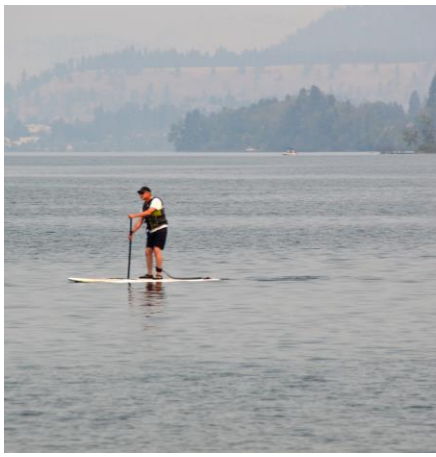
District of Lake Country

LAKE COUNTRY
Life. The Okanagan Way.

Water Master Plan





1577.0104.01

June 8, 2023

Prepared by:

URBAN SYSTEMS

304 – 1353 Ellis Street
Kelowna, BC V1Y 1S9
P: 250-762-2517
F: 250-763-5266

July 5, 2023 File: 1577.0104.01

District of Lake Country
10150 Bottom Wood Lake Road
Lake Country, BC V4V 2M1

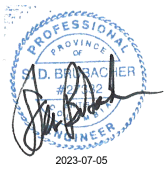
Attention: Kiel Wilkie, AScT, Utilities Manager

RE: Water Master Plan – Final Report

Enclosed please find a completed final report of the Water Master Plan. We appreciate the opportunity to collaborate with the District staff on the creation of this plan and the strategy for how the utility can sustainably deliver service to the District customers over the next 20 years.

Sincerely,

URBAN SYSTEMS LTD.



PERMIT TO PRACTICE
URBAN SYSTEMS LTD.
Signature
Date 2023-07-05
PERMIT NUMBER: 1000527
Engineers and Geoscientists BC (EGBC)

Steve Brubacher, P.Eng.
Principal

/sb
Enclosure

cc: Jason Barta, Joel Short – Urban Systems

\\usl.urban-systems.com\projects\Projects_KEL\1577\0104\01\R-Reports-Studies-Documents\R1-Reports\2023-02-10 Cover Letter.docx

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The District of Lake Country currently supplies water to the majority of residents, agricultural lands, and businesses located within municipal boundaries. This Water Master Plan has been prepared to enable the District of Lake Country to provide water that is sustainable and affordable for the community and environment.

As shown in *Figure 5*, this Master Plan provides a $167 million strategy that achieves:

1. Full compliance with existing Interior Health Authority policies by 2035 (grant funding dependent).
2. Adequate capacity to meet the growth needs of the District.
3. A consistent level of service to all existing customers.

This Plan takes a proactive risk management approach to address the major sources of risk exposure:

Risk	Response
Climate Change	▪ Complete an Agricultural Use Plan to inform strategies for supporting the resiliency of this important industry ▪ Water conservation measures to reduce water use requirements, including encouraging use of on-site water efficiency techniques ▪ Updated hydrological assessments to be completed for sources and regular updating to the Water Shortage Response Plan ▪ Further advance the exploration of a water reuse strategy in collaboration with the liquid waste management activities ▪ Maintenance of all four sources in order to help mitigate future impacts of invasive species, wildfires, and other future climate driven events.
Infrastructure Failure	▪ Source redundancy improved ▪ In-system storage increased ▪ Distribution system redundancy increased ▪ Proactive infrastructure replacement
Changing Regulations and Water Quality	▪ Development of a Water Strategy for balancing multiple stakeholders' interests in flows in Middle Vernon Creek ▪ Provisions made to accommodate future filtration of Kalamalka Lake ▪ Development of a strategy for future filtration at Beaver Lake WTP for Okanagan Lake water ▪ Development of a strategy for future system separation for agricultural water for the Beaver Lake supplied customers

Risk	Response
Changes to Growth and Development	▪ Works have been scheduled to allow flexibility ▪ Development of a strategy for future system separation for agricultural water for the Beaver Lake supplied customers
Inadequate Funds from Government Grants and Development Cost Charges	▪ Financial Plan has been prepared to assess the funding requirements ▪ Update rates and DCC Bylaw to reflect the recommendations of this Plan
Major Changes to the Watershed	▪ Protection Zones and Bylaws to be developed to increase intake protection ▪ Collaboration with other jurisdictions and stakeholders to be undertaken ▪ Beaver Lake Water Treatment Plant will provide buffer to water quality changes ▪ Increased depth of Kalamalka Lake Intake to provide increased protection ▪ Provision for Filtration Plan on Kalamalka to provide increased protection ▪ Strategy for Okanagan Lake Filtration at Beaver Lake WTP to inform longer term potential risks ▪ Update Watershed Risk Assessments and Reduction Strategies

The Water Master Plan provides the following recommendations for the District of Lake Country:

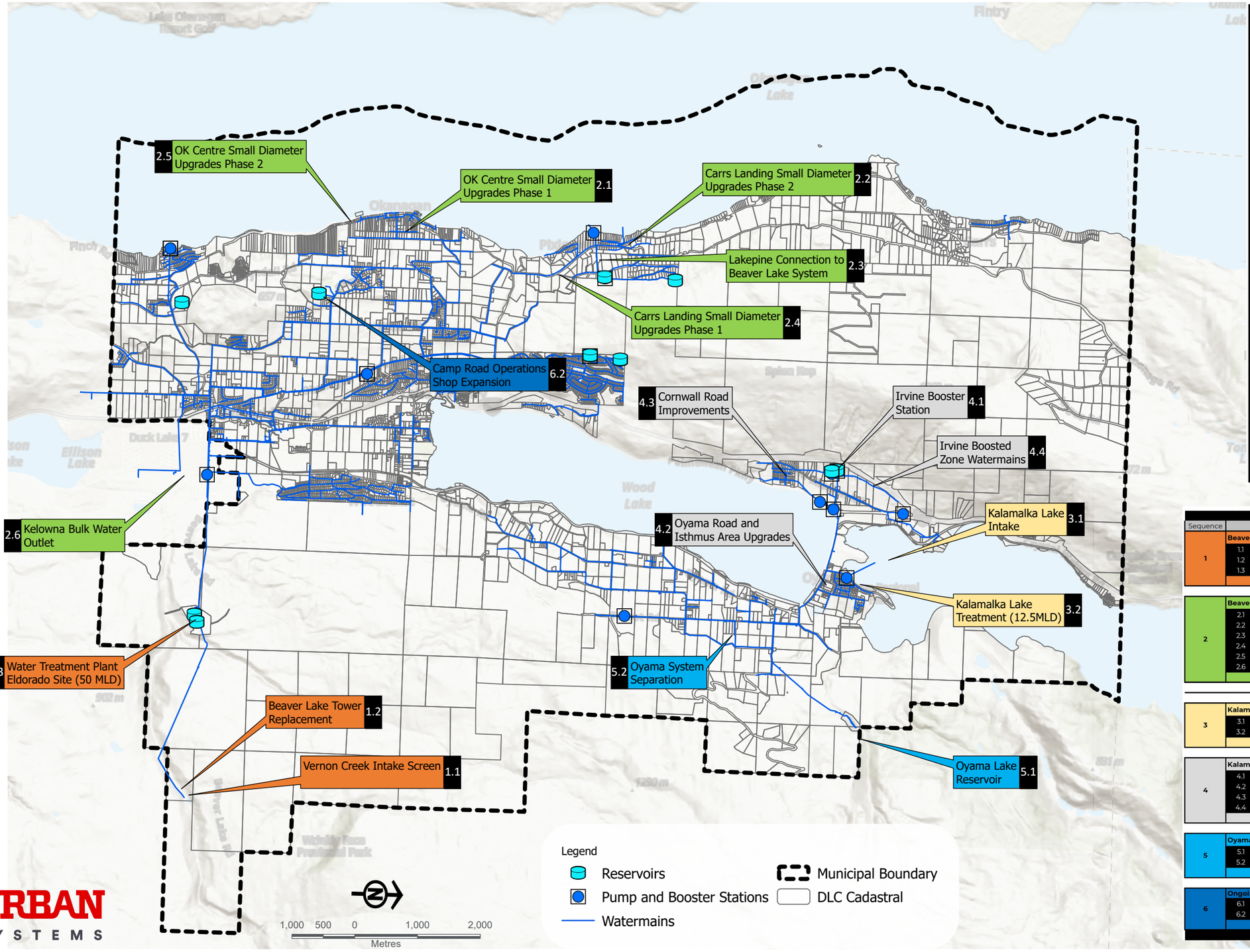
1. Update and convert licence capacity to match long term use requirements.
2. Complete the Water Strategy and Use Plan for Middle Vernon Creek.
3. Review and update the hydrologic assessments, watershed risk reduction strategies and dam safety recommendations.
4. Complete an Agricultural Use Plan, in consultation with the agriculture community, that aligns with the Water Strategy and Use Plan for Middle Vernon Creek.
5. Advance water reuse strategies in collaboration with liquid waste management activities.
6. Maintain updated hydraulic models for the distribution system.
7. Complete rate updates and updating of the Development Cost Charge Bylaw to align with this Plan.
8. Complete a Water Conservation Plan and follow through on the recommendations of that plan.
9. Monitor and update this Plan every 5-10 years or as appropriate.
10. Update the OCP to align with the Water Master Plan.
11. Complete the protection zones and licence of occupation for the Kalamalka and Okanagan Lake Intakes.
12. Complete the Carr's Landing Water Servicing Strategy with Implementation Plan that considers infrastructure phasing and financial capacity to expand the water system.

13. Achieve filtration deferral on the Okanagan Lake source and complete a Source Protection Plan that incorporates a plan for future filtration at the Beaver Lake WTP.

14. Develop a long term system separation plan for Beaver Lake agricultural customers that is integrated with system renewal.

District of Lake Country - Water Master Plan
Figure 5 - 20 Year Capital Projects Summary

LAKE COUNTRY
Life. The Okanagan Way.



Project Type Summary		
Type		Cost
Hydraulic Control Facilities		
1.1	Vernon Creek Intake Screen	$550,000
1.2	Beaver Lake Tower Replacement	$2,750,000
2.3	Lakepine Connection to Beaver Lake System	$632,500
3.1	Kalamalka Lake Intake	$1,265,000
4.1	Irvine Booster Station	$2,000,000
	Sub-total	$7,197,500
Pipelines		
2.1	OK Centre Small Diameter Upgrades - Phase 1	$2,354,000
2.2	Carrs Landing Small Diameter Upgrades - Phase 1	$1,424,500
2.4	Carrs Landing Small Diameter Upgrades - Phase 2	$2,139,500
2.5	OK Centre Small Diameter Upgrades - Phase 2	$1,562,000
2.6	Kelowna Bulk Water Outlet	$1,100,000
4.2	Oyama Road and Isthmus Area Upgrades	$1,479,500
4.3	Cornwall Road Improvements	$1,721,500
4.4	Irvine Boosted Zone Watermains	$1,375,000
5.2	Irrigation and Domestic System Separation	$22,297,000
6.1	Ongoing Watermain Upgrade and Replacement	$11,000,000
	Sub-total	$46,453,000
Water Storage		
5.1	Oyama Lake Reservoir	$1,842,500
	Sub-total	$1,842,500
Water Treatment		
1.3	Treatment Plant @ Eldorado Site (50 MLD)	$80,000,000
3.2	Kalamalka Lake Treatment (12.5 MLD)	$30,000,000
	Sub-total	$110,000,000
Operations		
6.2	Camp Road Operations Shop Expansion	$1,100,000
	Sub-total	$1,100,000
Total Water System Projects (2022 to 2040)		$166,593,000

Project Sequencing Summary					
Sequence	Title		Project Type	Year	Cost
1	**Beaver Lake Water Quality and Supply**				
	1.1	Vernon Creek Intake Screen	Hydraulic Control Facilities	1-5	$550,000
	1.2	Beaver Lake Tower Replacement	Hydraulic Control Facilities	1-5	$2,750,000
	1.3	Treatment Plant @ Eldorado Site (50 MLD)	Water Treatment	1-5	$80,000,000
	Sub-total				$83,300,000
2	**Beaver/Okanagan Distribution Upgrades**				
	2.1	OK Centre Small Diameter Upgrades - Phase 1	Pipelines	1-5	$2,354,000
	2.2	Carrs Landing Small Diameter Upgrades - Phase 1	Pipelines	1-5	$1,424,500
	2.3	Lakepine Connection to Beaver Lake System	Hydraulic Control Facilities	1-5	$632,500
	2.4	Carrs Landing Small Diameter Upgrades - Phase 2	Pipelines	1-5	$2,139,500
	2.5	OK Centre Small Diameter Upgrades - Phase 2	Pipelines	1-5	$1,562,000
	2.6	Kelowna Bulk Water Outlet	Pipelines	1-5	$1,100,000
	Sub-total				$9,212,500
3	**Kalamalka Water Quality and Supply**				
	3.1	Kalamalka Lake Intake	Hydraulic Control Facilities	1-5	$1,265,000
	3.2	Kalamalka Lake Treatment (12.5 MLD)	Water Treatment	6-10	$30,000,000
	Sub-total				$31,265,000
4	**Kalamalka System Distribution**				
	4.1	Irvine Booster Station	Hydraulic Control Facilities	1-5	$2,000,000
	4.2	Oyama Road and Isthmus Area Upgrades	Pipelines	6-10	$1,479,500
	4.3	Cornwall Road Improvements	Pipelines	6-10	$1,721,500
	4.4	Irvine Boosted Zone Watermains	Pipelines	11-20	$1,375,000
	Sub-total				$6,576,000
5	**Oyama System Separation**				
	5.1	Oyama Lake Reservoir	Water Storage	11-20	$1,842,500
	5.2	Irrigation and Domestic System Separation	Pipelines	11-20	$22,297,000
	Sub-total				$24,139,500
6	**Ongoing / Engineering**				
	6.1	Watermains - Upgrade and Replacement	Pipelines		$11,000,000
	6.2	Camp Road Operations Shop Expansion	Operations	1-5	$1,100,000
	Sub-total				$12,100,000
Total Water System Projects (2022 to 2040)					$166,593,000

URBAN SYSTEMS

1.0 INTRODUCTION

The District of Lake Country currently supplies water to the majority of residents, agricultural lands, and businesses located within municipal boundaries. This Water Master Plan has been prepared to inform decision making on water system efficiency and effectiveness, in order to help the District achieve long term viability and sustainability.

The District of Lake Country is located within a series of watersheds that supply water to Okanagan Lake. Prior to reaching Okanagan Lake, a portion of the runoff is stored within Oyama, Beaver, Crooked-Dee, Kalamalka, Duck, Damer, and Wood Lakes. At the present time, the District-owned water systems are supplied with water from one of four sources: Beaver Lake, Oyama Lake, Kalamalka Lake, and Okanagan Lake. These sources are fed with water from within the District's boundaries, in addition to runoff from upland areas. This water is used for consumptive and non-consumptive purposes in homes, businesses, and for irrigation.

1.1 Master Plan Scope

This Water Master Plan's scope is limited to the District's existing large water systems, their service areas, and system expansion which has wide community interest. A key component of this Water Master Plan is to evaluate and consider the ability to expand service from the existing water system to the Carr's Landing area of the community, as well as to expand service to customers in the 10th Street area. The timing for these potential expansions of the service areas is dependent on the acceptance from the benefiting properties, most likely through creation of a Local Service Area. The District does have a policy to acquire utilities owned by others as they become available, but only once required improvements have been completed, so as to not place financial burden onto existing users. This is of particular relevance to the Eastside Utility District which is adjacent to the Carr's Landing area and presently owned and operated by the Province.

2.0 BACKGROUND

2.1 Master Plan Process

The process to create this Plan began in 2020, and a steering committee was established to help construct the Water Master Plan process. The following activities were completed and reviewed with the steering committee, the Water Services Advisory Committee, and Council:

- Initial technical work that focused on forecasting demands and evaluating watershed capacity
- Assessment of servicing options for the Carr's Landing area
- Assessment of the Oyama and Kalamalka Servicing Options Review
- A review comparing the expansion of servicing from Okanagan Lake, in lieu of building a treatment plant for Beaver Lake
- Development of a 20-year capital projects list with a Water Master Plan community engagement strategy
- Completion of a detailed financial plan, along with a rate structure discussion with the committees and Council
- A public engagement process, reviewed by Council, was conducted to inform the public about the Water Master Plan and solicit feedback from stakeholders and residents in 2022
- Preparation of this Water Master Plan document to summarize the work completed and the path forward

2.2 Previous Studies

Table 1 summarizes the previous studies that have been referenced in the preparation of this Water Master Plan:

Table 1. Previous Studies

Title	Author	Date	Comments
Water Master Plan	Urban Systems	November 2012	The previous Water Master Plan that is superseded by this plan.
Lakestone Servicing Water Master Plan	Urban Systems	April 2016	The outcomes of this Water Master Plan have been incorporated into this plan.
Small Diameter Mains	Urban Systems	August 2016	The outcomes of this upgrading strategy have been incorporated into this plan.
Oyama Watershed and System Hydrologic Assessment	Urban Systems	March 2019	The outcomes of this assessment have informed the direction of this plan.
Carr's Landing Water Servicing Review	Urban Systems	March 2020	This servicing review was updated and superseded as part of this plan.
Dam Safety Reports	District	January 2022	Annual Dam Safety Reports prepared and submitted by District Staff

2.3 Operating Permits

The District of Lake Country operates their water systems under the authority of Interior Health, who issues operating permits for every drinking water system in Interior British Columbia.

Under the latest conditions from Interior Health, the following actions and time periods are relevant to this Water Master Plan:

- Provide treatment to the Beaver Lake source to meet the Drinking Water Objectives for Surface Water Supplies in BC and reduces disinfection by-product formation to below Health Canada Maximum Acceptable Concentrations by December 31, 2025
- Complete the outstanding items for filtration exemption for Okanagan Lake by March 31, 2022
- Complete an update to the DLC Master Water Plan to support infrastructure improvements to meet Drinking Water Objectives (including confirming the plan for Kalamalka Lake)
- Develop and implement a source protection plan for Okanagan Lake
- Review and Update Emergency Response and Contingency Plan and Water Quality Monitoring Programs

3.0 VISION AND GUIDING PRINCIPLES

The District of Lake Country's vision, unchanged from the 2012 Water Master Plan, is to provide water that is sustainable and affordable for the community and environment.

The following guiding principles have been used to guide the preparation of this Water Master Plan:

1. Take an active role in providing stewardship of the water resources within the basin
2. Retain all four existing sources
3. Plan based on securing filtration deferral for Okanagan Lake
4. Provide the same level of service to all customers:
    a. Adequate flow and pressure for both routine demands and fire protection needs
    b. Adequate water quality that meets Provincial regulations, health-based objectives of the *Canadian Guidelines for Drinking Water Quality*, and, where affordable, meets aesthetic objectives of the *Canadian Guidelines for Drinking Water Quality*
5. Strive to improve the level of service over time in a cost-effective manner
6. Provide a Plan that considers risks and plans accordingly with consideration for:
    a. Climate change
    b. Infrastructure failure
    c. Changing regulations
    d. Changing source water quality
    e. Changes to growth and development
    f. Inadequate funds from government grants and DCCs
    g. Major changes within the watershed (i.e. invasive species, wildfires).

7. Provide a Plan premised on financial stability, balancing capital improvement needs with infrastructure renewal requirements

The following guiding principles within the Official Community Plan are supported directly by this Water Master Plan. In addition, many objectives and policies within the OCP are consistent with the direction outlined by this Plan.

OCP Guiding Principles

- Preserve our rural and agricultural character
- Create a vibrant town centre
- Promote development in existing neighbourhoods
- Achieve sustainable development through smart growth
- Protect and enhance our natural environment
- Facilitate an active, healthy, inclusive community
- Maintain high-quality municipal services

OCP Goals and Objectives that Pertain to Infrastructure

- Preserve, protect, and enhance the natural environment
- Reduce greenhouse gas emissions and dependence on fossil fuels in Lake Country
- Be a leader in sustainable municipal practices
- Protect environmentally sensitive habitats in identified upland and foreshore areas
- Collaborate with government, First Nations, and conservation groups to ensure the long-term preservation of environmentally significant areas
- Fulfill Climate Action Charter commitments by continuing to work towards achieving carbon neutrality in all municipal operations
- Promote sustainable development with minimal environmental impact
- Continue to reduce water consumption through a range of approaches
- Manage and protect local resources to prevent irreversible or undesirable impacts
- Enhance Lake Country's environment through the implementation of Blue Dot policies that respect the right to a healthy environmental for all citizens
- Maintain high-quality drinking water in the District
- Expand and improve public infrastructure
- Provide reliable water and sewer services in an efficient and economically-feasible manner
- Ensure the expansion of public infrastructure is cost effective for all taxpayers
- Ensure all properties meet required servicing levels
- Increase safety along the residential-natural interface
- Protect and enhance the agricultural sector within the District of Lake Country
- Protect soil and water to aid in the preservation of viable farmland

4.0 WATER DEMANDS

An important first step in developing a Water Master Plan is to quantify both the existing and anticipated future demands to be placed on the water systems. In 2011, the District completed a Water Conservation Initiative Study and then implemented a universal water metering program, which has made a considerable impact in understanding water use and focusing efforts to reduce water consumption. The District has recently created a Water Conservation Plan which has been provided under separate cover.

4.1 Existing Water Use

In 2018, the District of Lake Country provided water to approximately 12,000 users through an estimated 4,600 connections. The total annual water use was approximately 7,650 million litres (21 ML/day) in 2018, with a maximum day demand of 80 ML/day. 2018 was determined as a representative average demand over the past 5 years. The following figures illustrate how this water is estimated to be used both on an average and maximum day basis:

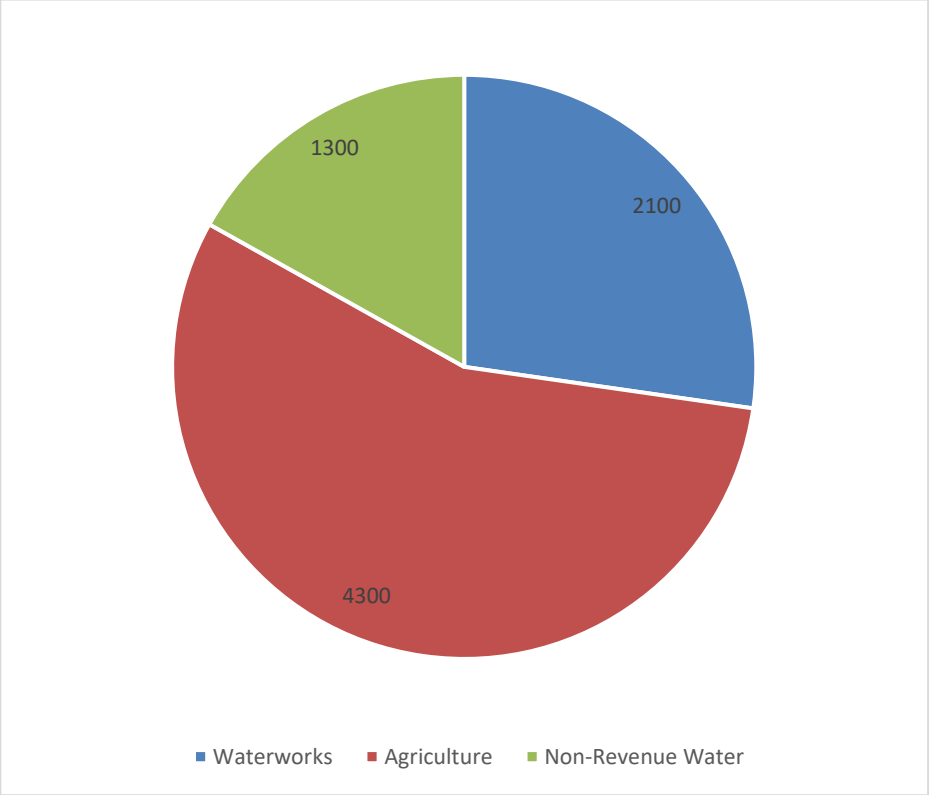


Figure 1. 2018 Water Use by Category (ML/Year Annual Average)

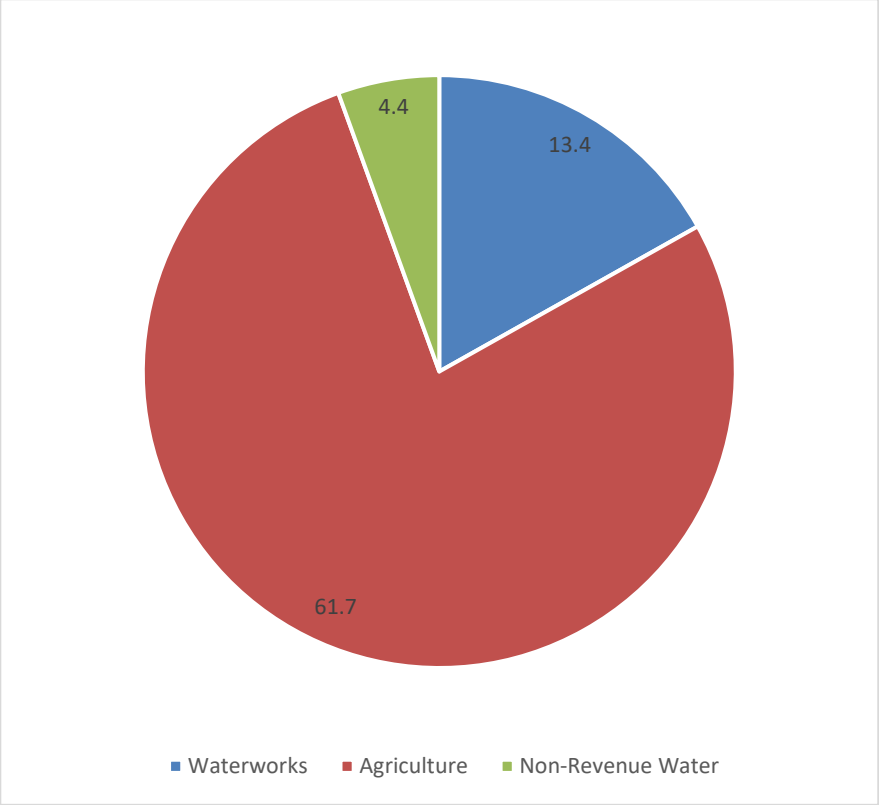


Figure 2. 2018 Water Use By Category (ML/Day Maximum Day)

As shown in *Figure 2*, over 78% of water use on a maximum day is used for agriculture. *Figure 3* shows the District's typical water use pattern charted by month. Water demands included in the "Other" category represent residential, commercial, institutional and industrial customers.

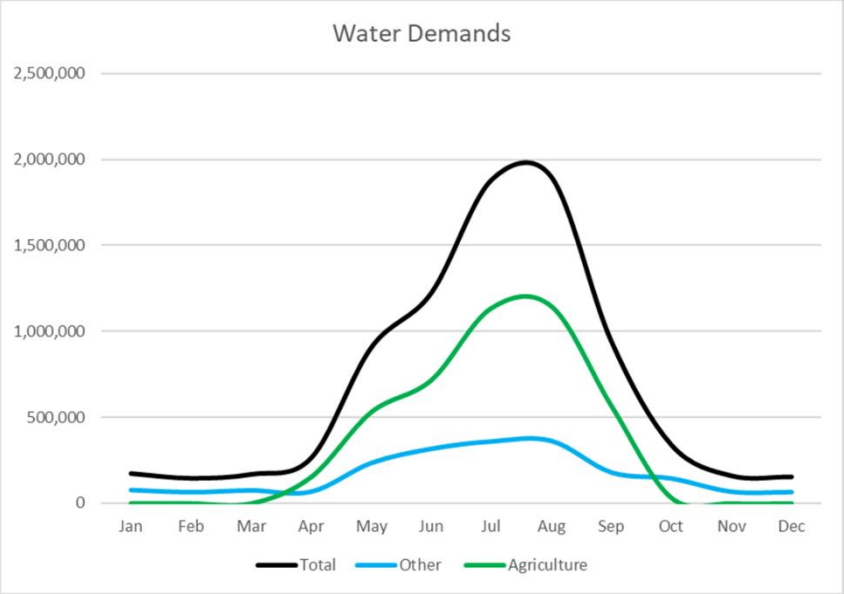


Figure 3. Existing Water Use Pattern

Before the District was fully metered, it was estimated that unmetered residential connections were using 330 L/c/day for indoor use and 1,600 L/c/day for outdoor use. Metering prior to the 2012 Master Plan had estimated water use for a limited metered residential customer base at 320 L/c/day indoor and 320 L/c/day for outdoor use. Now that the District is fully metered, they have a better understanding of its water use characteristics, shown below in *Figure 4* for 2018. It is important to note that these graphs consider the population in each home to be relatively consistent year-round and the value listed is based on the maximum day. As shown, the estimated indoor use is lower than previously estimated, while outdoor use is higher. Overall water use has been decreased by 22.5% since 2012 and is very close to meeting the objectives of the Water Master Plan. There are further water conservation efforts explored in the 2023 Water Conservation Plan that will help to achieve a 17.5% reduction in current water consumption within the next 10 years (excluding the potential impacts of climate variability). These efforts are grouped into demand side and supply side initiatives and include:

Demand Management Considerations

1. Mandated Efficient Water Systems (Agricultural)
2. Variable Rate Structure (Non-Agricultural customers)
3. Variable Rate Structure (Agricultural)
4. Water Meters Fixed Network Leak Detection Program
5. Distribution System Leak Detection Programs
6. Tensiometers

Supply Management Considerations

1. Removing Beaver Lake Obstruction
2. Water Management Plan
3. Automated Outlet Valve; and
4. Reclaimed Water and Groundwater Extraction

With implementation of the recommended initiatives including use of reclaimed water and groundwater extraction, an annual water savings of 2,121 ML (1,355ML – demand side and 766 ML – supply side) is projected.

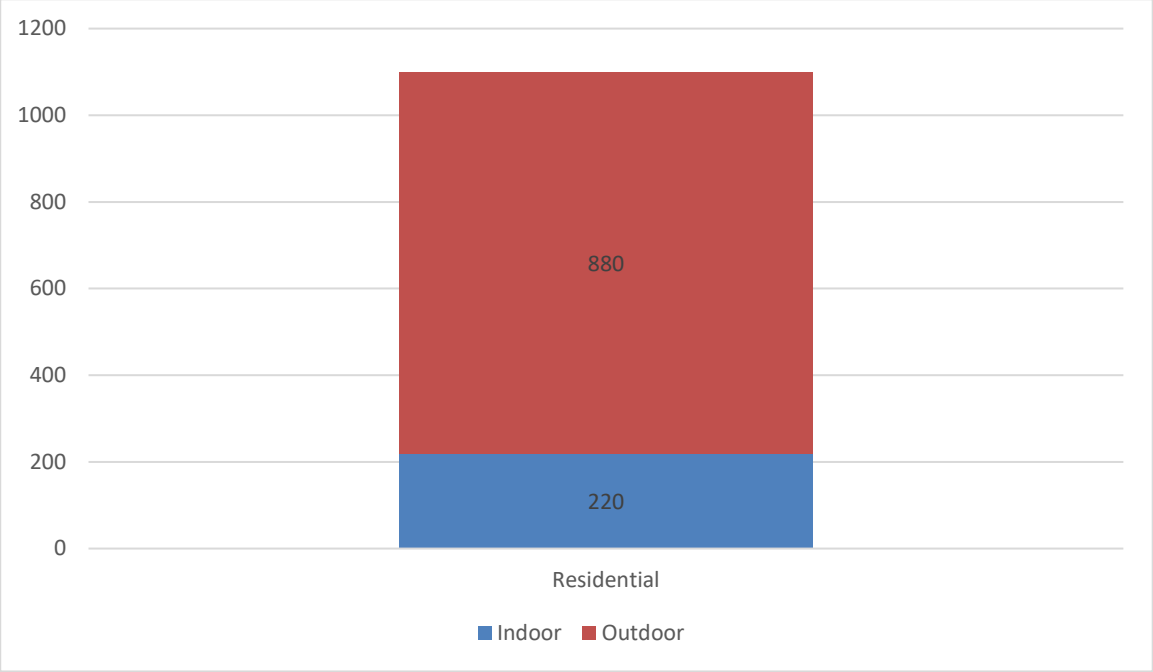


Figure 4. 2016-2018 Water Use Breakdown (Max Day L/Capita/Day)

The following unit demand rates are averages for customer categories across the District verified by District Supervisor Control and Data Acquisition (SCADA) data:

Category	**Unit Demand Rate**
Residential Maximum Day Demand	1100 L/capita/day
Agriculture Maximum Day Demand (Oyama/Kalamalka) Maximum Day Demand (Beaver/Okanagan)	66,400 L/day/ha 51,000 L/day/ha

4.2 Future Water Use

According to the District's Official Community Plan projections, an additional 4,800 residential units are forecast to be added to the system by 2040. Based on an average population density of 2.5 people per unit, it suggests an increase of 12,000 people. At the current metered rate of 1100 litres per day per person, maximum day water use would increase by 13.2 ML/day. The District has also identified a potential increase in irrigated agricultural area due to land with a water allotment that is not currently in production. This allotment has been estimated at 2.8 ML/day (average day) and 10 ML/day (maximum day). The water capacity for agriculture is based on an annual average application of 504mm (20") per hectare. This agricultural irrigation application will be reviewed in greater detail during the development of the Agricultural Use Plan. Institutional, Commercial, and Industrial (ICI) lands within the District are assumed to be mostly built out (with the exception of a Lake Country Business park adjacent to Glenmore Road).

The District of Lake Country supplies water to the City of Kelowna northern industrial park as per the Hiram Walker agreement (amended in 1999) and the 1994 Bulk Water agreement (Carion Road area). There are also properties that are in the City of Kelowna's boundaries that fall within the District's water servicing boundary and are connected to District of Lake Country infrastructure.

The District, together with the City of Kelowna and Okanagan Indian Band (OKIB), is developing a revised agreement for continued supply to the area up to a maximum of 9.5ML per day. Further objectives of the agreement are:

- To allow for water supply to OKIB lands
- To connect all City of Kelowna properties to water infrastructure owned by the City
- To establish a bulk supply and capital improvement rate structure based on full cost recovery

The District has identified an ICI growth of 9.5 ML/day for OKIB and City of Kelowna parcels served by the Okanagan Lake system over the duration of this Water Master Plan time period.

The District plans to keep focus on water use efficiency and effectiveness through proactive water use planning. One target is to reserve future water use savings and mitigation strategies, in order to help offset the impacts of climate variability. As such 2,121 ML in water savings and supply enhancements (355ML in conservation efforts and 1,766 ML in reclaimed water use/groundwater extraction implementation) have been reserved for the climate impacts and therefore no reductions in demand has been forecasted in **Table 2.**

A detailed growth breakdown is provided in the Design Criteria Technical Memo in **Appendix A**.

Table 2 summarizes the projected future water use needs of the District:

Table 2. 2040 Total Water Needs

	Average Day	Maximum Day
Existing Water Use	22.1 ML/day (8,124 ML/year)	79.5 ML/day
Water Conservation Savings/ Supply Enhancement Forecast	-5.8 ML/day (2,121 ML/year)	-20.9 ML/day
Climate Variability Reserve for Increased Water Use	5.8 ML/day (2,121 ML/year)	20.9 ML/day
Residential Growth	4.8 ML/day (1,760 ML/year)	13 ML/day
OKIB/Kelowna Growth	4.75 ML/day (1,734 ML/year)	9.5 ML/day
Agricultural Growth Reserve	2.8 ML/day (1,030 ML/year)	10 ML/day
Total	**34.5 ML/day (12,650 ML/year)**	**112 ML/day**

5.0 WATER SOURCES

The District of Lake Country receives its water from four sources: Beaver Lake, Okanagan Lake, Kalamalka Lake and Oyama Lake. In the cases of Beaver Lake and Oyama Lake, the intakes are located within the downstream creeks of Vernon Creek and Oyama Creek respectively. This section provides an overview of these sources with detailed information contained in the background report found in the 2012 Water Master Plan *Appendix B*.

5.1 Source Descriptions

A. Beaver (Beaver Lake) Chain

The Beaver Lake source has provided water to the District for over 100 years. Prior to incorporation this source was operated by the Winfield Okanagan Centre Irrigation District. It is located at the highest elevation of all the water sources and currently services the largest area. The watershed that feeds Beaver Lake has a surface area of 63 km^2. It includes both Beaver and Crooked Lakes as dammed storage reservoirs that rely on snowmelt to fill. The storage capacity of Beaver Lake is 11,880 ML (9,629 ac-ft) and the Crooked Lake (plus upstream chain of lakes) store 2,939 ML (2,383 ac-ft). The District currently stores water in the lakes during the fall to spring months and releases flows during the summer. Water flows from Crooked Lake into Beaver Lake and then into Vernon Creek where it is diverted by the District approximately six kilometres downstream. Beaver Lake is the District's largest water source in terms of volume used, primarily for the purpose of agriculture.

Dam safety review and consequence ratings were completed in 2011 (see 2012 Water Master Plan *Appendix C*). Annual Dam Safety Reports have most recently been submitted in 2022. Based on the dam safety regulations, the dam classifications have been set to 'extreme consequence' for Beaver Lake Dam and 'high consequence' for the Crooked Lake Dam. The emergency protection plan and operations, maintenance and surveillance manuals have been updated to meet dam safety requirements.

The 2011 dam safety review outlines deficiencies for Beaver Lake Dam, which include a spillway that does not meet current standards and a deteriorating gate tower and outlet works. The District has since made minor repairs to the outlet channel and has determined that the outlet requires replacement.

The Vernon Creek intake works and screens are housed in a concrete building that was significantly upgraded in 2002. The District is currently working towards automating the screen cleaning process.

The Eldorado Reservoir is an open reservoir containing 30,000 m^3 of storage. The large balancing reservoir was constructed in 2007 downstream of the Vernon Creek intake to aid in providing uninterrupted water service. Numerous landslide areas exist in the section of channel upstream of the Vernon Creek intake. Some remedial work of the slide areas has been completed; however, it is reported that large unstable banks remain that cannot be easily stabilized, which will result in further landslides, thereby potentially jeopardizing the water supply.

The construction of the Eldorado Reservoir has resulted in noticeable water quality benefits. This reservoir allows the supply from Vernon Creek to be shut off during high turbidity events. In 2009, a hydro generation facility was added to the intake to the reservoir.

In 2018, an enclosed Eldorado treated water storage reservoir was built with a volume of 6,000 m^3 and an associated low lift pump station. It stores water downstream of the Eldorado Reservoir once disinfection is complete. The District plans to construct a water treatment facility for this source, which is discussed later in this Plan.

During the dry summer months of 2021, the District received an order from the Department of Fisheries and Oceans to release additional flows into Vernon Creek in order to provide adequate fish flows. This posed a risk and challenge for the District, as they were not anticipating this order and it resulted in releasing storage that was designated for times of water scarcity or reoccurring drought. Mitigating this risk in future is discussed later in this Plan.

B. Okanagan Lake

Okanagan Lake became a water source for the District in 1994 through the acquisition of intake infrastructure and a water licence from the Hiram-Walker Distilleries. Okanagan Lake is fed by a watershed that is over 200km long with an area of over 6,000 km^2. This lake provides water to many communities in the Okanagan Valley. The quality of the water from Okanagan Lake is superior to any water in the valley, particularly when it is drawn from the depth that Lake Country extracts from.

Okanagan Lake is divided into three basins by underwater sills. Lake Country's intake is located in the largest and deepest of the basins. There are distinct water chemistry differences in each of the three basins[1].

The Okanagan Lake Pump Station was built in 1968 for the Hiram-Walker Distillery. The intake is located approximately 40m from the lakeshore at a depth of 33m[1]. This pump station is the District's largest residential potable supply.

In 2020 the District completed upgrades to the Okanagan Lake source, which included electrical upgrades, pumping capacity upgrades, the addition of a new ultraviolet disinfection system, and replacement of the existing chlorine disinfection system. Additionally, the Glenmore Booster Station, built in 2018, increases the District's ability to feed water from Okanagan Lake into the Beaver Lake system as a backup supply measure, or to supplement the Beaver Lake source during times of poor water quality.

The District intends to maintain filtration deferral on this source, but is prepared to add filtration, if required, at a later date. This process will be reflected in the source protection plan. A risk element for this source is the

[1] Okanagan Lake Source to Tap Assessment, Larratt Aquatic, July 2010.

likelihood of invasive Quagga mussels becoming established in Okanagan Lake. A risk reduction tactic the District has chosen to employ is maintaining the ability to supply the Okanagan Lake source from the upland Beaver Lake source, which is not prone to the mussels. There are also operational tactics the District has made provisions for, which should lessen the impact on the infrastructure. If or when the Quagga mussels become established, filtration or a treatment system will likely be needed to manage algae outbreaks.

C. Kalamalka Lake

The intake and water licence for Kalamalka Lake were owned and operated by the Oyama Irrigation District prior to acquisition by the District. The watershed feeding Kalamalka Lake has an area of 572 km^2. Water licences also are held by the Regional District of North Okanagan for an intake at the north end of Kalamalka Lake. The lake has a maximum depth of 142m and a volume of 1.52 million ML. Approximately 80% of the annual inflow comes from groundwater and Coldstream Creek, while the remaining inflow is from Wood Lake and Oyama Creek[2]. Kalamalka Lake operates over a very tight operating range between 391.06m and 391.82m, which prevents pre-freshet drawdown during high inflow periods.

The Kalamalka Lake intake is located 440m from the shoreline at a depth of 22m below the normal water surface of the lake. After screening, the intake feeds the pump station that boosts the water into the distribution system. It has been observed that large boats are having an impact on the intake at this depth, stirring up fine silts that are drawn into the intake. Furthermore, the existing intake depth is not at an ideal location as it is also a depth susceptible to algae blooms. Because of this, the District has included a plan to deepen the intake and provide future treatment to this source.

A key risk element for this source is the likelihood of invasive Quagga mussels becoming established in Kalamalka Lake. A key risk reduction tactic the District has chosen to employ is maintaining the ability to supply the Kalamalka Lake source from the upland Oyama Lake source, which is not prone to the mussels. There are also operational tactics the District has made provisions for, which should lessen the impact on the infrastructure. If or when the Quagga mussels become established, filtration or a treatment system will likely be needed, which is another component as to why planning for treatment on this source is considered prudent.

D. Oyama Lake

The Oyama Lake source was owned and operated by the Wood Lake Improvement District prior to acquisition by the District in 1998. This source has provided water since the early 1900s. The watershed feeding Oyama Lake has an area of 23.8 km^2. The watershed includes both Oyama Lake, with a storage capacity of 7,137 ML, and Damer Lake, with a capacity of 263 ML. The lakes rely on snowpacks for annual water regeneration. The intake is located on Oyama Creek approximately 2.6 km upstream from where the creek discharges into Kalamalka Lake.

Dam safety review and consequence ratings were completed for both Oyama Lake and Damer Lake in 2011 (see 2012 Water Master Plan *Appendix C*). Annual Dam Safety Reports have most recently been submitted in 2022. Based on the dam safety regulations, the dam classifications have been set to ‘high consequence’ for both reservoirs. The emergency protection plan and operations, maintenance and surveillance manuals have been updated to meet dam safety requirements.

[2] 2012 Water Master Plan Appendix B Source Water Supply and Demand Background Report

The Oyama Creek Intake includes fish screens, chlorine disinfection system, and a balancing tank prior to discharging into the distribution system.

5.2 Water Licenses and Flow Availability

Table 3 summarizes the water license diversion annual volume and flow availability from each source, as developed for the Water Master Plan in 2012. These do not include the storage license volumes for the lakes. The operational waste volume for Beaver Lake has been updated based on current District records.

Table 3. Water License Annual Flow Summary

	Beaver	Okanagan	Kalamalka	Oyama	Total
Existing Water License					
a. Irrigation	7,459 ML	0 ML	1,594 ML	2,639 ML	11,692 ML
b. Water Works	1,204 ML	10,997 ML	124 ML	1,252 ML	13,577 ML
c. Total	8,661 ML	10,997 ML	1,718 ML	3,891 ML	25,267 ML
Water Availability					
a. Watershed Yield	9,868 ML	10,997 ML	1,718 ML	4,400 ML	
b. Fish Flows	-1,750 ML	0 ML	0 ML	0 ML	
c. Est. Operational Waste	-1,296 ML	0 ML	0 ML	480 ML	
d. Total	6,822 ML	10,997 ML	1,718 ML	3,920 ML	24,136 ML

Table 4. Water License Waterworks Maximum Day Withdrawal Summary

	Beaver	Okanagan	Kalamalka	Oyama	Total
Existing Water License	4.8 ML/day	32 ML/day	0.3 ML/day	6.8 ML/day	44 ML/day

Table 5 summarizes the total water needs by licensed use type. The 'Waterworks' use type includes all uses other than agriculture and also includes the current unaccounted-for water use. The growth in water use represents the additional water source capacity needed less the water use reduction associated with conservation by existing customers.

Table 5. 2040 Water Needs by Use Type (Million Litres)

Flow Condition	Beaver	Okanagan	Kalamalka	Oyama	Total
Ultimate Demand Annual Irrigation/Waterworks	2,548/2,140	0/4,318	604/1,079	1,924/0*	5,076/7,538
Water License Annual Withdrawal Irrigation/Waterworks	**7,459/1,204**	**0/10,997**	**1,594/124**	**2,639/1,252**	**11,692/13,577**
License Surplus/(Deficit)	4,911/(937)	0/6,679	990/(955)	715/1,252	6,616/6,039
Total Water Availability	**6,822**	**10,997**	**1,718**	**3,920**	**24,136**
Availability Surplus/(Deficit)	2,134	6,679	35	1,996	11,522
Ultimate Max Day Demand (Non-Agriculture)	11.9	24.00	4.6	0*	40.5
Water License Max Day Withdrawal	**4.8**	**32.0**	**0.3**	**6.8**	**43.9**
Surplus/(Deficit)	(7.1)	8.0	(4.34)	6.8	3.4

**Based on separating the Oyama demands and servicing them from Kalamalka*

Based on the information outlined above, there appears to be sufficient source water available to meet average annual demands and maximum day demands in 2040. However, there will be the need to convert some of the irrigation license capacity into waterworks license capacity. In addition, there may be the need to rely on the Okanagan Lake Source to supplement the Beaver Lake Source when adequate instream flows are not able to be met. Further, with the separation of the Oyama domestic customers and connecting them to Kalamalka year-round some waterworks license will need to be transferred from Oyama.

The last available hydrological study for the Beaver and Kalamalka sources is from 1977. The Oyama Creek watershed's latest assessment was completed by the Ministry of Environment in 1987. Urban Systems completed an updated Oyama Watershed assessment in 2019. Okanagan Lake has undergone a comprehensive review by the Okanagan Basin Water Board.

It is recommended that an updated hydrological study be completed for the Beaver source. This assessment should determine if there is sufficient source water for annual use and to meet seasonal demands, both under today's conditions and under future climatic variations. The number of flow monitoring and weather monitoring stations should be

considered in advance of this study, in order to identify if additional stations are needed to complete the updated assessment and for ongoing monitoring. ***Water license amendments should be made to align with the future needs of the District.***

Given the overall sufficiency of water licenses, this is not likely a short-term, high priority item. However, it should be scheduled, and an opportunity sought to partner with other benefiting parties.

Beyond the 20-year timeframe, it was identified that storage capacity may need to be increased, subject to verification by the updated hydrologic assessment and the Middle Vernon Creek Water Strategy. Another option to consider in the future would be to install a dual distribution system in certain areas of Winfield that supplies groundwater mixed with reclaimed water. ***It is recommended that the District work to secure the right and ability in advance of requiring the upgrades.***

5.3 Watershed Assessments

Prior to the 2012 Water Master Plan, the District completed watershed assessments for the upper watersheds, including Oyama Lake and Vernon Creek, and the lower watersheds, Okanagan Lake and Kalamalka Lake. These assessments were completed to provide guidance on strategies to improve or maintain the highest quality water supply possible. In addition, they fulfill a prerequisite for applying for filtration exemption for the Okanagan and Kalamalka Lake sources. ***It is recommended that the District update the watershed risk reduction strategies contained in the assessments.***

Okanagan Lake

The Okanagan Lake watershed assessment concludes that the biggest threats to water quality are activities in and around the intake zone. As outlined in the 2012 Water Master Plan, it is recommended that an Intake Protection Zone be established and that the District apply for a License of Occupation over the protection zone. It is also advised that a bylaw be established to protect the Okanagan Lake foreshore. It is recommended that no storm outfalls or marina activities be permitted within this zone.

As outlined in **Section 5.1** the District recognizes that surface water bodies including Okanagan Lake are not immune to changing conditions which may at some point in the future provide challenges with maintaining a filtration exemption for this source. ***As such it is recommended that over the course of this Water Master Plan implementation time period that the District review and consider mitigation strategies for Okanagan Lake treatment.*** Strategies should include planning for a future filtration plant on the Okanagan Lake Source or in building a dedicated feed line to the future Beaver Lake Water Treatment Plant and expanded capacity as required at the Eldorado Site.

Kalamalka Lake

The Kalamalka Lake watershed assessment concludes that the greatest risks to water quality are activities around the lake edge and also within the intake zone. Similar to Okanagan Lake, it is recommended that an Intake Protection Zone be established, that the District apply for a License of Occupation, and that a bylaw be put into place to protect the foreshore. Unlike Okanagan Lake, an intake extension is recommended for Kalamalka Lake in order to improve raw water quality.

Due to the size and changes that have occurred in Kalamalka Lake since 2012, the District anticipates the eventual need for a filtration plant on this source. The presence and migration of Quagga mussels is a real risk in the lower freshwater lakes and this, combined with other factors, would accelerate the need for a filtration plant during this planning horizon. ***It is recommended that the District plan for the installation of a filtration plant on Kalamalka Lake.***

Oyama Lake and Beaver Lake

The Oyama Lake and Vernon Creek watershed assessment (Beaver Lake feeds into Vernon Creek) concludes that activities within the watercourses and upland watersheds pose the greatest risk to water quality. Since the intakes do not have the same buffering provided by Okanagan Lake and Kalamalka Lake, the impacts of these activities are significantly higher. This is further complicated by the fact that there is Provincial Crown land within the watersheds. As such the watershed is impacted not only by local land use decisions but also those under the jurisdiction of the provincial government. Interagency cooperation is key to protecting the water quality within these watersheds.

As part of this Water Master Plan, a review was completed to determine the best way to align water quality needs with source water quality abilities. It concluded that separating the domestic demands from the Oyama Lake source and placing them on the Kalamalka Lake source provides the greatest ability to eliminate the risks associated with the water quality of Oyama Lake.

As noted earlier, a hydrologic assessment was completed in 2018 of the Oyama Lake source in order to ascertain the potential impacts of climate change. The report concluded that the there will be inadequate source capacity to meet current demands during an estimated 1-in-100 year return period event under current climate conditions. The frequency of this shortfall could occur annually by the end of the century if climate change predictions are correct. The report recommends that flow and lake-level monitoring is critical data to collect and that the Water Shortage Response Plan be used to proactively consider water use restrictions. ***It is recommended that ongoing hydrologic data collection and assessment be completed for this source and that the Water Shortage Response plan be updated on a regular basis.***

6.0 WATER QUALITY AND TREATMENT

6.1 Introduction

Surface water sources, such as those that supply the District of Lake Country, are vulnerable to the presence of pathogenic (disease-causing) organisms due to contamination by fecal matter from warm-blooded animals. This situation can be further exacerbated by cattle ranching and recreational uses within watersheds. In addition to risks associated with microbiological contamination, the District of Lake Country sources also experience high turbidity and colour which, although not necessarily direct health risks, can be an indicator for health risks. High turbidity can render disinfection processes ineffective by shielding the organisms from the disinfectant. Colour in water can be caused by many factors. One such factor is organic materials. Excessive organic materials in the water can react with chlorine used for disinfection to produce levels of disinfection by-products that are shown to be harmful over extended periods of exposure.

6.2 Regulatory Requirements

The District of Lake Country's water services are governed by the *Drinking Water Protection Act* and *Drinking Water Protection Regulation*. Specific requirements for each water system are outlined in the conditions placed on the Permit to Operate. In addition to these regulations there also exists the Canadian Guidelines for Drinking Water Quality. These guidelines are not law in British Columbia, unless so imposed through conditions on operating permits. Within the guidelines there are both health-based and aesthetic guideline values. The District of Lake Country has chosen to meet all health-based guidelines from the CGDWQ and to meet the aesthetic objectives if the cost benefit analysis justifies it.

The initial conditions on the Lake Country Operating Permits require that plans be submitted to Interior Health that demonstrate how the District will meet the Canadian Guidelines and IH water treatment objectives which include[3]:

- 4 log virus inactivation;
- 3 log *Giardia Lamblia* inactivation or removal;
- 3 log *Cryptosporidium* inactivation or removal;
- 2 treatment processes;
- 1 NTU maximum for turbidity with a target of 0.1 NTU; and
- 0 *E. Coli* and *Fecal Coliform.*

Filtration of all surface sources is required to meet these objectives, except for sources that are needed to be of sufficiently high quality. Interior Health currently grants filtration deferral providing the following conditions are met as outlined in the Interior Health Filtration Exclusion Criteria[4][5]:

1. 4-log removal/inactivation of viruses and 3-log inactivation of protozoa (*Giardia Lamblia* and *Cryptosporidium*), using two disinfection processes;

2. Baseline of *Cryptosporidium* and *Giardia* established;

[3] 4-3-2-1-0 Drinking Water Objective Handout, Interior Health, January 2006
[4] Criteria to Demonstrate That a Water Supplier Can Achieve the GCDW Filtration Exclusion Criteria Handout, Interior Health, February 2008
[5] Considerations for Ongoing Monitoring Programs for Systems with Filtration Deferral Guideline, February 2008

3. Watershed control program;
4. ≤10% of the source water E. coli exceed 20/100mL in any 6 month period;
5. ≤10% of the source water total coliform samples exceed 100/100mL in any 6 month period;
6. Turbidity does not exceed 1 NTU 95% of the time in any 30 day period;
7. Peak Turbidity readings do not exceed 5 NTU for more than 2 days in a 1 year period; and
8. Annual average trihalomethanes (THM) concentrations do not exceed 0.100 mg/L.

Within this Plan, filtration plans are included in order to service all domestic demands except those serviced from Okanagan Lake. As outlined earlier it is recommended that a strategy be developed for the Okanagan Lake source in the event that filtration is required at some point in the future.

6.3 Water Quality Summary

Water quality sampling data has been summarized in *Table 6* for averages of colour, turbidity and hardness from the 2019 to present average monthly results. These are provided for comparative purposes only since more detailed analysis is required in order to inform the design of any water treatment system.

Table 6. Source Water Quality Summary

Parameter	Units	CGDWQ Health Based Guideline	CGDWQ Aesthetic Objective	Beaver Lake	Okanagan Lake	Kalamalka Lake	Oyama Lake
Colour	TCU		<15	42	5.5	5	58
Turbidity	NTU	<1.0		0.76	0.37	0.65	1.06
Hardness (as $CaCO_3$)	mg/l		<500	60	157	208	42

As outlined in the **Section 6.1** and **Section 6.2** turbidity is of concern since it impacts the effectiveness of the disinfection process. Colour is primarily an aesthetic concern but may also provide an indication of organic matter that produces disinfection by-products. The presence of disinfection by-products within the distribution system can be confirmed by additional tests. Hardness is an aesthetic parameter that affects not only the taste of the water but also the performance of various appliances including washing machines and dishwashers.

Of the four sources, Okanagan Lake and Kalamalka Lake are sources that consistently test below the 1.0 NTU turbidity guideline. Kalamalka Lake does see occasional minor spikes in turbidity, which is believed to be primarily attributed to recreational boating activity adjacent to the water intake and increase in algae growth. Both sources also experience low colour. Improvements to Kalamalka Lake's intake location may reduce the turbidity values to comply with the filtration deferral requirements, but planning for a future treatment plant is advised.

Beaver and Oyama Lake sources seasonally experience spikes in turbidity that exceed 1.0 NTU. Both Beaver and Oyama Lake sources experience elevated colour and associated high levels of organic matter. High colour and turbidity are linked to higher disinfection by-products when chlorine is used as the disinfectant.

The plan to address these issues are as followed:

1- Switch the Beaver Lake source to the Okanagan Lake source during low flow periods.

2- Construct a water treatment facility on the Beaver Lake source.

3- Transfer domestic water supply to Kalamalka Lake for the Oyama Lake customers.

6.4 Existing Treatment and Disinfection

Beaver, Oyama, Okanagan, and Kalamalka Lakes have existing chlorine disinfection facilities with adequate contact time to inactivate viruses. All systems provide a secondary chlorine disinfectant residual in the distribution system in order to control any system regrowth. Both Okanagan Lake and Kalamalka utilize UV disinfection as a second treatment barrier.

Table 7 summarizes the existing system comparison to the Interior Health Requirements:

Table 7. System Comparison to Interior Health Requirements

IH Requirement	Beaver Lake	Okanagan Lake	Kalamalka Lake	Oyama Lake
4 log virus inactivation	Yes	Yes	Yes	Yes
3 log Giardia Lamblia inactivation	Yes	Yes	Yes	Yes
3 log Cryptosporidium inactivation	No	Yes	Yes	No
2 Treatment Barriers	No[A]	Yes	Yes	No
1 NTU maximum for turbidity	No[A]	Yes[A]	Yes[A]	No[A]
0 E. Coli and Fecal Coliform	Yes[A]	Yes[A]	Yes[A]	Yes[A]

Note A: Requires Filtration to be installed or Filtration exemption to be granted to be considered in compliance by Interior Health.

7.0 WATER DISTRIBUTION

The District of Lake Country customers serviced by the water systems outlined in this Water Master Plan receive water from one of four sources. Beaver and Oyama Lake customers receive water from more than one source depending on the time of year. Okanagan Lake can supply Beaver Lake, and Kalamalka Lake can supply Oyama Lake, during low demand periods. **Section 9.0** provides an illustration of the existing distribution systems as well as details on each of the existing systems. The District's website has an interactive map that illustrates to customers what their current water source is as well as any advisories that are in place for that source. *Table 8* summarizes the characteristics of the distribution system.

Table 8. Distribution Systems Summary

	Total
Pipeline Length (km)	170 km
Pressure Zones	36
Pressure Reducing Stations	34
Pump Stations	11
Reservoirs	9
Total In-System Reservoir Volume (m^3)	16,130 m^3

In order to deliver adequate flow and pressure to customers, water distribution system planning considers water demands under average day, maximum day and peak hour conditions. The average day situation is used to confirm that the system maximum pressures are not too high. The maximum day situation is used to meet fire flow requirements and confirms that adequate flows can be conveyed to where they are needed without drawing the system pressures too low. Peak hour conditions determine if adequate conveyance capacity exists to meet minimum system pressure requirements.

7.1 In-System Storage

Evaluating in-system storage is an important step to understanding distribution system performance. The location and quantity of storage can have a significant impact on the conveyance needs of the distribution system. The most efficient systems employ in-system storage for three purposes:

1. Fire flow storage
2. Peak hour balancing
3. Emergency storage

Using an in-system storage reservoir for the purposes of fire flow and peak hour balancing eliminates the need to convey these high flows from extended distances or through the existing source network. Emergency storage is provided in many systems so that if a main supply pipeline, treatment plant or source experiences an interruption in water supply, then the system is not immediately out of water.

The District's objective is to provide fire storage to meet existing and future needs, in accordance with Fire Underwriters Survey, up to a maximum of 15,000 l/minute for a duration of 3.25 hours. Peak hour balancing is to be provided at 25% of non-agricultural maximum day demands. Balancing is not provided for agricultural demands because they are relatively constant during irrigation season and, as such, do not require balancing. Emergency storage is to be provided at an additional volume of 25% of fire storage and peak hour balancing where a backup source is not available to buffer the loss of a single source.

The treated water storage at the Eldorado site (Beaver Lake source) sustains flows during larger fire events. The Okanagan Lake reservoir is only sized for a maximum fire flow of 90 L/s under maximum day demand conditions. A PRV at the Glenmore Booster station allows supplemental water from the Beaver Lake system to enter the Okanagan Lake system to meet the required fire requirements.

A backup generator is present at the Kalamalka Lake intake, which can supplement flow for the Irvine reservoir.

7.2 Hydraulic Network Performance

Steady-state hydraulic models of the existing distribution systems were updated by Urban Systems using WaterCAD software. An upgrading strategy has been developed as part of the background studies and also updated as part of this Water Master Plan in order to provide the following hydraulic levels of service:

Table 9. Hydraulic Levels of Service

Category	Criteria
Maximum Static Pressure	827 kPa (120 Psi)
Minimum Static Pressure	275 kPa (40 Psi)
Peak Hour Minimum Pressure	250 kPa (35 Psi)
Fire Flow Minimum Pressure	
- At flow hydrant	140 kPa (20 Psi)
- At all other points in the system	0 kPa (0 Psi)
Fire Flows	
Residential Single Family/Duplex (Existing)	3,600 L/min
Residential Single Family/Duplex (Future)	5,000 L/min
Residential Three/Four Plex	5,400 L/min

Category	Criteria
Residential Apartments	9,000 L/min
Commercial	9,000 L/min
Institutional	9,000 L/min
Industrial	13,500 L/min

Specific criteria have been identified for the Small Diameter Mains and Lakestone Water Master Plan, which have been used and remain in effect for those specific projects.

It is recommended that the distribution system models be kept up to date in conjunction with implementing the chosen system improvements outlined later in this report.

8.0 ASSET RENEWAL

Asset Management BC has developed a framework in 2019 titled Asset Management for Sustainable Service Delivery. This framework outlines a process for developing and implementing Asset Management Plans. The process involves Assessing, Planning and Implementation phases. The District has been proactively assessing, developing and implementing asset management strategies well prior to the 2012 Water Master Plan and continues to update and advance these strategies in an integrated manner within the various Master Plans and other utility strategies. This Water Master Plan is no exception.

Much of the existing water system infrastructure was built in the late 1960s and early 1970s. Two major system improvements have been completed since the initial construction: adding the Kalamalka Lake water supply in 1996 and 2012 and the Eldorado Reservoirs to the Beaver Lake supply in 2007 and 2018. Aside from these two improvements, distribution system improvements have also been completed in order to support growth and development.

Since that time, the Small Water Diameter Mains Report was reviewed and determined what upgrading is needed in order to improve fire protection within the District. This upgrading work largely deals with the asset renewal requirements while at the same time improving the level of service.

The investment level for water system renewal is discussed in further detail in **Section 10**.

9.0 SOLUTIONS

With the Water Master Plan's overall direction set in 2012, this Water Master Plan focuses on finetuning specific strategies for key areas. Each of these focus areas was reviewed and evaluated in a stand-alone technical memo which can be found in **Appendix A**. It is worth noting that the majority of the memos were completed in 2020 and 2021 and that the selected capital program elements costs were further updated in 2022. The 2022 updates were based on additional investigation work into the treatment costs and the application of a 10% additional inflationary factor to the remaining 2021 estimates. We are in a very volatile time for infrastructure pricing and, as such, it is recommended that the costs in this plan be reviewed and updated frequently.

System expansion has been specifically considered for Carr's Landing and also for properties south of 10th Street, due to these being two key focus areas. It is worth noting that these are not the only potential service area expansions and that the District Staff adheres to Council's Water Restructure Policy 100, and amendments thereto, when considering system expansion. A servicing approach for the known development areas has been summarized in **Figure 6**.

9.1 Options Evaluation

Oyama/Kalamalka Servicing

A focus area of this Water Master Plan is to determine a preferred servicing strategy for addressing supply challenges, fire flow protection, and upcoming infrastructure renewal. The Oyama source is on a permanent Water Quality Advisory, which is currently mitigated by pumping water – outside of the irrigation season – from the Kalamalka Lake source through the Sawmill Booster Station. However, once the irrigation demands commence for the season, the customers in Oyama must be serviced from the Oyama source. As outlined in **Section 5.0**, there are water quality and future availability concerns associated with this source, both of which are compounded by current climate change projections.

Based on these considerations, the preferred servicing approach is to install a separate domestic system in Oyama that is fed from Kalamalka Lake. This eliminates the water quality risks posed by the Oyama source and further mitigates impacts on the domestic demands from a potential water shortage in the Oyama watershed. Fire protection in Oyama is to continue to be supplied by the Oyama irrigation system.

The Kalamalka Lake source has adequate total license capacity for this approach, but it would require conversion of some irrigation license to waterworks license to be in full compliance. This conversion of licenses is not only needed for future demand but also for the current demand of the Kalamalka system. For this servicing approach, the main outstanding question is where to increase the reservoir storage to address the storage deficiency. The existing Oyama storage could be divided between domestic and irrigation water fire storage; however, this requires the installation of 800m of additional water main. Alternatively, the capacity in the Sawmill Booster station exists to meet peak hour requirements; however, a generator will be required to be added.

Carr's Landing Area Servicing

The Carr's Landing area is currently serviced by a number of different water systems. Both Lakepine (adjacent to Carr's Landing) and Coral Beach are water systems owned and operated by the District but are not connected to the District's larger community water systems. In addition, Eastside Utilities is a private utility in the area that is operated by the Province of BC, and the remaining area is serviced by individual systems that are all fed from direct intakes into Okanagan Lake. A long-term servicing strategy was prepared to consider the various ways to service this area, and it is outlined in **Appendix A**.

The identified strategy is to extend the District's large community water system, fed from Beaver Lake source, to Carr's Landing in a multi-phased approach and connect these areas when public support is obtained. In analysis of the options for supplying water to the area, consideration for constructing a new Okanagan Lake intake was analyzed, or running a feed from the Lake's subdivision. The Beaver lake source option is recommended as the most feasible and practical to construct and maintain. The timing of this may need to follow the construction of the Beaver Lake Treatment Plant, so that water quality changes are minimized from what the current residents experience. There is the opportunity to address a number of the small diameter main upgrades with this work, so there are synergies that can be realized. It is recommended to gauge the community's interest in system expansion and complete as a next phase outside of the Water Master Plan.

Okanagan Lake Expansion and Dual Distribution

The District has explored increasing the capacity being supplied from Okanagan Lake, in order to potentially defer or eliminate the need for a filtration plant at the Beaver Lake source. This approach, outlined in greater detail in **Appendix A,** requires the construction of a new intake, pump station, pipeline, and disinfection system prior to discharging at the Eldorado Treated Water Reservoir. It further requires that the waterworks license be transferred to agricultural use. The estimated capital cost for this approach is in a similar order of magnitude as the new treatment plant.

Similarly, a high-level update was completed to the work undertaken in 2012 to assess dual distribution options for the Beaver Lake source service area. The objective of these two systems similar to the Oyama/Kalamalka service area is to reduce the customer demands that require filtration. Two primary options exist for creating this dual system:

- A new potable water system could be built in order to bring Okanagan Lake water to all domestic demands
- A new irrigation system could be built to supply the agricultural irrigation demands directly from the Beaver Lake source without treatment.

This approach has a higher capital cost and slightly lower operating cost than the treatment plant at Eldorado. Further at the present time it creates greater challenges for funding approaches such as grants and development cost charges. This dual distribution approach is likely best to integrate with the asset renewal strategy for the agriculture supply system built in the 1960s and 1970s since there very likely could be additional grant funding available for this specific purpose at that time. The timing for the asset renewal is currently forecasted to be beyond the financial time frame for this plan.

A risk assessment was completed of the three options, and through discussions with Council it was determined that proceeding with the filtration plant at the Eldorado site is the preferred approach. It is acknowledged that filtration exemption on Okanagan Lake may be at risk of being lost in the future, and, as such, it is recommended that a strategy be developed to mitigate this risk. Discussion with Council points to a preference to bring Okanagan Lake water to the Eldorado site when filtration is required in order to blend the sources and optimize the amount of treatment equipment

needed. Further, it is recommended that dual distribution be kept as a long-term strategy that can be used beyond the time frame of this plan in order to reduce the extent that treatment expansion is needed.

10th Street Servicing Extension

The final area of review was to determine the feasibility of extending the Okanagan Centre Road West watermain in order to service properties south of the current terminus. Three options were reviewed and are summarized in **Appendix A**. Through discussions with the District, it was decided to include Option 1, which includes only servicing the lots to 14th Street. This option is the most reasonable cost option, and it is not anticipated that the lot density south of 14th Street will warrant the extension of the water system. The cost for this expansion has not been included in the capital project list or the financial model because all or most of the cost is expected to be borne by the property owner by way of a Local Service Area.

9.2 Preferred Option

The $167 million worth of capital works associated with the preferred approach have been broken down into six major categories. Each project has been assigned a timeframe. The projects are graphically shown in the attached *Figure 5* and this section provides a general description of each project. *Figure 6* has been provided to provide greater clarity on how major development areas are to be serviced.

1. Beaver Lake Water Quality and Supply

The first set of projects improves the water quality and supply from the Beaver Lake Source. The District is also considering supplying the Beaver Lake source with Okanagan Lake water through the winter until a treatment plant can be constructed.

1.1 Vernon Creek Intake Screen – $550,000 (Year 1-5)

The intake screen in Vernon Creek needs to be replaced as it is at the end of its useful life. Automating the screen cleaning process improves operational needs and addresses safety concerns.

1.2 Beaver Lake Tower Replacement - $2,750,000 (Year 1-5)

The Beaver Lake Tower is at the end of its useful life and needs to be replaced.

1.3 Beaver Lake Water Treatment Plant - $80,000,000 (Year 1-5)

A new filtration plant is required at the Eldorado Reservoir at a capacity of 50 MLD in order to bring the Beaver Lake source into compliance with the Interior Health authority treatment objectives.

2. Beaver/Okanagan Distribution Upgrades

There are a number of water distribution upgrades that have been identified in the Small Water Mains, Lakepine Water Master Plan, and the options reviews completed for this Water Master Plan.

2.1 OK Centre Small Diameter Mains Phase 1 - $2,350,000 (Year 1-5)

Improved fire flows in the lower OK Centre area.

2.2 Carr's Landing Small Diameter Upgrades Phase 1 - $1,425,000 (Year 1-5)

Improved fire flows in the Carr's Landing area and provide the ability to extend the system in the future.

2.3 Lakepine Connection to Beaver Lake System - $633,000 (Year 1-5)

Decommissioning of the Okanagan Lake intake and connection of the Lakepine system to the Beaver Lake System.

2.4 Carr's Landing Small Diameter Upgrades Phase 2 - $2,140,000 (Year 1-5)

Further extension of the upgrades in Carr's Landing to address fire flow deficiencies and provide the ability to extend the system in the future.

2.5 Okanagan Centre Small Diameter Upgrades Phase 2 - $1,562,000 (Year 1-5)

Improved fire flows in the remaining Okanagan Centre Area.

2.6 Kelowna Bulk Water Outlet - $1,100,000 (Year 1-5)

Bulk metering and separation of Kelowna and DLC infrastructure.

3. Kalamalka Water Quality and Supply

The Kalamalka water quality improvements project is focused on improving the quality of water supplied to Kalamalka and eventually to the domestic customers in Oyama as well.

3.1 Kalamalka Lake Intake - $1,265,000 (Year 1-5)

This project involves extending the intake in order to improve the turbidity fluctuations.

3.2 Kalamalka Lake Treatment Plant - $30,000,000 (Year 6-10)

A new 12.5 MLD filtration plant is planned for at Kalamalka Lake in the event that the filtration exemption is not able to be secured.

4. Kalamalka System Distribution

4.1 Irvine Booster Station - $2,000,000 (Year 1-5)

This project involves upgrading the Irvine Booster Station to an above-ground facility that provide domestic, irrigation, and fire flow capacity for the zone.

4.2 Oyama Road and Isthmus Area Upgrades - $1,480,000 (Year 6-10)

This project addresses fire flow deficiencies by upgrading the supply trunk to the area.

4.3 Cornwall Road Improvements - $1,722,000 (Year 6-10)

This project addresses fire flow deficiencies by upgrading the supply trunk to the area.

4.4 Irvine Boosted Zone Watermains - $1,375,000 (Year 11-20)

This project addresses fire flow deficiencies by upgrading watermains downstream of the booster station.

5. Oyama System Separation

The goal of this group of projects is to allow the Oyama domestic demand to be supplied from the Kalamalka Lake source under all demand conditions and upgrade fire flows supplied by the Oyama Lake source.

5.1 Oyama Lake Reservoir - $1,843,000 (Year 11-20)

This includes the construction of a new reservoir for potable water peak hour balancing. This reservoir may not be required if this storage is added in the Kalamalka water system.

5.2 Irrigation and Domestic System Separation - $22,297,000 (11-20)

Installation of a new dedicated domestic water system and upgrades to the irrigation system in order to improve the provision of fire flows.

6. Ongoing

6.1 Ongoing Annual Work - $11,000,000 ($550,000 per year)

The final project category captures the aggregate of smaller projects which include:

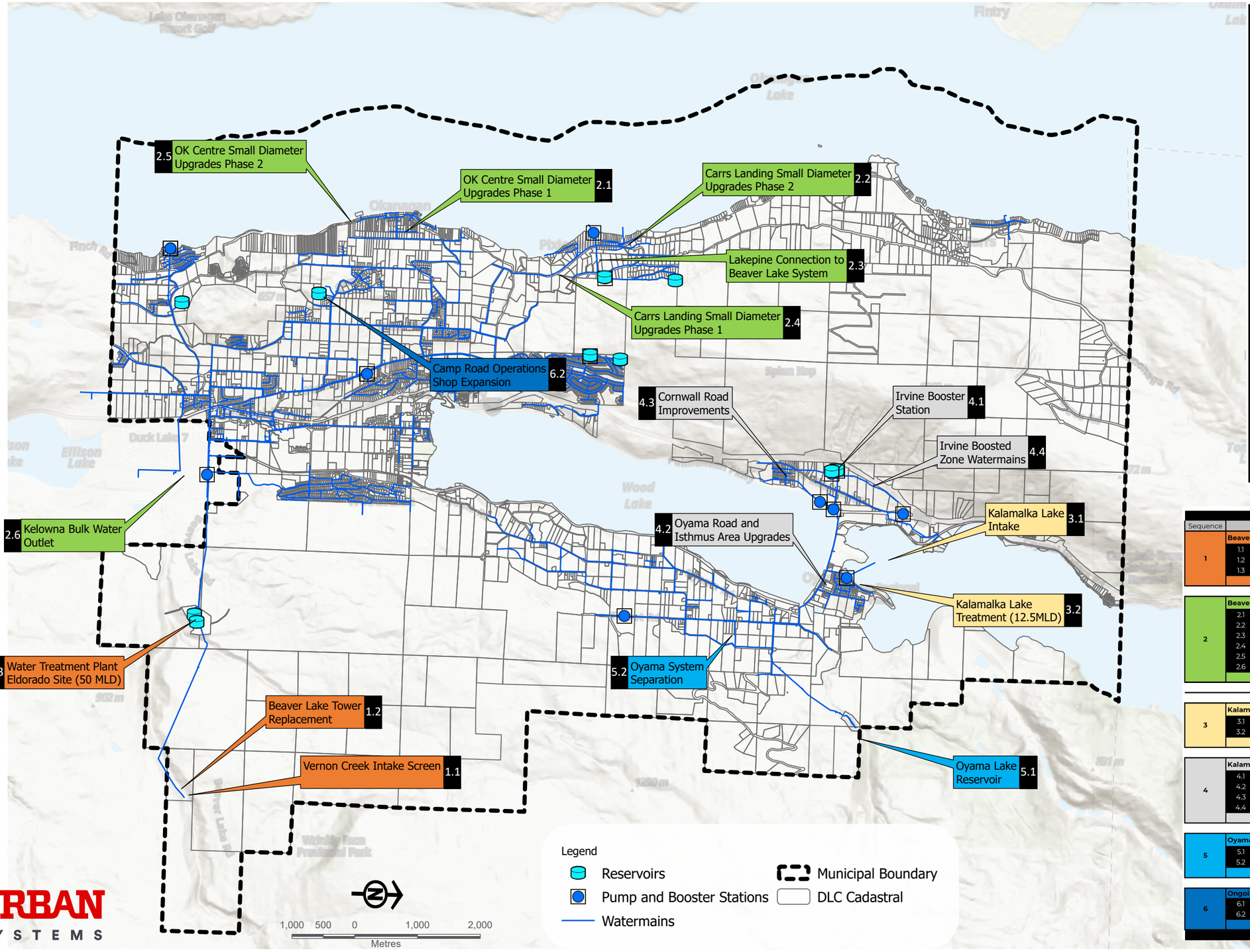
- Condition upgrades for pipes not already captured
- Confined space improvements
- Development of an Agricultural Use Plan
- Develop and implement Water Conservation Plan
- Development of a Lower Vernon Creek Water Strategy
- Development of an Okanagan Lake Loss of Filtration Exemption Strategy
- Updated Hydrometric Studies for Beaver Lake and Kalamalka Lake
- Updating the Watershed Risk Assessment and Mitigation Plans
- Updating of the Water Master Plan
- Updating of the Water Rates and Development Cost Charges
- Secure the right and ability to increase storage at Beaver Lake

6.2 Camp Road Operations Shop Expansion - $1,100,000 (1-5)

Renewal and expansion of the operations shop to facilitate growth.

District of Lake Country - Water Master Plan
Figure 5 - 20 Year Capital Projects Summary

LAKE COUNTRY
Life. The Okanagan Way.



Project Type Summary		
Type		Cost
Hydraulic Control Facilities		
1.1	Vernon Creek Intake Screen	$550,000
1.2	Beaver Lake Tower Replacement	$2,750,000
2.3	Lakepine Connection to Beaver Lake System	$632,500
3.1	Kalamalka Lake Intake	$1,265,000
4.1	Irvine Booster Station	$2,000,000
	Sub-total	$7,197,500
Pipelines		
2.1	OK Centre Small Diameter Upgrades - Phase 1	$2,354,000
2.2	Carrs Landing Small Diameter Upgrades - Phase 1	$1,424,500
2.4	Carrs Landing Small Diameter Upgrades - Phase 2	$2,139,500
2.5	OK Centre Small Diameter Upgrades - Phase 2	$1,562,000
2.6	Kelowna Bulk Water Outlet	$1,100,000
4.2	Oyama Road and Isthmus Area Upgrades	$1,479,500
4.3	Cornwall Road Improvements	$1,721,500
4.4	Irvine Boosted Zone Watermains	$1,375,000
5.2	Irrigation and Domestic System Separation	$22,297,000
6.1	Ongoing Watermain Upgrade and Replacement	$11,000,000
	Sub-total	$46,453,000
Water Storage		
5.1	Oyama Lake Reservoir	$1,842,500
	Sub-total	$1,842,500
Water Treatment		
1.3	Treatment Plant @ Eldorado Site (50 MLD)	$80,000,000
3.2	Kalamalka Lake Treatment (12.5 MLD)	$30,000,000
	Sub-total	$110,000,000
Operations		
6.2	Camp Road Operations Shop Expansion	$1,100,000
	Sub-total	$1,100,000
Total Water System Projects (2022 to 2040)		$166,593,000

Project Sequencing Summary					
Sequence	Title		Project Type	Year	Cost
1	**Beaver Lake Water Quality and Supply**				
	1.1	Vernon Creek Intake Screen	Hydraulic Control Facilities	1-5	$550,000
	1.2	Beaver Lake Tower Replacement	Hydraulic Control Facilities	1-5	$2,750,000
	1.3	Treatment Plant @ Eldorado Site (50 MLD)	Water Treatment	1-5	$80,000,000
	Sub-total				$83,300,000
2	**Beaver/Okanagan Distribution Upgrades**				
	2.1	OK Centre Small Diameter Upgrades - Phase 1	Pipelines	1-5	$2,354,000
	2.2	Carrs Landing Small Diameter Upgrades - Phase 1	Pipelines	1-5	$1,424,500
	2.3	Lakepine Connection to Beaver Lake System	Hydraulic Control Facilities	1-5	$632,500
	2.4	Carrs Landing Small Diameter Upgrades - Phase 2	Pipelines	1-5	$2,139,500
	2.5	OK Centre Small Diameter Upgrades - Phase 2	Pipelines	1-5	$1,562,000
	2.6	Kelowna Bulk Water Outlet	Pipelines	1-5	$1,100,000
	Sub-total				$9,212,500
3	**Kalamalka Water Quality and Supply**				
	3.1	Kalamalka Lake Intake	Hydraulic Control Facilities	1-5	$1,265,000
	3.2	Kalamalka Lake Treatment (12.5 MLD)	Water Treatment	6-10	$30,000,000
	Sub-total				$31,265,000
4	**Kalamalka System Distribution**				
	4.1	Irvine Booster Station	Hydraulic Control Facilities	1-5	$2,000,000
	4.2	Oyama Road and Isthmus Area Upgrades	Pipelines	6-10	$1,479,500
	4.3	Cornwall Road Improvements	Pipelines	6-10	$1,721,500
	4.4	Irvine Boosted Zone Watermains	Pipelines	11-20	$1,375,000
	Sub-total				$6,576,000
5	**Oyama System Separation**				
	5.1	Oyama Lake Reservoir	Water Storage	11-20	$1,842,500
	5.2	Irrigation and Domestic System Separation	Pipelines	11-20	$22,297,000
	Sub-total				$24,139,500
6	**Ongoing / Engineering**				
	6.1	Watermains - Upgrade and Replacement	Pipelines		$11,000,000
	6.2	Camp Road Operations Shop Expansion	Operations	1-5	$1,100,000
	Sub-total				$12,100,000
Total Water System Projects (2022 to 2040)					$166,593,000

URBAN SYSTEMS

District of Lake Country - Water Master Plan
Figure 6 - Development-Related Water System Expansion

LAKE COUNTRY
Life. The Okanagan Way.

A Ponderosa Drive - Watermain upgrades to support development
B Woodsdale-Oceola Loop - Watermain upgrades to support development
C Newene Road Extension - Watermain upgrade and extension to support development
D Jardine Booster Station - Increase capacity to support development
E Lakestone Development - New watermains to top of mountain
F Lakestone 655m Reservoir - New reservoir and mountain top
G Sage Glenn Extension - New watermain to lower elevation units in Lakestone
H Beaver Lake Extension - Higher pressure main from Dick Road to service McCoubrey Road/plateau
K Business Park/Northview - Improve fire protection flows and system pressure to support development
L Business Park Realignment - Relocate existing OK Centre Road West watermain

OK Lake
OK Lake
Camp Rd
Lakestone 655 Reservoir F
Lakestone Development E
K Business Park & Northview
L Business Park Realignment
Sage Glenn to Lakestone G
Beaver Lake Extension to McCoubrey Plateau H
Jardine Booster Station D
Lower Lakes
Woodsdale to Oceola Loop B
A Ponderosa Drive Improvements
Newene Road Extension C
Jim Bailey
Duck Lake 7
Wood Lake

Legend
- Reservoirs
- Pump and Booster Stations
- Municipal Boundary
- DLC Cadastral

Core Development Areas
- Chase
- Heritage Drive
- Lakestone Area
- Northview
- Ponderosa Road
- Woodsdale
- Woodsdale East

Core Retrofit Areas
- Kelvern Road
- Newene Road

Expanded Development Areas
- Business Park
- McCoubrey Road

- Development Projects
- Watermains
- Future Reservoir

1,000 500 0 1,000 2,000
Metres

URBAN SYSTEMS

10.0 FINANCIAL PLAN

A financial plan has been developed to support the implementation of this Water Master Plan.

The guiding principles for the financial plan are as follows:

- Ensure adequate funding is received to fund daily water operation, capital improvements, and capital renewal projects;
- Rely on senior government support for key water quality improvements;
- Ensure system expansion is paid for by the benefitting parties (Development or Local Service Area);
- Establish predicable rate increases that provide rate stability.

This financial plan considers not only the capital requirements for the upgrades presented but also the infrastructure renewal requirements to address existing infrastructure condition while maintaining or improving the level of service. A breakdown of the plan costs includes:

- Water Quality Improvements - $135 Million
- System Renewal - $24 Million
- Supply Enhancements - $8 Million

Further, the operating costs are adjusted based on the anticipated increased costs associated with expanded water treatment. For the Beaver Lake WTP it is assumed that two additional full-time operators will be required and an annual cost of $520,000 for power, heat, chemicals and spare parts. The Kalamalka plant is assumed to require 25% of the operating costs given that it is approximately 25% of the size.

As outlined, the Water Master Plan includes approximately $24 million of capital projects that will also result in renewal of existing infrastructure. The District has selected this level of investment in infrastructure renewal based on balancing the risks associated with infrastructure failure over the next 20 years with the ability of the District to raise rates to fund this renewal.

The District is moving towards sustainable financing of its water infrastructure, and has developed a Financial Strategy **(Appendix C)** to guide investments (capital and operating) over the next 20 years, provide a defensible plan for cost recovery, and outline an approach to achieving long term revenue stability.

To pay for these projects, the District has the following primary sources of revenues:

- Water rates paid by users;
- Grants provided by other levels of government;
- Local service area parcel taxes to pay for works that benefit a specific area;
- Funds paid by developers to cover their impacts on growth, primarily through Development Cost Charges, but also from other growth related charges such as up front developer contributions.

The District can also borrow money to pay for projects, but that borrowed money needs to be paid for by rates, parcel taxes, or development cost charges.

The financial analysis set out in **Appendix C** provides a number of options and the implications of each option. The financial plan is not a static document and each year the District will need to consider the available and projected finances to determine the timing for changes in water rates and the timing for projects. Under each option set out in **Appendix C** the District will need to increase rates in order to construct, operate, and maintain the water system components and achieve financial sustainability.

The model shows that the District has applied a realistic, yet conservative assumption for grants to fund overall water service delivery responsibilities. A 50% assistance is assumed for future water treatment and storage expansion, a 50% grant for system separation mains and a 25% grant for annual system improvements. The 50% grant amount reflects a realistic projection that, while some grants pay for 66% or even 73%, the District will only be successful for some projects or parts of projects.

The model allocates a portion of major projects to be paid for by growth through development cost charges. The Beaver Lake Water Treatment Plant and Beaver Lake Tower Replacement projects are allocated 42% to growth for recovery through DCCs; and the Kalamalka Lake Treatment Plant and intake are allocated 50% to growth for DCCs. The allocation is based on an estimate of who benefits and drives the demand for each project.

Development Cost Charges ensure that developers pay their fair share of the costs and ensure that growth pays for growth. Development cost charges can only be used to pay for the portions of new capital projects required for growth. For example, if a project is required 58% to serve the existing population and 42% to provide room for growth, then DCCs can be used to pay for the 42% required for growth. DCCs cannot be used to pay for replacement or renewal of aging infrastructure. They also can't be used to pay for any operations and maintenance costs, even if those costs are associated with growth. While a separate more detailed analysis will be required to calculate DCCs, the model indicates that significant increases will be required for DCCs in order to pay for the portions of major projects required to serve growth.

The risks inherent in this financial plan for the water system fall into four main categories. The first is maintaining filtration exemption for Okanagan Lake. The second is achieving the assumed growth rate and the third is whether grant funding will be made available as assumed. The final risk is whether the investment level in infrastructure renewal is sufficient to sustain the level of service objectives of the District. The District has assessed these risks and will monitor them with the intention of adjusting the plan further when or if it becomes necessary.

The financial recommendations based on the analysis are as follows:

- Chose an option and update the water rates as set out in the financial analysis in **Appendix C**.
- Monitor inflation and make regular inflationary changes to rates.
- Re-evaluate the 2025 and later rate increases based on IHA acceptance of a phasing plan for construction of the Beaver Lake Water Treatment Plant.
- Monitor actual capital costs and ongoing operations and maintenance costs and update the analysis every 5 to 10 years or if significant changes occur in costs.
- Conduct a detailed review and update the Water Development Cost Charges based on the capital projects and benefit allocations set out in the Water Master Plan.

11.0 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, this Water Master Plan provides a $167 million strategy that will allow the District of Lake Country to provide water that is sustainable and affordable for the community and environment. It will do so by achieving:

1. full compliance with existing Interior Health Authority policies by early 2030's (contingent on grants);
2. adequate capacity to meet the growth needs of the District; and
3. a consistent level of service to all existing customers.

This plan takes a proactive risk management approach to address the major sources of risk exposure:

Risk	Response
Climate Change	▪ Complete an Agricultural Use Plan to inform strategies for supporting the resiliency of this important industry ▪ Water conservation measures to reduce water use requirements, including encouraging use of on-site water efficiency techniques ▪ Updated hydrological assessments to be completed for sources and regular updating to the Water Shortage Response Plan ▪ Further advance the exploration of a water reuse strategy in collaboration with the liquid waste management activities ▪ Maintenance of all four sources in order to help mitigate future impacts of invasive species, wildfires, and other future climate driven events.
Infrastructure Failure	▪ Source redundancy improved ▪ In-system storage increased ▪ Distribution system redundancy increased ▪ Proactive infrastructure replacement
Changing Regulations and Water Quality	▪ Development of a Water Strategy for balancing multiple stakeholders' interests in flows in Middle Vernon Creek ▪ Provisions made to accommodate future filtration of Kalamalka Lake ▪ Development of a strategy for future filtration at Beaver Lake WTP of Okanagan Lake water ▪ Development of a strategy for future system separation for agricultural water for the Beaver Lake supplied customers
Changes to Growth and Development	▪ Works have been scheduled to allow flexibility

Risk	Response
	▪ Development of a strategy for future system separation for agricultural water for the Beaver Lake supplied customers
Inadequate Funds from Government Grants and Development Cost Charges	▪ Financial Plan has been prepared to assess the funding requirements ▪ Update rates and DCC Bylaw to reflect the recommendations of this Plan
Major Changes to the Watershed	▪ Protection Zones and Bylaws to be developed to increase intake protection ▪ Collaboration with other jurisdictions and stakeholders to be undertaken ▪ Beaver Lake Water Treatment Plant will provide buffer to water quality changes ▪ Increased depth of Kalamalka Lake Intake to provide increased protection ▪ Provision for Filtration Plant on Kalamalka to provide increased protection ▪ Strategy for Okanagan Lake Filtration Plan at Beaver Lake WTP to inform longer term potential risks ▪ Update Watershed Risk Assessments and Reduction Strategies

The Water Master Plan provides the following recommendations for the District of Lake Country:

1. Update and convert licence capacity to match long term use requirements.
2. Complete the Water Strategy and Use Plan for Middle Vernon Creek.
3. Review and update the hydrologic assessments, watershed risk reduction strategies and dam safety recommendations.
4. Complete an Agricultural Use Plan, in consultation with the agriculture community, that aligns with the Water Strategy and Use Plan for Middle Vernon Creek.
5. Advance water reuse strategies in collaboration with liquid waste management activities.
6. Maintain updated hydraulic models for the distribution system.
7. Complete rate updates and updating of the Development Cost Charge Bylaw to align with this Plan.
8. Complete a Water Conservation Plan and follow through on the recommendation of that plan.
9. Monitor and update this Plan every 5-10 years or as appropriate.
10. Update the OCP to align with the Water Master Plan.
11. Complete the protection zones and licence of occupation for the Kalamalka and Okanagan Lake Intakes.

12. Complete the Carr's Landing Water Servicing Strategy with Implementation Plan that considers infrastructure phasing and financial capacity to expand the water system.

13. Achieve filtration deferral on the Okanagan Lake source and complete a Source Protection Plan that incorporates a plan for future filtration at the Beaver Lake WTP.

14. Develop a long term system separation plan for Beaver Lake agricultural customers that is integrated with system renewal.

appendix a

TECHNICAL MEMOS

Title:	District of Lake Country - Water Master Plan Update – Design Criteria
Date:	April 08, 2022
File:	1577.0104.01 – R2
Revision:	5

The Water Master Plan Update will require analysis of the District of Lake Country (District) hydraulic water model. The existing conditions scenario of the hydraulic water model was updated in April 2019 to reflect current infrastructure and demands. This memo outlines the design criteria guiding the overall assessment of the District's water supply system. While the water model is not being updated as part of this Master Plan assessment these criteria can be used to update the model in a subsequent assignment in order to evaluate the impact on projects needed to support growth.

The District has noted previously that there are relatively recent watermains that are not shown in the current GIS dataset. Many of these watermains are a likely associated with smaller developments on the periphery of the water system. However, any recent upgrades (or abandoned pipes) along major distribution trunks should be incorporated into the existing and future conditions models prior to any future analysis work.

In general, levels of service are expected to remain unchanged from the 2012 Water Master Plan.

Existing Water Demands

The District provided SCADA data for the period of 2016 through 2019. 2019 was quite wet and was not included in the analysis below. The overall system demands for the four (4) major systems (Kalamalka, Oyama, Okanagan, Beaver) are summarized in Table 1 below.

Table 1 – Existing System Demands from SCADA

Demand Scenario	Unit	2016	2017	2018	Average
ADD	L/s	269	268	239	**258**
MDD	L/s	906	984	873	**921**
PHD	L/s	1,047	1,145	1,011	**1,068**
Ratio MDD:ADD	-	3.4	3.7	3.7	**3.6**
Ratio PHD:MDD	-	1.2	1.2	1.2	**1.2**

The District noted that there was an average of 2,600 acres of agricultural irrigation in production in all of its water systems, consuming between 1,600 and 2,000 cubic meters per acre per year.

An application rate of 508mm/year (20 inches) – which equates to 2,055 m3/year - will be utilized to estimate future demands for any additional agricultural use.

The annual consumption records for 2017 and 2018 estimate non-revenue water at 15% and 19% of average day demands respectively. A value of 20% will be used in the water models.

Urban Systems maintains two separate models for the District:

- Model #1 represents the combined Okanagan and Beaver Lake systems.
- Model #2 represents the combined Kalamalka Lake and Oyama Creek system.

Unit counts were updated in the models in 2019. Unit demands were adjusted in order to best match the overall SCADA records for the system flows during peak daily and peak hourly conditions. Tables 2a and 2b list the revised unit demands for the two models respectively.

Table 2a – Existing Water Demands
Okanagan and Beaver Lake Systems

Unit Demand Type	Unit Count	Unit Rate (L/s/unit)	System MDD (L/s)	Peaking Factor	System PHD (L/s)
Irrigated Hectares	655	0.59000 (1)	386.5	1.10	425.1
Metered Domestic – Indoors	10,669 (3)	0.00255 (2)	27.2	1.50	40.8
Metered Domestic – Outdoors	10,669 (3)	0.01019 (2)	108.7	1.50	163.1
Subtotal			**522**		**629**
Non-revenue water (20% of ADD)			32		32
Total			**555**	**1.20**	**661**
Average value from 2016-2018 SCADA data			555		665
Ratio between model & SCADA			99.9%		99.4%

(1) Set unit agricultural value to achieve good alignment under MDD conditions.

(2) 0.00255 + 0.01019 = 1100 L/capita/day, which correlates well with Q3 data (1125 L/c/d average for 2017/2018) for residential and seasonal irrigation

(3) Equivalent population: unit counts as provided by District in 2012 and subsequent growth estimates between 2012 and 2019. Includes CoK lands

Table 2b – Existing Water Demands
Kalamalka Lake and Oyama Creek Systems

Unit Demand Type	Unit Count	Unit Rate (L/s/unit)	System MDD (L/s)	Peaking Factor	System PHD (L/s)
Irrigated Hectares	411	0.79600 (1)	327.2	1.1	359.9
Metered Domestic – Indoors	1,543 (2)	0.00255	3.9	1.5	5.9
Metered Domestic – Outdoors	1,543 (2)	0.01019	15.7	1.5	23.6
Subtotal			**347**	**384**	**389**
Non-revenue water (20% of ADD)			19		19
Total			**366**	**1.10**	**408**
Average value from 2016-2018 SCADA data			366		402
Ratio between model and SCADA			100.0%		101.5%

(1) Set unit agricultural rate to achieve good alignment under MDD conditions.

(2) Equivalent population: 610 Single family units, 7 multifamily units and an average density of 2.5 persons/unit

Bylaw Design Criteria for Future Demands

Demands due to growth are set out in the District's Subdivision and Development Servicing Bylaw 985, 2016. Table 3 presents the bylaw demand criteria for domestic consumption.

Table 3 – Bylaw Domestic Demand Criteria

Demand Scenario	Unit	Value
Average Day Demand (ADD)	L/capita/day	900
MDD	L/capita/day	1,800
PHD	L/capita/day	4,000
Ratio MDD:ADD	-	2.0
Ratio PHD:MDD	-	2.2

Non-residential demands for industrial, commercial, and institutional (ICI) development are based on an equivalent population determined by the size of development multiplied by the values in Table 3. ICI densities are listed in Table 4 below.

Table 4 – Equivalent Populations for ICI Development

Development Type	Density (people/Ha)
Industrial	50
Institutional	50
Commercial	75

The District will continue to rely on the bylaw values from Tables 3 and 4 to guide water system design for new developments. For the Water Master Plan, however, the current usage recorded by the District's SCADA system (Tables 2a and 2b) will be applied to future growth to determine ultimate system demands.

Existing irrigation volumes varied between 1,600 and 2,000 cubic meters per acre in the 2016-2018 data. A District review of agricultural usage has led to a recommended average application of 20 inches/acre (508mm/acre, 2,055 m^3/acre or 5,080 m^3/hectare) to be used for all analyses in the Water Master Plan. The existing irrigation demands in the water model may need to be reviewed and adjusted.

The 2012 Water Master Plan assumed the District's water consumption would achieve a 25% water use efficiency reduction. Universal metering has since been completed and the 2012 approximate usage of 10,000 ML/day was reduced to 7,325 ML/day by 2018/2019, meeting the objectives of the 2012 WMP. Further reductions due to conservation are not currently forecast given their uncertainty.

The District has requested that 120 L/s be allocated for the ultimate buildout of the City of Kelowna lands. The current MDD estimate is 10 L/s to the City parcels.

Fire Flows

Fire flow for developments are governed by Fire Underwriters Survey (FUS) requirements and are reviewed on a case by case basis during the permitting stage. For the Water Master Plan, the District's minimum fire flow requirements based on land use/zoning will be used to determine system deficiencies and are shown in Table 5.

Table 5 – Required Fire Flow

Zoning	Status	Required Fire Flow	
		(L/s)	(L/min)
Residential – Single/two dwelling housing	Existing	60	3,600
Residential – Single/two dwelling housing	Future	83	5,000
Residential - Modular/mobile homes	Existing	60	3,600
Residential - Modular/mobile homes	Future	83	5,000
Residential - Threeplex/fourplex housing	Existing/Future	90	5,400
Residential - Apartments and row housing	Existing/Future	150	9,000
Commercial	Existing/Future	150	9,000
Institutional	Existing/Future	150	9,000
Industrial	Existing/Future	225	13,500

Supplemental to the values presented in Table 5, the design criteria presented in the Small Diameter Watermains and Lakestone Water Master Plan Integration reports shall remain in effect for those study areas.

Pressures

General system operation and PRV settings are not expected to change, however a cursory review of system pressures will form part of the hydraulic model analysis, typically under static and peak hour demand conditions. Table 6 outlines the District's criteria for pressures.

Table 6 – Pressure Constraints

Flow Condition	Pressure (kPa)	Pressure (psi)
Maximum static	827	120
Minimum static	275	40
Minimum residual – peak hour	250	35
Minimum residual – flow hydrant under MDD+FF	140	20

Growth Forecasts and Demands

The District provided approximate locations, unit counts and timing to reflect the growth anticipated across the municipality for the next 20 years.

The growth map has been attached for reference to this document. It is assumed that all retrofit areas identified on the map are already serviced by the community water system. In additional to the map, the District anticipates 9.5 ML/d (110 L/s) additional growth within the City of Kelowna parcels serviced by the Okanagan Lake system. All institutional, commercial and industrial lands are considered built-out within the District and as such, no additional growth in ICI demands have been forecast.

Table 7 provides a broad overview of the growth projections and the community water system that each area would be connected to.

Table 7 – Residential Growth Projections and Demands

Development	Probable Water Source	Estimated Units	Equivalent Population (1)	ADD (ML/d) (3)	MDD (ML/d) (2)
The Lakes	Okanagan/Beaver	150	375	0.15	0.41
Lakestone	Okanagan/Beaver	800	2000	0.81	2.20
Lots 61/62 Tyndall Road	Okanagan/Beaver	100	250	0.10	0.28
Lakestone – Floating phase	Okanagan/Beaver	150	375	0.15	0.41
Glenmore 3	Okanagan/Beaver	30	75	0.03	0.08
Chase Road	Okanagan/Beaver	20	50	0.02	0.06
Main Street	Okanagan/Beaver	450	1125	0.46	1.24
McCarthy North	Okanagan/Beaver	175	437.5	0.18	0.48
McCarthy South	Okanagan/Beaver	300	750	0.30	0.83
Copper Hill	Okanagan/Beaver	65	162.5	0.07	0.18
Woodsdale West	Okanagan/Beaver	550	1375	0.56	1.51
Woodsdale East	Okanagan/Beaver	150	375	0.15	0.41
Lodge Road South	Okanagan/Beaver	90	225	0.09	0.25
McCoubrey Plateau	Okanagan/Beaver	650	1625	0.66	1.79
Glenmore Industrial	Okanagan/Beaver	150	375	0.15	0.41
Carr's Landing – Lakepine	Okanagan/Beaver	113	282.5	0.11	0.31
Carr's Landing – Barkley	Okanagan/Beaver	25	62.5	0.03	0.07
Carr's Landing – Eastside	Okanagan/Beaver	146	365	0.15	0.40
Carr's Landing – Coral Beach	Okanagan/Beaver	80	200	0.08	0.22
Carr's Landing – Private	Okanagan/Beaver	75	187.5	0.08	0.21
Cornwall Road	Kalamalka	100	250	0.10	0.28
Oyama Isthmus	Kalamalka	300	750	0.30	0.83
Pelmewash Parkway – North	Kalamalka	50	125	0.05	0.14
Pelmewash Parkway – South	Okanagan/Beaver	50	125	0.05	0.14
	Total	**4,786**	**11,965**	**4.85**	**13.17**

(1) assumed density of 2.5 persons per unit

(2) residential demand rate of 1,100 L/capita/day applied based on SCADA data (same value as Tables 2a and 2b)

(3) residential demand rate of 405 L/capita/day applied based on SCADA data

The demands due to expansion of agricultural to full production have been based upon using an average measured application rate of 20 inches per acre per year as average day demand for lands currently not in production. Full allotment, an application of 30 inches/acre/year, will not be considered in the report. For maximum day demand estimates, the current application rate of 0.59 L/s/Ha (as determined by SCADA) has been used for the future growth lands as well. The irrigation rate for existing lands in production has not been increased from the currently observed rate, which is 30% below the 20 inches per year.

In November 2019, the District prepared an Agricultural Water Assessment report. Table 8 presents the current and potential agricultural production lands within the community.

Table 8 – Agriculture Potential

Water Source	Land in Production		Land not in Production		Total Land	
	Acre	Ha	Acre	Ha	Acre	Ha
Beaver/Okanagan	1,618	655	290	117	1,908	772
Oyama Creek	786	318	148	26	934	344
Kalamalka Lake	230	93	63	60	293	153
Total	**2,634**	**1,066**	**501**	**203**	**3,135**	**1,269**

Tables 9a and 9b show the anticipated growth in agricultural demand based on Table 8 land areas and the unit rates for the respective water sources.

Table 9a – Agriculture Potential – Average Day Demand (ADD)

Water Source	New Production Lands (Ha)	Unit Agricultural Rate		ADD (L/s)
		L/Ha/s	L/Ha/day	
Beaver/Okanagan	117	0.161 (1)	13,920	18.90
Oyama Creek	60	0.161 (1)	13,920	9.56
Kalamalka Lake	26	0.161 (1)	13,920	4.11
Total	**203**			**32.66**

(1) maximum 20" (0.508m) application per year = 2,055 m3/year

Table 9b – Agriculture Potential – Maximum Day Demand (MDD)

Water Source	New Production Lands (Ha)	Unit Agricultural Rate		MDD (L/s)
		L/Ha/s	L/Ha/day	
Beaver/Okanagan	117	0.590 (1)	51,000	69.24
Oyama Creek	60	0.590 (1)	51,000	35.34
Kalamalka Lake	26	0.590 (1)	51,000	15.04
Total	**203**			**119.62**

(1) recorded value from 2016-281 SCADA data

An estimate of ultimate demands for each combined system is presented in Table 10 and Table 11.

Table 10 – Ultimate Demands (ADD)

Development	Kalamalka/Oyama		Okanagan/Beaver		Total	
	ML/day	ML/year	ML/day	ML/year	ML/day	ML/year
Existing Waterworks	0.80	310	5.90	2,143	6.70	2,453
Existing Agriculture	5.70	2,094	5.30	1,952	11.00	4,046
Non-revenue Water	1.60	601	2.80	1,024	4.40	1,625
Total Existing ADD	**8.10**	**3,005**	**14.00**	**5,119**	**22.1**	**8,124**
Growth from Residential	0.46	168	4.38	1,597	4.83	1,767
Growth within CoK parcels	0	0	4.75	1,734	4.75	1,734
Growth from Agriculture	1.20	434	1.60	596	2.80	1,030
Ultimate Demand	**9.76**	**3,607**	**24.73**	**9,047**	**34.49**	**12,654**

Table 11 – Ultimate Demands (MDD)

Development	Kalamalka/Oyama		Okanagan/Beaver		Total	
	L/s	ML/day	L/s	ML/day	L/s	ML/day
Existing Waterworks	20	1.70	136	11.7	156	13.40
Existing Agriculture	327	28.30	386	33.40	714	61.70
Non-revenue Water	19	1.60	32	2.80	52	4.50
Total Existing MDD	**366**	**31.60**	**555**	**47.90**	**921**	**79.50**
Growth from Residential	14.3	1.24	138	11.89	152	13.12
Growth - CoK parcels	0	0	110	9.5	110	9.5
Growth from Agriculture	50	4.40	69	6.00	119	10.40
Ultimate Demand	**430**	**37.24**	**870**	**75.2**	**1,300**	**112**

Licensing

Table 12 summarizes the current licensing held by the District.

Table 12 – Water License Annual Flow Summary

	Kalamalka	Oyama	Okanagan	Beaver	Total
Existing Water License (ML)					
a. Irrigation	1,594	2,639	0	7,459	11,692
b. Water Works	124	1,252	10,997	1,204	13,577
c. Total	1,718	3,891	10,997	8,661	25,267
Water Availability					
a. Watershed Yield	1,718	4,400	10,997	9,868	
b. Fish Flows	0	0	0	1,750	
c. Estimate Operational Waste	0	480	0	617	
d. Total	1,718	3,920	10,997	7,501	24,136

Table 13 compares the estimated system demands due to growth and the maximum withdrawal rates from each source.

Table 13 – Water Works Projections (ML/day)

Flow Condition	Kalamalka	Oyama	Okanagan	Beaver	Total
Existing consumption (MDD)	0.90	0.80	7.80	4.00	13.50
Non-revenue Water	0.40	1.30	2.10	0.70	4.50
Development growth (residential)	1.24	0.00	4.72	7.17	13.12
City of Kelowna growth (ICI)	0	0	9.5	0	9.5
Ultimate demand (non-agricultural)	2.54	2.10	24.00	11.87	40.54
Water License Max. Day Withdrawal	**0.3**	**6.8**	**32.0**	**4.80**	**44.0**

As Table 10 shows, the total estimated waterworks requirement is 2,453 + 1,767 +1,734 + 1,625 (100% of NRW) = 7,578 ML/year, which can be accommodated by the current licensing. The future demands for the Kalamalka and Beaver Lake systems exceed their respective maximum day withdrawal rates and will require partial conversion of irrigation license to waterworks use.

Future Model Updates

The growth units form Tables 7 and 8 in the future should be added to the future conditions model per the general locations shown on the development map. Future demand in each area should be allocated evenly across all model nodes within the catchment.

Climate Change Impacts

The 2012 WMP included a 10% increase for demand growth due to climate change. Climate change impacts are difficult to predict and quantify. The District will actively measure and manage water use to adjust to future supply conditions and not build in an additional capacity.

Storage

Reservoirs are typically sized to include balancing, fire flow and emergency storage. Given that both the Okanagan/Beaver Lake and Kalamalka Lake/Oyama Creek systems are interconnected and have dual sources for supply, emergency storage is not expected to be a requirement and storage sizing will be predicated solely on fire flow and balancing needs. Emergency storage will only be required for satellite zones, such as the Lakes and Lakestone.

The treated water storage at the Eldorado site (Beaver Lake source) sustains flows during larger fire events. The Okanagan Lake reservoir is only sized for a maximum fire flow of 90 L/s under maximum day demand conditions. A PRV at the Glenmore Booster station allows supplemental water from the Beaver Lake system to enter the Okanagan Lake system.

A backup generator is present at the Kalamalka Lake intake and booster station, which can supplement flow from both the Irvine and Oyama reservoirs.

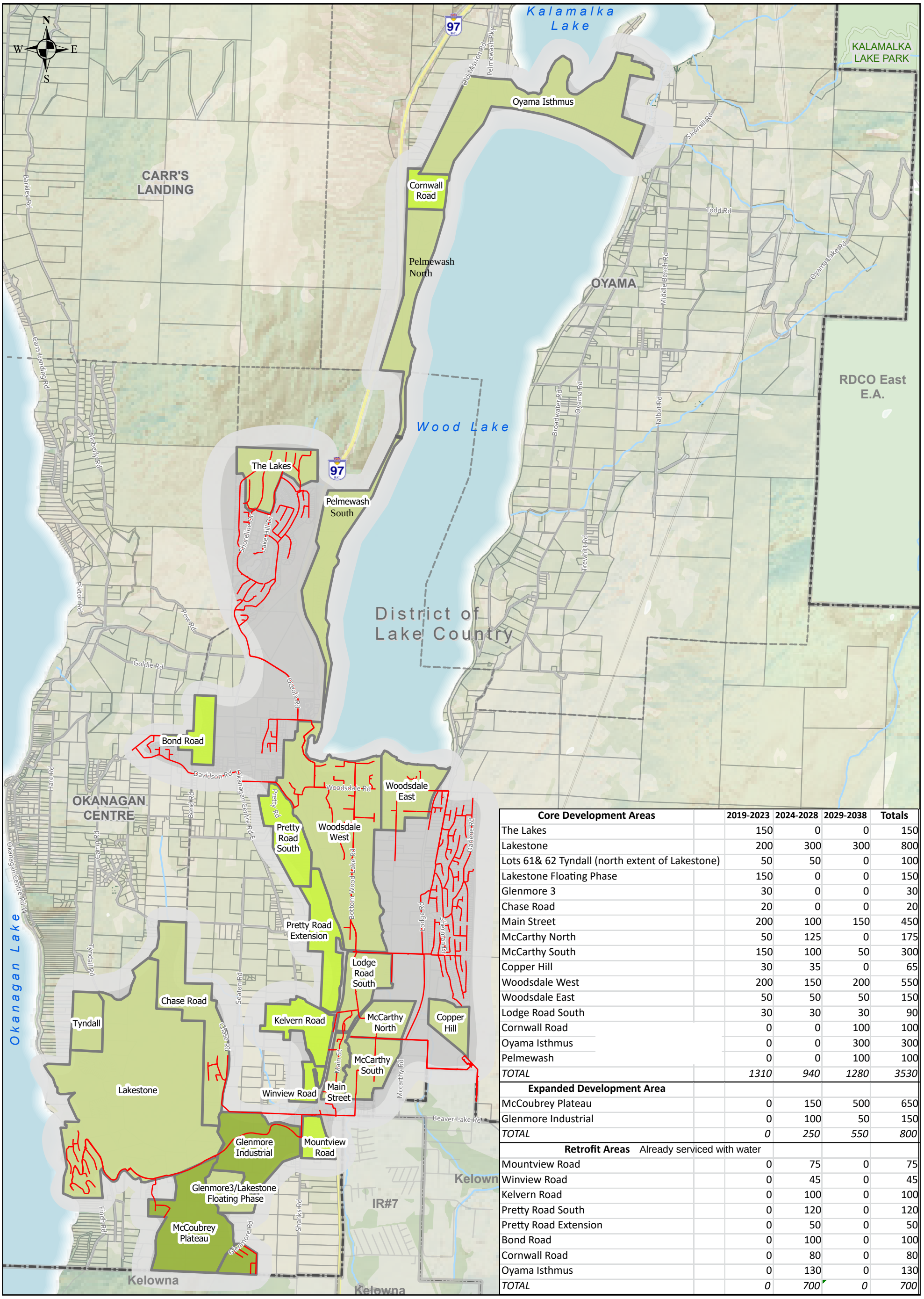
Sincerely,

URBAN SYSTEMS LTD.

Jason Barta
Municipal Infrastructure Analyst

Reviewed by;

Steve Brubacher,
Principal, Project Engineer



Core Development Areas		2019-2023	2024-2028	2029-2038	Totals
The Lakes		150	0	0	150
Lakestone		200	300	300	800
Lots 61& 62 Tyndall (north extent of Lakestone)		50	50	0	100
Lakestone Floating Phase		150	0	0	150
Glenmore 3		30	0	0	30
Chase Road		20	0	0	20
Main Street		200	100	150	450
McCarthy North		50	125	0	175
McCarthy South		150	100	50	300
Copper Hill		30	35	0	65
Woodsdale West		200	150	200	550
Woodsdale East		50	50	50	150
Lodge Road South		30	30	30	90
Cornwall Road		0	0	100	100
Oyama Isthmus		0	0	300	300
Pelmewash		0	0	100	100
TOTAL		*1310*	*940*	*1280*	*3530*
Expanded Development Area					
McCoubrey Plateau		0	150	500	650
Glenmore Industrial		0	100	50	150
TOTAL		*0*	*250*	*550*	*800*
Retrofit Areas	Already serviced with water				
Mountview Road		0	75	0	75
Winview Road		0	45	0	45
Kelvern Road		0	100	0	100
Pretty Road South		0	120	0	120
Pretty Road Extension		0	50	0	50
Bond Road		0	100	0	100
Cornwall Road		0	80	0	80
Oyama Isthmus		0	130	0	130
TOTAL		*0*	*700*	*0*	*700*

Sewer Area Boundaries and Growth Area Projections

Legend

- Collection System
- Area Type
- Core Development
- Core Retrofit
- Expanded Development
- Sanitary Service Area

LAKE COUNTRY
Life. The Okanagan Way.

Scale: 1:35,000

0 0.25 0.5 km

MEMORANDUM

DATE: September 10, 2021
TO: Kiel Wilkie (District of Lake Country)
CC: Greg Buchholz (District of Lake Country)
FROM: Steve Brubacher and Jason Barta
FILE: 1577.0104.01
SUBJECT: Kalamalka and Oyama Servicing Rev.2

1.0 INTRODUCTION

The purpose of this memorandum is to provide an updated analysis of the servicing approaches for the area serviced by the Kalamalka and Oyama water supplies. Both systems are comprised of agricultural and domestic customers. At the present time, the Kalamalka source has both chlorination and UV disinfection installed in order to treat viruses and bacteria while the Oyama supply only has chlorination installed. The two systems are interconnected such that water from the Kalamalka system can be pumped into the Oyama system through the Sawmill Booster Station. The Sawmill booster station capacity is 50 l/s with the largest pump out of service. This allows the Kalamalka system to supply the combined system demands outside of the agricultural irrigation season.

The District is interested in exploring a domestic customer separation strategy for Oyama so that Kalamalka water can be supplied to them year round and avoid the need for a water quality advisory and impacts associated with high turbidity. Fire flows are proposed to remain supplied from the irrigation system. Further the District recognizes that additional treatment may be an eventual requirement for either source. The risk requiring filtration for Kalamalka Lake is the potential presence of mussels or toxic algae while in Oyama it is the high turbidity events. By supplying all domestic water use from one source only a single treatment plant will be required. The preferred location for this treatment plant is Kalamalka Lake given the lower variability in water quality.

2.0 WATER DEMANDS AND SOURCE CAPACITY

The following table illustrates both the existing and anticipated growth in demand for each system.

	Existing		Future	
	Annual Demand (ML/year)	**Maximum Day Demand (ML/day)**	**Annual Demand (ML/year)**	**Maximum Day Demand (ML/day)**
Kalamalka	**788**	**7.7**	**1084**	**10.3**
-Kalamalka Waterworks	164	0.9	331	2.1
-Kalamalka Agriculture	474	6.4	604	7.7
-Kalamalka N.R.W.	150	0.4	150	0.4
Oyama	**2,217**	**23.9**	**2,521**	**27.0**
-Oyama Waterworks	146	0.8	146	0.8
-Oyama Agriculture	1,620	21.9	1,924	25.0
-Oyama N.R.W.	451	1.3	451	1.3

For comparison below are the Water Licenses and source water availability as estimated in the 2012 Master Plan.

	Kalamalka	Oyama
Existing Water License		
a. Irrigation	1,594 ML/year	2,639 ML/year
b. Water Works (Maximum day withdrawal)	124 ML/year (0.3 ML/day)	1,252 ML/year (6.8 ML/day)
c. Total	**1,718 ML/year**	**3,891 ML/year**
Water Availability		
a. Watershed Yield	1,718 ML/year	4,400 ML/year
b. Fish Flows	0 ML	0 ML
c. Est. Operational Waste	0 ML/year	480 ML/year
d. Total	**1,718 ML/year**	**3,920 ML/year**

The 2019 Oyama Watershed and System Hydrologic Assessment concluded that the system is marginally deficient in the 200 year time frame with projected climate change impacts in meeting a current annual demand of 2,188 ML/year. In drought years, it will be necessary to limit agricultural irrigation to align with source supply. As illustrated above, the District will need to partially convert some of the Kalamalka irrigation license to meet current and future waterworks needs.

3.0 SERVICING OPTIONS

In collaboration with the District we have reviewed a number of servicing options that build off of the work previously completed. The proposed servicing concept is illustrated in Figures 1 and 2. We have not modeled the domestic distribution network but rather assumed that a 100mm distribution line will be used in most locations since there are not any hydrants.

The Oyama system upgrades identified in the Small Diameter Watermains (SDWM) report did not address fire flow availability as the District was unsure of how the system would ultimately be operated at the time. The SDWM identified one viable watermain loop near Oyama and Broadwater Roads and provided costs for replacement of GI watermains and existing PRV stations.

Figure 1 shows the watermain upgrades necessary to provide the target fire flow of 83 L/s (5,000 L/min) to all parcels within the Oyama service area.

Below is a summary of the booster station performance parameters and reservoir storage assessment.

Sawmill Booster Station

- Required Design flow: 10.2 l/s with a balancing reservoir, OR
  14.8 to provide peak hour flows without a reservoir in place.
- Existing Installed Capacity: 50 l/s

Reservoir Storage Assessment

Reservoir Storage Requirements	Kalamalka (Irvine)	Oyama
	Volume	Volume
A. Fire Storage	83 L/s for 1.75 hrs = 525 m3	83 L/s for 1.75 hrs = 525 m^3
B. Peak Hour Balancing – 25% of MDD (non-agricultural demands only)	25% of 2.5 ML/day or 635 m3	25% of 2.1 ML/day or 515 m3
C. Emergency Storage – 25% of A+B	0 (1)	260 (2)
Total Required (m3)	1,160 m3	1,300 m3
Total Available (m3)	1,000 m3	1,500 m3

(1) emergency power available to run single duty pump at station

(2) Sawmill booster does not have backup power.

Based on the design criteria, the Kalamalka system is showing a storage deficiency. The backup generator at the Kalamalka pump station can allow 1-125 hp pump to run at 85 L/s. Under normal power conditions, the two duty pumps can provide 135 L/s of flow to the system, sufficient for the maximum day demand of 117 L/s, but not the peak hour demand of 177 L/s. The Sawmill PRV can supplement flow to the Kalamalka system, providing the shortfall in volume from the Oyama system. The storage capacity requirements in Kalamalka will need to be reviewed in further detail if and when the treatment plant advances or incorporated into the Irvine Booster station upgrade project.

There is sufficient storage at the existing Oyama reservoir to accommodate the domestic balancing at that location if one of the reservoir cells was dedicated to domestic storage and the other to raw water fire flow storage. However, to do so would require approximately 800 meters more dedicated supply main plus an additional 800 meters of distribution main back to Todd Road. The additional watermain requirements associated with consolidating all storage at the existing Oyama Reservoir site is estimated at $840,000 but does not include land acquisition or access road construction.

Alternatively, there is sufficient capacity in the Sawmill Booster Station such that peak hour demands can be met, but a generator would be required at the booster station to eliminate power failure impacts.

The costing in the next section has been presented based on two options (with and without a new reservoir and associated main).

4.0 CAPITAL COSTS

The capital costs for this servicing concept are summarized below. These are in 2021 dollars.

Description	Without New Balancing Reservoir	With New Balancing Reservoir
Fire Flow Upgrades	$6,108,000	$6,108,000
System Separation	$8,863,000	$8,863,000
Balancing Reservoir and Dedicated Supply Main	$0	$1,240,000
Subtotal	$14,971,000	$16,211,000
25% Contingency allowance	$3,743,000	$4,053,000
10%/15% Engineering allowance	$1,552,000	$1,676,000
Total	**$20,266,000**	**$21,940,000**

5.0 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, we have developed a servicing concept that will allow for the separation of the Oyama domestic demands from the irrigation demands. The concept will remove the need for a water quality advisory each spring and also centralize the need for treatment on the source with the most consistent water quality.

It is recommended that the District review the service concept presented as well as the financial viability to confirm the path forward. Once confirmed that if a new reservoir is determined to be the best solution, it is recommended that a balancing reservoir location be reviewed.

Finally, we recommend that the District develop a phasing plan.

Sincerely,
URBAN SYSTEMS LTD.

Jason Barta
Municipal Infrastructure Analyst

Steve Brubacher, P.Eng.
Principal

/sb
Enclosure

U:\Projects_KEL\1577\0104\01\R-Reports-Studies-Documents\R2-Tech Memos\2022-11-30 Oyama Kalamalka Technical Memo - Rev 2.docx

URBAN SYSTEMS MEMORANDUM

DATE: August 6, 2021
TO: Kiel Wilkie (District of Lake Country)
CC: Greg Buchholz (District of Lake Country)
FROM: Steve Brubacher and Jason Barta
FILE: 1577.0104.01
SUBJECT: Carrs Landing Servicing - Rev. 2

1.0 INTRODUCTION

The purpose of this memorandum is to provide an update to the Carrs Landing Water Servicing Review completed by Urban Systems in March 2020. The objectives of this review are to provide a cost-effective servicing strategy that can be phased. The Water Service Area map has been included in Appendix A illustrating the boundary for each system.

Service Area	Current Ownership and Operation
Lakepine	District of Lake Country
Barkley	Private (Individual Systems)
Eastside	Private (Operated by the Province of BC)
Coral Beach	District of Lake Country
Carrs Landing	Private (Individual Systems)

2.0 WATER DEMANDS

The water demands presented in the previous memo have been updated to reflect the overall updated Water Master Plan demand values based on District wide consumption trends. As these systems are integrated it will be important that leak detection be completed since some of the systems currently exceed these demand thresholds. No water is provided for agricultural use.

- Domestic Demands
    - Density of 2.5 people per dwelling unit
    - Max Day Demand of 1,100 litres/person/day
    - Peak Hour Demand of 1,650 litres/person/day (peaking factor of 1.5)
- Fire Flow = 83 l/s for a duration of 1.75 hours

Service Area	Existing parcel count within boundary	Full buildout (see note below)	Equivalent Population	Maximum Day Demand (l/s)	Peak Hour Demand (l/s)
Lakepine	113	226	565	7.2	10.8
Barkley	25	50	125	1.6	2.4
Eastside	146	292	730	9.3	14.0
Coral Beach	80	160	400	5.1	7.7
Carrs Landing	75	150	375	4.9	7.4
Total	**439**	**878**	**2,195**	**28.0**	**42.1**

The full buildout assumes a one single family dwelling per parcel as well as one secondary suite per parcel. This can be reviewed in further detail as part of design and oversizing considered at that time based on the timing for the anticipated growth.

3.0 SERVICING OPTIONS

In collaboration with the District we have reviewed a number of servicing options that build off of the work previously completed. It has been determined that while previously discounted, a servicing concept that extends the existing District water system along Carrs Landing Road is preferred. Due to the variation in elevations, there is the need to either install a booster station in order to supply water to the Lower Lakepine Reservoir or to install a 1.8 km dedicated high pressure main from the upstream side of the Goldie pressure reducing valve station to the Lower Lakepine Reservoir.

The booster station option (Option #1) will pump water from the Carrs Landing Road watermain to the Lower Lakepine Reservoir. The high pressure trunk option (Option #2) allows gravity flow into the Lower Lakepine Reservoir but requires an upgrade to the existing booster station suction side piping in order to maintain an adequate HGL for the existing booster.

Both options will ultimately require an upgrade of the existing Lower Lakepine Booster station from its current capacity of 6 L/s to 25 L/s.

The table below is a summary of the booster station performance parameters and reservoir storage assessment.

Option	Existing booster @ Lake	Carrs Landing Road booster	Lower Lakepine booster
#1	Decommission	30 L/s @ 90m TDH	25 L/s @ 77m TDH Maintain altitude valve
#2	Decommission	n/a	25 L/s @ 77m TDH. Maintain altitude valve

The proposed Carrs Landing Road booster can be constructed with a staged approach. Stage 1 includes 2 – 10 L/s pumps (one duty and one standby) sufficient to meet the needs of the Lakepine system, Stage 2 adds a third identical pump to meet the ultimate needs of the Lakepine and Carrs Landing expansion areas. Stage 2 will not include a fourth, backup pump as the District has advised that they will manage flows should operational issues occur with the booster station that takes one pump out of service.

The District has determined that the booster station (Option #1) is the preferred servicing approach since it allows the District to proceed with water quality and fire flow objectives in separate phases, thereby breaking capital expenditures into more manageable amounts per year.

From a distribution perspective a number of options have also been reviewed. Extending servicing to the remainder of the service area requires connection to the Upper Lakepine Reservoir HGL with eventual pressure reducing valves as the service extends north in order to fill the existing Eastside and Coral Beach Reservoirs.

The proposed servicing concepts are outlined in Figures 1-4. The phasing approach is assumed to generally occur from south to north.

Phase 1 involves supplying Beaver Lake source water to the Lakepine system. Fire flow availability along a portion of Carrs Landing Road is improved in Phase 1 under Option #2 since the high pressure supply trunk and Small Diameter Watermain upgrades will be installed in a common trench.

Phase 2 implements (Option #1) or augments (Option #2) the upgrades along Carrs Landing Road (Small Diameter Watermain upgrades) to increase fire flow availability to existing customers on Carrs Landing, Pixton and McCreight Roads as well as within the Lakepine System.

Phase 3 of the concepts expands the water system north of Lakepine to provide service to the remainder of the Carrs Landing area.

The existing Eastside (2), Lower Lakepine and Coral Beach Reservoirs are not adequately sized for fire storage and as such will only provide local peak hour balancing. As such the main from the Upper Lakepine Reservoir needs to be sized to convey fire flows all the way to the northern end of the system.

Reservoir Storage Assessment

Reservoir	Existing Volume (m3)	A (m3) Fire Flow	B (m3) Balancing	C (m3) Emergency	Required Volume (m3)	Has sufficient storage?
Upper Lakepine	962	525	234	190	948	Yes
Lower Lakepine	309	0	83	21	103	Yes
Eastside #1	153	0	60	15	75	Yes
Eastside #2	364	0	141	35	176	Yes
Coral Beach	89	0	110	28	138	**No**

The Coral Beach reservoir will be required to draw additional balancing volume from the Eastside #1 reservoir.

4.0 CAPITAL COSTS

The capital costs ($2020) for the servicing concepts have been broken down by phase as illustrated on Figures 1-4. A detailed breakdown is provided in **Appendix A**.

- Phase 1a – Connect Lakepine system to Beaver Lake Source Water
- Phase 2a – Small Diameter Watermain Upgrades
- Phase 2b – Lakepine Fire Flow Upgrades
- Phase 3 – Carrs Landing, Barkley, Eastside and Coral Beach

Phase	Description	Option #1	Option #2
1	Connect Lakepine system to Beaver Lake	$788,000	$1,793,000
2a	Small Diameter watermain Fire Flow upgrades	$2,018,000	$1,441,000
2b	Lakepine Fire Flow Upgrades	$700,000	$700,000
3	Expand system north	$11,727,000	$11,892,000
	Subtotal	$15,233,000	$15,826,000
	25% Contingency allowance	$3,808,000	$3,957,000
	10% (linear) / 15% (facilities) Engineering allowance	$1,642,000	$1,674,000
	Sub-Total	**$20,683,000**	**$21,457,000**
	Water Meters (Barkley, Eastside, Carrs Landing)	$246,000	$246,000
	Allotment Fees ($7,533 per property – Barkley, Eastside, Carrs Landing)	$1,853,000	$1,853,000
	Total	**$22,782,000**	**$23,556,000**

From a cost allocation perspective Phases 1 and 2 are part of the Small Diameter Mains upgrades and as such are recommended to be funded through the Water Utility Fund. Phase 3, the water meters, and the allotment fees are recommended to be apportioned to each system by the number of existing connections. The District may consider a latecomer type agreement in order to obtain cost participation from new connections and reduce the cost to existing customers. The following table summarizes the cost allotment to each system.

Service Area	Cost Allocation (Option 1)	Cost Allocation (Option 2)
Barkley	$1.434,000	$1,450,000
Eastside	$8,372,000	$8,468,000
Coral Beach	$3,905,000	$3,957,000
Carrs Landing	$4,301,000	$4,350,000

5.0 CONCLUSIONS AND RECOMMENDATIONS

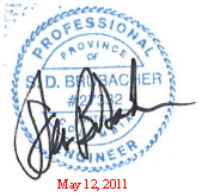
There are two potential servicing concepts that extend the water supply to the Carrs Landing area. Both conceptual options have similar capital costs. Option #1 will have higher annual operating and maintenance costs than Option #2 due to the lift required to pump water from Carrs Landing Road to the Upper Lakepine reservoir. However, Option #1 has a lower initial capital investment than Option #2 and may be the only feasible solution from a financial standpoint.

The pressure zones for the Carrs Landing expansion area are theoretical only and should be optimized at the detailed design stage.

It is also recommended that the District complete leak testing and condition investigation prior to interconnecting the existing private water systems in order to ensure that demands align with what has been projected.

Sincerely,

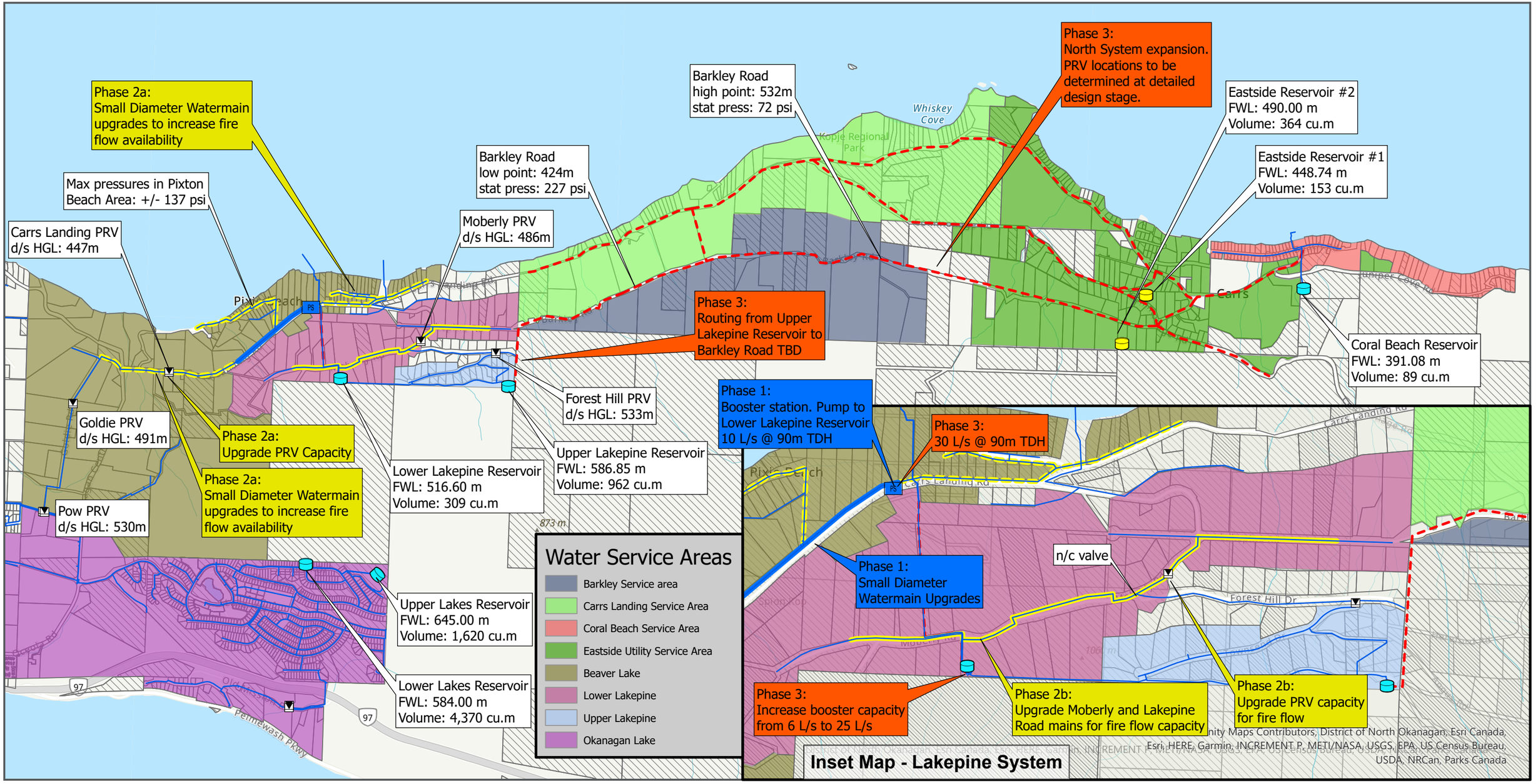
URBAN SYSTEMS LTD.



Jason Barta
Municipal Infrastructure Analyst
/sb
Enclosure

Steve Brubacher, P.Eng.
Principal

U:\Projects_KEL\1577\0104\01\R-Reports-Studies-Documents\R2-Tech Memos\2021-08-05 Carrs Landing Technical Memo - Rev 2.docx



URBAN systems

500 250 0 500 1,000
Metres

Coordinate System:

Scale: 1:25,000 (When plotted at 11"x17")

Data Sources:
- District of Lake Country OpenData

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

Project #: 1577.0104.01
Author: JB
Checked: SB
Status: Draft
Revision: A
Date: 2021 / 8 / 6

- Reservoirs
- Private Reservoirs
- PRVs
- Option 1 Booster
- Vacant Lands
- DLC Cadastral

- Existing Watermains
- Small Diameter Watermain Upgrades (Phase 1)
- Small Diameter Watermain Upgrades (Phase 2a)
- Lakepine Fire Flow Upgrades (Phase 2b)
- North Expansion WaterMains (Phase 3)

Notes

Phase 1 project note

Phase 2 project note

Phase 3 project note

LAKE COUNTRY
Life. The Okanagan Way.

District of Lake Country
Water Master Plan
FIGURE 1
Carr's Landing Water Improvements Option #1

U:\Projects_KEL\1577\0104\01\D-Design\GIS\Projects\Pro_Projects\CarrsLandingExpansion.aprx Last updated by jbarta on August 6, 2021 at 2:52 PM

Carr's Landing Water System Expansion
Option 1

Project:	1577.0104.01-D
Date:	Aug 05, 2021:
Created by:	J. Barta
Reviewed by:	S. Brubacher

PHASING PLAN

PHASE 1: (District Projects for Water Quality)

Construct 10 L/s booster station north of Pixton Road.
Decommission existing Lakepine booster at Okanagan Lake.
Upgrade 100mmØ Carrs Landing Road watermains per Small Diameter Watermains Report.

PHASE 2a: (District Projects for Fire Flow)

Upgrade Carrs Landing, Pixton & McCreight Road watermains per Small Diameter Watermains Report.
Replace Carrs Landing PRV station (capacity and bring above ground).

PHASE 2b: (District Projects for Fire Flow)

Upgrade Moberly and Lakepine Road (lower PZ) watermains
Replace Moberly PRV station (capacity and bring above ground).

PHASE 3: (Extend system to Carrs Landing/Eastside/Barkey/Coral Beach areas)

Upgrade Lower Lakepine Booster Station capacity from 6 L/s to 25 L/s.
Existing altitude valve (PRV) within Lower Lakepine booster to remain active
Construct new main (high pressure trunk) from Upper Lakepine reservoir to Lakepine Road.
Confirm high pressure trunk main routing at detailed design stage.
Confim need for dedicated supply main to Upper Lakepine Reservoir.
Extend High Pressure trunk from Lakepine Road to Coral Beach
Construct new distribution network and PRV's for pressure zones

GROWTH

2016-2019 SCADA data provides the following residential consumption information:
ADD: 405 L/capita/day
MDD: 1,100 L/capita/day

Service Area	Existing homes plus infill (max 1 SFE per lot)					Buildout assumes 1 SFE + 1 Sec. suite per lot				
	Lot Count	Equivalent Population	ADD ML/day	MDD ML/day	MDD L/s	Lot Count	Equivalent Population	ADD ML/day	MDD ML/day	MDD L/s
Lakepine	113	282.5	0.1	0.3	3.6	226	565	0.22	0.62	7.2
Barkley	25	62.5	0.0	0.1	0.8	50	125	0.06	0.14	1.6
Eastside	146	365	0.2	0.4	4.6	292	730	0.3	0.8	9.3
Coral Beach	80	200	0.1	0.2	2.5	160	400	0.16	0.44	5.1
Private	75	187.5	0.1	0.2	2.4	150	375	0.16	0.42	4.9
Total	**439**	**1097.5**	**0.5**	**1.2**	**14.0**	**878**	**2195**	**0.9**	**2.4**	**28.0**

LEGEND

150mmø Existing Main Diameter
200mmø Proposed Diameter/Phase
PRV
Pump Station
Existing Water System
Main to be abandoned
Phase 1 Upgrades
Phase 2 Upgrades
Phase 3 Upgrades

RESERVOIR STORAGE

S = A + B + C
A: 25% of MDD for balancing storage
B: Fire flow storage - 83 L/s for 1.75 hours
C: emergency storage - 25% of A + B

Reservoir	Volume	MDD (L/s)	Stores Fire Flow	FF Vol Req'd	Balancing Req'd	Emerg Req'd	Volume Required	Sufficient Storage?	Balancing provided for
Lakepine - Upper	962	10.82	Yes	525	234	190	948	Yes	Upper Lakepine, Carrs, Barkley
Lakepine - Lower	309	3.82	**No**	0	83	21	103	Yes	Lower Lakepine, Moberly LSA
Eastside Reservoir #1	153	2.79	**No**	0	60	15	75	Yes	Lower Eastside
Eastside Reservoir #2	364	6.51	**No**	0	141	35	176	Yes	Upper Eastside
Coral Beach	89	5.09	**No**	0	110	28	138	No	Coral Beach
Total	1877	29.03							

As the table above shows, the Coral beach reservoir is quite small and doesn't have sufficient balancing storage.
However, it should be possible to draw the additional peak flow from Eastside Reservoir #1 to the Coral Beach area

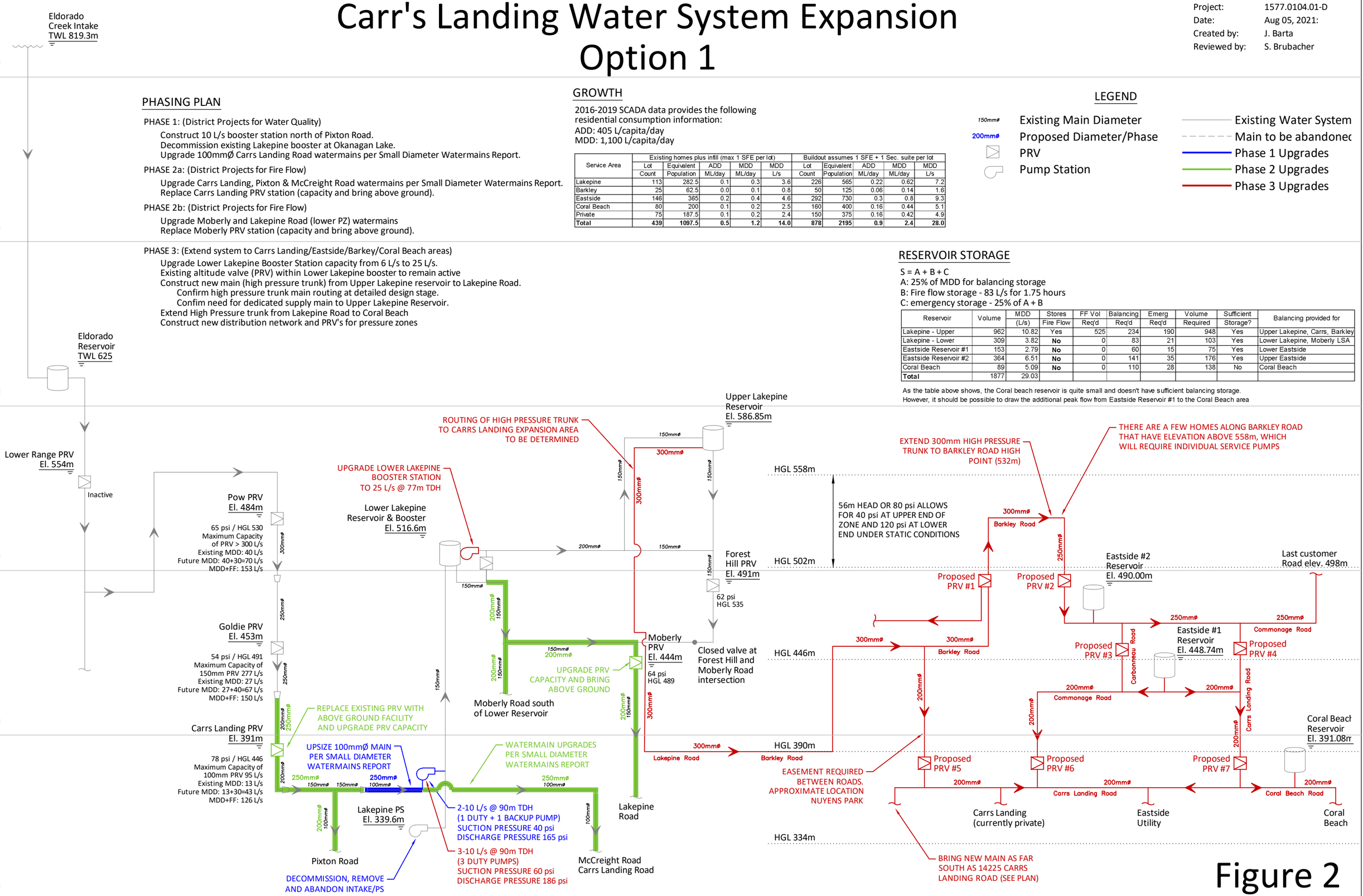


Figure 2

Phase 2a:
Remainder of Small Diameter Watermain upgrades to increase fire flow availability (Carrs Landing/McCreight/Pixton Roads)

Max pressures in Pixton Beach Area: +/- 137 psi

Phase 1:
300mm high pressure trunk and Small Diameter Upgrades along Carrs Landing Road in common trench

Carrs Landing PRV
d/s HGL: 447m

Moberly PRV
d/s HGL: 486m

Barkley Road
low point: 424m
stat press: 227 psi

Barkley Road
high point: 532m
stat press: 72 psi

Phase 3:
North System expansion.
PRV locations to be determined at detailed design stage.

Eastside Reservoir #2
FWL: 490.00 m
Volume: 364 cu.m

Eastside Reservoir #1
FWL: 448.74 m
Volume: 153 cu.m

Coral Beach Reservoir
FWL: 391.08 m
Volume: 89 cu.m

Phase 3:
Routing from Upper Lakepine Reservoir to Barkley Road TBD

Forest Hill PRV
d/s HGL: 533m

Upper Lakepine Reservoir
FWL: 586.85 m
Volume: 962 cu.m

Goldie PRV
d/s HGL: 491m

Phase 2a:
Upgrade PRV Capacity

Lower Lakepine Reservoir
FWL: 516.60 m
Volume: 309 cu.m

Phase 1:
High pressure trunk to tie in upstream of Goldie PRV

Pow PRV
d/s HGL: 530m

Upper Lakes Reservoir
FWL: 645.00 m
Volume: 1,620 cu.m

Lower Lakes Reservoir
FWL: 584.00 m
Volume: 4,370 cu.m

Water Service Areas
- Barkley Service area
- Carrs Landing Service Area
- Coral Beach Service Area
- Eastside Utility Service Area
- Beaver Lake
- Lower Lakepine
- Upper Lakepine
- Okanagan Lake

Phase 1:
High pressure trunk interconnect with Lakepine system

Phase 3:
Upgrade main to 250mm to maintain HGL for booster suction pressure

n/c valve

Phase 3:
Increase booster capacity from 6 L/s to 25 L/s

Phase 2b:
Upgrade Moberly and Lakepine Road mains for fire flow capacity

Phase 2b:
Upgrade PRV capacity for fire flow

Inset Map - Lakepine System

URBAN systems

500 250 0 500 1,000
Metres

Coordinate System:

Scale: 1:25,000
(When plotted at 11"x17")

Data Sources:
- District of Lake Country OpenData

Project #: 1577.0104.01
Author: JB
Checked: SB
Status: Draft
Revision: A
Date: 2021 / 8 / 6

- Reservoirs
- Private Reservoirs
- PRVs
- Vacant Lands
- DLC Cadastral
- Existing Watermains
- Lakepine Interconnect Upgrades (Phase 1)
- Small Diameter Watermain Upgrades (Phase 2a)
- Lakepine Fire Flow Upgrades (Phase 2b)
- North Expansion WaterMains (Phase 3)

Notes

Phase 1 project note

Phase 2 project note

Phase 3 project note

LAKE COUNTRY
Life. The Okanagan Way.

District of Lake Country
Water Master Plan
FIGURE 3
Carr's Landing Water Improvements Option #2

Carr's Landing Water System Expansion
Option 2

Project:	1577.0104.01-D
Date:	Aug 05, 2021:
Created by:	J. Barta
Reviewed by:	S. Brubacher

PHASING PLAN

PHASE 1: (District Projects for Water Quality)

Construct high pressure trunk - Goldie PRV to Lower Lakepine Reservoir.
Decommission existing Lakepine booster at Okanagan Lake.
Upgrade Carrs Landing Road watermains per Small Diameter Watermains Report.
High pressure trunk/SDW upgrades in common trench

PHASE 2a: (District Projects for Fire Flow)

Upgrade Pixton & McCreight Road watermains per Small Diameter Watermains Report.
Replace Carrs Landing PRV station (capacity and bring above ground).

PHASE 2b: (District Projects for Fire Flow)

Upgrade Moberly and Lakepine Road (lower PZ) watermains
Replace Moberly PRV station (capacity and bring above ground).

PHASE 3: (Extend system to Carrs Landing/Eastside/Barkey/Coral Beach areas)

Upgrade Lower Lakepine Booster Station capacity from 6 L/s to 25 L/s.
Upgrade suction side piping to maintain adequate pressure.
Existing altitude valve (PRV) within Lower Lakepine booster to remain active
Construct new main (high pressure trunk) from Upper Lakepine reservoir to Lakepine Road.
Confirm high pressure trunk main routing at detailed design stage.
Confim need for dedicated supply main to Upper Lakepine Reservoir.
Extend High Pressure trunk from Lakepine Road to Coral Beach
Construct new distribution network and PRV's for pressure zones

GROWTH

2016-2019 SCADA data provides the following residential consumption information:
ADD: 405 L/capita/day
MDD: 1,100 L/capita/day

Service Area	Existing homes plus infill (max 1 SFE per lot)					Buildout assumes 1 SFE + 1 Sec. suite per lot				
	Lot Count	Equivalent Population	ADD ML/day	MDD ML/day	MDD L/s	Lot Count	Equivalent Population	ADD ML/day	MDD ML/day	MDD L/s
Lakepine	113	282.5	0.1	0.3	3.6	226	565	0.22	0.62	7.2
Barkley	25	62.5	0.0	0.1	0.8	50	125	0.06	0.14	1.6
Eastside	146	365	0.2	0.4	4.6	292	730	0.3	0.8	9.3
Coral Beach	80	200	0.1	0.2	2.5	160	400	0.16	0.44	5.1
Private	75	187.5	0.1	0.2	2.4	150	375	0.16	0.42	4.9
Total	**439**	**1097.5**	**0.5**	**1.2**	**14.0**	**878**	**2195**	**0.9**	**2.4**	**28.0**

LEGEND

- 150mmø Existing Main Diameter
- 200mmø Proposed Diameter/Phase
- PRV
- Pump Station
- Existing Water System
- Main to be abandoned
- Phase 1 Upgrades
- Phase 2 Upgrades
- Phase 3 Upgrades

RESERVOIR STORAGE

S = A + B + C
A: 25% of MDD for balancing storage
B: Fire flow storage - 83 L/s for 1.75 hours
C: emergency storage - 25% of A + B

Reservoir	Volume	MDD (L/s)	Stores Fire Flow	FF Vol Req'd	Balancing Req'd	Emerg Req'd	Volume Required	Sufficient Storage?	Balancing provided for
Lakepine - Upper	962	10.82	Yes	525	234	190	948	Yes	Upper Lakepine, Carrs, Barkley
Lakepine - Lower	309	3.82	**No**	0	83	21	103	Yes	Lower Lakepine, Moberly LSA
Eastside Reservoir #1	153	2.79	**No**	0	60	15	75	Yes	Lower Eastside
Eastside Reservoir #2	364	6.51	**No**	0	141	35	176	Yes	Upper Eastside
Coral Beach	89	5.09	**No**	0	110	28	138	No	Coral Beach
Total	1877	29.03							

As the table above shows, the Coral beach reservoir is quite small and doesn't have sufficient balancing storage.
However, it should be possible to draw the additional peak flow from Eastside Reservoir #1 to the Coral Beach area

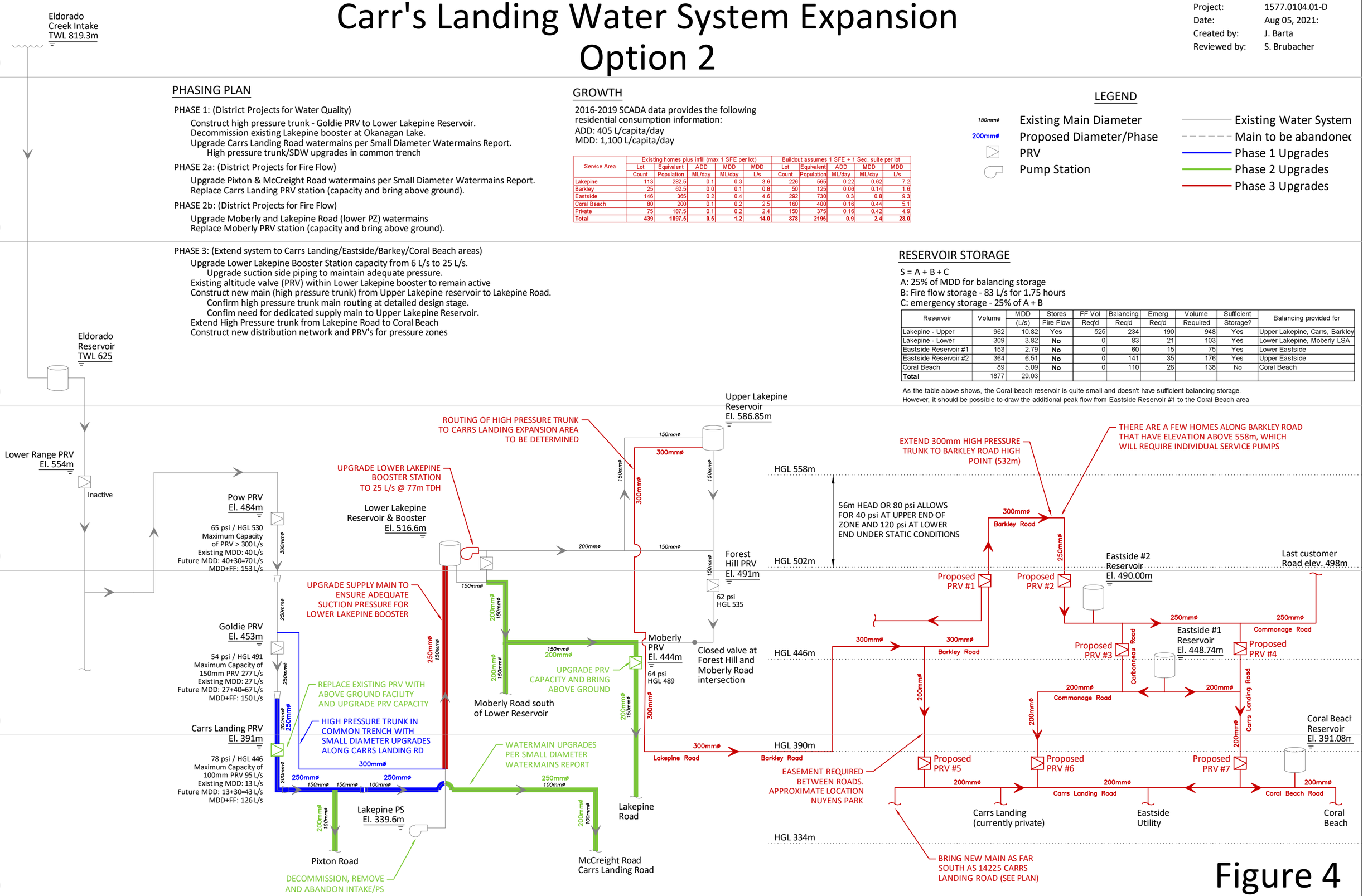


Figure 4

Carrs Landing Water Supply - Option #1 1577.0104.01D 05-Aug-21

Phase 1 - connect Lakepine system to Beaver Lake source water (New Booster Station)
Phase 2a - construct FF improvements (Small Diameter Watermains)
Phase 2b - construct FF improvements (Moberly Road/Lakepine System)
Phase 3 - extend water supply to Carrs Landing, Barkley, Commonage and Coral Beach Road areas

PHASE 1	Unit	Quantity	Unit Cost	Extension
Booster Station - 2-10 L/s @ 90m TDH	Hp	30	$12,000	$360,000
250mm PVC DR18 watermain (Small Diameter)	m	635	$595	$377,825
Decommission Lakepine booster (OK Lake)	LS	1	$50,000	$50,000
			Subtotal - Phase 1	**$788,000**
PHASE 2a	Unit	Quantity	Unit Cost	Extension
200mm PVC DR18 watermain (Small Diameter)	m	1775	$545	$967,375
250mm PVC DR18 watermain (Small Diameter)	m	1345	$595	$800,275
Carrs Landing PRV replacement	LS	1	$250,000	$250,000
			Subtotal - Phase 2a	**$2,018,000**
PHASE 2b	Unit	Quantity	Unit Cost	Extension
200mm PVC DR18 watermain (Moberly/Lakepine)	m	1010	$545	$550,450
Moberly PRV replacement	LS	1	$150,000	$150,000
			Subtotal - Phase 2b	**$700,000**
PHASE 3	Unit	Quantity	Unit Cost	Extension
200mm PVC DR18 watermain	m	11780	$545	$6,420,100
250mm PVC DR18 watermain	m	830	$595	$493,850
300mm PVC DR18 watermain	m	4960	$645	$3,199,200
Booster Station - Add third 10 L/s pump	Hp	15	$12,000	$180,000
Upgrade Lower Lakepine booster to 25 L/s	Hp	32	$12,000	$384,000
New PRV facility	LS	7	$150,000	$1,050,000
			Subtotal - Phase 3	**$11,727,000**
Summary				
			Subtotal - Option 1	**$15,233,000**
			Contingency (25%)	$3,808,000
			Engineering (10%/15%)	$1,642,000
			Total - Option 1	**$20,683,000**

10% Engineering allowance for linear infrastructure.
15% Engineering allowance for pump stations and PRV facilities.
Estimate does not include geotechnical testing, land acquisition costs or legal fees.
Unit costs for watermains includes an allowance for road restoration (asphalt, base and subbase courses)
Watermain unit costs assume 20% of trench excavation will encounter bedrock

New Booster Station suction and discharge pressures
Phase 1 prior to Small Diameter Watermain upgrades: 40 psi and 165 psi
Phase 2a after Small Diameter Watermain upgrades: 60 psi and 186 psi
Phase 1 design point: 10 L/s @ 90m TDH. 1 duty and 1 standby pump (80% efficiency)
Phase 2a design point: 30 L/s @ 90m TDH. 3 duty pumps (80% efficiency)
Phase 3 Lower Lakepine Booster Upgrade: 25 L/s @ 77m TDH, 2 duty pumps

Phase 3 cost estimate does not include allowance for dedicated supply main to Upper Lakepine Reservoir

Carrs Landing Water Supply - Option #2 1577.0104.01D 05-Aug-21

Phase 1 - connect Lakepine system to Beaver Lake source water (High Pressure Trunk)
Phase 2a - construct FF improvements (Small Diameter Watermains)
Phase 2b - construct FF improvements (Moberly Road/Lakepine System)
Phase 3 - extend water supply to Carrs Landing, Barkley, Commonage and Coral Beach Road areas

PHASE 1	Unit	Quantity	Unit Cost	Extension
250mm PVC DR18 watermain (Small Diameter)	m	970	$595	$577,150
250mm PVC DR18 watermain (High Pressure Trunk)	m	2070	$563	$1,165,410
Decommission Lakepine booster (OK Lake)	LS	1	$50,000	$50,000
			Subtotal - Phase 1	**$1,793,000**
PHASE 2a	Unit	Quantity	Unit Cost	Extension
200mm PVC DR18 watermain (Small Diameter)	m	1775	$545	$967,375
250mm PVC DR18 watermain (Small Diameter)	m	375	$595	$223,125
Carrs Landing PRV replacement	LS	1	$250,000	$250,000
			Subtotal - Phase 2	**$1,441,000**
PHASE 2b	Unit	Quantity	Unit Cost	Extension
Moberly PRV replacement	LS	1	$150,000	$150,000
200mm PVC DR18 watermain (Moberly/Lakepine)	m	1010	$545	$550,450
			Subtotal - Phase 2	**$700,000**
PHASE 3	Unit	Quantity	Unit Cost	Extension
200mm PVC DR18 watermain	m	11780	$545	$6,420,100
250mm PVC DR18 watermain	m	830	$595	$493,850
300mm PVC DR18 watermain	m	4960	$645	$3,199,200
Upgrade Lower Lakepine booster to 25 L/s	Hp	32	$12,000	$384,000
250mm PVC DR18 watermain (booster suction)	m	580	$595	$345,100
New PRV facility	LS	7	$150,000	$1,050,000
			Subtotal - Phase 3	**$11,892,000**
Summary				
			Subtotal - Option 2	**$15,826,000**
			Contingency (25%)	$3,957,000
			Engineering (10%/15%)	$1,674,000
			Total - Option 2	**$21,457,000**

10% Engineering allowance for linear infrastructure.
15% Engineering allowance for pump stations and PRV facilities.
Estimate does not include geotechnical testing, land acquisition costs or legal fees.
Unit costs for watermains includes an allowance for road restoration (asphalt, base and subbase courses)
Watermain unit costs assume 20% of trench excavation will encounter bedrock

Estimated maximum pressure along high pressure trunk is 190 psi.
High pressure trunk installed in common trench with Carrs Landing Road Small Diameter upgrades

Phase 3 booster station suction piping upgrade is required due to increased flows to accommodate Carrs Landing expansion. Upgrade is from high pressure trunk to suction side Lower Lakepine booster.

Phase 3 cost estimate does not include allowance for dedicated supply main to Upper Lakepine Reservoir

URBAN SYSTEMS MEMORANDUM

DATE: March 4, 2021
TO: Kiel Wilkie (District of Lake Country)
CC: Greg Buchholz (District of Lake Country)
FROM: Steve Brubacher and Jason Barta
FILE: 1577.0104.01
SUBJECT: 10th Street (Okanagan Centre Road W) Watermain Extension

1.0 INTRODUCTION

The District has requested that Urban System investigate the feasibility of extending the Okanagan Centre Road West watermain from its current terminus at 10th Street, further south to 15th Street, or beyond.

The analysis assumes that all upgrades noted in the Small Diameter Watermains Report (SDW, 2016) are included in the hydraulic model. Sizing will be based on future (2032) MDD plus fire flow conditions.

2.0 WATER DEMANDS

South of 10th street, the existing cadastral map shows very long and slender properties oriented perpendicular to the lake.

There are approximately 15 existing or potential units between 10th and 14th Streets. There are another 30 existing or potential units from 14th Street to the hairpin corner further south along the roadway.

The hairpin corner was chosen as the furthest possible limit for the watermain extension. Properties further south from the hairpin corner would more realistically be serviced from the Lakestone distribution network.

Based on a full buildout of all potential properties to the south – to a single family standard and density – the estimated MDD is approximately 3 L/s. This demand was added to the hydraulic model.

3.0 HYDRAULIC ANALYSIS

A variety of extension options were added to the hydraulic model and are shown in Figure 1. Fire flow availability was assessed at 14th Street (elevation 349 meters) and 9775 Okanagan Centre Road west (elevation 356 meters, last property on north side of hairpin corner). The analysis was reviewed under future MDD conditions.

3.1 OPTION 1 – 200MM WATERMAIN EXTENSION

The model estimates the available fire flow at 14th Street and 9775 to be 6,700 L/min and 3,800 L/min, respectively. The new watermain at both locations meets the minimum fire flow requirement for single family housing as set out in the District's Subdivision and Development Servicing (SDS) Bylaw.

3.2 OPTION 2- 250MM WATERMAIN EXTENSION

The model estimates the available fire flow at 14th Street and 9775 to be 10,200 L/min and 6,500 L/min, respectively. The new watermain between 10th and 14th Street meets the Okanagan Centre Area Target Fire Flow Rate of 10,000 L/min as set out in the Small Diameter Watermains Report. The new watermain south of 14th Street exceeds the SDS bylaw minimum for single family as well as the elevated residential fire flow target set out in the Small Diameter Watermains Report.

3.3 OPTION 3 – 250MM AND 200MM EXTENSION

A new 250mm watermain from 10th Street to 14th Street and a 200mm watermain from 14th Street to 9775 provides a minimum 10,200 L/min along the 250mm main and 4,300 L/min south of 14th Street.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Table 1 list key benefits and constraints of each of the presented options.

Table 1 – Options Analysis

	Option 1	Option 2	Option 3
Capital cost	Lowest	Highest	Middle
10th Street to 14th Street (project length approximately 700 meters)			
Meets SDS bylaw minimum fire flow requirements	Yes	Yes	Yes
Meets 5,000 L/min SDW Report FF requirements	Yes	Yes	Yes
Meets 10,000 L/min SDW Report FF requirements	No	Yes	Yes
South of 14th Street (project length approximately 1,300 meters)			
Meets SDS bylaw minimum fire flow requirements	Yes	Yes	Yes
Meets 5,000 L/min SDW Report FF requirements	No	Yes	No
Meets 10,000 L/min SDW Report FF requirements	No	No	No

The 10,000 L/min minimum fire flow target for the Okanagan Centre Area cannot be met south of 14th Street without additional upstream upgrades – above and beyond those identified in the Small Diameter Watermain Report.

The watermain extension should be reduced to 150mm diameter, south of the last fire hydrant installed as part of the project.

The watermain extension can only be interconnected to the Lakestone system with an additional PRV, likely near or south of the hairpin corner adjacent to 9775 Okanagan Centre Road West.

Sincerely,

URBAN SYSTEMS LTD.

Jason Barta
Municipal Infrastructure Analyst

Steve Brubacher, P.Eng.
Principal

/sb
Enclosure

U:\Projects_KEL\1577\0104\01\R-Reports-Studies-Documents\R2-Tech Memos\2021-03-04 10th Street Extension Technical Memo.docx

URBAN systems

200 100 0 200 400
Metres

Coordinate System: NAD 1983 UTM Zone 11N

Scale: 1:8,000 (When plotted at 11"x17")

Data Sources:

- Reservoirs
- Private Reservoirs
- Hydrants
- PRVs
- Vacant Lands
- Existing Watermains
- Small Diameter - 200mm
- Small Diameter - 250mm
- Small Diameter - 300mm
- Extension - 10th St to 14th St
- Extension - South of 14th Street

Notes

Option 1:
200mm extension 10th Street to 9775

Option 2:
250mm extension 10th Street to 9775

Option 3:
250mm extension 10th Street to 14th Street
200mm extension 14th Street to 9775

Project #: 1577.0104.01
Author: JB
Checked: SB
Status: Draft
Revision: A
Date: 2021 / 3 / 4

LAKE COUNTRY
Life. The Okanagan Way.

District of Lake Country
Water Master Plan
FIGURE 1
10th Street Watermain Extension Options

U:\Projects_KEL\1577\0104\01\D-Design\GIS\Projects\Pro_Projects\CarrsLandingExpansion.aprx Last updated by jbarta on March 4, 2021 at 5:52 PM

URBAN SYSTEMS

January 27, 2022 File: 1577.0104.01

District of Lake Country
10150 Bottom Lake Road
Lake Country, BC V4V 2M1

Attention: Kiel Wilkie, AScT

RE: Okanagan Lake Supply Expansion R2

As communicated, the District has asked for the analysis of an alternative servicing concept based on removing dependence on the Beaver Lake source and instead feeding those demands from an expanded license from Okanagan Lake (assuming such a license can be secured). It is envisioned that this supply concept will include:

- A new intake, chlorination facility, and pump station to convey Okanagan Lake Water to the Eldorado Reservoir site (assumed in close proximity to the existing facility)
- A new UV disinfection at the Eldorado Reservoir site prior to discharge into the treated water storage
- A new ~6.0 km dedicated main to the Eldorado Reservoir

Below is a summary of the annual water demands and Water Licenses:

Beaver Lake Licenses -Agriculture -Waterworks **-Total**	 7,459 ML/year 1,204 ML/year **8,663 ML/year**
Okanagan Lake Licenses -Agriculture -Waterworks **-Total**	 0 ML/year 10,997 ML/year **10,997 ML/year**
Okanagan Demands -Existing Demands (Ag) - Existing Demands (Waterworks) - Non Revenue Water -Demand Growth (Ag) - Demand Growth (Waterworks) - Demand Growth (Kelowna Supply – Waterworks) -**Total Demands**	 98 ML/year 1,429 ML/year 768 ML/year 0 ML/year 634 ML/year 1420 ML/year **4,348 ML/year**
Beaver Lake Demands -Existing Demands (Ag) - Existing Demands (Waterworks) - Non Revenue Water -Demand Growth (Ag) - Demand Growth (Waterworks) -**Total Demands**	 1,854 ML/year 733 ML/year 256 ML/year 596 ML/year 963 ML/year **4,402 ML/year**

As illustrated if all demands were to be shifted to Okanagan Lake there will be a surplus Waterworks license and a deficiency of Agriculture Water license.

In order to convey all of current demands met by Beaver Lake, the Okanagan Lake system will need to be expanded by 50 ML/day. Note that 50 ML/day represents the (existing and growth allowance) maximum day demand scenario for the customers supplied from Beaver Lake and is not based on the annual average demands presented in the table above. This capacity assumes that the Glenmore Interconnect pump station that conveys water from the existing Okanagan Lake fed system to the Beaver Lake System remains for emergency use only.

The estimated capital cost for the improvements needed to convey this flow from Okanagan Lake is $44,230,000 including a 25% allowance for contingency and 10-15% for engineering but excluding, borrowing or land acquisition costs. This is broken down in the table below and the pumping and pipeline costs are based on the unit rates in the Water Master Plan.

Cost Estimate	**Quantity**	**Unit**	**Unit Rate**	**Extension**
Intake	1	LS	$ 3,000,000	$ 3,000,000
Pump Station	3970	HP	$ 5,180	$ 20,550,000
Pipeline (600mm)	6000	m	$ 1,780	$ 10,680,000
UV (50 ML/day)	1	LS	$ 10,000,000	$ 10,000,000
			Total	**$ 44,230,000**

As a comparison the capital cost for the Beaver Lake source WTP is $47,600,000. On an operating cost basis the pumping and UV electricity cost from Okanagan Lake is estimated at $0.4 Million per year in the first year and increasing to $0.55 Million per year by year 20 (based on $0.10/kWh) while the operating cost for the WTP is estimated at $0.55 Million in the initial year and rising to $0.86 Million by year 20 based on an assumed average cost of $0.20/$m^3$ (based on Peachland's operating costs). The 20 year capital plus operating costs assuming a 0% discount rate (inflation=interest) is $62 Million for the Beaver WTP and $54 Million (plus land acquisition) for the expanded Okanagan Lake Supply.

The cost for the Okanagan Lake supply assumes filtration exemption is maintained. In the event that filtration is needed on Okanagan Lake then a filtration plant cost will need to be added.

A multiple account evaluation of the two source options is outlined below:

	Beaver WTP	**Okanagan Lake Source Expansion**
Regulatory Risks	Filtration exemption not available No license conversion required Risk of impacts to DFO/MoE orders for Lower Vernon Creek base flows	Expanded reliance on filtration exemption License conversion required for agriculture use

	Beaver WTP	**Okanagan Lake Source Expansion**
		Eliminates supply risks with upper watershed
Source Redundancy	Two separate sources maintained	One source is lost
Water Quality Risks	Risks impacted by upland watershed but filtration barrier provided	Risks impacted by Okanagan Lake watershed and no filtration barrier provided. Filtration may be required at a later date.
Operational Level of Complexity	Higher	Lower
Capital Cost	$47.6 Million	$44.3 Million + Land Acquisition
20 Year Total Capital + Operating	$62 Million	$54 Million + Land Acquisition

As illustrated the costs of both options are within the same order of magnitude and provide a different risk profile for each. The largest risk with increased reliance on Okanagan Lake is the ability to maintain a filtration exemption otherwise the treatment costs will also be required for this supply option. The largest risk for the Beaver Lake Supply is the Lower Vernon Creek environmental flow needs and the potential risks associated with land slides, wild fires and climate change in the watershed.

Sincerely,

URBAN SYSTEMS LTD.

Steve Brubacher, P.Eng.
Principal
U:\Projects_KEL\1577\0104\01\A-Administration\Work Plan\2021-11-26 OK Lake Expansion Scope R1.docx

appendix b

UNIT COSTS

LAKE COUNTRY WATER MASTER PLAN WATER PIPE COST PER METRE (0-2m depth) DERIVATION

ASSUMPTIONS: 4 of trench in asphalt

Item	Description	Unit	150mm to 400mm Distribution Quantity	Unit Price	Total	200mm to 600mm Transmission Quantity	Unit Price	Total	100mm to 200mm Domestic Only Quantity	Unit Price	Total
A.	**SITE PREPARATION**										
1.01	Aspalt milling	lin.m.	1	15.00	$15.00	1	15.00	$15.00	1	15.00	$15.00
1.02	Disposal of Unsuitable and Import (allowance)	cu.m.	0	50.00	$0.00	0	50.00	$0.00	0	50.00	$0.00
1.03	Rock excavation (20%)	lin.m.	0.20	150.00	$30.00	0.20	150.00	$30.00	0.20	150.00	$30.00
1.04	Traffic control	lin.m.	1.00	15.00	$15.00	1.00	15.00	$15.00	1.00	15.00	$15.00
	SUBTOTAL - SECTION A				**$60**			**$60**			**$60**
B.	**ROAD WORK RESTORATION**										
2.01	Granular subbase (350mm depth)	sq.m.	4.0	15.00	$60.00	4.0	15.00	$60.00	4.0	15.00	$60.00
2.02	Granular base (100mm depth)	sq.m.	4.0	10.00	$40.00	4.0	10.00	$40.00	4.0	10.00	$40.00
2.03	Asphalt (75mm)	sq.m.	4.0	25.00	$100.00	4.0	25.00	$100.00	4.0	25.00	$100.00
	SUBTOTAL - SECTION B				**$200**			**$200**			**$200**
C.	**WATER WORKS**										
3.01	Tie-in complete (1 per 400m distribution 1 per 1000m transmission)	ea.	0.0025	5,000.00	$12.50	0.001	5,000.00	$5.00	0.0025	5,000.00	$12.50
3.02	Air/Vacuum Valve (1 per 500m)	ea.	0.002	2,500.00	0.002	0.002	2,500.00	$5.00	0.002	2,500.00	$5.00
3.03	Hydrants (1 per 150m)	ea.	0.007	6,500.00	$43.33	0.007	6,500.00	$43.33	0.000	6,500.00	$0.00
3.04	Service Connection (1 per 50m)	ea.	0.02	1,500.00	$30.00	0	1,500.00	$0.00	0.02	1,500.00	$30.00
	SUBTOTAL - SECTION C				**$86**			**$53**			**$48**
	SUMMARY				**$345.84**			**$313.33**			**$307.50**

		Distribution						Transmission							Domestic Only		
Pipe Size (mm)		150	200	250	300	350	400	200	250	300	350	400	500	600	100	150	200
Pipe Cost (native fill)		**$150.00**	**$200.00**	**$250.00**	**$300.00**	**$350.00**	**$400.00**	**$200.00**	**$250.00**	**$300.00**	**$350.00**	**$400.00**	**$550.00**	**$ 700.00**	**$125.00**	**$ 150.00**	**$ 200.00**
Extra Costs		$345.84	$345.84	$345.84	$345.84	$345.84	$345.84	$313.33	$313.33	$313.33	$313.33	$313.33	$313.33	$313.33	$307.50	$307.50	$307.50
Subtotal		$495.84	$545.84	$595.84	$645.84	$695.84	$745.84	$513.33	$563.33	$613.33	$663.33	$713.33	$863.33	$1,013.33	$432.50	$457.50	$507.50
Contingency (25%)		$123.96	$136.46	$148.96	$161.46	$173.96	$186.46	$128.33	$140.83	$153.33	$165.83	$178.33	$215.83	$253.33	$108.13	$114.38	$126.88
Engineering (10%)		$61.98	$68.23	$74.48	$80.73	$86.98	$93.23	$64.17	$70.42	$76.67	$82.92	$89.17	$107.92	$126.67	$54.06	$57.19	$63.44
TOTAL UNIT COST		**$680.00**	**$750.00**	**$820.00**	**$890.00**	**$960.00**	**$1,030.00**	**$710.00**	**$770.00**	**$840.00**	**$910.00**	**$980.00**	**$1,190.00**	**$1,390.00**	**$590.00**	**$630.00**	**$700.00**
PRV Stations	100-150mm in Above Ground Chamber with 50mm Bypass	200mm in Above Ground Chamber with 50mm Bypass	**Pump Stations**	0-25 HP Total Installed	25-75 HP Total Installed	75-150HP Total Installed	150-400HP Total Installed	400-500HP Total Installed	500HP+ Total Installed	**Reservoirs**	0-1000 m3	1000-2000 m3	2000-3000 m3	3000-4000 m3	4000+m3		
Capital Cost	**$150,000**	**$250,000**	Capital Cost	**$16,000**	**$12,000**	**$8,000**	**$6,000**	**$4,800**	**$3,600**	Capital Cost	**$1,440**	**$1,280**	**$1,120**	**$880**	**$560**		
Contingency (25%)	$37,500	$62,500	Contingency (25%)	$4,000	$3,000	$2,000	$1,500	$1,200	$900	Contingency (25%)	$360.00	$320.00	$280.00	$220.00	$140.00		
Engineering (15%)	$28,125	$46,875	Engineering (15%)	$3,000	$2,250	$1,500	$1,125	$900	$675	Engineering (10%)	$180.00	$160.00	$140.00	$110.00	$70.00		
TOTAL UNIT COST	**$215,630**	**$359,380**	**TOTAL UNIT COST**	**$23,000**	**$17,250**	**$11,500**	**$8,630**	**$6,900**	**$5,180**	**TOTAL UNIT COST**	**$1,980**	**$1,760**	**$1,540**	**$1,210**	**$770**		

Note:

Land Costs excluded

All unit costs are suitable for community wide master planning and overall utility funding. Contingency allowances may need to be increased as projects are brought forward individuallly.

appendix C

FINANCIAL PLAN

URBAN SYSTEMS MEMORANDUM

DATE: February 3, 2023
TO: Kiel Wilke, District of Lake Country
CC: Steve Brubacher, Urban Systems
FROM: Joel Short, Urban Systems
FILE: 1577.0104.01
SUBJECT: Financial Strategy

1.0 INTRODUCTION

This memo sets out the increases in water rates in order to set the stage for financial sustainability in meeting directions in the Water Master Plan. There are some key initiatives required to implement the Water Master Plan and the District should continue on the path of increasing rates to ensure that it is moving in the direction needed to generate the revenues required to pay for the improvements and continued sustainable service delivery.

2.0 MAJOR PROJECTS AND COSTS

We conducted a financial analysis that assumes specific capital projects will be required and that the major projects such as the Beaver Lake Water Treatment plant and Kalamalka Lake Treatment will receive grants to pay for a significant portion of the projects. We also assumed that operating and maintenance cost will be increasing with the addition of new components.

The specific projects included in the financial analysis are set out in table 2.1 below:

Table 2.1 - Major Water Project Timing and Costs

Project Title	**Water System**	**Year**	**Cost** (Before grants)
Long Term Projects			
Annual System Improvements (Beyond Small Diam)	Any	ongoing	$11,000,000
Treatment Facilities			
Beaver Lake WTP (50MLD)	Beaver	2026	$80,000,000
Kalamalka Lake Treatment (12.5MLD)	Kalamalka/ Oyama	2030	$30,000,000
Major Capital Projects			
Irvine Booster Station	Kalamalka	2022/2023	$2,000,000
Vernon Creek Intake Screen	Beaver	2023	$550,000
Carrs Landing Small Diameter Upgrades Phase 1	Beaver	2025	$1,424,500
Beaver Lake Tower Replacement	Beaver	2024	$2,750,000
Camp Road Operations Shop Expansion	Beaver/Okanagan	2025	$1,100,000
Okanagan Centre SD - Phase 1	Beaver	2022/2023	$2,354,000

Project Title	Water System	Year	Cost (Before grants)
Kalamalka Lake Intake	Kalamalka	2025	$1,265,000
Kelowna Bulk Water Outlet	Beaver/Okanagan	2024	$1,100,000
Lakepine Connection to Beaver System	Beaver	2026	$632,500
Carrs Landing Small Diameter Upgrades Phase 2	Beaver	2026	$2,139,500
Okanagan Centre SD - Phase 2	Beaver	2027	$1,562,000
Oyama Road and Isthmus Area Upgrades	Kalamalka	2028	$1,479,500
Cornwall Road Improvements	Kalamalka	2031	$1,721,500
Oyama System Separation - Reservoir	Oyama	2034	$1,842,500
Oyama System Separation - Watermains	Oyama	2035	$22,297,000
Irvine Boosted Zone Watermains	Kalamalka	2038	$1,375,000
Capital Program Total			$166,593,000

The project year identified in Table 2.1 is for analysis purposes only and will be subject to change as analyzed through the annual budgeting process. Each year the District will need to make decisions on the appropriate timing for various projects.

Grants are assumed for a few projects:

- Annual System Improvements (Beyond Small Diameter) – 25% grant
- Beaver Lake WTP (50MLD) – 50% grant
- Kalamalka Lake Treatment (12.5MLD) – 50% grant
- Oyama System Separation – Reservoir – 50% grant
- Oyama System Separation – Watermains – 50% grant

The 50% grant amount reflects a realistic projection that, while some grants pay for 66% or even 73%, the District will only be successful for some projects or parts of projects. The 50% funding amount for large projects was chosen as a conservative estimate. For all other projects we assumed that the District would need to pay for the projects directly without any grants.

The model assumes that the District will need to borrow money for the following large projects:

- Beaver Lake WTP (50MLD) in 2026
- Kalamalka Lake Treatment (12.5MLD) in 2030
- Oyama System Separation – Watermains in 2035

In order to sustain the long term health of the water reserve funds (and depending on the funding scenario chosen), the model also assumes that funds may need to be borrowed due to the timing and cost of the following projects:

- Carrs Landing Small Diameter Upgrades Phase 2 in 2026
- Okanagan Centre SD – Phase 2 in 2027

For these Okanagan Centre and Carrs Landing projects, the use of reserve funds, internal municipal borrowing, or external borrowing will need to be evaluated at the time of the expense.

Borrowing is assumed through the Municipal Finance Authority at 4.61% over 20 years (the MFA rate when preparing this memo). The borrowing rate will need to be monitored as rate changes will impact finances.

The model assumes that the Beaver Lake Water Treatment Plant is constructed as one large project, but the finances could be improved if the Interior Health Authority (IHA) accepted a phasing plan for construction of the Beaver Lake Water Treatment Plant. This would allow the District to spread the costs over a longer time period providing more time to generate and recover funds.

The model assumes that Development Cost Charges (DCCs) are collected to pay for a portion of some projects and the funds come from the DCC reserve fund. The projects are required partially to serve new growth and the percentages allocated to growth are as follows:

- Beaver Lake WTP (50MLD) – 42% of costs attributed to growth - for recovery by DCCs
- Beaver Lake Tower Replacement – 42% of costs attributed to growth - for recovery by DCCs
- Kalamalka Lake Treatment (12.5MLD) – 50% of costs attributed to growth - for recovery by DCCs
- Kalamalka Lake Intake - 50% of costs attributed to growth - for recovery by DCCs

The model assumes that the benefit allocation is applied to the entire cost of the project, before applying grants, because the Ministry will not allow unconfirmed grants to be included in calculating DCCs. As noted below, the District will need to update the water DCCs based on the new Water Master Plan. If the District receives grants for DCC projects, then the grant amount will need to be considered in relation to the DCC change and determine if DCC charges need to be recalculated.

Another cost that is included in the analysis is for asset renewal for the water treatment plants – about half the plant cost is recovered at 2% per year (this assumes an average 50-year life for some components) and half at 1% per year (this assumes an average 100-year life for some other components) with collection starting once the project is constructed.

Operations and maintenance costs are assumed to increase for the new treatment plants as set out in the table below.

Table 2.2 – Operations and Maintenance costs for New Treatment Plants

Beaver Lake WTP (50MLD)	
• Power/Heat	$250,000
• Chemicals	$240,000
• Parts	$30,000
• Staff – 2x FTE	$240,000
Kalamalka Lake Treatment (13.5MLD)	
• Power/Heat (25% of Beaver Lake)	$62,500
• Chemicals (25% of Beaver Lake)	$60,000
• Parts (25% of Beaver Lake)	$7,500
• Staff (25% of Beaver Lake)	$60,000

The District will need to monitor these costs and may need to make adjustments to cost recovery as the actual costs are determined.

Regular operations and maintenance costs are based on 2022 costs for Salaries, wages, and benefits; Contract services; Materials and supplies; Utilities; Interest expense; and Administration, plus an estimated 10% increase for 2023.

Costs and revenues for the Coral Beach System are excluded from this analysis and will need to be analyzed as part of the ongoing Carr's Landing expansion. Costs and revenues for the Lakepine system are included, as this system will be integrated with the overall system in the long term.

3.0 INCREASES IN WATER RATES

The increases in water rates are set out in the following scenarios:

1. Scenario 1: Significant initial increase in 2023 followed by another increase in 2025 with another potential increase in 2029. Inflation is not factored into this scenario and would need to be considered with each subsequent rate adjustment.
2. Scenario 2: A significant initial increase in 2023 followed by another increase in 2025 with another potential increase in 2029, including assumed inflationary values listed below.
3. Scenario 3a: Equal increases spread over 5 years that includes assumed inflationary values listed below.
4. Scenario 3b: Increases spread over 5 years, but with higher increases early in order to reduce negative impact on reserve funds. Includes assumed inflationary values listed below.

To illustrate changes with inflation added under Scenario 2, 3a and 3b, the increases are shown with assumed inflation amounts added. The District will need to monitor inflation and add the actual inflation amounts to the rates. In all scenarios, the rates have been established in order to meet a goal of generating approximately 40% of the revenue from variable rates (per cubic metre of consumption) and 60% of the revenue from fixed base rates.

For illustrative purposes, the assumed inflation rates are as follows:

- 2023: inflation 5%
- 2024: inflation 3%
- 2025: inflation 2%
- 2026: inflation 2%
- 2027 onwards: inflation 2%

The water rates under **Scenario 1**, without inflation, are set out in table 3.1 below

Table 3.1 – Scenario 1 - Water Rates Without Inflation

Category	Rate in 2022	2023	2025
Rate per cubic metre of consumption	$ 0.86	$1.12	$1.29
Single Detached Residential base rate	$ 468	$565	$630
Multifamily Residential base rate	$ 374.40	$455	$510
Commercial – Varies depending on connection size (percentage increase shown)		21%	12%
Seasonal Irrigation	$ 150	$185	$210
Agricultural Charge per Acre	$ 125	$145	$165
Non Connected charges	$ 100	$240	$270
Percentage increase over previous year (average)*		**22.9%**	**12.9%**

*except Non Connected charges, which had a higher increase from 2022 to 2023

Under Scenario 1 the rates are increased in 2023 with another increase in 2025. The initial increase in rates of about 23% in 2023 help to generate funds required for major projects starting in 2024 and 2025. The approximately 13% rate increase in 2025 is required to generate more funding for upcoming projects. Under Scenario 1 another increase of about 3% is required in 2029.

The water rate increases under **Scenario 2**, including inflation, are set out in Table 3.2 below.

Table 3.2 – Scenario 2 - Water Rates Including Assumed Inflation

Category	Rate in 2022	2023	2025	2027
Rate per cubic metre of consumption	$ 0.86	$1.18	$1.42	$1.48
Single Detached Residential base rate	$ 468	$593	$695	$723
Multifamily Residential base rate	$ 374.40	$478	$563	$585
Commercial – Varies depending on connection size (percentage increase shown)		27.1%	14.2%	4%
Seasonal Irrigation	$ 150	$194	$232	$241
Agricultural Charge per Acre	$ 125	$152	$182	$189
Non Connected charges	$ 100	$240	$298	$310
Percentage increase over previous year (average)*		**29.3%**	**15.2%**	**4%**

*except Non Connected charges, which had a higher increase from 2022 to 2023

Scenario 2 is similar to Scenario 1 except that it includes assumed inflation. The rates are increased in 2023 and 2025. The initial increase in rates of about 29% in 2023 cover recent inflation and help to generate funds required for major projects starting in 2024. The approximately 15% rate increase in 2025 is required to generate more funding for upcoming projects with inflation. Under Scenario 2, another rate increase of about 10% is required in 2029.

The water rate increases under **Scenario 3a** are set out in Table 3.3 below.

Table 3.3 – Scenario 3a - Water Rates Including Assumed Inflation

Category	Rate in 2022	2023	2024	2025	2026	2027
Rate per cubic metre of consumption	$ 0.86	$0.98	$1.13	$1.29	$1.42	$1.56
Single Detached Residential base rate	$ 468	$511	$558	$610	$670	$737
Multifamily Residential base rate	$ 374.40	$408	$446	$488	$536	$590
Commercial – Varies depending on connection size (percentage increase shown)		9.1%	9.3%	9.2%	10.0%	10.0%
Seasonal Irrigation	$ 150	$164	$179	$195	$215	$236
Agricultural Charge per Acre	$ 125	$131	$143	$156	$172	$189
Non Connected charges	$ 100	$240	$275	$301	$331	$364
Percentage increase over previous year (average)*		**10.0%**	**10.0%**	**10.0%**	**10.0%**	**10.0%**

*except Non Connected charges, which had a higher increase from 2022 to 2023

Under Scenario 3a there are 5 equal 10% rate increases spread over 5 years, including assumed inflation. The rates need to continue upwards towards 2027 in Scenario 3a because the rates need to make up for the lower rates in 2023 and the gradual phase-in. Aside from regular inflationary increases, no additional jumps in rates are required in 2029. While the average rate increase is 10%, the increases for consumption are higher than the increases to the base rates in order to keep the 40/60 split for consumption vs base rates.

The water rate increases under **Scenario 3b** are set out in Table 3.4 below.

Table 3.4 – Scenario 3b - Water Rates Including Assumed Inflation

Category	Rate in 2022	2023	2024	2025	2026	2027
Rate per cubic metre of consumption	$ 0.86	$1.03	$1.19	$1.36	$1.49	$1.59
Single Detached Residential base rate	$ 468	$531	$590	$650	$703	$739
Multifamily Residential base rate	$ 374.40	$425	$472	$520	$563	$591
Commercial – Varies depending on connection size (percentage increase shown)		13.4%	11.2%	10.2%	8.1%	5.1%
Seasonal Irrigation	$ 150	$170	$189	$208	$225	$237
Agricultural Charge per Acre	$ 125	$136	$151	$167	$180	$189
Non Connected charges	$ 100	$240	$280	$309	$334	$351
Percentage increase over previous year (average)*		**14.5%**	**11.8%**	**10.7%**	**8.4%**	**5.2%**

*except Non Connected charges, which had a higher increase from 2022 to 2023

Under Scenario 3b the rate increases are spread over 5 years and include inflation. The increase is somewhat higher in the earlier years in order to reduce the negative impact on the reserve funds while addressing the higher assumed rate of inflation in the earlier years. The rates need to continue upwards towards 2027 in Scenario 3b because the rates need to make up for the lower rates in 2023 and the gradual phase-in. Aside from regular inflationary increases, no additional jumps in rates are required in 2029.

The growth in users on the system combined with the increases in rates help to generate the revenue to pay for the system if the assumed grants and DCC revenues are available.

4.0 INCREASES IN REVENUES

Another way to view the increases is to consider the overall percentage increase in annual revenues. In order to pay for the capital projects required along with the increases in operations and maintenance costs, the District will need to generate additional revenues on an annual basis. The amounts of revenues required under each scenario are set out in the Tables 3.5 to 3.8 below for Scenarios 1, 2, 3a, and 3b, along with the percentage changes in revenues.

Table 3.5 – Scenario 1 - Required Increases in Revenues – Without Inflation

Year	Funding From Rates	% Increase in Revenues
2022	$4.6M	4.5% (Complete)
2023	$5.68M	23.4%
2025	$6.79M	19.5%
2029	$7.53M	10.9%

Table 3.6 – Scenario 2 - Required Increases in Revenues - Including Assumed Inflation

Year	Funding From Rates	% Increase in Revenues
2022	$4.6M	4.5% (Complete)
2023	$5.96M	29.6%
2025	$7.49M	25.6%
2029	$8.99M	20.0%

Table 3.7 – Scenario 3a - Required Increases in Revenues - Including Assumed Inflation

Year	Funding From Rates	% Increase in Revenues
2022	$4.6M	4.5% (Complete)
2023	$5.09M	10.6%
2024	$5.81M	14.2%
2025	$6.64M	14.2%
2026	$7.43M	11.9%
2027	$8.35M	12.3%

Table 3.8 – Scenario 3b - Required Increases in Revenues - Including Assumed Inflation

Year	Funding From Rates	% Increase in Revenues
2022	$4.6M	4.5% (Complete)
2023	$5.30M	15.1%
2024	$6.14M	15.9%
2025	$7.05M	14.8%
2026	$7.81M	10.9%
2027	$8.41M	7.7%

In Scenario 3a and 3b only inflationary amounts are required after 2027, and the revenues required in 2029 are about $9M.

Because of the projected increase in the number of connections, the rates noted in tables 3.1, 3.2, 3.3 and 3.4 further above do not need to increase quite as much as the required increase in revenues shown in tables 3.5, 3.6. 3.7 and 3.8.

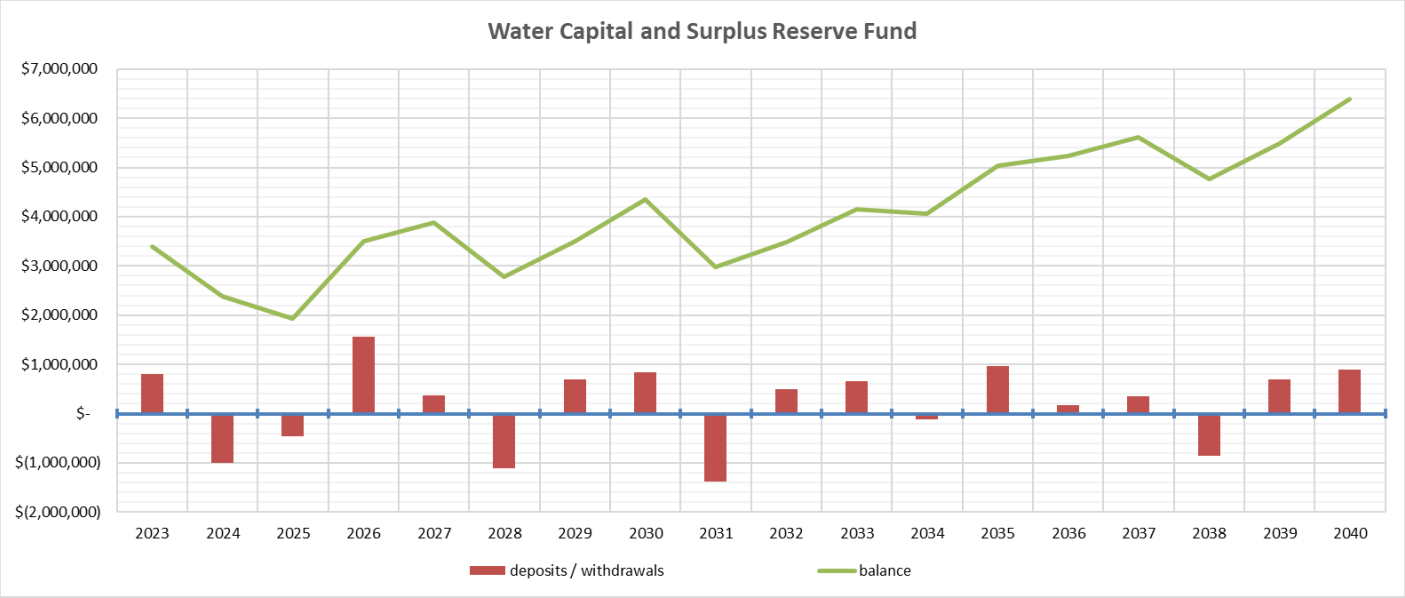
Under the current capital plan and model, the analysis indicates that further rate increases will not be required in the future beyond 2029, other than increases to keep up with inflation. The revenue generated compared to the costs incurred should be regularly monitored to ensure that increases to account for inflation are actually generating the revenues required. Furthermore, the District may need to re-evaluate the later rate increases based on IHA acceptance of a phasing plan for construction of the Beaver Lake Water Treatment Plant.

5.0 RESERVE FUND BALANCES

These rate increases aim to maintain a positive balance in the Water Capital Reserve Fund and the Water Surplus Reserve Fund combined.

The resulting reserve fund balances under **Scenario 1** are shown in the following chart. The reserve fund balance ranges between about $2M and $5M until 2035.

Scenario 1 Reserve Fund Balances

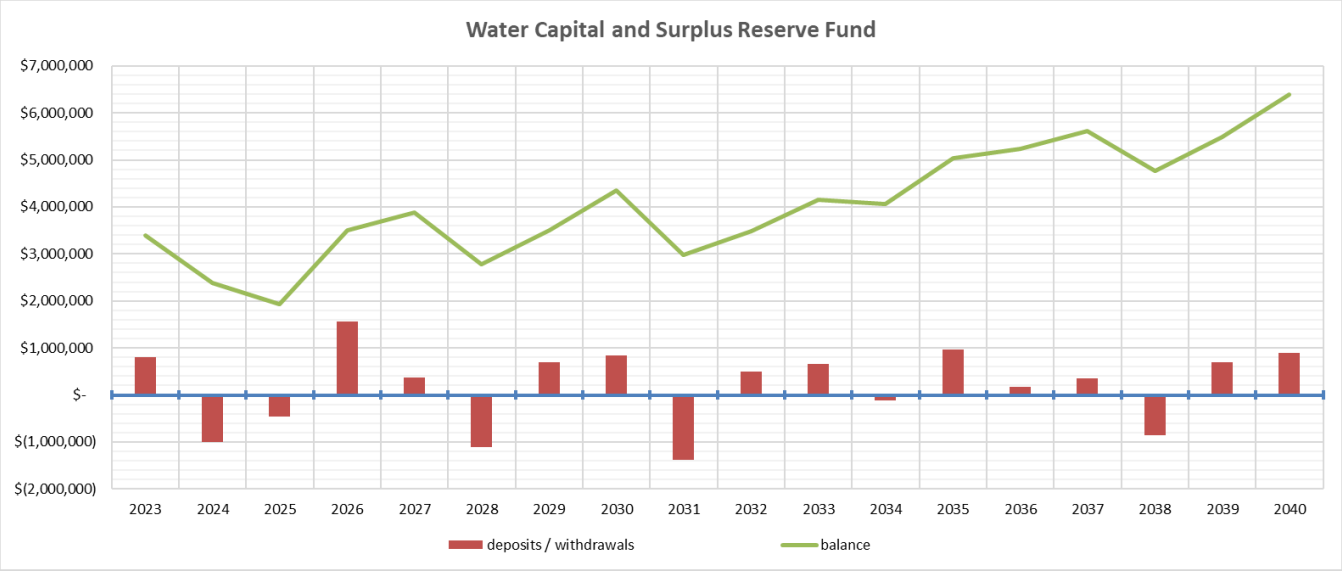


The reserve fund is drawn down to a level of about $2M in 2025 because of the projects required in both 2024 and 2025. After 2025 the reserve fund recovers until more significant expenditures in 2028, but still remains positive.

The reserve fund balances are shown in 2022 dollars and the balances for Scenario 1 and Scenario 2 are virtually the same since Scenarios 1 and 2 are the same except that Scenario 2 includes inflation for costs and revenues. Since both the costs and the revenues are inflated by the same percentage the impact on the reserve fund for Scenarios 1 and 2 are similar. However, if in Scenario 1 the costs were inflated, but the water rates were not inflated, the reserve fund would quickly run into a deficit.

The resulting reserve fund balances under **Scenario 2** are shown in the following chart. The reserve fund balance generally ranges between about $2M and $5M until 2035.

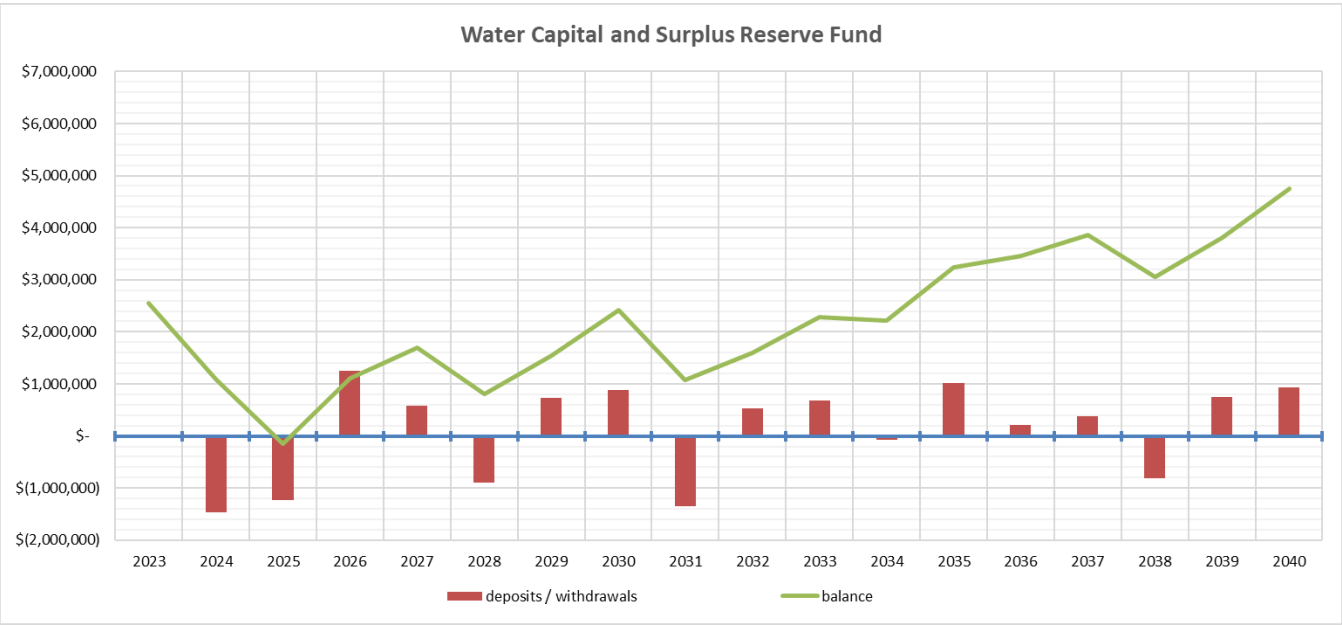
Scenario 2 Reserve Fund Balances



Similar to Scenario 1, the reserve fund is drawn down to a level of about $2M in 2025 because of the projects required in both 2024 and 2025. After 2025 the reserve fund recovers until more significant expenditures in 2028, but still remains positive.

The resulting reserve fund balances under **Scenario 3a** are shown in the next chart. The reserve fund balance ranges between about negative $145,000 and positive $3M until 2035, and generally fits in the $1M to $2M range from 2026 until about 2034.

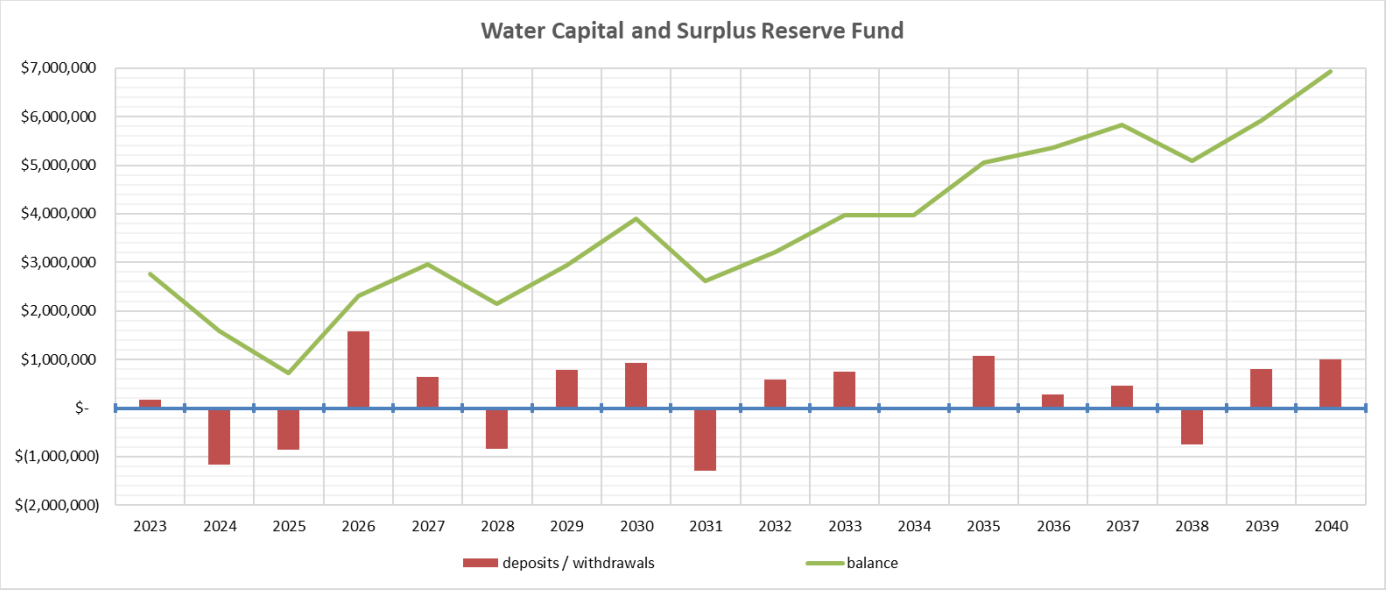
Scenario 3a Reserve Fund Balances



Scenario 3a, with the equal increase in rates over 5 years, results in a negative reserve fund balance in 2025. This is because of significant projects required in 2024 and 2025. While the fund goes negative it gradually recovers as the rates are increased every year over the 5 years.

The resulting reserve fund balances under **Scenario 3b** are shown in the next chart. The reserve fund balance ranges between a low of about $725,000 and $4M until about 2034.

Scenario 3b Reserve Fund Balances



Scenario 3b, with the gradual increase in rates over 5 years and with higher increases early in the 5 year period, sees the reserve fund dip but still stay positive at $725,000 in 2025. The dip is because of significant projects required in 2024 and 2025. Scenarios 1 and 2 have less of a dip in the reserve funds by having a more significant increase in the rates in 2023. Compared to Scenario 2, Scenario 3b reaches about the same point in reserve fund balances by about 2033.

For all scenarios borrowing is required for some specific projects in order to smooth out the impacts on the reserve funds. As noted in the assumptions in Section 2 above, borrowing is assumed for Beaver Lake WTP; Okanagan Centre Small Diameter mains; Carrs Landing Small Diameter Upgrades Phase 2; Kalamalka Lake Treatment; and the Oyama System Separation.

6.0 DEVELOPMENT COST CHARGES

Development Cost Charges (DCCs) are another important source of revenue in addition to water rates and grants. Development Cost Charges ensure that developers pay their fair share of the costs and ensure that growth pays for growth. Development cost charges can only be used to pay for the portions of new capital projects required for growth. For example, if a project is required 60% to serve the existing population and 40% to provide room for growth, then DCCs can be used to pay for the 40% required for growth. DCCs cannot be used to pay for replacement or renewal of aging infrastructure. They also can't be used to pay for any operations and maintenance costs, even if those costs are associated with growth.

The analysis indicates the Water DCCs would need to increase significantly. The current single family water DCCs are at about $7500, and this rate would likely need to increase to about the $20,000 range in order for new

development to pay for the impact that new growth has on the water system. The District Water DCCs will need to be analyzed in detail to determine the exact increases required to address projects required due to growth. With significant increases in the water DCCs, the initial analysis indicates that the DCC reserve fund can be sustained without going into a deficit. This is possible if funds are borrowed to cover the amounts allocated to growth and recoverable through DCCs. This spreads the costs out and allows the District to collect DCCs to pay the debt servicing costs. If the District aims to take cash directly from the DCC reserve funds to pay for the DCC recoverable amounts, then the reserve fund goes into a deficit. This analysis does not include the past projects constructed that will continue to be funded from DCCs as this would require a full DCC analysis to complete. The District should conduct a detailed review and update the Water Development Cost Charges based on the capital projects and benefit allocations set out in the Water Master Plan.

7.0 RECOMMENDATIONS

Based on the analysis set out in this memo and the discussions held throughout the master planning process, the financial recommendations are as follows:

- Choose a rate scenario and update the water rates bylaw, and then re-evaluate future increases based on:
    - regular inflationary changes.
    - IHA acceptance of a phasing plan for construction of the Beaver Lake Water Treatment Plant.
    - Unanticipated required changes to the capital plan.
- Monitor actual capital costs and ongoing operations and maintenance costs and update the analysis every 5 to 10 years or if significant changes occur in costs.
- Conduct a detailed review and update the Water Development Cost Charges based on the capital projects and benefit allocations set out in the Water Master Plan.

8.0 CLOSING

There are many variables and assumptions to be considered in conducting the financial analysis and determining the appropriate rate increases. It will be necessary to monitor revenues, reserve fund balances, and actual project costs on a regular basis to ensure financial sustainability of the system. Adjustments in the future are inevitable as situations change. The identified rate increases are based on the information we have available and our understanding of the projects and the approach the District wishes to use.

Sincerely,

URBAN SYSTEMS LTD.

Joel Short, MCIP, RPP
Senior Planner / Principal

/js

U:\Projects_KEL\1577\0104\01\R-Reports-Studies-Documents\R3-Cost Recovery Analysis\Memos\2023-02-01-Water rate increases memo-V14.docx