of Works & Utilities is obtained and confirmed in writing.

F. DISCHARGE MONITORING

1. Additional discharge measurement, sampling, analysis and reporting shall be undertaken by the Permittee when required by the Director of Works & Utilities.

2. All sampling, measurements, tests and analyses of waste discharges shall be carried out in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, or an alternate method approved by the Director of Works & Utilities. Samples shall be analyzed by an independent agency at the expense of the discharger, unless other arrangements have been approved by the Director of Works & Utilities.

G. pH MONITORING

Enforcement of pH levels, as listed in Appendix C of this Permit, shall be based on GRAB SAMPLE. The Permittee should be aware that pH levels measured in a Composite Sample will provide an average pH of the waste stream and will not indicate

the total range of pH in the effluent. The Permittee is encouraged to doperiodic GRAB SAMPLE pH analyses to ensure permit compliance.

This Appendix sets out requirements for the monitoring of the discharge of Non-Domestic Waste from a _____. Any changes in method or location of monitoring must be authorized, in writing, by the Director of Works & Utilities.

A. DISCHARGE SAMPLING AND ANALYSES

The Permittee shall carry out the following sampling and analysis program, to commence on _____.

1. Continuous Discharges

(a) Effective _____, the Permittee shall measure or estimate, using an approved flow monitoring device or method, the daily discharge during each month of operation. The following information shall be recorded:

Total flow for the month (m3)
Number of operating days during the month
Average daily flow for the month (m3/day)
Maximum daily flow for the month (m3/day)

(b) One Composite Sample, in accordance with Schedule E of Bylaw No. 6618-90, shall be collected from Sample Point _____, as described in Appendix B, Section B, during one normal operating day once per _____. The Composite Sample shall consist of equal portions of discrete samples collected on a minimum frequency of _____ over the period of discharge to SEWER. This sample shall be analyzed for the following parameters:

_____

The sample start and stop times shall be recorded.

(c) The Discharge flow for the periods that the Composite Sample specified in Section _____ are collected shall be recorded.

(d) During the period that the Composite Sample described in Section _____ is taken, one GRAB SAMPLE shall be collected from Sample Point _____, as described in Appendix B, Section B. This GRAB SAMPLE shall be analyzed for the following parameters:

The sample date and time shall be recorded.

2. Batch Discharges

(a) The Permittee shall maintain a log of each batch discharge to SEWER. For each month of operation, the following information shall be reported for each batch discharge:

Type of batch discharge
Volume (m3)

Date on which discharging occurred

The discharge log shall be kept available for inspection for a minimum period of one year.

(b) _____ GRAB SAMPLE(s) shall be collected from one batch discharge from the Sample Point _____, as described in Appendix B, Section B, once per _____. This sample shall represent the quality of the total batch and shall be analyzed for the following parameters:

_____

The sampling dates and times shall be recorded.

(c) _____ GRAB SAMPLE(s) shall be collected from one batch discharge from the Sample Point _____, as described in Appendix B, Section B, once per _____. This sample shall represent the quality of the total batch and shall be analyzed for the following parameters:

_____

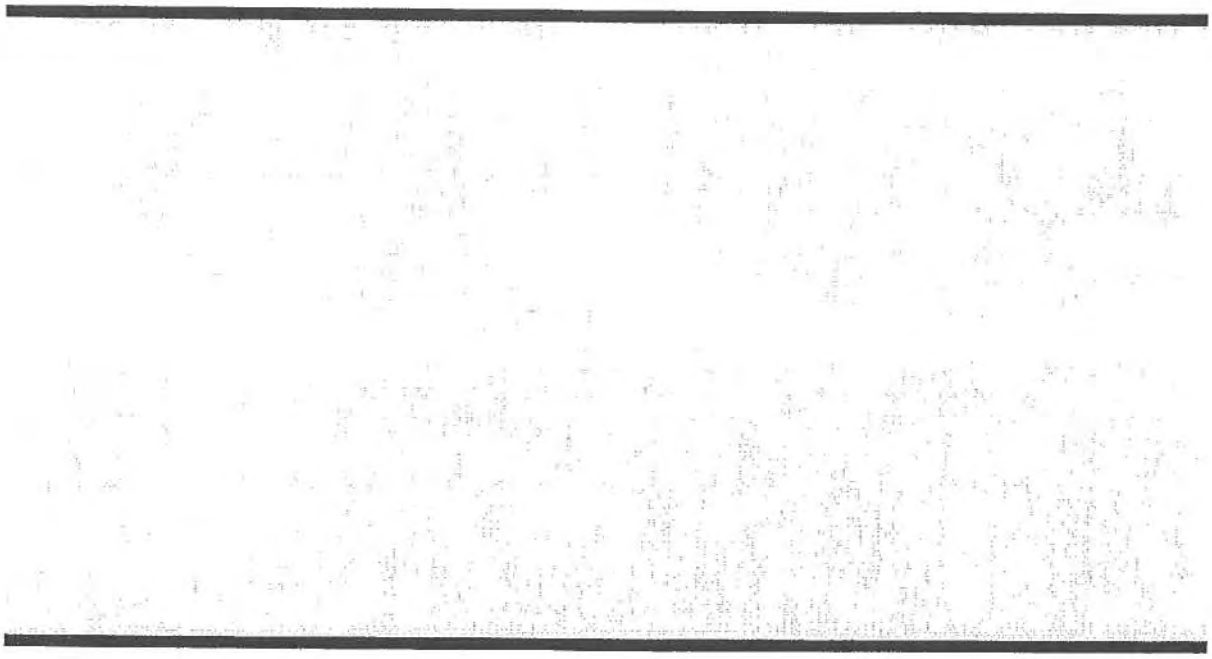
(d) The Discharger shall record the total volume of each batch discharge from which the samples specified in Sections _____ are collected.

B. LOCATION OF APPROVED SAMPLE POINTS

The approved sample points are as follows, and as shown on the attached schematic of approved sample points and treatment processes. Sample point _____ is considered to be the point of discharge to SEWER.

SAMPLE POINT NO.	DESCRIPTION
Sample Point 1	_____
Sample Point 2	_____

PHOTOGRAPH OF APPROVED SAMPLING POINT
SUPPLIED BY PERMITTEE



This Appendix sets out requirements for the quantity and quality of the discharge of Non-Domestic Waste from a _____. Where a compliance program has been specified, existing works or procedures must be maintained in good operating condition and operated in a manner to minimize the discharge of contaminants during the interim period until the net works have been installed.

AUTHORIZED DISCHARGE CHARACTERISTICS

1. AUTHORIZED RATE OF DISCHARGE

   The Permittee shall not exceed the following:

2. AUTHORIZED DISCHARGE CRITERIA

   a) The Permittee shall not discharge PROHIBITED WASTE as defined in Section 2.1 of the Bylaw.

   b) The Permittee shall not discharge RESTRICTED WASTE as defined in Section 2.2 of the Bylaw with the following exceptions:

Parameter	Authorized Range or Maximum Concentration	Compliance By

   c) The Permittee shall not discharge SPECIAL WASTE as defined in Section 2.1 of the Bylaw.

   d) The Permittee shall not discharge STORM WATER or COOLING WATER as defined in Section 2.1 of the Bylaw.

This Appendix sets out the waste sources, works and procedures for the authorized discharges to SEWER. The Director of Works & Utilities may require that further works be installed if the existing works, in his opinion, do not provide an acceptable level of treatment. New works or alterations to existing works must be approved, in principle, by the Director of Works & Utilities. New waste sources must be authorized, in writing, by the Director of Works & Utilities.

AUTHORIZED WORKS AND PROCEDURES

The authorized waste sources, works and procedures to treat and/or control the waste discharge are:

	SOURCE	COMPLETION DATE	WORKS & PROCEDURES
1.	_____	_____	_____
2.	_____	_____	_____

REPORTING REQUIREMENTS FOR WASTE DISCHARGE PERMIT

The Permittee is required to submit the following reports to the Director of Works & Utilities:

a) By not later than _____ and at three month intervals thereafter, the Permittee shall submit a report detailing the results of the discharge sampling and analysis program for the preceding _____ as specified in Appendix B, Sections _____.

b) By not later than _____, the Permittee shall submit a written report outlining the specifications of the flow monitoring device or method used to determine the flow rate as described in Appendix B, Section A.1 of this Permit.

Additional reporting shall be undertaken by the Permittee when required by the Director of Works & Utilities.

Schedule "4.E"

Evaluation of Wastewater

Flow Proportioned Sampling

Proper sampling techniques are essential for accurate testing in evaluation of wastewater. To be representative of the entire flow, samples should be taken where the wastewater is well mixed.

An instantaneous grab sample represents conditions at the time of sampling only, and cannot be considered to represent a longer time period, since the character of a wastewater is usually not stable.

A composite sample is a mixture of individual grabs proportioned according to the wastewater flow pattern. Compositing is commonly accomplished by collecting individual samples at regular time intervals, for example, every hour on the hour, and by storing them in a refrigerator or ice chest; coincident flow rates are read from an installed flow meter or are determined from some other flow recording device. A representative sample is obtained by mixing together portions of individual samples relative to flow rates at sampling times.

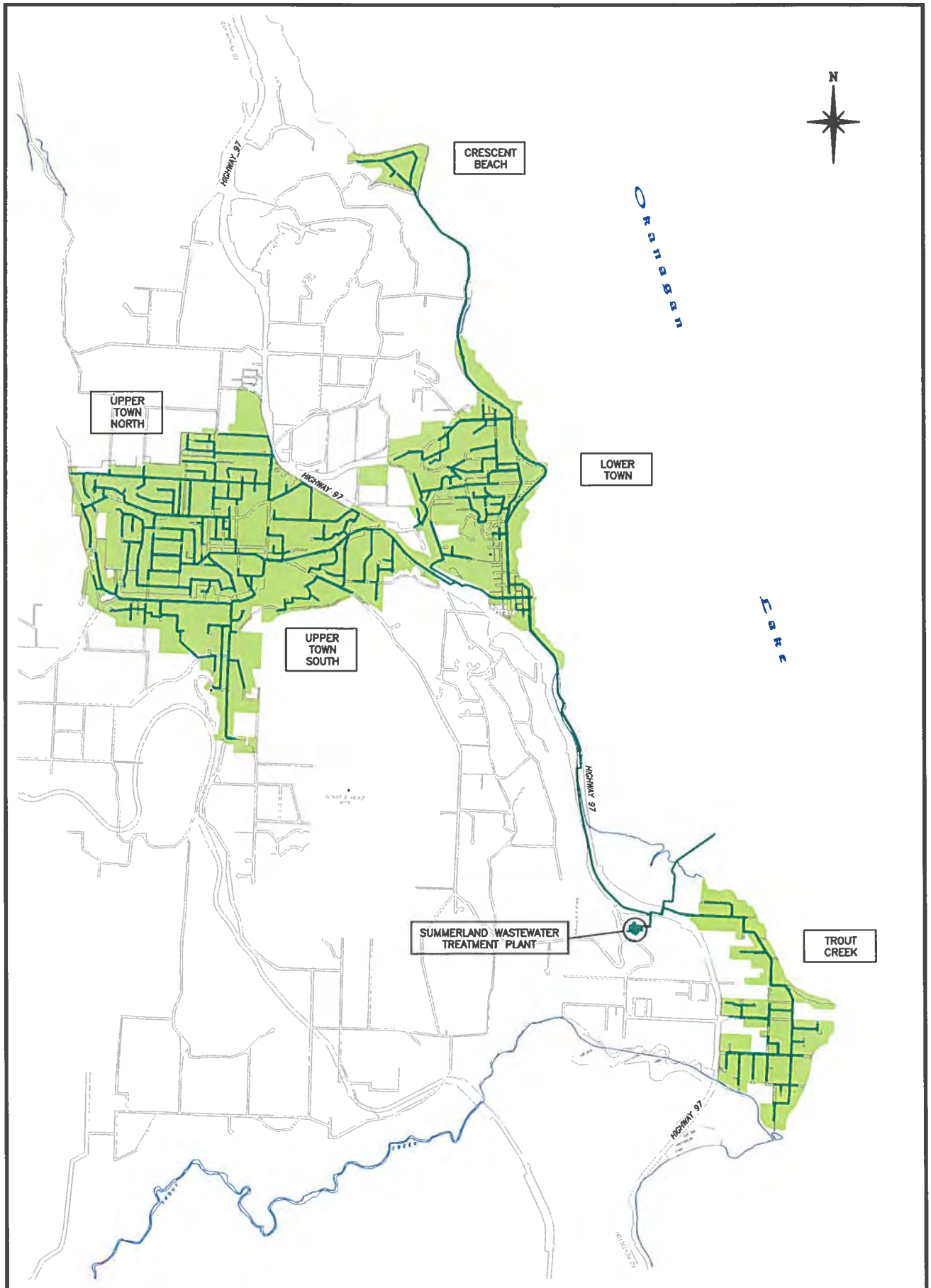
Composite samples representing specified time periods are tested to appraise plant performance and loadings. Weekday specimens collected over a 24-hour period are most common. Average daily BOD, TSS, and Oil & Grease data are used to calculate plant yield treatment efficiencies. Integrated samples during the period of peak flow, usually 8 to 12 hr. depending on influent variation, allow determination of maximum loadings on treatment units.

Example:

Hourly samples were taken of wastewater entering a treatment system. The following equations illustrate the portions to be used from the hourly grabs to provide composite samples for the 24-hr duration and during the period of maximum 8-hr loading, between 9 A.M. and 5 P.M. The composite sample volumes needed for laboratory testing are approximately 2500ml.

Calculations for the portions of hourly samples to be used in compositing are tabulated as follows:

		Portions of Hourly Samples in Millilitres for:	
Time	Flow (gpm)	24-hr Composite	8-hr Composite
Midnight	490	0.15 x 490 = 74	
1 A.M.	420	0.15 x 420 = 63	
2 A.M.	360	0.15 x 360 = 54	
3 A.M.	310	0.15 x 310 = 47	
4 A.M.	290	0.15 x 290 = 43	
5 A.M.	310	0.15 x 310 = 46	
6 A.M.	390	0.15 x 390 = 58	
7 A.M.	560	0.15 x 560 = 84	
8 A.M.	620	0.15 x 620 = 93	
9 A.M.	900	0.15 x 900 = 135	0.3 x 900 = 270
10 A.M.	1040	0.15 x 1040 = 156	0.3 x 1040 = 310
11 A.M.	1130	0.15 x 1130 = 170	0.3 x 1130 = 340
Noon	1160	0.15 x 1160 = 174	0.3 x 1160 = 350
1 P.M.	1120	0.15 x 1120 = 168	0.3 x 1120 = 340
2 P.M.	1060	0.15 x 1060 = 159	0.3 x 1060 = 320
3 P.M.	1000	0.15 x 1000 = 150	0.3 x 1000 = 300
4 P.M.	950	0.15 x 950 = 143	0.3 x 950 = 290
5 P.M.	910	0.15 x 910 = 136	
6 P.M.	870	0.15 x 870 = 130	
7 P.M.	810	0.15 x 810 = 121	
8 P.M.	760	0.15 x 760 = 114	
9 P.M.	690	0.15 x 690 = 103	
10 P.M.	630	0.15 x 630 = 94	
11 P.M.	540	0.15 x 540 = 81	
Total composite sample volumes		2596 ml	2520 ml



DISTRICT OF SUMMERLAND SANITARY SEWER COLLECTION SYSTEM

DATE CREATED: December 23, 2003
FILE NAME: SUM_SAN_COL_SYS.dwg

SCALE 1:25,000
Sewer Information Current as of December 1, 2003

DISTRICT OF SUMMERLAND

Bylaw Services
13211 Henry Ave, Box 159, Summerland BC, V0H 1Z0
Tel: 250-494-6451 Fax: 250-494-1415
www.summerland.ca

January 16, 2024

District of Summerland Works and Utilities Wastewater Division
7630 Dunn Street
Summerland BC
V0H1Z4

Re: District of Summerland Sewage Regulation Bylaw 98-002 – 2023 Report

In 2023 we had six (6) concerns raised regarding the District of Summerland Sewage Regulation Bylaw 98-002. Investigations showed that none of the concerns identified impacted the District Sanitary Sewer System.

Date	Address	Issue
June 22, 2023	10815 Rutherford	RV connected to Septic System. Report came in as connected to Sewer System. Resolved
July 26, 2023	12610 Giants Head	RV hooked up to Sewer System complaint. RV is not hooked up to Sewer. Uses home facilities. Resolved
August 14, 2023	9206 Shale	Business dumping grape by-product and cleaning solution on property and it is filling our catch basins. Catch basins drain to the storm system. Working with owner to ensure this does not happen again.
August 25, 2023	13608 Hwy 97	Sewage leaking from Septic System onto the street and neighbouring property. Leak did not enter District Sewer System. Resolved
October 5, 2023	12610 Giants Head	RV leaking raw sewage on the road. Owner cleaned up. Did not enter District Sewer System. Resolved
November 9, 2023	12610 Giants Head	RV leaking raw sewage on the road. Owner cleaned up. Did not enter District Sewer System. Resolved

Compliance with the regulation has been achieved for these issues with the exception of 9206 Shale Avenue. Working with the business to ensure this does not occur again.

Yours Truly,

Darren Krell
Bylaw Enforcement Officer

APPENDIX F

FLOW ANALYSIS

Table 1.0

Daily Average and Monthly Total Flows, 2023

2023	Authorized Daily Flow *m3/d*	Average Daily Flow *m3/d*	Total Monthly Flow *m3*
January	4000	2446.3	75835.4
February	4000	2436.3	68216.4
March	4000	2335.5	72400.5
April	4000	2170.3	65109.0
May	4000	1864.5	57799.5
June	4000	1897.5	56925.0
July	4000	1967.0	60977.0
August	4000	1945.2	60301.2
September	4000	1944.8	58344.0
October	4000	2302.7	71383.7
November	4000	2202.3	66069.0
December	4000	2268.4	70320.4

Yearly Avg	2148.4	65306.8
Total		**783,683**

Table 1.1

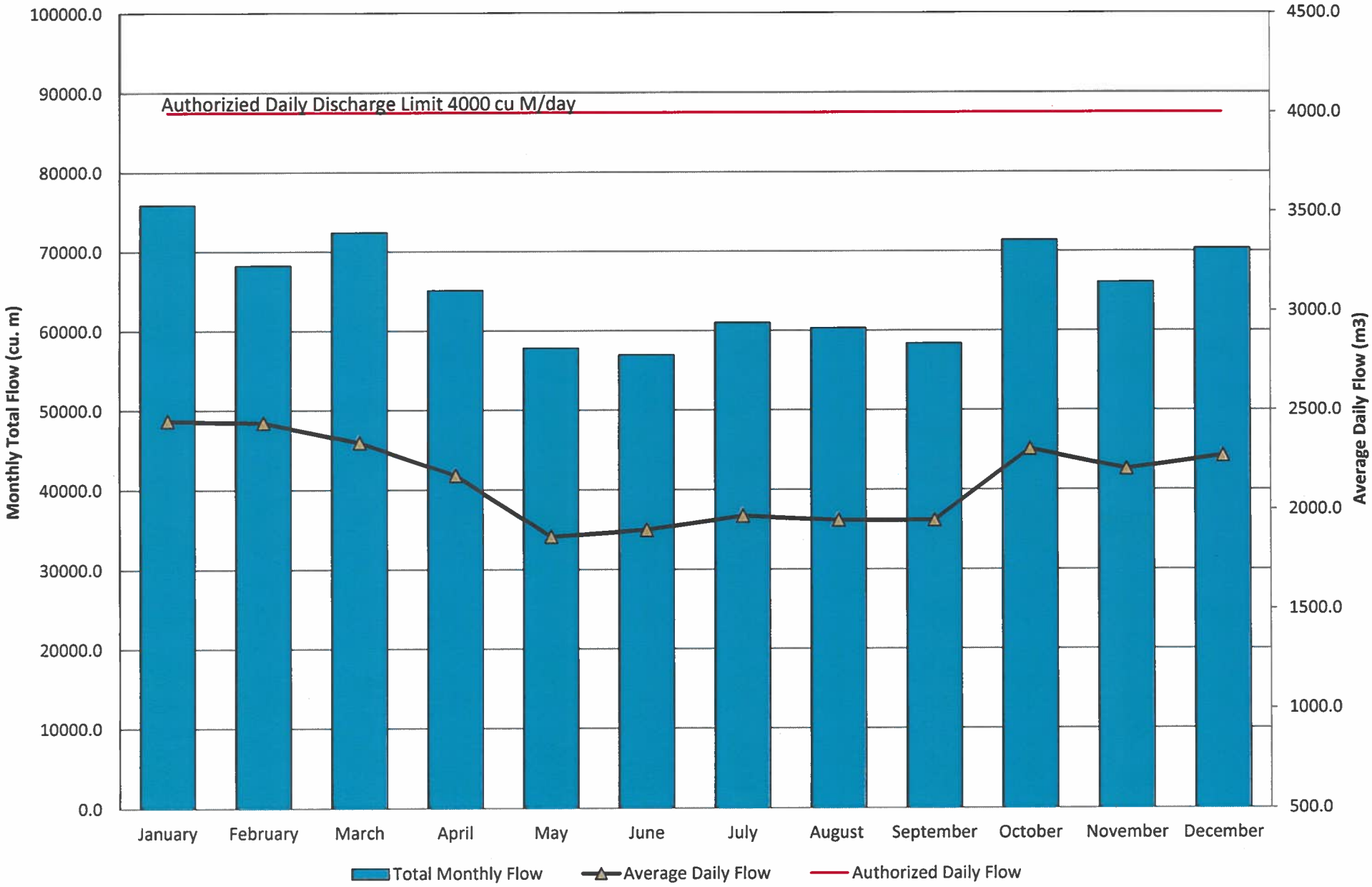
Daily Average and Monthly Total Flows, 2023

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	2429.5	2377.1	2465.0	2194.6	1793.9	1913.9	1858.6	2000.5	1826.7	2237.0	2230.7	2237.1
2	2548.6	2402.9	2436.0	2310.7	1833.9	1906.3	1927.3	2012.7	1720.9	2346.1	2315.0	2218.4
3	2449.9	2322.1	2380.4	2287.6	1805.0	1897.5	2047.3	1990.8	1749.8	2298.9	2230.5	2202.7
4	2433.0	2338.0	2354.0	2377.5	1875.1	1971.2	1976.9	2007.3	1850.8	2231.7	2105.9	2212.4
5	2399.7	2420.3	2481.1	2457.7	1888.0	1980.0	2002.1	1925.9	1775.3	2370.7	2290.7	2240.9
6	2387.2	2396.8	2410.1	2394.8	1796.7	1944.7	1983.5	1944.7	1797.3	2318.5	2311.2	2274.1
7	2420.7	2439.1	2374.5	2418.0	1776.0	1987.4	1972.6	2037.8	1833.7	2241.5	2245.9	2324.4
8	2549.1	2385.9	2460.5	2395.9	1809.5	1961.7	1907.8	2009.4	1830.8	2295.5	2145.5	2291.9
9	2493.7	2345.0	2390.1	2428.7	1868.7	1987.2	1963.5	2028.1	1712.3	2386.9	2128.3	2313.1
10	2534.4	2299.7	2363.8	2521.3	1867.4	1944.1	1994.6	2006.6	1885.6	2452.6	2105.1	2402.0
11	2496.2	2331.9	2331.2	2442.0	1885.8	2059.8	2088.2	2013.2	1796.5	2424.5	2124.6	2333.7
12	2610.0	2338.4	2324.3	2421.3	1848.6	1999.4	1994.2	1949.6	1856.5	2370.5	2096.5	2308.2
13	2433.8	2378.0	2405.8	2386.4	1805.7	1972.3	1946.5	1950.1	1833.0	2278.6	2189.2	2367.2
14	2341.7	2362.0	2389.3	2421.4	1853.0	1900.2	1989.5	1995.6	1841.3	2280.7	2147.3	2357.4
15	2439.7	2498.0	2391.9	2372.0	1847.8	1882.6	1911.6	1991.1	1805.5	2349.0	2220.1	2285.4
16	2409.4	2505.0	2359.5	2384.5	1835.6	1818.2	1945.0	1999.7	1777.5	2334.1	2239.5	2185.1
17	2467.0	2479.0	2320.5	2348.0	1860.5	1778.6	1979.7	1984.3	1824.1	2338.8	2230.3	2208.4
18	2487.6	2396.3	2345.1	2300.3	1796.0	1871.8	1936.7	1964.4	1823.4	2484.6	2110.5	2243.2
19	2448.3	2425.0	2377.0	2254.9	1832.8	1865.9	1975.6	1962.8	1855.6	2434.9	2223.0	2301.9
20	2400.8	2506.0	2363.7	2262.5	1828.5	1848.5	1931.3	1912.3	2063.4	2373.7	2258.3	2234.7
21	2377.7	2514.0	2347.2	1726.5	1889.8	1851.3	1972.4	1884.2	1868.2	2194.1	2195.1	2316.8
22	2438.9	2670.5	2292.0	1661.3	2201.0	1793.5	1918.5	1890.6	2110.2	2322.2	2236.8	2233.1
23	2413.5	2613.7	2259.1	1729.0	1830.9	1831.9	1946.1	1950.7	2083.4	2238.6	2230.5	2230.4
24	2472.5	2568.1	2198.9	1803.3	1857.3	1732.8	2040.8	1892.3	2148.1	2277.0	2178.3	2294.5
25	2454.8	2494.4	2163.8	1797.2	1921.4	1889.4	1969.9	1901.2	2140.0	2249.1	2144.1	2167.8
26	2452.5	2547.0	2259.5	1821.6	1919.0	1886.6	2029.8	1840.6	2186.0	2239.5	2208.5	2185.0
27	2420.6	2444.0	2239.7	1835.9	1800.3	1896.1	1956.3	1874.9	2219.1	2203.2	2186.0	2221.9
28	2350.1	2418.7	2223.9	1776.0	1889.4	1903.7	1979.2	1843.4	2252.4	2186.8	2188.1	2239.2
29	2493.9		2164.7	1763.8	1911.4	1813.4	1889.4	1811.7	2206.6	2247.8	2280.1	2212.1
30	2426.7		2265.0	1815.4	1918.6	1834.9	1954.0	1889.1	2669.1	2188.0	2272.7	2309.6
31	2353.9		2262.6		1951.4		1989.4	1836.9		2188.7		2368.2
Minimum	2342	2300	2164	1661	1776	1733	1859	1812	1712	2187	2097	2168
Maximum	2610	2671	2481	2521	2201	2060	2088	2038	2669	2485	2315	2402
Average	2446	2436	2335	2170	1864	1897	1967	1945	1945	2303	2202	2268
Flow Total	75,835	68,217	72,400	65,110	57,799	56,925	60,978	60,303	58,343	71,384	66,068	70,321

Yearly Treated Total	783,683 cu.m

Graph 1.0

Monthly Total and Daily Average Flows, 2023



Graph 1.0

APPENDIX G

EFFLUENT QUALITY PARAMETERS

Table 2.0

Effluent Quality Parameters 2023

Parameter	Permissible Level
BOD (mg/l)	10
Total Suspended Solids (mg/l)	10
Total Phosphorus (mg/l as P)	2.0
99 Percentile	1.5
90 Percentile	1.0
Annual Average	0.25
Level to strive for	0.01
Total Nitrogen (mg/l as N)	6.0
Fecal Colifom (MPN)	50

APPENDIX H

INFLUENT ANALYSIS ACCREDITED LAB

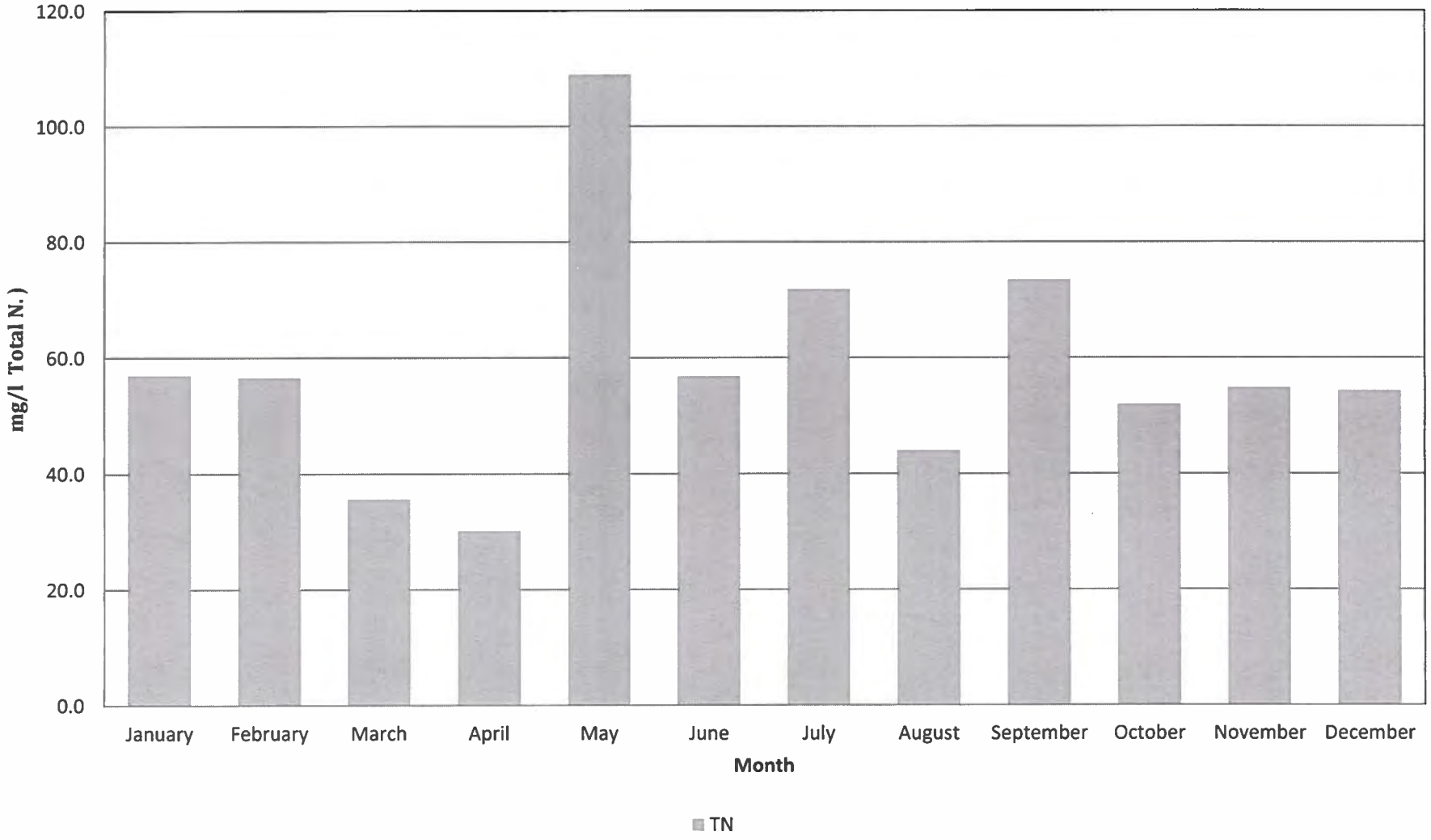
Table 3.0

Monthly Grab Sample Data and Yearly Average Accredited Lab Influent Analysis, 2023

	Influent				
	Lab	BOD	TN	TP	pH
Month		mg/L	mg/L	mg/L	pH
January	CARO	173	57.0	6.98	7.53
February	CARO	224	56.6	5.78	7.60
March	CARO	96	35.7	3.21	7.70
April	CARO	97	30.2	3.20	7.66
May	CARO	800	109.0	36.60	7.41
June	CARO	577	56.8	15.90	7.44
July	CARO	756	71.9	21.80	7.68
August	CARO	401	44.0	13.60	7.38
September	CARO	659	73.5	25.70	7.21
October	CARO	184	51.9	5.61	7.43
November	CARO	164	54.8	5.69	7.35
December	CARO	144	54.3	4.82	7.30
Min		96	30.2	3.20	7.21
Average		356	58.0	12.41	7.47
Max		800	109.0	36.60	7.70

Graph 3.0

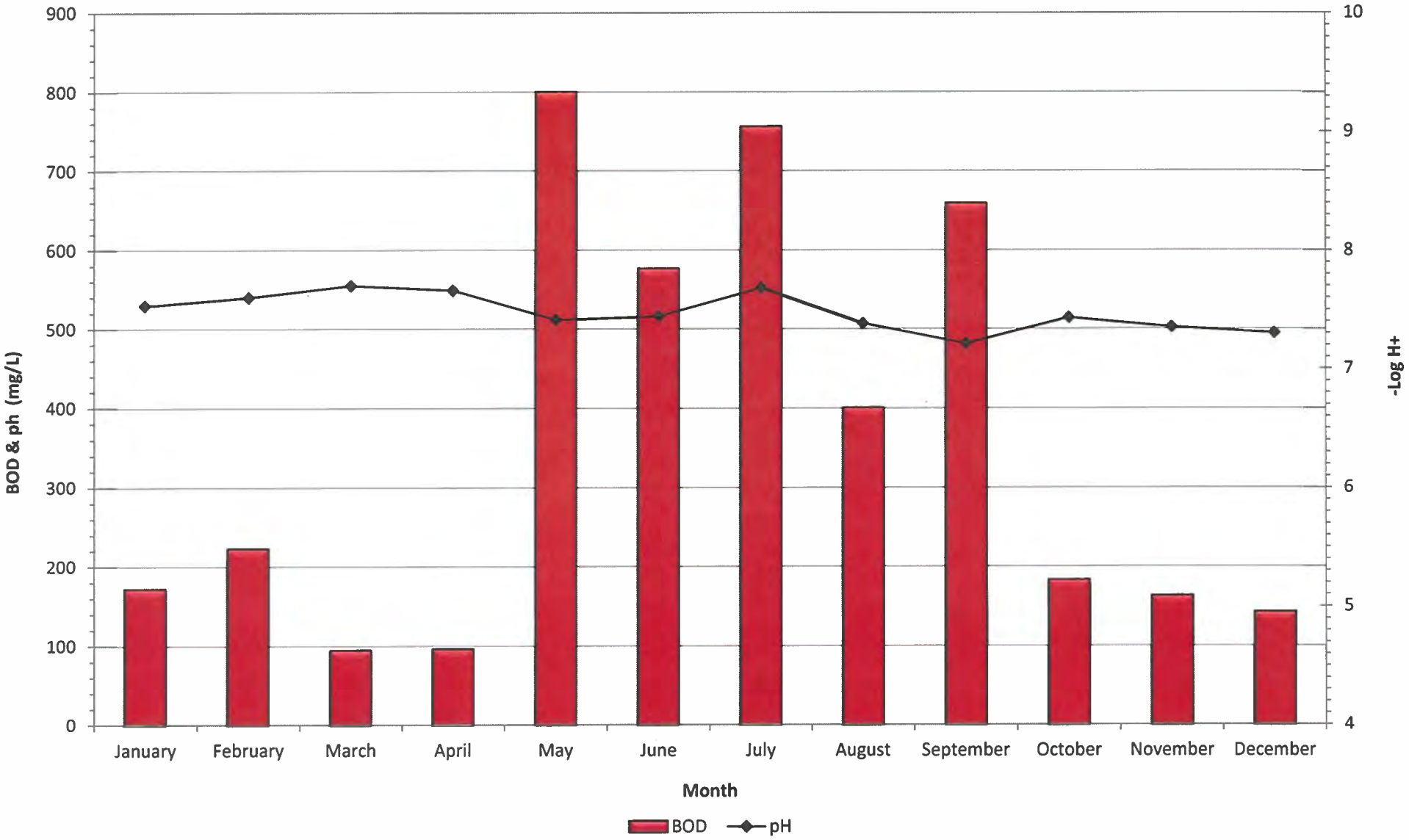
Monthly Grab Sample Data
Total Nitrogen
Accredited Lab Influent Analysis, 2023



Graph 3.0

Graph 3.1

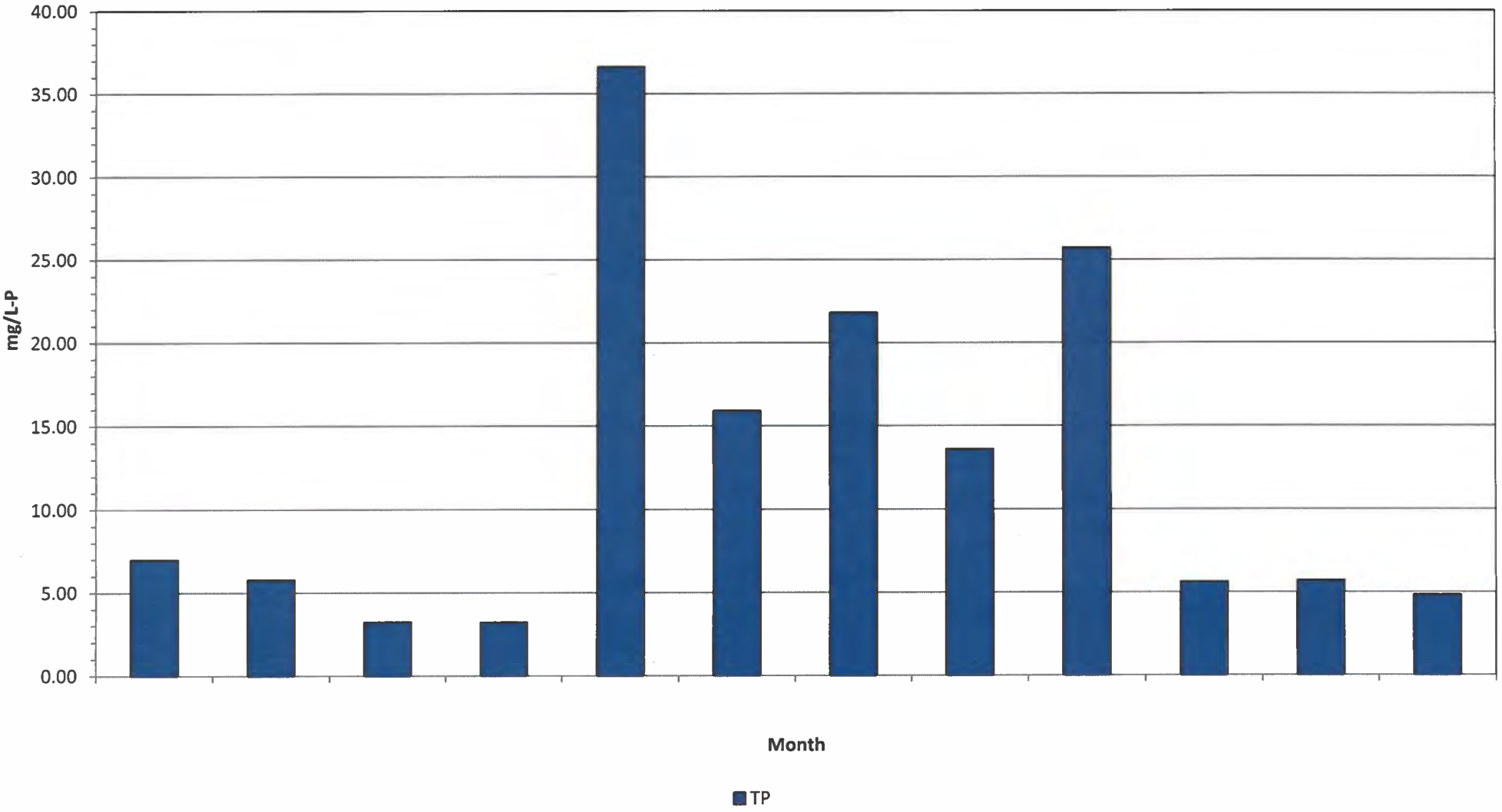
Monthly Grab Sample Data
BOD & pH
Accredited Lab Influent Analysis, 2023



Graph 3.1

Graph 3.2

Monthly Grab Sample Data
Total Phosphorus
Accredited Lab Influent Analysis, 2023



APPENDIX I

INFLUENT ANALYSIS INTERNAL LAB

Table 4.0

Grab Sample Data
Monthly and Yearly Averages
Internal Lab Influent Analysis, 2023

Month	Influent		
	OPO-4	NH3-N	pH
	mg/l	*mg/l*	*mg/l*
January	4.95	43.47	7.73
February	7.18	45.94	7.93
March	4.92	43.72	7.85
April	5.16	43.66	7.56
May	9.03	55.71	7.53
June	8.70	51.07	7.52
July	9.75	48.99	7.24
August	10.45	48.65	7.32
September	8.26	42.57	7.38
October	5.31	41.42	7.64
November	5.33	52.78	7.58
December	4.92	48.68	7.61
Yearly Min	4.92	41.42	7.24
Yearly Avg	7.00	47.22	7.57
Yearly Max	10.45	55.71	7.93

APPENDIX J

EFFLUENT ANALYSIS ACCREDITED LAB

Table 5.0

Monthly and Yearly Averages
Accredited Lab Effluent Analysis, 2023

Effluent									
Month	Lab	Total Coliforms	Fecal Coliforms	TSS	BOD	TKN-N	TN	NH3-N	TP
January	Caro	1	<1	2.2	<5.8	1.61	3.58	0.08	0.200
February	Caro	<1	<1	<2	<5.6	1.96	4.42	0.87	0.145
March	Caro	291	147	8.3	<15.4	4.76	7.16	2.60	0.402
April	Caro	220	88	4.6	<7.6	3.20	5.09	1.39	0.211
May	Caro	10	2	<4	<3.2	1.57	3.34	0.12	0.160
June	Caro	12	1	2.6	<5.3	1.38	3.32	0.10	0.121
July	Caro	67	11	2.0	<5.3	1.30	3.72	0.12	0.142
August	Caro	299	71	<2.0	<6.5	1.54	3.12	0.14	0.912
September	Caro	1	<1	<2.0	<6.2	1.08	4.73	<0.050	0.582
October	Caro	3	<1	<2	<7.7	1.32	5.24	0.07	0.654
November	Caro	<1	<1	<2	<4.4	1.28	5.06	0.10	0.804
December	Caro	1	<1	<4	<6.4	1.47	4.35	0.16	0.244
Min		1	1	2.0	<2.9	1.08	3.12	<0.050	0.121
Average		76	27	3.1	6.6	1.87	4.43	0.48	0.381
Max		299	147	8.3	<15.4	4.76	7.16	2.60	0.912

Table 5.1

Monthly and Yearly Averages
Accredited Lab Effluent Analysis, 2023

		Effluent					C3 Reclaimed Effluent	
Month	Lab	OPO-4	pH	Organic Nitrogen	Nitrates	Nitrites	Total Coliforms	C3 Fecal Coliforms
January	Caro	0.04	7.25	1.53	1.95	0.015	1	<1
February	Caro	0.04	7.10	1.08	2.41	0.047	<1	<1
March	Caro	0.06	7.31	2.16	2.15	0.242	>2420	156
April	Caro	0.01	7.26	1.81	1.53	0.353	12	1
May	Caro	0.01	6.83	1.46	1.72	0.048	8	2
June	Caro	0.01	7.20	1.29	1.92	0.023	<1	<1
July	Caro	0.01	7.54	1.18	2.40	0.025	20	<1
August	Caro	0.49	7.60	1.40	1.44	0.140	<1	<1
September	Caro	0.37	7.36	1.08	3.64	0.017	2	<1
October	Caro	0.25	7.00	1.25	3.89	0.031	<1	<1
November	Caro	0.37	7.05	1.18	3.73	0.058	<1	<1
December	Caro	0.11	6.98	1.31	2.82	0.057	<1	<1
	Min	0.01	6.83	1.08	1.44	0.02	<1	<1
	Average	0.15	7.21	1.39	2.47	0.09	205	14
	Maximum	0.49	7.60	2.16	3.89	0.35	>2420	156

Table 5.2

Yearly Average
External Lab Results 2008-2023

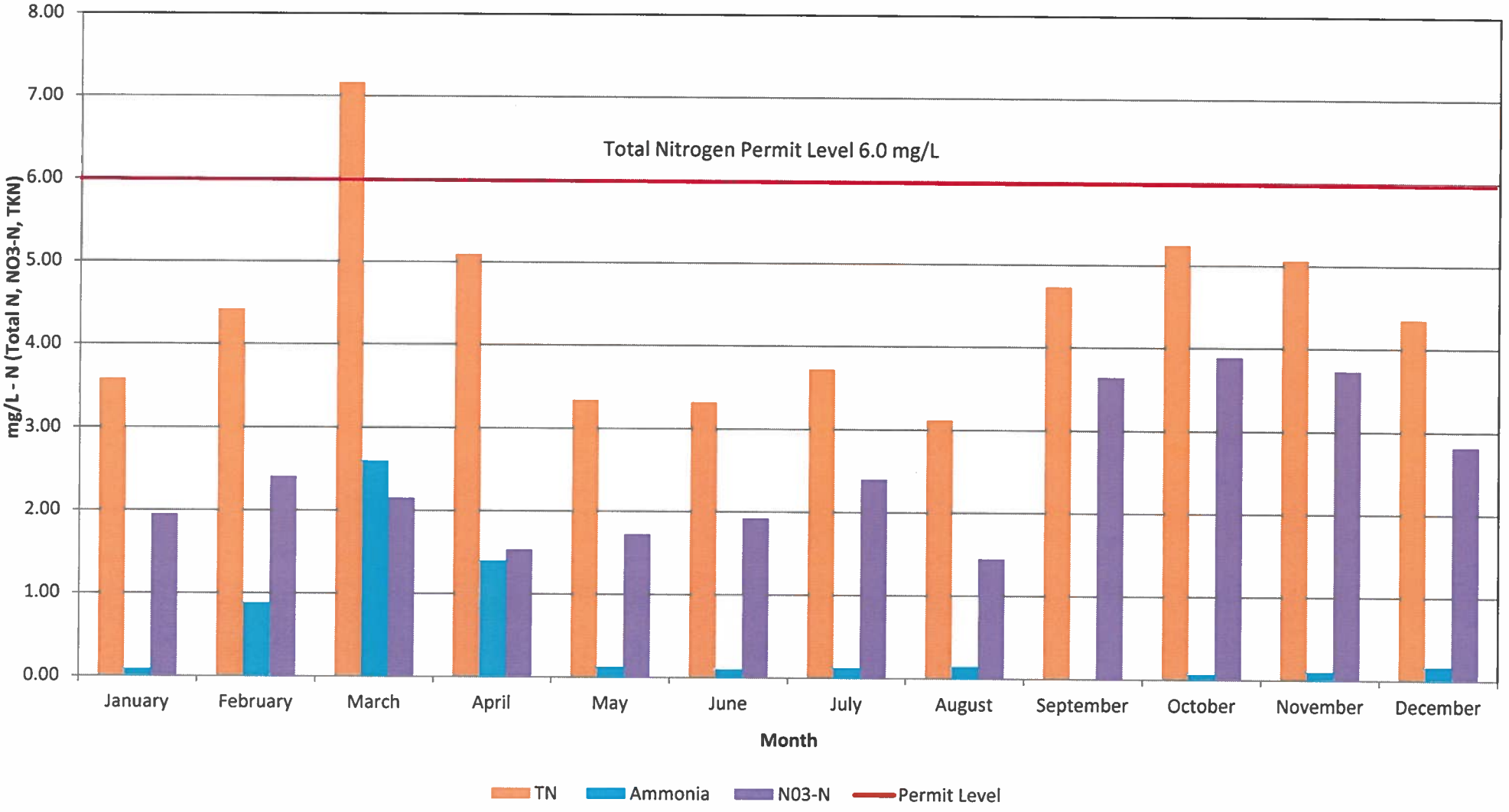
External Lab Results 2008-2023

EFFLUENT						
Year	Lab	Fecal Coliforms	TSS	BOD	TN	Total P
2008	CARO	7	2.7		6.74	
2009	CARO	9	2.3	10.0	5.82	
2010	CARO	5	1.6	11.0	4.71	
2011	CARO	45	4.3	0.8	6.43	
2012	CARO	13	2.4	<10	4.55	0.221
2013	CARO	0	2.7	<10	6.45	0.803
2014	CARO	1549	3.0	<10	5.45	0.484
2015	CARO	7	3.5	<10	5.55	0.275
2016	CARO	0	0.0	0.4	4.74	0.198
2017	CARO	5	0.6	2.0	3.91	0.212
2018	CARO	27	3.0	6.0	4.34	0.432
2019	CARO	9	2.7	6.5	5.68	0.236
2020	CARO	4	2.8	8.2	5.03	0.212
2021	CARO	6	2.9	6.1	4.34	0.163
2022	CARO	3	3.0	8.5	4.41	0.149
2023	CARO	27	3.1	6.6	4.43	0.381

INFLUENT					
Year	Lab	BOD	TN	TP	pH
2008	CARO	182	36.4	5.8	6.9
2009	CARO	139	38.3	4.8	7.5
2010	CARO				
2011	CARO	223	47.1	7.1	7.6
2012	CARO	222	48.1	6.8	7.5
2013	CARO	222	48.1	6.8	7.5
2014	CARO	228	46.9	5.4	7.4
2015	CARO	319	46.1	7.2	7.3
2016	CARO	391	65.8	10.6	7.1
2017	CARO	268	52.4	7.7	7.4
2018	CARO	224	45.6	6.1	7.0
2019	CARO	309	56.4	11.6	7.1
2020	CARO	296	49.9	9.8	6.6
2021	CARO	269	57.7	7.8	7.2
2022	CARO	203	53.2	5.2	7.5
2023	CARO	356	58.0	12.4	7.5

Graph 5.0

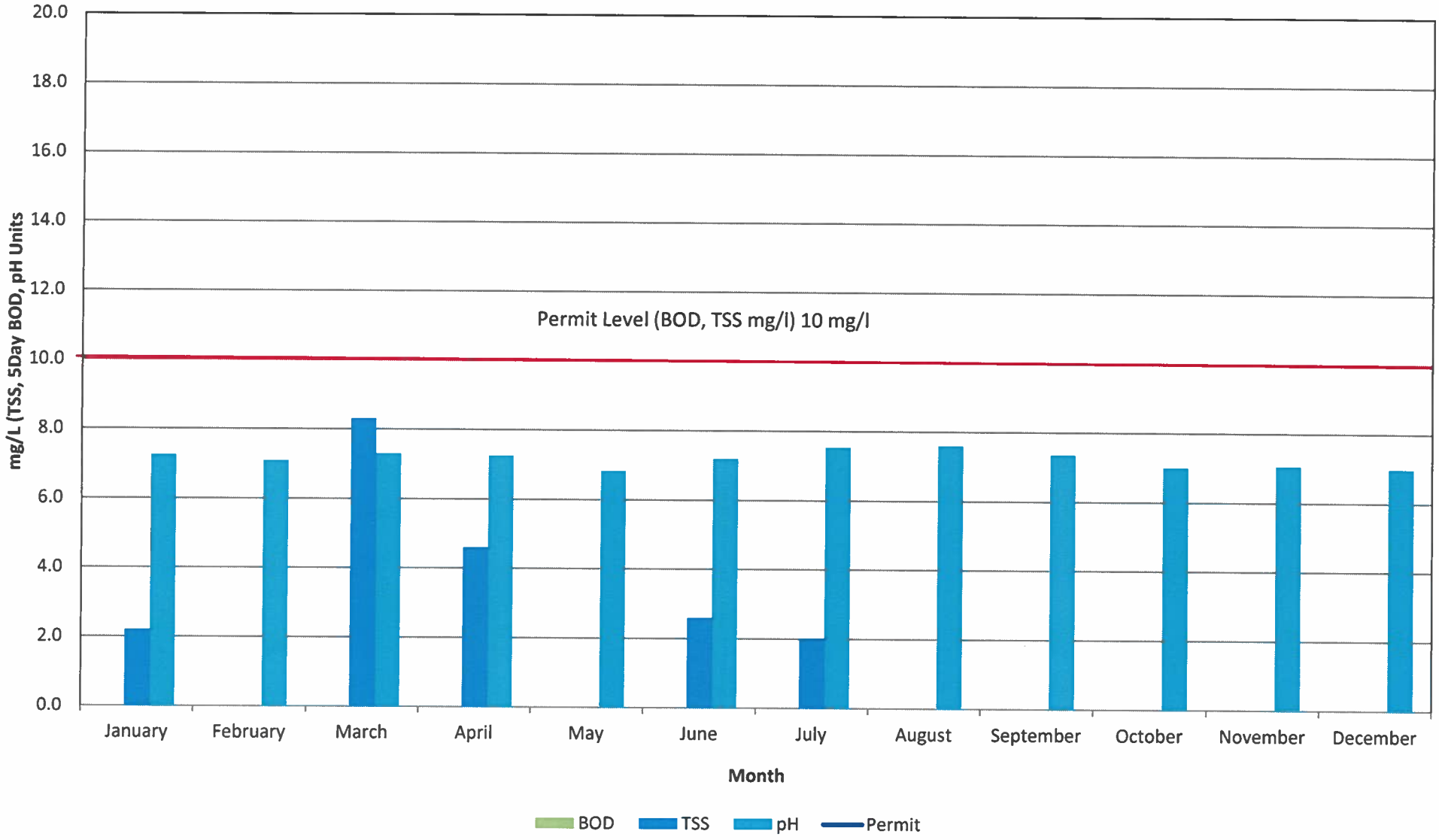
Monthly Grab Sample Data
Accredited Lab Effluent Analysis - 2023



Graph 5.0

Graph 5.1

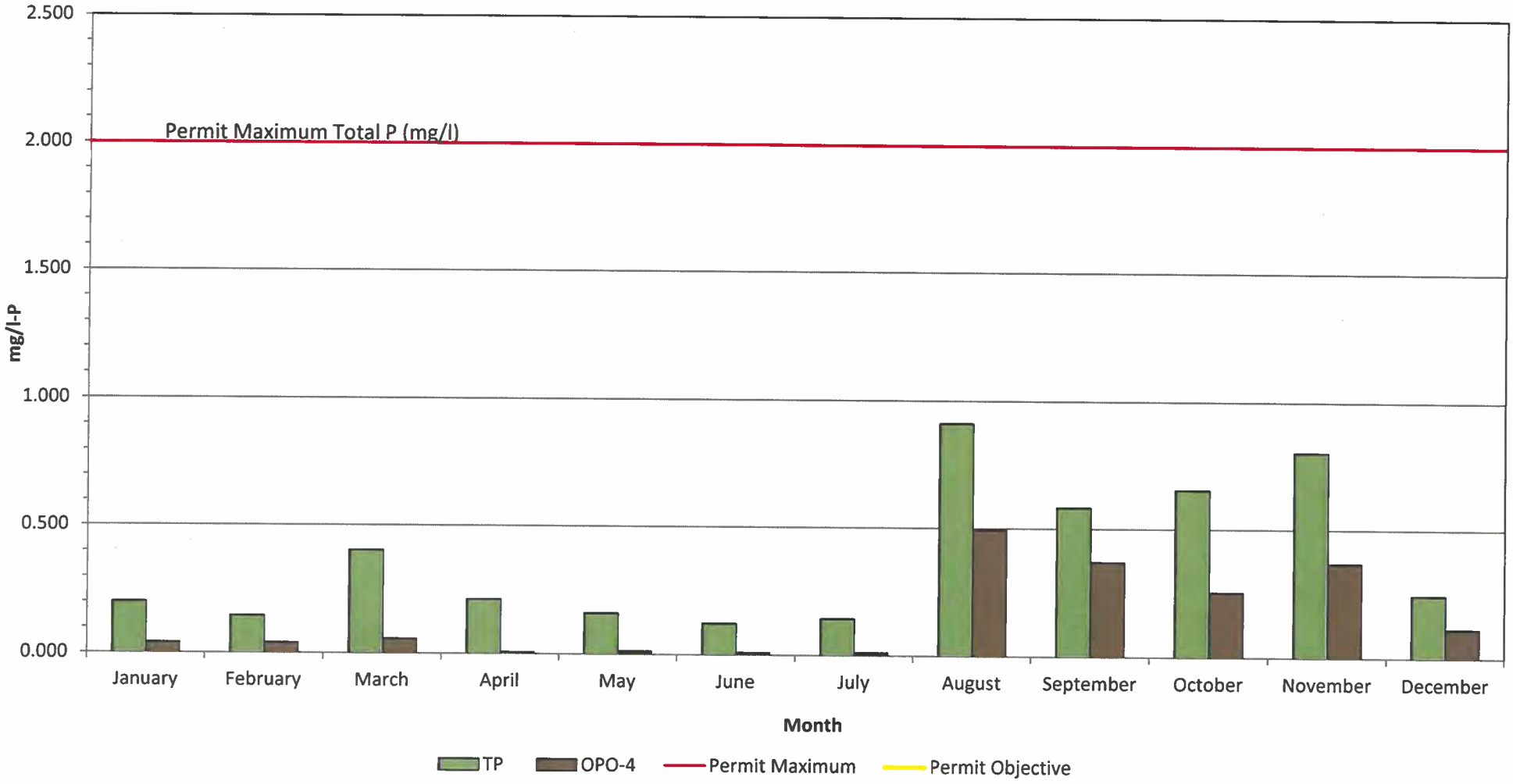
Monthly Grab Sample Data
TSS, 5-Day BOD, pH
Accredited Lab Effluent Analysis - 2023



Graph 5.1

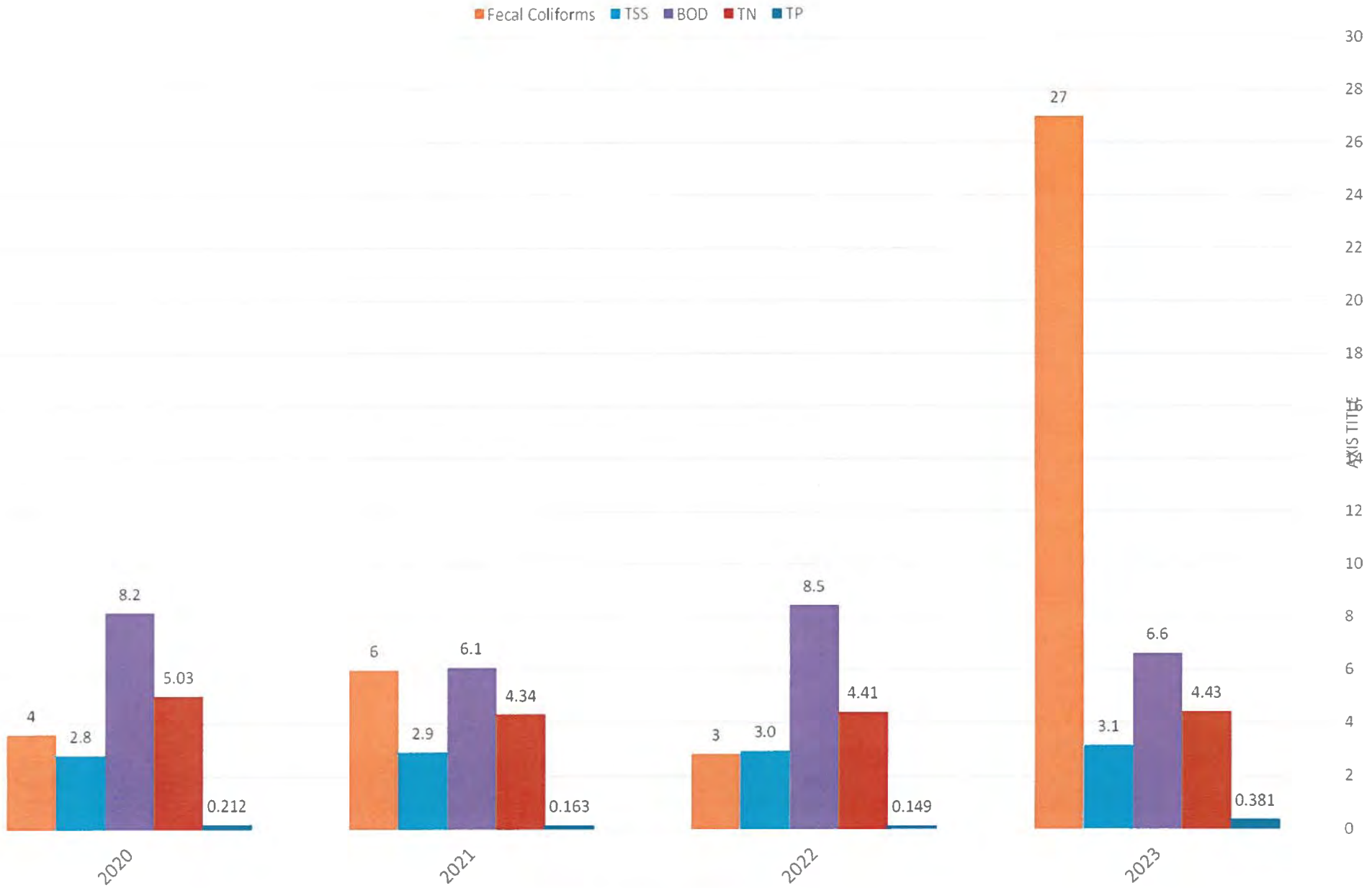
Graph 5.2

Monthly Grab Sample Data
Total Phosphorous
Accredited Lab Effluent Analysis - 2023



Graph 5.2

Graph 5.3
External Lab Yearly Averages
Effluent Samples 2020-2023



Graph 5.3

APPENDIX K

EFFLUENT ANALYSIS INTERNAL LAB

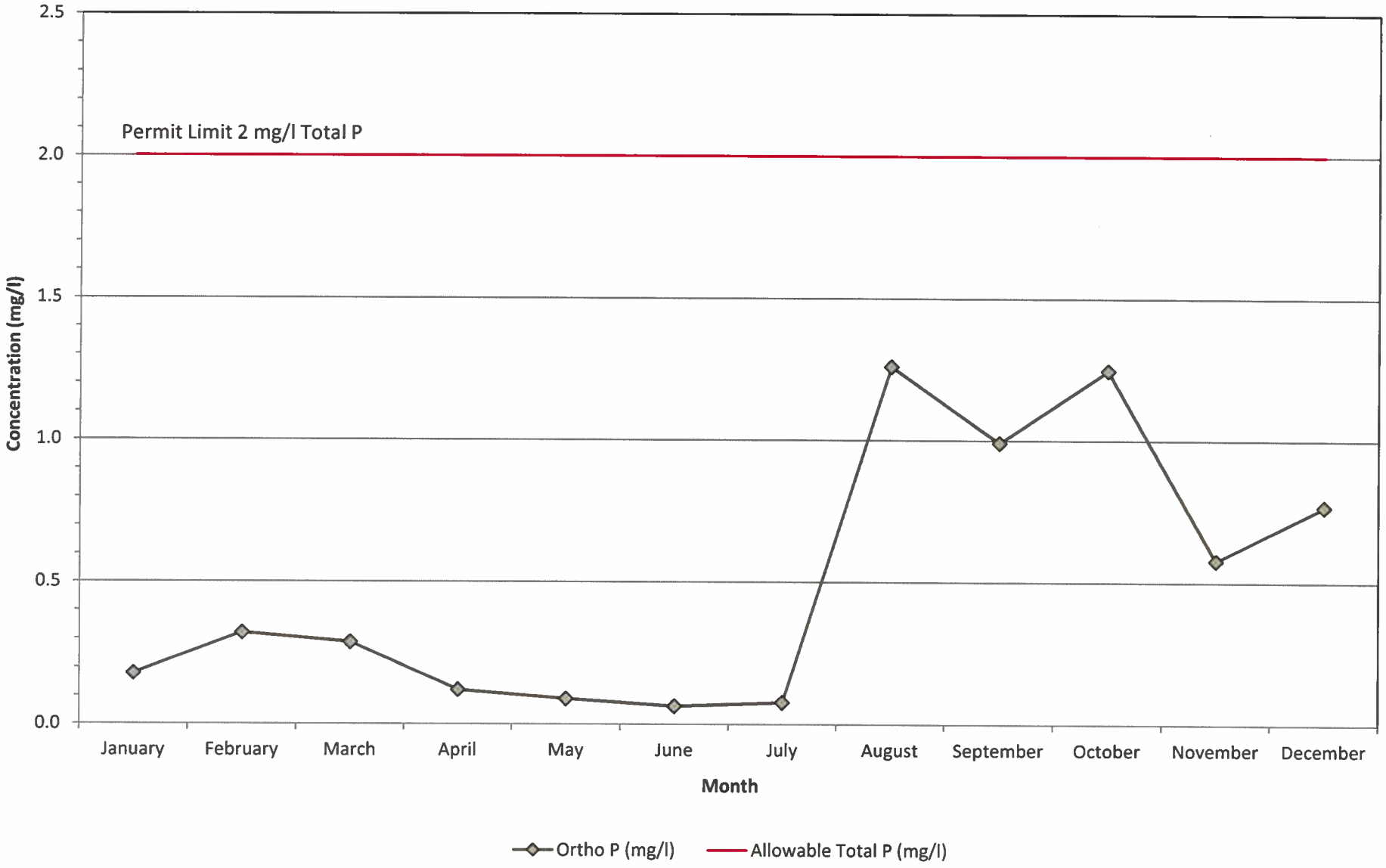
Table 6.0

Grab Samples, Monthly and Annual Averages
Internal Effluent Analysis, 2023

Final Effluent

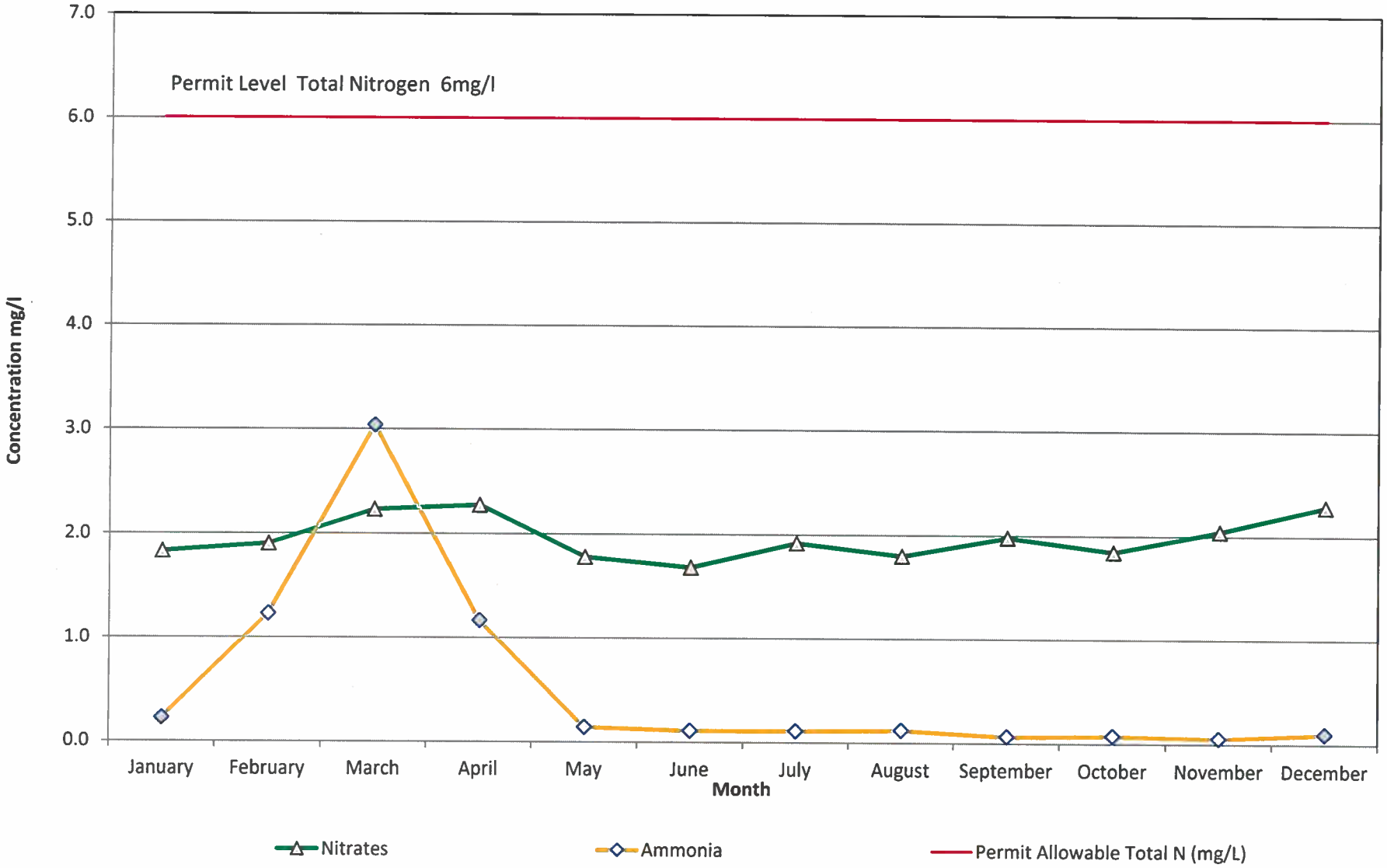
2023	Ortho-P	Nitrates	Ammonia	pH
	mg/L	*mg/L*	*mg/L*	*mg/L*
January	0.178	1.8	0.22	6.71
February	0.320	1.9	1.23	6.79
March	0.287	2.2	3.04	6.89
April	0.120	2.3	1.17	6.77
May	0.089	1.8	0.14	6.81
June	0.063	1.7	0.11	6.73
July	0.076	1.9	0.11	6.65
August	1.258	1.8	0.12	6.87
September	0.991	2.0	0.06	6.81
October	1.244	1.8	0.07	6.77
November	0.577	2.0	0.05	6.81
December	0.767	2.3	0.10	6.76
Yearly Min	0.063	1.7	0.05	6.65
Yearly Avg	0.497	2.0	0.53	6.78
Yearly Max	1.258	2.3	3.04	6.89

Graph 6.0
Monthly Average Effluent Grab Sample Data: Ortho P, Internal Lab 2023



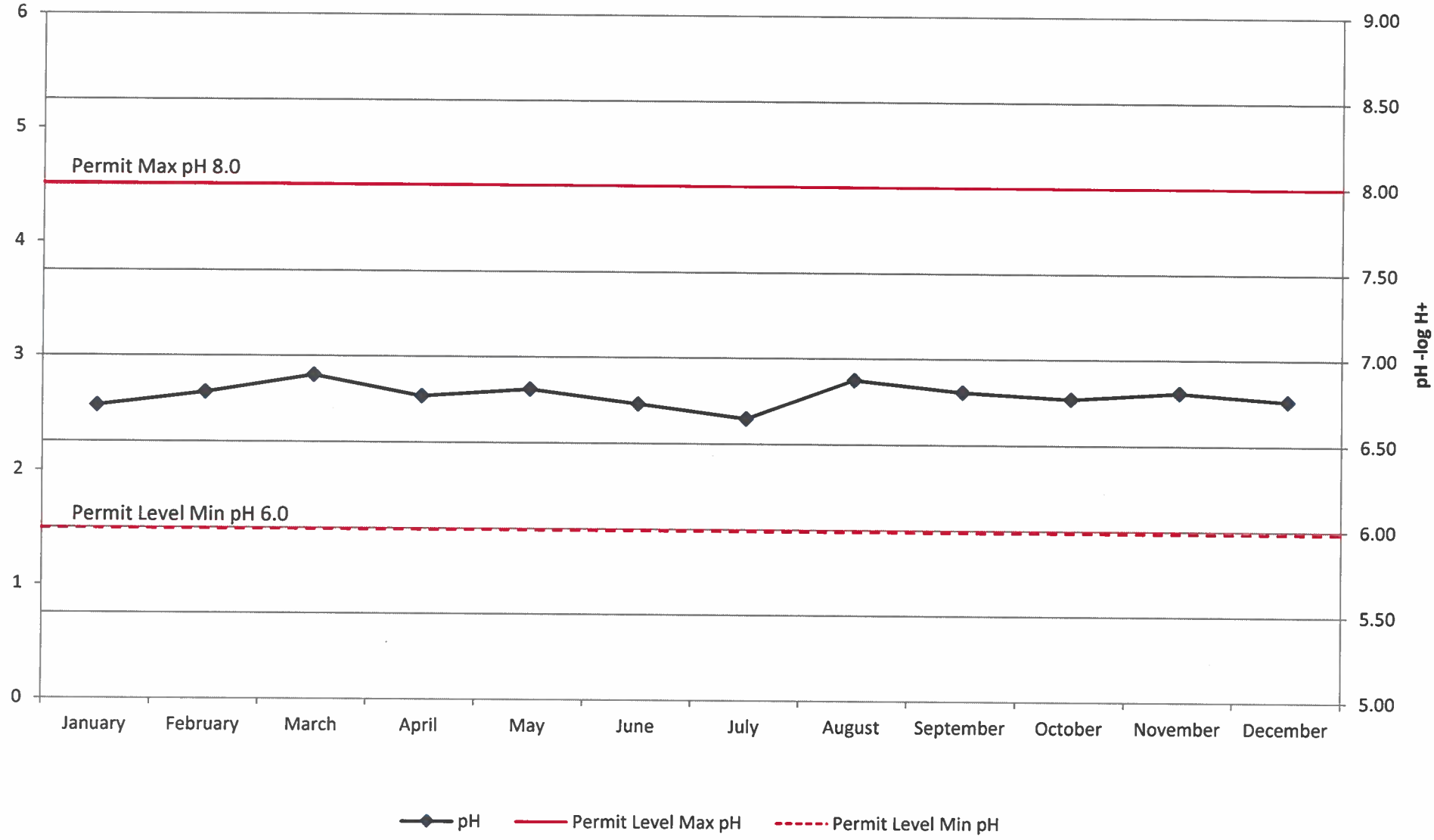
Graph 6.0

Graph 6.1
Monthly Average Grab Sample Data
Nitrates & Ammonia
Internal Lab Effluent Analysis - 2023



Graph 6.1

Graph 6.2
Monthly Average Grab Sample Data
pH
Internal Lab Effluent Analysis - 2023



Graph 6.2

APPENDIX L

LAKE SAMPLING

LARRATT AQUATIC

Okanagan Lake Collaborative Monitoring Agreement
2023 Summary Report

Prepared for:
Okanagan Basin Water Board
City of Kelowna
Regional District of Central Okanagan
District of Summerland
BC Ministry of Environment and Climate Change Strategy

Larratt Aquatic Consulting Ltd. 105-2081 McDougall Rd. West Kelowna B.C. V1Z 4A2
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Executive Summary

The British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) in partnership with local municipalities, commissioned an annual collaborative monitoring program to sample water quality in Okanagan Lake every year since 2011. Now operated by the Okanagan Basin Water Board (OBWB), sampling occurred monthly from March to September at four locations in 2023.

A primary function of the monitoring was to determine attainment of Okanagan Lake water quality objectives, along with increasing the temporal resolution of water quality data for Okanagan Lake, specifically with the goal of determining trends in nutrient and biological data. Similar to previous years, parameters such as temperature and dissolved oxygen were measured throughout the water column as well as several chemical parameters including silica, nitrogen, and phosphorus at discrete depths. Biological data including phytoplankton and zooplankton biomass with taxonomic identification were also collected. This report summarizes the 2023 findings and sets these recent data within the context of this program (2011-2023).

The results to date indicate that the Armstrong Arm is the most impacted by human activities and watershed degradation. These impacts include including agriculture, cattle range, logging, septic systems adjacent to the shoreline, and now the White Rock Lake wildfire. This site had the most exceedances and the most parameters trending towards greater exceedances. Weather was the dominant factor on water quality at Okanagan Centre, Kelowna, and Summerland but long-term data still demonstrates human impacts.

Physical

Okanagan Lake is usually stratified from May to November, it mixes in mid-November and then freely mixes over the winter. Secchi depth was highest in late winter and decreased each spring in response to increased phytoplankton activity. Water clarity was below average for Okanagan Lake in 2023 because of high algae production. All sites failed to meet the Secchi depth objective in 2023.

Chemical

Dissolved oxygen (DO) is essential for all aquatic animals and is high throughout Okanagan Lake at all times except in the hypolimnion of the Armstrong Arm where DO fell below the water quality objective each summer including 2023. Silica, an important micronutrient, had stable concentrations in Okanagan Lake over the past 20 years.

Total nitrogen (TN) exceeded the objective at Summerland, Kelowna, and Okanagan Centre during 2023 as it did in most years. Previously identified increasing trends in TN and nitrate paused with a stable period over the past few years while TN declined in the Armstrong Arm since 2017. This is an encouraging result but the long-term increasing trend may resume in future years.

Total phosphorus (TP) had a year-over-year increasing trend at all sites from 2011-2023, and forms part of a longer-term trend since the mid-2000s. TP includes phosphorus associated

with suspended sediment carried into the lake. It increased in Okanagan Lake during wet years such as 2017-2018 and decreased during dry years such as 2019 and 2021. Dissolved phosphorus is less affected by freshets than TP and was stable or declining at the three main basin sites while it also increased in the Armstrong Arm.

The ratio of total nitrogen to total phosphorus (N:P) available to phytoplankton will play a major role in which types of phytoplankton proliferate in a lake. A lower N:P ratio (abundant phosphorus relative to nitrogen) will favour the growth of cyanobacteria. The N:P ratio failed to meet the objective in the Armstrong Arm in 2023 with a downwards trend at all sites.

Biological

Chlorophyll-a was used as a measure of photosynthetic activity in Okanagan Lake. A decreasing north to south trend in the chlorophyll-a data occurred over the course of this study. All sites met the chlorophyll-a objectives during 2023. However, a significant increasing trend occurred at Kelowna and Armstrong Arm from 2011-2023, part of a trend since the mid-2000s.

Phytoplankton abundance during 2023 was high compared to 2011-2023 because of elevated cyanobacteria densities. All sites did not meet the phytoplankton biovolume objective nor did they meet the phytoplankton taxonomy objective during 2023 because of elevated cyanobacteria densities, particularly the Armstrong Arm.

Zooplankton results were not available at the time of writing but will be added as revised version of this report when they are available.

The following areas of concern have been identified that may require further investigation on the part of the Ministry:

- Chronically low Secchi depth in the Armstrong Arm
- Increasing nitrate in hypolimnion of Okanagan Lake since 1970s (although stable during past 5 years)
- Increasing total phosphorus at all sites except Summerland since early 2000s
- Decreasing N:P ratio in the Armstrong Arm
- High densities of potentially toxic cyanobacteria in Armstrong Arm during 2018-2021
- Role of Climate Change in water quality changes in Okanagan Lake
- Phosphorus loading to the Armstrong Arm and north basin of Okanagan Lake from the White Rock Lake wildfire

Water Quality Objectives, 2011-2023 Values, and Trends for Okanagan Lake

Table 1: Okanagan Lake water quality objectives

Parameter (Nordin, 2005)	**Summerland**	**Kelowna**	**Ok Centre**	**Armstrong Arm**
Secchi Depth (growing season average: Apr-Sep)	>7m	>6m	>6m	>5m
Dissolved Oxygen (minimum in bottom waters)	-	-	-	>5 mg/L
TP (mg/L as P) (maximum at spring overturn)	<0.007	<0.008	<0.008	<0.01
Chlorophyll-a (µg/L) (maximum seasonal average)	<4.5	<4.5	<4	<5
TN (mg/L as N) (maximum at spring overturn)	<0.230	<0.230	<0.230	<0.250
N:P Ratio (spring weighted ratio)	>25:1	>25:1	>25:1	>25:1
Algae Taxonomy (% heterocystous cyanobacteria)	<5%	<5%	<5%	<5%
Algae Biomass (µL/L) (growing season average)	<0.75	<0.75	<0.75	<0.75
Zooplankton Biomass (µg/L) (growing season average)	>50	>50	>50	>50
Zooplankton Taxonomy (% cladocerans)	>5%	>5%	>5%	>5%

Table 2: Attainment of Okanagan Lake water quality objectives compared to growing season averages during 2023

Objective	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth	6.0	5.3	5.8	2.8
Dissolved Oxygen	7.88	8.23	8.30	2.13
TP (mg/L) 0:10m:	0.005	0.006	0.007	0.012
20-45m:	0.005	0.005	0.006	0.019
Chlorophyll-a (µg/L)	1.74	1.97	2.16	3.08
TN (mg/L) 0-10m:	0.216	0.220	0.22	0.244
20-45m:	0.237	0.237	0.239	0.280
N:P Ratio 0-10m:	59:1	49:1	33:1	20:1
20-45m:	57:1	47:1	41:1	18:1
Algae Taxonomy (% heterocystous cyanobacteria)	12.5%	13.6%	12.5%	44.2%
Algae Biovolume (µL/L)	0.790	1.135	1.004	0.814
Zooplankton Biomass (µg/L)	-	-	-	-
Zooplankton Taxonomy (% cladocerans)	-	-	-	-

Legend:

Achieved objective	Achieve objective in some but not all samples	Did not achieve objective

Table 3: Summary of trends compared to attainment of water quality objectives in Okanagan Lake during 2011-2023

Objective	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth	-	-	-	-
Dissolved Oxygen	-	-	-	-
TP (mg/L) 0:10m:	↑	↑	↑	↑
Chlorophyll-a (µg/L)	-	↑	-	↓
TN (mg/L) 0-10m:	-	-	-	↓
N:P Ratio 0-10m:	↓	↓	↓	↓
Algae Taxonomy (% heterocystous cyanobacteria)	↑	↑	↑	↑
Algae Biovolume (µL/L)	↑	↑	-	-
Zooplankton Biomass (µg/L)	-	-	-	-
Zooplankton Taxonomy (% cladocerans)	-	-	-	-

Legend:

Achieved objective	Achieve objective in some but not all samples	Did not achieve objective

Preferred Citation

Self, J., 2024. Okanagan Collaborative 2023 Summary Report. Prepared by Larratt Aquatic Consulting Ltd. Prepared for Okanagan Basin Water Board.

Report prepared by: Larratt Aquatic Consulting Ltd.

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Table of Figures and Tables

Definitions

The following terms are defined as they are used in this report.

Term	Definition
Algae bloom	A superabundant growth of algae that may result in surface scum depending on type of algae that is blooming
Anoxic	Devoid of oxygen
Bioavailable	Available for use by plants or animals
Chlorophyll-a	Primary photosynthetic pigment in algae; used as a measure of photosynthetic activity
Cyanobacteria	Bacteria-like algae having cyanochrome as the main photosynthetic pigment
Diatoms	Algae that have hard, silica-based "shells" frustules
Fall overturn	Surface waters cool and sink, until a fall storm mixes the water column
Eutrophic	Nutrient-rich, biologically productive water body
Hypoxic	Very low dissolved oxygen
Macronutrient	The major constituents of cells: nitrogen, phosphorus, carbon, sulphate, H
Micronutrient	Small amounts are required for growth; Si, Mn, Fe, Co, Zn, Cu, Mo etc.
Microflora	The sum of algae, bacteria, fungi, *Actinomycetes,* etc., in water or biofilms
Monomictic	"One Mixing": describes lakes that are thermally stratified in summer and mixed in winter
Nutrient limitation	A nutrient will limit or control the potential growth of organisms e.g. P or N
Phytoplankton	Algae that float, drift or swim in water columns of reservoirs and lakes
Plankton	Those organisms that float or swim in water
Riparian	The interface between land and a stream or lake
Secchi depth	Depth where a 20 cm Secchi disk can be seen; measures water transparency
Thermocline	The lake zone of greatest change in water temperature with depth (> 1°C/m); it separates the surface water (epilimnion) from the cold hypolimnion below
Zooplankton	Minute animals that graze algae, bacteria and detritus in water bodies

Term	Definition
AFDM	Ash-free dry mass
Chl-a	Chlorophyll-a units µg/L
DO	Dissolved oxygen units mg/L
N	Nitrogen units mg/L as N
Ortho-P	Orthophosphate ≈ SRP monomeric inorganic phosphorus units mg/L as N
P	Phosphorus units mg/L as P
DIN	Dissolved inorganic nitrogen = ammonia + nitrate + nitrite units mg/L as N
TDN	Total dissolved nitrogen = ammonia + nitrate + nitrite + dissolved organic N units mg/L as N
TDP/DP	Total dissolved phosphorus units mg/L as P
TN	Total nitrogen: organic + dissolved units mg/L as N
TP	Total phosphorus: organic + dissolved units mg/L as P

Lake Classification by Trophic Status Indicators (Nordin, 1985)

Trophic Status	chlorophyll-a ug/L	Total P ug/L	Total N ug/L	Secchi disc m	Phytoplankton density (cells/mL)	Phytoplankton biomass (mg/m^3)
Oligotrophic	0 – 2	1 – 10	<100	> 6	<1000	0-500
Mesotrophic	2 – 5	10 – 20	100 – 500	3 – 6	1000-5000	500-2000
Eutrophic	>5	> 20	500-1000	< 3	>5000	>2000

Nutrient Balance Definitions for Microflora (Dissolved Inorganic N : Dissolved Inorganic P) (Nordin,1985)

Phosphorus Limitation	Co-Limitation of N and P	Nitrogen Limitation
>15 : 1	<15 : 1 – 5 : 1	5 : 1 or less

1.0 Introduction

1.1 Overview

The British Columbia Ministry of Environment and Climate Change Strategy (ENV) in partnership with the City of Kelowna, the Regional District of Central Okanagan, and the District of Summerland began a seasonal sampling program of Okanagan Lake in 2011 to increase the temporal resolution of water quality data being gathered. This program was performed collaboratively between ENV staff, Okanagan Nation Alliance (ONA; 2011), and Larratt Aquatic Consulting (2012-2023). The current program is overseen by the Okanagan Basin Water Board (OBWB). Okanagan Lake was sampled monthly from March to September from 2011-2023 at four key sites (Figure 1, Table 4).

Table 4: GPS coordinates of sampling sites

Site Name	EMS ID	Latitude	Longitude
Summerland	0500454	49.600550°	-119.628030°
Kelowna	0500236	49.861350°	-119.513420°
Ok Centre	0500730	50.089900°	-119.478270°
Armstrong Arm	0500239	50.315450°	-119.357180°

Note: EMS = Environmental Monitoring System and serves as ENV's database of water quality

Sampling focused on three broad subjects at each site: physical parameters, water chemistry, and biological activity.

Physical parameters including temperature profiles were taken at each site on each date to build a composite image of conditions in Okanagan Lake over time (Figure 4). Secchi depth, a measure of water clarity, was also recorded for each site.

In addition, dissolved oxygen profiles were taken and a range of parameters were chemically analyzed from samples taken in the epilimnion (1-5-10 m composite) and the hypolimnion (20-32-45 m composite). Chemistry focused on the major nutrients in their various forms. Chemistry results were analyzed by ALS Environmental throughout this study.

Biological sampling included generic parameters such as chlorophyll-a concentration and biomass, as well as detailed taxonomic classification of phytoplankton (algae) and zooplankton.

The 2023 data were added to the existing 2011 – 2022 database upon which all the analyses in this report were performed. Water quality objectives were based upon Nordin (2005) (Appendix 1).

Figure 1: Okanagan Basin Watershed with four sampling locations identified

1.2 Weather and Climate Conditions in 2023

The weather during any given year will have a major impact on physical conditions, water chemistry, and biological activity in Okanagan Lake during that and subsequent years. The weather during 2023 was another unusual year for the Okanagan climate (Figure 2). Spring was cooler than normal for the Okanagan with a large freshet in the Mission Creek watershed followed by a shift to hot dry weather that extended through the end of the year; 2023 was the driest year on record for the Okanagan. The water level of Okanagan Lake was held near normal despite the very hot and dry conditions because of very low outflows in the Okanagan River (Figure 3). The summer drought primed the conditions for the McDougall Creek wildfire that devastated West Kelowna. Numerous large wildfires have occurred recently within the Okanagan that affect the hydrology of the watershed. For example, damage to the Whiteman Creek watershed from the 2021 White Rock Lake wildfire caused major flooding and infrastructure damage during the large 2023 freshet. This type of extreme weather is expected to become more frequent and more intense because of Climate Change.

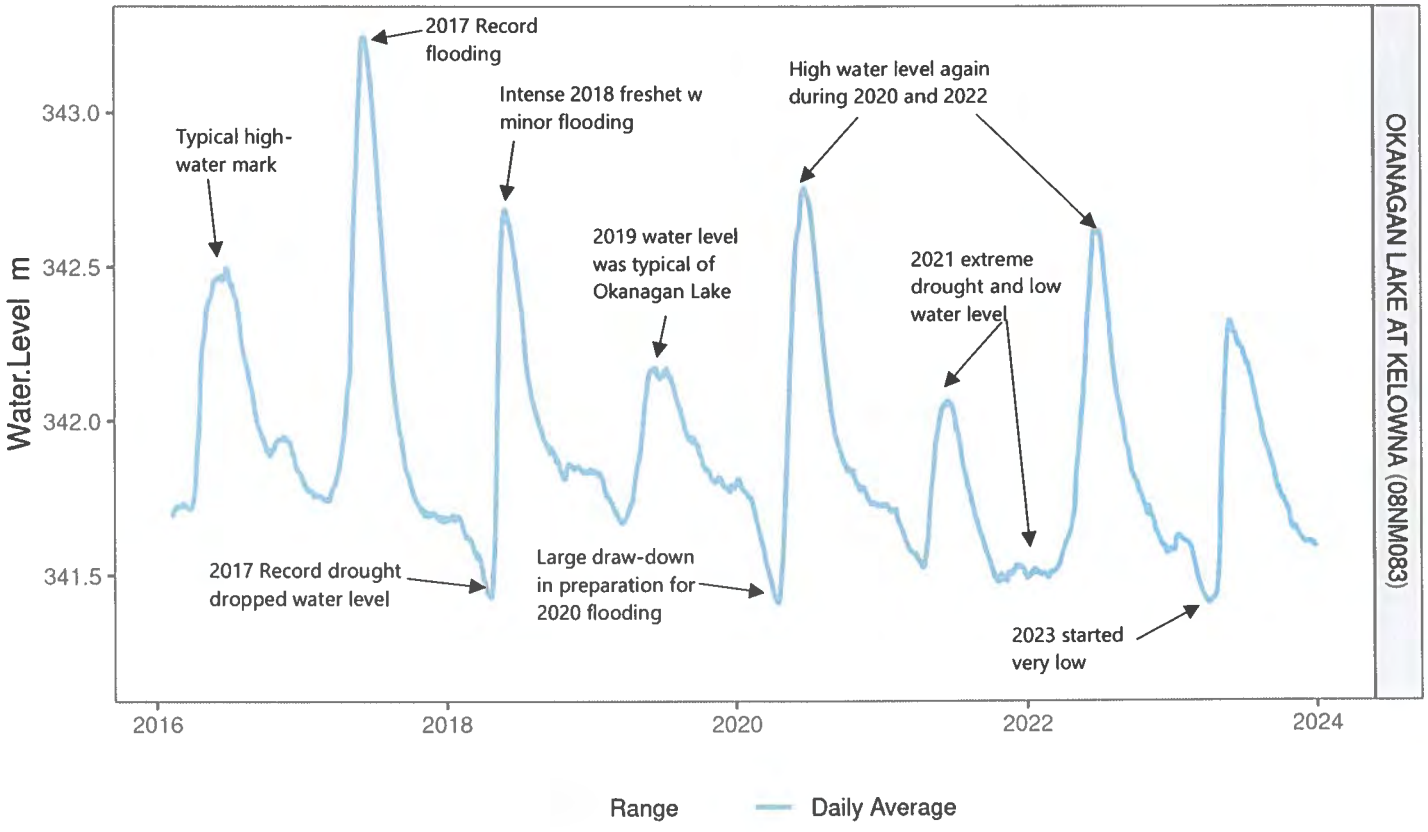

Figure 2: Water level in Okanagan Lake at Kelowna from 2016-2023
Source: (Water Office, 2024)

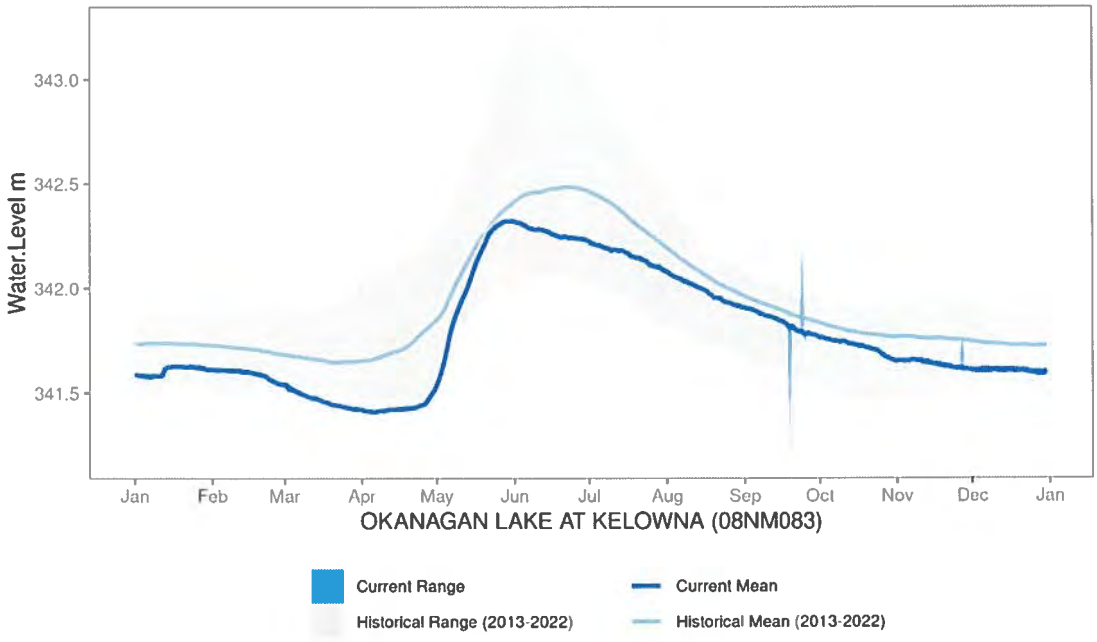

Figure 3: Water level in Okanagan Lake during 2023 compared to previous 10 years
Source: (Water Office, 2024)

2.0 Results & Discussion

2.1 Physical

2.1.1 Temperature

Okanagan Lake is a deep monomictic lake. From May to November each year, the surface water (epilimnion) is thermally isolated from the deep water (hypolimnion) by a thermocline. The sun warms the epilimnion to over 20 °C each summer while water below 20 m changes temperature by less than 4 °C annually (Figure 4).

The three main basin sites (Summerland, Kelowna, and OK Centre) exhibit similar thermal behavior while the northern Armstrong Arm site is shallower and reaches a higher surface temperature each summer (Figure 4). Thermal stratification in Okanagan Lake breaks down each November and the water column freely circulates through the winter. There were no statistically significant trends in the 2011–2023 temperature data either annually, seasonally (Mann-Kendall trend tests).

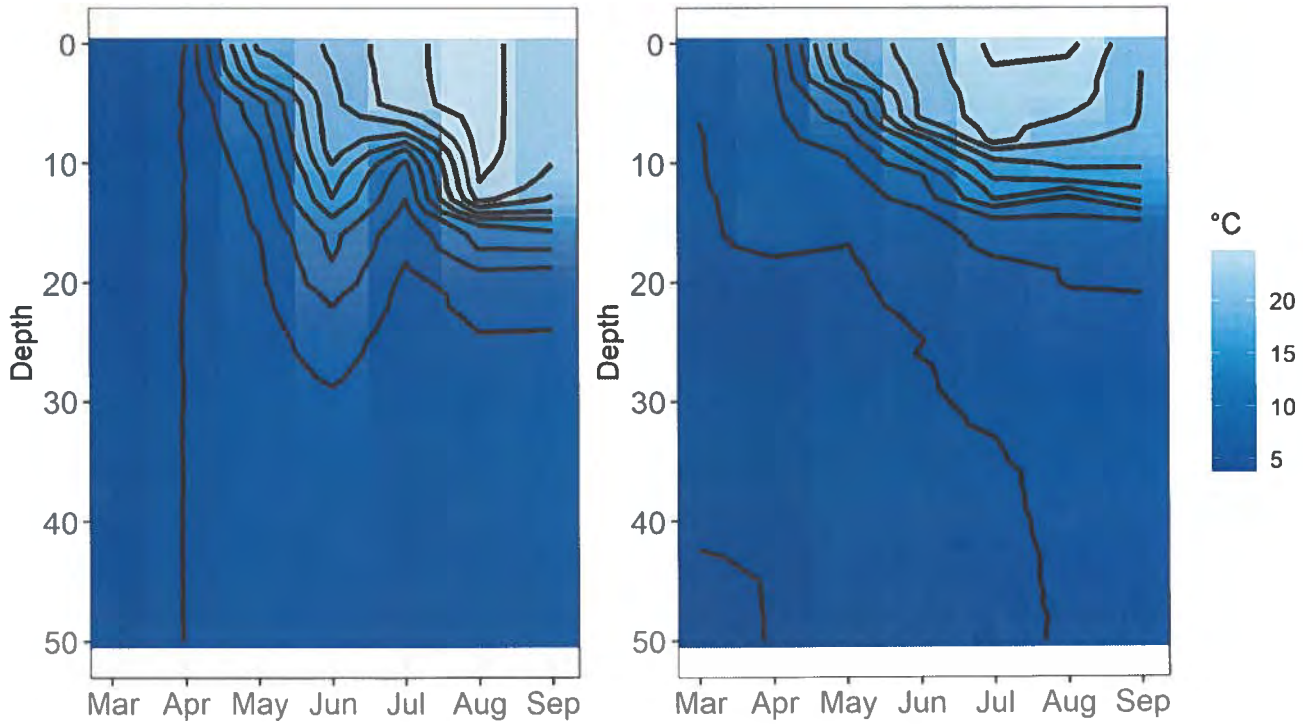

Figure 4: Temperature profiles for Okanagan Lake at Summerland (left) and Armstrong Arm (right), 2023

Notes: Lines represent contours of same temperature or dissolved oxygen within the water column through time. Samples not collected during March 2020 at Armstrong Arm because of ice-cover

Surface water temperatures of Okanagan Lake at all four sites were below average throughout the cool, wet spring before transitioning to above average during the late spring into fall months (Figure 5). Surface temperatures during May and June were among the warmest recorded for that time of year (Figure 5).

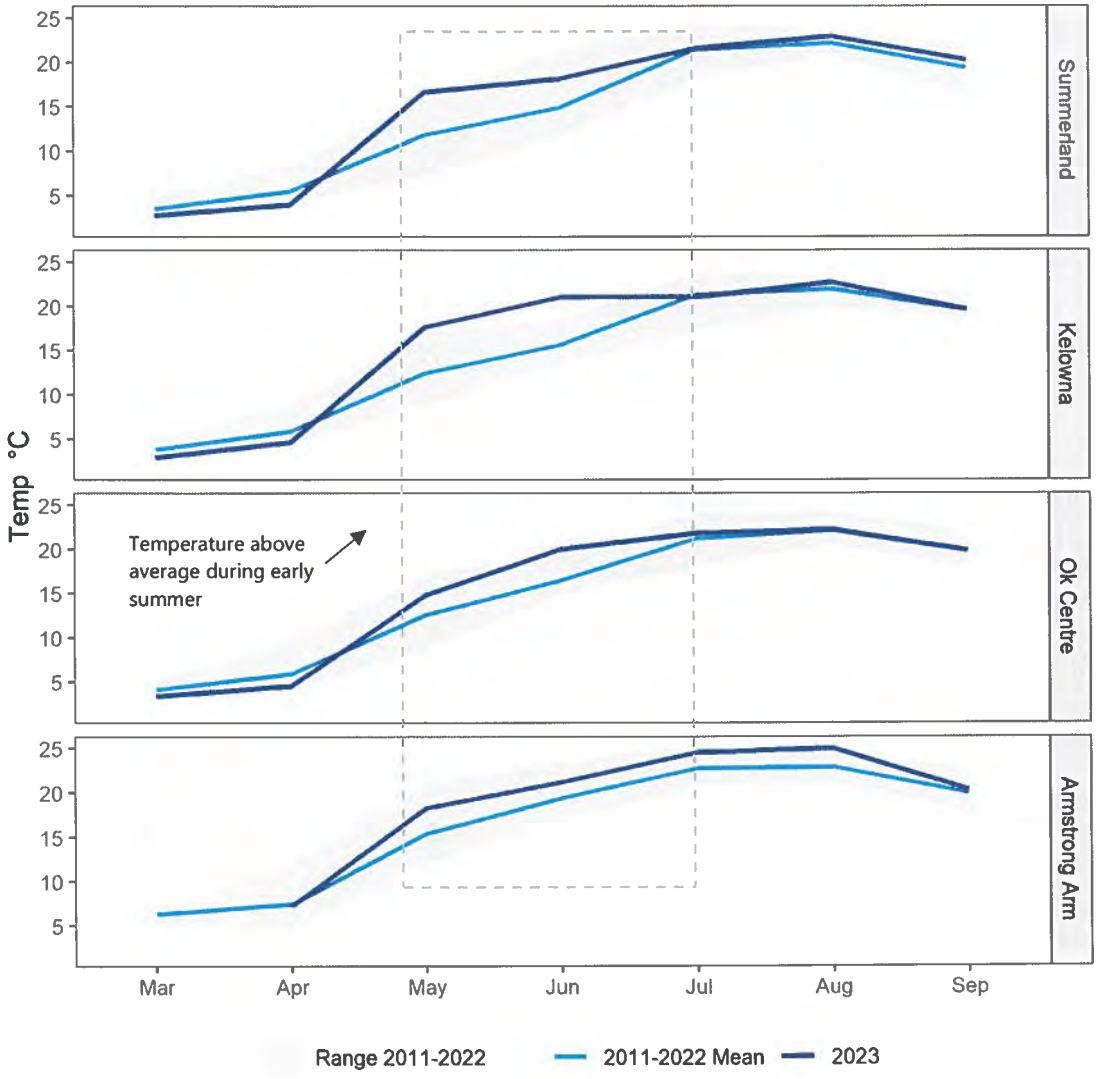

Figure 5: Temperature at Okanagan Lake sampling sites during 2023 compared to 2011-2022

2.1.2 Water Clarity and Secchi Depth

Water clarity, as measured by Secchi depth, ranged from a minimum of only 1.8 m at Armstrong Arm in May to a maximum of 11.7 m at Okanagan Centre in March during 2023 (Table 5). Secchi depth annual averages were below the 2011-2022 average during 2023 (Figure 6, Figure 7). All sites failed to meet their respective objectives during 2023 (Table 5). The overall average for Okanagan Lake historically has been 6.5-6.6 m but averaged 5.6 ± 2.9 m in 2023 (Andrusak et al., 2006; Nordin, 2005). The relatively low water clarity during 2022 may relate to an increasing trend in chlorophyll-a observed throughout the lake during the past 10 years (Figure

17). Extensive watershed damage from recent large wildfires also contributes fine sediment and nutrients to Okanagan Lake that directly and indirectly impair water clarity.

Secchi depth followed a consistent pattern each year. Maximum Secchi depths occurred in the late winter when biological activity was the lowest. During increased spring algal growth and freshet, the Secchi depth dropped dramatically to the lowest of the year at all sites. As nutrients were used up, algae concentrations diminished, and water clarity increased through the summer and into the fall (Figure 6).

The Secchi depth in the Armstrong Arm was much lower than at the other sites in Okanagan Lake during all years. This is clearly illustrated in Figure 7. Secchi depth was stable from 2011-2023 and there were no statistically significant year-over-year trends in the Secchi depth data from 2011-2023 but there was a significant drop when the 1973-2023 historical data was considered (Mann-Kendall tests, Figure 7). This long-term trend is related to a period of high water-clarity in the years following the installation of nutrient removal systems at wastewater treatment plants; the current lower water clarity likely relates to the cumulative effects of increased population and human activities within the Okanagan watershed over the past 30 years.

Table 5: Growing Season (Apr-Sep) Secchi depth in meters at Okanagan Lake sampling sites, 2023

Site	Objective	Average	StdDev	Max	Min
Summerland	7.0	6.0	1.5	8.3	4.1
Kelowna	6.0	5.3	1.5	7.4	3.4
Ok Centre	6.0	5.8	3.1	11.4	2.5
Armstrong Arm	5.0	2.8	0.8	3.8	1.8

Note: Objective refers to growing season average (Apr-Sep); Coloured shading indicates status of objective during that year with green meaning met objective and red meaning failed to meet objective

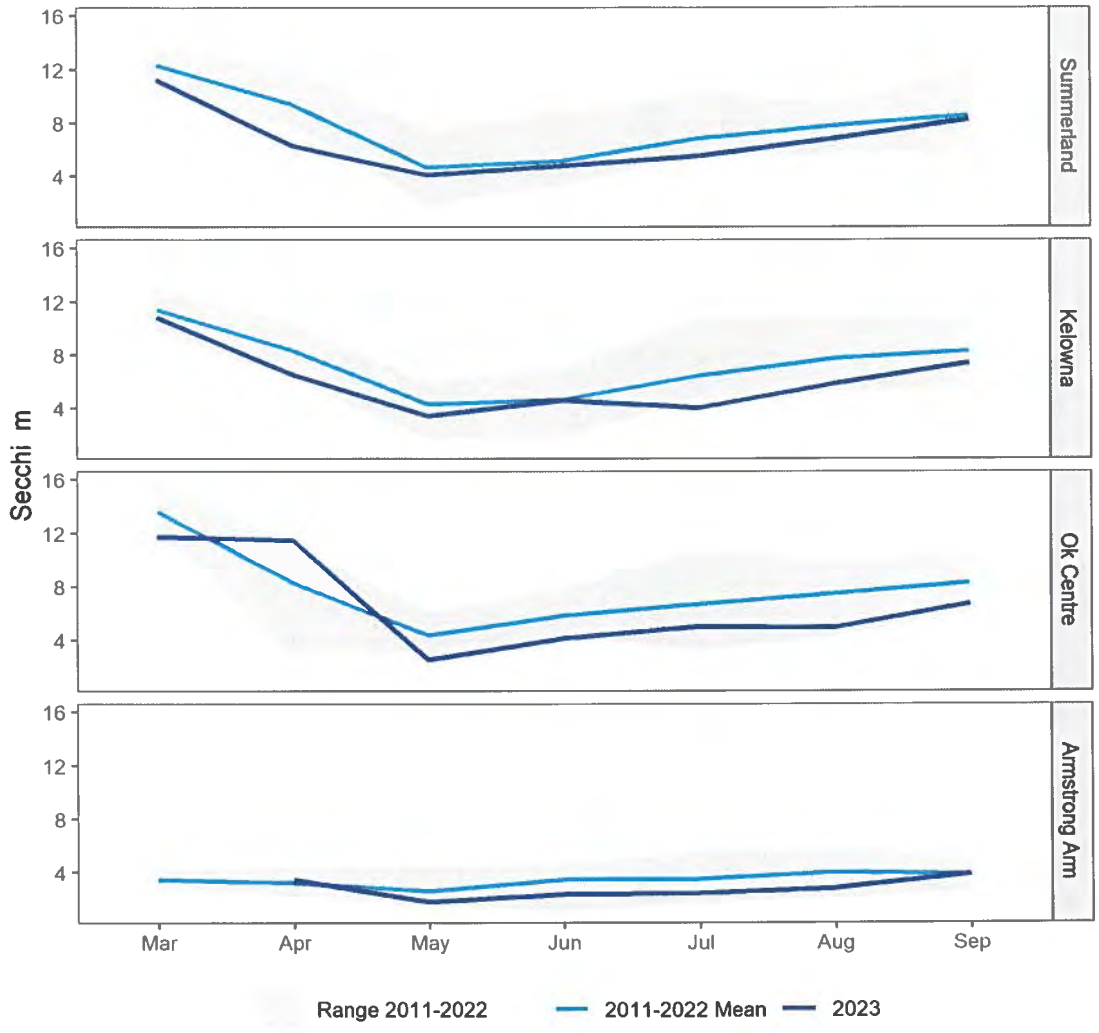

Figure 6: Secchi depth at Okanagan Lake sampling sites during 2023 compared to 2011-2022

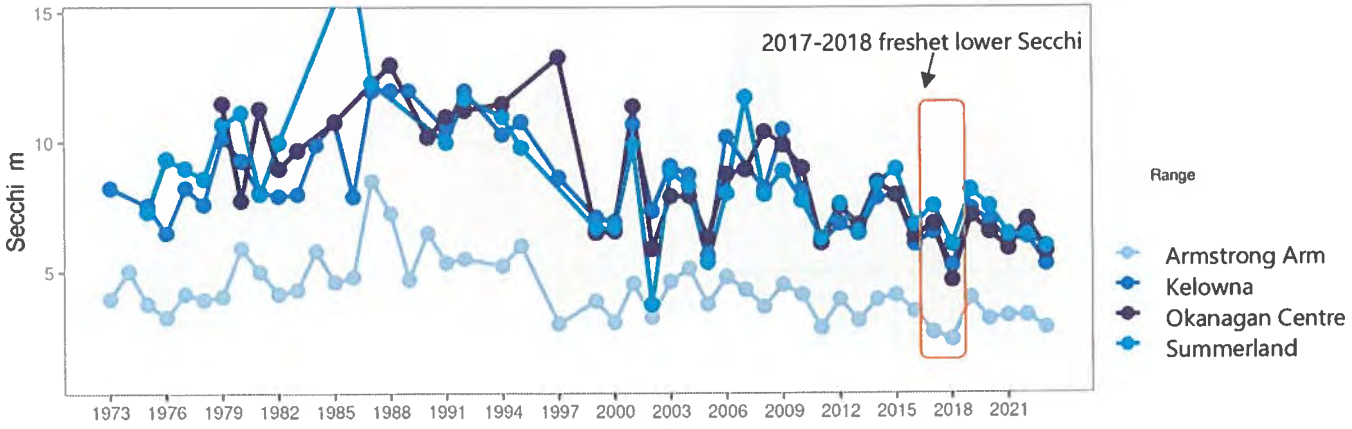

Figure 7: Annual average secchi depth in Okanagan Lake from 1973-2023

2.2 Chemistry

Chemistry sampling focused on dissolved oxygen, nitrogen and phosphorus (the most important aquatic nutrients), and silica, a key micronutrient. Increasing nutrient trends frequently result from human activities such as wastewater effluent disposal, riparian degradation, agriculture, fertilizer use, storm water, etc. These human-caused impacts are gradual and are easiest to detect as year-over-year trends.

2.2.1 Dissolved Oxygen

Dissolved oxygen (DO) is essential for all aquatic animals. Low DO will stress fish and possibly preclude them from certain portions of the water column. Hypoxic conditions occur when DO is very low (<2 mg/L) and this has a profound impact on water chemistry through the mobilization of nutrients and metals from the sediment. The three major basin sites (Summerland, Kelowna, and OK Centre) exhibit similar thermal and high dissolved oxygen behavior while the northern Armstrong Arm site is shallower and behaves differently. The later reaches a higher surface temperature and experiences a reduction in dissolved oxygen in the deep water each summer (Figure 8). The reduction in dissolved oxygen is caused by decomposition of organic material in the sediment and deep water and can lead to internal nutrient loading if oxygen becomes depleted. The Armstrong Arm is the only site with a dissolved oxygen objective (>5 mg/L in bottom water), a threshold that it fails to meet every year. By September 2022, the low dissolved oxygen zone (depth below red line in Figure 8) had expanded to 35 m thick with a minimum concentration of only 2.13 mg/L.

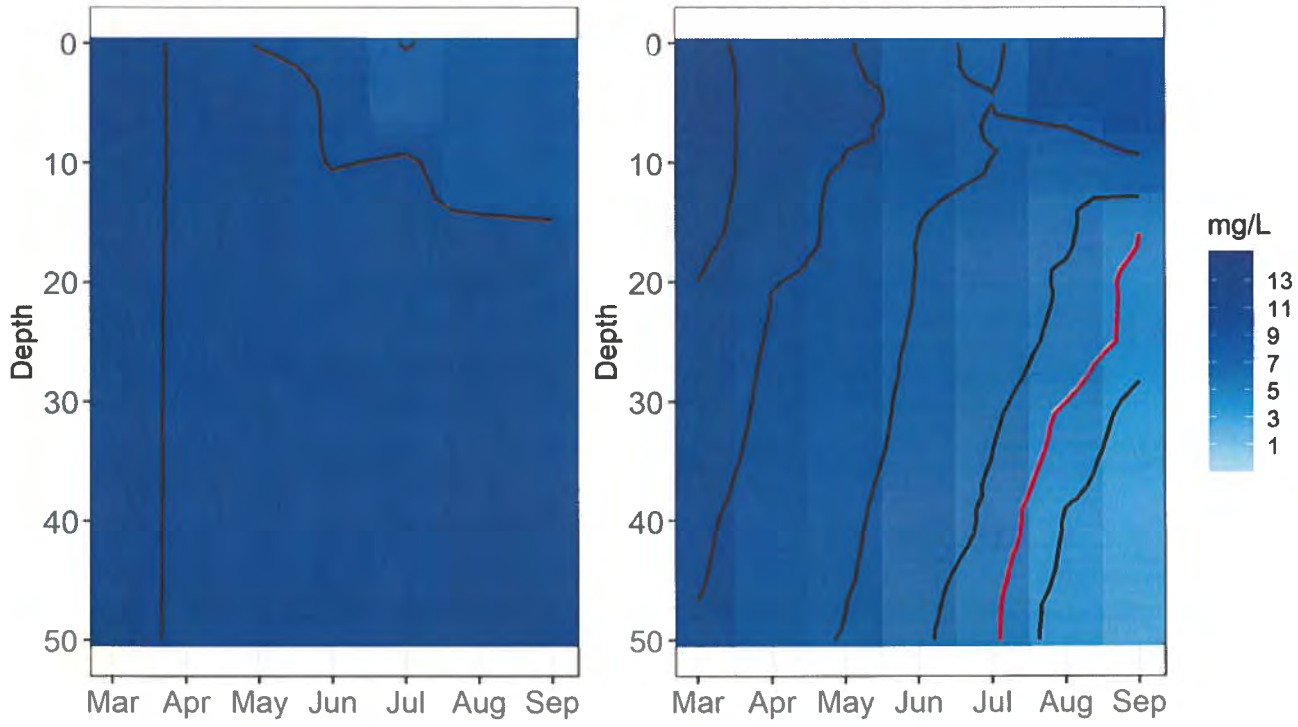

Figure 8: Dissolved oxygen profiles for Okanagan Lake at Summerland (left) and Armstrong Arm (right) during 2023

Dissolved oxygen profile illustrates high dissolved oxygen concentrations at Summerland and characteristic oxygen depletion in deep waters of the Armstrong Arm. Lines represent contours of same dissolved oxygen within the water column through time. Note: The red line on dissolved oxygen plot represents Water Quality Objective; all water below this line does not meet the objective.

2.2.2 Silica

Diatoms, a major group of algae in Okanagan Lake, use silica (measured as dissolved silica) as a structural building block for their cell walls. While no objectives for silica concentrations in Okanagan Lake have been set, monitoring continues as silica is a key micronutrient for this important group of algae. Silica sampling shifted to only March and September beginning in 2015 because it did not change significantly over the course of the growing season from 2011-2014. Silica was higher during 2017-2018, likely an effect of the flooding and intense freshets during those years, but when looking at the long-term data, there was an increasing trend from the 1970s to 2000 followed by a period of stability since 2000 (Table 6, Figure 9).

Table 6: Silica concentration in mg/L at Okanagan Lake sampling sites, 2023

Site	Average	StdDev	Max	Min
Armstrong Arm	8.06	1.10	10.30	6.78
Kelowna	6.69	0.50	7.32	5.89
Ok Centre	7.06	0.47	7.64	6.39
Summerland	6.35	0.99	7.31	3.27

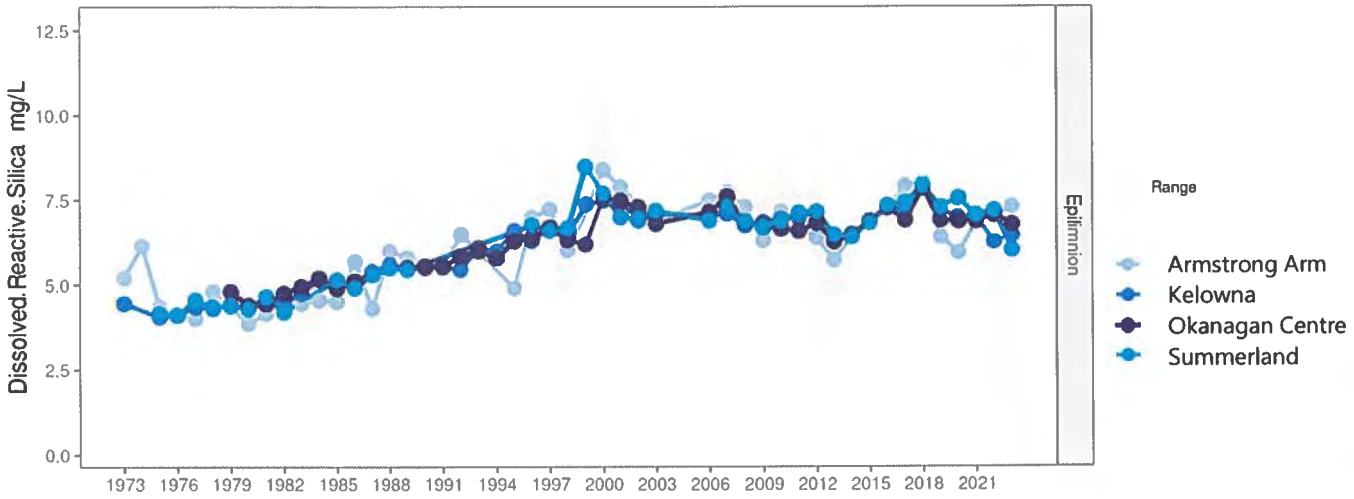

Figure 9: Annual average silica concentration in Okanagan Lake at each sampling site by year with trends highlighted, 1973-2023

2.2.3 Nitrogen and Phosphorus

Nitrogen and phosphorus are the most important nutrients in most aquatic environments. Nutrient limitation occurs when an essential element (most commonly nitrogen and/or phosphorus) is in relatively short supply. Algae production is limited by the availability of that nutrient despite potential abundance of other nutrients. In the Okanagan, phosphorus is the main limiting nutrient while dissolved inorganic nitrogen also limits productivity during the summer. Their concentrations are directly linked to the amount of algae that the lake produces (Nordin, 2005).

Nitrogen

Total nitrogen (TN) averaged 0.225 ± 0.031 mg/L as N in the epilimnion of Okanagan Lake during 2023. The objective for Okanagan Lake was set as a spring value (March sample date[1]) of 0.230 mg/L for the main basins and 0.250 mg/L for the Armstrong Arm. The objective was exceeded at Summerland, Kelowna, and Okanagan Centre during 2023 as it has in most years (Table 7). TN, previously identified as increasing, appears to have stabilized in the main basins while TN showed a declining trend in the Armstrong Arm from 2017-2023 (Mann-Kendall, p≤0.02; Table 7). Average TN values were comparable to those found in the literature for Okanagan Lake (0.17-0.23 mg/L as N; Andrusak et al.,2000).

[1] The Armstrong Arm sample is typically collected in early April because of ice-cover in that part of the lake

Table 7: Total nitrogen in mg/L as N concentration at Okanagan Lake sampling sites, 2023

Site	Depth	Objective	Trend	Avg	SD	Max	Min
Summerland	<10m	0.230	-	0.216	0.025	0.26	0.181
	>20m		-	0.237	0.019	0.268	0.212
Kelowna	<10m	0.230	-	0.220	0.026	0.261	0.192
	>20m		-	0.237	0.016	0.26	0.219
Ok Centre	<10m	0.230	-	0.220	0.028	0.254	0.185
	>20m		-	0.239	0.022	0.278	0.204
Armstrong	<10m	0.250	↓*	0.244	0.041	0.31	0.193
Arm	>20m		↓*	0.280	0.039	0.353	0.245

Note: Red shaded cells indicate that the Spring value exceeded the objective while green indicates that the value met the objective. Statistical significance of general trends derived from all data for a site may disappear when depths are split apart due to smaller sample size | * = Trend from 2017-2023

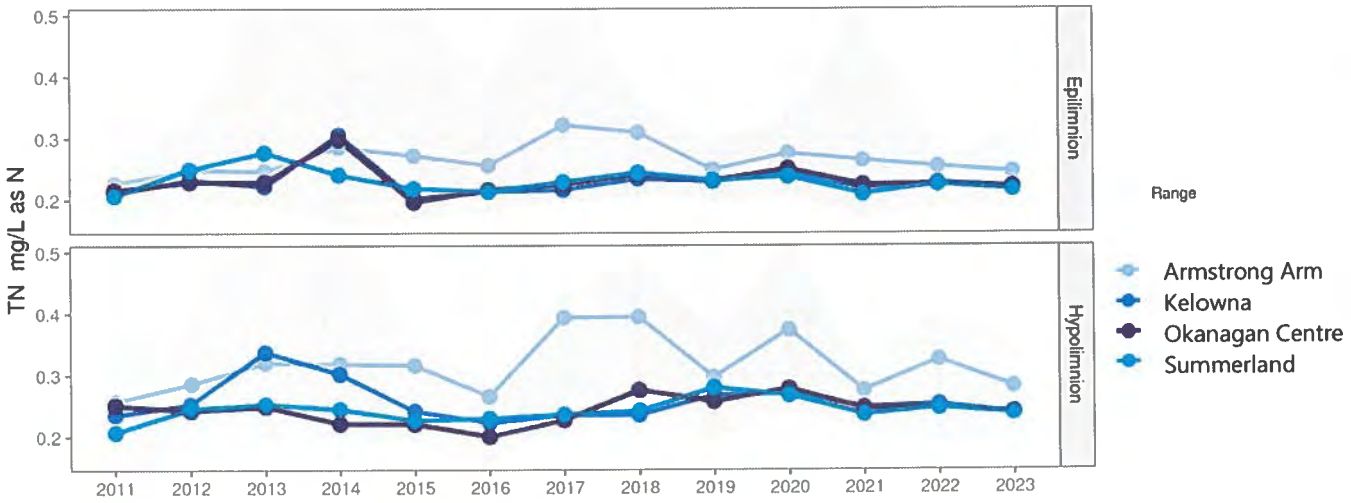

Figure 10: Annual average total nitrogen in Okanagan Lake, 2011-2023

Hypolimnetic nitrate increased at all sites from 2011-2023 (Mann-Kendall, $p<0.001$; Figure 11), but was stable at all sites from 2019-2023, despite the longer-term trend. Analysis of the entire Okanagan Lake water chemistry database indicates that this trend has been ongoing for decades (1973-2023 dataset; Mann-Kendall, $p<0.001$; Figure 11). This suggests a connection to human activities in the region because the trend has continued through several wet-dry climate cycles. There is also recent research noting that changes in nitrate concentration are a marker of climate change (Mas-Pla & Menció, 2019; Stuart et al., 2011). Layered on top of this trend are short-term variations depending on a given year's weather.

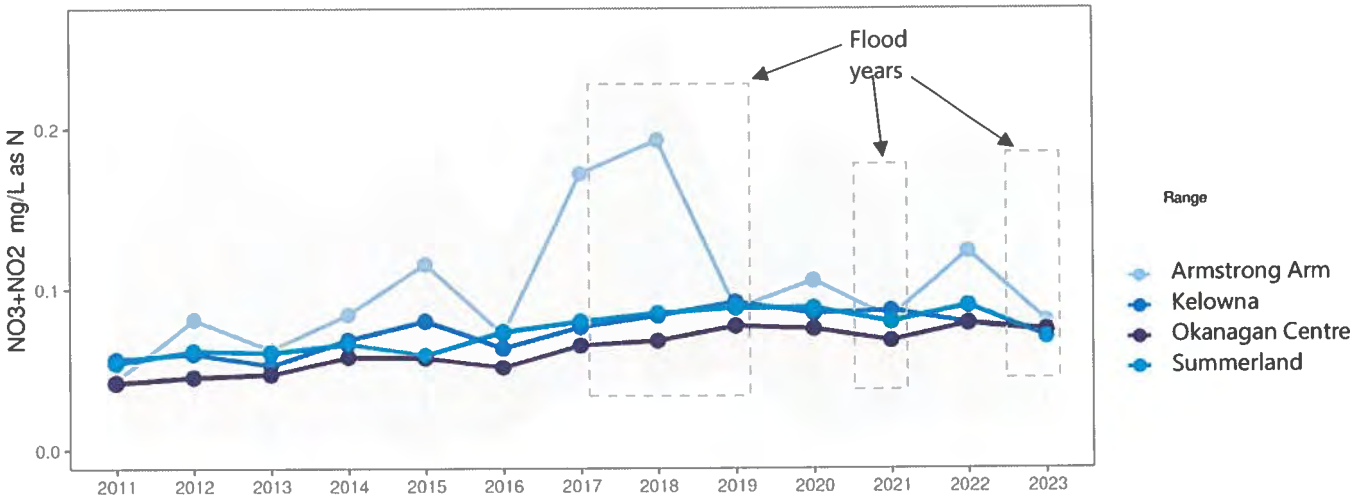

Figure 11: Annual average nitrite (NO_2) + nitrate (NO_3) in mg/L as N in the deep water of Okanagan Lake, 2011-2023

Nitrate is rapidly consumed by algae in the epilimnion each spring and thermal stratification prevents replenishment from the deeper water during the summer (Figure 11). Nitrate increased dramatically each summer in the hypolimnion of the Armstrong Arm because of chemistry associated with the low-DO conditions (Figure 12). For example, nitrate increased from <0.0032 mg/L as N in the epilimnion to 0.179 mg/L as N in the hypolimnion by Sept 2023.

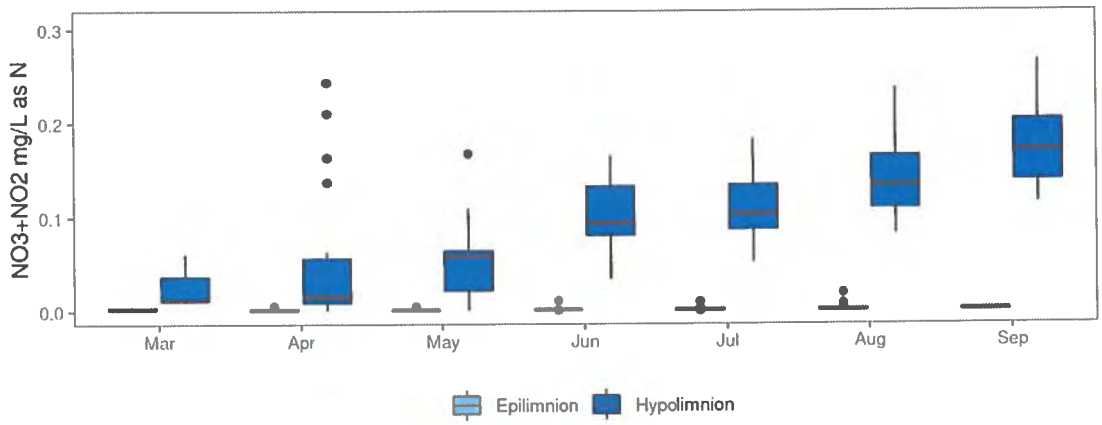

Figure 12: Nitrate + nitrite in Okanagan Lake at Armstrong Arm by month illustrating seasonal accumulation of nitrate in low oxygen hypolimnion, 2011-2023

Phosphorus

Total phosphorus (TP) measures all forms of phosphorus including those that may not be bioavailable. Total phosphorus averaged 0.008 ± 0.006 mg/L as P across Okanagan Lake during 2023 (Table 8). The TP objective for Okanagan Lake applies to the maximum phosphorus concentration at the spring overturn (Nordin, 2005; taken as March[2]). The objectives range from 0.007 mg/L in the south basin to 0.010 mg/L in the Armstrong Arm.

The TP objective was exceeded in the epilimnion and hypolimnion of Armstrong Arm in 2023, as it was in most years from 2011-2023 (Table 8). Increasing trends in TP occurred at all sites from 2011-2023 (Mann-Kendall, p≤0.04; Table 8, Figure 13). This trend was driven, in part, by large increases in TP during wet years such as 2012-2013 and 2017-2018, 2020, and 2022. The trend was also more pronounced in the Armstrong Arm and north basin compared to the central or south basins. TP includes phosphorus associated with suspended sediment carried into the lake and it increases in Okanagan Lake during wet years and decreases during dry years (Figure 13).

Table 8: Total phosphorus (mg/L as P) at Okanagan Lake sampling sites during 2023

Site	Depth	Objective	Trend	Avg	SD	Max	Min
Summerland	<10m	0.007	↑	0.005	0.000	0.005	0.004
	>20m		↑	0.005	0.001	0.007	0.004
Kelowna	<10m	0.008	-	0.006	0.001	0.009	0.005
	>20m		↑	0.005	0.001	0.006	0.005
Ok Centre	<10m	0.008	↑	0.007	0.002	0.010	0.005
	>20m		↑	0.006	0.001	0.008	0.004
Armstrong	<10m	0.010	↑	0.012	0.005	0.020	0.007
Arm	>20m		↑	0.019	0.009	0.036	0.013

Note: Red shaded cells indicate that spring overturn value exceeded the objective while green shaded cells met the objective during 2022. Trends are based upon 2011-2023 data only

[2] The Armstrong Arm spring sample is typically collected in early April because of ice-cover in March

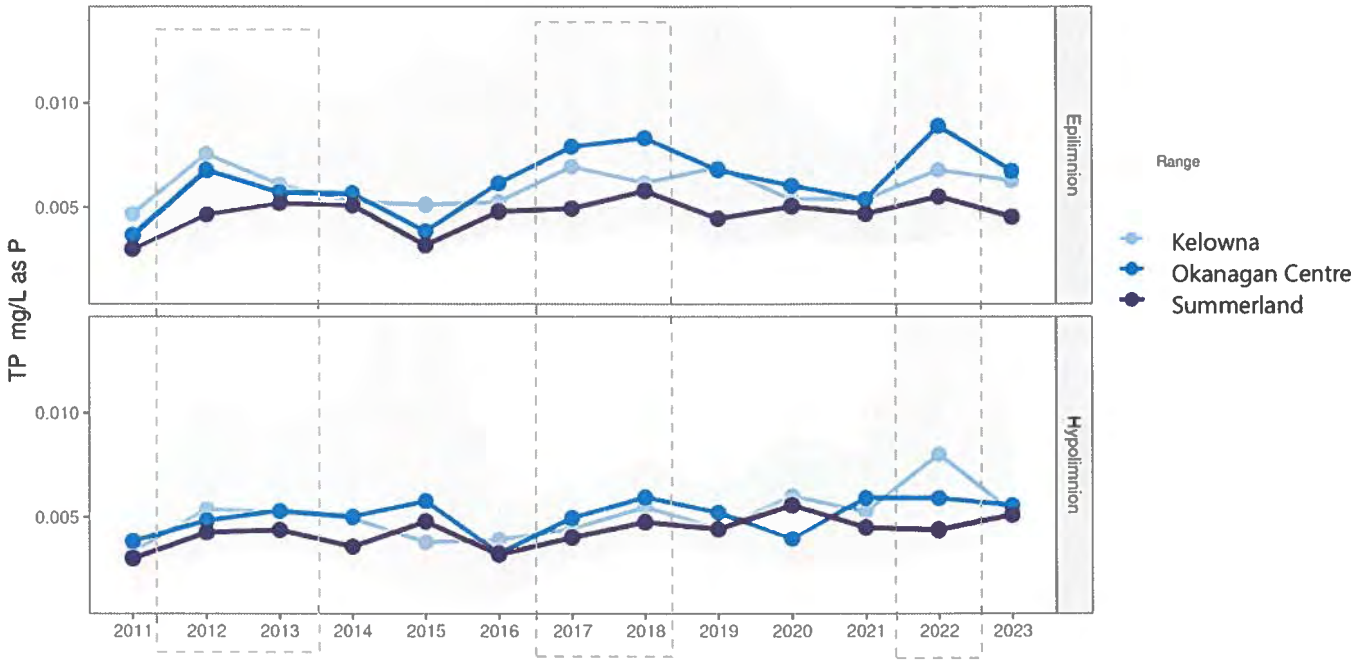

Figure 13: Annual average total phosphorus in Okanagan Lake at the three major basin sampling sites by year from 2011-2023

Notes: Grey boxes indicate wet years, decreasing trend from 1973-2005 and increasing trend from 2005-2023

TP experienced minor seasonal variation with a slight increase during freshet in some years at Summerland, Kelowna, and Okanagan Centre while there was dramatic variation in the Armstrong Arm over the course of each growing season. TP increased in the hypolimnion during the summer, possibly from phosphorus released from the sediment under low-oxygen conditions while algae productivity reduced surface concentrations over the growing season (Figure 14).

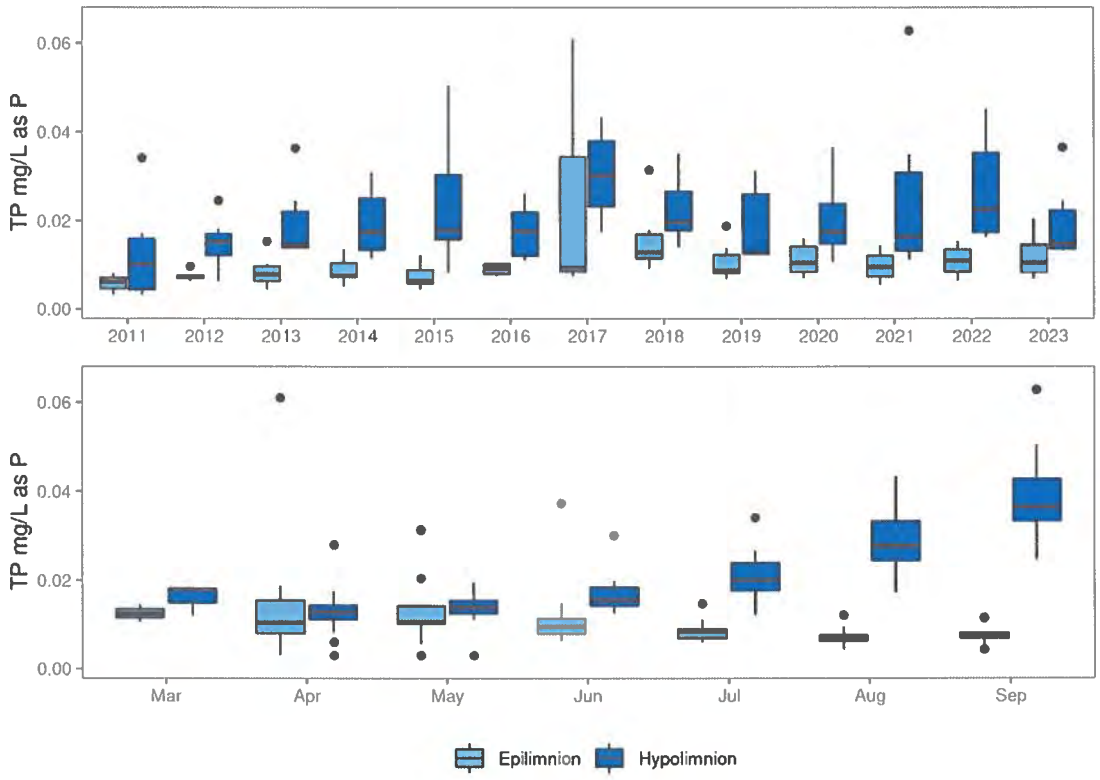

Figure 14: Total phosphorus in the Armstrong Arm, 2011-2023
Note: small reduction in eplimnetic TP over the growing season but it does not drop below detection as nitrate does

Dissolved phosphorus (TDP) measures the more bioavailable forms of phosphorus and is a good indicator of potential impacts to biota. TDP in the epilimnion and the hypolimnion of the Armstrong Arm increased (Mann-Kendall for 2011-2023 in the hypolimnion, p≤0.02). TDP was stable at Kelowna and Okanagan Centre but decreased in the epilimnion at Summerland from 2011-2023 (Mann-Kendall, p≤0.02). Despite the stable long-term trend, TDP was noticeably higher in the Okanagan Centre epilimnion samples immediately following the White Rock Lake Fire (Sep 2021) followed by a short-term decline through 2023 (Figure 15). Ortho-phosphate measures only the soluble reactive phosphorus fraction of the TDP and there were no significant trends in ortho-phosphate data at any of the sites from 2011-2023 with 93% of samples from the major basin sample sites having undetectable concentrations during 2023. Anoxic conditions in the Armstrong Arm increase hypolimnetic orthophosphate each summer.

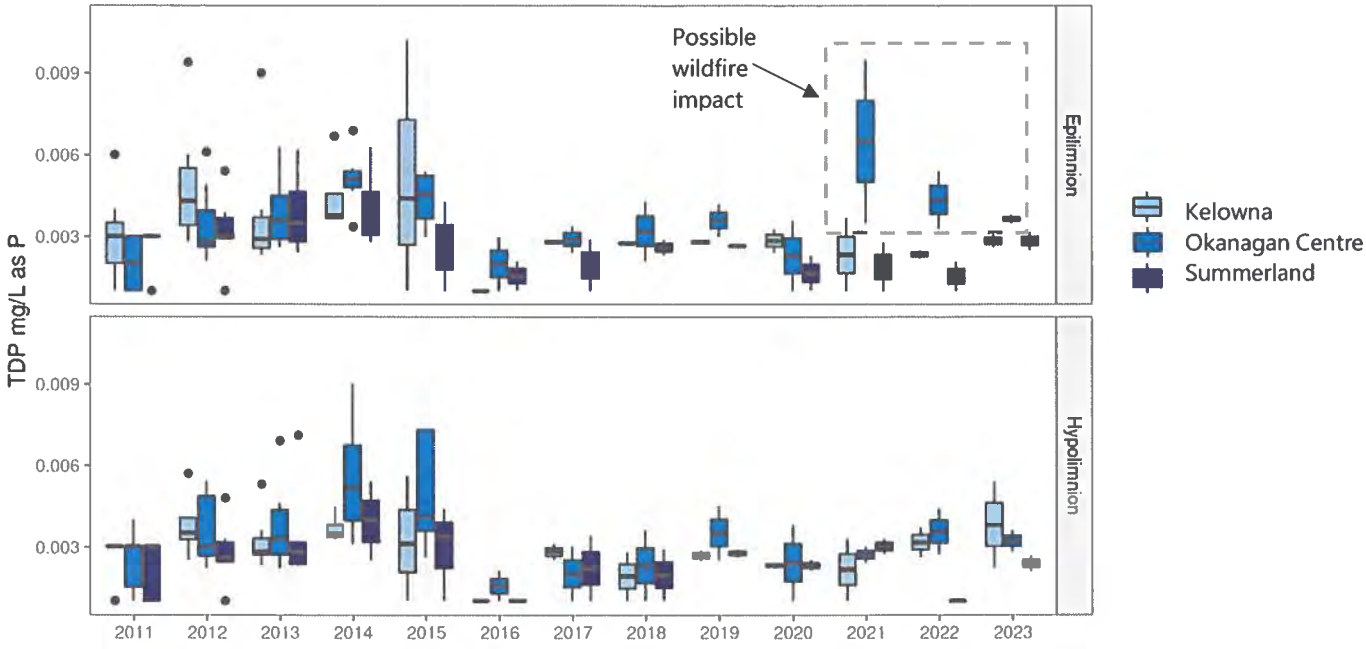

Figure 15: Annual average dissolved phosphorus in Okanagan Lake illustrating declining long-term trend at Okanagan Centre, Kelowna, and Summerland from 2011-2023

N:P Ratio

The ratio of nitrogen to phosphorus is a key factor in determining which types of phytoplankton will proliferate. Many species of cyanobacteria can fix atmospheric nitrogen and are therefore limited primarily by available phosphorus. These algae are more likely to bloom when phosphorus is abundant relative to nitrogen. The Okanagan Lake objective for the spring ratio of total nitrogen to total phosphorus is >25:1 in March samples. The objective was met at Summerland, Kelowna, and Okanagan Centre during 2023 while the Armstrong Arm had higher phosphorus concentrations than the rest of Okanagan Lake and did not meet the objective in 2023 (Figure 13, Table 9). The TN:TP ratio decreased at all sites from 2011-2023 (Mann-Kendall, $p \leq 0.02$) (Figure 13). The declining TN:TP trend is related to corresponding increasing trends in TP in Okanagan Lake (Table 8).

Table 9: Ratio of average TN to average TP during spring at Okanagan Lake sampling locations, 2011-2023

Site	Depth	TN	TP	2023 Ratio	Objective	Trend
Summerland	<10m	0.216	0.0045	59:1	>25:1	↓
	>20m	0.237	0.0051	57:1	>25:1	↓
Kelowna	<10m	0.220	0.0063	49:1	>25:1	-
	>20m	0.237	0.0052	47:1	>25:1	↓
Ok Centre	<10m	0.220	0.0067	33:1	>25:1	↓
	>20m	0.239	0.0056	41:1	>25:1	↓
Armstrong Arm	<10m	0.244	0.0118	20:1	>25:1	↓
	>20m	0.280	0.0194	18:1	>25:1	↓

Note: red shaded cells indicate that the value did not meet the objective while green shaded cells met the objective during 2022 | TN and TP columns display annual averages while ratio column is specific to the spring sample date

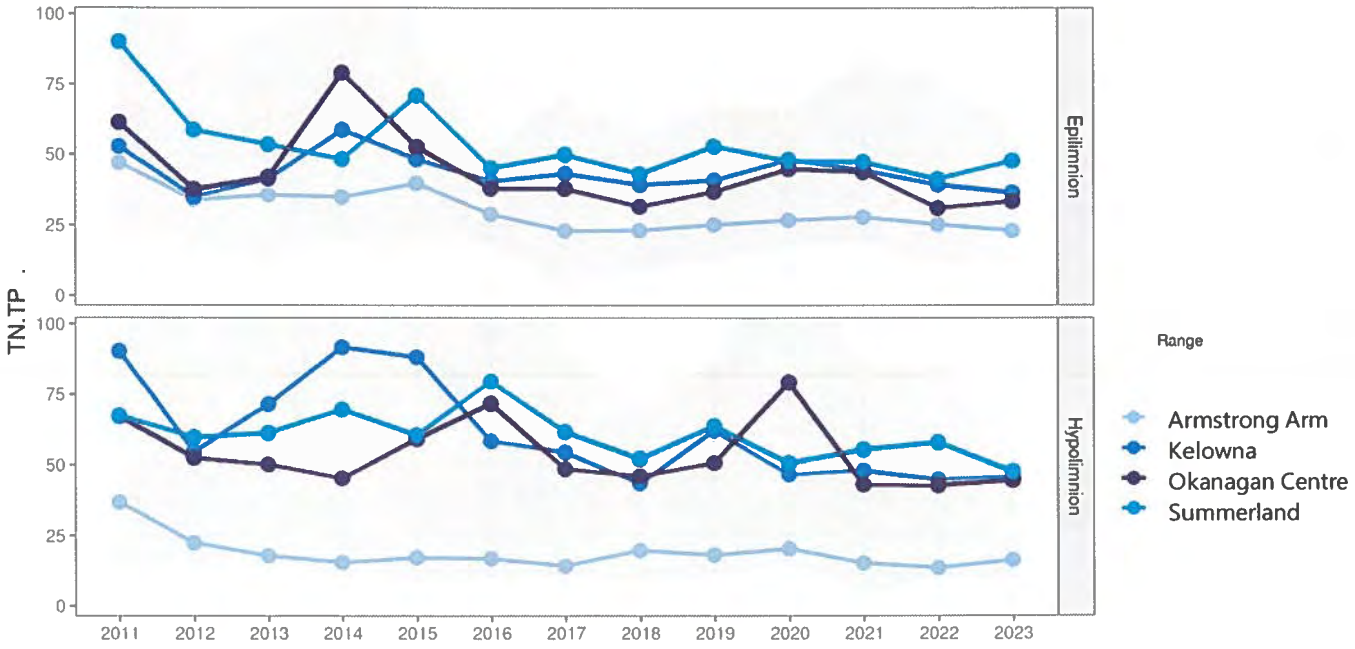

Figure 16: Nitrogen to phosphorus ratio at Okanagan Lake sampling sites 2011-2023

2.3 Biology

2.3.1 Phytoplankton

The Armstrong Arm of Okanagan Lake is shallower and has the potential to produce more phytoplankton and zooplankton than the deep basins of Okanagan Lake regardless of human activity. Phytoplankton and zooplankton samples were taken from all four sites were analyzed during 2022. Biomass analysis and taxonomic identification were performed on the taxonomy samples while chlorophyll-a concentrations were monitored as a productivity metric for phytoplankton abundance.

Chlorophyll-a

Chlorophyll-a (chl-a) is a photosynthetic pigment found in most freshwater algae species. As expected, chl-a followed an inverse trend to Secchi depth (Figure 6, Figure 17). Chl-a was lowest in the late winter and peaked in April-May during the increased spring algal growth before decreasing through the summer. During 2023, chl-a concentrations met the objectives at all sites (Table 10). Spring chl-a concentrations were high with a maximum of 5.2 µg/L in the Armstrong Arm (Table 10). Average chl-a concentrations in the Armstrong Arm have declined significantly since 2017 and averaged the lowest since 2014 (Mann-Kendall, p=0.01). Chl-a followed a similar if less pronounced pattern at Okanagan Centre (Figure 17), an encouraging result despite the watershed damage from the White Rock Lake wildfire (Figure 17).

In most years, including 2023, there was a north to south decreasing trend in the chlorophyll-a data with the Armstrong Arm having the highest and Summerland having lowest average concentrations (Table 10).

Table 10: Chlorophyll-a in µg/L at Okanagan Lake sampling sites, 2023

Site	Objective	Trend	Average	StdDev	Max	Min
Summerland	4	-	1.74	0.91	2.94	0.81
Kelowna	4.5	↑	1.97	0.84	3.03	1.10
Ok Centre	4.5	-*	2.16	0.42	2.59	1.48
Armstrong Arm	5	↓*	3.08	1.12	5.16	1.78

Note: Green shading indicates met objective during 2022 | * = 2017 to 2023

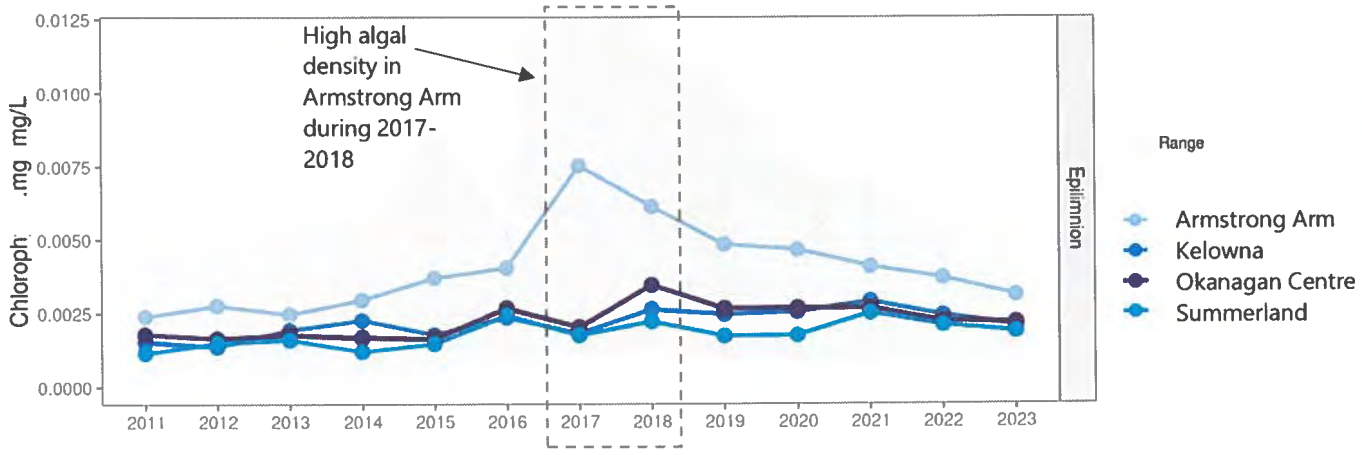

Figure 17: Annual chlorophyll-a concentration at the four Okanagan Lake sampling sites, 2011-2023

Phytoplankton Biovolume

Phytoplankton biovolume samples were collected as one litre composites from 1-10 m and the biovolumes were determined taxonomically. From 2011-2014, biomass was determined using

ash-free dry mass (AFDM). It is not possible to directly compare the results from the two methodologies and only the 2015-2023 results are considered here.

The objective is that the growing season average should be <0.75 µL/L (Table 11). Samples from all sites failed to meet the objective during 2023 because of above average phytoplankton production (Table 11, Figure 18, Figure 19).

Phytoplankton biovolume increased significantly from 2015-2023 at Summerland and at Kelowna (MK tests, p=0.001) - a trend that matches chlorophyll-a (Figure 18). Productivity was lower during 2022 than 2021 but increased again during 2023. A one-year lag has been observed between wet years and elevated productivity in Okanagan Lake and this effect helps explain why 2019 and 2021 production was very high despite the much smaller freshets (Figure 18). This is likely related to the higher productivity in 2023 because of the large 2022 freshet. Production in 2024 is therefore expected to be remain elevated after a smaller the moderate freshet combined with extensive watershed damage from wildfires.

Table 11: Phytoplankton biovolume in µL/L at Okanagan Lake sampling sites, 2023

Site	Objective	Trend	Average	StdDev	Max	Min
Summerland	<0.75	↑	0.790	0.710	2.168	0.224
Kelowna	<0.75	↑	1.135	1.263	3.673	0.199
Ok Centre	<0.75	-	1.004	0.820	2.281	0.142
Armstrong Arm	<0.75	-	0.814	0.256	1.316	0.553

Notes: Green shading = met objective while red shading = did not meet objective.

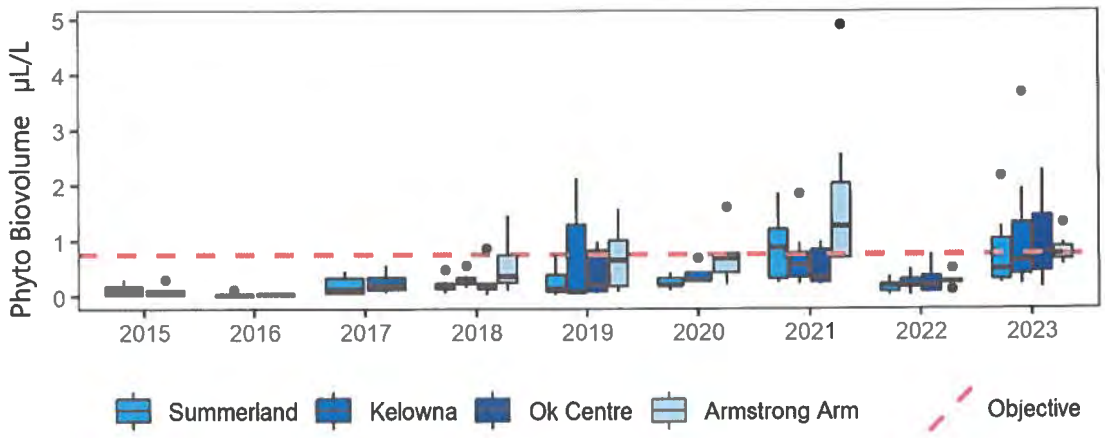

Figure 18: Phytoplankton Biovolume at Summerland and Kelowna, 2015-2023

Phytoplankton Taxonomy

Algae samples were identified to the species level and then grouped into broad algae types for analysis in this report. Diatoms tend to proliferate in the spring and their numbers decrease through the summer. Cyanobacteria were always numerous throughout the growing season in Okanagan Lake, but typically peaked in the late summer (Figure 19, Table 12). Algae counts were highest in the Armstrong Arm throughout the year but all sites experienced high densities of

cyanobacteria during 2023 (

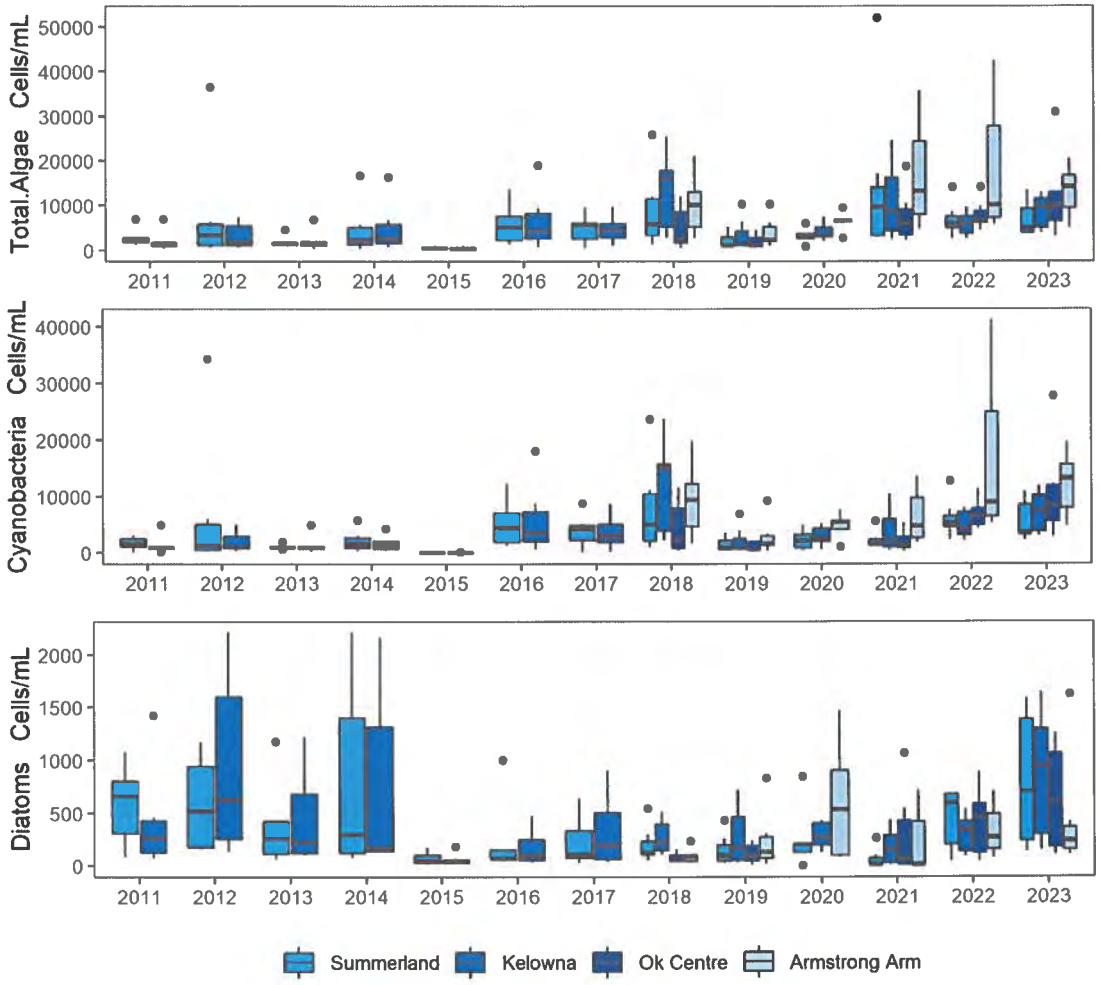

Figure 20). Very high cyanobacteria densities in the Armstrong Arm may be a marker for nutrients delivered to Okanagan Lake from the areas burned in the White Rock Lake wildfire.

Table 12: Average phytoplankton counts by major algae groups in cells/mL, 2023

	2023 Averages			
Algae Type	Summerland	Kelowna	Okanagan Centre	Armstrong Arm
Diatoms	800	838	624	420
Greens	129	102	261	180
Yellow-Brown	212	266	282	299
Cyanobacteria	5622	7086	10422	11954
Dinoflagellates	0	5	0	0
Other.Flagellates	127	175	177	165
Total Algae	6913	8472	11797	13032

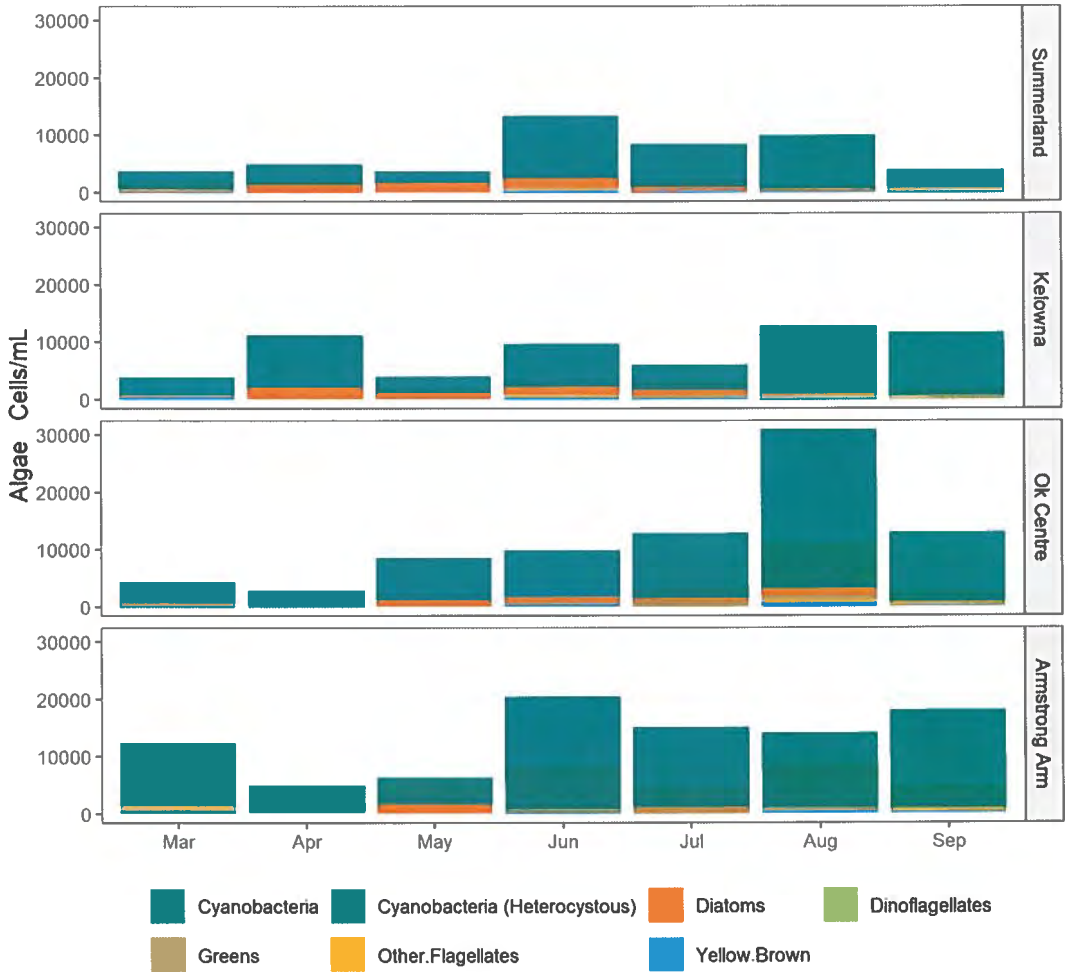

Figure 19: Taxonomic breakdown of algae by major types during 2023

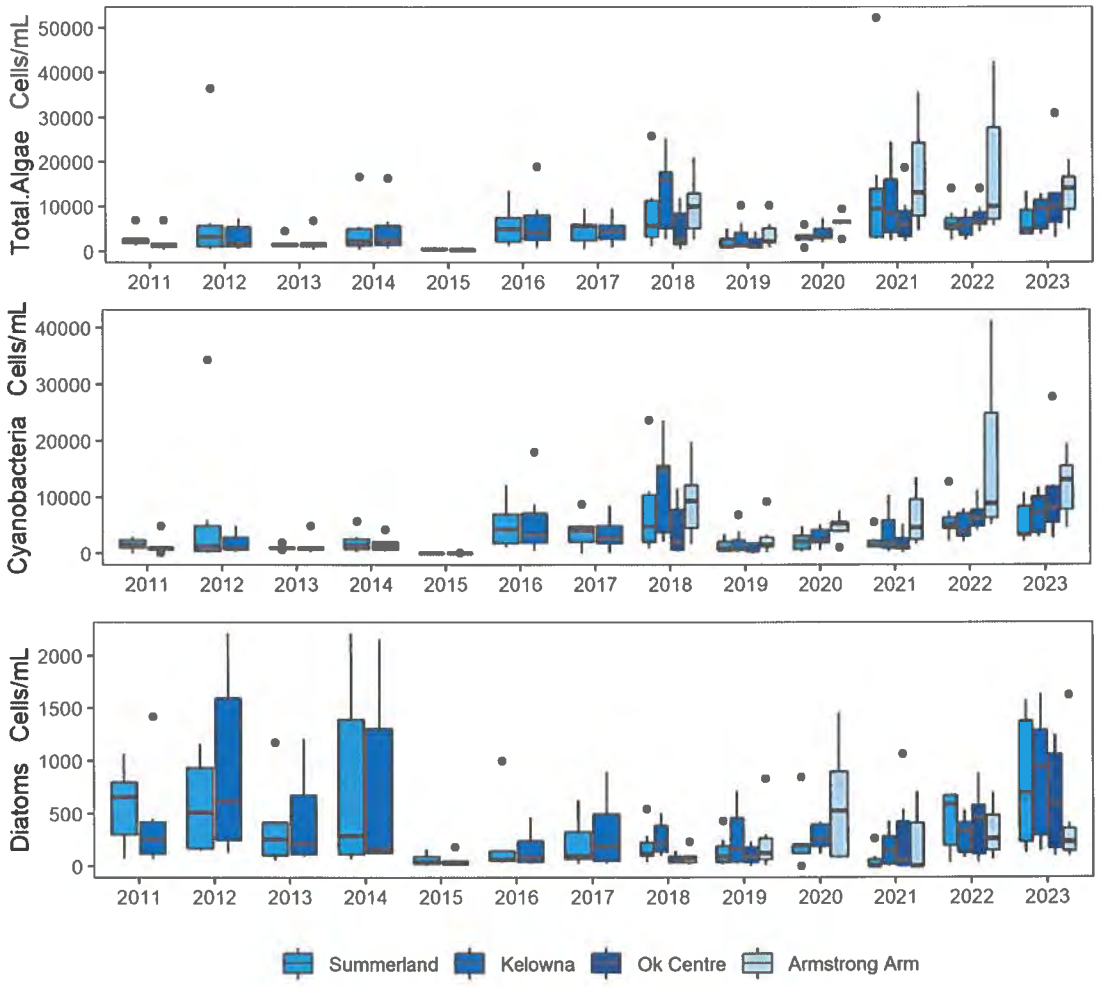

Figure 20: Total algae, cyanobacteria, and diatom counts in Okanagan Lake, 2011-2023

The Okanagan Lake objective for phytoplankton taxonomy states that no more than 5% of total cell counts should be heterocystous cyanobacteria in a given sample. These and other cyanobacteria can produce toxins that are harmful to human health when they are present in high concentrations. The heterocystous cyanobacteria objective was exceeded during most years including 2023 (82% of samples from 2023 exceeded this objective; Table 13). While problematic, the cyanobacteria densities observed during 2023 were not high enough to cause acute health concerns at any of the sites. Significant year-over-year increasing trends were detected in the heterocystous cyanobacteria counts from 2011-2023 at all sites (Mann-Kendall, $p \leq 0.02$).

Table 13: Percent of total algae counts that were heterocystous cyanobacteria from 2023

Site	Objective	Trend	# Exceeding	Average	StdDev	Max	Min
Summerland	<5%	↑	5/7	12.5%	12%	38%	5%
Kelowna	<5%	↑	6/7	13.6%	9%	26%	3%
Ok Centre	<5%	↑	5/7	12.5%	8%	26%	1%
Armstrong Arm	<5%	↑	7/7	44.2%	18%	66%	22%

Note: Yellow shading indicates that the site did not meet the objective in most but not all samples

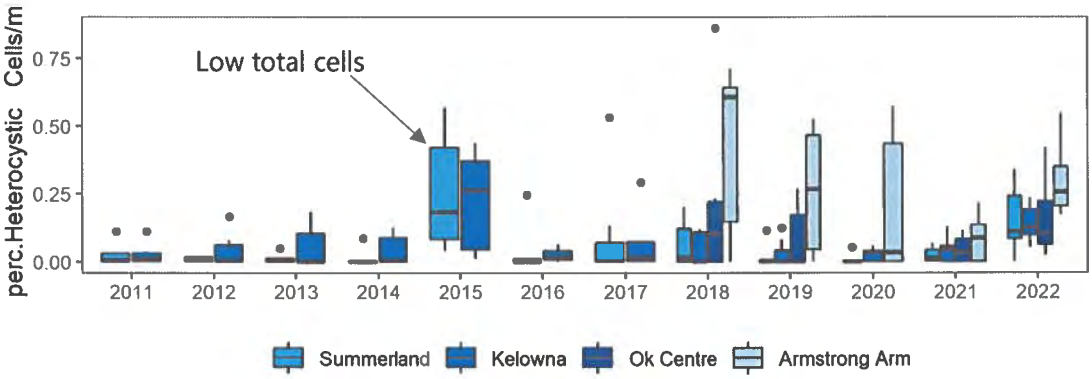

Figure 21: Percent of total algae counts that were heterocystous cyanobacteria, 2011-2023

2.3.2 Zooplankton

Zooplankton results were not available at the time of writing. This report will be updated when those results become available.

3.0 Conclusions

This report summarizes the 2023 findings within the context of the 2011-2023 dataset. This report also extracts trends from the data accumulated by the Okanagan Lake Collaborative Sampling program to date (2011-2023) and compares those to the long-term historical database (1973-2023). The effects of Climate Change are already being felt in the Okanagan in recent years with repeated swings between large freshets and intensely dry summers; 2023 was the driest year on record for the Okanagan. While the results to date indicate that Okanagan Lake exhibits evidence of human activities, the Armstrong Arm is most impacted by continued human activities and watershed degradation, a situation likely to get worse because of the White Rock Lake wildfire; major flooding occurred on the Whiteman Creek drainage during freshet 2023. This site had the most exceedances and the most problematic trends, that is, trends moving parameters towards greater exceedances and poorer water quality.

Dissolved Oxygen Each year the temperature of Okanagan Lake increases seasonally in the surface waters until the lake becomes thermally stratified, usually in May. This physical dynamic isolates the deep water from the atmosphere and leads to oxygen depletion below the thermocline in Armstrong Arm. The Armstrong Arm therefore failed to meet the dissolved oxygen objective in 2023, as it has in each year of this study.

Nutrients
Silica analysis of water samples revealed a long period of stable conditions over the past 20 years.

Total nitrogen had been identified as increasing during this study but appears to have stabilized in recent years except for the Armstrong Arm where a declining trend was observed from 2017-2023. Total nitrogen exceeded the water quality objectives at Summerland, Kelowna, and Okanagan Centre during 2023. Nitrate increased significantly in the Armstrong Arm and in the hypolimnion at all sites from 2011-2023, although as with TN, appears to have stabilized over the past few years, an encouraging shift. This is part of a decades long increasing trend in hypolimnetic nitrate in Okanagan Lake that has continued through multiple wet-dry climate cycles and is likely caused by increasing human impacts within the Okanagan region.

Phosphorus concentrations were highest in the Armstrong Arm where they exceeded the objective during 2023. There were increasing trends in TP from 2011-2023 at all four sites driven in part by increases during wet years such as 2017-2018. The Armstrong Arm is more heavily impacted by human activities and has numerous phosphorus sources such as nutrient enrichment of the Deep Creek watershed from over 100 years of agriculture, and the rise may become exacerbated by nutrients shed from the areas burned during the 2021 White Rock Lake fire. Dissolved phosphorus (TDP) and ortho-P represent the more bioavailable forms of phosphorus and were stable or declining at Summerland, Kelowna, Okanagan Centre while TDP increased at the Armstrong Arm. TDP was elevated at Okanagan Centre since the 2021 White Rock Lake wildfire. Samples from the Armstrong Arm exceeded the nitrogen-phosphorus ratio objective in 2022, with a decreasing trend in that ratio from 2011-2023 at all sites.

Phytoplankton Productivity Chlorophyll-a (chl-a) concentrations increased each spring during the annual spring high algal growth period and then decreased over the summer and into the fall. Peak chl-a was moderate at all sites during 2023. Previous research by ENV has identified a one-year lag between major nutrient inputs and increases in phytoplankton productivity so it was expected that 2023 productivity would be higher after the large 2022 freshet. As expected, the phytoplankton biovolume was high and did not met the objective at any site during 2023.

The taxonomic data indicated that cyanobacteria numerically dominated the phytoplankton samples in 2023, as in every year studied. Samples from all sites exceeded the <5% heterocystous cyanobacteria objective in most samples during 2023 and Armstrong Arm exceeded the objective in all samples.

Table 14 to Table 16 summarize the findings of this report for 2011-2023 by pairing trends to objective exceedances. Special focus should be paid to parameters that did not meet the objective and for which the data trended in the adverse direction over the course of the sampling program.

The following areas of concern have been identified that may require further investigation on the part of the Ministry:

- Chronically low Secchi depth in the Armstrong Arm
- Increasing nitrate in hypolimnion of Okanagan Lake since 1970s (although stable during past 5 years)
- Increasing total phosphorus at all sites since early 2000s
- Decreasing N:P ratio in the Armstrong Arm
- High densities of potentially toxic cyanobacteria in Armstrong Arm during 2018-2023
- Phosphorus loading to the Armstrong Arm and north basin of Okanagan Lake from the White Rock Lake wildfire (2021) and the McDougall Creek wildfire (2023).

Armstrong Arm frequently exceeds most objectives and is the site most at risk of water quality degradation including harmful algae blooms, poor drinking water quality, anoxic conditions, and further eutrophication. There is also high likelihood of further degradation because of the White Rock Lake wildfire. It must be acknowledged that Armstrong Arm is shallower and therefore would be more productive than the deep basins of Okanagan Lake regardless of human activity. However, human activities in the watershed have impacted this northern-most basin of the lake.

The period of 2016-2023 was marked by multiple extreme weather events that have left a distinct mark on the water quality record of Okanagan Lake. Climate Change and is expected to increase the frequency and intensity of extreme weather events in the future. Climate Change also compounds the loss of resilience in Okanagan watersheds leading to greater water quality changes from those extreme weather events.

Table 14: Okanagan Lake Water Quality Objectives

Objectives (Nordin, 2005)	**Summerland**	**Kelowna**	**Ok Centre**	**Armstrong Arm**
Secchi Depth (growing season average)	7m	6m	6m	5m
Dissolved Oxygen (minimum in bottom waters)	-	-	-	>5 mg/L
TP (mg/L as P) (maximum at spring overturn)	0.007	0.008	0.008	0.01
Chlorophyll-a (µg/L) (maximum seasonal average)	<4.5	<4.5	<4	<5
TN (mg/L as N) (maximum at spring overturn)	0.230	0.230	0.230	0.250
N:P Ratio (spring weighted ratio)	>25:1	>25:1	>25:1	>25:1
Algae Taxonomy (% heterocystous cyanobacteria)	<5%	<5%	<5%	<5%
Algae Biomass (µL/L) (growing season average)	<0.75	<0.75	<0.75	<0.75
Zooplankton Biomass (µg/L) (growing season average)	>50	>50	>50	>50
Zooplankton Taxonomy (% cladocerans)	>5%	>5%	>5%	>5%

Table 15: Attainment of Okanagan Lake water quality objectives compared to growing season averages during 2023

Objective	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth	6.0	5.3	5.8	2.8
Dissolved Oxygen	7.88	8.23	8.30	2.13
TP (mg/L) 0:10m:	0.005	0.006	0.007	0.012
20-45m:	0.005	0.005	0.006	0.019
Chlorophyll-a (µg/L)	1.74	1.97	2.16	3.08
TN (mg/L) 0-10m:	0.216	0.220	0.22	0.244
20-45m:	0.237	0.237	0.239	0.280
N:P Ratio 0-10m:	59:1	49:1	33:1	20:1
20-45m:	57:1	47:1	41:1	18:1
Algae Taxonomy (% heterocystous cyanobacteria)	12.5%	13.6%	12.5%	44.2%
Algae Biovolume (µL/L)	0.790	1.135	1.004	0.814
Zooplankton Biomass (µg/L)	-	-	-	-
Zooplankton Taxonomy (% cladocerans)	-	-	-	-

Legend:

Achieved objective	Achieve objective in some but not all samples	Did not achieve objective

Table 16: Summary of trends (2011-2023) and the water quality objectives for Okanagan Lake collaborative sampling program during 2023

Objective	Summerland	Kelowna	Ok Centre	Armstrong Arm
Secchi Depth	-	-	-	-
Dissolved Oxygen	-	-	-	-
TP (mg/L) 0:10m:	↑	↑	↑	↑
Chlorophyll-a (µg/L)	-	↑	-	↓
TN (mg/L) 0-10m:	-	-	-	↓
N:P Ratio 0-10m:	↓	↓	↓	↓
Algae Taxonomy (% heterocystous cyanobacteria)	↑	↑	↑	↑
Algae Biovolume (µL/L)	↑	↑	-	-
Zooplankton Biomass (µg/L)	-	-	-	-
Zooplankton Taxonomy (% cladocerans)	-	-	-	-

Legend:

Achieved objective	Achieve objective in some but not all samples	Did not achieve objective

↑ = Increasing Trend ↓ = Decreasing Trend - = No Trend

4.0 Recommendations

The following recommendations are made for the program moving forward:

- Continue the monitoring program, unchanged in 2023
- Complete another summary report at the end of the next three-year cycle (next in 2024)

5.0 References

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6.0 Appendices

6.1 Appendix 1: 2011-2023 Sampling Data

All data used in this report can be found in the data transfer file
MoE-Synth-DB.xlsx

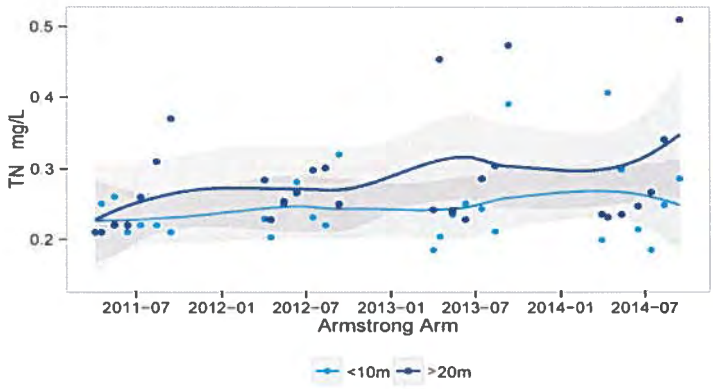
6.2 Appendix 2: Statistics and Graphing Overview

Statistical analyses were performed on data to support interpretations made throughout this report. The use of the word 'significantly' within this report is understood to signify that the claim being made has stood up under statistical analysis. Unless otherwise stated, all statistical analyses were performed to a confidence of greater than or equal to 95% ($p \leq 0.05$). The ± symbol indicates plus or minus the standard deviation throughout this report.

Trends were determined through Mann-Kendall linear regression. Mann-Kendall is a non-parametric test for linearity in data. The test produces a Tau-value and a p-value. The Tau value gives the direction of the data and the p-value indicates whether the trend is statistically significant.

Throughout this report the monthly sampling data was grouped seasonally for additional analyses. March, April, and May data were combined as "Spring"; June, July, and August as "Summer"; and September as "Fall".

Correlations were performed using the Pearson's Correlation method and all R values reported at Pearson's Correlation Coefficients.



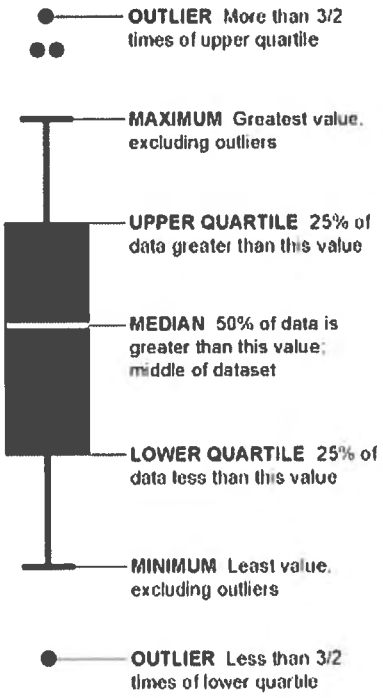
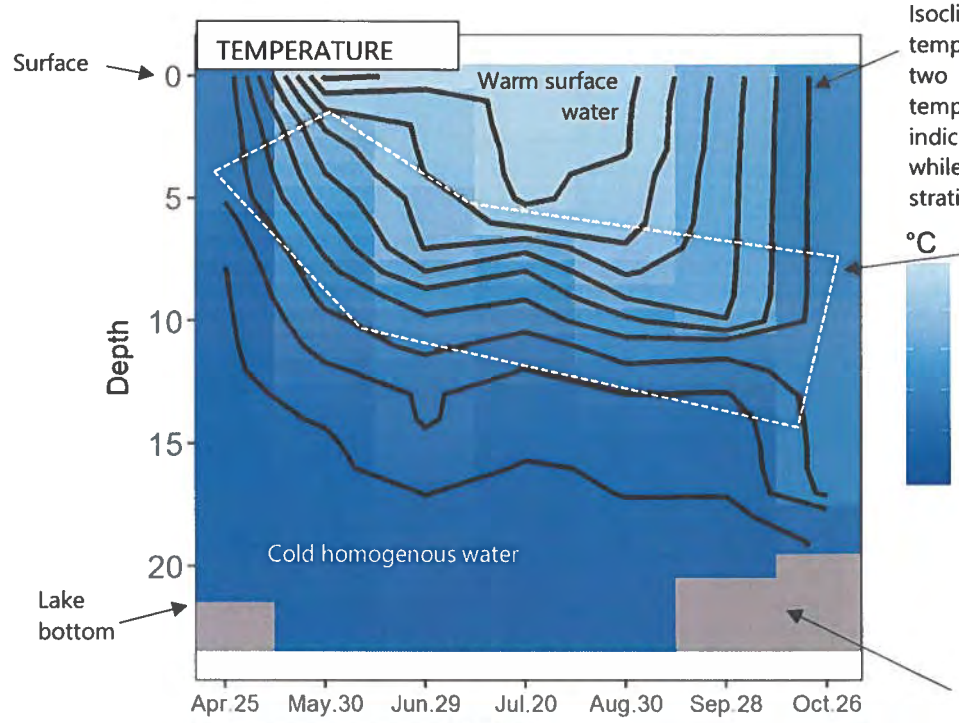


Figure i: Example scatterplot and boxplot

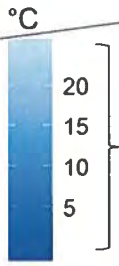
Includes all data for a parameter sorted by depth, LOESS polynomial trendlines and the standard errors of those trendlines are also included. Example boxplot is labeled with key information. Whiskers represent the distance to the highest or lowest point within 1.5 * IQR where IQR represents the range between the upper and lower quartiles.

How to Read Temperature/DO Profile Plot

Temperature and dissolved oxygen profiles were routinely collected as part of this study. They are displayed in several locations throughout this report. An example of a temperature graph and a dissolved oxygen graph, descriptions of their key features and how to read them are presented here.



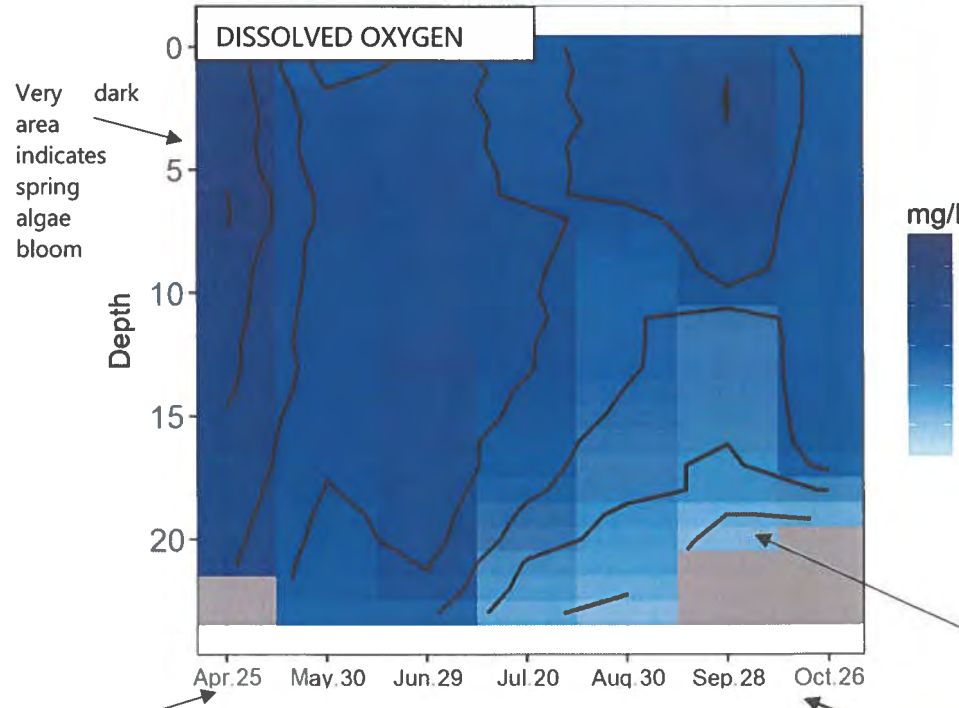
Isoclines = areas of equivalent temperature. That is, the space between two lines is approximately the same temperature. Large spaces between lines indicate homogenous water column while many lines close together indicates stratified conditions

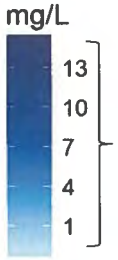


Tight concentration of lines = rapid change in temperature over short depth (i.e. thermocline)

Scale: Lighter shading = warmer water

Gray area indicates lake bottom. This appears on the plot when profiles were taken at sites with different depths on different dates. For example, on Jul 20, the profile was at a site 24 m deep but on Oct 26, the profile was done only at a site 19 m deep. This can occur when weather conditions move the sampling boat into a slightly different location on the lake.





Scale: Lighter shading = Low DO (anoxic conditions)
Darker shading = High DO (algae blooms)

Light area indicates oxygen depletion along sediments

Each vertical column in graph represents conditions within a column of the lake on given date. For example, on Apr 25, DO was very high through entire water column but on Sept 28, there was significant oxygen depletion in the deep water.

----------End of Report----------

APPENDIX M

LAB ANALYSIS REPORTS

CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23A0792
PO NUMBER		**RECEIVED / TEMP**	2023-01-10 11:35 / 7.9°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-01-16 12:05
PROJECT INFO		**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

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It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

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If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23A0792
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-01-16 12:05

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23A0792-01) | Matrix: Wastewater | Sampled: 2023-01-10 08:00					
General Parameters					
Solids, Total Suspended	**2.2**	2.0	mg/L	2023-01-12	
Effluent (E230437) (23A0792-02) | Matrix: Wastewater | Sampled: 2023-01-10 08:00					PRES
Anions					
Nitrate (as N)	**1.95**	0.010	mg/L	2023-01-11	
Nitrite (as N)	**0.015**	0.010	mg/L	2023-01-11	
Phosphate (as P)	**0.0398**	0.0050	mg/L	2023-01-11	
Calculated Parameters					
Nitrate+Nitrite (as N)	**1.97**	0.0100	mg/L	N/A	
Nitrogen, Total	**3.58**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.53**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.080**	0.050	mg/L	2023-01-11	
BOD, 5-day	< 5.8	2.0	mg/L	2023-01-16	
Nitrogen, Total Kjeldahl	**1.61**	0.050	mg/L	2023-01-16	
pH	**7.25**	0.10	pH units	2023-01-12	HT2
Phosphorus, Total (as P)	**0.200**	0.0050	mg/L	2023-01-13	
Effluent Coliform (23A0792-03) | Matrix: Wastewater | Sampled: 2023-01-10 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**1**	1	MPN/100 mL	2023-01-11	CST2
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-01-11	CST2
C3 Coliform (23A0792-04) | Matrix: Fresh Water | Sampled: 2023-01-10 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**1**	1	MPN/100 mL	2023-01-11	CST2
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-01-11	CST2
Influent (E230439) (23A0792-05) | Matrix: Fresh Water | Sampled: 2023-01-10 08:00					PRESa
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-01-12	
Nitrite (as N)	< 0.010	0.010	mg/L	2023-01-12	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**57.0**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23A0792
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-01-16 12:05

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (23A0792-05) | Matrix: Fresh Water | Sampled: 2023-01-10 08:00, Continued					PRESa
General Parameters					
BOD, 5-day	**173**	2.0	mg/L	2023-01-16	
Nitrogen, Total Kjeldahl	**57.0**	0.050	mg/L	2023-01-16	
pH	**7.53**	0.10	pH units	2023-01-12	HT2
Phosphorus, Total (as P)	**6.98**	0.0050	mg/L	2023-01-13	

Sample Qualifiers:

CST2	Results may be biased low, due to potential matrix interference
HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for Nitrogen, phos in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for Phos in the laboratory and the holding time has been extended.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23A0792
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-01-16 12:05

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, ph > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

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CARO
ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23B1582
PO NUMBER		**RECEIVED / TEMP**	2023-02-15 11:00 / 8.1°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-02-21 15:14
PROJECT INFO		**COC NUMBER**	No Number

Introduction:

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If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23B1582
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-02-21 15:14

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23B1582-01) | Matrix: Wastewater | Sampled: 2023-02-15 08:00					
General Parameters					
Solids, Total Suspended	< 2.0	2.0	mg/L	2023-02-16	
Effluent (E230437) (23B1582-02) | Matrix: Wastewater | Sampled: 2023-02-15 08:00					PRES
Anions					
Nitrate (as N)	**2.41**	0.010	mg/L	2023-02-16	
Nitrite (as N)	**0.047**	0.010	mg/L	2023-02-16	
Phosphate (as P)	**0.0394**	0.0050	mg/L	2023-02-16	
Calculated Parameters					
Nitrate+Nitrite (as N)	**2.46**	0.0100	mg/L	N/A	
Nitrogen, Total	**4.42**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.08**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.874**	0.050	mg/L	2023-02-17	
BOD, 5-day	< 5.6	2.0	mg/L	2023-02-21	
Nitrogen, Total Kjeldahl	**1.96**	0.050	mg/L	2023-02-17	
pH	**7.10**	0.10	pH units	2023-02-16	HT2
Phosphorus, Total (as P)	**0.145**	0.0050	mg/L	2023-02-16	
Effluent Coliform (E230437) (23B1582-03) | Matrix: Wastewater | Sampled: 2023-02-15 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2023-02-15	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-02-15	
C3 Coliform (E231678) (23B1582-04) | Matrix: Fresh Water | Sampled: 2023-02-15 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2023-02-15	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-02-15	
Influent (E230439) (23B1582-05) | Matrix: Fresh Water | Sampled: 2023-02-15 08:00					PRESa
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-02-16	
Nitrite (as N)	< 0.010	0.010	mg/L	2023-02-16	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**56.6**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23B1582
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-02-21 15:14

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (23B1582-05) | Matrix: Fresh Water | Sampled: 2023-02-15 08:00, Continued					PRESa
General Parameters					
BOD, 5-day	**224**	2.0	mg/L	2023-02-21	
Nitrogen, Total Kjeldahl	**56.6**	0.050	mg/L	2023-02-17	
pH	**7.60**	0.10	pH units	2023-02-16	HT2
Phosphorus, Total (as P)	**5.78**	0.0050	mg/L	2023-02-16	

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for Nitrogen, phos in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for Phos in the laboratory and the holding time has been extended.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23B1582
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-02-21 15:14

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, ph > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

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CARO
ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23C2486
PO NUMBER		**RECEIVED / TEMP**	2023-03-22 10:40 / 12.9°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-03-28 12:25
PROJECT INFO		**COC NUMBER**	No Number

Introduction:

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If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23C2486
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-03-28 12:25

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent (23C2486-01) | Matrix: Water | Sampled: 2023-03-22 08:30					
Anions					
Nitrate (as N)	**2.15**	0.010	mg/L	2023-03-23	
Nitrite (as N)	**0.242**	0.010	mg/L	2023-03-23	
Phosphate (as P)	**0.0557**	0.0050	mg/L	2023-03-23	
Calculated Parameters					
Nitrate+Nitrite (as N)	**2.40**	0.0100	mg/L	N/A	
Nitrogen, Total	**7.16**	0.100	mg/L	N/A	
Nitrogen, Organic	**2.16**	0.100	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**2.60**	0.050	mg/L	2023-03-23	
BOD, 5-day	< 15.4	2.0	mg/L	2023-03-28	
Nitrogen, Total Kjeldahl	**4.76**	0.050	mg/L	2023-03-27	
pH	**7.31**	0.10	pH units	2023-03-23	HT2
Phosphorus, Total (as P)	**0.402**	0.0050	mg/L	2023-03-23	
Effluent Coliform (23C2486-02) | Matrix: Wastewater | Sampled: 2023-03-22 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**291**	1	MPN/100 mL	2023-03-23	
Coliforms, Fecal (Q-Tray)	**147**	1	MPN/100 mL	2023-03-23	
C3 Coliform (23C2486-03) | Matrix: Fresh Water | Sampled: 2023-03-22 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**> 2420**	1	MPN/100 mL	2023-03-23	
Coliforms, Fecal (Q-Tray)	**156**	1	MPN/100 mL	2023-03-23	
Influent (E230439) (23C2486-04) | Matrix: Fresh Water | Sampled: 2023-03-22 08:30					
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-03-23	
Nitrite (as N)	< 0.010	0.010	mg/L	2023-03-23	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**35.7**	2.00	mg/L	N/A	
General Parameters					
BOD, 5-day	**95.6**	2.0	mg/L	2023-03-28	
Nitrogen, Total Kjeldahl	**35.7**	0.050	mg/L	2023-03-27	
pH	**7.70**	0.10	pH units	2023-03-23	HT2
Phosphorus, Total (as P)	**3.21**	0.0050	mg/L	2023-03-23	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23C2486
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-03-28 12:25

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23C2486-05) | Matrix: Wastewater | Sampled: 2023-03-22 08:30					
General Parameters					
Solids, Total Suspended	**8.3**	2.0	mg/L	2023-03-27	

Sample Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23C2486
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-03-28 12:25

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23D1792
PO NUMBER		**RECEIVED / TEMP**	2023-04-18 11:30 / 9.8°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-04-24 13:24
PROJECT INFO		**COC NUMBER**	No Number

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Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23D1792
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-04-24 13:24

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23D1792-01) | Matrix: Wastewater | Sampled: 2023-04-18 08:00					
General Parameters					
Solids, Total Suspended	**4.6**	2.0	mg/L	2023-04-21	
Effluent (23D1792-02) | Matrix: Wastewater | Sampled: 2023-04-18 08:00					PRES
Anions					
Nitrate (as N)	**1.53**	0.010	mg/L	2023-04-19	
Nitrite (as N)	**0.353**	0.010	mg/L	2023-04-19	
Phosphate (as P)	**0.0060**	0.0050	mg/L	2023-04-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	**1.89**	0.0100	mg/L	N/A	
Nitrogen, Total	**5.09**	0.100	mg/L	N/A	
Nitrogen, Organic	**1.81**	0.100	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**1.39**	0.050	mg/L	2023-04-19	
BOD, 5-day	< 7.6	2.0	mg/L	2023-04-24	
Nitrogen, Total Kjeldahl	**3.20**	0.050	mg/L	2023-04-20	
pH	**7.26**	0.10	pH units	2023-04-19	HT2
Phosphorus, Total (as P)	**0.211**	0.0050	mg/L	2023-04-21	
Effluent Coliform (23D1792-03) | Matrix: Wastewater | Sampled: 2023-04-18 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**220**	1	MPN/100 mL	2023-04-19	
Coliforms, Fecal (Q-Tray)	**88**	1	MPN/100 mL	2023-04-19	
C3 Coliform (23D1792-04) | Matrix: Fresh Water | Sampled: 2023-04-18 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**12**	1	MPN/100 mL	2023-04-19	
Coliforms, Fecal (Q-Tray)	**1**	1	MPN/100 mL	2023-04-19	
Influent (E230439) (23D1792-05) | Matrix: Fresh Water | Sampled: 2023-04-18 08:00					PRESa
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-04-19	
Nitrite (as N)	< 0.010	0.010	mg/L	2023-04-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**30.2**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23D1792
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-04-24 13:24

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (23D1792-05) | Matrix: Fresh Water | Sampled: 2023-04-18 08:00, Continued					PRESa
General Parameters					
BOD, 5-day	**97.3**	2.0	mg/L	2023-04-24	
Nitrogen, Total Kjeldahl	**30.2**	0.050	mg/L	2023-04-20	
pH	**7.66**	0.10	pH units	2023-04-19	HT2
Phosphorus, Total (as P)	**3.20**	0.0050	mg/L	2023-04-21	

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for Nitrogen, phos in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for Phos in the laboratory and the holding time has been extended.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23D1792
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-04-24 13:24

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

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ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23E2099
PO NUMBER		**RECEIVED / TEMP**	2023-05-16 10:15 / 15.0°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-05-24 12:29
PROJECT INFO		**COC NUMBER**	No Number

Introduction:

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If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23E2099
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-05-24 12:29

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23E2099-01) | Matrix: Wastewater | Sampled: 2023-05-16 08:30					
General Parameters					
Solids, Total Suspended	< 4.0	2.0	mg/L	2023-05-17	
Effluent (E230437) (23E2099-02) | Matrix: Wastewater | Sampled: 2023-05-16 08:30					PRES
Anions					
Nitrate (as N)	**1.72**	0.010	mg/L	2023-05-17	
Nitrite (as N)	**0.048**	0.010	mg/L	2023-05-17	
Phosphate (as P)	**0.0114**	0.0050	mg/L	2023-05-17	
Calculated Parameters					
Nitrate+Nitrite (as N)	**1.76**	0.0100	mg/L	N/A	
Nitrogen, Total	**3.34**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.46**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.118**	0.050	mg/L	2023-05-17	
BOD, 5-day	< 3.2	2.0	mg/L	2023-05-22	
Nitrogen, Total Kjeldahl	**1.57**	0.050	mg/L	2023-05-18	
pH	**6.83**	0.10	pH units	2023-05-18	HT2
Phosphorus, Total (as P)	**0.160**	0.0050	mg/L	2023-05-18	
Effluent Coliform (E230437) (23E2099-03) | Matrix: Wastewater | Sampled: 2023-05-16 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**10**	1	MPN/100 mL	2023-05-17	
Coliforms, Fecal (Q-Tray)	**2**	1	MPN/100 mL	2023-05-17	
C3 Coliform (E231678) (23E2099-04) | Matrix: Fresh Water | Sampled: 2023-05-16 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**8**	1	MPN/100 mL	2023-05-17	
Coliforms, Fecal (Q-Tray)	**2**	1	MPN/100 mL	2023-05-17	
Influent (E230439) (23E2099-05) | Matrix: Fresh Water | Sampled: 2023-05-16 08:30					PRESa
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-05-17	
Nitrite (as N)	< 0.010	0.010	mg/L	2023-05-17	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**109**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23E2099
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-05-24 12:29

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (E230439) (23E2099-05) | Matrix: Fresh Water | Sampled: 2023-05-16 08:30, Continued					PRESa
General Parameters					
BOD, 5-day	**800**	2.0	mg/L	2023-05-22	
Nitrogen, Total Kjeldahl	**109**	0.050	mg/L	2023-05-18	
pH	**7.41**	0.10	pH units	2023-05-18	HT2
Phosphorus, Total (as P)	**36.6**	0.0050	mg/L	2023-05-18	RE2

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for NH3, TKN, TP in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for TKN, TP in the laboratory and the holding time has been extended.
RE2	Result was confirmed by re-analysis prior to reporting.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23E2099
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-05-24 12:29

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, ph > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23F1843
PO NUMBER		**RECEIVED / TEMP**	2023-06-14 10:52 / 16.4°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-06-21 09:54
PROJECT INFO		**COC NUMBER**	No Number

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Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23F1843
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-06-21 09:54

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23F1843-01) | Matrix: Wastewater | Sampled: 2023-06-14 08:00					
General Parameters					
Solids, Total Suspended	**2.6**	2.0	mg/L	2023-06-18	
Effluent (23F1843-02) | Matrix: Wastewater | Sampled: 2023-06-14 08:00					PRES
Anions					
Nitrate (as N)	**1.92**	0.010	mg/L	2023-06-15	
Nitrite (as N)	**0.023**	0.010	mg/L	2023-06-15	
Phosphate (as P)	**0.0089**	0.0050	mg/L	2023-06-15	
Calculated Parameters					
Nitrate+Nitrite (as N)	**1.94**	0.0100	mg/L	N/A	
Nitrogen, Total	**3.32**	0.100	mg/L	N/A	
Nitrogen, Organic	**1.29**	0.100	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.095**	0.050	mg/L	2023-06-14	
BOD, 5-day	< 5.3	2.0	mg/L	2023-06-20	
Nitrogen, Total Kjeldahl	**1.38**	0.050	mg/L	2023-06-18	
pH	**7.20**	0.10	pH units	2023-06-15	HT2
Phosphorus, Total (as P)	**0.121**	0.0050	mg/L	2023-06-15	
Effluent Coliform (23F1843-03) | Matrix: Wastewater | Sampled: 2023-06-14 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**12**	1	MPN/100 mL	2023-06-14	
Coliforms, Fecal (Q-Tray)	**1**	1	MPN/100 mL	2023-06-14	
C3 Coliform (23F1843-04) | Matrix: Fresh Water | Sampled: 2023-06-14 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2023-06-14	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-06-14	
Influent (23F1843-05) | Matrix: Fresh Water | Sampled: 2023-06-14 08:00					PRESa
Anions					
Nitrate (as N)	< 0.100	0.010	mg/L	2023-06-15	RA1
Nitrite (as N)	< 0.100	0.010	mg/L	2023-06-15	RA1
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.100	0.100	mg/L	N/A	
Nitrogen, Total	**56.8**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23F1843
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-06-21 09:54

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (23F1843-05) | Matrix: Fresh Water | Sampled: 2023-06-14 08:00, Continued					PRESa
General Parameters					
BOD, 5-day	**577**	2.0	mg/L	2023-06-20	
Nitrogen, Total Kjeldahl	**56.8**	0.050	mg/L	2023-06-18	
pH	**7.44**	0.10	pH units	2023-06-15	HT2
Phosphorus, Total (as P)	**15.9**	0.0050	mg/L	2023-06-15	

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for NH3, TKN, TP in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for TKN, TP in the laboratory and the holding time has been extended.
RA1	The Reporting Limit for this sample has been raised due to matrix interference.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23F1843
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-06-21 09:54

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	NA / SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23G1519
PO NUMBER		**RECEIVED / TEMP**	2023-07-12 10:56 / 14.4°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-07-19 14:31
PROJECT INFO			

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Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23G1519
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-07-19 14:31

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23G1519-01) | Matrix: Wastewater | Sampled: 2023-07-12 08:00					
General Parameters					
Solids, Total Suspended	**2.0**	2.0	mg/L	2023-07-15	
Effluent (23G1519-02) | Matrix: Wastewater | Sampled: 2023-07-12 08:00					PRES
Anions					
Nitrate (as N)	**2.40**	0.010	mg/L	2023-07-15	
Nitrite (as N)	**0.025**	0.010	mg/L	2023-07-15	
Phosphate (as P)	**0.0104**	0.0050	mg/L	2023-07-15	
Calculated Parameters					
Nitrate+Nitrite (as N)	**2.43**	0.0100	mg/L	N/A	
Nitrogen, Total	**3.72**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.18**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.119**	0.050	mg/L	2023-07-14	
BOD, 5-day	**< 5.3**	2.0	mg/L	2023-07-18	
Nitrogen, Total Kjeldahl	**1.30**	0.050	mg/L	2023-07-18	
pH	**7.54**	0.10	pH units	2023-07-14	HT2
Phosphorus, Total (as P)	**0.142**	0.0050	mg/L	2023-07-14	
Effluent Coliform (23G1519-03) | Matrix: Wastewater | Sampled: 2023-07-12 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**67**	1	MPN/100 mL	2023-07-13	HT1
Coliforms, Fecal (Q-Tray)	**11**	1	MPN/100 mL	2023-07-13	HT1
C3 Coliform (23G1519-04) | Matrix: Wastewater | Sampled: 2023-07-12 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**20**	1	MPN/100 mL	2023-07-13	HT1
Coliforms, Fecal (Q-Tray)	**< 1**	1	MPN/100 mL	2023-07-13	HT1
Influent (23G1519-05) | Matrix: Wastewater | Sampled: 2023-07-12 08:00					PRES
Anions					
Nitrate (as N)	**0.018**	0.010	mg/L	2023-07-15	
Nitrite (as N)	**0.020**	0.010	mg/L	2023-07-15	
Calculated Parameters					
Nitrate+Nitrite (as N)	**0.0387**	0.0100	mg/L	N/A	
General Parameters					

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23G1519
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-07-19 14:31

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (23G1519-05) | Matrix: Wastewater | Sampled: 2023-07-12 08:00, Continued					PRES
General Parameters, Continued					
BOD, 5-day	**756**	2.0	mg/L	2023-07-19	
pH	**7.68**	0.10	pH units	2023-07-14	HT2
Phosphorus, Total (as P)	**21.8**	0.0050	mg/L	2023-07-14	

Sample Qualifiers:

HT1	The sample was prepared and/or analyzed past the recommended holding time.
HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for tkn and phos in the laboratory and the holding time has been extended.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23G1519
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-07-19 14:31

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23H2820
PO NUMBER		**RECEIVED / TEMP**	2023-08-22 09:55 / 8.8°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-08-28 12:07
PROJECT INFO		**COC NUMBER**	No Number

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Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23H2820
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-08-28 12:07

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23H2820-01) | Matrix: Wastewater | Sampled: 2023-08-22 08:30					
General Parameters					
Solids, Total Suspended	< 2.0	2.0	mg/L	2023-08-23	
Effluent (23H2820-02) | Matrix: Wastewater | Sampled: 2023-08-22 08:30					PRESa
Anions					
Nitrate (as N)	**1.44**	0.010	mg/L	2023-08-23	
Nitrite (as N)	**0.140**	0.010	mg/L	2023-08-23	
Phosphate (as P)	**0.492**	0.0050	mg/L	2023-08-23	RE2
Calculated Parameters					
Nitrate+Nitrite (as N)	**1.58**	0.0100	mg/L	N/A	
Nitrogen, Total	**3.12**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.40**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.139**	0.050	mg/L	2023-08-24	
BOD, 5-day	< 6.5	2.0	mg/L	2023-08-28	
Nitrogen, Total Kjeldahl	**1.54**	0.050	mg/L	2023-08-25	
pH	**7.60**	0.10	pH units	2023-08-24	HT2
Phosphorus, Total (as P)	**0.912**	0.0050	mg/L	2023-08-23	
Effluent Coliform (23H2820-03) | Matrix: Wastewater | Sampled: 2023-08-22 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**299**	1	MPN/100 mL	2023-08-22	
Coliforms, Fecal (Q-Tray)	**71**	1	MPN/100 mL	2023-08-22	
C3 Coliform (23H2820-04) | Matrix: Wastewater | Sampled: 2023-08-22 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2023-08-22	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-08-22	
Influent (23H2820-05) | Matrix: Wastewater | Sampled: 2023-08-22 08:30					PRES
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-08-23	
Nitrite (as N)	< 0.010	0.010	mg/L	2023-08-23	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**44.0**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23H2820
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-08-28 12:07

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (23H2820-05) | Matrix: Wastewater | Sampled: 2023-08-22 08:30, Continued					PRES
General Parameters					
BOD, 5-day	**401**	2.0	mg/L	2023-08-28	
Nitrogen, Total Kjeldahl	**44.0**	0.050	mg/L	2023-08-25	
pH	**7.38**	0.10	pH units	2023-08-24	HT2
Phosphorus, Total (as P)	**13.6**	0.0050	mg/L	2023-08-23	

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for TKN, NH3 in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for TKN, NH3, TP in the laboratory and the holding time has been extended.
RE2	Result was confirmed by re-analysis prior to reporting.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23H2820
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-08-28 12:07

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, ph > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23I2529
PO NUMBER		**RECEIVED / TEMP**	2023-09-20 10:40 / 17.0°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-09-27 10:07
PROJECT INFO		**COC NUMBER**	No Number

Introduction:

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If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23I2529
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-09-27 10:07

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23I2529-01) | Matrix: Wastewater | Sampled: 2023-09-20 08:00					
General Parameters					
Solids, Total Suspended	< 2.0	2.0	mg/L	2023-09-22	
Effluent (23I2529-02) | Matrix: Wastewater | Sampled: 2023-09-20 08:00					PRES
Anions					
Nitrate (as N)	**3.64**	0.010	mg/L	2023-09-22	
Nitrite (as N)	**0.017**	0.010	mg/L	2023-09-22	
Phosphate (as P)	**0.370**	0.0050	mg/L	2023-09-22	
Calculated Parameters					
Nitrate+Nitrite (as N)	**3.65**	0.0100	mg/L	N/A	
Nitrogen, Total	**4.73**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.08**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	< 0.050	0.050	mg/L	2023-09-21	RE2
BOD, 5-day	< 6.2	2.0	mg/L	2023-09-26	
Nitrogen, Total Kjeldahl	**1.08**	0.050	mg/L	2023-09-25	
pH	**7.36**	0.10	pH units	2023-09-22	HT2
Phosphorus, Total (as P)	**0.582**	0.0050	mg/L	2023-09-22	
Effluent Coliform (23I2529-03) | Matrix: Wastewater | Sampled: 2023-09-20 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**1**	1	MPN/100 mL	2023-09-21	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-09-21	
C3 Coliform (23I2529-04) | Matrix: Wastewater | Sampled: 2023-09-20 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**2**	1	MPN/100 mL	2023-09-21	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-09-21	
Influent (23I2529-05) | Matrix: Wastewater | Sampled: 2023-09-20 08:00					PRES
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-09-22	
Nitrite (as N)	**0.018**	0.010	mg/L	2023-09-22	
Calculated Parameters					
Nitrate+Nitrite (as N)	**0.0179**	0.0100	mg/L	N/A	
Nitrogen, Total	**73.5**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23I2529
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-09-27 10:07

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (23I2529-05) | Matrix: Wastewater | Sampled: 2023-09-20 08:00, Continued					PRES
General Parameters					
BOD, 5-day	**659**	2.0	mg/L	2023-09-26	
Nitrogen, Total Kjeldahl	**73.5**	0.050	mg/L	2023-09-25	
pH	**7.21**	0.10	pH units	2023-09-22	HT2
Phosphorus, Total (as P)	**25.7**	0.0050	mg/L	2023-09-22	

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for TP, TKN, NH3 in the laboratory and the holding time has been extended.
RE2	Result was confirmed by re-analysis prior to reporting.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23I2529
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-09-27 10:07

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23J2915
PO NUMBER		**RECEIVED / TEMP**	2023-10-24 11:00 / 15.2°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-10-31 12:54
PROJECT INFO		**COC NUMBER**	No Number

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If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23J2915
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-10-31 12:54

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23J2915-01) | Matrix: Wastewater | Sampled: 2023-10-24 08:00					
General Parameters					
Solids, Total Suspended	< 2.0	2.0	mg/L	2023-10-27	
Effluent (23J2915-02) | Matrix: Wastewater | Sampled: 2023-10-24 08:00					PRES
Anions					
Nitrate (as N)	**3.89**	0.010	mg/L	2023-10-27	
Nitrite (as N)	**0.031**	0.010	mg/L	2023-10-27	
Phosphate (as P)	**0.254**	0.0050	mg/L	2023-10-27	
Calculated Parameters					
Nitrate+Nitrite (as N)	**3.92**	0.0100	mg/L	N/A	
Nitrogen, Total	**5.24**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.25**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.067**	0.050	mg/L	2023-10-25	
BOD, 5-day	< 7.7	2.0	mg/L	2023-10-31	
Nitrogen, Total Kjeldahl	**1.32**	0.050	mg/L	2023-10-30	
pH	**7.00**	0.10	pH units	2023-10-28	HT2
Phosphorus, Total (as P)	**0.654**	0.0050	mg/L	2023-10-26	
Effluent Coliform (23J2915-03) | Matrix: Wastewater | Sampled: 2023-10-24 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**3**	1	MPN/100 mL	2023-10-25	
Coliforms, Fecal (Q-Tray)	**< 1**	1	MPN/100 mL	2023-10-25	
C3 Coliform (23J2915-04) | Matrix: Wastewater | Sampled: 2023-10-24 08:00					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2023-10-25	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-10-25	
Influent (23J2915-05) | Matrix: Wastewater | Sampled: 2023-10-24 08:00					PRESa
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-10-27	
Nitrite (as N)	**0.016**	0.010	mg/L	2023-10-27	
Calculated Parameters					
Nitrate+Nitrite (as N)	**0.0165**	0.0100	mg/L	N/A	
Nitrogen, Total	**51.9**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23J2915
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-10-31 12:54

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (23J2915-05) | Matrix: Wastewater | Sampled: 2023-10-24 08:00, Continued					PRESa
General Parameters					
BOD, 5-day	**184**	2.0	mg/L	2023-10-31	
Nitrogen, Total Kjeldahl	**51.9**	0.050	mg/L	2023-10-30	
pH	**7.43**	0.10	pH units	2023-10-28	HT2
Phosphorus, Total (as P)	**5.61**	0.0050	mg/L	2023-10-26	

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for TKN, NH3, TP in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for TKN, TP in the laboratory and the holding time has been extended.

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APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23J2915
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-10-31 12:54

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23K1536
PO NUMBER		**RECEIVED / TEMP**	2023-11-14 11:00 / 11.1°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-11-21 11:13
PROJECT INFO		**COC NUMBER**	No Number

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If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23K1536
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-11-21 11:13

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23K1536-01) | Matrix: Wastewater | Sampled: 2023-11-14 08:30					
General Parameters					
Solids, Total Suspended	< 2.0	2.0	mg/L	2023-11-15	
Effluent (23K1536-02) | Matrix: Wastewater | Sampled: 2023-11-14 08:30					PRES
Anions					
Nitrate (as N)	**3.73**	0.010	mg/L	2023-11-16	
Nitrite (as N)	**0.058**	0.010	mg/L	2023-11-16	
Phosphate (as P)	**0.369**	0.0050	mg/L	2023-11-16	
Calculated Parameters					
Nitrate+Nitrite (as N)	**3.79**	0.0100	mg/L	N/A	
Nitrogen, Total	**5.06**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.18**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.098**	0.050	mg/L	2023-11-17	
BOD, 5-day	< 4.4	2.0	mg/L	2023-11-21	
Nitrogen, Total Kjeldahl	**1.28**	0.050	mg/L	2023-11-19	
pH	**7.05**	0.10	pH units	2023-11-17	HT2
Phosphorus, Total (as P)	**0.804**	0.0050	mg/L	2023-11-17	
Effluent Coliform (23K1536-03) | Matrix: Wastewater | Sampled: 2023-11-14 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2023-11-14	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-11-14	
C3 Coliform (23K1536-04) | Matrix: Wastewater | Sampled: 2023-11-14 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2023-11-14	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-11-14	
Influent (23K1536-05) | Matrix: Wastewater | Sampled: 2023-11-14 08:30					PRESa
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-11-16	
Nitrite (as N)	< 0.010	0.010	mg/L	2023-11-16	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**54.8**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23K1536
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-11-21 11:13

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (23K1536-05) | Matrix: Wastewater | Sampled: 2023-11-14 08:30, Continued					PRESa
General Parameters					
BOD, 5-day	**164**	2.0	mg/L	2023-11-21	
Nitrogen, Total Kjeldahl	**54.8**	0.050	mg/L	2023-11-19	
pH	**7.35**	0.10	pH units	2023-11-17	HT2
Phosphorus, Total (as P)	**5.69**	0.0050	mg/L	2023-11-17	

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for TKN, NH3, TP in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for TKN, TP in the laboratory and the holding time has been extended.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23K1536
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-11-21 11:13

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
pH units	pH < 7 = acidic, ph > 7 = basic
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

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Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline (s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

CERTIFICATE OF ANALYSIS

REPORTED TO	Summerland, District of Box 159 SUMMERLAND, BC V0H 1Z0		
ATTENTION	Ryan Cleverdon	**WORK ORDER**	23L1373
PO NUMBER		**RECEIVED / TEMP**	2023-12-12 11:00 / 12.6°C
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-12-19 09:44
PROJECT INFO		**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO/IEC 17025:2017 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

By engaging our services, you are agreeing to CARO Analytical Service's Standard Terms and Conditions outlined here: https://www.caro.ca/terms-conditions

If you have any questions or concerns, please contact me at bwhitehead@caro.ca

Authorized By:

Brent Whitehead
Account Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23L1373
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-12-19 09:44

Analyte	Result	RL	Units	Analyzed	Qualifier
Effluent TSS (23L1373-01) | Matrix: Wastewater | Sampled: 2023-12-12 08:30					
General Parameters					
Solids, Total Suspended	< 4.0	2.0	mg/L	2023-12-13	
Effluent (23L1373-02) | Matrix: Wastewater | Sampled: 2023-12-12 08:30					PRES
Anions					
Nitrate (as N)	**2.82**	0.010	mg/L	2023-12-13	
Nitrite (as N)	**0.057**	0.010	mg/L	2023-12-13	
Phosphate (as P)	**0.114**	0.0050	mg/L	2023-12-13	
Calculated Parameters					
Nitrate+Nitrite (as N)	**2.88**	0.0100	mg/L	N/A	
Nitrogen, Total	**4.35**	0.0500	mg/L	N/A	
Nitrogen, Organic	**1.31**	0.0500	mg/L	N/A	
General Parameters					
Ammonia, Total (as N)	**0.159**	0.050	mg/L	2023-12-13	
BOD, 5-day	< 6.4	2.0	mg/L	2023-12-18	
BOD, 5-day Carbonaceous	< 5.8	2.0	mg/L	2023-12-18	
Nitrogen, Total Kjeldahl	**1.47**	0.050	mg/L	2023-12-18	
pH	**6.98**	0.10	pH units	2023-12-18	HT2
Phosphorus, Total (as P)	**0.244**	0.0050	mg/L	2023-12-14	
Effluent Coliform (23L1373-03) | Matrix: Wastewater | Sampled: 2023-12-12 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	**1**	1	MPN/100 mL	2023-12-12	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-12-12	
C3 Coliform (23L1373-04) | Matrix: Wastewater | Sampled: 2023-12-12 08:30					
Microbiological Parameters					
Coliforms, Total (Q-Tray)	< 1	1	MPN/100 mL	2023-12-12	
Coliforms, Fecal (Q-Tray)	< 1	1	MPN/100 mL	2023-12-12	
Influent (23L1373-05) | Matrix: Wastewater | Sampled: 2023-12-12 08:30					PRESa
Anions					
Nitrate (as N)	< 0.010	0.010	mg/L	2023-12-13	
Nitrite (as N)	< 0.010	0.010	mg/L	2023-12-13	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**54.3**	2.00	mg/L	N/A	

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Summerland, District of	**WORK ORDER**	23L1373
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-12-19 09:44

Analyte	Result	RL	Units	Analyzed	Qualifier
Influent (23L1373-05) | Matrix: Wastewater | Sampled: 2023-12-12 08:30, Continued					PRESa
General Parameters					
BOD, 5-day	**144**	2.0	mg/L	2023-12-18	
Nitrogen, Total Kjeldahl	**54.3**	0.050	mg/L	2023-12-18	
pH	**7.30**	0.10	pH units	2023-12-18	HT2
Phosphorus, Total (as P)	**4.82**	0.0050	mg/L	2023-12-14	

Sample Qualifiers:

HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.
PRES	Sample has been preserved for NH3, TP, TKN in the laboratory and the holding time has been extended.
PRESa	Sample has been preserved for TP, TKN in the laboratory and the holding time has been extended.

CARO ANALYTICAL SERVICES

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Summerland, District of	**WORK ORDER**	23L1373
PROJECT	Dist. of Summerland WWTP - PE13627	**REPORTED**	2023-12-19 09:44

Analysis Description	Method Ref.	Technique	Accredited	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2021)	Automated Colorimetry (Phenate)	✓	Kelowna
Anions in Water	SM 4110 B (2020)	Ion Chromatography	✓	Kelowna
Biochemical Oxygen Demand in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Biochemical Oxygen Demand, Carbonaceous in Water	SM 5210 B (2019)	Dissolved Oxygen Meter	✓	Kelowna
Coliforms, Fecal in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Coliforms, Total in Water	SM 9223 (2016)	Quanti-Tray / Enzyme Substrate Endo Agar	✓	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2021)	Block Digestion and Flow Injection Analysis	✓	Kelowna
pH in Water	SM 4500-H+ B (2021)	Electrometry	✓	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2021)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	✓	Kelowna
Solids, Total Suspended in Water	Solids in Water, Filtered / SM 2540 D* (2020)	Solids in Water, Filtered / Gravimetry (Dried at 103-105C)	✓	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

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APPENDIX N

SLUDGE ANALYSIS AND LANDFILL SCALE WEIGHTS

Compost Facility Operations Guide; Best Practices

Engineering and Public Works
District of Summerland

TABLE OF CONTENTS

COMPOST FACILITY OPERATIONS GUIDE; BEST PRACTICES

1. Background Information

Compost is a valuable soil amendment formed by the breakdown of organic material by microorganisms such as bacteria, fungi, and actinomycetes. Similar to the making of bread, cheese, beer or wine, it employs the metabolic activity of microbes to produce a desirable end product. Composting occurs naturally if the right conditions are present. For composting to proceed properly, the prepared mixture of composting organic feedstocks must have certain characteristics in order to create the conditions for these microbes to thrive.

Carbon to Nitrogen Ratio

There must be a balance of carbon-rich feedstocks and nitrogen-rich feedstocks in the composting mixture. This provides the microorganisms with the balanced diet they need. Carbon-rich materials include brown leaves, brown pine needles, and ground-up wood and branches. Nitrogen-rich feedstocks include grass clippings, green leaves, fruit culls and biosolids.

Moisture

There must be sufficient moisture for the microorganisms to continue to metabolize the feedstocks and convert them to humus. If the mixture of organic feedstocks is too dry, materials will not break down, or will do so very slowly. With dry compost there is a risk of fire from spontaneous combustion or spark. This situation is discussed in more detail in Section 11.

If the mixture is too wet, it will break down very slowly and generate odours. Overly wet compost will not reach the temperatures required for the destruction of pathogens and weed seeds.

Oxygen

Oxygen must be present for the right microbes to remain active. With insufficient oxygen, the desirable aerobic microbes will become dormant, and the anaerobes will take over the composting process. It is important to avoid this situation because anaerobes compost very slowly, they produce foul odours which can result in complaints, and they do not generate the higher temperatures necessary for destruction of pathogens and weed seeds. It is important to aerate the pile to encourage the metabolic action of aerobic microorganisms.

Pile Size

To ensure the above conditions are met, in a commercial operation, compost piles must be large enough to allow temperatures to build up. Most backyard composters lack the size necessary to generate the heat needed to kill pathogens. As mentioned above, piles that are too large are subject to spontaneous combustion, as discussed in Section 11.

2. Government Regulations

The two main regulations that must be followed in the production of biosolids compost that is to be sold, are:

- The Federal *Fertilizers Act*
- The Provincial *Organic Matter Recycling Regulation* (OMRR), of the *Environmental Management Act*

These can both be found online.

Records of pile turnings, pile temperatures, and lab test results, and these records must be kept on file for a period of not less than 36 months. In order to track the compost through the processes of turning, temperature readings, and testing, each windrow should be given a unique identification number. This number must follow the product all the way through to the consumer, and must be recorded on all sales receipts.

One effective way of keeping track of individual batches is to maintain a log book with a page for each windrow, recording temperatures, turning dates, and sampling dates. The original lab results must also be kept on file.

3. Building piles

Mixing Feedstocks

As previously explained, the feedstocks used must be balanced with one another for carbon and nitrogen content. The C:N ratio of the finished compost must fall between 15 and 35. Mixing ground yard waste and brown leaves (carbon-rich feedstocks) with grass clippings, biosolids and seasonal fruit culls (nitrogen-rich feedstocks) generally produces a good C:N ratio, provided the biosolids are mixed in at a percentage of no more than 25% of the premix volume.

A combination of different particle sizes is important to give the pile the proper 'structure' to allow the composting to proceed in an aerobic fashion. Having some larger pieces of up to 5 inches in their longest dimension creates air spaces within the pile, allowing the desirable aerobic microbes to flourish.

Aeration is also enhanced through the use of correct techniques when building piles. Allowing the premixed feedstocks to 'dribble' off the edge of the loader bucket when building (or turning) piles will keep the structure as fluffy as possible and ensure sufficient oxygen is present to get the process started, and keep it active for several days. Figure 1 provides a graphic representation of the effect the turning frequency has on pile temperature (taken from the Master Composter's Resource Manual).

Mix feedstocks as uniformly as possible. A homogeneous mixture of the feedstocks is necessary to get the compost process started and keep it proceeding smoothly. The microbes need to be able to access both carbon and nitrogen readily. It is also important in avoiding the possibility of spontaneous combustion.

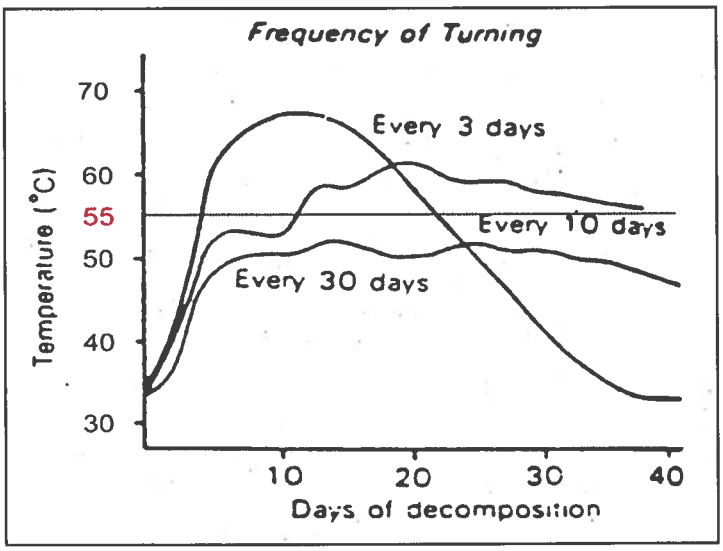

Figure 1

Pile Size

Pile size is partly dictated by the equipment used to build the windrows, but in general, the height should not exceed 3.7 meters (12 feet) as this reduces effectiveness and increases the risk of fire.

4. Adding Water

On the coast, composting operations are often conducted under cover to keep the rain off the piles. In the Okanagan, it is most often a lack of process water which is of concern. Insufficient moisture in the compost windrow leads to:

- slow or stalled composting;
- the possibility of overly high temperatures resulting in risk of fire; and
- incomplete composting that results in a compost with nitrogen content that is too high for regulatory requirements, or for safe use in horticultural applications.

Overly wet piles also create problems. Too much moisture fills up valuable air spaces, resulting in compost that breaks down anaerobically and produces strong foul odours.

The moisture content of composting feedstocks must fall between 40 and 65%, both for effective composting, and for meeting regulatory requirements. In fact,

regulations allow compost to be as dry as 35%, but spontaneous combustion can occur at moisture levels between 25% and 40%, so it is best to keep the compost above this range, especially once the active turning phase is complete.

Water can be added by a water truck or irrigation system with emitters set up along the top of the windrow. It is helpful to use a loader bucket to create a trough in the top of the windrow before adding water, to allow the water to sink into the pile rather than run down the sides. It is important to turn the pile as soon as possible after adding moisture to keep the piles uniformly moist. The addition of moisture is best timed to occur early on the same day as, or on the day before, a scheduled turning.

There are some issues associated with adding water to windrowed compost that operators should be aware of. The first is leachate control. If compost containing biosolids is being produced on porous ground, there is a possibility of pathogens and other dissolved materials entering the ground water.

If the operation is located in an area which has buried garbage underlying the compost windrows, irrigating the compost may add water to the buried waste, resulting in the production of toxic gases, leachate, greenhouse gases and odours.

To avoid problems with leachate production and groundwater contamination, piles should not be overwatered. Added moisture should be confined to the compost windrow without overspray or ponding adjacent to windrows. Piles should be turned as soon after moisture addition as possible to incorporate the moisture evenly into the compost.

5. Turning Piles

The District of Summerland uses a 'turned windrow' composting process. According to the BC Organic Matter Recycling Regulation (OMRR), the following procedure must be followed for turned windrows, in order to produce Class 'A' compost that is approved for sale:

> "...the windrow composting method whereby organic matter is processed in a windrow involving periodic aeration and mixing of the windrow, with a temperature of not less than 55° Celsius maintained for at least 15 days and not fewer than 5 turnings of the windrow made during the high temperature period to promote uniform exposure of the compost to thermophilic temperatures."

Turning piles redistributes nutrients and moisture by breaking up pockets of unmixed material, and results in a better quality compost product in less time. It cools hot compost piles so that beneficial microbes remain active, and stops

development of the conditions that result in spontaneous combustion. Most importantly, turning piles introduces oxygen throughout the compost.

In a large compost pile, aerobic microbes are present throughout the pile, metabolizing feedstocks and converting organic material to humus. The microbes need oxygen to do this, and soon use up the available oxygen in the material surrounding them. For microbes located near the outside of the pile, this is not a problem, as air infiltrates the material to replace the oxygen lost. Deeper into the pile, as the oxygen is depleted, it is less readily replaced. Once the oxygen has been used up, the aerobic microbes become dormant until there is more oxygen present.

If the more vigorous aerobes become inactive, the anaerobic microbes can gain a foothold and start breaking down the compost feedstocks. There are several consequences to this: Anaerobes work very slowly, they do not generate the temperatures necessary for pathogen and weed seed destruction, and they produce bad-smelling metabolic byproducts. In practical terms, this means that the compost could take as much as ten times as long to be ready for screening and sale, taking up valuable space and losing potential revenue. The compost cannot be approved for sale, even if it has broken down sufficiently because potentially harmful pathogens will still be present and odours will result in complaints from the public.

According to OMRR, windrows must be turned five times during the thermophilic, high temperature phase. This means that once the temperature has risen above 55°C for several days, it's time to turn the pile. The pile should be turned again until the required number of five turns has been achieved while the temperature remains high.

The regulations require the temperature to remain in the thermophilic phase for 15 days. This is easily achieved provided the pile is constructed properly. Turnings should also occur:

- if the pile or part of the pile cools down below 55°C, if the time/temperature requirements have not yet been met, in order to kick start the process,
- if the pile temperature rises above 73°C, to cool the pile down and avoid a potential fire situation,
- if temperatures taken in different parts of the pile vary by more than fifteen degrees, even if they are within the 55 to 75 degree range,
- if the compost is overly wet, to encourage evaporation of excess moisture, or
- if water has been added to the windrow, to ensure even incorporation.

Equipment operators should strive to loosen up the material as much as possible when turning, and avoid simply moving masses of coagulated material from one point to another. As mentioned in Section 3 on Building Piles, material should be

tossed or allowed to dribble off the edge of the loader bucket to ensure air comes into contact with as much of the material as possible. To achieve maximum penetration of air into the finished windrow, operators should avoid compacting or patting down piles,.

Wheel loaders are most commonly used for turning windrows, but excavators can also be effective. Windrow turners can be particularly useful pieces of equipment in a facility that plans to continue operating into the foreseeable future.

6. Recording Temperatures

Pile temperatures are taken with a long temperature probe inserted all the way into the pile and left in place for at least 20 seconds, or until the reading has stabilized. Pile temperatures must be recorded on each business day. With long windrows, as in the situation with the Summerland operation, temperatures should be taken from at least three evenly spaced points on the pile and averaged to give the 'official' reading.

The temperature of screened product should also be taken three days after screening or turning. This gives an indication of the maturity of the compost, or of how complete the composting process is. If the compost is 'finished', there will be little energy left in the pile to drive the composting process, and a low temperature will indicate that the microbes are no longer actively metabolizing this material. The temperature should be no more than 20 degrees higher than the ambient temperature.

If the temperature is too high, the material must once more be turned on a Monday, Tuesday or Friday (to avoid weekend work), and the temperature taken again, three days later, with the above process repeated until the compost is deemed mature.

7. Screening

Once compost has met time, temperature and turning requirements, and has achieved a dark colour and earthy smell, it is ready for screening.

For efficient screening, the compost must be between 35% and 55% moisture content. Compost that is too dry will blow around in the screening process, resulting in loss of the desirable fine portion of the compost. Compost that is too wet will blind the screener, resulting in poor separation of fines and 'overs', requiring rescreening at a later date.

The compost at the Summerland Landfill is screened to ½ inch This practice should continue as it produces a good grade of product. The screen openings can be reduced to as little as ¼ inch for a fine specialty product for topdressing lawns, or to as large as ¾ of an inch if there are concerns about excessive 'overs'. The operator should be aware that larger screen openings could allow small rocks into the finished product, reducing the product's attractiveness and value.

8. Testing

When to Sample

Testing is carried out on the product which is offered to the public for sale. This means compost must be screened and mature before taking samples for testing. As mentioned in Section 6, compost maturity is determined by taking the temperature of the compost with a temperature probe three days after turning, or screening a pile. If the temperature does not rise to more than 20 degrees Celsius above ambient temperature, the compost may be considered mature.

If the temperature exceeds this parameter, it is an indication that the feedstocks are continuing to break down, and that the composting process is not yet complete. If this happens, the Operator should wait one week, turn the pile, and take another temperature reading 3 days after turning. Repeat as necessary until maturity is reached. After maturity samples can be collected for testing at least 3 days after a turn.

Preparation

It is important to plan ahead when sampling. Samples to be tested for microbiological parameters must be tested within 72 hours of collection. It's best to sample early in the week, and get samples to the commercial lab as promptly as possible once they have been collected. The lab should be notified at least one day in advance that samples will be arriving, so that they can prepare the necessary media and reagents. The ideal scenario involves notifying the lab on a Friday or Monday, and collecting samples on a Monday or Tuesday.

Tests Required

Physical Parameters

Compost must be sampled for the following physical parameters once for every 1000 Tonnes, or once per year; whichever comes first. This is currently the annual production rate in Summerland, so unless production increases, one sample per year is sufficient. Summerland were to have two or more separate compost products, there would need to be a duplicate set of test results for each type of compost.

Take one composite sample annually of at least 750 ml (3+ cups) total to test for the following (regulatory limits for each factor are shown in brackets):

- C:N Ratio (15-35)
- Percent foreign matter (≤1%)
- Sharp foreign matter (0%)
- Percent Moisture (35%-65%)
- Arsenic (≤13 µg/g dry wt)
- Cadmium (≤3 ")
- Chromium (≤100 ")
- Cobalt (≤34 ")
- Copper (≤400 " – limit under review; may go to 600)
- Lead (≤150 ")
- Mercury (≤2 ")
- Molybdenum (≤5 ")
- Nickel (≤62 ")
- Selenium (≤2 ")
- Zinc (≤500 ")
- Percent Organic Matter (>15%)*
- Total Nitrogen (N)**
- Water insoluble nitrogen**
- Total and Available Phosphorus (P_2O_5)**
- Soluble Potash (K_2O)**
- pH**

*Required under Federal Fertilizers Act

**These parameters are not required under the Organic Matter Recycling Regulation, but are important in order to explain to customers how to use the product, as required by the Federal Fertilizers Act. The Federal Fertilizers Act also requires testing for metals, but has less stringent limits, so operators should follow the Provincial OMRR limits, in brackets after each parameter.

Microbiological Parameters

In addition, each batch or windrow must be tested for microbiological parameters. There are approximately 7 windrows produced per year, and 10 samples must be taken over the year, as per the Federal Fertilizers Act. Taking 2 samples from each batch, from different locations on the stockpile ensures that regulatory requirements are being met. Take samples using sterile technique, to test for:

- Fecal coliforms (<1000 mpn/g dry wt) (required by both Fertilizers Act and OMRR)
- *Salmonella* (nondetect) (required under Fertilizers Act)

How to Collect Samples

Pre-label sample bags (large Ziploc freezer bags) with Sharpie marker:

- Date and time of sampling
- Name: "District of Summerland Compost"
- Windrow or 'batch' identification number
- Sample number (1, 2, 3... etc)
- What samples are to be tested for

Sampling for Physical Parameters

For the annual comprehensive sample, sterile technique is not of concern. Remove top 6 inches of compost from the outside surface of the compost pile. This is done because the compost on the pile surface may have become either dried out or saturated in precipitation, and fine material blows away, so surface samples are not representative of the product.

Use a gloved hand or a clean trowel to take a handful of compost and place it in a large pre-labeled Ziploc freezer bag. Repeat this procedure to take samples from at least 3 different evenly spaced locations to make up a composite sample. Make sure bag is sealed between samples, and again immediately after final sample is added to the bag to ensure minimal moisture loss.

Sampling for Microbiological Parameters

Use sterile technique to collect samples to be tested for fecal coliforms and *Salmonella*.

First rinse trowel with squirt bottle containing 10% Javex (or 80% Ethanol, or other approved disinfectant), taking care not to splatter clothing. Wipe with clean paper towel to remove excess disinfectant.

"Vectors" such as birds, insects and small mammals have access to the pile surface, and may deposit fecal coliforms there. This surface material must be removed before sampling to avoid contamination of samples. With a gloved hand, scoop off the top 5 centimeters (2 inches) of compost from the pile surface at the sampling location in an area of 60cm by 60cm (2 feet x 2 feet), sweeping sideways. Start at the top of the area to be cleared and work to the bottom to avoid contaminating the freshly cleared area with surface compost. Discard the glove, and put on a clean one. Use the sterilized trowel and clean disposable glove to dig a hole between 35 cm to 60 cm (14 to 24 inches) deep horizontally into the pile. Ensure the trowel touches just the bottom and sides of the hole while digging, without touching the inside top surface.

To collect the sample, the staff person should invert the labeled sampling bag over their hand and grab a large handful of compost from the inside top surface of the hole, using the freezer bag. Try to get the sample from as deep into the hole as possible, without allowing compost from the surface of the pile to touch the inverted bag. Turn the bag right-side-out over the sample, squeezing out

excess air as the bag is sealed, and taking care not to touch the interior of the bag.

Place the bagged sample directly into a cooler with frozen ice packs in it to chill the samples and keep them cold. Spreading the compost out into a thin layer within the bag allows it to cool more quickly.

Repeat for the second sample, in a different location, preferably on the other side of the pile. Make sure the trowel is cleaned off, then rinsed with disinfectant solution for each sampling location, but the glove can be left on after the first sampling location to clear away the surface material at the second location, before changing.

Every effort should be made to get the samples to the lab the same day as sampling.

9. Labeling requirements

The Canadian Food Inspection Agency, through the Federal Fertilizers Act has specific labeling requirements regarding compost. The "label" refers to information that must be given to each customer, each time they purchase the product. For a bulk product, the required information may be presented as a handout, or printed directly on the receipt.

Handouts have been prepared that must be given to each customer. According to the Federal Fertilizers Act, the information they must carry includes:

- The product name ("Compost")
- The net weight (this will appear on the receipt)
- The company name and complete postal address
- The lot number (this is the windrow or batch identification number)
- Guaranteed analysis – only percent organic matter and percent moisture are required. The District is not making official nutrient claims, and therefore is not required to list the percentages of nitrogen, phosphorus and potassium.
- Directions for use – this is a soil conditioner that should be mixed with soil at no more than 1 part compost to 4 parts soil.
- Cautionary statements – the label should recommend hand washing after using the product.

10. Selling Compost Product

The compost produced at the Summerland Landfill is a high quality product, rich in nutrients and high in organic content. It improves the texture and water-holding capacity of soil, and provides macro and micronutrients that increase

plant vigour, improving disease and insect resistance, flower colour, drought resistance, and growth rate. It is important that this product not be undervalued.

When a customer purchases a landscaping material like compost, they usually have a required volume in mind. For instance, they may want a bucket of compost to mix into their hanging baskets, or they may need a cubic yard to mulch their shrub bed. Most customers will want to purchase the product by volume.

The District of Summerland compost is sold by the kilogram or tonne. The mass of a given volume of compost can vary significantly depending on its moisture content, and moisture content can vary wildly by time of year. The same amount of effort and expense goes into producing that volume regardless of moisture content, thus compost moisture content should be kept as consistent as possible.

11. Compost Fires

The Mechanics of Spontaneous Combustion

Fires frequently occur in compost windrows and feedstock stockpiles. There are many different sources of combustion, including welding sparks, lightning, cigarette butts, and heat from equipment and vehicles, but spontaneous combustion is the most common and least understood cause of compost fires.

Spontaneous combustion occurs when organic materials self-heat to a temperature high enough to cause them to ignite. Typically, composting materials ignite at temperatures between 150 and 200°C.

In a compost pile, the temperature rises due to the biological activity within the pile. If the temperature reaches 70 or 80°C, the microorganisms die or become dormant and the biological heating stops. In a pile with low moisture content, there is insufficient evaporation to cool the pile down once this point is reached.

From this point to the ignition temperature (150°C and higher), heat-releasing chemical reactions take over. As the temperature rises, the speed of the temperature increase accelerates, with the reaction rate doubling with every 10°C increase in temperature.

There are some key conditions in which spontaneous combustion will occur:

- presence of biological activity
- moisture levels between 25% and 40%
- large or well-insulated piles
- limited air flow
- time for temperature to build up

A non-uniform mixture of materials or uneven moisture distribution are also factors that can contribute to spontaneous combustion.

Large undisturbed piles such as feedstock stockpiles and curing piles are at greatest risk.

Warning: A large pile containing an undetected smoldering fire could change to a flaming fire if the material is opened up, and oxygen is allowed to fuel the fire. Workers should not walk on top of piles at risk of spontaneous combustion as they may break through a crust to a pocket of smoldering fire. Temperature probes can help monitor pile temperature, but operators should be aware that the temperature can vary significantly from adjacent locations in the pile, especially in non-uniform piles.

Avoiding Fires

Monitor organics piles for hot spots – high temperature, visible vents, smoke or burning smell
Ensure adequate ventilation and moisture content
Avoid piles higher than 3.7 meters (12 feet)
Ensure that piles are not left undisturbed for long periods of time

Extinguishing Fires

The fire department should be called (phone 911) to deal with any fire. Surface fires and internal fires are handled differently. For surface fires, arising from lightning, sparks or heat from equipment etc, the best method of suppression is simply to apply water.

For fires that arise due to spontaneous combustion, which is more likely an internal fire, equipment should be stationed around the perimeter of the pile; *never* on top. Material should be removed from the edges of the pile, and soaked, working inwards until the burning sections are isolated and quenched.

As material is removed it should be spread on the ground or stacked in small piles to cool.

Compost fires should not be smothered with soil, as it could take up to two years for the pile to cool.

12. Compost Facility Layout

How the compost facility is laid out can have an enormous impact on the cost of the operation. Every time a piece of equipment touches the compost, the cost of running the operation goes up. The distance over which materials are moved also affects the bottom line.

The quality and safety of the finished product can be affected by poor facility design. The operation should be structured to avoid cross contamination, where pathogens from fresh biosolids are transferred to "pasteurized" material that has already undergone the pathogen-reduction process. Pathogens from raw biosolids get caught up in equipment tires, and traffic patterns should be carefully planned and adhered to.

A linear or circular layout where feedstocks enter at one end, and customers leave the facility with finished compost at the other end is the most practical.

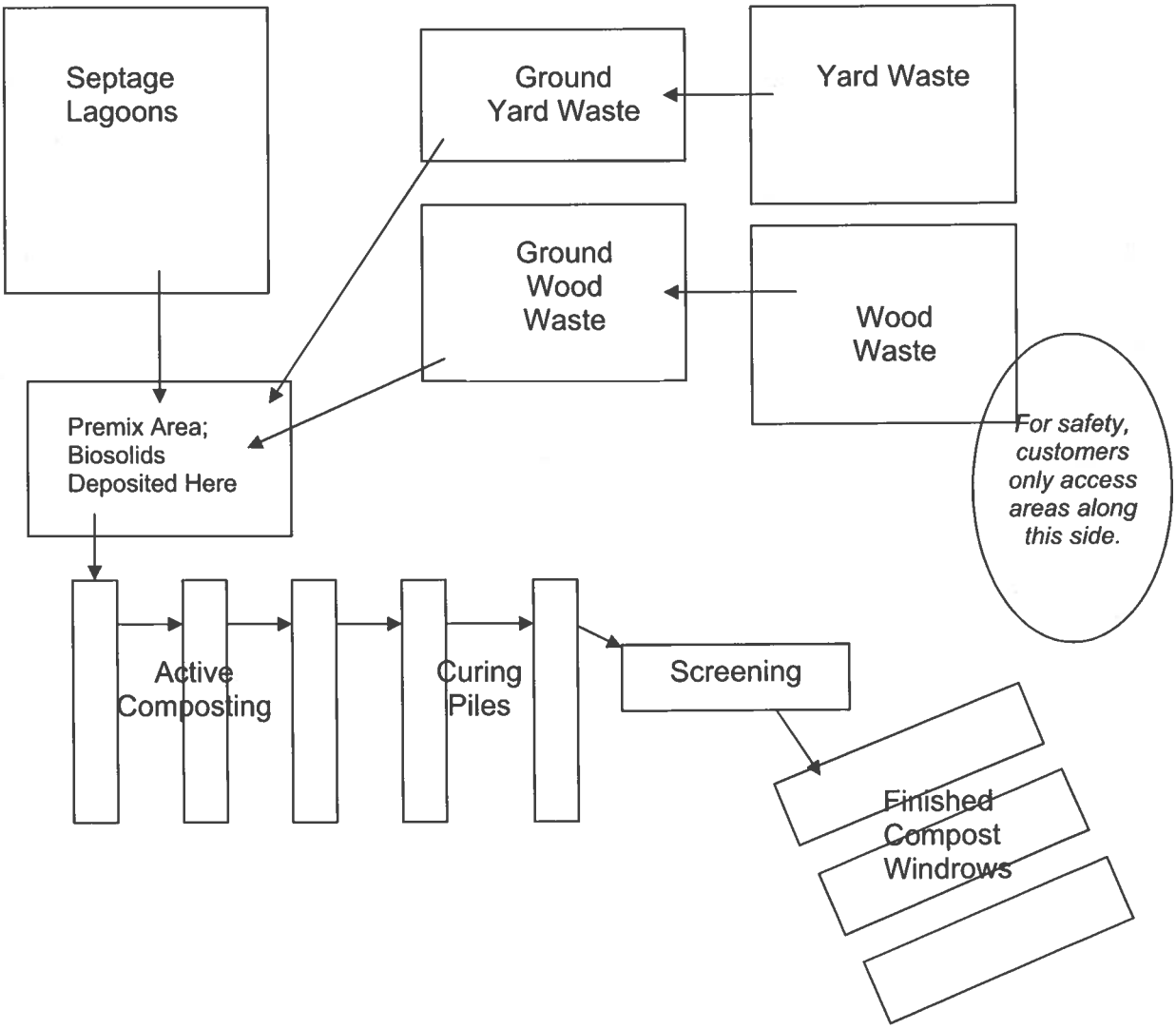

Table 7.0

Dewatered Primary Sludge and Waste Activated Sludge Hauled to Compost Site, 2023

Date	January	February	March	April	May	June	July	August	September	October	November	December
	kg	*kg*	*kg*	*kg*	*kg*	*kg*	*kg*	*kg*	*kg*	*kg*	*kg*	*kg*
1		6470	8330					6760	8510		4270	9020
2					7790	6900		5190				
3	4320	6140	7550		4560					4460	5390	
4				7540			9140	5710		8000		
5				4310	7340		6670		8080			8280
6	4370			6960		8340			7650	8070		5680
7		6710	5750			8230	9190		7120		6770	
8		7680	7940						5250		5740	7490
9					7730	9080		9920				
10		6010	8100		5680					7030	5070	
11	6220			6220			9300	7410		6910		
12				7240	8450		8890		7780			7580
13	6950					8720			7730	8390		5570
14		6750	7720	8950		7240	7950		4740		2430	
15			8710					7240	6070		6710	5870
16					7610	9230		5660				
17	7740	4630	8090		6230					8270	6460	
18	6780						9360	6690		6020		
19	3860				8740		6280		8990			6950
20	5410			4630		7750	5880		7040	4180		4560
21		2620	5500	7460		5280	4750				6750	
22		5340	6820					8080	7180		6370	6220
23					5780	7040		4330				
24	7250	8370	7320		4720						6900	
25	6380			7390			8550	5690		2540		
26				7100	8980		6530		5600			
27	5840					7790			5840	8570		4150
28			7120	7120		6430					6330	
29			6340					6190			4240	7350
30					8580	8740		6780				
31	6280		6490							7540		

Minimum	3860	2620	5500	4310	4560	5280	4750	4330	4740	2540	2430	4150
Maximum	7740	8370	8710	8950	8980	9230	9360	9920	8990	8570	6900	9020
Average	5950	6072	7270	6811	7092	7752	7708	6588	6970	6665	5648	6560
Count	12	10	14	11	13	13	12	13	14	12	13	12
Total	**71400**	**60720**	**101780**	**74920**	**92190**	**100770**	**92490**	**85650**	**97580**	**79980**	**73430**	**78720**

Loads to Compost	**149**	**Trucks**
Total Hauled	**1,009,630**	**kg/yr**
Average Haul Weight	**6,776**	**kg**

Table 7.1
Historical Primary Sludge and Waste Activated Sludge Hauled to Compost Site , 2023

Month	2006	2007	2008	2009	2010	2011	2012
January	75130	77595	93254	71154	63065	44235	71400
February	30850	84694	66295	66295	50385	39690	60720
March	67085	80175	116670	60640	70395	69505	101780
April	87605	70525	100190	90035	90035	57625	74920
May	43535	89963	86190	131120	162100	71235	92190
June	79745	95420	99060	93565	73755	48200	100770
July	72010	94720	79535	70105	72930	72770	92490
August	82815	93980	64655	132065	83385	89675	
September	98345	54615	82570	72925	67350	72955	97580
October	55825	98595	72555	82050	63200	67835	79980
November	64935	50260	90295	71555	41855	62995	73430
December	57185	44250	46820	101765	76365	49285	78720
Yearly Total (kg)	815,065	934,792	998,089	1,043,274	914,820	746,005	923,980
Yearly Month Avg. (kg)	67,922	77,899	83,174	86,940	76,235	62,167	83,998
Yearly Day Avg. (kg)	2,233	2,561	2,734	2,858	2,506	2,044	2,531

Month	2013	2014	2015	2016	2017	2018	2019
January	41355	60415	43540	74165	54020	79080	44250
February	77115	59680	55500	71450	45460	40720	49590
March	112085	54875	77675	60610	50640	51950	55650
April	113790	86640	74665	63380	63370	86970	52860
May	75220	67120	71870	75910	87480	89720	108840
June	75235	82945	53840	75230	66140	67100	50340
July	72395	58500	87490	67200	87960	81870	77930
August	45520	73515	38660	82220	84420	47320	72860
September	74910	68430	51990	67990	77490	91530	68440
October	86735	69805	47775	41450	70010	53450	118160
November	47235	33770	49285	48520	75090	51000	81690
December	48035	59805	16845	50290	59830	39420	58070
Yearly Total (kg)	869,630	775,500	669,135	778,415	821,910	780,130	838,680
Yearly Month Avg. (kg)	72,469	64,625	55,761	64,868	68,493	65,011	69,890
Yearly Day Avg. (kg)	2,383	2,125	1,833	2,133	2,252	2,137	2,298

Month	2020	2021	2022	2023	2024	2025	2026
January	68660	86330	75460	71400	0	0	0
February	63920	76010	84570	60720	0	0	0
March	77720	111960	72840	101780	0	0	0
April	91550	91200	90790	74920	0	0	0
May	100950	71940	79320	92190	0	0	0
June	86300	92870	86890	100770	0	0	0
July	89950	92770	72710	92490	0	0	0
August	79590	90070	61860	85650	0	0	0
September	80680	65530	71030	97580	0	0	0
October	73080	85810	74020	79980	0	0	0
November	54520	87940	72980	73430	0	0	0
December	96700	83510	64900	78720	0	0	0
Yearly Total (kg)	963,620	1,035,940	907,370	1,009,630	-	-	-
Yearly Month Avg. (kg)	80,302	86,328	75,614	84,136	-	-	-
Yearly Day Avg. (kg)	2,640	2,838	2,486	2,766	-	-	-

Table 7.2

Dewatered Sludge Analysis 2023

	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22-Mar-23	8300	0.37	0.46	100	<0.1	10.1	9.3	0.296	14600	3.9	0.6	125
22-Aug-23	10900	0.58	0.6	136	<0.1	17.0	18.1	0.404	18900	6.1	0.82	175
Min	8300	0.37	0.46	100	<0.1	10.1	9.3	0.296	14600	3.9	0.60	125
Average	9600	0.48	0.53	118	<0.1	13.6	13.7	0.350	16750	5.0	0.71	150
Maximum	10900	0.58	0.60	136	<0.1	17.0	18.1	0.404	18900	6.1	0.82	175

	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Ag
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22-Mar-23	1000	2.52	0.38	1640	22.0	0.110	5.35	3.65	13800	1680	1.16	0.63
22-Aug-23	1620	4.30	0.43	3110	46.1	0.233	6.49	4.87	20200	1990	2.04	1.06
Min	1000	2.52	0.38	1640	22.0	0.110	5.35	3.65	13800	1680	1.16	0.63
Average	1310	3.41	0.41	2375	34.1	0.172	5.92	4.26	17000	1835	1.60	0.85
Maximum	1620	4.30	0.43	3110	46.1	0.233	6.49	4.87	20200	1990	2.04	1.06

	Na	Sr	S	Te	Tl	Th	Sn	Ti	U	V	Zn	Zr
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22-Mar-23	246	86	2120	<0.1	<0.1	<0.5	7.2	37.9	10.1	1.5	183	10.7
22-Aug-23	405	119	4480	<0.1	<0.1	<0.5	10.1	61.6	5.61	2.5	321	11.3
Min	246	86	2120	<0.1	<0.1	<0.5	7.2	37.9	5.61	1.5	183	10.7
Average	326	102	3300	<0.1	<0.1	<0.5	8.7	49.8	7.86	2.0	252	11.0
Maximum	405	119	4480	<0.1	<0.1	<0.5	10.1	61.6	10.10	2.5	321	11.3

Graph 7.0

Dewatered Sludge to Landfill
Yearly Weights 2014 - 2023