Lakeshore Water System Assessment Report

Presented To:

REGIONAL DISTRICT
RDOS

Dated: February 2024

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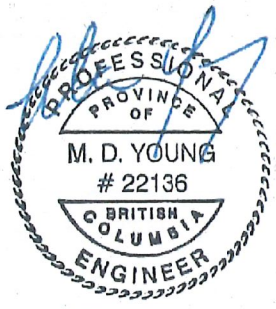

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Executive Summary

The Regional District of Okanagan-Similkameen (RDOS) has been approached by a private water utility owner and requested to take over the Lakeshore Water Utility. Ecora was retained by the RDOS to complete some of the initial steps of the Utility Acquisition Policy, which involves engineering and financial assessments of the existing infrastructure. The general condition of the infrastructure was found to be poor to fair but in operation on a daily basis. Required repair work was listed and cost estimates were prepared for this work. Some of the major repair work is listed here:

- The Lakeshore Pumphouse building needs major repairs.
- The valves and steel pipework in the Sunnybrook Pumphouse are corroded.
- The access ladders into Sunnybrook and Apple Court Reservoirs need to be replaced.
- The concrete roof slab of the Apple Court Reservoir is cracked and must be sealed.
- The Apple Court Pumphouse:
    - Replacement of a 1.5 kW jockey pump and a 450 Litre pressure tank.
    - Replacement of the building heaters.

Capacity constraints of the existing infrastructure were identified. This includes the following:

- The combined water storage capacity of the reservoirs is deficient by 220 m^3.
- The minimum fire hydrant flow rate of 60 L/s is not available at all fire hydrants.
- The flow rate of the pumps installed in the Sunnybrook Pumphouse is insufficient.
- The Christie Mountain Pumphouse also has undersized pumps.

Upgrades and improvements were recommended to comply with federal, provincial, and RDOS regulations and standards. Some of these are as follows:

- The largest recommended upgrade project is a 2.5 ML/day water treatment plant to ensure compliance with the Drinking Water Treatment Objectives (British Columbia, 2015) and the Guidelines for Canadian Drinking Water Quality (Health Canada, 2020).
- SCADA and radio communications must be added to all pumphouses and reservoirs to comply with RDOS standards. Real-time system data will be reported to a central computer system with backup power.
- The 150 mm ductile iron pumping main from the Lakeshore Pumphouse has reached the end of its lifespan and must be replaced.
- A gravel access road to be constructed to the existing Christie Mountain tank as it is currently only accessible by private driveway.
- Adequately sized emergency generators to be installed at the Lakeshore and Sunnybrook Pumphouses.
- A new pressure-reducing valve station is to be installed near the Sunnybrook Reservoir to supply fire water to the lowest pressure zone.
- Security alarms and fences to be added to the pumphouse and reservoir sites.
- Replacement of the Christie Mountain Pumphouse due to structural concerns.

Cost estimates were prepared for all the upgrade and improvement projects. The value of the existing infrastructure was estimated and operating costs were listed. The results of the financial assessments are as follows:

- The current value of the existing infrastructure is estimated to be $4.67 million.
- Immediate repair work is estimated to amount to at least $380k.
- Additionally, approximately $11.3 million is required for upgrades in the next 4 years to bring the system into compliance with national, provincial, and local regulations, and bylaws, and to meet current standards.
- The current annual operation and maintenance costs for the privately owned system are about $264k and the annual income from water tariffs and availability charges amount to $241k.
- If a mortgage had to be taken out for the Lakeshore Water System at a compound interest rate of 6% per year and an amortization period of twenty years, then households and vacant lots can expect to see an increase to $3,900 per year and $2,925 per year respectively to cover capital expenses and increases in operational costs. It was estimated that the rates would increase further by 2.2% per year to cover inflation.

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Acronyms and Abbreviations

AANDC	Aboriginal Affairs and Northern Development Canada
CBC	Canadian Broadcasting Corporation
CPCN	Certificate of Public Convenience and Necessity
EOCP	Environmental Operators Certification Program
HA	Health Authority
HMI	Human machine interface
hp	Horsepower
HVAC	Heating Ventilation and Air Conditioning
IHA	Interior Health Authority
PH	Pumphouse
PLC	Programmable Logic Controller
PRV	Pressure Reducing Valve
RDOS	Regional District of Okanagan-Similkameen
SRW	Statutory Right of Way
SCADA	Supervisory Control And Data Acquisition
TDH	Total Dynamic Head
UV	Ultra-violet
VFD	Variable Frequency Drive
WSA	Water Sustainability Act

1. Background

The owner of the Vintage Views Development sewer and Lakeshore Waterworks utilities approached the Regional District of Okanagan-Similkameen (RDOS) expressing a desire to discuss the transfer of ownership of both systems to the RDOS. The RDOS follows a Utility Acquisition Policy when receiving such requests. The assessments of the water and sewer systems are one of the first steps required in the utility acquisition policy.

Ecora Engineering & Resource Group Ltd. (Ecora) was retained by the Regional District Okanagan-Similkameen on April 11, 2023, to undertake assessments of the Vintage Views Sanitary and Lakeshore Water Systems. These assessments form part of the RDOS Utility Acquisition Policy. The findings of the assessments of the Lakeshore Water System are discussed in this report.

The area that the Lakeshore Highlands water system serves developed in multiple stages over time starting in the year 1976. Lakeshore Highlands, Heritage Hills, and Vintage Views are the semi-urban, residential neighborhoods located on the hillside east of East Side Road, between Okanagan Falls and Penticton. Together, these areas are approximately 112 ha in size. The location of the development area in relation to Skaha Lake, Penticton, and Okanagan Falls is shown in Figure 1.

Lakeshore Waterworks Ltd. is a privately held corporation that owns and operates the Lakeshore Waterworks System. The utility received its first Certificate of Public Convenience and Necessity (CPCN) in 1975 authorizing the construction and operation of the water system to serve 51 lots and has expanded several times over the years. The current system configuration has 270 residential customers and 41 vacant lots.

The water system holds five provincial licenses to withdraw water directly from Skaha Lake. The utility treats this water with chlorine but does not meet the Ministry of Health's multi-barrier approach to Drinking Water Treatment Objectives (British Columbia, 2015). Upgrades to the water system will be required to meet these objectives and this is discussed further in Paragraphs 4.3.3 and 8.

2. Assessment Criteria

Assessing a water system requires evaluating various aspects to ensure its efficiency, safety, and sustainability. Some assessment criteria to consider when evaluating a water system include the following:

- Water Quality:
    - Chemical Composition: Assess the levels of contaminants such as heavy metals, chemicals, and pollutants in the water.
    - Microbial Contamination: Check for the presence of bacteria, viruses, and other microorganisms that may pose health risks.
    - Taste and Odor: Evaluate the taste and odor of the water, which can affect its acceptability.
- Water Quantity/Capacity:
    - Flow Rate: Measure the volume of water delivered per unit of time to ensure it meets demand.
    - Storage Capacity: Evaluate the system's ability to store and distribute water during peak demand and emergencies.
    - Water Availability: Assess the system's capacity to provide a reliable water supply, considering seasonal variations and drought conditions.
- Infrastructure Condition:

- Pipe Condition: Inspect the condition of pipes, valves, and fittings for leaks, corrosion, and damage.
- Pump Efficiency: Evaluate the efficiency of pumps and motors in terms of energy consumption and performance.
- Reservoir and Treatment Facilities: Assess the state of reservoirs, treatment plants, and storage tanks for capacity and maintenance needs.

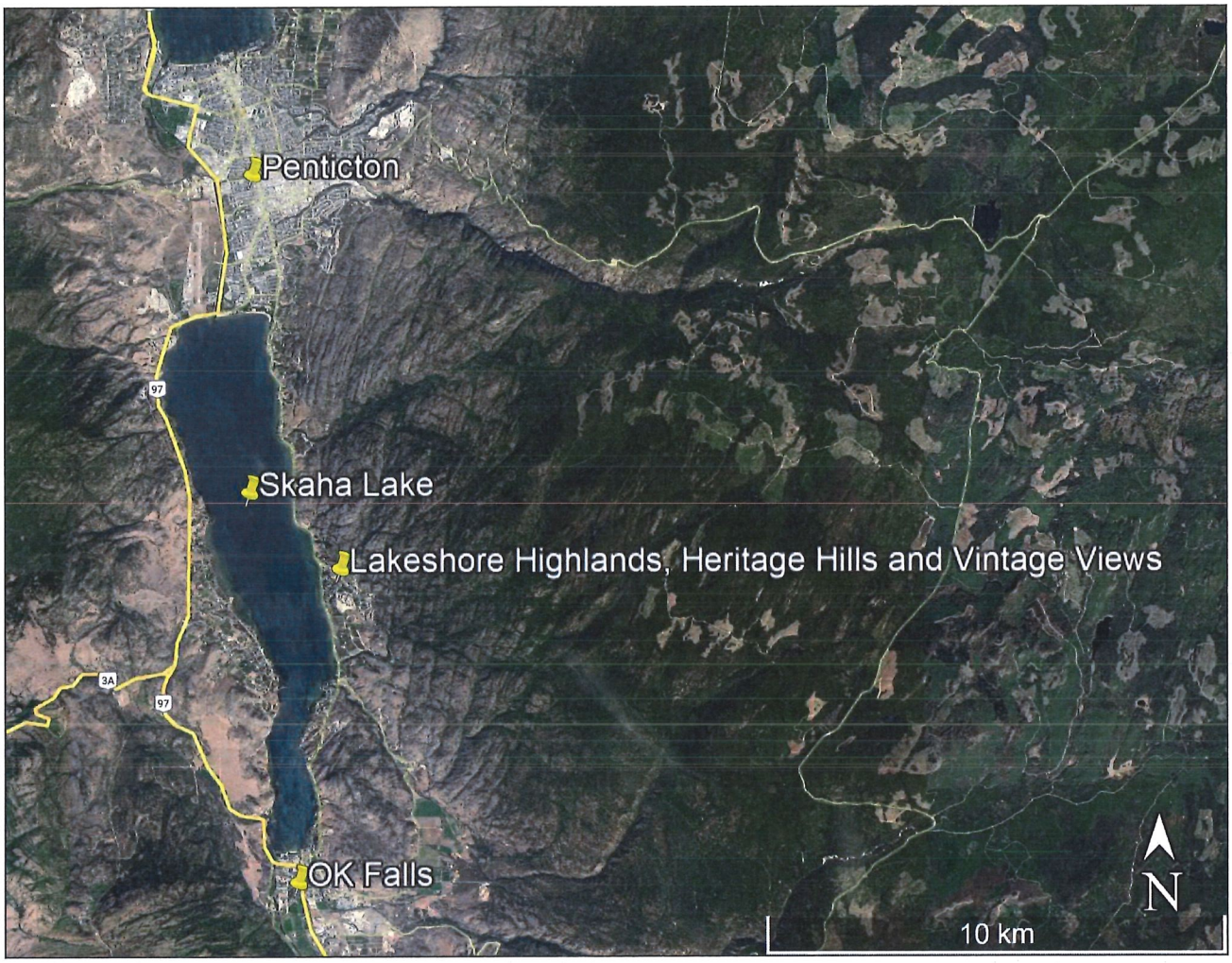

Figure 1: Location of Lakeshore Highlands, Heritage Hills, and Vintage Views

- Compliance and Regulations:
  - Regulatory Compliance: Ensure the water system meets local bylaws and provincial and federal water quality and safety regulations.
  - Permits and Licensing: Verify that the system has the necessary permits and licenses to operate legally.

- Safety and Security:
    - Emergency Preparedness: Evaluate the system's readiness to respond to emergencies such as natural disasters, contamination events, or system failures.
    - Security Measures: Assess security protocols to protect against intentional contamination or cyber threats.
- Environmental Impact:
    - Sustainability: Consider the environmental impact of water extraction, treatment, and distribution, with a focus on resource conservation and minimizing ecological harm.
    - Ecosystem Impact: Evaluate the potential effects of the water system on local ecosystems, including aquatic habitats and water sources.
- Financial Viability:
    - Cost Efficiency: Analyze the operational and maintenance costs relative to the quality and quantity of water provided.
    - Revenue Generation: Assess revenue sources, such as user fees, grants, and subsidies, to ensure financial sustainability.
- Infrastructure Resilience:
    - Aging Infrastructure: Evaluate the age of critical components and assess the need for maintenance, repair, or replacement.
    - Redundancy: Determine the system's ability to maintain water supply during infrastructure failures.
- Future Growth and Expansion:
    - Capacity Planning: Assess the system's ability to accommodate population growth and increased water demand.
    - Long-term Sustainability: Consider strategies for expanding and improving the system to meet future needs.
- Water Conservation and Efficiency:
    - Water Losses: Calculate and reduce non-revenue water losses through leaks or unauthorized usage.
    - Efficiency Programs: Implement water-saving technologies and incentives for customers to reduce consumption.
- Data and Monitoring:
    - Monitoring Systems: Ensure the availability of real-time monitoring and data collection for system performance and water quality.
    - Data Analysis: Analyze collected data to identify trends, potential issues, and areas for improvement.

3. Regulatory Overview

Ensuring the provision of safe, reliable, and sustainable water services is a priority for the Government of British Columbia. To achieve these goals, various regulatory bodies and frameworks oversee water utilities in the province. This regulatory overview provides a concise summary of the key regulatory aspects governing water utilities in British Columbia.

Regulatory Authorities:

- The Water Management Branch of the Ministry of Water, Land, and Resource Stewardship: A private water utility must hold a Certificate of Public Convenience and Necessity (CPCN). Under the Water Sustainability Act and the Utilities Commission Act, the Ministry of Water, Land, and Resource Stewardship is responsible for regulating 122 privately owned water utilities that serve approximately 20,000 households in British Columbia.
- Ministry of Health: The Ministry of Health plays a crucial role in ensuring the safety and quality of drinking water in British Columbia. It enforces the *Drinking Water Protection Act*, which establishes standards for drinking water quality, treatment, and distribution. A Construction Permit must be issued by the Health Authority before a water system may be constructed, extended, or upgraded. The Health Authority also monitors the quality of water supplied by utilities and the general condition of existing infrastructure.
- Ministry of Environment & Climate Change Strategy, Environmental Protection & Sustainability. The *Water Sustainability Act* (WSA) has been in force since February 29, 2016, and benefits all British Columbians by providing tools for managing water during shortages, including temporarily restricting water and groundwater use to protect essential household needs and critical environmental flows.

Key Aspects:

- Water Quality and Safety: The Ministry of Health sets and enforces water quality standards, monitors compliance, and conducts regular inspections of water treatment facilities to safeguard public health.
- Emergency Preparedness: Water utilities are required to have emergency response plans in place to ensure continuity of service during natural disasters, emergencies, or system failures.
- Environmental Compliance: Water utilities must comply with environmental regulations and obtain necessary permits from the Province when planning projects that may impact water bodies or ecosystems.
- Conservation and Efficiency: The Province encourages water utilities to adopt water conservation measures and improve the efficiency of their operations to reduce water wastage and environmental impact.
- Customer Relations: Utilities are obligated to provide transparent billing, customer service, and dispute resolution mechanisms to address consumer concerns and inquiries.
- Infrastructure Investment: Water utilities must regularly invest in maintaining and upgrading their infrastructure to ensure reliable and efficient service delivery.

Challenges and Future Considerations:

- Climate Change Resilience: BC is experiencing changing weather patterns, including droughts and wildfires, which may affect water supply and quality. Water utilities must develop resilience plans to adapt to these challenges.
- Indigenous Rights and Consultation: Indigenous communities in BC have constitutionally protected rights related to water resources. Utilities must engage in meaningful consultation and accommodate these rights when planning water projects.
- Aging Infrastructure: Many water utilities in BC are grappling with aging infrastructure, requiring significant investments to ensure continued service reliability.
- Population Growth: As the population in BC grows, water utilities must plan for increased demand and expand their capacity accordingly.

Conclusion:

The regulatory framework governing water utilities in British Columbia is designed to ensure the delivery of safe, reliable, and environmentally sustainable water services. It encompasses rate regulation, water quality standards, environmental compliance, and various other aspects to protect the interests of both ratepayers and the environment. Adapting to challenges like climate change and engaging with Indigenous communities are critical considerations for the future of water utilities. Regular collaboration between regulatory authorities, utilities, and stakeholders is essential to meet the evolving needs of the province's residents while safeguarding its water resources.

4. Engineering Assessment of Existing System

4.1 System Overview

A layout drawing of the existing water system and a schematic layout are presented in Appendix A and Appendix B respectively. A brief description of the water system is provided below:

- Lake intake (constructed in 1976, elevation of 327.66 m): Water enters a 250 mm pipe from the intake screen on the lakebed, located approximately 200 m from the eastern shore of Skaha Lake to a wet well directly beneath the Lakeshore Pumphouse.
- Lakeshore Pumphouse (constructed in 1976, ground elevation of approximately 339 m): Two submersible pumps (2 x 75 kW) installed in the wet well pump water through a dedicated 150 mm ductile iron and PVC water main to the Sunnybrook Reservoir. The pumps were replaced in 2011. The pumps are equipped with variable frequency drives (VFDs). Sodium hypochlorite is dosed directly into the pumping main to deactivate any pathogens in the raw water. Chlorination is the only water treatment that is currently being performed.
- Sunnybrook Reservoir (constructed in 1976, ground elevation of approximately 454 m): The concrete reservoir has a capacity of 113 m^3. The 150 mm water main from the Lakeshore Pumphouse feeds directly into the reservoir. There are two outlets exiting from this reservoir, one to a gravity pipe network, supplying water to 65 houses, and another outlet to the Sunnybrook Pumphouse.
- Contact Time in the pumping main and the Sunnybrook Reservoir: At the future Maximum Day Demand of 28.8 L/s the contact time in the dedicated pumping main and the Sunnybrook Reservoir would be approximately 8.5 minutes and 65 minutes respectively. The total contact time will be almost 74 minutes. However, this calculation assumes that there is no short-circuiting in the Sunnybrook Reservoir. Baffles might be required inside the existing structure to promote plug flow.

- Sunnybrook Pumphouse (constructed in 1982, expanded in 1992, ground level of approximately 454 m): This pumphouse is currently equipped with two "canned" lineshaft turbine centrifugal pumps (2 x 18.75 kW). The delivery manifold of the pumphouse splits into two directions, one pumping into the pipe network of the Apple Court Reservoir and the other passes through a pressure-reducing valve system before supplying 10 houses in the last 150 m of Sunnybrook Drive. The Apple Court Reservoir pipe network has approximately 168 existing houses and 36 empty lots connected to it.
- Apple Court Reservoir (constructed in 1989, ground level of approximately 540 m): This concrete reservoir has a capacity of 573 m^3. It has a common inlet and outlet.
- Apple Court Pumphouse (constructed in 2002, ground level of approximately 529 m): This pumphouse draws water from the Apple Court Reservoir pipe network. It is equipped with two centrifugal and one jockey pump (2 x 7.5 kW + 1 kW), pumping directly into a pipe network supplying 12 sprinklered houses and two empty lots with water.
- Christie Mountain Pumphouse (constructed in 1997, ground level of approximately 510 m): This pumphouse draws water from the Apple Court Reservoir pipe network and pumps into the Christie Mountain Tank and its pipe network. It is equipped with two centrifugal pumps (2 x 3.75 kW), pumping directly into a pipe network supplying 15 houses, three empty lots, and the 250 m^3 Christie Mountain Steel Tank with water.
- Christie Mountain Steel Tank (constructed in 1998, ground level of approximately 563 m): This steel tank has a capacity of 250 m^3. It has a common in and outlet pipe. This tank is the highest component of the Lakeshore Water System.

4.2 Water Licenses

The following licenses are held by Lakeshore Waterworks Ltd. The maximum volume that may be used per day is 2,253 m^3. The licenses are attached as Appendix C. This compares well with the calculated current and future maximum day demands of 2,160 m^3 and 2,490 m^3 respectively. (See Paragraph 4.4.1):

Table 1: Licenses held by the Lakeshore Water System

Licence Number	Date Issued	Maximum Daily Volume (m^3/day)	Maximum Annual Volume (m^3/day)
C047163	15 November 1976	97	
C060448	3 December 1984	17	
C105487	8 February 1996	261	
C107476	29 April 1996	250	83
C117063	22 May 2002	1,628	452
Total		**2,253**	

4.3 Water Quality

4.3.1 Lake Water Quality

Skaha Lake is not eutrophic/nutrient-rich and has been experiencing improvement in water quality since 1971. The quality of the effluent from the Penticton Wastewater Treatment Plant, that flows into Skaha Lake has been improving constantly since the 1970s. The turbidities measured over the last decade at different depths in the lake are presented in Figure 2 below (British Columbia, 2023). The measured turbidities are relatively low:

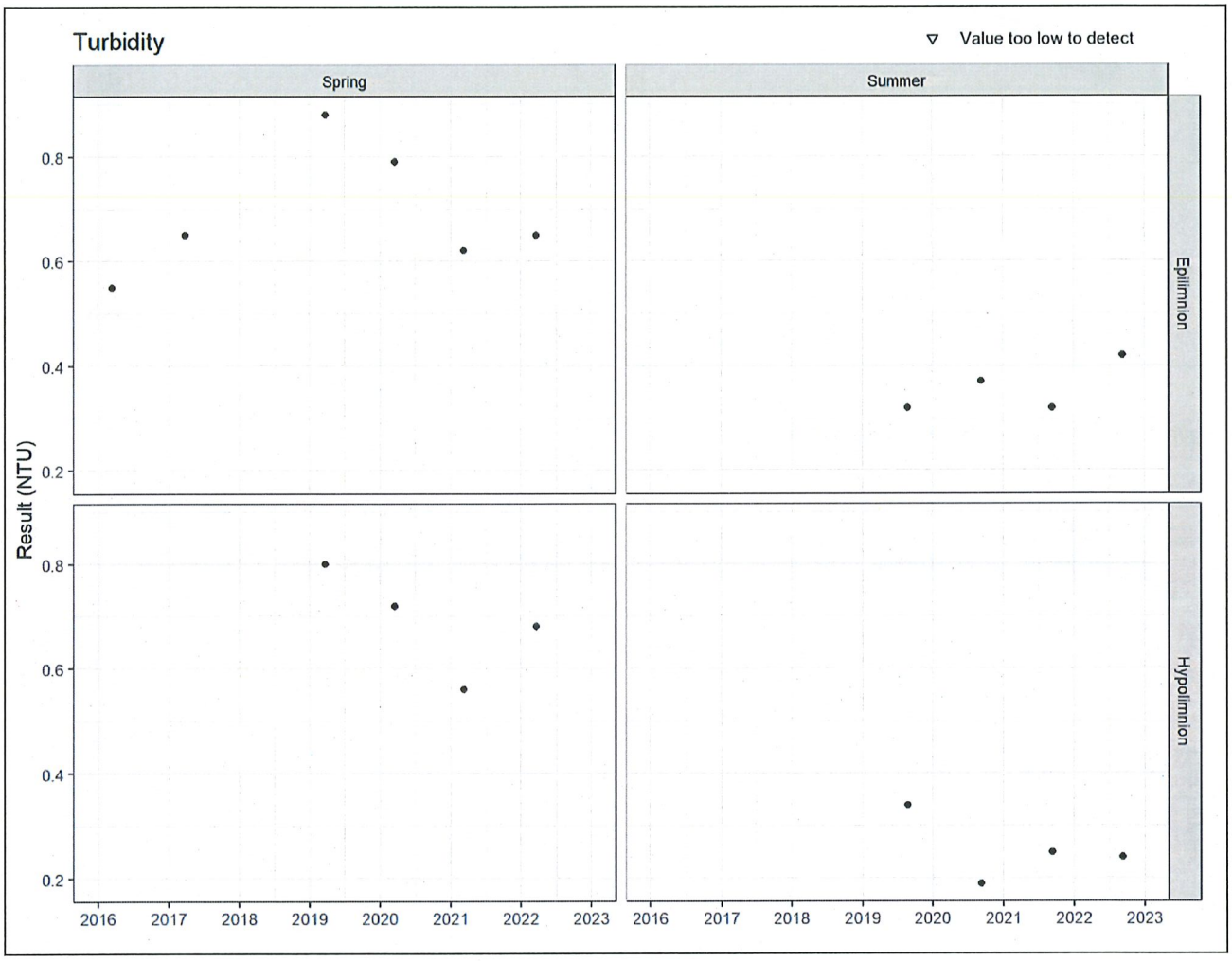

Figure 2: Turbidity measurement results for Skaha Lake at different depths

Measured dissolved oxygen levels are presented in Figure 4 below (British Columbia, 2023). Aquatic organisms, such as fish, require dissolved oxygen to survive. Wastewater consumes dissolved oxygen in freshwater bodies.

The measured values are relatively high (all above 8 mg/L) because the saturation concentrations of oxygen in freshwater are 14.6 mg/L and 11.9 mg/L at water temperatures of 0°C and 10°C respectively.

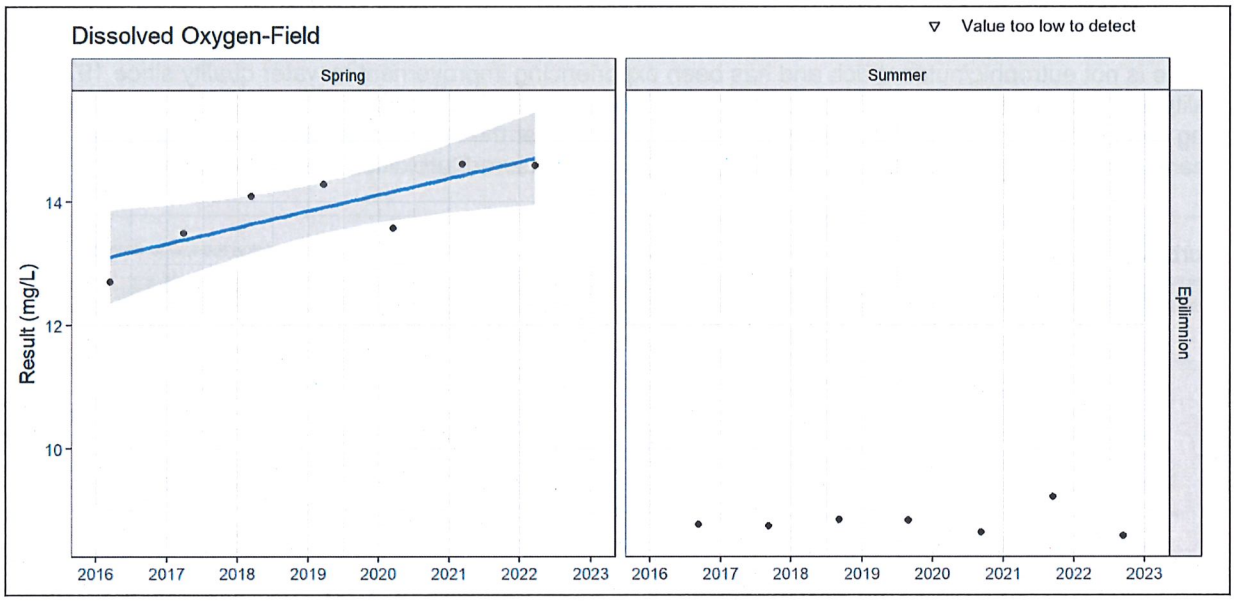

Figure 4: Dissolved oxygen measurements in Skaha Lake

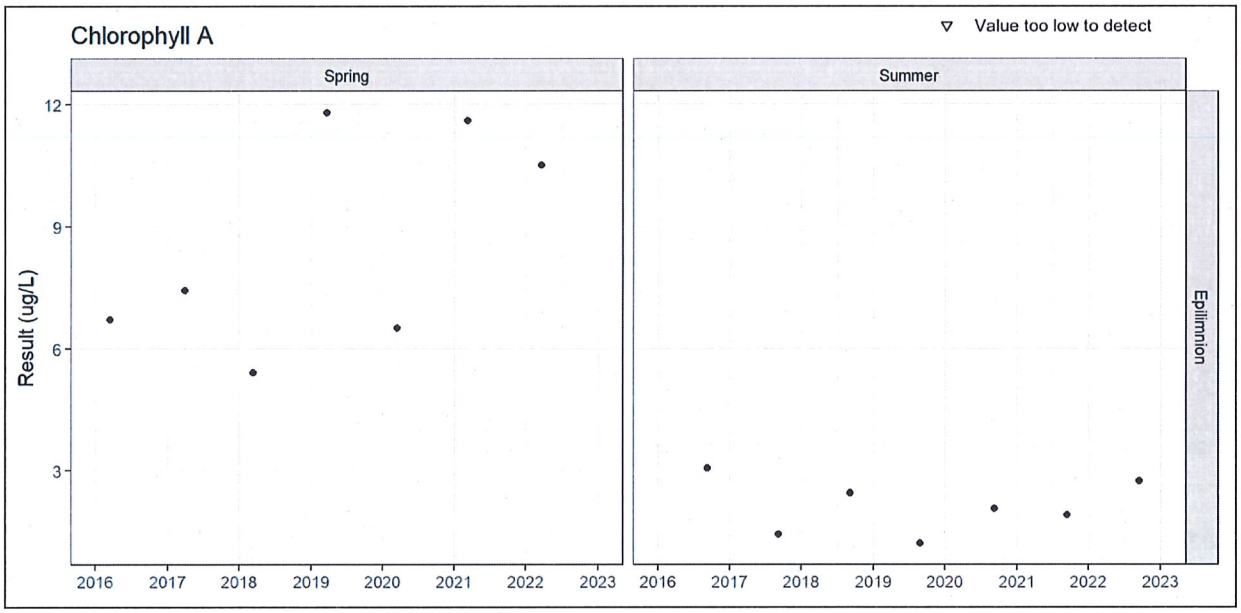

Figure 3: Chlorophyll-a concentrations in Skaha Lake

The chlorophyll-a concentrations measured in Skaha Lake are shown in Figure 3 (British Columbia, 2023). Chlorophyll-a concentrations are a measurement of how much algae are present in the lake. The levels are slightly elevated during spring and freshet. Chlorine can react with algae to form unwanted disinfection byproducts. In general, the algae concentrations are relatively low.

The total nitrogen levels measured in Skaha Lake at different depths are shown in Figure 5 below (British Columbia, 2023). All the concentrations are below 0.5 mg/L which is indicative of an oligotrophic / nutrient-poor water body, which is desirable and shows low human impact.

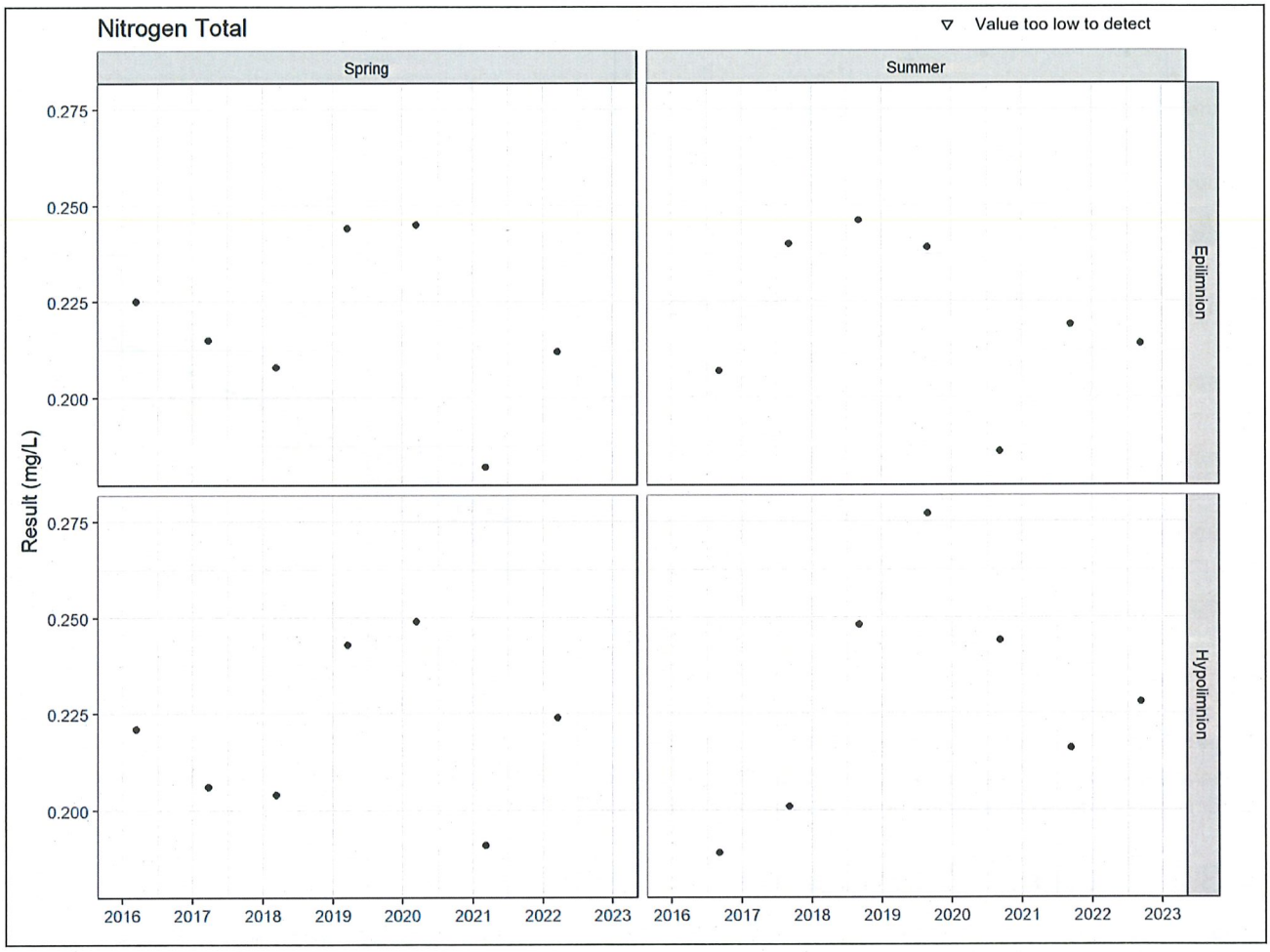

Figure 5: Total nitrogen levels at different depths in Skaha Lake

The total phosphorous concentrations measured in Skaha Lake are presented in Figure 6 below (British Columbia, 2023). The concentrations indicate oligotrophic conditions (low levels of nutrients) in the water. This indicates relatively clean water for a surface water body such as a lake.

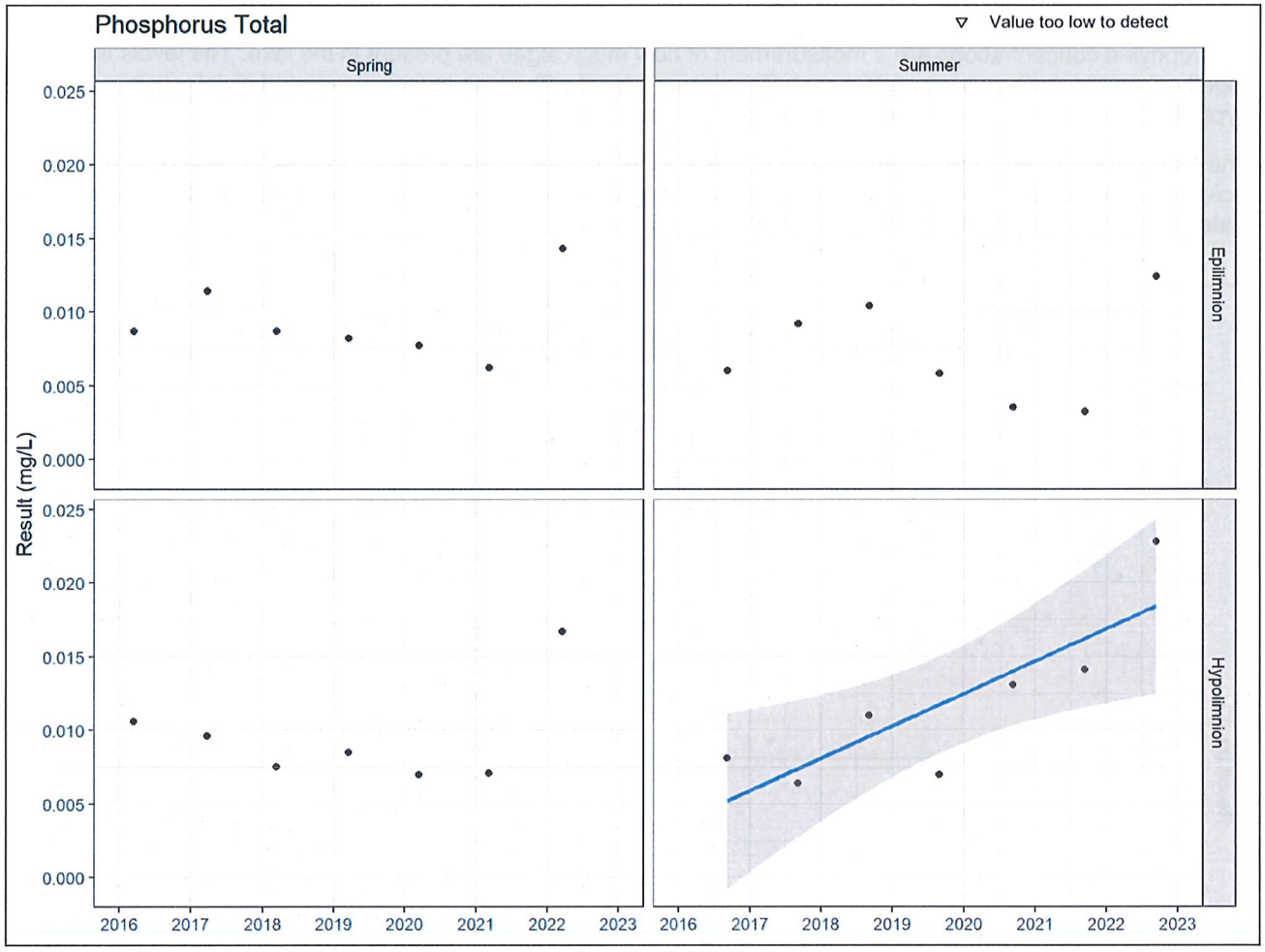

Figure 6: Total phosphorous measurements at different depths in Skaha Lake

Generally, Skaha Lake has good water quality with infrequent minor algal blooms occurring during freshet. Even good lake water requires adequate treatment before distribution to households.

4.3.2 Treated Water Quality

Sodium hypochlorite is dosed to the lake water at the Lakeshore Pumphouse. The system operator tests the residual chlorine almost daily at different locations in the water system.

The intent of the chlorine residual is to keep the chlorine level above a minimum concentration for a certain contact time to inactivate pathogens in the water. The residual concentrations must therefore be above certain levels at different locations in the distribution system. Water is also sampled on a weekly basis and sent to *Caro Laboratories* to test for *Escherichia Coli* (E. coli) and Total Coliforms only, which are good indicators of fecal contamination.

The chlorine contact time from dosing to reaching the first customer is not confirmed to be sufficient to deactivate all pathogens. Additionally, with no online chlorine analyzer, the chlorine dosing system is manually controlled based on distribution system residual readings. Another deficiency with the chlorine dosing system is the lack of an alarm that would indicate if the dosing pumps stopped.

As observed in laboratory test results over the past summer months, the water system has frequent positive results for coliforms. The current disinfection process is insufficient to treat the surface water source.

4.3.3 Drinking Water Treatment Objectives

The current system (of only chlorinating lake water) does not comply with the Ministry of Health's Drinking Water Treatment Objectives (British Columbia, 2015). The 4-3-2-1-0 requirements of the Treatment Objectives are as follows:

- 4-log reduction or inactivation of viruses.
- 3-log reduction or inactivation of *Giardia* and *Cryptosporidium*. Chlorine is not effective in the destruction of these protozoan oocysts. Ultraviolet (UV) radiation is more effective against these organisms.
- Two treatment processes in series are required for surface water treatment. There is currently only one treatment process (chlorination). Additional treatment is required.
- Less than or equal to (≤) one nephelometric turbidity unit (NTU) of turbidity. The lake water will not always naturally comply with this requirement. Physical separation is required to remove suspended solids from the water. Some form of media and or membrane filtration will suit the Skaha Lake water. If the severity and duration of algal blooms were to increase, then dissolved air floatation would be suggested. Coagulation, flocculation, and sedimentation are used for more turbid waters in warmer climates.

A water treatment plant (WTP) will be required to comply with current standards.

4.4 Water Demand

4.4.1 Complete system

The water demand for the complete system fed from the Lakeshore Pumphouse is presented in Table 2 below:

Table 2: Total water demand

Description	Number	Unit
Houses	270	Single-family units
Empty Lots	41	Lots
Total Future	311	Single-family units
Maximum Day Demand (MDD)	8,000	L/single family unit/day
Current MDD	2,160	m^3/day
Current MDD	25	L/s
Future MDD	2,490	m^3/day
Future MDD	28.8	L/s
Peak Hourly Demand (PHD)	13,600	L/single family unit/day
Current PHD	3,670	m^3/day
Current PHD	42.5	L/s
Future PHD	4,230	m^3/day
Future PHD	48.95	L/s

4.4.2 Sunnybrook Pumphouse Demand

The water demand for the Sunnybrook Pumphouse is presented in Table 3 below:

Table 3: Sunnybrook Pumphouse water demand

Description	Number	Unit
Houses	195	Single-family units
Empty Lots	41	Lots
Total Future	236	Single-family units
Maximum Day Demand (MDD)	8,000	L/single family unit/day
Current MDD	1,560	m^3/day
Current MDD	18.06	L/s
Future MDD	1,890	m^3/day
Future MDD	21.85	L/s
Peak Hourly Demand (PHD)	13,600	L/single family unit/day
Current PHD	2,650	m^3/day
Current PHD	30.69	L/s
Future PHD	3,210	m^3/day
Future PHD	37.15	L/s

4.4.3 Apple Court Pumphouse Demand

The water demand for the Apple Court Pumphouse is presented in Table 4 below:

Table 4: Apple Court Pumphouse Water Demand

Description	Number	Unit
Houses	12	Single-family units
Empty Lots	2	Lots
Total Future	14	Single-family units
Maximum Day Demand (MDD)	8,000	L/single family unit/day
Current MDD	100	m^3/day
Current MDD	1.11	L/s
Future MDD	110	m^3/day
Future MDD	1.30	L/s
Peak Hourly Demand (PHD)	13,600	L/single family unit/day
Current PHD	160	m^3/day
Current PHD	1.89	L/s
Future PHD	190	m^3/day
Future PHD	2.20	L/s

4.4.4 Christie Mountain Pumphouse Demand

The water demand for the Christie Mountain Pumphouse is presented in Table 5 below:

Table 5: Apple Court Pumphouse Water Demand

Description	Number	Unit
Houses	15	Single-family units
Empty Lots	3	Lots
Total Future	18	Single-family units
Maximum Day Demand (MDD)	8,000	L/single family unit/day
Current MDD	120	m^3/day
Current MDD	1.39	L/s
Future MDD	140	m^3/day
Future MDD	1.67	L/s
Peak Hourly Demand (PHD)	13,600	L/single family unit/day
Current PHD	200	m^3/day
Current PHD	2.36	L/s
Future PHD	240	m^3/day
Future PHD	2.83	L/s

4.5 Fire Demand

The RDOS bylaw (Regional District of Okanagan-Similkameen, 2021) states that the fire flow shall be in accordance with "Water Supply for Public Fire Protection – A Guide to Recommended Practice" as published by Fire Underwriter's Survey (FUS) (Fire Underwriters Survey, 2020), but with minimum flow rates for Low-Density Residential and Medium Density Residential of 60 L/s and 150 L/s respectively. The fire demand for this area was therefore based on the minimum fire demand of 60 L/s for Low-Density Residential developments. The corresponding fire storage volume is 302 m^3, based on 60 L/s flowrate and duration of 1.4 hr. (Fire Underwriters Survey, 2020)

4.6 Pumping Capacity

Pumphouses are required to deliver the MDD with one pump being out of service. The required and modeled pumping capacities are presented in Table 6 below. The pumping capacities of the Sunnybrook and Christie Mountain Pumphouses were found to be deficient and wouldn't meet the required maximum day demand (MDD) and must be increased with higher flow pumps.

Table 6: Required and modeled Pumphouse capacities

Description	Required Capacity (L/s)	Modeled Capacity (L/s)	Legend
Lakeshore Pumphouse	28.8	40.9	Meets flow rate requirements
Sunnybrook Pumphouse	21.9	13.3	
Apple Court Pumphouse	1.3	9.5	Does not meet flow rate requirements
Christie Mountain	7.0*	3.2	

*Based on filling the fire storage of 302 m^3 within 12 hours

4.7 Water Storage

The required and actual water storage volumes are presented in Table 7 below. It was found that there is a deficit of 220 m^3 in water storage capacity. It is recommended that a new reservoir be constructed directly adjacent to the existing Christie Mountain steel tank, which is the highest water storage site (in elevation) and where there is space available on the existing right of way. From the highest point in the water system, the water can gravitate anywhere, except to the 65 houses that are gravity-fed from the Sunnybrook Reservoir. It is, therefore, also recommended to install a PRV station between the Apple Court Reservoir Pressure Zone and the Sunnybrook Reservoir Gravity Pressure Zone.

Table 7: Required vs. existing water storage capacities.

Required Volume			Existing Storage Capacity		
Description	**Number**	**Unit**	**Description**	**Volume**	**Unit**
Fire Flow	60.00	L/s	Sunnybrook Reservoir (1976)	113	m^3
Fire Duration	1.40	hr	Apple Court Reservoir (1989)	573	m^3
A. Fire Volume	**302**	**m^3**	Christie Mountain Tank (1998)	250	m^3
Houses	270	Single-family units	**Provided Total**	**936**	**m^3**
Empty Lots	41	Lots			
Total Future	311	Single-family units			
Maximum Day Demand (MDD)	8,000	L/single family unit/day			
Future MDD	2.49	ML/day			
B. 25% of MDD	**622**	**m^3**			
C. 25% of (A+B)	**231**	**m^3**			
Total Required Volume =A + B + C	**1,156**	**m^3**	**Volume Required Deficit**	**220**	**m^3**

4.8 Water Distribution

The existing distribution network consists of approximately 10,226m of water mains. Approximate installation dates are presented in Table 8 below. 55% of the pipelines were installed before 1992 and are therefore currently older than 30 years. However, buried PVC pipes might last longer than 100 years:

Table 8: Water main installation dates

Year	Number of added house connections in the given years	Percentage of Total House Connections (%)	Pipe length (m)	Percentage of Total Pipe Length in a given year (%)	Cumulative Percentage of Total Pipe Length (%)	Material
1976	0	0%	1031	10%	10%	PVC and Ductile Iron Pumping Main
1979	65	21%	2460	24%	34%	PVC

Year	Number of added house connections in the given years	Percentage of Total House Connections (%)	Pipe length (m)	Percentage of Total Pipe Length in a given year (%)	Cumulative Percentage of Total Pipe Length (%)	Material
1982	10	3%	180	2%	36%	PVC
1990	87	28%	1995	20%	55%	PVC
1992	0	0%	570	6%	61%	PVC
1993	33	11%	680	7%	68%	PVC
1995	10	3%	290	3%	70%	PVC
1998	10	3%	480	5%	75%	PVC
2002	9	3%	205	2%	77%	PVC
2003	6	2%	165	2%	79%	PVC
2007	81	26%	2170	21%	100%	PVC
Total	**311**	**100%**	**10226**	**100%**		

The water main sizes and materials are presented in Table 9 below. Approximately 95% of pipelines consist of PVC and only 5% consist of ductile iron. Almost 70% of the water mains have a diameter of 150 mm:

Table 9: Diameters and materials of water mains

Diameter (mm)	Pipe length (m)	Percentage of Total Pipe Length (%)	Material
250	201	2%	PVC
200	3070	30%	PVC
150	530	5%	Ductile Iron
150	6425	63%	PVC
Total	**10226**	**100%**	

There are currently 33 fire hydrants connected to the system. The spacing of the fire hydrants shall not exceed a spacing of 250 m, neither shall any residence be more than 300 m from a hydrant as required by the RDOS bylaws. Two additional fire hydrants are proposed to satisfy the spacing requirements.

4.9 Metered or Non-metered Connections

Some household water meters were witnessed within the road right of ways. The water meter readings are currently not recorded, and it is unknown whether they are functioning. It was, therefore, assumed that half of all the existing water meters need replacement because household water meters generally do not last more than 20 years. Households pay a flat rate of $270 per quarter ($1,080 per year). Vacant lots pay $756 per year. The tariffs are attached in Appendix G.

4.10 Water System Capacity

Hydraulic modeling of the complete system was performed by Ecora in *Epanet.* The findings from hydraulic modeling were as follows:

- The flows available at fire hydrants were found to vary between 35 L/s and 100 L/s. The flow availability at fire hydrants is presented on the layout in Appendix D.
- There is insufficient water storage for firefighting in some areas, particularly in the Sunnybrook Reservoir gravity zone.
- All houses in the Apple Court Pumphouse Pressure Zone are required to be protected with sprinklers.

The recommendations from hydraulic modeling to meet capacity requirements are as follows:

- Construct a new 220 m^3 concrete reservoir adjacent to the existing Christie Mountain Tank on the existing statutory right of way (SRW), which is the highest reservoir site in the system.
- Refurbish and test the pressure-reducing valve (PRV) at the Christie Mountain Pumphouse, so that water may flow to the lower-lying area in an emergency.
- Install a new PRV at the Sunnybrook Reservoir that will allow flow from the higher pipe network to gravitate into the Sunnybrook gravity zone during an emergency. The storage volume in the Sunnybrook Reservoir is insufficient for firefighting.
- Provide standby generators for the Lakeshore and Sunnybrook Pumphouses for emergencies.
- Replace the pumps in the Sunnybrook Pumphouse with higher flow rate pump models.
- Construct a new Christie Mountain Pumphouse and install higher flow rate pump models.
- Replace the existing ductile iron pumping main running from the Lakeshore Pumphouse towards the Sunnybrook reservoir. Flow velocities were found to be relatively high in this water main.
- Larger diameter pipelines are suggested for future pipe replacements.

4.11 Water System Pressure

The Lakeshore water main is the only dedicated pumping main in the system carrying water from the lake to the Sunnybrook Reservoir. Other Pumphouses pump directly into the supply network. The maximum pressures that this 47-year-old pumping main experiences under different scenarios are presented in Table 10 below. It is strongly recommended that the ductile iron section of this water main be replaced. Ductile iron pipes may be degraded by corrosion (both on the inside and the outside). This specific pipe has been conveying corrosive chlorinated water for almost five decades:

Table 10: Maximum pressures in the Lakeshore Pumping Main

Description	Max Static Pressure (m)	Max Static Pressure (psi)	Max Pressure with a Closed Valve (m)	Max Pressure with a Closed Valve (psi)	Max Pressure with Open Valve (m)	Max Pressure with Open Valve (psi)	Max Pressure with Water Hammer - Estimated (m)	Max Pressure with Water Hammer - Estimated (psi)
Lakeshore Pumping Main	119	169	244	347	149	212	269	383

The maximum and minimum pressures in the various supply pressure zones are presented in Table 11 below. It was found that the minimum pressures in the system will occur during a maximum day demand (MDD) combined with a fire flow scenario, i.e. the peak hourly demand (PHD) scenario did not lead to the lowest pressures. The pressures were obtained from hydraulic modeling on computer and not from field measurements:

Table 11: Maximum and minimum pressures in different supply zones

Pressure Zone	Max Pressure at No Flow (m)	Max Pressure at No Flow (psi)	Min Pressure at MDD plus Fire Flow (m)	Min Pressure at MDD plus Fire Flow (psi)
Sunnybrook Reservoir Gravity Zone	115	164	0	0
Apple Court Reservoir Pressure Zone	140	199	13	18
Christie Mountain Tank Pressure Zone	66	94	12	17
Apple Court Drive Pumped Zone	87	124	0	0

4.12 Infrastructure

4.12.1 Pumphouses

4.12.1.1 Lakeshore Pumphouse

The Lakeshore Pumphouse was constructed in 1976. The pumps were replaced in 2011. The general condition of the Pumphouse is poor. The building is in a derelict condition and a hazardous materials assessment by a qualified professional is required before undertaking any rehabilitation work. (See Figure 7 to Figure 14 below.)

1) The exterior of the building and the site require remedial work to meet RDOS and Work Safe standards:
    a) Refurbish Exterior Building Envelope: Walls, insulation, and roof.
    b) Debris/rubble removal and erosion control around the site
    c) Stairs required between top and bottom levels.
    d) Outside handrails to be replaced due to corrosion.
    e) Fencing to prevent unauthorized access.
2) Interior:
    a) Repair leaks on pump control valve and pressure switches.
    b) Replace and secure dosing tubes.
    c) Supply chlorine spill containment.
    d) Install eyewash and shower near the sodium hypochlorite.
    e) Replace wiring, cables, panels, controls, and sensors. (Remove redundant instruments.)
    f) Add an online turbidity meter.

g) Painting, lighting, and safety signage

h) Upgrade the heating, ventilation, and air conditioning (HVAC) system. (VFDs require cooling.)

i) Install equipment and HMI requirements for SCADA connectivity.

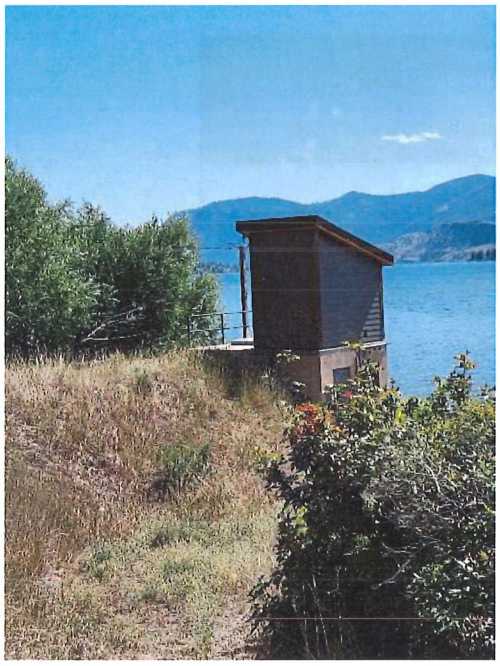

Figure 7: Lakeshore Pumphouse with top and bottom level rooms

Figure 8: Lakeshore Pumphouse: Wet well and pump headers

Figure 9: Lakeshore Pumphouse: Disintegrating outer walls.

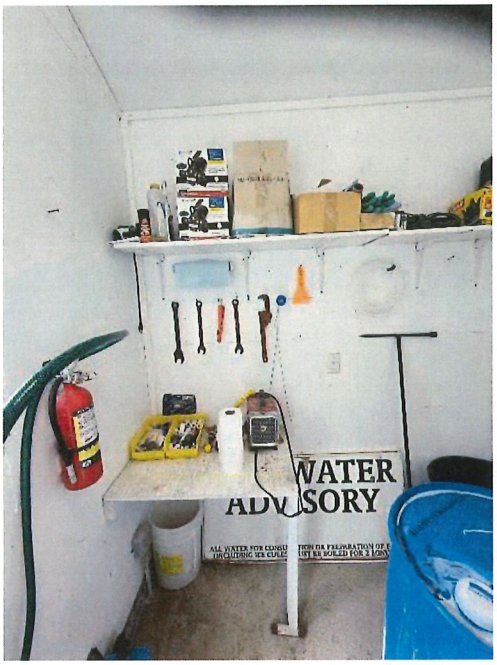

Figure 10: Lakeshore Pumphouse: Top level work bench

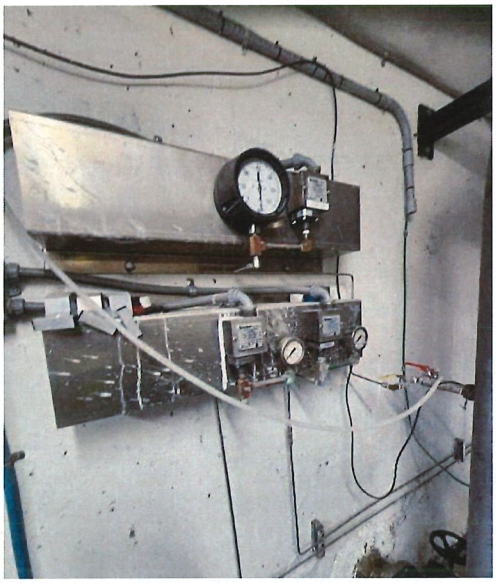

Figure 11: Lakeshore Pumphouse: Bottom Level: Mechanical pressure gauges and tubes

Figure 12: Lakeshore Pumphouse: Outside walls

Figure 13: Lakeshore Pumphouse: Bottom Level: Electrical panels

Figure 14: Lakeshore Pumphouse: Bottom Level: Leak through roof

4.12.1.2 Sunnybrook Pumphouse

General condition:

The first portion of the building was constructed in 1982. The building was extended, and the pumps were replaced in 1992. The general condition of the Pumphouse is discussed here, after visual assessments were conducted. (See Figure 15 to Figure 18 below.)

1) Building Remedial Work required to meet RDOS and Work Safe standards:
    a) Replace and secure dosing tubes.
    b) Repair and clean the outside and inside of the building.
    c) Replace corroded valves and pipework.
    d) Refurbish wiring, cables, and sensors. (Remove redundant instruments.)
    e) Replace the online chlorine analyzer.
    f) Install a new PLC cabinet, HMI requirements, and other equipment for SCADA connectivity.
    g) Painting, lighting, safety signage
    h) Upgrade HVAC (VFDs require cooling.)

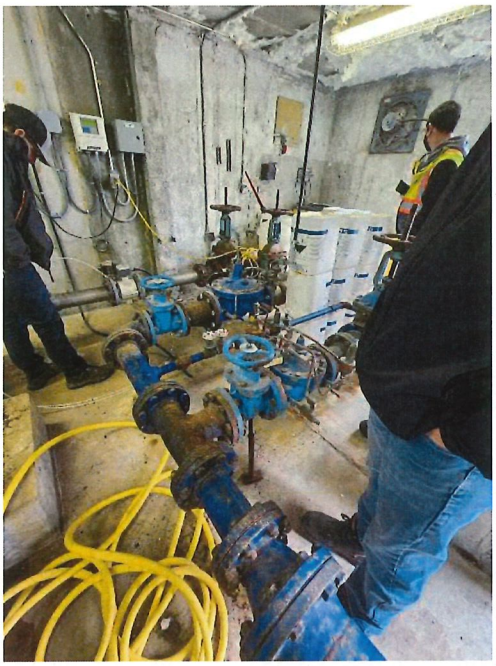

Figure 15: Sunnybrook Pumphouse: Corroded pipework and valves, untidy tubes, dirty ceiling

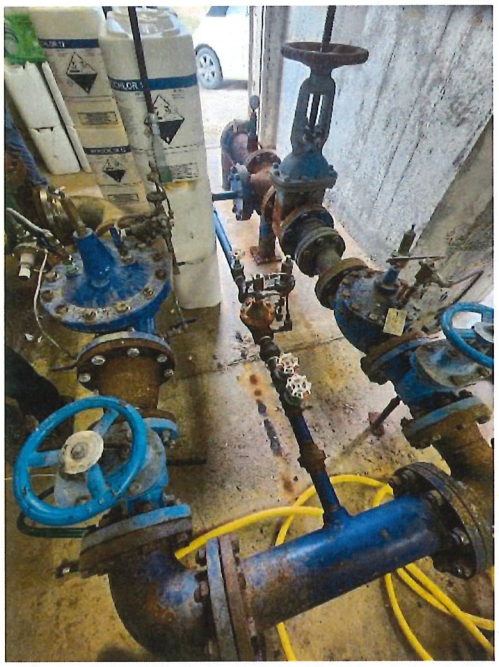

Figure 16: Sunnybrook Pumphouse: Corroded steel pipework and corroded valves

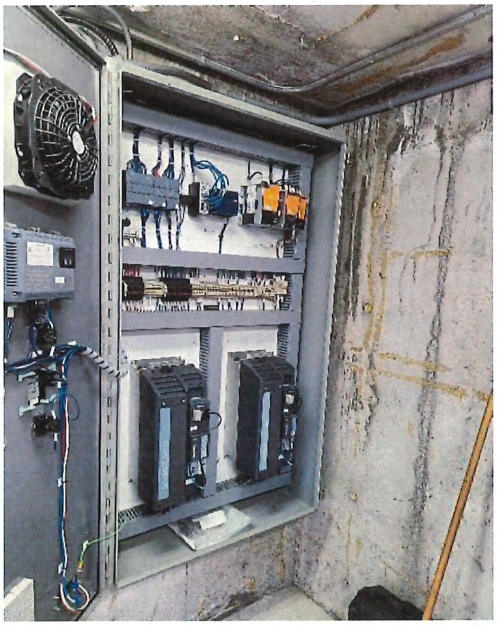

Figure 17: Sunnybrook Pumphouse: 600 Volt Variable frequency drives (VFDs) and programmable logic controller (PLC) in the same box

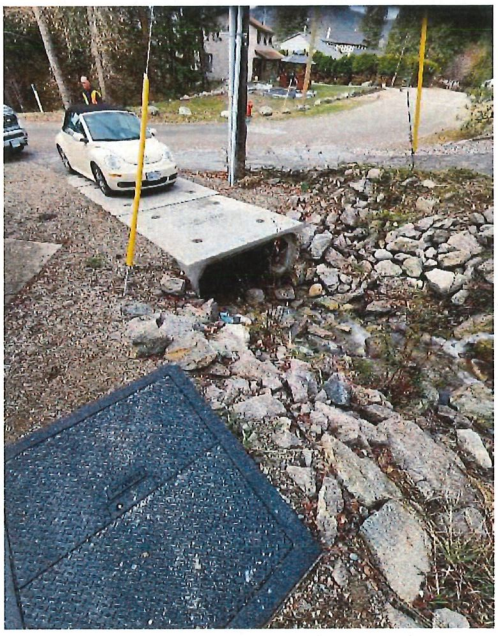

Figure 18: Sunnybrook Pumphouse: Creek and a box culvert outside the building

Flood Hydrology:

There is a flooding risk at this pump station. Preliminary hydrology calculations indicate a 1 in 100-year flow rate for the creek (directly next to the existing Pumphouse) of 20 m^3/s. The existing 2.4 m x 1.1 m box culvert is too small to convey the peak flow rate. The water might cross the road at a depth of 300 mm to 600 mm deep at peak flow. However, it is an extremely steep site. The general slope of the creek is approximately 20%. Stormwater will drain away relatively quickly. It is unlikely that the existing concrete structures will wash away because they are relatively heavy and sturdy. The size of the catchment area is 340 ha.

Capacity:

The pumps are undersized and cannot supply the Maximum Day Demand (MDD). With 1 pump running the maximum flow rate is approximately 13 L/s while the MDD is 21.85 L/s. Pumps to be replaced with higher flow and power pumps. (One pump must be able to supply the MDD.) The pump station can achieve 25 L/s with the two existing pumps running together in parallel. Upgrade from 2 x 18.75 kW pumps to 2 x 45 kW pumps.

4.12.1.3 Christie Mountain Pumphouse

General Condition:

1) Structural concerns/risks: A previous owner or contractor piled relatively large rocks against the back wall of the existing pump room. There are cracks in the concrete walls. (See Figure 19, Figure 20, and Figure 22 below.) It is uncertain whether these cracks were caused by impact/kinetic force or are caused by the existing static loads on the walls. It is uncertain whether there is a safety risk associated with using this building.
2) The existing pressure-reducing valve (PRV) must be tested/refurbished. (See Figure 23.)
3) Chlorine dosing tubes must be replaced and secured.
4) A chlorine analyzer must be added.
5) Repair and clean the outside and the inside of the building.
6) Corroded valves, seals, and pipes must be replaced or re-painted as applicable.
7) The heating, ventilation, and air-conditioning (HVAC) must be updated as it is currently inadequate.
8) Install new HMI and other equipment for SCADA connectivity and an unauthorized access alarm.

Capacity:

1) The pumps must be upgraded to be capable of filling the fire water storage within 12 hours. This is to ensure that water is available for fighting fires in an emergency:
    a) Existing pumps: Flow of 3.15 L/s at a total dynamic head (TDH) of 73 m (104 psi); Total Power of 7.5kW (10 hp), that is 2 x 3.75 kW (2 x 5 hp).
    b) Future Pumps: Flow of 7 L/s at a TDH of 73 m (104 psi); Total Power of 15kW (20 hp), that is 2 x 7.5 kW (2 x 10 hp).

Future upgrades:

1) A new building is required for the new proposed pumps, as the larger pumps will not fit in the existing building.
2) New larger diameter mechanical pipes and valves will be required for the new pumps.
3) A new building will require new HVAC.
4) The registration of a new statutory right of way (SRW) will be required for the new building.

Figure 19: Christie Mountain Pumphouse: Cracks in concrete walls

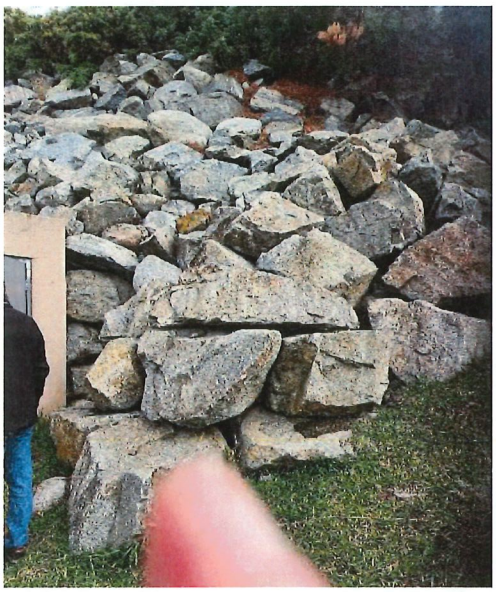

Figure 20: Christie Mountain Pumphouse: Rocks piled against the back wall

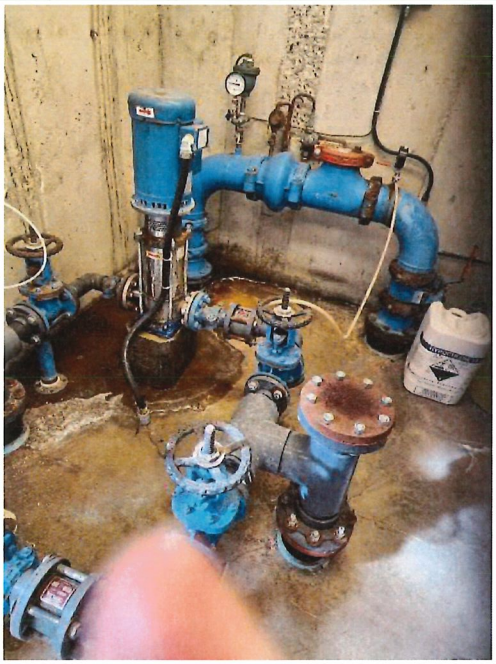

Figure 21: Christie Mountain Pumphouse: Water leaking from pump

Figure 22: Christie Mountain PH: More cracks in the walls

Figure 23: Christie Mountain Pumphouse: Pressure Reducing Valve requiring testing and refurbishment.

Figure 24: Christie Mountain Pumphouse: Corrosion visible on pump electrical motor frame

4.12.1.4 Apple Court Pumphouse

General Condition:

1) The structure and building walls seem to generally be in good condition. (See Figure 25.)
2) Various leaks of joints and seals need to be repaired.
3) The HVAC is not working properly and must be updated. (See Figure 27.)
4) One pressure tank is damaged and needs to be replaced.
5) Installation of a VFD would be a better option as the system cycles on and off very frequently.
6) The jockey pump has been removed and needs to be replaced. (See Figure 26.)
7) The generator requires a complete overhaul and servicing.

Figure 25: Apple Court Pumphouse: Cinder block walls are generally in a good condition.

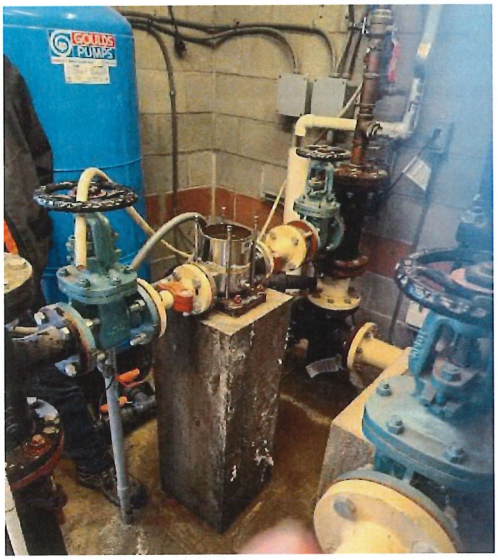

Figure 26: Apple Court Pumphouse: Jockey pump requires replacement.

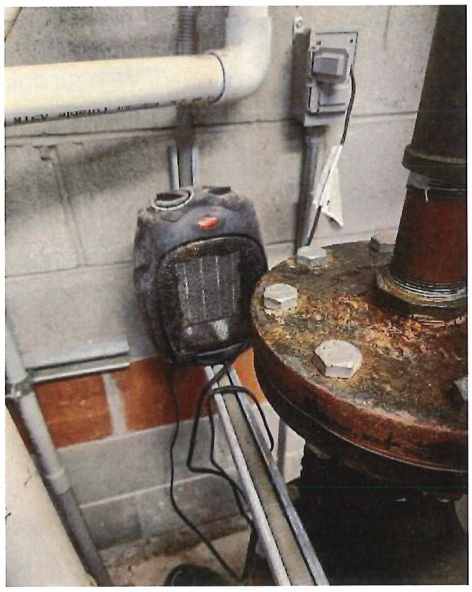

Figure 27: Apple Court Pumphouse: Portable room heater plugged into the wall outlet.

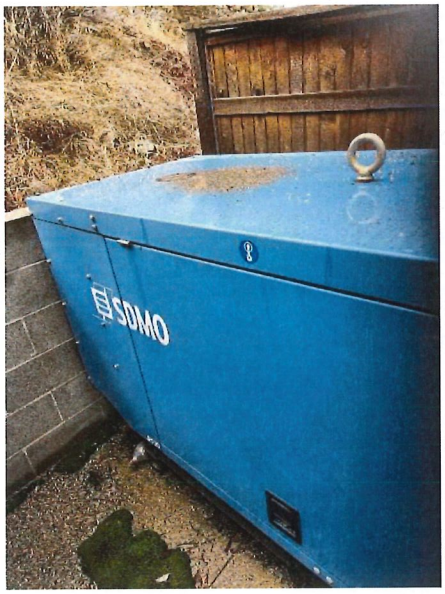

Figure 28: Apple Court Pumphouse: Outside generator

4.12.2 Reservoirs

Reportedly, reservoirs and tanks are cleaned out on an annual basis in spring by professional divers. Reinforced concrete structures may last between 50 and 100 years, but the durability depends on many factors, including the cover depth to the main steel reinforcing, the original concrete strength, and other factors. Reinforced concrete structures, despite their initial strength and durability, are not immune to the ravages of time. Over the years, a variety of factors contribute to their deterioration, chief among them being the ingress of carbon dioxide (CO2), which is present in the atmosphere, into the concrete matrix. This gas infiltrates the porous concrete surface and reacts with the alkalis in the cement, forming carbonates. This reaction leads to a gradual reduction in the pH of the concrete, a phenomenon known as carbonation. As the pH decreases, the passive oxide layer protecting the reinforcing steel bars (rebar) begins to break down. Consequently, the rebar becomes susceptible to corrosion, which can result in the expansion of the steel and cracking of the concrete cover, ultimately compromising the structural integrity of the entire system. Furthermore, chlorine gas released from the disinfected water may also attack the concrete over time.

4.12.2.1 Sunnybrook Reservoir

The Sunnybrook reinforced concrete reservoir has a capacity of 113 m^3 and was constructed in 1976 (current age of 46 years). No concrete scanning, destructive, or non-destructive testing was performed as part of this project. No comment can, therefore, be made on the concrete strength, the cover depth to rebar, or the ingress of CO_2 into the concrete matrix.

The reservoirs are also constantly in service and could also not be inspected internally. The top of the Sunnybrook Reservoir that is exposed and visible was found to be crack-free, leak-free, and aged, but not damaged in any way. There were no indications of water leaks around the structure. The stormwater channels around the structure were in good condition. The internal steel ladder was removed and corroded. Without doing additional testing the remaining life of the Sunnybrook Reservoir may be assumed to fall somewhere between 13 years and 53 years. (See Figure 29 to Figure 31)

Required upgrades and repairs on the Sunnybrook reservoir include the following:

1. Complete drain and clean of the reservoir walls and floor.
2. Replacement of the steel ladder.
3. Communication and alarming upgrade to reservoir hatch.

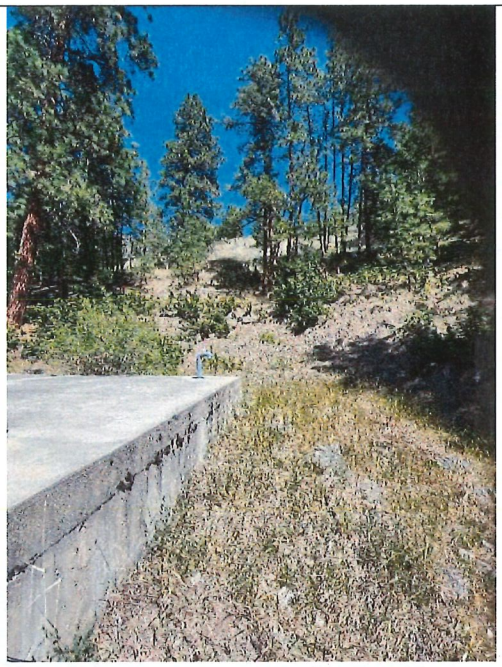

Figure 29: Sunnybrook Reservoir: Top of the concrete walls and roof slab on the left; stormwater channel on the right

Figure 30: Sunnybrook Reservoir

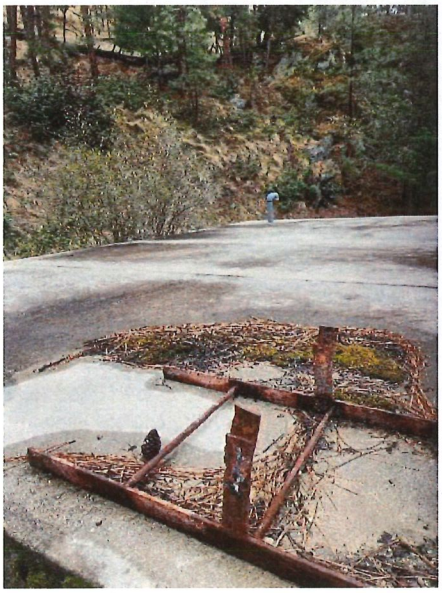

Figure 31: Sunnybrook Reservoir: Corroded steel ladder

4.12.2.2 Apple Court Reservoir

The Apple Court Reservoir (also known as Big Horn Trail Reservoir) consists of reinforced concrete, has a capacity of 573 m^3, and was constructed in 1989 (current age of 34 years). The top of the Apple Court Reservoir which is exposed and visible was found to have many surface cracks. There were no indications of water leaks around the structure. Several locations on the top of the reservoir where the vents and hatch are located were sealed with silicone sealer. These sites are potential entry points for water infiltration into the reservoir. The internal steel ladder was corroded. Without doing additional testing the remaining life of the Apple Court Reservoir may be assumed to fall somewhere between 26 years and 66 years. (See Figure 29 to Figure 31)

The immediate upgrades and repairs recommended include:

1. Replacement of steel ladder.
2. Structural assessment of the reservoir.
3. Replacing sealant around vents and hatch or sealing the entire surface depending on the results of the assessment.

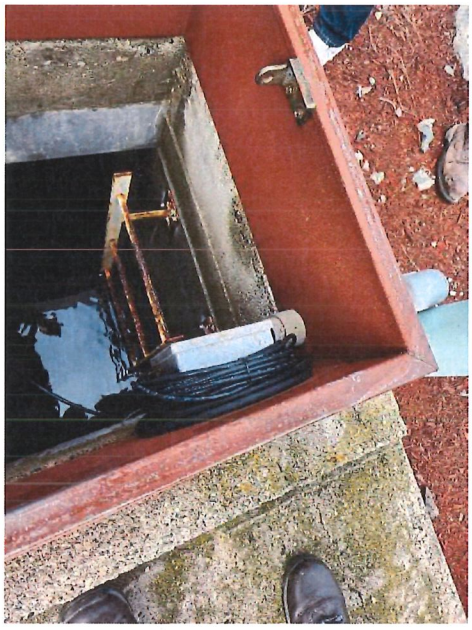

Figure 32: Apple Court Reservoir: Internal ladder shows signs of corrosion.

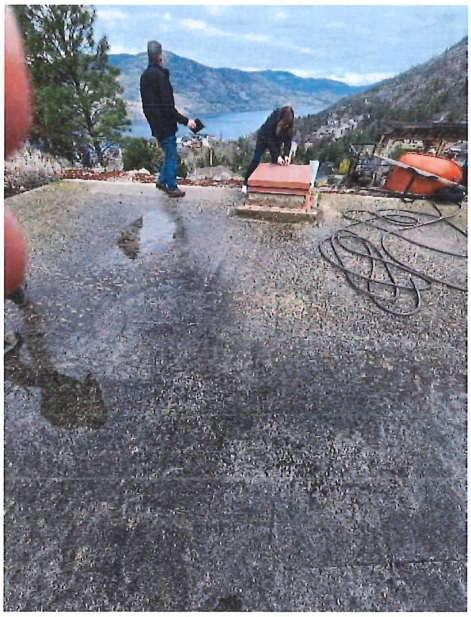

Figure 33: The roof slab of the Apple Court Reservoir is covered with lichen and moss, but generally in good condition.

4.12.2.3 Christie Mountain Steel Tank

The 9 m-high steel tank was installed in 1998 (25 years old) and has a capacity of 250 m^3. Steel water storage tanks are generally not favored by the RDOS for the following reasons:

- Corrosion: Steel tanks are susceptible to corrosion, which can lead to rust formation and compromise the tank's structural integrity. Corrosion can be accelerated by the water's pH levels, chemicals, and contaminants.

- Maintenance Requirements: Regular maintenance, including inspections and coating applications, is necessary to prevent and address corrosion. This can increase operational costs and downtime.
- Cold Cracking: Extremely low temperatures can cause the steel to become brittle and susceptible to cracking. This can compromise the tank's structural integrity.
- Freeze-Thaw Cycles: In cold climates, water inside the tank can freeze during winter and expand, potentially causing damage to the tank walls or seams.
- Insulation Requirements: Steel tanks in cold climates may require additional insulation to prevent water from freezing, which adds to the cost and complexity of the tank installation.
- Condensation: Temperature differentials between the inside and outside of the tank can lead to condensation, which can contribute to corrosion over time.
- Ice Accumulation: Ice buildup on the exterior of the tank can be a concern in very cold climates, adding weight and potentially stressing the tank's support structure.
- High heat during summer months increases the water temperature in the steel reservoir which impacts the available chlorine residual.

The Christie Mountain Tank and the connected pipelines are on a registered SRW, however, it can only be accessed over private property using a private driveway. The tank was not inspected, tested, or scanned as part of this project.

Immediate actions recommended include:

1. Drain and clean the reservoir and inspect for corrosion.
2. Review communications and SCADA capabilities and upgrade as required.

4.12.3 Vaults and Manholes

The system does not have any vaults or manholes.

4.13 System Monitoring and Communication

All reservoirs and pumphouses are to be connected to the RDOS SCADA system.

4.14 Security

5. Financial, Liability and Asset Report

5.1 Financial Reports

Corporate financial statements are deemed private information and was, therefore, not included in this report.

5.2 Asset Report

5.2.1 Listing

The list of existing water infrastructure assets of the Lakeshore Water Utility may be summarized as follows:

- Approximately 10,226 m of water mains, installed between 1976 and 2010,
- 311 house connections supplying 270 households and 41 vacant lots.
- 33 fire hydrants.
- Two concrete reservoirs and one steel tank with a total storage capacity of 936 m^3; and
- Four Pumphouses (with total installed power, including standby units of 211 kW [283 hp])

5.2.2 Estimated Current Value

5.2.2.1 Methodology

The following method was followed in estimating the current value of the infrastructure: The estimated lifespans of water infrastructure components from two different sources, and the life expectancies adopted for this assessment are presented in Table 12 below:

Table 12: Life expectancies for water infrastructure components

Component	EPA (EPA: United States Environmental Protection Agency, 2022)	Life Expectancy of Potable Water Assets (Statistics Canada, 2022)	Adopted Life Expectancy for this investigation
Pumping Equipment	10 years	n/a	20 years
Concrete Storage Reservoirs	30 years	27 years	70 years (50 to 100 years)
Steel Water Storage Tanks	30 years	40 years	50 years
Pipes	35 years	63 years	50 years (PVC pipes may last over a hundred years)
Valves	35 years	n/a	35 years
Computers & Software	5 years	n/a	10 years
Cinder Block Buildings	30 years	n/a	50 years
Hydrants	40 years	n/a	60 years
Treatment equipment	n/a	33 years	30 years

Construction cost estimates were prepared based on what it would cost to design and construct the existing infrastructure in 2023. The depreciation of the value of the infrastructure was based on the age/years that transpired since construction compared to the typical lifespan of the components. I.e., if a pump was installed 12 years ago and the total lifespan of pumps is assumed to be 20 years, then the depreciation was assumed to be 60% (or 12 years divided by 20 years). If the pump costs $100k to install, then the depreciation in the value of that pump is $60k (or 60% x $100k).

Furthermore, the assets were also devalued by the immediate remedial/repair work required for the asset. The estimated cost of remedial work was, therefore, subtracted from the remaining asset value after the depreciation had been subtracted. Additionally, substantial improvements are required to bring the system into regulatory compliance, meet all RDOS standards, and upgrade the assets at the end of their service life. The current estimated value of the system is presented in Table 13, while all the mandatory improvements are presented in Paragraph 8.

Note that there may be additional upgrades or replacements required not included in the report as condition assessments were not conducted as part of the scope of work at this time. Therefore, the cost of all the remedial work may further reduce the current value of the existing water system infrastructure.

5.2.2.2 Results

The resulting value of the existing infrastructure and the remaining life is presented in Table 13 below:

Table 13: Estimate of Current Value and remaining life of the existing water infrastructure, "Class D" estimate

Year Constructed	Description	Estimated Construction Cost in 2023 (Including 20% Contingency and Engineering Fee)	Depreciation	Estimate of Repair/ Remedial Work Required (2023)	Estimated Current Value (2023)	Remaining Life - Estimated (Years)	Remaining Life - Estimated (%)
1976	Lake intake pipe (250mm) and pumping main (150 mm)	$ 2,090,000.00	$ 1,960,000.00	$ -	$ 130,000.00	3	6%
1976	Sunnybrook Reinforced Concrete Reservoir 113 m3	$ 320,000.00	$ 220,000.00	$ 10,000.00	$ 90,000.00	21	27%
1976	Lakeshore Pumphouse (2 x 75 kW; 3.5 ML/day)	$ 2,490,000.00	$ 1,550,000.00	$ 110,000.00	$ 830,000.00	12	34%
1979	Sunnybrook gravity pipe network (2,502m of mains; 9 hydrants)	$ 1,230,000.00	$ 1,040,000.00	$ -	$ 190,000.00	8	16%
1982 & 1992	Sunnybrook Pumphouse (2 x 18.75 kW; 1.1 ML/day)	$ 1,610,000.00	$ 1,220,000.00	$ 150,000.00	$ 240,000.00	13	15%
1982	Last 180m of Sunnybrook Drive (180m of mains; 2 hydrants)	$ 150,000.00	$ 110,000.00	$ -	$ 40,000.00	15	26%
1989	Apple Court/Big Horn Reservoir 573 m3	$ 1,500,000.00	$ 770,000.00	$ 50,000.00	$ 680,000.00	34	45%
1990	Pipe Network between Sunnybrook and Apple Court Reservoir	$ 1,110,000.00	$ 690,000.00	$ -	$ 420,000.00	20	37%
1992	Pipe Network Parsons Road (570m of mains; 1 hydrant)	$ 260,000.00	$ 160,000.00	$ -	$ 100,000.00	21	39%
1993	Christie Pipe Network (680m of mains; 2 hydrants)	$ 410,000.00	$ 230,000.00	$ -	$ 180,000.00	24	44%
1995	Big Horn Trail Street Pipe Network (290m of mains; 1 hydrant)	$ 190,000.00	$ 100,000.00	$ -	$ 90,000.00	26	48%
1997	Christie Mountain Pumphouse (2 x 3.75 kW)	$ 190,000.00	$ 130,000.00	$ -	$ 60,000.00	16	31%
1998	Christie Mountain Top Pipe Network (480m of mains; 3 hydrants)	$ 280,000.00	$ 130,000.00	$ -	$ 150,000.00	28	52%
1998	Christie Mountain Steel Tank 250m3	$ 910,000.00	$ 460,000.00	$ -	$ 450,000.00	24	49%
2002	Apple Drive Pipe Network (205m of mains; 1 hydrant)	$ 160,000.00	$ 60,000.00	$ -	$ 100,000.00	33	61%
2002	Apple Court Pumphouse (2 x 7.5 kW +1.5kW)	$ 250,000.00	$ 150,000.00	$ 60,000.00	$ 40,000.00	16	17%
2003	Apple Court Pipe Network (165m of mains; 1 hydrant)	$ 140,000.00	$ 50,000.00	$ -	$ 90,000.00	35	63%
2007	Vintage Views Pipe Network (2,170m of mains; 6 hydrants)	$ 1,140,000.00	$ 350,000.00	$ -	$ 790,000.00	37	69%
		$ 14,430,000.00	**$ 9,380,000.00**	**$ 380,000.00**	**$ 4,670,000.00**	**18**	**32%**

5.2.3 Operations and Maintenance

5.2.3.1 Part Suppliers and Distributors

Suppliers are listed in Table 14 below:

Table 14: Suppliers

Work Description	Company and contact	Contact details
Water testing	Caro Analytical Services, Kelowna	250-765-9646
Chlorine	ZEP Okanagan	250-493-8222
Pipes and Valves	Andrew Sheret Limited	250-493-6754
Dosing pumps	ClearTech	+1-800-387-7503

5.2.3.2 O&M Records

No operations and maintenance records were received from the utility.

5.2.3.3 EOCP Classification

Lakeshore Waterworks has the following facilities classified with EOCP:

- Lakeshore Waterworks Ltd. Water Treatment Plant: This facility has been classified with EOCP since 2016, and according to the most recent classification - it is a Level I Water Treatment Facility (classification expired on 29 Oct 2023). The facility classification and certified operators must be updated.
- Lakeshore Waterworks Ltd. Water Distribution System: This facility has been classified with EOCP since 2013, and according to the most recent classification - it is a Level II Water Distribution system (classification expired on 30 June 2020). The facility classification and certified operators must be updated.

5.3 Statutory Right of Ways and Easements

All registered SRWs for the existing water system were found and downloaded from the BC Land Title & Survey website. (BC Land Title & Survey, 2023) All the SRWs documentation is available should the RDOS wish to scrutinize these documents.

Comments on current water system SRWs:

- The Sunnybrook Reservoir and Pumphouse: The SRW plan is not registered on the two titles. The SRW plan is already available, but a lawyer must register the SRW on the two property titles.
- The Lakeshore Pumphouse is on a Ministry of Transportation (MOTI) right of way.
- There is sufficient space on the existing SRW of the Christie Mountain Reservoir for an additional tank or concrete reservoir, however, additional SRW space is likely required for future expansion.
- Insufficient space on the SRW for a new building at Christie Mountain Pumphouse.

5.4 Land Parcel Ownership

Land parcel ownership for reservoirs, tanks, and Pumphouses is presented in Table 15 below:

Table 15: Land parcel ownership for reservoirs, tanks, and Pumphouses

INFRASTRUCTURE	RELEVANT SRW PLAN	AFFECTED PID	AFFECTED PARCEL	NOTES
APPLE COURT RESERVOIR	KAP78857	025-946-676	STRATA LOT 2, PLAN KAS2658	
APPLE COURT RESERVOIR	KAP78857	COMMON PROPERTY	PLAN KAS2658	
APPLE COURT PUMPHOUSE	KAP70885	COMMON PROPERTY	PLAN KAS2658	
APPLE COURT PUMPHOUSE	KAP70885	025-946-315	LOT B, PLAN KAP75602	
SUNNYBROOK RESERVOIR AND PUMPHOUSE	A12570	018-569-609	LOT 22, PLAN KAP51283	**SRW PLAN NOT REGISTERED ON TITLE**, SRW PLAN COVERS PORTIONS OF OTHER PARCELS
SUNNYBROOK RESERVOIR AND PUMPHOUSE	A12570	031-158-463	LOT 1, PLAN EPP101526	**SRW PLAN NOT REGISTERED ON TITLE**, SRW PLAN COVERS PORTIONS OF OTHER PARCELS
CHRISTIE MOUNTAIN PUMPHOUSE	PARCEL B, PLAN KAP62190	024-190-357	LOT 2, PLAN KAP62187	
CHRISTIE MOUNTAIN RESERVOIR	KAP62191	024-190-462	LOT 13, PLAN KAP62187	SRW PLAN ALSO COVERS PORTIONS OF PART LOT 2, PART LOT 3, PART LOT 5, ALL OF PLAN KAP62187
LAKESHORE PUMPHOUSE	N/A	N/A	DL 3967s, SDYD	

5.5 Legal

5.5.1 Liens and Lawsuits

Nothing reported by the owner at this time.

5.5.2 Fines and Debts

Nothing reported by the owner at this time.

6. Staffing and Support Resources

6.1 Staffing Report

A Level 1 Operator (registered with the Environmental Operators Certification Program [EOCP]) has been employed by the Lakeshore Water Utility since October 2008. The operator has passed the following two certifications:

- The Small Water Systems Course, and
- The Operator Level 1 course.

The operator's responsibilities include the following:

- Daily inspection of all pump stations and reservoirs.
- Record runtimes on all pumps
- Test chlorine residuals at all stations.
- Alternately testing chlorine residuals at homes in the upper and lower zones for compliance.
- Responsible for ordering and dosing chlorine (sodium hypochlorite) as needed.
- Submit water samples once a week through IH for our lab in Kelowna. Weekly tests are done for Total Coliforms and *E. coli.*
- Small repairs and maintenance at all stations.
- Flushing of all fire hydrants in spring.
- Weed eating and cleanup of all stations throughout the summer.
- Snow removal at all stations in the winter.
- Oversee divers for reservoir cleaning once per year.
- Organize and oversee the ground crew in the event of any water leaks or water main repairs.
- Organize and oversee road repairs (asphalt patching after road work)
- Monitor Heritage Hills for summer water (consumption) restrictions from May 1 to Oct. 1
- On emergency call 24/7 for all calls related to water concerns.
- On-site in the event of fires or floods.

- Hand deliver to each home, boil water notices in the event of poor water quality.
- Hand deliver water billing in the event of money owed.
- Locate curb shut-offs for homes needing assistance for home water repairs.

6.2 Contractors

Contractors that are regularly utilized by the Lakeshore Waterworks Ltd are listed in Table 16 below:

Table 16: Contractors for the Lakeshore Waterworks Ltd.

Work Description	Company and contact	Contact details
Divers: Annual cleaning of the lake intake and reservoirs	*Ocean Tec*	250-462-0583
Electrical	*Wine Capital Electric*	250-809-5174 winecapitalelectric.com
Pumps	*Penticton Pump Service*	250-328-9070
Excavations	*BTN Excavating*	250-488-5203 billy@btnexcavating.com
Chlorination	*Mealing Water Worx Consulting*	250 241 7355

7. Documentation, Information and Administration

7.1 Business Incorporation Information

The business incorporation information for Lakeshore Waterworks Ltd is available should the RDOS wish to scrutinize the information.

7.2 Bylaws and Controls

7.2.1 Fees and Tariffs

The latest water tariffs are attached as Appendix G.

7.3 Drawings, GIS, and Specifications

Record drawings are available for most of the civil, mechanical, and electrical installations, however, it is not entirely clear how the water pipe in Parsons Road connects to the water system. Record drawings were not received for recent changes to the electrical systems at Lakeshore and Sunnybrook Pumphouses. The complete list of available record drawings is presented in Appendix H.

7.4 System Modeling

Hydraulic modeling of the system has been completed. See Paragraph 4.10.

7.5 Operation and Maintenance Plans

There are no formal operation and maintenance manuals or plans provided by the utility.

Complete Operation and Maintenance Plans must be prepared for the intake, each Pumphouse, each reservoir, hydrants, instrumentation, controls, and all other equipment.

7.6 Reports and Studies

No reports were received. A couple of reports that should be prepared as soon as possible include:

- A full master plan showing complete asset replacement over the service life is required. This report only provides immediate upgrades and does not include the full asset management plan.
- A Source Water Protection study would be required on Skaha Lake as part of the treatment system design.

7.7 Standards and Procedures

The following standard procedures are followed by the operator of the system:

- Annual flushing of hydrants
- Divers inspect and clean reservoirs, tanks, and the lake intake annually.
- Daily testing of chlorine residuals
- Weekly water sampling and testing

Should the RDOS take over the system, then bylaws and procedures will need to be prepared.

7.8 Safety and Health

No Safety and Health Plans, Reports, or Audits were provided by the utility.

8. Infrastructure Upgrades and System Improvement

When prioritizing water system upgrade projects, several criteria are commonly considered to ensure that resources are allocated efficiently and effectively. These criteria may vary depending on the specific circumstances and goals of the water system, but here are some common factors:

1) Health and Safety: Projects that address immediate health and safety concerns are given high priority. This includes projects that address water quality issues, remove contaminants, or upgrade systems to meet regulatory standards.

2) Infrastructure Condition: The overall condition of the water system infrastructure is an important consideration. Projects that address aging or deteriorating infrastructure, such as pipes, pumps, and treatment plants, may be prioritized to prevent failures and improve system reliability.

3) System Capacity: If the existing water system is approaching or exceeding its capacity, projects that enhance system capacity, such as expanding treatment facilities or increasing storage capacity, may be prioritized to meet growing demand and avoid service disruptions.

4) Vulnerability and Resilience: Projects that improve the resilience of the water system to natural disasters, climate change impacts, or other emergencies may be prioritized. This can include measures like backup power systems, improved water source protection, or flood mitigation strategies.

5) Cost-Benefit Analysis: Analyzing the cost-effectiveness and benefits of different projects is crucial. Projects with a high benefit-to-cost ratio, which provide significant improvements relative to their cost, may receive higher priority.

6) Stakeholder Input: Input from various stakeholders, such as water utility managers, local government officials, community members, and relevant experts, can help prioritize projects. Their insights on system needs, community priorities, and local constraints can influence decision-making.

7) Regulatory Requirements: Projects required to meet regulatory obligations or to address compliance issues may be prioritized to avoid penalties or legal consequences.

8) Long-Term Planning: Projects aligned with long-term planning objectives, such as sustainability goals, water conservation initiatives, or integrated water resource management strategies, may be given priority to ensure a more sustainable and future-proofed water system.

9) Operational Requirement: Necessary to operate the system effectively and efficiently.

Table 17: Infrastructure upgrades and system improvement projects

Project Number	Description	Motivation for project	Estimated Construction Cost in 2023 (Including 40% Contingency and Engineering Fee)	Implementation Period (Years)	Assumed Inflation per year (Based on average inflation over the last 20 years)	Estimated Construction Cost in the year of implementation (Including 40% Contingency and Engineering Fee)
1	Test and Service Christie Mountain PRV Station	1) Health & Safety (Fire fighting)	$ 40,000.00	1	2.2%	$ 40,000.00
2	Structural engineer's evaluation of the existing Christie Mountain Pumphouse	1) Health & Safety (Operator)	$ 30,000.00	0.5	2.2%	$ 30,000.00
3	New 200 mm Force Main from Lakeshore Pumphouse, Length of 530 m	1) Health & Safety (Fire fighting; emergencies) 4) Vulnerability and Resilience	$ 1,050,000.00	2	2.2%	$ 1,100,000.00
4	Two additional Fire Hydrants	1) Health & Safety (Fire fighting)	$ 30,000.00	0.5	2.2%	$ 30,000.00
5	Christie Mountain Second Reservoir 220m³	1) Health & Safety (Fire fighting)	$ 810,000.00	4	2.2%	$ 880,000.00
6	Replace 135 Water Meters	2) Infrastructure condition 9) Operational requirement	$ 530,000.00	4	2.2%	$ 580,000.00
7	Access Road to Christie Mountain Tank	9) Operational requirement	$ 270,000.00	1	2.2%	$ 280,000.00
8	SCADA, communications, analyzers, alarm upgrades	9) Operational requirement	$ 390,000.00	1	2.2%	$ 400,000.00
9	Work Safe Projects: Chlorine Handling	1) Health & Safety (Operator)	$ 30,000.00	1	2.2%	$ 30,000.00
10	Replace Fifteen (15) Gate Valves	2) Infrastructure condition	$ 150,000.00	10	2.2%	$ 190,000.00
11	New Sunnybrook PRV Station	1) Health & Safety (Fire fighting)	$ 360,000.00	2	2.2%	$ 380,000.00
12	New Water Treatment Plant (2.5 ML/day)	1) Health & Safety (water quality) 7) Regulatory Requirements	$ 6,530,000.00	4	2.2%	$ 7,120,000.00
13	New Generator for Lakeshore Pumphouse (150 kVA)	1) Health & Safety (Fire fighting; emergencies) 4) Vulnerability and Resilience	$ 430,000.00	1	2.2%	$ 440,000.00

Project Number	Description	Motivation for project	Estimated Construction Cost in 2023 (Including 40% Contingency and Engineering Fee)	Implementation Period (Years)	Assumed Inflation per year (Based on average inflation over the last 20 years)	Estimated Construction Cost in the year of implementation (Including 40% Contingency and Engineering Fee)
14	New Generator for Sunnybrook Pumphouse (100 kVA)	1) Health & Safety (Fire fighting; emergencies) 4) Vulnerability and Resilience	$ 340,000.00	1	2.2%	$ 350,000.00
15	Upgrade Sunnybrook Pumphouse with higher flow rate pumps (Replace 2 x 18.75 kW with 2 x 45 kW)	1) Health & Safety (Fire fighting) 3) System Capacity	$ 260,000.00	3	2.2%	$ 280,000.00
16	New Christie Mountain Pumphouse with higher flow rate pumps (Replace 2 x 3.75 kW with 2 x 15 kW)	1) Health & Safety (Fire fighting)	$ 830,000.00	4	2.2%	$ 910,000.00
			$ 12,080,000.00			**$ 13,040,000.00**

The proposed upgrade and system improvement projects that are required for regulatory compliance and to meet the RDOS standards are presented in Table 17 below. The details of each of the proposed projects are included following the table. The motivation for each of the proposed projects is presented below:

1. **Test and Service Christie Mountain PRV Station:** The PRV is situated inside the existing Christie Mountain Pumphouse building. It allows water to flow from the Christie Mountain Steel Tank into the lower-lying pipe network. The mechanical pressure gauges must be replaced. A permanent or temporary clamp-on Doppler-type flow meter can be installed on the PRV's pipework. A downstream fire hydrant should be opened and the functioning of the PRV verified.
2. **Structural engineer's evaluation of the existing Christie Mountain Pumphouse:** The existing building will continue to house the existing PRV. A structural engineer must check the existing structure is safe for use.
3. **New 200 mm, 24 bar (350 psi) Pumping Main from Lakeshore Pumphouse, Length of 530 m:** The existing ductile iron pumping main is nearly 50 years old. Ductile iron is prone to corrosion and this water main has been conveying chlorinated water at velocities in excess of 2 m/s to the Sunnybrook Reservoir since 1976. Chlorine is corrosive and attacks metal pipes. High flow velocities may lead to abrasive pitting on pipe walls. It is recommended to replace this portion of the pumping main.
4. **Two (2) additional Fire Hydrants:** The installation of two additional fire hydrants is required to comply with maximum hydrant spacing in terms of the RDOS bylaws.
5. **Christie Mountain Second Reservoir 220 m^3:** The existing system does not have sufficient water storage capacity to fight fires for the required duration. The addition of 220 m^3 water storage capacity will only satisfy the minimum RDOS requirements. It is extremely important to be able to fight building fires to protect property and lives. Reportedly, wildfires in British Columbia are becoming more severe due to climate change. (Canadian Broadcasting Corporation (CBC), 2023)
6. **Replace 135 Household Water Meters:** It was assumed that half of the household water meters require replacement. Households can be billed for actual water usage instead of a flat rate. Water use will be monitored, which will also facilitate locating leaks.
7. **Access Road to Christie Mountain Tank:** Current access to Christie Mountain Tank is via a private driveway. It is recommended that a gravel road be constructed over Crown Land to facilitate access for the construction of an additional reservoir and operation and maintenance. A conceptual design has been created for this gravel access road and is presented in Appendix F.
8. **SCADA, communications, analyzers, and alarms:** Data from the water system must be reported to a central computer in accordance with RDOS standards. Any problems with the water system will be reported in real-time to a control room. Security: Unauthorized access of a building or reservoir hatch will raise an alarm, prompting an operator to investigate the cause of the alarm.
9. **Work Safe: Chlorine handling:** Chlorine is currently being dosed at the Lakeshore Pumphouse. Containment is required below the 55-gallon chlorine drums to prevent any spillages from flowing into the surrounding environment. An emergency shower and eyewash station is required enabling the operator to rinse their eyes, face, and body immediately after accidentally coming into contact with chemicals.
10. **Replace Fifteen (15) Gate Valves:** The replacement of fifteen gate valves that are currently already more than 35 years old is recommended. Gate valves must be operational to shut off flows when maintenance is required.
11. **New Sunnybrook pressure-reducing valve (PRV) Station:** In the case of a fire, it must be possible to feed water from higher zones to the Sunnybrook Reservoir Gravity Zone. The Sunnybrook Reservoir only has a storage capacity of 113 m^3 which is insufficient for firefighting. When the pressure in the downstream (Sunnybrook) gravity zone falls below a set limit, then the PRV will open and feed water from the high-lying pipe network into the low-lying areas.

12. **New Water Treatment Plant (2.5 ML/day):** The lake water is currently only chlorinated before distribution. The system does not comply with the Drinking Water Treatment Objectives for BC. The addition of media filtration and UV disinfection are recommended to treat the lake water to acceptable standards. A typical pressure filter installation is presented in Figure 34. Filtration removes suspended solids from water, which may include mud, algae, bacteria, viruses, other pathogens, etc. Filtration clarifies untreated water. Preliminary design calculations indicate that six (6) x 1.6 m diameter pressure filters will be required to treat the Maximum Day Demand (MDD) of the Lakeshore System. These are to be installed in a heated building or shipping containers. UV disinfection is much more effective against protozoan oocysts such as *Giardia* and *Cryptosporidium* than chlorine and is also strongly suggested for the proposed water treatment plant. An optional chlorination dosing point will also be suggested. The heated building floor space requirement for the above-mentioned equipment will be approximately 160 m^2(1,600 sq. ft.). The proposed WTP will also require land to be constructed. There is insufficient space for the WTP at the Lakeshore Pumphouse. It might be possible to purchase a lot for the WTP in the vicinity of the Sunnybrook Reservoir. This is the largest of the proposed upgrade projects and might require grant funding or financing with debt payments for a period of 20 to 30 years.

13. **New Generator for Lakeshore Pumphouse (150 kVA):** A generator is proposed for Lakeshore Pumphouse to be able to supply water during power outages. It is also recommended to construct a roof over this relatively large generator. Centrifugal pumps with variable frequency drives (VFDs), such as those at the Lakeshore Pumphouse, have starting currents that are two to three times higher than the running current of the pumps. The generator must be relatively large to be able to start the installed pumps (2 x 75 kW).

14. **New Generator for Sunnybrook Pumphouse (100 kVA):** A generator is proposed for Sunnybrook Pumphouse to be able to supply water during power outages. The Sunnybrook Pumphouse supplies water to the largest water storage facility in the system, the Apple Court Reservoir (573 m^3).

15. **Upgrade Sunnybrook Pumphouse with higher flow rate pumps:** The existing pumps cannot supply the required MDD of the system and they should be replaced with higher flow pumps. If any pump is out of service, then the remaining pump must be capable of pumping the MDD of the system. The existing two 18.75 kW (2 x 25 hp) pumps should be replaced with two 45 kW pumps (2 x 60 hp).

16. **New Christie Mountain Pumphouse with higher flow rate pumps (Replace 2 x 3.75 kW with 2 x 15 kW:** This pump station supplies the highest water storage facility within the system. It must be possible to fill the fire water storage volume of 302 m^3 within 12 hours. The new higher-flow pumps and their piping won't fit inside the existing building. A new building should be constructed, and a new statutory right of way must be registered.

All the listed projects are either mandatory or relatively important for implementation within the next 5 years.

9. Financial Implications

9.1 Mortgage

If a mortgage had to be taken out for the Lakeshore Water System at a compound interest rate of 6% per year and an amortization period of twenty years, then households and vacant lots can expect to see an increase to $3,900 per year and $2,925 per year respectively to cover capital expenses and increases in operational costs. It was estimated that the rates would increase further by 2.2% per year to cover inflation.

Figure 34: A typical pressure filter installation

9.2 Cashflow

An estimated cost of remedial work and capital projects for the water utility over the next four (4) years is presented in Table 18 below:

Table 18: Estimated required cash flow for the Lakeshore Waterworks over the next 4 years.

Number	Description	Year 1	Year 2	Year 3	Year 4	Total Estimated Cashflow for Year 1 to Year 4
1	Remedial Work	$342,000.00	$38,000.00	$ -	$ -	$ 380,000.00
2	Upgrade Projects	$ 3,364,500.00	$ 4,065,500.00	$ 2,807,500.00	$ 2,802,500.00	$13,040,000.00
3	Operation and maintenance	$ 264,000.00	$ 285,500.00	$ 307,000.00	$ 328,500.00	$ 1,185,000.00
Sub-Totals		**$ 3,970,500.00**	**$ 4,389,000.00**	**$ 3,114,500.00**	**$ 3,131,000.00**	**$ 14,605,000.00**

9.3 Operational Expenditure

The operating expenses for the year 2022 were $264,444. Future operational costs will increase with service transition to the RDOS to meet standard operation levels, and due to the required capital upgrades.

RDOS will prepare a proposed budget for the water system if acquisition proceeds based on the regulatory requirements, operational needs, and upgrade projects.

9.4 Rate Structure

The current rate structure consists of the payment of a fixed flat rate per household. One advantage of this is that the reading of water meters is not required. This rate structure would be continued by the RDOS until changed by bylaw.

Other rate structures that may be considered for this water system are briefly described below:

- **Variable Charges:** Consumption-Based Pricing: The majority of the cost should be based on actual water consumption and would require full metering of the users. The more water a customer uses, the more they pay per unit (usually measured in gallons or cubic meters). This encourages water conservation and ensures that high-water users pay more.
- **Tiered Pricing:** Tiered Blocks: Implement a tiered pricing structure for fully metered users where the cost per unit of water increases as consumption levels rise. This discourages excessive water usage. For example:
    - Tier 1: For essential needs (e.g., cooking, sanitation) at a lower cost per unit.
    - Tier 2: For moderate use (e.g., bathing, laundry) at a slightly higher cost.
    - Tier 3: For excessive use (e.g., irrigation, filling swimming pools) at a significantly higher cost.
- **Seasonal Pricing:** Peak and Off-Peak Rates: Consider charging higher rates during peak water demand periods (e.g., summer months or drought conditions) and lower rates during off-peak periods to encourage conservation during times of scarcity.

10. Risks

Technical risks:

There are limitations to this engineering assessment because in-depth condition tests and investigations were not performed. It is possible that certain defects of the existing infrastructure were not identified.

The general condition of the existing water infrastructure seems to be fair to poor. There is a flooding risk at the Sunnybrook Pumphouse from the creek passing nearby. However, it is not expected that a flood would cause major damage to the existing infrastructure. Any future flooding will also drain relatively quickly due to the steep terrain.

A rock slope was piled against the back of the Christie Mountain Pumphouse. The existing building's concrete walls show major cracking, and it is suggested that a structural engineer evaluate whether the building is currently safe to occupy.

It was found during the site assessments that the jockey pump inside the Apple Court Pumphouse was removed with exposed electrical wires at the former pump position. The electrical supply was off but not locked out. This is a Health and Safety risk.

Pipe bursts can interrupt water provision for several hours or days. The condition of the 47-year-old ductile iron pumping main from the Lakeshore Pumphouse should be verified within the next year. However, given the infrastructure is reaching the end of its service life, replacement is recommended.

Financial risks:

Approval to Borrow: A key part of the acquisition process will include approval from the users to borrow funds to complete the necessary upgrades and replacements to achieve regulatory compliance and meet appropriate standards. This would be part of the assent process for system users.

Maintenance and Upkeep: Once the RDOS takes over the utility, it becomes responsible for maintaining and upgrading the water infrastructure. Deferred maintenance from past years or unexpected repair and replacement costs will add to the required budget.

Rate Setting Challenges: Local governments need to set water rates that are fair and affordable for residents while also generating enough revenue to cover operational and maintenance costs. Balancing this equation can be challenging and will require regular rate adjustments.

Political and Public Pressure: Local politics and public opinion can influence decisions related to the water utility. Pressure to keep rates low or to invest in specific areas may affect the financial stability and sustainability of the utility. Education of the users will be important to understand the anticipated costs for upgrades and management of the water system.

Unforeseen Events: Natural disasters, infrastructure failures, or other unforeseen events can result in significant financial burdens for local governments. Having adequate reserves and emergency funds is crucial to address such situations. At present, the water system does not have capital reserves available.

Legal and Regulatory Risks: Legal disputes with the private utility or other stakeholders can lead to financial liabilities. However, no legal disputes are currently surrounding the Lakeshore Waterworks Ltd.

11. Conclusion

The age and general condition of the existing infrastructure were described in this report. Capacity constraints were highlighted. Infrastructure upgrades and system improvements were proposed to comply with federal and provincial regulations. The system users will need to understand the estimated total costs of the infrastructure repairs, upgrades, improvements, and operating costs in the next stage of the RDOS acquisition process.

It is recommended that water tariffs be increased to begin building reserves in the coming year before a final decision is made by the RDOS on acquiring the water utility.

12. References

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Appendix A

Layout Drawing

NO.	DATE (YY/MM/DD)	DRN	REVISION	CH'KD

PERMIT TO PRACTICE

SEAL

DESIGN: MAP
DRAWN: MAP
CHECKED: DR
DATE: AUG 2023
SCALE: 1:7500

RDOS

VINTAGE VIEWS WATER & SANITARY ASSESSMENT
RDOS

WATER LOCATION PLAN

ecora
#201-244 MAIN STREET PENTICTON, BC, V2A 5E3
PHONE: 250-492-2227
www.ecora.ca

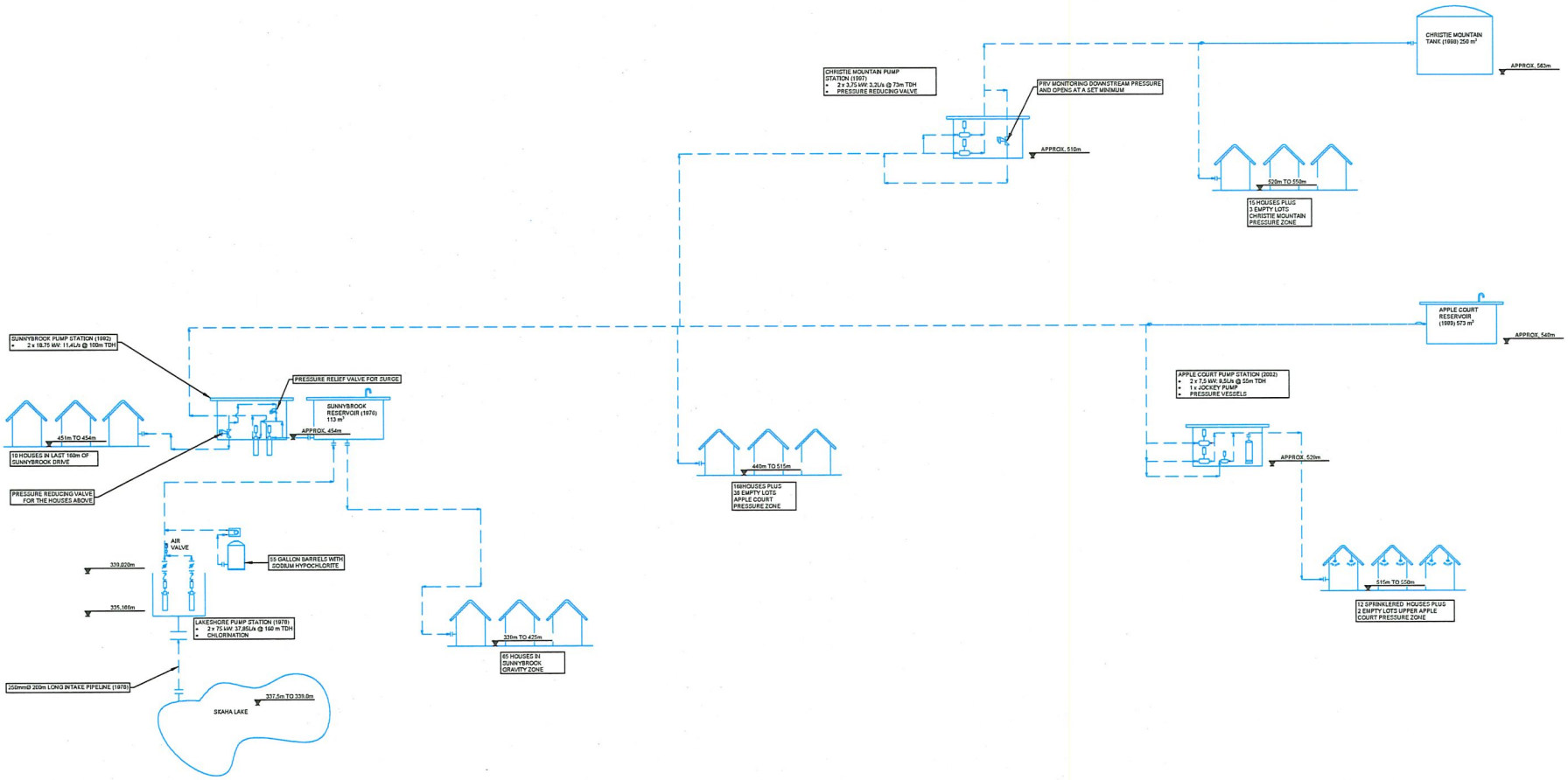
DRAWING NO. 230122-WLP

REV A

FILE LOCATION: K:\2023\230122\ECRA\04-ENGINEERING\01-ESDTS\01\230122 WATER NETWORK 20231115.DWG PRINTED ON: 9/26/2023 1:15 PM

Appendix B

Existing and Proposed Future Schematic Layout Drawings



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EXISTING

PROPOSED

INSTRUMENT LINES

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A	2023-07-26	DR	FOR INFORMATION	MDY

ecora
#201-284 MAIN STREET, PENTICTON, BC, V2A 5B2
PHONE: 250-492-2227
www.ecora.ca

RESIST TO PRACTICE

SEAL

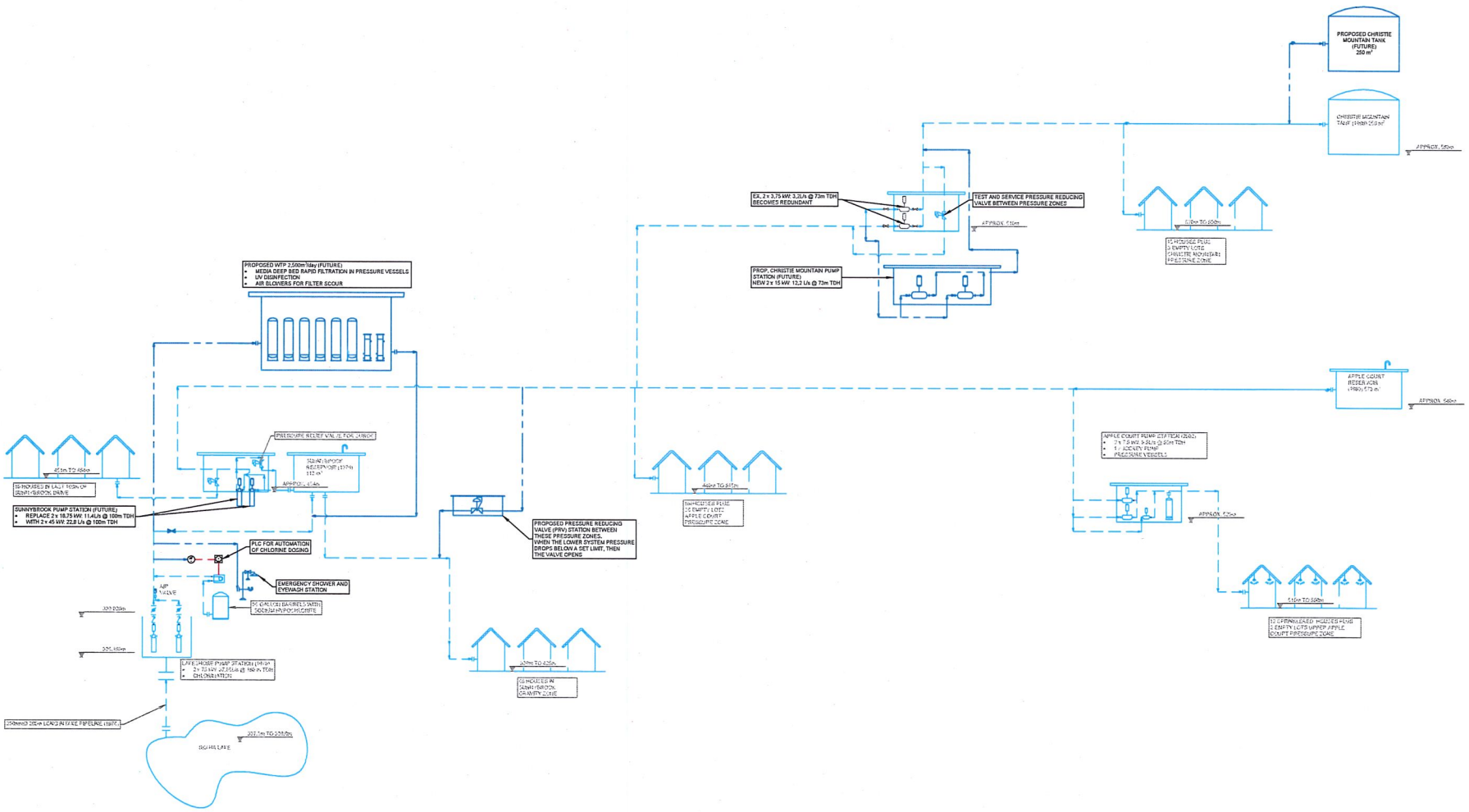
DESIGN:	DR
DRAWN:	DR
CHECKED:	MDY
DATE:	2023-07-26
SCALE:	N.T.S.

RDOS

LAKESHORE WATER SYSTEM
PRIVATE OWNER
EXISTING SCHEMATIC LAYOUT

Drawing No. 230122-SC0.1

Rev.No A



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EXISTING

PROPOSED

INSTRUMENT LINES

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ecora
#201-284 MAIN STREET, PENTICTON, BC, V2A 5B2
PHONE: 250-492-2227
www.ecora.ca

RESPECT TO PRACTICE

SEAL

DESIGN:	DR
DRAWN:	DR
CHECKED:	MDY
DATE:	2023-07-26
SCALE:	N.T.S.

RDOS

LAKESHORE WATER SYSTEM
PRIVATE OWNER
PROPOSED SCHEMATIC LAYOUT

Drawing No. 230122-SC1.1

Rev.No A

Appendix C

Water Licenses

WATER RESOURCES SERVICE
WATER RIGHTS BRANCH

DEPARTMENT OF
ENVIRONMENT

THE PROVINCE OF BRITISH COLUMBIA—WATER ACT

CONDITIONAL WATER LICENCE

Lakeshore Waterworks Ltd. c/o A.R. Colby, 264 Westminster Avenue, West, Penticton, B.C. V2A 1J9

is/are hereby authorized to divert and use water as follows:—

(a) The source(s) of the water-supply is/are Skaha Lake.

(b) The point(s) of diversion is/are located as shown on the attached plan.

(c) The date from which this licence shall have precedence is 2nd December, 1974.

(d) The purpose for which the water is to be used is waterworks.

(e) The maximum quantity of water which may be diverted is 25,500 gallons a day, and such additional quantity as the Engineer may from time to time determine should be allowed for losses.

(f) The period of the year during which the water may be used is the whole year.

(g) ~~The land upon which the water is to be used and to which~~ this licence is appurtenant is to the undertaking of the licensee as set out in Certificate of Public Convenience and Necessity No. 148/1976, and any substitution thereof or amendment thereto.

(h) The works authorized to be constructed are diversion structure, pump, pipe and reservoir, which shall be located approximately as shown on the attached plan.

(i) The construction of the said works shall be commenced on or before the 31st day of May, 1977, and shall be completed and the water beneficially used on or before the 31st day of December, 1980.

H.D. DeBeck,
Comptroller of Water Rights.

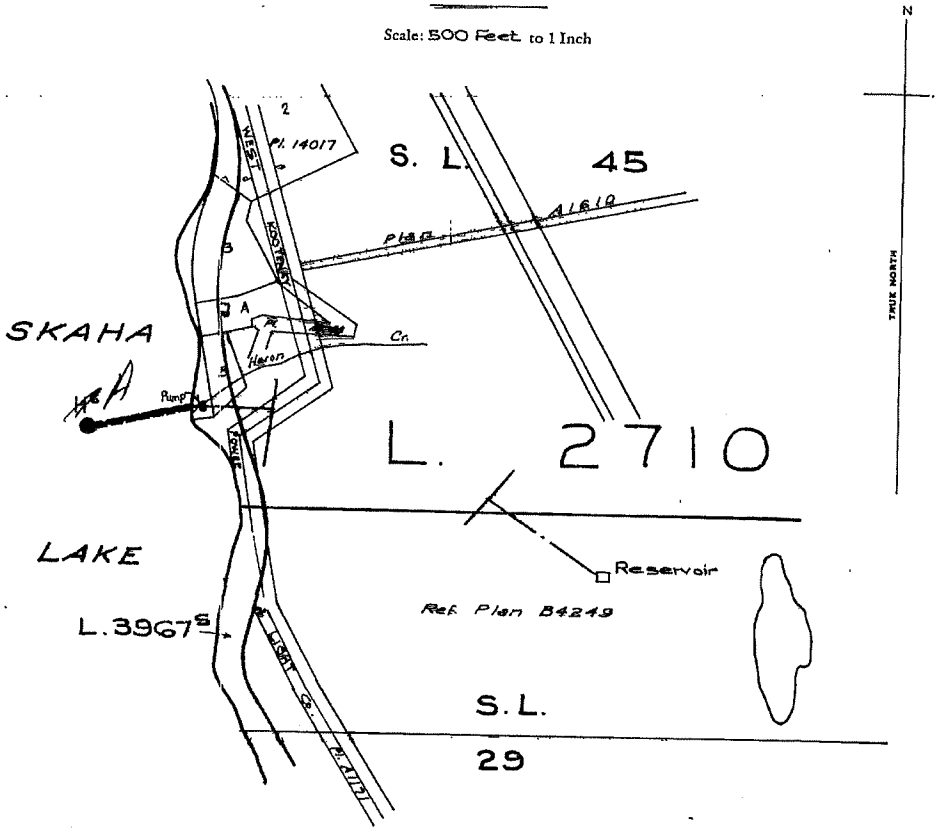
File No. 0328167 Date issued: 15 November, 1976 Conditional Licence No. 47163

ENTERED ON
Map No. 1553B
By RK

British Columbia

PENTICTON WATER DISTRICT
SIMILKAMEEN DIVISION OF YALE DISTRICT

Scale: 500 Feet to 1 Inch



LEGEND

Point of Diversion
W.R. Map 1583S 82-E-033-3-3
Pipe
Right of Way

Signature

Date 15th Nov. 1976
C.L. 47163
File 0328167
R/W Permit No. 10751
Precinct Penticton

200-279-1969

WATER MANAGEMENT BRANCH

MINISTRY OF ENVIRONMENT

THE PROVINCE OF BRITISH COLUMBIA—WATER ACT

CONDITIONAL WATER LICENCE

Lakeshore Waterworks Limited, c/o A.J. Ricard and Associates Corp., 2664 Kingsway, Port Coquitlam, British Columbia V3C 1T5

is hereby authorized to divert and use water as follows:

(a) The source of the water-supply is Skaha Lake.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is 17th July, 1981.

(d) The purpose for which the water is to be used is waterworks.

(e) The maximum quantity of water which may be diverted is 4,500 gallons a day and such additional quantity as the Engineer may from time to time determine should be allowed for losses.

(f) The period of the year during which the water may be used is is the whole year.

(g) This licence is appurtenant to the undertaking of the licensee as set out in Certificate of Public Convenience and Necessity No. 422/1981 and any substitution thereof or amendment thereto.

(h) The works authorized to be constructed are diversion structure, pump, pipe and balancing tank, which shall be located approximately as shown on the attached plan.

(i) The construction of the said works shall be commenced on or before the 30th day of April, 1985, and shall be completed and the water beneficially used on or before the 31st day of December 1988.

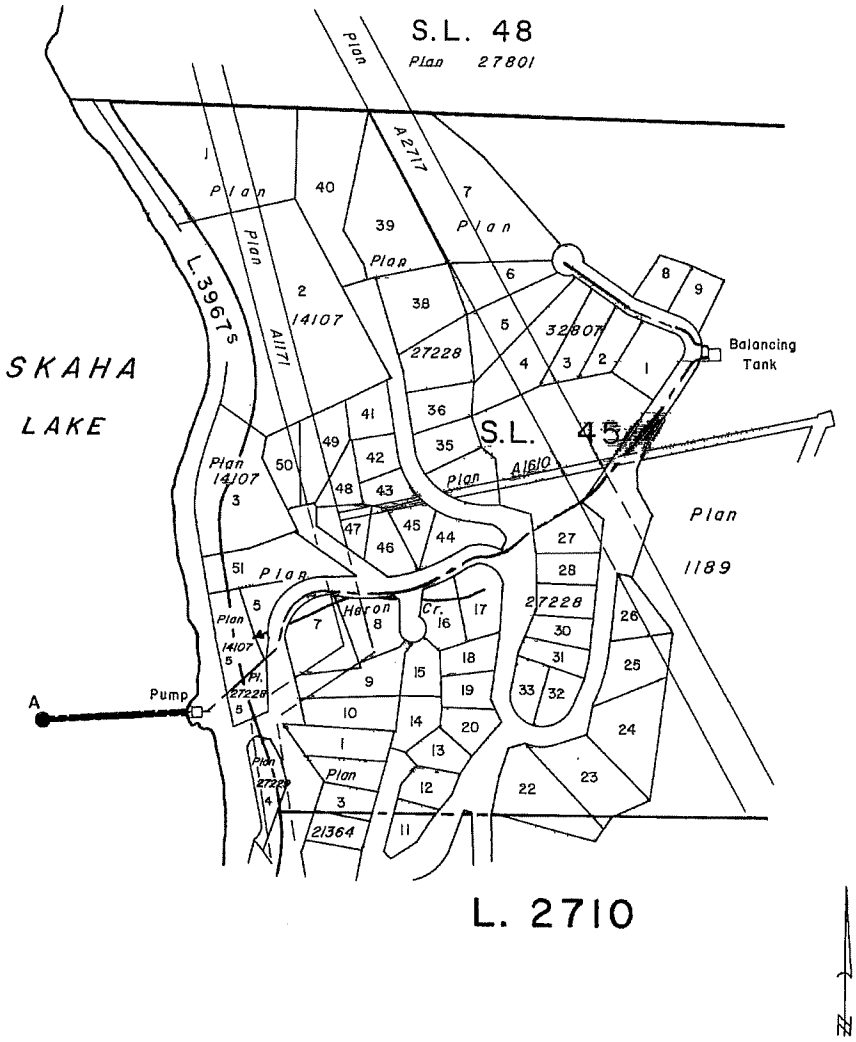
(j) The works authorized under Clause (h) hereof shall be constructed to operate with a lake elevation of 1102.9 to 1111.0 feet.

A. Zackodnik, P.Eng.
Regional Water Manager
Southern Interior Region

ENTERED ON
Map No. _____
By LK

File No. 0369141 Date issued: DEC 3 1984 Conditional Licence 60448

Province of British Columbia



WATER DISTRICT : PENTICTON
PRECINCT : PENTICTON
LAND DISTRICT : SIMILKAMEEN DIVISION OF YALE

LEGEND

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Point of Diversion : ●
Map Number : WR 82 · E · 033 · 3 · 3
Pipe : ——— – – ———
Permit over Crown Land: ▬▬▬

Signature [signature]
Date DEC 3 1984

C.L. 60448
File 0369141
P.C.L. 14412

Water Management Branch

Ministry of Environment, Lands and Parks

THE PROVINCE OF BRITISH COLUMBIA - WATER ACT

CONDITIONAL WATER LICENCE

Lakeshore Waterworks Ltd, c/o BC Environment, Deputy Comptroller of Water Rights, Parliament Buildings, Victor BC V8V 1X4,

is hereby authorized to divert and use water as follows:

(a) The source of the water supply is Skaha Lake.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is October 2, 1992.

(d) The purpose for which this licence is issued is waterworks.

(e) The maximum quantity of water which may be diverted is 8,395,000 gallons per year to a maximum of 69,000 gallons a day.

(f) The period of the year during which the water may be used is the whole year.

(g) The land upon which the water is to be used and to which this licence is appurtenant is the undertaking of the licensee as set out in Certificate of Public Convenience and Necessity 422/1981 and any substitution thereof or amendment thereto.

(h) The works authorized to be constructed are intake, pump, pipe, balancing tank and distribution system, located approximately as shown on the attached plan.

(i) The construction of the said works shall be completed and the water shall be beneficially used on or before the 31st day of December 1999. Thereafter, the licensee shall continue to make regular beneficial use of water in the manner authorized herein.

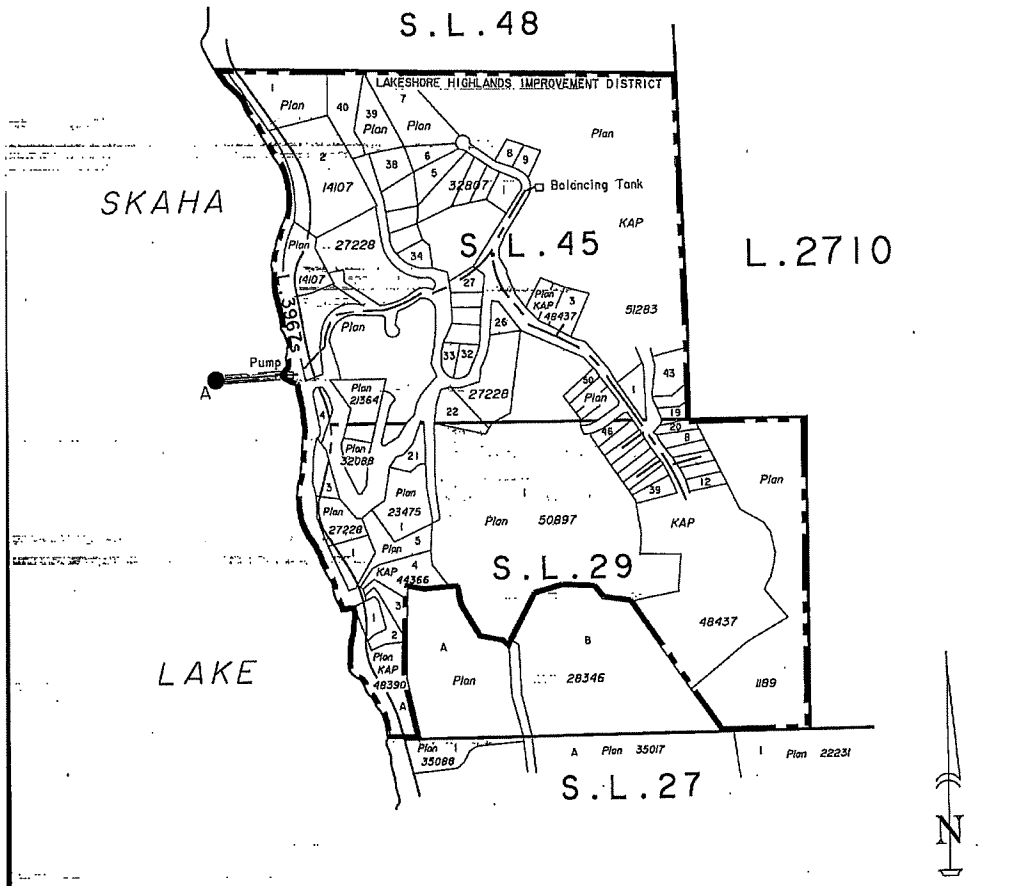
(j) The works authorized under clause (h) hereof shall be constructed to operate with a lake elevation of 1102.9 to 1111.0 feet (336.16 to 338.6 metres) Geodetic Survey of Canada datum.

B.J. Symonds, P.Eng.
Acting Regional Water Manager
Water Management Program
Southern Interior Region

Date Issued: February 8, 1996

File No. 8001929 Conditional Licence 105487

Province of British Columbia



WATER DISTRICT : PENTICTON
PRECINCT : PENTICTON
LAND DISTRICT : SIMILKAMEEN DIV. OF YALE

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Point of Diversion : ●
Map Number : WR 82.E.033.3.3
Pipe : ———
Permit over Crown Land : ———

Signature : [signature]
Date : February 6, 1996

C.L. 105487
File 8001929
P.C.L. 21855

Water Management Branch

Ministry of Environment, Lands and Parks

THE PROVINCE OF BRITISH COLUMBIA - WATER ACT

CONDITIONAL WATER LICENCE

Appel Estates Ltd. are hereby authorized to divert and use water as follows:

(a) The source of the water-supply is Skaha Lake.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is December 1, 1993.

(d) The purpose for which this licence is issued is waterworks

(e) The maximum quantity of water which may be diverted is 8,030,000 gallons per annum not to exceed 66,000 gallons a day.

(f) The period of the year during which the water may be used is the whole year.

(g) The land upon which the water is to be used and to which this licence is appurtenant is the undertaking of the licensee as set out in Certificate of Public Convenience and Necessity No. 422/1981, and any substitution thereof or amendment thereto.

(h) The works authorized to be constructed are intake, pump, pipe, balancing tank, and distribution system, located approximately as shown on the attached plan.

(i) The construction of the said works shall be completed and the water shall be beneficially used on or before the 31st day of December 1999. Thereafter, the licensee shall continue to make regular beneficial use of water in the manner authorized herein.

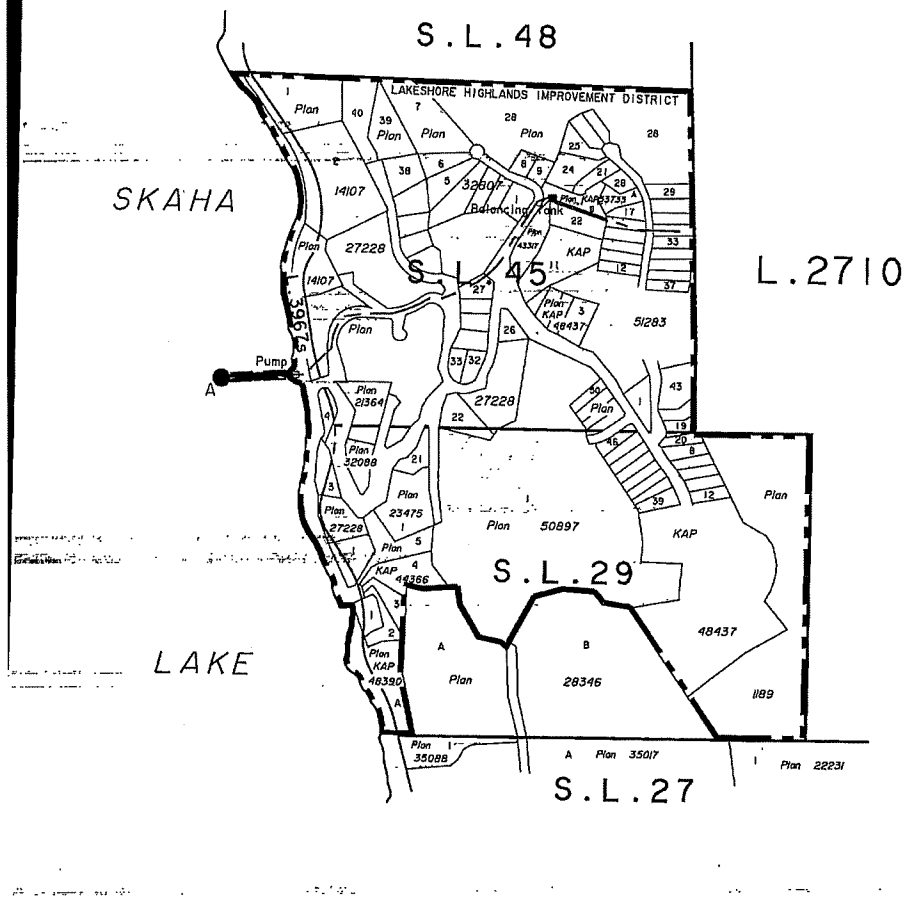
(j) The works authorized under clause (h) hereof shall be constructed to operate with a lake elevation of 1102.9 to 1111.0 feet (336.2 to 338.6 metres) Geodetic Survey of Canada datum.

B.J. Symonds, P.Eng.
Acting Regional Water Manager
Water Management Program
Southern Interior Region

Date Issued: April 29, 1996

File No. 8002160 Conditional Licence 107476

Province of British Columbia



WATER DISTRICT : PENTICTON
PRECINCT : PENTICTON
LAND DISTRICT : SIMILKAMEEN DIV. OF YALE

LEGEND
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Point of Diversion : ●
Map Number : WR B2.E.033.3.3
Pipe :
Permit over Crown Land :

Signature: [signature]
Date: April 29, 1996

C.L. 107476
File 8002160
P.C.L. 21969

BRITISH COLUMBIA

WATER ACT

CONDITIONAL WATER LICENCE

The Lakeshore Waterworks Ltd, c/o the Utility Regulation Section of Ministry of Sustainable Resource Management, Deputy Comptroller of Water Rights is hereby authorized to divert and use water as follows:

(a) The source on which the rights are granted is Skaha Lake.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is 31st January, 2002.

(d) The purpose for which this licence is issued is waterworks.

(e) The maximum quantity of water which may be diverted is 43,617,500 gallons per year not to exceed a maximum withdrawal of 430,200 gallons per day.

(f) The period of the year during which the water may be used is the whole year.

(g) The land upon which the water is to be used and to which this licence is appurtenant is the undertaking of the licensee within the boundaries of Lakeshore Waterworks Ltd. As set out in CPCN 581/July10, 1986 and any substitution thereof or amendment thereto.

(h) The authorized works are screened intake, pump, pipe, balancing tank and distribution system which shall be located approximately as shown on the attached plan.

(i) The construction of the said works has been completed and the water is being beneficially used. The licensee shall continue to make regular beneficial use of the water in the manner authorized herein.

(j) This licence is issued pursuant to the provisions of the Water Act to ensure compliance with that statute, which makes it an offence to divert or use water from a stream in British Columbia without proper authorization. It is the responsibility of the licensee to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

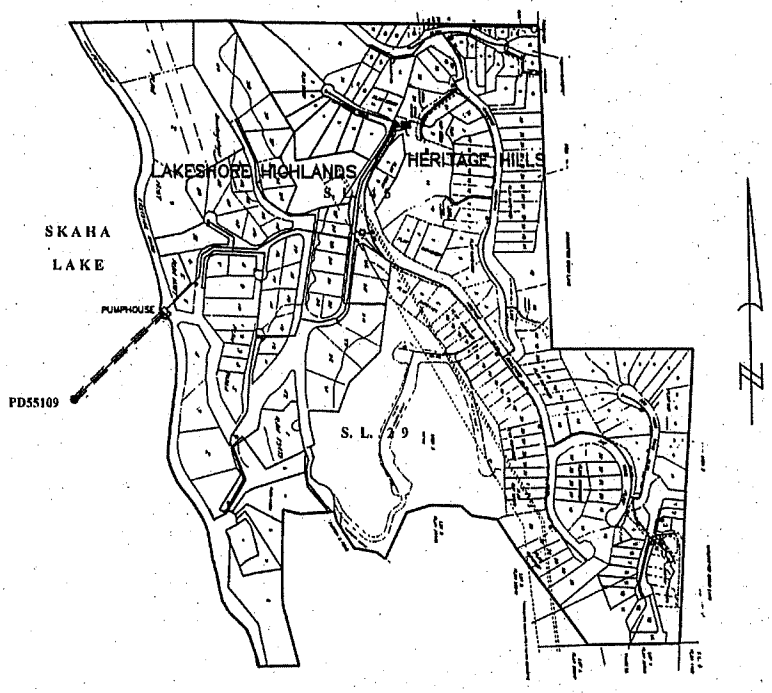
Don I. McKee, P.Eng.
Assistant Regional Water Manager
Southern Interior Region

Date Issued: May 22, 2002

File: 3003916

CONDITIONAL LICENCE: 117063

BRITISH COLUMBIA



WATER DISTRICT	: Penticton		
PRECINCT	: Penticton	Signature:	
LAND DISTRICT	: S.D.Y.D.	Date:	May 22, 2002

LEGEND

Scale :	1:7500	Water Licence : CL 117063
Water Rights Map :	82E.033.3.3	**PCL: 24028**
Point of Diversion / PD55109	⊙	
Pipe :	▬▬▬	
Dwelling :	□	
Permit over Crown Land :	= = = =	File : 3003916

The boundaries of the land to which this licence is appurtenant are shown thus: ▬▬

Appendix D

Fire Hydrant Flow Rates

NO.	DATE (YY/MM/DD)	DRN	REVISION	CH'KD

PERMIT TO PRACTICE

SEAL

DESIGN: DR
DRAWN: MAP
CHECKED: DR
DATE: AUG 2023
SCALE: 1:5,000

RDOS

VINTAGE VIEWS WATER & SANITARY ASSESSMENT
RDOS

HYDRANT FLOW RATE PLAN

ecora
#203-244 MAIN STREET PENTICTON, BC, V2A 5B2
PHONE: 250-492-3227
www.ecora.ca

DRAWING NO. 230122-HF

REV A

FILE LOCATION: Y:\2023\230122\CIVIL\05-FIGURES\EXPORTS\PLAN\PLAN\230121 HYDRANT FLOW RATES.DWG PRINTED ON: 10/4/2023 12:19 PM

Appendix E

Cost Estimates

Project

Service Christie Mountain PRV Station

Description	Unit	Quantity	Unit Price	Cost	Cost (Incl. Contingency and Engineering)
Mobilize	LS	1	$3,000.00	$ 3,000.00	$ 4,650.00
Install a clamp-on Doppler type flow meter	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
Install 3 new pressure transmitters	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
			Construction Total	**$ 23,000.00**	
			Contingency (40%)	**$ 9,200.00**	
			Engineering (15%)	**$ 3,450.00**	
			Grand Total	**$ 35,650.00**	

Project

Structural evaluation of Christie Mountain Pumphouse

Description	Unit	Quantity	Unit Price	Cost	Cost (Incl. Contingency and Engineering)
Mobilize	LS	1	$3,000.00	$ 3,000.00	$ 4,650.00
Install a clamp-on Doppler type flow meter	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
Install 3 new pressure transmitters	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
			Construction Total	**$ 23,000.00**	
			Contingency (40%)	**$ 9,200.00**	
			Engineering (15%)	**Included**	
			Grand Total	**$ 32,200.00**	

Project

Replace Lakeshore Pumping Main (530 m)

Description	Unit	Quantity	Unit Price	Replacement Cost (2023)	Cost (Incl. Contingency and Engineering)
Steel Casing (300)	lm	20	$400.00	$ 8,000.00	$ 12,400.00
90º Bend (200)	ea	4	$850.00	$ 3,400.00	$ 5,270.00
45º Bend (200)	ea	2	$850.00	$ 1,700.00	$ 2,635.00
22.5º Bend (200)	ea	6	$850.00	$ 5,100.00	$ 7,905.00
11.25º Bend (200)	ea	4	$850.00	$ 3,400.00	$ 5,270.00
GV (200)	ea	2	$1,600.00	$ 3,200.00	$ 4,960.00
HDPE Class 350 (250)	lm	530	$1,050.00	$ 556,500.00	$ 862,575.00
Pavement Removal (Regardles of Depth)	m^2	530	$20.00	$ 10,600.00	$ 16,430.00
200mm - 75mm (-) Granular Sub-Base - Supply, haul, place and compact	m^2	530	$30.00	$ 15,900.00	$ 24,645.00
150mm - 25mm(-) Crushed Gravel Base - Supply & Install	m^2	530	$21.00	$ 11,130.00	$ 17,251.50
Saw Cut Asphalt or Concrete Pavements	lm	750	$15.00	$ 11,250.00	$ 17,437.50
50mm Hot Mix Asphalt - Supply & Install c/w Tight Blade	m^2	530	$26.00	$ 13,780.00	$ 21,359.00
Ajust Manholes, Valve Boxes, etc. to Road Grades	ea	3	$250.00	$ 750.00	$ 1,162.50
Precast Concrete Thrust Block	ea	5	$350.00	$ 1,750.00	$ 2,712.50
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$30,000.00	$ 30,000.00	$ 46,500.00
			Construction Total	**$ 676,460.00**	
			Contingency (40%)	**$ 270,584.00**	
			Engineering (15%)	**$ 101,469.00**	
			Grand Total	**$ 1,048,513.00**	$ 1,048,513.00

Project

Two additional Fire Hydrants

Description	Unit	Quantity	Unit Price	Replacement Cost (2023)	Cost (Incl. Contingency and Engineering)
Hydrant	ea	2	$5,000.00	$ 10,000.00	$ 15,500.00
Precast Concrete Thrust Block	ea	2	$350.00	$ 700.00	$ 1,085.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
			Construction Total	**$ 20,700.00**	
			Contingency (40%)	**$ 8,280.00**	
			Engineering (15%)	**$ 3,105.00**	
			Grand Total	**$ 32,085.00**	**$ 32,085.00**

Project

Additional 220 m3 Concrete Tank at Christie Mountain

Description	Unit	Quantity	Unit Price	Replacement Cost (2023)	Cost (Incl. Contingency and Engineering)
Clearing, Grubbing and Dust Control	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
Earthworks (Cut and Fill)	LS	1	$80,000.00	$ 80,000.00	$ 124,000.00
Structural Fill Import	LS	1	$17,000.00	$ 17,000.00	$ 26,350.00
Rock Removal Allowance	LS	1	$29,000.00	$ 29,000.00	$ 44,950.00
Concrete Reinforcement	LS	1	$50,000.00	$ 50,000.00	$ 77,500.00
Cast-In-Place Concrete	LS	1	$250,000.00	$ 250,000.00	$ 387,500.00
Topsoil, Finish Grading, and Seeding	LS	1	$12,000.00	$ 12,000.00	$ 18,600.00
Waterworks - Piping, Fittings etc.	LS	1	$35,000.00	$ 35,000.00	$ 54,250.00
Site Servicing	LS	1	$15,000.00	$ 15,000.00	$ 23,250.00
Site Improvements	LS	1	$6,000.00	$ 6,000.00	$ 9,300.00
Telemetry Wiring	lm	30	$150.00	$ 4,500.00	$ 6,975.00
Re-instatement of Existing Asphalt Driveway in SRW	LS	1	$8,000.00	$ 8,000.00	$ 12,400.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
			Construction Total	**$ 521,500.00**	
			Contingency (40%)	**$ 208,600.00**	
			Engineering (15%)	**$ 78,225.00**	
			Grand Total	**$ 808,325.00**	**$ 808,325.00**

Project

Replace 135 water meters

Description	Unit	Quantity	Unit Price	Replacement Cost (2023)	Cost (Incl. Contingency and Engineering)
25mm Water Service Connection c/w Curbstop, Double Strap Stainless Steel S	ea	135	$1,200.00	$ 162,000.00	$ 251,100.00
25mm Municipex Water Service Supply and Install c/w pipe bedding and 2x4 Marker	lm	1350	$110.00	$ 148,500.00	$ 230,175.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$30,000.00	$ 30,000.00	$ 46,500.00
			Construction Total	**$ 340,500.00**	
			Contingency (40%)	**$ 136,200.00**	
			Engineering (15%)	**$ 51,075.00**	
			Grand Total	**$ 527,775.00**	$ 527,775.00

Project

Gravel Road to Christie Mountain Tank

Description	Unit	Quantity	Unit Price	Replacement Cost (2023)	Cost (Incl. Contingency and Engineering)
Clearing, Grubbing (offsite disposal) and Dust Control	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
Tree Removal	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
Drain and clean reservoir and inspect for corrosion	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
Review communications and SCADA capabilities and upgrade as required	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
Earthworks (Cut, Offsite disposal of Excess) - Access Road	m3	4000	$10.00	$ 40,000.00	$ 62,000.00
Earthworks (Fill) - Access Road	m3	2000	$20.00	$ 40,000.00	$ 62,000.00
Bed Rock Allowance - Access Road	m3	800	$30.00	$ 24,000.00	$ 37,200.00
Access Road Drainage	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
Subgrade Prep - Access Road	sq.m	800	$10.00	$ 8,000.00	$ 12,400.00
Steel Casing (375) - Access Road	lm	30	$500.00	$ 15,000.00	$ 23,250.00
19mm Minus Crushed Gravel, 150mm depth - Access Road	m3	135	$50.00	$ 6,750.00	$ 10,462.50
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$4,000.00	$ 4,000.00	$ 6,200.00
			Construction Total	**$ 162,750.00**	
			Contingency (40%)	**$ 65,100.00**	
			Engineering (15%)	**$ 24,412.50**	
			Land Tenure Application for crown land and Legal Survey	**$ 15,000.00**	**$ 15,000.00**
			Grand Total	**$ 267,262.50**	**$ 267,262.50**

Project

SCADA, communications, analyzers, alarm upgrades

Description	Unit	Quantity	Unit Price	Replacement Cost (2023)	Cost (Incl. Contingency and Engineering)
Existing Sunnybrook Reservoir: SCADA, communications, hatch alarm	LS	1	$20,000.00	$ 20,000.00	$ 31,000.00
Existing Lakeshore Pumphouse: SCADA, communications and controls	LS	1	$50,000.00	$ 50,000.00	$ 77,500.00
Existing Lakeshore Pumphouse: Flow meter, turbidity meter	LS	1	$60,000.00	$ 60,000.00	$ 93,000.00
Existing Sunnybrook Pumphouse: SCADA, communications and controls	LS	1	$40,000.00	$ 40,000.00	$ 62,000.00
Existing Apple Court Reservoir: SCADA, communications, hatch alarm	LS	1	$20,000.00	$ 20,000.00	$ 31,000.00
Existing Apple Court Pumphouse: SCADA, communications, alarms	LS	1	$20,000.00	$ 20,000.00	$ 31,000.00
Existing Christie Mountain Pumphouse: SCADA, communications, alarms	LS	1	$20,000.00	$ 20,000.00	$ 31,000.00
Existing Christie Mountain Tank: SCADA, communications and alarms	LS	1	$20,000.00	$ 20,000.00	$ 31,000.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$4,000.00	$ 4,000.00	$ 6,200.00
			Construction Total	**$ 254,000.00**	
			Contingency (40%)	**$ 101,600.00**	
			Engineering (15%)	**$ 38,100.00**	
			Grand Total	**$ 393,700.00**	**$ 393,700.00**

Project

Work Safe Projects: Chlorine Handling

Description	Unit	Quantity	Unit Price	Replacement Cost (2023)	Cost (Incl. Contingency and Engineering)
Waterworks - Chlorine Spill Containment	LS	1	$2,500.00	$ 2,500.00	$ 3,875.00
Waterworks - Emergency Shower and Eyewash Station	LS	1	$15,000.00	$ 15,000.00	$ 23,250.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$1,000.00	$ 1,000.00	$ 1,550.00
			Construction Total	**$ 18,500.00**	
			Contingency (40%)	**$ 7,400.00**	
			Engineering (15%)	**$ 2,775.00**	
			Grand Total	**$ 28,675.00**	**$ 28,675.00**

Project

Replace Fifteen (15) Gate Valves

Description	Unit	Quantity	Unit Price	Replacement Cost (2023)
Project Notification (Water Shut off Notifications	LS	1	$5,000.00	$ 5,000.00
GV (150)	ea	13	$1,400.00	$ 18,200.00
GV (200)	ea	2	$1,600.00	$ 3,200.00
C900 PVC Class 200 (150) Spool Pipes	lm	30	$250.00	$ 7,500.00
50mm Hot Mix Asphalt - Supply & Install c/w Tight Blade	m^2	75	$26.00	$ 1,950.00
Hot mix asphalt	m2	2	$1,600.00	$ 3,200.00
200mm - 75mm (-) Granular Sub-Base - Supply, haul, place and compact	m^2	75	$30.00	$ 2,250.00
150mm - 25mm(-) Crushed Gravel Base - Supply & Install	m^2	75	$21.00	$ 1,575.00
Robar couplers	ea	30	$589.89	$ 17,696.70
Precast Concrete Thrust Block	ea	15	$350.00	$ 5,250.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$30,000.00	$ 30,000.00
			Construction Total	**$ 95,821.70**
			Contingency (40%)	**$ 38,328.68**
			Engineering (15%)	**$ 14,373.26**
			Grand Total	**$ 148,523.64**

Upgrade Project:

Sunnybrook PRV Station (60L/s)

Description	Unit	Quantity	Unit Price	Cost	Cost (Incl. Contingency and Engineering)
General Requirements	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
Mobilization	LS	1	$50,600.00	$ 50,600.00	$ 78,430.00
Concrete	LS	1	$2,310.00	$ 2,310.00	$ 3,580.50
PRV from Mechanical supplier	LS	1	$137,500.00	$ 137,500.00	$ 213,125.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
			Construction Total	**$ 210,410.00**	
			Contingency (40%)	**$ 84,164.00**	
			Engineering (15%)	**$ 31,561.50**	
			Sub-Total	**$ 326,135.50**	
			SRW Registration	**$ 30,000.00**	$ 30,000.00
			Grand Total	**$ 356,135.50**	$ 356,135.50

Project:

New 2.5 ML/day (29 L/s) WTP: Media Filtration; UV Disinfection

Description	Unit	Quantity	Unit Price	Cost	Cost (Incl. Contingency and Engineering)
General Requirements	LS	1	$101,200.00	$ 101,200.00	$ 156,860.00
Mobilization	LS	1	$50,600.00	$ 50,600.00	$ 78,430.00
Concrete	LS	1	$115,000.00	$ 115,000.00	$ 178,250.00
Buildings	LS	1	$1,725,000.00	$ 1,725,000.00	$ 2,673,750.00
Earthworks - Building	LS	1	$34,500.00	$ 34,500.00	$ 53,475.00
Hard Rock Allowance - Building	m3	560	$25.00	$ 14,000.00	$ 21,700.00
Earthworks (Cut, Offsite disposal of Excess) - Parking & Access Road	m3	300	$25.00	$ 7,500.00	$ 11,625.00
Earthworks (Fill) - Parking & Access Road	m3	300	$20.00	$ 6,000.00	$ 9,300.00
Hard Rock Allowance	m3	30	$25.00	$ 750.00	$ 1,162.50
Subgrade Prep - Parking & Access Road	sq.m	300	$5.00	$ 1,500.00	$ 2,325.00
Utilities and Waterworks	LS	1	$660,000.00	$ 660,000.00	$ 1,023,000.00
Manholes and catchbasins	LS	1	$407,000.00	$ 407,000.00	$ 630,850.00
Electrical Installation materials	LS	1	$418,000.00	$ 418,000.00	$ 647,900.00
Electrical Site Work Labor and Permitting	LS	1	$289,685.00	$ 289,685.00	$ 449,011.75
Instruments supply	LS	1	$30,000.00	$ 30,000.00	$ 46,500.00
PLC and HMI Programming (Lot)	LS	1	$40,000.00	$ 40,000.00	$ 62,000.00
90º Bend (200)	ea	4	$850.00	$ 3,400.00	$ 5,270.00
45º Bend (200)	ea	2	$850.00	$ 1,700.00	$ 2,635.00
22.5º Bend (200)	ea	2	$850.00	$ 1,700.00	$ 2,635.00
11.25º Bend (200)	ea	2	$850.00	$ 1,700.00	$ 2,635.00
GV (200)	ea	3	$1,600.00	$ 4,800.00	$ 7,440.00
C900 PVC Class 150 (200)	lm	250	$250.00	$ 62,500.00	$ 96,875.00
Blowoff	ea	1	$4,000.00	$ 4,000.00	$ 6,200.00
Hydrant	ea	1	$5,000.00	$ 5,000.00	$ 7,750.00
Precast Concrete Thrust Block	ea	13	$350.00	$ 4,550.00	$ 7,052.50
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$30,000.00	$ 30,000.00	$ 46,500.00
			Construction Total	**$ 4,020,085.00**	
			Contingency (40%)	**$ 1,608,034.00**	
			Engineering (15%)	**$ 603,012.75**	
			Sub-Total	**$ 6,231,131.75**	
			Purchase Lot	**$ 300,000.00**	$ 300,000.00
			Grand Total	**$ 6,531,131.75**	$ 6,531,131.75

Project:

Generator for Lakeshore Pump Station - 150 kVA

Description	Unit	Quantity	Unit Price	2023 Estimate	2023 Estimate (Incl. Contingency and Engineering)
Clearing, Grubbing and Dust Control	LS	1	$1,000.00	$ 1,000.00	$ 1,550.00
Earthworks (Cut and Fill)	LS	1	$2,000.00	$ 2,000.00	$ 3,100.00
Structure (concrete and wood frame building)	LS	1	$108,000.00	$ 108,000.00	$ 167,400.00
Backup Generator	LS	1	$148,500.00	$ 148,500.00	$ 230,175.00
Site Improvements	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
			Construction Total	**$ 274,500.00**	
			Contingency (40%)	**$ 109,800.00**	
			Engineering (15%)	**$ 41,175.00**	
			Grand Total	**$ 425,475.00**	**$ 425,475.00**

Project:

Generator for Sunnybrook Pump Station - 100 kVA

Description	Unit	Quantity	Unit Price	Cost	Cost (Incl. Contingency and Engineering)
Clearing, Grubbing and Dust Control	LS	1	$1,000.00	$ 1,000.00	$ 1,550.00
Earthworks (Cut and Fill)	LS	1	$2,000.00	$ 2,000.00	$ 3,100.00
Structure (concrete and wood frame building)	LS	1	$72,000.00	$ 72,000.00	$ 111,600.00
Backup Generator	LS	1	$130,000.00	$ 130,000.00	$ 201,500.00
Site Improvements	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
			Construction Total	**$ 220,000.00**	
			Contingency (40%)	**$ 88,000.00**	
			Engineering (15%)	**$ 33,000.00**	
			Grand Total	**$ 341,000.00**	**$ 341,000.00**

Project

Sunnybrook Pump House

				Flow	TDH
Current Installed Power=	**37.5 kW**	**50 hp**	**(2 x 18.75 kW)**	**11.36 LPS**	**100m**
Future Installed Power=	**90 kW**	**120 hp**	**(2 x 45kW)**	**22.8 LPS**	**100m**

Description	Unit	Quantity	Unit Price	Cost	Cost (Incl. Contingency and Engineering)
Mechanical:					
Pumps supply, install, test commission, 2 x 45kW	LS	1	$100,000.00	$ 100,000.00	$ 155,000.00
Electrical:					
New electrical utility service	LS	1	Not required	Not required	Not required
New Starters: 2 x 45 kW VFDs in New Enclosures	LS	2	$27,000.00	$ 54,000.00	$ 83,700.00
Electrical cabling - Splitter to Starter	LS	1	$14,000.00	$ 14,000.00	$ 21,700.00
			Construction Total	**$ 168,000.00**	
			Contingency (40%)	**$ 67,200.00**	
			Engineering (15%)	**$ 25,200.00**	
			Grand Total	**$ 260,400.00**	**$ 260,400.00**

Project

Christie Mountain PH

				Flow	TDH
Current Installed Power=	**7.5 kW**	**10 hp**	**(2 x 3.75 kW)**	**3.15 LPS**	**73.2m**
Future Installed Power=	**30 kW**	**40 hp**	**(2 x 15kW)**	**7 LPS**	**100m**

Description	Unit	Quantity	Unit Price	Cost	Cost (Incl. Contingency and Engineering)
Clearing, Grubbing and Dust Control	LS	1	$3,000.00	$ 3,000.00	$ 4,650.00
Earthworks (Cut and Fill)	LS	1	$24,000.00	$ 24,000.00	$ 37,200.00
Structure (concrete and wood frame building)	LS	1	$205,000.00	$ 205,000.00	$ 317,750.00
Pump, System Components, Controls, Electrical - Supply and Install	LS	1	$170,000.00	$ 170,000.00	$ 263,500.00
Waterworks - Piping, Fittings etc.	LS	1	$75,000.00	$ 75,000.00	$ 116,250.00
Electrical - Heating, Lighting, Ventilation	LS	1	$41,000.00	$ 41,000.00	$ 63,550.00
Site Servicing: Drainage, Conduits	LS	1	$10,000.00	$ 10,000.00	$ 15,500.00
Site Improvements	LS	1	$5,000.00	$ 5,000.00	$ 7,750.00
General Requirements - Mobilization, Traffic Control, Survey, etc.	LS	1	$3,000.00	$ 3,000.00	$ 4,650.00
			Construction Total	**$ 536,000.00**	
			Contingency (40%)	**$ 214,400.00**	
			Engineering (15%)	**$ 80,400.00**	
			Grand Total	**$ 830,800.00**	**$ 830,800.00**

Appendix F

Conceptual Layout of the Proposed Gravel Access Road to Christie Mountain Tank

NO.	DATE (YY/MM/DD)	DRN	REVISION	CH'KD
A	23/07/10	MAP	FOR INFORMATION	DR

PERMIT TO PRACTICE

SEAL

DESIGN: MAP
DRAWN: MAP
CHECKED: DR
DATE: JUL 2023
SCALE: 1:500

RDOS

VINTAGE VIEWS WATER SYSTEM
RDOS

CHRISTIE MOUNTAIN RESERVOIR EXPANSION

ecora

#201-204 MAIN STREET PENTICTON, BC, V2A 5B2
PHONE: 778-953-2227
www.ecora.ca

DRAWING NO. 230122-SK01

REV A

FILE LOCATION: V:\PROJECTS\2023\23-123\CIVIL\04-DRAWINGS\01-REPORTS\230122 RESERVOIR SKETCH.DWG PRINTED ON: 7/10/2023 11:29 AM

Appendix G

Water Tariff

29th November 2019

NOTICE OF AN APPLICATION BY:

LAKESHORE WATERWORKS LTD

PROPOSING TO INCREASE RATES EFFECTIVE 1ST JANUARY 2020

Notice is hereby given that Lakeshore Waterworks Ltd has made application to the Deputy Comptroller of Water Rights for his/her consent to the filing under the provisions of the Water Utility Act and the Utilities Commission Act of rates and charges for service. A summary of the proposed rates is as follows:

Existing Rates: - Water Usage Fee $180 quarterly
Water Availability $504 annually (applicable to vacant lots)
Current Replacement Reserve Trust Fund contribution is 15% annually from above rates collected

Proposed Rates: - Water Usage Fee $270 quarterly
Water Availability $ 756 annually (applicable to vacant lots)
Turn on Fee - $75
Proposed Replacement Reserve Trust Fund contribution is 17% annually from above rates collected

Lakeshore Waterworks Ltd has not had a rate increase in 6 years. The utility is not able to sustain itself financially or provide adequate service in the future at its current fee structure.

There is increasing pressure for more testing and higher standards in the water quality and service delivered. This cost needs to be included as we better prepare Lakeshore Waterworks Ltd for the years ahead.

The Replacement Reserve Trust Fund needs to be increased substantially to be better prepared for infrastructure upkeep and replacement over the next few decades. Our system contains components that are 40 years old or more already, **THIS CANNOT BE OVERLOOKED**.

We are working closely with INTERIOR HEALTH to ensure the high quality of water / service to customers and are following their directions closely.

Any person wishing further information in connection with the proposed rates or reasons for the proposed changes should write to:

Lakeshore Waterworks Ltd. PO Box 24073 Govt St RPO, Penticton, BC V2A 8L9
Or
Email: speedway17@shaw.ca or organiseandco@shaw.ca

By direction of the Deputy Comptroller of Water Rights, comments on the application are to be forwarded to Chris McMillan, Secretary to the Deputy Comptroller of Water Rights, PO Box 9340 STN PROV GOVT, Victoria, BC V8W 9M1, or by email Chris.Mcmillan@gov.bc.ca to be in his hands on or before 31st December 2019, with a copy to Lakeshore Waterworks Ltd. As all submissions may be included as evidence, please ensure that a copy is provided to the Utility.

A copy of the complete application is available for public inspection at: 2750 Barnes Street. Penticton, BC V2A 6T5 (By Appointment)

Appendix H

List of Record Drawings

Date	Title	Number	Company	Format
1976-07-27	Lakeshore Highlands As Built Plan of 6" Pumping Main & 10" Intake	N/A	Alan R. Colby Consulting	PDF
1976-07-27	Lakeshore Highlands As Built Plan of 25,000 Gallon Reservoir	N/A	Alan R. Colby Consulting	PDF
1979-01-29	Lakeshore Highlands Plan Showing Stages of Development	N/A	Alan R. Colby Consulting	PDF
1981-10-01	Lakeshore Highlands - Phase 1 Water Pumping Station	1196-4	Hayes, Laird Engineering LTD.	PDF
1982-06-23	Lakeshore Highlands - Watermain Phase 1	1196-3	Hayes, Laird Engineering LTD.	PDF
1982-06-23	Lakeshore Highlands - Pump Station Electrical	1196-6	Hayes, Laird Engineering LTD.	PDF
1989-05-12	Lakeshore Highlands Phase II - Booster Pump Station	106	J&B Engineering LTD.	PDF
1989-07-04	Lakeshore Highlands Phase II - Plan of Waterline Along Road A & B	104	J&B Engineering LTD.	PDF
1990-06-01	Lakeshore Highlands - 150 Watermain for Lot A & B on Sunnybrook Drive	GL-100	Reid Crowther & Partners LTD.	PDF
1990-10-05	Appel Estates - Watermain for Lots 1-5 Cul-de-sac on Eastside Road	W-100	Reid Crowther & Partners LTD.	PDF
1992-06-01	Parson's Road - Re-alignment & Waterline	107	J&B Engineering LTD.	PDF
1992-06-14	Lakeshore Highlands Phase II - Proposed Watermain	2774-1	Hunter Laird Engineering LTD.	PDF
1992-09-10	Lakeshore Waterworks - Booster Station Electrical Control Schematics & Panel Details	395-011-E2	Interior Control & Instrumentation	PDF
1992-09-10	Lakeshore Waterworks - Booster Station Electrical Plan, Elevations, Single Line Diagram	395-011	Interior Control & Instrumentation	PDF
1992-09-10	Lakeshore Waterworks - Booster Station Station Plan and Piping Layout	395-011-03	Interior Control & Instrumentation	PDF
1992-09-10	Lakeshore Waterworks - Booster Station Sections and Details	395-011-04	Interior Control & Instrumentation	PDF
1993-05-11	Heritage Hills Subdivision Phase 3 - Proposed Watermains Areas 1 & 2	2774-2	Hunter Laird Engineering LTD.	PDF
1994-06-01	Heritage Hills Subdivision - Watermains Site Plan	Appel-1	Damax Consultants LTD.	PDF
1995-10-17	Heritage Hills Area 2 Waterworks - Big Horn Trail Asbuilt Drawings	2774-4	Damax Consultants LTD.	PDF
1997-09-01	North Christie Subdivision - Booster Pump Chamber Details	574-011-D1	True Engineering Consulting Group	PNG
1998-06-01	North Christie Subdivision - Waterworks		Damax Consultants LTD.	PDF
2001-05-01	Heritage Hills Area 2 - Booster Station Mechanical Plan and Sections	574-031-01	True Engineering Consulting Group	JPG
2002-03-04	Heritage Hills - Watermain As Constructed Drawing		Damax Consultants LTD.	PDF
2002-06-05	Lakeshore Highlands Phase II - Watermain Asbuilt Lots A-D	2774-1	Damax Consultants LTD.	PDF
2003-06-16	Heritage Hills - Site Plan for Proposed Subdivision - 4 Fee Simple & 6 Strata Lots	02-053-01	Chesapeake Services LTD.	PDF
2006-09-14	Vintage Views - Sanitary & Water Access Plan/Profile STA. 0+260 to 0+410	12-SW	Quantum Consulting Group LTD.	PDF
2006-09-14	Vintage Views - Roads & Utilities - Road 2 Plan/Profile STA. 0+000 to 0+360	18-RS	Quantum Consulting Group LTD.	PDF
2006-09-14	Vintage Views - Sanitary & Water - Road 2 Plan/Profile STA. 0+000 to 0+360	19-SW	Quantum Consulting Group LTD.	PDF
2006-09-14	Vintage Views - Roads & Utilities - Road 2 Plan/Profile STA. 0+300 to 0+420	20-RS	Quantum Consulting Group LTD.	PDF
2006-09-14	Vintage Views - Sanitary & Water - Road 2 Plan/Profile STA. 0+300 to 0+420	21-SW	Quantum Consulting Group LTD.	PDF
2006-09-14	Vintage Views - Roads & Utilities - Road 3 Plan/Profile STA. 0+000 to 0+100	22-RS	Quantum Consulting Group LTD.	PDF
2006-09-14	Vintage Views - Sanitary & Water - Road 3 Plan/Profile STA. 0+000 to 0+100	23-SW	Quantum Consulting Group LTD.	PDF
2006-09-14	Vintage Views - Road & Utilities - Road 4 Plan/Profile STA. 0+000 to 0+100	24-RS	Quantum Consulting Group LTD.	PDF
2006-09-14	Vintage Views - Sanitary & Water - Road 4 Plan/Profile STA. 0+000 to 0+200	26-SW	Quantum Consulting Group LTD.	PDF
2007-03-21	Vintage Views - Sanitary & Water - Access Plan/Profile STA. 0+000 to 0+260	06-090-01	Chesapeake Services LTD.	PDF
2007-04-02	Vintage Views - Sanitary & Water - Access Plan/Profile STA. 0+260 to 0+410	06-090-02	Chesapeake Services LTD.	PDF

Date	Title	Number	Company	Format
2010-02-09	Vintage Views - Sanitary & Water - Road 2 Plan/Profile STA. 0+000 to 0+120	07-154-05	Chesapeake Services LTD.	PDF
2010-02-09	Vintage Views - Sanitary & Water - Road 4 Plan/Profile STA. 0+000 to 0+260	07-154-05	Chesapeake Services LTD.	PDF
2010-03-23	Heritage Hills Water Composite	07-014-Comp	Chesapeake Services LTD.	PDF
2010-06-21	Custom VSD Control Panel With Submonitor, LA, LR, CCT, 6x CR's, Summer/Winter SS, & 3x Pilot Lights	3LS-115-28047	Selectric Inc.	PDF
2010-07-15	Vintage Views - 3 Lot Subdivsion of Lot 10 KAP50897	08-149-01	Chesapeake Services LTD.	PDF
2010-11-18	Heritage Hills Pump Station Upgrades - Cover Page	07-014-01	Chesapeake Services LTD.	PDF
2011-11-11	Heritage Hills Pump Station Upgrades - Plans & Profiles	07-014-02	Chesapeake Services LTD.	PDF
2011-11-11	Heritage Hills Pump Station Upgrades - Details	07-014-03	Chesapeake Services LTD.	PDF
2010-11-18	Heritage Hills Pump Station Upgrades - Overhead Powerline Plan & Profile, Detail	07-014-04	Chesapeake Services LTD.	PDF
2010-11-18	Heritage Hills Pump Station Upgrades - New Pump Can Details	07-014-05	Chesapeake Services LTD.	PDF
N/A	13-141 - Lift Station Detail	N/A	N/A	PDF
2016-04-01	Chadwell Place Record Drawings - Cover	PE-13-141-A-01	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Composite Utility Plan	PE-13-141-A-02	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Chadwell Place Plan & Profile STA 0+000 to 0+280	PE-13-141-A-03	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Chadwell Place Plan & Profile STA 0+280 to 0+580	PE-13-141-A-04	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Chadwell Place Plan & Profile Cul-De-Sac	PE-13-141-A-05	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - SRW - Vintage Blvd to Prop Lift Stn - Plan & Profile	PE-13-141-A-06	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Lot 2 Egress Road - Plan & Profile	PE-13-141-A-07	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Electrical & Gas Plan (Fortis)	PE-13-141-A-08	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Shaw Plan	PE-13-141-A-09	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Sections (0+080 to 0+240)	PE-13-141-A-10	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Sections (0+260 to 0+420)	PE-13-141-A-11	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Sections (0+420 to 0+660)	PE-13-141-A-12	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Standard Details	PE-13-141-A-13	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Redi-Rock Retaining Wall Details	PE-13-141-A-14	Ecora Engineering & Resource Group	PDF
2016-04-01	Chadwell Place Record Drawings - Sanitary Lift Station Details	PE-13-141-A-15	Ecora Engineering & Resource Group	PDF
2016-04-04	Subdivision Plan EPP61041	14-171F	Steven J. Buzikievich Land Surveying	PDF
2014-11-02	300 Heritage Blvd - Sanitary Sewer Plan & Profile	PE-14-252-P-01	Ecora Engineering & Resource Group	PDF
2004-03-01	Heritage Hills Area Two - Septic Field Site Plan & Details	574-051-01	True Engineering Consulting Group	PDF
2004-03-01	Heritage Hills Area Two - Septic Tank & Effluent Pump Site Plan & Details	574-051-02	True Engineering Consulting Group	PDF
2001-06-01	Heritage Hills Area Two - Sewage Treatment & Disposal System - Structural Details	574-051-03	True Engineering Consulting Group	PDF
2004-03-01	Heritage Hills Area Two - Sewage Treatment Plant - Site Plan & Holding Tank Details	574-052-01	True Engineering Consulting Group	JPG
2004-03-01	Heritage Hills Area Two - Sewage Treatment Plant - Piping Details	574-052-02	True Engineering Consulting Group	PDF
2004-03-01	Heritage Hills Area Two - Sewage Treatment Plant - Influent Pump Tank Plan, Section & Details	574-052-03	True Engineering Consulting Group	PDF

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2003-06-20	Heritage Hills Area Two - Sewage Treatment Plant - Structural Details	574-052-04	True Engineering Consulting Group	PDF
2004-01-12	Heritage Hills Area Two - Sewage Treatment Plant - Structural Details	574-052-05	True Engineering Consulting Group	PDF
2003-08-25	Heritage Hills Area Two - Sewage Treatment Plant - Exterior Wall Details	574-052-06	True Engineering Consulting Group	PDF
2003-07-17	Heritage Hills Area Two - Sewage Treatment Plant - Ventilation & Misc. Details	574-052-07	True Engineering Consulting Group	PDF
2003-07-17	Heritage Hills Area Two - Sewage Treatment Plant - Electrical Plans & Details	574-052-06	True Engineering Consulting Group	PDF
2008-04-08	45 Lot Base Land Strata Development - Cover	N/A	Chesapeake Services LTD.	PDF
2008-04-08	45 Lot Base Land Strata Development - Site Plan	07-154-01	Chesapeake Services LTD.	PDF
2008-04-08	45 Lot Base Land Strata Development - Proposed Lot Layout	07-154-02	Chesapeake Services LTD.	PDF
2008-04-08	45 Lot Base Land Strata Development - Composite Utility Plan	07-154-03	Chesapeake Services LTD.	PDF
2008-04-08	45 Lot Base Land Strata Development - Road 2 - Road & Storm - Plan & Profile	07-154-04	Chesapeake Services LTD.	PDF
2008-04-08	45 Lot Base Land Strata Development - Road 2 - Water & Sanitary - Plan & Profile	07-154-05	Chesapeake Services LTD.	PDF
2008-04-08	45 Lot Base Land Strata Development - Road 2 - Water & Sanitary - Plan & Profile	07-154-06	Chesapeake Services LTD.	PDF
2008-04-08	45 Lot Base Land Strata Development - Details	07-154-07	Chesapeake Services LTD.	PDF
2004-05-04	3 Fee Simple & 6 Strata Lots - Site Plan	02-053-01	Chesapeake Services LTD.	PDF
2004-04-21	3 Fee Simple & 6 Strata Lots - Strata Road Profile	02-053-02	Chesapeake Services LTD.	PDF
2004-04-21	3 Fee Simple & 6 Strata Lots - Elec, TV, Tel, Gas Plan	02-053-03	Chesapeake Services LTD.	PDF
2004-04-04	3 Fee Simple & 6 Strata Lots - Site Plan - Water System Asbuilts	02-053-04	Chesapeake Services LTD.	PDF
2004-04-04	3 Fee Simple & 6 Strata Lots - Lot Plan & Topog for Subdivision	02-053-05	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views - Key Plan	06-090-00	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Road & Storm - Access Plan/Profile STA 0+000 to 0+260	06-090-01	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Sanitary & Water - Access Plan/Profile STA 0+000 to 0+260	06-090-02	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Road & Utilities - Access Plan/Profile STA 0+260 to 0+410	06-090-03	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Road & Utilities - Easement From Parsons Road	06-090-04	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Sanitary & Water - Access Plan/Profile STA 0+260 to 0+410	06-090-05	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Road & Utilities - Road 1 Plan/Profile STA 0+000 to 0+300	06-090-06	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Sanitary & Water - Road 1 Plan/Profile STA 0+000 to 0+300	06-090-07	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Roads & Storm - Road 2 Plan/Profile STA 0+000 to 0+360	06-090-08	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Sanitary & Water - Road 2 Plan/Profile STA 0+000 to 0+360	06-090-09	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Road & Storm - Road 3 Plan/Profile STA 0+000 to 0+100	06-090-10	Chesapeake Services LTD.	PDF
2008-07-07	Vintage Views Phase 1 - Sanitary & Water - Road 3 Plan/Profile STA 0+000 to 0+100	06-090-11	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Road 2 - Water & Sanitary - Plan/Profile	07-154-05	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Site Plan	07-154-01	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Lot Layout	07-154-02	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Composite Utility Plan	07-154-03	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Road 2 - Road & Storm - Plan/Profile	07-154-04	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Road 4 - Road, Water & Sanitary - Plan/Profile	07-154-06	Chesapeake Services LTD.	PDF

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2010-02-26	Vintage Views Phase 2 - CatV & Tel Plan	07-154-07	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Elec Plan	07-154-08	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Details	07-154-09	Chesapeake Services LTD.	PDF
2010-02-26	Vintage Views Phase 2 - Storm Water Management Plan	07-154-10	Chesapeake Services LTD.	PDF
2010-03-23	Heritage Hills Water Composite	07-014-Comp	Chesapeake Services LTD.	PDF
2015-10-01	Water System Composite Plan	Figure 1	Chesapeake Services LTD.	PDF
N/A	Lakeshore 7 Vintage Views 24x36 Map	N/A	N/A	PDF
N/A	Lakeshore 7 Vintage Views 24x36 Map with Imagery	N/A	N/A	PDF
N/A	Lakeshore 7 Vintage Views 24x36 Map with Imagery	N/A	N/A	TIF
2002-08-30	Heritage Hills - Site Plan	Figure 2	Golder Associates	PDF
2002-05-02	Heritage Hills - Site Plan	Figure 2	Golder Associates	PDF
2002-08-30	Heritage Hills - Percolation Test	Figure 3	Golder Associates	PDF