Project No.: 18066-07

March 23, 2021

Okanagan Falls Irrigation District
1109 Willow Street
Okanagan Falls, B.C. V0H 1R0

Attention: Ms. Kim Kirkham
Administrator

Re: OFID Water Master Plan

We are pleased to present the Okanagan Falls Irrigation District (OFID) Water Master Plan. This plan presents capital projects to address the known requirements and current concerns for the OFID water system, and gives recommendations both for current deficiencies as well as future growth requirments.

The implementation of this plan will bring significant benefits to OFID users, including improved water quality, increased system redundancy and development of needed additional storage. A key component of the plan is the developed economic model that resulted in recommended CEC rate update and a timeline for capital project implementation.

We appreciate your input and assistance in assembling this document, and look forward to helping you implement these projects in the future.

Sincerely,

CTQ CONSULTANTS LTD.

Marliese von Huene, P.Eng.
Project Engineer

Antonio Faccini, M. Eng., P. Eng.
Senior Engineer – Project Manager

Okanagan Falls Irrigation District

2021 Water Master Plan

Prepared for:

Okanagan Falls Irrigation District

1109 Willow Street
Okanagan Falls, BC V0H 1R0

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CTQ File: 18066-07

March 23, 2021

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APPENDICES

EXECUTIVE SUMMARY

This Water Master Plan provides a comprehensive assessment of the existing combined water system in Okanagan Falls Irrigation District (OFID) and updates the *Water System Capital Expenditure Charges Summary Report* prepared in 2016 by WSP Canada Inc. This report identifies existing system deficiencies and recommends solutions with timing based on project priority, OFID stakeholder preferences, future growth requirements, and OFID budget restraints.

The current OFID water system is a shared community asset that serves approximately 2,220 people. To protect this asset and plan for the future, current operational challenges were identified within this report. The main difficulties for the water system include high manganese content in one of the five wells, providing sufficient chlorine contact time for adequate inactivation of viruses, providing fire flow, and ensuring adequate storage capacity in both pressure zones. Additionally, a majority of the administrative and operational staff were only recently hired, making organization and recording of relevant data a challenge. However, with assistance from the administrative and operational staff, this report was created to assist all staff with knowledge on the current status of the system and set a clear path forward as the system grows and evolves.

The **Regulatory Criteria** section of this report discusses design values for calculations and sources for all relevant guidelines and regulations used within this report. This data sets all the expected boundaries for proper operation of the system.

The **Existing Water System** section takes a closer look at all aspects of the water system including pressure zones, pipe material and ages, wells and their respective aquifers, water source licensing, water quality, water consumption, and assessments of well capacity, storage, and overall system performance through modeling.

The water source capacity is appropriate for the current demands but there is not spare capacity for significant growth. The main challenges facing the district are quality issues in the lower pressure zone, the deficit in the storage capacity and lack of redundancy in the system. All these issues are addressed in this water master plan with capital projects that will provide a solution to the current challenges.

The **Future Water System** section begins with a detailed discussion of historical and expected future population growth within Okanagan Falls. Future growth buildout is analyzed from historical growth trends, community planning documents, and limits based on geographic constraints. The projections based on historical trends do not reflect the anticipated growth in the region. This section ends with a growth forecast based on inquiries and applications submitted to OFID.

The **Recommended Projects** section identifies all challenging areas identified through the previous sections and the recommended solutions for each. This section includes both capital projects and operations and maintenance projects.

The 17 recommended capital projects were prioritized to address the issues identified in the analyses of the system. The combined cost estimate of the capital projects is approximately 4.63 million dollars.

There are six high priority projects to be completed by OFID. The recommended order for their implementation is as follows:

- Lower Zone Dedicated Main
- Cascade Valve Relocation
- Mosley Place Blowoff
- Upper Zone Storage Expansion
- 11th Avenue Main Upgrade
- Maple Street Main Upgrade

The **Financial Plan** section identifies estimated costs for each of the recommended capital projects and recommends timing of the projects based on OFID's operating budget. Additionally, CEC rates are analyzed based on expected projects and anticipated future development. The proposed CEC rates are compared with those of other water utilities in the region.

An economic model based on financial information provided by OFID, cost estimates for the proposed capital projects, and cost apportiontment between existing and future users was used to propose a porject execution timeline.

The timeline took into consideration the priority rate of the projects and the forecasted available resources for their implementation. The economic model results are included in this report and a digital version will be provided to OFID for future adjustments. The economic model relfects today's reality but uses several assumptions about future conditions that might change. The digital version of the economic model is a tool for OFID for the future assessment of the conditions before implementing capital projects.

The **Summary** section provides the conclusions and recommendation resulting from the preparation of this master plan.

It is recommended that this plan is adopted by Okanagan Falls Irrigation District. The key items to be implemented are the adjustment to the CEC rates and high priority capital projects listed in this plan.

1. INTRODUCTION

1.1. History of Okanagan Falls Irrigation District (OFID)

According to *1964 History of Okanagan Falls* written by Edna Badgley, the community of Okanagan Falls was originally laid out in 1892, with many street names remaining the same since that time. In 1934, OFID was formed to provide irrigation water to local agricultural landowners for a variety of ranches, orchards, and other farming uses. Homes started using the system for potable water in the early 1950s, and the system has been a combined potable water/irrigation system ever since. Today the system serves a population of about 2,167 and continues to provide irrigation water for over 25 hectares of parks and agricultural land. Though the original well that provided water to the system has since been abandoned, there are now five wells (drilled between 1968 and 2014) and two reservoirs (built in 1977 and 1997) in the system.

1.2. Water Master Plan

OFID has retained CTQ Consultants (CTQ) to provide this overview and has provided a wide variety of previous reports and other materials to aid in the preparation of this Water Master Plan. The observations and recommendations in the report are the result of continuous dialogue among OFID and CTQ staff.

This Water Master Plan serves as a high-level assessment of OFID's water supply system. The study looked at the following components of the system:

- Source Capacity
- Water Licencing
- Raw Water Quality
- Treatment Requirements
- Distribution System Capacity
- Storage Capacity
- Capital Expenditure Charges
- Cash Flow for Capital Project Implementation

The report begins with a discussion of the regulatory agencies and requirements that the system must follow, then discusses individual aspects of the water distribution system. CTQ completed a review of the current licencing, installed pumped capacity at the sources and a system hydraulic assessment under current and future conditions. The assessment resulted on identified capital projects to address current deficiencies and future service conditions. The report includes an economic analysis for recommendations on Capital Expenditure Charges and timeline of required projects.

1.3. Water Master Plan Objectives

The main objectives of this Water Master Plan are as follows:

- Review licencing requirements
- Assess the hydraulic capacity of the existing system
- Provide a plan for improving water quality
- Identified current system deficiencies and projects to solve them

- Update the list of required Capital Projects
- Identify future water distribution needs
- Provide cost estimates for the identified Capital Projects
- Determine Capital Project cost apportionment between current and future users
- Make recommendations on Capital Expenditure Charges required for future projects
- Recommend a Capital Project execution time-line achievable by OFID
- Provide OFID with a document that facilitates their communication with approval authorities, external agencies and users

1.4. Key Terms

The following is a list of key terms and abbreviations used in this report

KEY TERM	Definition
ADD	Average Day Demand
AO	Aesthetic Objective
MDD	Maximum Day Demand
PHD	Peak Hour Demand
FF	Fire Flow
EPANET	US Environmental Protection Agency software for water distribution
H2ONET	Innovyze brand software for water distribution
L/ca/d	Litres per capita per day
MAC	Maximum Acceptable Concentrations
AO	Aesthetic Objective
CT	The residual disinfectant concentration multiplied by the contact time (for chlorine disinfection)

1.5. Acknowledgements

CTQ Consultants recognizes the following individuals who provided significant time and effort in support of the development of this document:

- Kim Kirkham, OFID Administrator
- Sig Held, OFID Operator
- Liam McCalum, OFID Operator
- Okanagan Falls Irrigation District Board of Trustees

2. REGULATORY CRITERIA

2.1. Introduction

This section discusses the governing regulations and design criteria that dictate public water system design. These criteria help provide customers with reliable, safe water and help water system owners determine which aspects of their system need to be improved. The following sections will aid in determining the priority and timing of recommendations at the end of the report.

2.2. Regulations

Okanagan Falls Irrigation District (OFID) is obligated to meet the requirements of The Drinking Water Protection Act, assented to April 11, 2001. The following list summarizes these requirements, with an emphasis on Part 2 requirements. It is provided for quick reference based on the current published information; however, it is recommended to always refer to the latest official publication to obtain current requirements.

- **Part 2, Section 6 -** Requirement for water supply systems to provide potable water and meet the additional requirements established by the regulations or by its operating permit
- **Part 2, Section 7 -** Construction permit and requirements for construction, installation, alteration or extension of the water supply system
- **Part 2, Section 8 -** Operating permits and other requirements for water supply systems
- **Part 2, Section 9 -** Qualification standards for persons operating water supply systems
- **Part 2, Section 10 -** Emergency response and contingency plans
- **Part 2, Section 11 -** Water monitoring requirements
- **Part 2, Section 12 -** Immediate reporting if standard not met
- **Part 2, Section 13 -** Threats to drinking water report
- **Part 2, Section 14 -** Public notice for threats to drinking water
- **Part 2, Section 15 -** Publication of other information
- **Part 2, Section 16 -** Floodproofing drinking water and other wells
- **Part 3 -** Water system assessments and plans, if required by regulators
- **Part 4 -** Drinking water protection
- **Part 5 -** Drinking water protection plans
- **Part 6 -** General requirements

The above regulations shall be read in conjunction with the Drinking Water Protection Regulation, B.C. Reg. 200/2003. The current version was deposited and effective May 16, 2003 and last amended November 15, 2018 by B.C. Reg. 237/2018. This document provides specific requirements for items included in the Drinking Water Protection Act.

Given the water sources used by OFID, some sections of the Groundwater Protection Regulation Act are applicable and should be consulted to make sure law requirements are met. Special attention should be given to Part 6 - Well Identification, Part 7 - Well Operation and Maintenance, and Part 9 - Well Deactivating and Decommissioning.

2.3. Water Quality Criteria

Source water quality standards are set by The British Columbia Ministry of Environment and Climate Change Strategy in the *Source Drinking Water Quality Guidelines* (SDWQGs). This document establishes acceptable levels of various contaminants found in source water across the province. Based on these guidelines, additional drinking water quality regulations for OFID and other local water systems are set by the BC Ministry of Health and are enforced by the local health authority, Interior Health, as seen in Table 2.1. These agencies have jurisdiction on both public and private water systems. See Section 3.5 for discussion on existing water quality, and water testing results in Appendix F.

Table 2.1: Interior Health Maximum Acceptable Concentrations (MAC) and Aesthetic Objectives (AO)

Anions			
Chloride	AO	<250	mg/L
Fluoride	**MAC**	1.5	mg/L
Nitrogen, Nitrate as N	**MAC**	10	mg/L
Nitrogen, Nitrite as N	**MAC**	1	mg/L
Sulfate	AO	<500	mg/L

Calculated Parameters			
Solids, Total Dissolved	AO	<500	mg/L

General Parameters			
Colour, True	AO	<15	CU
Cyanide, total	**MAC**	0.2	mg/L
pH	RANGE	7.0-10.5	pH

Microbiological Parameters			
Coliforms	**MAC**	0	CFU/100 mL
E. coli	**MAC**	0	CFU/100 mL

Total Metals			
Antimony	**MAC**	0.006	mg/L
Arsenic	**MAC**	0.01	mg/L
Barium	**MAC**	2	mg/L
Boron	**MAC**	5	mg/L
Cadmium	**MAC**	0.005	mg/L
Chromium	**MAC**	0.05	mg/L
Copper	**MAC**	2	mg/L
Iron	AO	<0.3	mg/L
Lead	**MAC**	0.005	mg/L
Manganese	**MAC**	0.12	mg/L
Mercury	**MAC**	0.001	mg/L
Selenium	**MAC**	0.05	mg/L
Sodium	AO	<200	mg/L
Uranium	**MAC**	0.02	mg/L
Zinc	AO	<5	mg/L

For ground water sources, additional guidance for pathogens can be found in BC Ministry of Health's *Drinking Water Treatment Objectives (Microbiological) for Ground Water Supplies in British Columbia (November 2015)*. This document provides guidance on pathogen treatment options for "at-risk" water sources, based on a standard assessment within a document titled *Guidance Document for Determining Ground Water at Risk of Containing Pathogens* (GARP). These two documents together guide a drinking water officer and local water operator to determine specific treatment requirements for possible pathogens in the system. Though a GARP assessment has not been completed in OFID, an assessment of the OFID source water and protection recommendations were laid out in a 2011 report, based on the BC Ministry of Health's *Comprehensive Drinking Water Source to Tap Assessment Guide* (CS2TA), as required under OFID's Operating Permit at the time. This 2011 report mainly recommended considerations for future well sites to avoid possible contamination and specific testing for the next 3-5 years after the report was written. It is unknown which of these specific recommendations were completed.

2.4. Engineering Analysis Criteria

Water Demand Criteria

Water demand within OFID varies significantly throughout the year, as discussed in more detail in Section 3.6. To support the hydraulic capacity assessment, the demand criteria will be based on the demand requirements included in Schedule B, Section 2.2 of the *Okanagan Falls Irrigation District Subdivision and Servicing Bylaw No. 398* as presented in Table 2.2.

Table 2.2: Design Demands

Average Daily Demand (ADD)	900 L/ca/d
Maximum Daily Demand – Single Family Domestic (MDD)	2,400 L/ca/d
Maximum Daily Demand – Multi-family Domestic (MDD)	1,800 L/ca/d
Maximum Daily Demand – Irrigation	80,775 l/d/ha
Peak Hour Demand (PHD)	1.7 times domestic MDD + Irrigation

The population density for residential users adopted for this report is as shown in Table 2.3.

Table 2.3: Design Densities

Single Family Residential	3 people per unit
Multi-family Residential	2 people per unit

Industrial, commercial, and institutional demands are assessed in case by case basis as single family equivalent units.

Fire Demand

As indicated in Schedule B, Section 2.42 of the *Okanagan Falls Irrigation District Subdivision and Servicing Bylaw No. 398*, OFID's letters patent does not require the District to provide fire protection. However, the analysis carried out for this water master plan adopted a minimum fire flow of 60 L/s for assessment of the current system capacity. This figure is in line with previous analysis that have determined available fire flow throughout most of the system and have used this value to assess the existing storage capacity.

Static and Residual Pressures

System pressure requirements included in Schedule B, Section 2.42 of the *Okanagan Falls Irrigation District Subdivision and Servicing Bylaw No. 398* as presented in Table 2.4 were adopted for the analyses carried out for this master plan:

Table 2.4: Design Pressures

Minimum Pressure at PHD	275 kPa (40 psi)
Maximum Allowable Pressure	865 kPa (125 psi)
Minimum Residual Pressure under MDD + FF	140 kPa (20 psi)
Minimum Residual Pressure under ADD	310 kPa (45 psi)

For the modelling of average day demand (ADD), maximum day demand (MDD), peak hour demand (PHD), and MDD + fire flow (FF) scenarios, it was assumed that all water pumps were off (system was entirely gravity-fed).

Storage Capacity

Storage capacity is provided by the two existing enclosed reservoirs. The criteria historically used by OFID is to ensure enough stored volume is available to supply six hours of domestic MDD, plus a fire demand of 60 L/s for 1.5 hours.

Distribution Network

The design criteria for the distribution network are summarized in Table 2.5.

Table 2.5: Distribution Network Criteria

Minimum Pipe Diameter (Except dead ends with no hydrant required)	150 mm
Minimum Pipe Diameter for Dead Ends (Length less than 200 m)	100 mm
Maximum flow velocity under MDD + FF	4 m/s
Maximum flow velocity under MDD	2 m/s

2.5. Water Model Update

Updating the existing water system model with recent system upgrades and accurate demands was essential to establish recommendations for capital projects. Modeling was completed using EPANET Version 2.0, then was later converted to Innovyze H2ONET software. The model was started from an earlier version of the model provided by OFID. To begin the modelling update, pipe layout and diameters were edited to match the existing system, elevations throughout were assigned based on 2019 OBWB LiDAR data, pumps were added with curves based on recent SCADA data, nodes were added at or near all fire hydrants to allow for reliable fire flow simulations, reservoirs were edited to match the existing conditions, and nodes and pipes were renamed to distinguish between upper and lower pressure zones.

Additionally, it was necessary to take a detailed look at OFID's service boundary during this process. The previously drawn boundary lacked detail in certain areas of town. CTQ worked with OFID to determine the exact level of service provided at all properties, then updated the boundary map and used this information to determine demands for the model. GIS demand polygons were then drawn within the boundary to assign areas and their corresponding unit counts to the model nodes. These polygons will simplify demand tracking and future updates to the model when growth occurs. Demands were also scaled to establish scenarios for ADD, MDD, and PHD.

After this work was completed, model results were calibrated with known pressures and flow rates within the existing system. This was aided by operator knowledge, SCADA data, and fire hydrant testing. Once model results matched what was expected in the field, the model was used to determine potential improvement areas. A second version of the model was also created to simulate expected growth in 5 years, in accordance with the expected growth discussed in Section 4 of this report.

2.6. Growth Projection Criteria

Growth projection criteria included a review of existing population statistics, topography, and land uses within the study area in an effort to establish baseline data to inform current and future servicing pressures within the OFID service area. Non-developable lands due to steep slopes and proximity to watercourses were assessed to inform an understanding of land development constraints. Statistical data was derived from provincial and federal agencies, while local development criteria and community planning objectives were obtained from the Regional District of Okanagan-Similkameen (RDOS).

The Growth Projection analysis is presented in Section 4 of this report.

2.7. Financial Criteria

An economic model was developed to review the anticipated cash flow and performance of the OFID reserve funds for the proposed capital projects.

A cost estimate in 2021 dollars was completed for each proposed capital project. The cost estimates are based on unit prices seen in the industry in the last year. As the included cost estimates are completed using conceptual designs, a contingency allowance of 25% has been included for almost all proposed projects. An allowance of 15% for project administration and engineering is also included.

The economic model includes the following information provided by OFID:

- Current reserves balances
- Anticipated Tolls and Taxes annual increase
- Revenue for 2020
- 2020 Transfers to Asset Replacement Fund and Capital Expenditure Reserve

The model uses predicted growth information as per Section 4 of this report. See Section 6 for additional details on the financial analysis.

3. EXISTING WATER SYSTEM

3.1. Introduction

This section discusses the water system as it currently exists, including the existing infrastructure, licensing, demands, and treatment. Expected system growth and recommendations will be given later in the report.

3.2. Water Distribution System

OFID owns and operates a distribution water system comprised of the following key components:

- Approximately 17,940 m of water mains
- Six groundwater wells (one of which has been abandoned)
- Two reservoirs
- A pressure reducing valve to separate the pressure zones.

A system schematic is shown in Figure 3.1, and the approximate location of all major facilities is shown in Figure 3.2. A few agricultural users within the OFID boundary have private wells to offset their water usage from OFID's system (Figure A2 in the Appendix), and some users utilize OFID water exclusively for fire flow purposes (Figure A3 in the Appendix). The area outside of the OFID boundary is serviced by private wells exclusively.

Pressure Zones and Reservoirs

The OFID water system is comprised of two pressure zones, PZ 410 and PZ 465. These pressure zones each have a reservoir, and the zone names roughly correspond to the base elevation of each of these reservoirs. Reservoirs are inspected and cleaned (if required) every three years, with the most recent inspections in October 2017 and November 2018. For both the 2014 and 2017/2018 inspections, the lower reservoir required cleaning (material build-up of over ½ inch in depth), but the upper reservoir did not require cleaning after either inspection.

The characteristics of both reservoirs are summarized in Table 3.1. The lower zone reservoir includes a much smaller reservoir from 1970 that is still in use after a reservoir expansion completed in 2007. Storage capacity is assessed in Section 3.7.

Table 3.1: Existing Reservoirs

	UPPER ZONE RESERVOIR	LOWER ZONE RESERVOIR*
Year Built	1997	1977
Materials	Reinforced Concrete	Reinforced Concrete
Base Elevation	464.82 m	409.67 m
Water Storage Volume	1,135 m^3	Main: 1,240 m^3 Small: 150 m^3 Total: 1,390 m^3
Dimensions	18.2 x 22.1 x 4.1 m	20.6 x 20.8 x 3.5 m
Typical Operating Level	60% pumps on to 91% pumps off	60% pumps on to 91% pumps off
Overflow/Full Supply Level	468.12 m	412.47 m

* Data listed is all for the main lower reservoir, unless otherwise noted.

The two pressure zones are connected at three points within the system. Two of these connections are semi-permanently closed with gate valves, and one connection is controlled by a 200 mm pressure reducing valve (referred to as the "cascade valve"). See Figure 3.2 for locations of the pressure zones and related facilities.

Currently, due to chlorine residual concerns, the cascade valve is set to be closed regardless of the pressures in the lower zone. OFID operators have indicated that there are no records of the cascade valve being used in the past. To aid with easier maintenance and monitoring in the future, there have been discussions about the potential of raising the underground cascade valve vault to an above-ground structure.

To assess the storage and system capacity, demand values were determined for each zone as shown in Table 3.2.

Table 3.2: Existing Design Demands by Pressure Zone

	UPPER ZONE	LOWER ZONE	TOTAL
Average Day Demand (ADD)	26.44 L/s	36.79 L/s	63.23 L/s
Maximum Day Demand (MDD)	42.95 L/s	68.34 L/s	111.29 L/s
Peak Hour Demand (PHD)	61.44 L/s	105.99 L/s	167.43 L/s

Water Distribution Infrastructure

The combined potable/irrigation water distribution system consists of polyvinyl chloride (PVC), asbestos cement (AC), and galvanized steel pipes with the majority being PVC. Backflow preventers have been installed in the system and OFID has a cross connection program that is currently being updated by the operators. Table 3.3 provides a summary of the existing pipe network distribution by material and diameter.

The oldest documented distribution mains still in place were built in 1960, with many upgrade projects since that time. No pipes are known to be over their typical lifespan as can be seen in Table 3.4. These results are also summarized in Figure A4 in the Appendix.

Table 3.3: Existing Pipe Network Distribution by Material and Diameter

	PVC	AC	STEEL	OTHER[1]
Total Length	8,825 m	8,975 m	90 m	50 m
Length of Mains <100 mm	1,090 m	0 m	0 m	50 m
Length of 100-200 mm Mains	7,105 m	8,080 m	90 m	0 m
Length of Mains >200 mm	630 m	895 m	0 m	0 m

[1]Mains of undocumented pipe material

Table 3.4: Existing Pipe Network Expected Lifespan

	PVC	AC	STEEL
Length with 5-10 years left	0 m	165 m	90 m
Length with 10+ years left	15,967 m	16,929 m	0 m
Length with unknown install date	1,683 m	856 m	0 m

Typical lifespans - PVC: 100 years, AC: 70 years, steel: 50 years. Note, lifespans can vary greatly depending on environment and working conditions, these values are meant for reference only.

Though OFID is not required to provide fire flow within their boundaries, 55 public hydrants and a number of yard hydrants (often referred to as standpipes) are maintained by the District and the hydrants have been included in the water system modeling results. Hydrants maintained by the District are inspected twice annually, and records are maintained by the District. Based on September 2020 hydrant inspection reports produced by South Okanagan Waterworks, the majority of hydrants are in good working order, with about 25% in need of minor maintenance in the next year or so. There are also hydrants that do not have the required one meter of spacing to operate effectively and are being hindered by various retaining walls, landscaping, and/or fences, and a few hydrants that require extensions. See the hydrant reports for additional information.

Locations of all hydrants and service coverage (based on the Regional District of Okanagan-Similkameen (RDOS) *Subdivision Servicing Bylaw #2000, 2002*) can be seen in Figure 3.3. Currently, there are several mains in the system that are inadequately sized to provide fire flow to their existing hydrants. These mains have been identified in the recommended projects in Section 5.1.

3.3. Water Source Aquifers

OFID currently uses five groundwater wells to supply water to users. Four of these wells draw water from Aquifer 264 and one draws water from Aquifer 265. The provincial government has an online tool to access information on identified aquifers. The Aquifer Search website can be accessed at https://apps.nrs.gov.bc.ca/gwells/aquifers/.

Each aquifer is rated based on yield, vulnerability, and concerns related to the sustainability of the resource. A classification number is given to each aquifer to designate the condition of the aquifer as shown below. Development refers to the amount of groundwater withdrawn from the aquifer versus the potential for the aquifer to provide groundwater. High development means that the aquifer is closer to capacity. Vulnerability relates to the potential for surface contamination based on aquifer hydrogeology alone and does not take into consideration the existing land uses. High vulnerability could mean that an aquifer is closer to the surface or is possibly not protected by low-permeability layers.

I. Heavy aquifer development
II. Moderate aquifer development
III. Light aquifer development

Vulnerability of the aquifer is rated using the following indicators:

A. High vulnerability
B. Moderate vulnerability
C. Low vulnerability

Aquifer 264 is classified as IIB and Aquifer 265 is classified as IIIA. Additional information on both aquifers is included in Appendix E.

3.4. Water Licensing

The water licensing for OFID was recently reviewed by the Thompson Okanagan Region office of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Their May 6, 2020 communication provides information on the current licences as summarized in Table 3.5:

Table 3.5: Water Licensing Data

Point of Diversion	Aquifer	Date of Precedence	Purpose of Licence	Maximum volume to be diverted
WTN 22939 (Well No 2)	264	November 11, 1969	Waterworks: Local Provider and Irrigation: Local Provider	Waterworks: 139,700 m^3 per year Irrigation: 50,840 m^3 per year
WTN 38801 (Well No 3)	264	January 1, 1978	Waterworks: Local Provider and Irrigation: Local Provider	Waterworks: 83,820 m^3 per year Irrigation: 30,510 m^3 per year
WTN 82362 (Well No 4)	265	January 1, 1990	Waterworks: Local Provider and Irrigation: Local Provider	Waterworks: 55,880 m^3 per year Irrigation: 20,340 m^3 per year
WTN 115751 (Well No 5)	264	May 5, 2006	Waterworks: Local Provider and Irrigation: Local Provider	Waterworks: 178,810 m^3 per year Irrigation: 65,080 m^3 per year
WTN 115528 (Well No 6)	264	November 1, 2012	Waterworks: Local Provider and Irrigation: Local Provider	Waterworks: 100,580 m^3 per year Irrigation: 36,610 m^3 per year

It should be noted that licenced volumes for Irrigation Local Provider can be used between May 1 and September 30 while licenced volumes for Waterworks Local Provider can be used from January 1 to December 31.

The combined currently licenced volumes are:

Waterworks Local Provider:	558,790 m^3 per year
Irrigation Local Provider:	203,380 m^3 per year
Combined Total:	762,170 m^3 per year

Water licensing in OFID is generally adequate when compared to the system water consumption (see Section 3.6 for additional consumption details). Aside from a high water usage year in 2015, the total licensed amount has been sufficient. When volumes are analyzed on a well-by-well basis, there are a few sources producing close to or above their licensed amounts. In 2018, Well #4 was above its licenced volume for the year, however then Well #4 was out of order for a majority of 2019. Due to this, Well #3 appears to have been used to make up for the difference in the upper zone, which caused it to produce above its licensed amount for 2019. Additionally, Well #2 is producing close to its licensed amount and could exceed the license regularly if lower zone growth is not accounted for by using Well #5 more often.

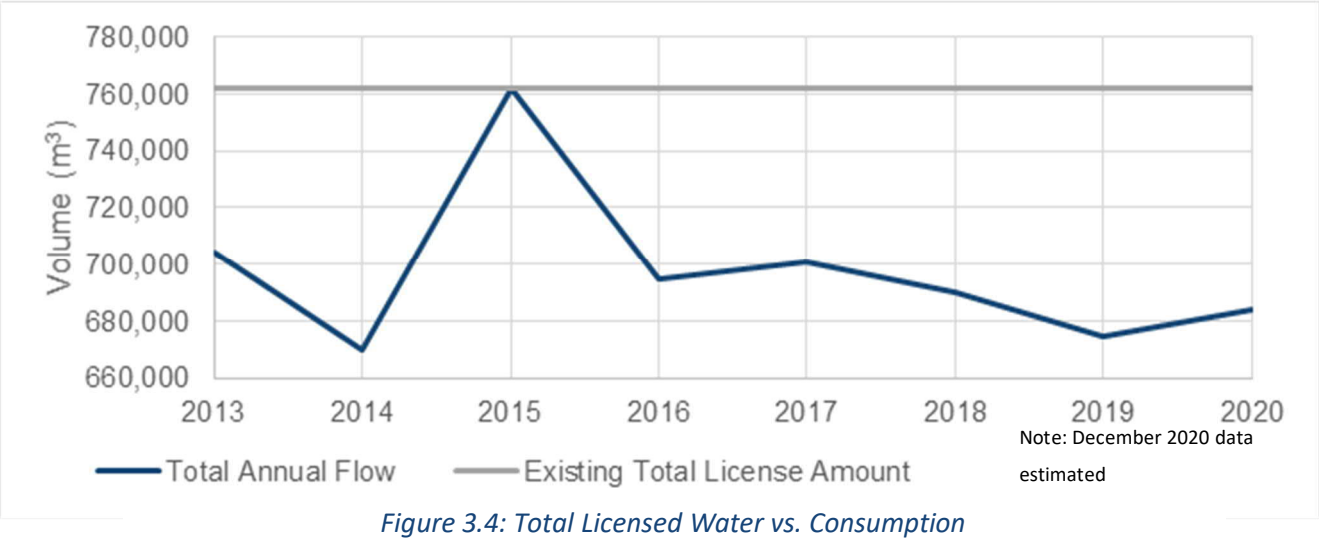


Figure 3.4: Total Licensed Water vs. Consumption

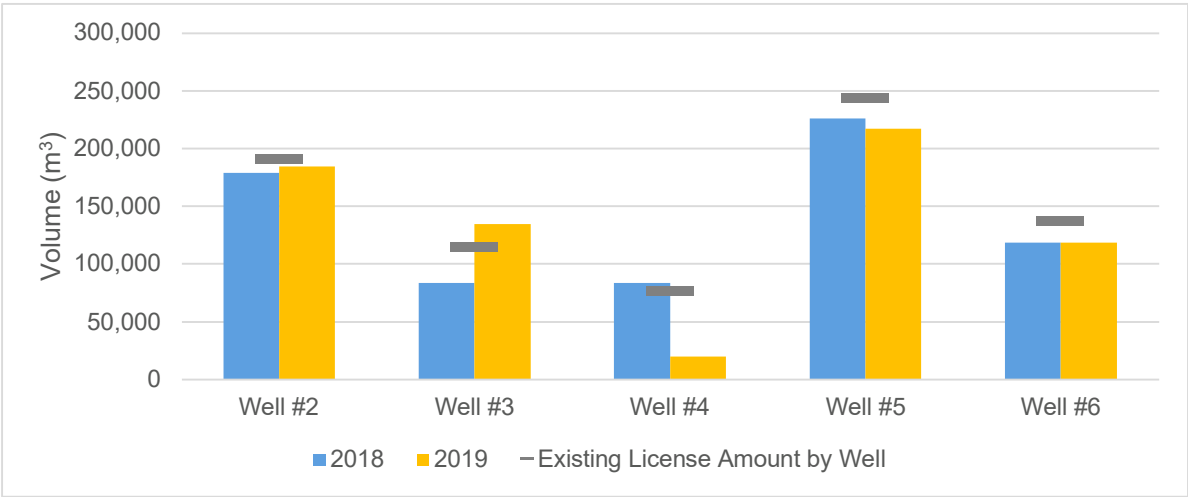


Figure 3.5: Licenced Water vs. Consumption by Well

3.5. Water Quality and Treatment

Source water quality standards are set by the Ministry of Environment and can include both Maximum Acceptable Concentrations (MAC) and Aesthetic Objectives (AO), depending on the contaminant. Overall, the five groundwater wells in OFID provide water to users without substantial treatment, only utilizing disinfection by chlorine injection on the two lower zone wells (Well #2 and #5).

The existing chlorine treatment systems in the lower zone inject chlorine at the well sites, then allow the water to travel into the distribution mains immediately afterwards. Based on the *LT1ESWTR Disinfection Profiling and Benchmarking* manual (US EPA) standards for calculating CT (Residual disinfectant concentration multiplied by the contact time), the current system does not provide the required CT between chlorine injection and the first users. Based on a maximum pH around 8.1, a temperature of 9.5°C, and a minimum chlorine residual of 0.32 mg/L (all values as recorded in the lower zone), the required contact time for 4-log inactivation of viruses by free

chlorine in this system is 25 minutes. Additionally, it is important to maintain chlorine levels in the system as a residual disinfectant beyond the amount necessary for CT for virus inactivation.

Due to the lack of chlorination in the upper zone, if the cascade valve should ever open to allow flow into the lower zone for emergency reasons, the chlorine levels in the lower zone would become diluted. Therefore, OFID currently has the cascade valve set to permanently closed to prevent lowering the chlorine levels in the lower zone.

Well #6 in the upper zone was built with dedicated space for chlorination equipment if required, but this has not been installed at this point.

OFID raw water sources are comprehensively tested once per year and generally have consistently good water quality, as can be seen in the testing results in Appendix F. However recent manganese content at Well #2 have consistently been measured over the MAC of 0.12 mg/L. Based on data from 2018-2020, Well #2 provides about 45% of the water for the lower zone.

Iron and manganese are metals often found in groundwater sources, especially in deeper wells where water has been in contact with the surrounding rock for a significant period. However, generally manganese is found at a lower concentration than iron. As can be seen in Figure 3.6, this was true for OFID's Well #2 prior to early 2018, before a significant shift occurred. The manganese concentration has remained above the MAC since March 2019.

Other possible sources of manganese in groundwater, aside from typical underground minerals, can be from aquifer contamination through septic systems, industrial effluent, or landfill leachate. It is important to investigate possible causes of the changes in manganese concentration.

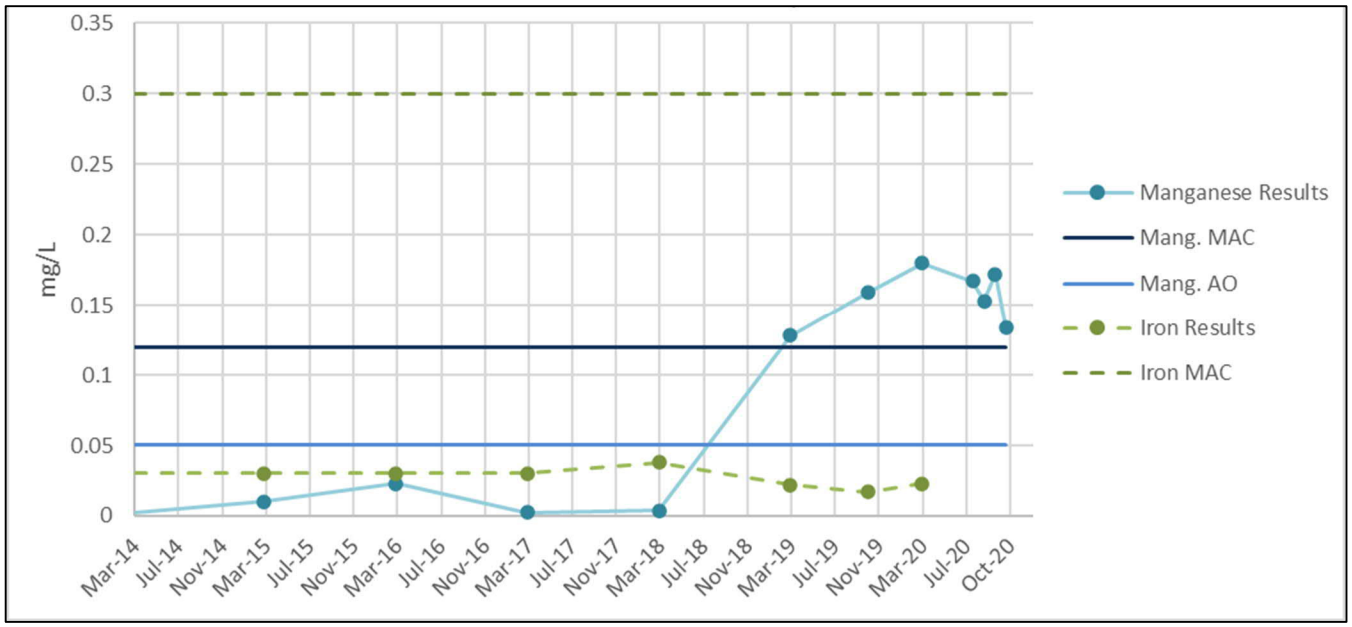


Figure 3.6: Well #2 Water Quality Data

Due to the higher manganese concentration, the District has been increasing the frequency of water quality testing at Well #2. As no additional treatment for manganese is available for the system at this time, OFID

prioritized blending the lower zone water between the two wells until a more permanent solution can be found. If both Well #5 and #2 are consistently used in sync, the concentration of manganese from the two sources would be below the MAC, assuming the water is perfectly blended and manganese concentrations do not exceed prior levels.

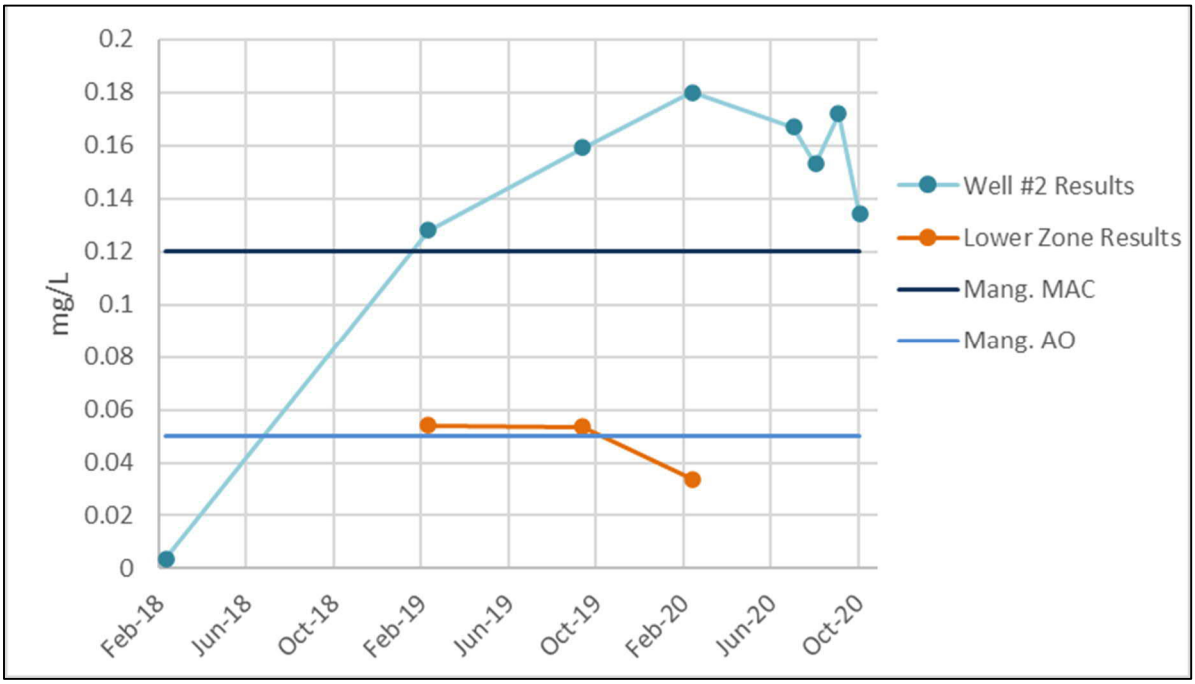


Figure 3.7: Manganese Testing Results

Aside from water quality testing results, the system has received a few water quality complaints from customers. Specifically, calls typically come in from areas like the south end of Cedar Street, the north end of Hody Drive and on 6th Avenue near Eastside Road. These areas are all dead-end lines, and the District already reportedly flushes all possible dead-end lines on a regular basis to maintain a high water quality. However, there is a dead-end line on Mosley Place that does not have a hydrant or standpipe available to flush the line.

3.6. Historic Water Consumption

Annual water consumption in Okanagan Falls has remained relatively consistent over the past eight years, as shown by well production data summarized in Table 3.6. Generally, total flows are significantly below the total licenced amount, as discussed in Section 3.4, aside from a high water usage year in 2015.

According to well production data from the past three years, summer water usage is significantly higher than winter, as shown in Table 3.7. Summer consumption is commonly over five times larger than winter consumption. Due to a lack of water metering across the system, it is difficult to trace what users consume the majority of the water, but based on estimates it appears that over 80% of the peak water use during the summer is likely residential.

Table 3.6: Historic Yearly Water Consumption

Year	Total Annual Flow (US gallons)	Total Annual Flow (m^3)	Percentage Above / Below Mean
2013	186,086,000	704,400	101.0%
2014	176,979,700	669,900	96.0%
2015	201,341,700	762,200	109.3%
2016	183,429,500	694,400	99.6%
2017	185,089,400	700,600	100.4%
2018	182,280,300	690,000	98.9%
2019	178,146,300	674,400	96.7%
2020*	180,653,200	683,800	98.0%
8 Year Average	**184,250,800**	**697,500**	**100%**

* Note: December 2020 data estimated

Water conservation measures are taken in OFID every year from May 1st to September 30th. This program limits which days residential watering can occur based on street address numbering. The restrictions also prevent any residential sprinkling from 12:00 pm-7:00pm (during the heat of the day).

Table 3.7: Historic Monthly Water Consumption (m^3)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	22,864	21,149	21,980	26,428	49,371	96,560	158,989	140,081	89,899	33,569	19,553	20,196
2018	20,899	19,187	19,848	26,683	86,875	102,368	150,369	135,509	65,296	26,949	17,679	18,345
2019	20,583	17,667	19,156	29,942	100,160	109,075	117,852	128,987	67,298	26,651	18,467	18,519
2020	19,342	17,584	19,869	40,005	74,358	75,454	126,618	145,495	91,060	34,743	20,392	-
AVG	***20,922***	***18,897***	***20,213***	***30,765***	***77,691***	***95,864***	***138,457***	***137,518***	***78,388***	***30,478***	***19,023***	***19,020***

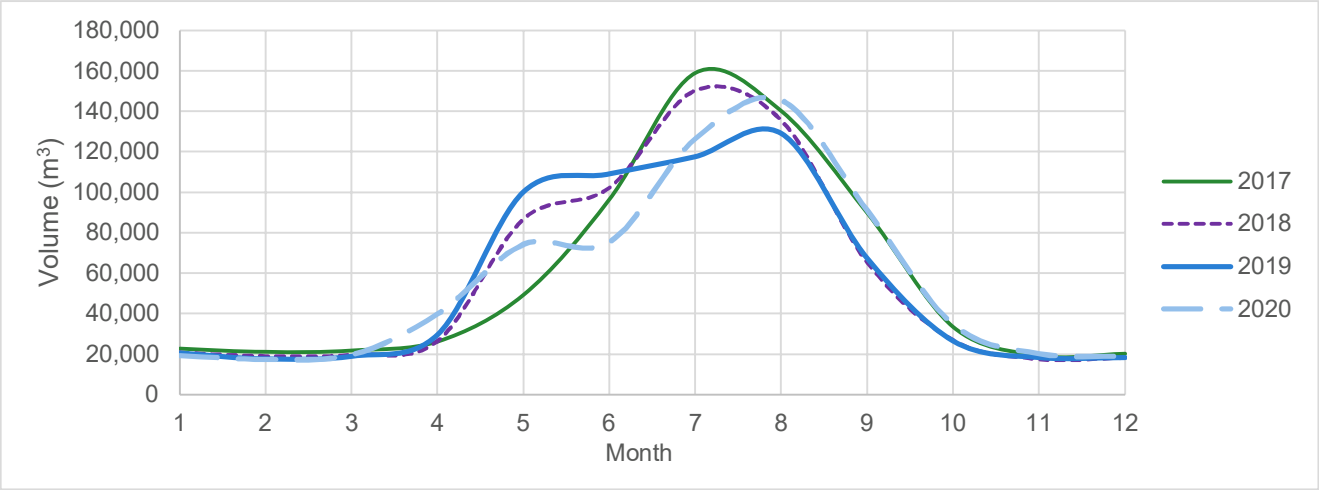


Figure 4.8: Historic Monthly Water Consumption

The available historical flows drawn from each of the wells is summarized in Table 3.8. Usage data was not recorded separately for each well before 2018. In the OFID system, Wells #2 and #5 supply the lower pressure zone and represent most of the total system consumption. Wells #3, #4, and #6 supply the upper pressure zone. Note that Well #1 is no longer in use and has been abandoned. Currently the only well with standby power is Well #6.

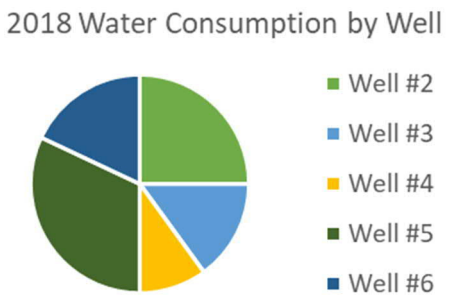


Table 3.8: Historic Yearly Water Consumption by Well

		WELL #2		WELL #3		WELL #4		WELL #5		WELL #6	
YEAR	Total Volume	Volume	% of Total	Volume	% of Total	Volume	% of Total	Volume	% of Total	Volume	% of Total
	m^3	m^3		m^3		m^3		m^3		m^3	
2018	690,043	178,817	26%	83,374	12%	83,451	12%	225,946	33%	118,455	17%
2019	674,357	184,350	27%	134,580	20%	19,704*	3%	217,260	32%	118,464	18%

*Note: Well #4 was out of commission during the second half of 2019 and is being replaced in fall 2020.

To enable better tracing of water use across the system, OFID has submitted a grant application to increase the number of meters in public and commercial facilities across town. This would add twelve new meters to the existing ten meters in town, and would include a variety of parks, the school, and agricultural users. Metering also has the added benefit of often significantly reducing the amount of water consumed by users. As all components in the system are designed for the maximum day demand the system experiences, an overall reduction in water consumption would extend the life of the system for many years. Continued addition of water meters should remain a priority.

For modeling the water system, it was important to determine which areas in town had unique water demand patterns. During this investigation, the following sites were noted:

- 4731 Seventh Avenue – This agricultural site uses OFID water only for minimal uses and obtains a majority of their irrigation water from a private well.
- 598 Eastside Road – This agricultural site operates exclusively on a private well.
- North End of Peachcliff Drive – This agricultural site operates exclusively on a private well.
- Okanagan Falls Provincial Park – This campsite/park uses OFID water for irrigation, but supplements with a private well.
- Peach Cliff Estates – This neighbourhood uses OFID water only for fire flow, all irrigation and potable water is provided through private wells.

None of the sites above currently have flow meters, so water use had to be estimated within the water model. These sites have also been highlighted in Figures A2 and A3 in the Appendix.

3.7. Water Source and System Assessments

Well Capacity Assessment

Though only pump curves for Well #4 and #6 were available from the District, approximate design points could be established for the other wells based on run data from SCADA. Installed pumping capacity at each well is summarized in Table 3.9.

Table 3.9: Well Flow Capacities

	WELL #2 (LOWER ZONE)		WELL #3 (UPPER ZONE)		WELL #4* (UPPER ZONE)		WELL #5 (LOWER ZONE)		WELL #6 (UPPER ZONE)	
	Flow	TDH	Flow	TDH	Flow	TDH	Flow	TDH	Flow	TDH
	L/s	m of head	L/s	m of head	L/s	m of head	L/s	m of head	L/s	m of head
DESIGN POINT	31.7	165.8	28.4	141.7	28.1	119.5	33.8	82.3	25.6	138.1

* Well #4 was out of commission during the second half of 2019 and was replaced in the fall of 2020.

Based only on the values above the pumping capacities at OFID are as follows:

- Lower zone approximately 65.5 L/s
- Upper zone approximately of 82.1 L/s,
- Combined OFID total capacity of approximately 147.6 L/s.

The current design maximum day demands are:

- 68.3 L/s in the lower zone
- 43.0 L/s in the upper zone,
- 111.3 L/s combined total.

Based on the above flows, the installed capacity for the lower zone is slightly lower than required. The upper zone has excess capacity that could supplement the lower zone. This could be accomplished by use of the cascade valve to allow excess pumping capacity in the upper zone to support the lower zone. With the cascade valve active, the pumping capacity would be sufficient.

Water Storage Assessment

Storage volume criteria typically includes a balance of potable water use and fire storage. The criteria historically used by OFID is to ensure storing volumes equivalent to six hours of domestic MDD, plus a fire demand of 60 L/s for 1.5 hours (324 m^3).

The assessment does not include storage reduction due to pumping capacity as there is no pump redundancy in the existing wells. The existing and required storage volumes for each pressure zone is as follows:

- Upper Zone:

Balancing Storage	42.95 L/s * 3,600 sec/hr * 6 hours	= 927.72 m^3
Fire Storage		+ 324 m^3
Total Required Upper Zone		**= 1,252 m^3**

Existing Upper Zone Storage		**1,135 m^3**

- Lower Zone:

Balancing Storage	68.34 L/s * 3,600 sec/hr * 6 hours	= 1,476.14 m^3
Fire Storage		+ 324 m^3
Total Required Lower Zone		**= 1,800 m^3**
Existing Lower Zone Storage		**1,390 m^3**

The calculation above shows that existing storage is currently insufficient in both the upper and lower zones. However, if the cascade valve was allowed to supply the lower pressure zone during fire flow events, fire storage could be contained entirely in the upper zone reservoir. With the cascade valve active, the required storage volume for each pressure zone would be:

- Upper Zone:

Balancing Storage	42.95 L/s * 3,600 sec/hr * 6 hours	= 927.72 m^3
Fire Storage		+ 324 m^3
Total Required Upper Zone		**= 1,252 m^3**
Existing Upper Zone Storage		**1,135 m^3**

- Lower Zone:

Balancing Storage	68.34 L/s * 3,600 sec/hr * 6 hours	= 1,476.14 m^3
Fire Storage		
(Provided by Upper Reservoir through in-line Cascade Valve)		+ 0 m^3
Total Required Lower Zone		**= 1,476 m^3**
Existing Lower Zone Storage		**1,390 m^3**

With the cascade valve active, storage is still insufficient in both zones, but an increase to the upper zone storage would solve the issue for the entire system. Expansion of storage capacity is discussed in the proposed capital projects.

Modeling Assessment of Existing System

The water system model was essential to determine specific deficiencies and upgrades necessary in the system. After the model was updated prior to this assessment, as described in Section 2.5, the following demand scenarios were simulated to test the existing system:

1. ADD – Ensure no pressures below 45 psi with all pumps off
2. PHD – Ensure no pressures below 40 psi with all pumps off
3. MDD – Ensure no line velocities over 2 m/s with all pumps off
4. MDD+FF – Ensure every hydrant can provide 60 L/s with all pumps off, additionally no pressures below 20 psi and no velocities above 4 m/s are allowed

All simulations were completed assuming the cascade valve remains closed. The first three tests did not pose any difficulties for the system in the model. However, testing fire flows showed a variety of required system upgrades. Though about half the hydrants are able to deliver the required flow with no issues, some hydrants cause low pressures or high line velocities at the required flow rate, and some hydrants are not able to provide the required

60 L/s. These tests showed a few common problem areas and all deficiencies can be seen in Appendix D. The recommended line upsizing resulted in capital projects included in this report.

3.8. Existing System Required Projects

Summary of System Deficiencies

Though the OFID system has generally good water quality and sufficient capacity for most daily scenarios, there are a few items that need to be analyzed and corrected. The deficiencies currently experienced by OFID are as follows:

- Lack of centralized filing system and detailed record-keeping (building and development permit statistics, business licensing statistics, existing residential unit counts, or total gross floor area by use types, etc.)
- Elevated manganese content in Well #2 source water
- Lack of understanding of the cause of the increased manganese levels in Well #2
- Insufficient contact time for lower zone chlorine treatment
- Inability to use existing cascade valve without diluting chlorine residual in lower zone
- Insufficient storage capacity in both pressure zones
- Insufficient pumping capacity in lower zone
- Very few meters on services
- Dead-end lines that require frequent flushing
- Various undersized pipes for fire flows
- Many pipes of undocumented material or install date
- Some pipes, service connections, and hydrants nearing the end of their typical lifespan

Though there is no conceivable project that could fix all these items, there are some solutions that are able to address multiple deficiencies at once. See Section 5 for additional information on all recommended projects.

4. FUTURE WATER SYSTEM

4.1. Geography

The community of Okanagan Falls is located at the southern end of Skaha Lake, roughly 15 minutes from Penticton, and has a total land area of approximately 3.34 km^2. A primarily rural and scenic area, Okanagan Falls has an abundance of warm, dry weather which is ideally suited to the many orchards and vineyards emerging from the landscape. The topography is fairly flat close to the lake and gains elevation with the presence of rolling hills and rocky outcroppings south of the Skaha Lake. A creek (Shuttleworth Creek) runs east-west through the community.

OFID is the primary water service provider for the Okanagan Falls area. Approximately 16% of the land base serviced by the OFID is within close proximity to watercourses (within 30m) or includes steep slopes in excess of 50%.

4.2. Land Uses and Economic Development

Distribution of Land Uses

A full range of land uses are represented within the community and include agricultural, industrial, commercial, and residential. Industrial, residential, and agricultural lands dominate the area (see Figure 4.1 and Figure A5 in the Appendix) and the community's housing is largely low-density single-detached homes. According to Stats Canada census data from 2016, middle-density housing forms (duplexes, fourplexes, townhouses, low-density mid-rise) are significantly under-represented within the community. In 2019, 26 affordable senior's housing units were completed, and more are anticipated, which indicates both a desire for different housing forms and willingness to fill the missing need.

Despite the region's winery and orchard successes and high volume of regional and tourist traffic travelling through the community, Okanagan Falls has been experiencing an economic decline for the past several years.

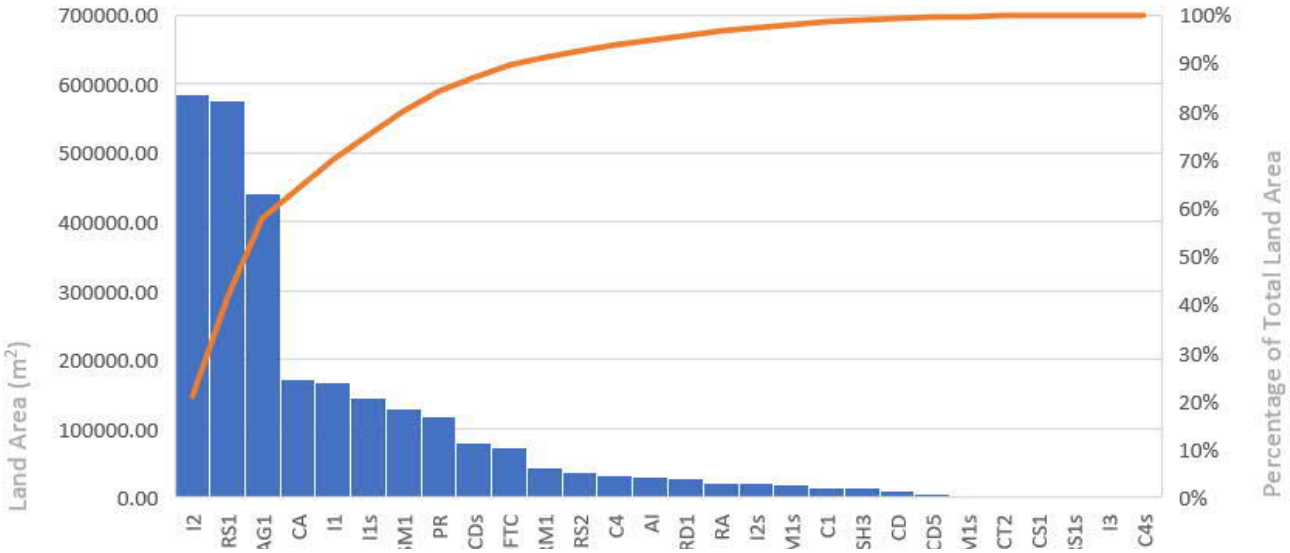


Figure 4.1: Distribution of Existing Land Uses Within OFID Service Area

The area maintains limited community services including a school, recentre, and commercial and financial services.

Future Land Use Pattern

The community's Official Community Plan (OCP) aims to influence the creation of a compact and sustainable community land use pattern that takes advantage of and makes possible cost-efficient use of services and infrastructure. To support this approach to growth, the OCP defines Primary and Secondary growth areas that aim to focus growth in the core of the community. This includes the commercial area just south of Skaha Lake and the surrounding areas at the valley bottom, approximately east of Green Lake Road and south of McLean Creek Road. Moving south from Skaha Lake towards Vaseux Lake, the desired land uses pattern transitions from Commercial, Mixed-use, Medium density residential, Low density residential, to Agricultural and Industrial.

In 2014, the Regional District of Okanagan-Similkameen (RDOS) completed a Town Centre Plan aimed at revitalizing the core of Okanagan Falls and defining it as the location for commercial development in support of economic prosperity. This plan was backed by community support desiring amenities in this area. The Town Centre vision involves a reorientation of the existing centre from Highway 97 over towards the area abutting Skaha Lake. This Plan promotes a range of land uses in intended to create a compact community and stimulate harmonious economic activity. The Town Centre Plan area is depicted in red in Figure 3 of the Appendix.

Current Land Use Pattern

When reviewing existing land use patterns (Figure 4.2) against the OCP's growth directives (Figure 4.3), a community in transition becomes apparent. The area south of 9th Ave (Highway 97) and west of Main Street (also Highway 97) maintains a greater degree of variation in land uses in close proximity than what is desired in the OCP. The differences between both the OCP and the existing land use pattern indicates a history of less comprehensive land use planning and a desire to change that for this area of the community.

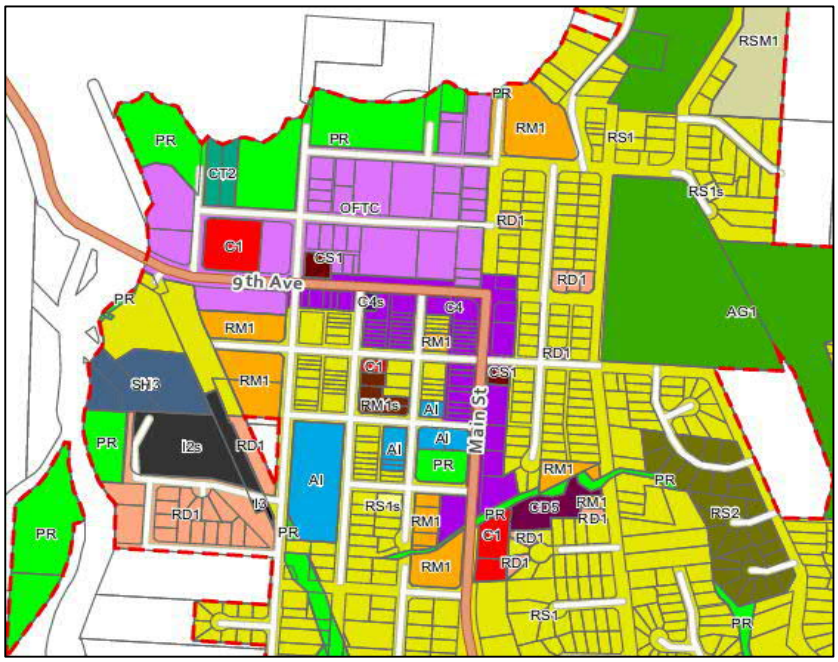


Figure 4.2: Existing Land Use Pattern (Parcel Zoning Derived from Zoning Bylaw No. 2455, 2008)

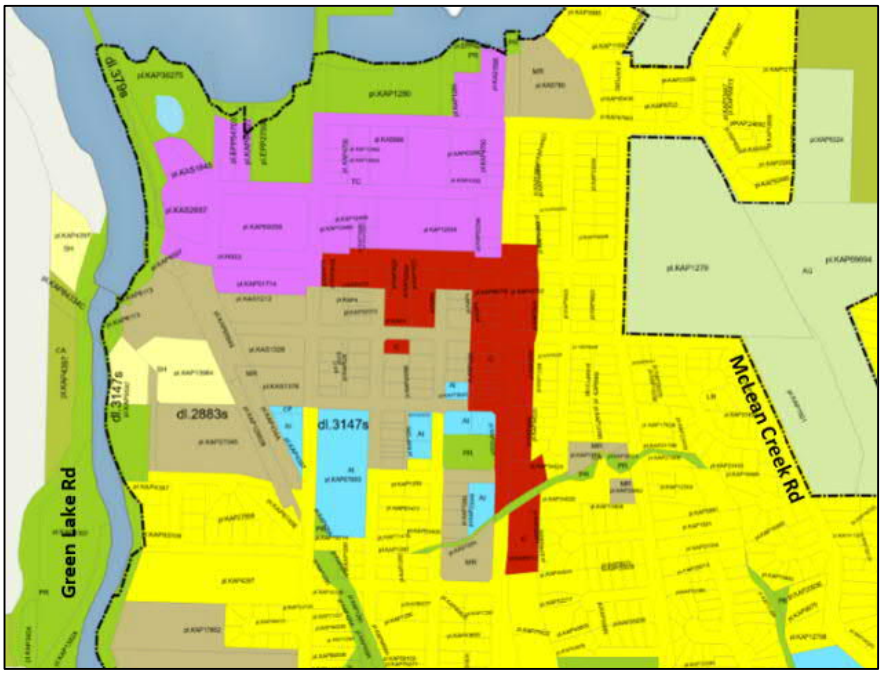


Figure 4.3: Desired Land Use Pattern
(OCP Schedule 'B', Bylaw No. 2603, 2013)

Economic Development Objectives

RDOS recently completed a three-year plan in the *2020 Economic Development and Recovery Plan for Okanagan Falls,* with the goal of improving the economic climate of the community. RDOS aims to "…improve the economic and social sustainability of the community of Okanagan Falls and the surrounding area." The plan is a call to action on strategic directions that aim to:

- Infuse the area with young families
- Offer support to businesses
- Address infrastructure challenges
- Explore the incorporation of Okanagan Falls
- Create a community brand
- Improve and beautify the downtown
- and capitalize on existing community amenities.

The Plan identifies tourism, affordable living and industrial employment lands as presenting immediate opportunities, while also noting that success of the Plan is challenged by insufficient services and needed infrastructure upgrades.

One Plan directive, (Action 3.1) speaks to the need to liaise with OFID for the purpose of identifying water system upgrades and related costs in an effort to increase fire flow capacity in the Okanagan Falls area and most importantly within the Town Centre area as a priority. This Plan offers the most current insight into anticipated development trend and local support for areas for growth. This Plan supports expressed OCP Primary growth objectives.

If successful, this Plan could result in increased density within the area closest to Skaha Lake and south of 9th Ave (Highway 97) and west of Main Street (also Highway 97), which in turn will have implications for water servicing.

The evolution of this Plan suggests a push and degree of support for increasing development in this area by both the local government and local businesses. As such, this study is timely and will assist in ascertaining the degree to which infrastructure will need to be upgraded to support the outcomes of this Plan and overall future growth of the area.

4.3. Population Growth Estimate based on Historical Data

Understanding future growth and water use demand is key to supporting informed decisions related to OFID short- and long-term planning, resource allocation, and capital budget expenditures**.** To understand future demand for OFID services within the current study area, statistical data from relevant local, provincial, and federal sources has been reviewed.

Population projections are not intended to offer an exact picture of future growth, but rather are useful for anticipating the pace and direction of change. When anticipated growth is understood, communities can then plan for the most appropriate actions to meet the future desires of area residents and decision makers. The jurisdictional boundaries of Okanagan Falls and OFID are close but do not perfectly align, as seen in Figure A6 in the Appendix. Given their near alignment, we can utilize census data to ascertain how population growth in this area may affect OFID service demand.

Table 4.1: Statistics Canada 2016 Okanagan Falls Data

Population and Dwellings	
Population (2011)	2,080
Population (2016)	2,167
Population percentage change – 2011 to 2016	4.2%
Total private dwellings	1,248
Land areas	3.34 km^2

As seen in Table 4.1, the community experienced a 4.2% population increase between 2011 and 2016, a higher rate of growth than shown in census data for the Okanagan-Similkameen region at 2.8%. Between the most recent 2016 census data through to 2041, the full region is anticipated to grow approximately 0.84% annually (excluding on-reserve counts within the Regional District's *South Okanagan Regional Growth Strategy Area, Bylaw No. 20, 2017).* Projected population growth data specific to the Okanagan Falls area is not available.

Development Trends and Statistics

Information on local development trends can provide useful data including the rate of growth and demand within certain business sectors, within certain areas of the community, desired development forms and densities, and the desire and/or ability to comply with existing zoning regulations.

RDOS unfortunately does not collect or maintain statistical data related to building and development permit statistics (over the last five years or in-progress), business licensing statistics, existing residential unit counts, or total gross floor area (GFA) related to use type (e.g. commercial, industrial). Additionally, OFID currently does not maintain complete records of existing servicing levels based on land use and use/building types. Without this data, it is challenging to determine local development trends relevant to land use type and density, such as, typical low and medium density residential unit buildout, average gross floor area (GFA) of commercial and industrial

development and locations within the community that are seeing the most growth. Therefore, this analysis focused simply on existing land uses and their potential for maximum buildouts, in consideration of limitations due to environmental constraints (slopes and watercourses) and parking requirements. Desired community land use patterns expressed in the OCP, the Town Centre Plan and the *2020 Economic Development and Recovery Plan* for Okanagan Falls have been utilized to anticipate future growth locations.

Baseline data was derived from provincial and federal census statistics and RDOS. The use of building and development permits would add value by providing actual trends and rates for development occurring within the study area. Some challenges respecting data acquisition was experienced and included:

- Building and development permit statistics over the past five years, including instream permits (to determine average actual growth rates and areas of highest growth). This information is either not tracked and/or not accessible by RDOS.
- Data on the existing number of residential units and total gross floor areas (GFAs) of existing use types (e.g. commercial, industrial) to utilize in the measurement of future growth projections.
- OFID user data by land use type.
- The C4 zone is the only zone in the applicable zoning bylaw that does not include a maximum density measure similar to all other zones. Therefore, assumptions had to be made as to the potential number of units that could be achieved on the upper floors of any development within this zone.

Once baseline data was established, a complete review of total land area and related allowable land uses was completed. The scope of this analysis did not include an in-depth consideration for each individual parcel within the study area. However, steep slopes in excess of 50%, as well as all lands within 30 m of a watercourse were eliminated from consideration of developable lands in accordance with Area 'D' OCP Development Permit Areas (DPAs), as shown in Figure A7 in the Appendix. Other environmentally related DPAs, such as the Environmentally Sensitive DPA was not included in the analysis. This was due to the fact that determining true environmentally sensitive values (knowing which areas must be protected, can be built upon provided mitigative measures are in place and/or areas formally determined not to have high ESA values) necessitates assessment by a registered biologist, which is not in the scope of this study.

After accounting for relevant DPA criteria, a detailed assessment of buildout potential for all zones and land areas within the study area was completed. This necessitated review of both the RDOS *Area "D" Official Community Plan* and *Area "D" Zoning Bylaw*. Maximum buildout scenarios included consideration of buildout potential for both existing parcels (if no new parcels were created), as well as lands where subdivision potential exists. Maximum densities were derived from *Area "D" East Skaha Vaseux Zoning Bylaw No. 2455, 2008* (amended to June 4, 2020). In determining maximum buildout potential, the following assumptions were made:

- Determining subdivision potential was based solely on parcel size and existing zoning.
- Calculations for maximum buildout potential are based on number of existing parcels within the study area, minimum required parcel areas for each zone, allowable densities identified within the applicable Zoning Bylaw, servicing assumptions (community services assumed).
- Parking requirement considerations were included for multiple family (in excess of duplex and excluding mobile home parks), commercial, mixed -use and industrial uses due to fact that significant provisions for parking are typically required in the development of these land uses and can have profound implications on development potential. Loading spaces were not considered as part of the parking calculations.

- For land uses specific to commercial and industrial only, gross floor area (GFA) calculations are based on minimum allowable parcel size and maximum allowable site coverage within the applicable zone to determine building footprint, unless parking is a limiting factor, in which case the area required for surface parking has been considered when determining developable GFA.
- Commercial and industrial developments are assumed to consume an average single storey at 11ft tall ceilings.
- Where mixed use developments are permitted, it is assumed that commercial use will exist on the first floor only and residential units will occur on the remaining upper floors.
- In order to anticipate the number of apartment units at full buildout, a residential ceiling height of 10 ft and average unit size of 1,100 ft2 is assumed where the zoning does not provide a maximum density measure (e.g. C4 zone).
- In the CD zone calculations, single detached housing is assumed.

Parking Calculation Assumptions:

- All parking is assumed to be surface parking due to the extraordinary costs of underground and parkade parking, unless it is a mixed-use development, in which case, underground parking is assumed.
- Only uses which would result in large numbers of units or GFA to the site (e.g. multi-family, commercial, industrial, Institutional) have been considered for parking calculations. Other, less density uses (e.g. single family, duplex, agriculture, parks) have been excluded from parking calculations due to the fact that parking related requirements can easily be accommodated within the area of land not comprising parcel coverage.
- Where commercial and industrial uses apply, building footprint is assumed to match maximum allowable parcel coverage.
- In the rare case where total land area does not permit maximum GFA building due to the limiting factor of surface parking and the zone is not a mixed-use zone, the maximum GFA buildout has been adjusted to be based on parking rather than on parcel coverage.

Residential Buildout Analysis

Under existing parcel configuration and zoning regulations there is the potential to achieve 2,799 residential units at full buildout. This is an increase of 1,551 additional residential units over the number of households reported in the 2016 census data (1,248 households). When subdivision potential is considered under existing zoning regulations the opportunity at full buildout is even greater at 3,566 residential units. This is an increase of 2,318 additional residential units over the number of households reported in the 2016 census data (1,248 households).

Table 4.2 summarizes the Residential Buildout Scenarios analyses results.

Table 4.2: Residential Buildout Scenarios

Residential Land Use Type	Buildout Based on Number of Parcels	Buildout Based on Available Land and Minimum Required Parcel Size
Single & Two Family Parcels (RS1, RS2, RD1 Zones)	586 Single Family Homes AND 560 Accessory Homes OR 560 Single Family Homes, 560 Accessory Homes AND 52 Units in Duplex Form	783 Single Family Homes AND 737 Accessory Homes OR 737 Single Family Homes, 737 Accessory Homes AND 248 Units in Duplex Form
Apartment, Townhouse Medium Density (RM1 Zone)	N/A as density is based on units per hectare of land	283 multiple family units
Apartment, Mixed-Use Density (OFTC, C4 Zones)	N/A as density is based on units per hectare of land	968 units
Commercial/Industrial Caretaker Units (CS1, CT2, I1, I2, I3, C1 Zones)	66 units	593 units

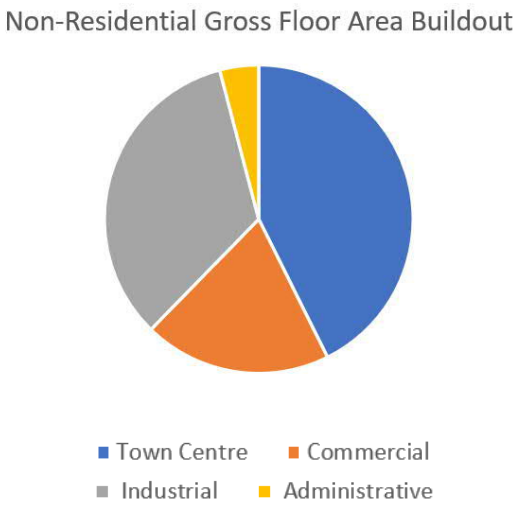
In the buildout scenario for residential units under existing parcel configuration, a greater degree of balance is achieved in the distribution of unit types. Under the subdivision induced buildout scenario, the residential unit mixed is dominated by single and two-family forms followed by mixed-use apartment forms.

Non-Residential Buildout Analysis

The maximum opportunity for buildout of non-residential space was based on existing zoning regulations and total land available for development, again factoring out steep slopes over 50% and areas within 30 m of a watercourse. It was unnecessary to consider the total gross floor area (GFA) buildouts based on existing parcels, as GFA is determined by land area and not number of parcels. Parking requirements were also factored into the analysis, as they can be limiting factors to development.

Table 4.3: Non-Residential Buildout

Commercial & Industrial Land Use Type	Buildout Based on Available Land and Minimum Required Parcel Size
Town Centre (OFTC Zone)	56,577 m^2
Commercial (C1, C4, CS1 Zones)	26,097 m^2
Industrial (I1, I2, I3 Zones)	44,592 m^2
Administrative (A1 Zone)	5,400



Development Opportunities - Rate of Growth

It is difficult to ascertain what development opportunities exist without adequate baseline data from which to measure potential growth. However, to achieve a high-level understanding of the possible rate of growth the anticipated regional growth rate for the Okanagan-Similkameen region (0.84% annually) was applied to the most current population to achieve a population count for 2020. Based on 2016 Census data, the average number of persons per household is 2.0 persons per household. This value was then used to determine the corresponding number of additional households anticipated due to population growth each year, as seen in Table 4.4. This trend was then continued to establish future population estimates for the next five years, as seen in Table 4.5.

Table 4.4 : Estimation of Current Population

SOURCE OF DATA	YEAR	CENSUS POPULATION COUNT	CENSUS HOUSEHOLD COUNT
census data available	2016	2,167	1,248
SOURCE OF DATA	**YEAR**	**ANTICIPATED POPULATION COUNT**	**ANTICIPATED HOUSEHOLD COUNT**
0.84% growth rate applied to previous years' count	2017	2,180	1,257
	2018	2,193	1,266
	2019	2,206	1,275
	2020	2,219	1,284

Table 4.5: Estimation of Future Population (in 5 Years)

SOURCE OF DATA	YEAR	ANTICIPATED POPULATION COUNT	ANTICIPATED HOUSEHOLD COUNT
0.84% growth rate applied to previous years' count	2020	2,219	1,284
	2021	2,232	1,293
	2022	2,245	1,303
	2023	2,258	1,313
	2024	2,271	1,323
	2025	2,284	1,333

To compare estimated 5-year growth to total buildout, two methods can be used. Currently, many parcels are not at the minimum required size for their zoning requirements. Maximum buildout with minimum lot sizes versus buildout based on the current parcel sizing as it exists can be seen in Table 4.6.

Table 4.6: Residential Buildout Scenario Comparison

SOURCE OF DATA	YEAR	ANTICIPATED HOUSEHOLD COUNT	BUILDOUT BASED ON NUMBER OF PARCELS	MAX. BUILDOUT BASED ON AVAILABLE LAND AND MINIMUM REQUIRED PARCEL SIZE
0.84% growth rate applied to previous years' count	2020	1,284	2,799 residential units	3,566 residential units
	2021	1,293		
	2022	1,303		
	2023	1,313		
	2024	1,323		
	2025	1,333		
EXCESS UNITS AFTER ANTICIPATED HOUSEHOLD COUNT FOR 2025			**1,466**	**2,233**

Development Opportunities - Growth Locations

The OCP's Primary and Secondary growth areas, largely encompassing the valley bottom located south of Lions Gardens and Christie Memorial Park, adjacent to Skaha Lake, have been utilized in determining the basis for anticipated growth areas. The OCP aims to direct anticipated growth into the Okanagan Falls Townsite adjacent to and south of Skaha Lake. The Okanagan Town Centre is anticipated to be the area for primary commercial development, mixed-use and tourist commercial development. Medium density development, anticipated to serve all ages and lifestyles, is largely intended to be located south of 9th Ave (Highway 97) and west of Cedar Street, according to *Area "D" East-Skaha Vaseux Official Community Plan Bylaw No. 2603, 2013*.

The area identified as 'Priority #1 Mixed Development' and represented by red colouring on Figure A1 of the Appendix is anticipated to see the most immediate growth and an area to be comprised of a mix of uses. Focusing development within this area creates a compact and sustainable community, while taking advantage of cost-efficient use of services and infrastructure. This vision is expressed in the area's Official Community Plan (OCP), the Town Centre Plan and the *2020 Economic Development and Recovery Plan* for Okanagan Falls. Given the extensive support for compact mixed-use development expressed in all of these Plans, and best planning practices for walkability, community vibrancy, and efficient use of infrastructure, this analysis has identified the Town Centre area as the primary development location. Infrastructure planning should include consideration for the expressed support for an increase in mixed-uses within this location that include commercial, tourist commercial and medium density residential.

The area identified as 'Medium Density Residential Development' and represented by yellow colouring on Figure A1 of the Appendix is currently an area comprised of varied land uses. However, this area is envisioned in the OCP to be redeveloped into medium density residential. This is the starkest land use change when comparing the OCP Future Land Use pattern against existing land use patterns for Okanagan Falls. This change of use will help support the prosperity of the 'Priority #1 Mixed Development' area, while also supporting objectives for compact and sustainable community development and efficient use of infrastructure reflected in the Plans.

4.4. Future Water System Improvements

Though historical data in and around Okanagan Falls suggests only a slight increase in population over the next five years (2,219 in 2020 to 2,284 in 2025), the District has received inquiries on several proposed developments that suggest a potential for much higher growth in the next few years than previously observed in the historical trend. Three large projects (currently going through District review) would be adding around 120 multifamily units and 28 industrial units.

Based on this higher expected growth rate, water modeling was completed to determine the potential impacts of these developments to the system. The model therefore includes the minimal projected growth based on historical growth patterns, all current development permits under District review, and an additional assumed 250 multifamily units and three additional commercial spaces in the priority development area of downtown (between 8th and 9th Ave.) These demands were all included to ensure the system will be sufficient regardless of potential future developments. The four demand scenarios discussed in Section 3.7 were then simulated in this future model. Based on this analysis, the only projects identified beyond the existing issues in the system were along Maple Street and Eastside Road. These projects will be described in more detail later in this report. However, these results are based on current information; therefore, the model should be continually updated with future developments to ensure no further projects are required.

5. RECOMMENDED PROJECTS

5.1. Recommended Capital Projects

Lower Zone Dedicated Main from Water Sources to Reservoir

Implementation of this project would address the following deficiencies:

- High manganese content: Blending water from Wells #2 and #5 would provide a combined manganese concentration lower than required by the water quality standards, assuming manganese concentration does not continue to rise.
- Low CT values for disinfection: Installation of the dedicated main to the Reservoir will provide more than enough contact time to increase the CT value beyond the calculated 25 minutes necessary for the system, achieving the required 3-Log virus inactivation for the supplied water.
- Water discoloration: It is anticipated that oxidize manganese and iron will precipitate at the reservoir helping with the supplied water aesthetics. It is not known if a filtration system will be required in the future but installing the dedicated main will also provide an opportunity for installation of filtration equipment at the Lower Reservoir site if necessary.

The dedicated main to the Lower Reservoir is comprised of the following components:

- Approximately 90 m of a new 200 mm main on 11th Avenue from Well #2 to east side of Main Street.
- Approximately 850 m of a new 250 mm main from 11th Avenue and Main Street to the Lower Reservoir. The main would be installed on Main Street and 10th Avenue and will use the existing ROW to the Reservoir.
- Convert the existing 150 mm diameter main on the east side of Main Street from Well #5 to 11th Avenue to a dedicated transmission main.
- Transfer existing services and hydrants off the 150 mm distribution main to the dedicated main. The exact number of services and hydrants to be transferred are to be confirmed, but current information indicates four services, and one hydrant connection would require transferring.
- Connection and reconfiguration of piping at 11th Avenue and Main Street to separate the dedicated main.
- Reconfiguration of piping at the Lower Reservoir.

Cascade Valve Relocation

Implementation of this project would address the following deficiencies:

- Lower Zone Storage Deficiency: By implementing a permanent interconnection between the two pressure zones, the fire storage can be stored only at the upper zone increasing the balancing storage available from the Lower Reservoir.
- Lower Zone Increased Redundancy: The lack of a chlorination system at the interconnection between the two pressure zones prevents the supply of water from the upper zone to the lower zone. Having an interconnection with a chlorine injection system in place would allow the use of water from the upper zone while maintaining the appropriate levels of chlorine in the lower distribution system. The interconnection could be used if one of the lower zone sources is temporary off-line increasing the redundancy of the system in the lower zone.

The Cascade Relocation Project is comprised of the following components:

- Relocation of the Pressure Reducing Valve to an above ground building to avoid confined space and engulfment risk issues existing in the current valve chamber. The new building shall be designed with enough space for installation of a chlorine injection system. A potential location for the new building at the west end of the Cemetery has been discussed with OFID Staff.
- Approximately 265 m of a new 200 mm main from the existing PRV location to the interconnection with the new Lower Zone Dedicated Main near Well #5.
- Piping reconfiguration from the upper zone to the new building.

Upper Zone Storage Expansion

To provide adequate storage for the entire system, the upper zone reservoir needs an additional 203 m^3 of storage after the Cascade Valve Relocation project is complete. For redundancy and to allow for future growth, it is recommended to duplicate the storage volume of the Upper Reservoir.

The proposed Upper Reservoir expansion can be designed to be built in phases with the first phase providing 835 m^3 of additional storage. Phase 1 of the Upper Reservoir expansion would provide the extra 203 m^3 currently needed by OFID and 632 m^3 of additional storage. The 632 m^3 will allow servicing 351 single family equivalent new units.

11th Avenue Main Upgrade

This project addresses a fire flow deficiency that affects 12 hydrants in the western half of the lower zone. The line that requires upgrading is on 11th Avenue, between Willow Street and Main Street, specifically the 150 mm AC line in that area. This 150 mm line is insufficiently sized for fire demands and should be upsized.

Maple Street Main Upgrade

This project addresses a future growth and fire flow deficiency that affects four hydrants in the northern lower zone. The line that requires upgrading is on Maple Street, between 10th Avenue and 7th Avenue, specifically the 38 mm and 100 mm PVC lines. The current configuration causes select system pressures to drop below 20 psi and does not allow the required 60 L/s for fire flow to be carried to one of the hydrants. Additionally, as future growth occurs in the next five years, this line will cause low pressures in the system during peak hour demands as well.

7th Avenue Main Upgrade

This project addresses a fire flow deficiency that affects two hydrants the northern lower zone. The 100 mm line that requires upgrading is on 7th Avenue, between Hody Drive and Maple Street. The current configuration causes select system pressures to drop below 20 psi. Therefore, this 100 mm line is insufficiently sized for fire demands and should be upsized.

Mosley Place Standpipe Blowoff Valve

This project addresses the need for a way to flush the dead-end line on Mosley Place. This project will add a standpipe/blowoff valve at the end of Mosley Place.

14th Avenue Looped Main

This project addresses a fire flow deficiency that affects two hydrants the southern lower zone. A 150 mm line is required along 14th Avenue, between Willow Street and Main Street. The current configuration causes select system pressures to drop below 20 psi. This additional line loops a dead-end line near Main Street in with the rest of the system and ensures adequate fire flow.

New Water Source

Although the current OFID source capacity is enough for the existing demands a new source with extra capacity will be required to support system growth. The objective of this project is to develop a new source to supply in the range of 64 L/s. This flow would allow replacing Well #2 and having spare capacity to supply in the range of 380 additional single family units.

Hawthorne Crescent Main Upgrade

This project addresses a fire flow deficiency that affects the hydrant on Hawthorne Crescent. The lines that require upgrading are on Hawthorne Crescent and Cedar Street, namely the 150 mm AC line along Hawthorne Crescent and the short segment of 100 mm AC on Cedar Street between two segments of 150 mm PVC, just northwest of 1305 Cedar Street. The current configuration causes select system pressures to drop below 20 psi.

Eastside Road Main Upgrade

This project addresses a peak hour flow deficiency in the future growth model that affects 6th Avenue near Eastside Road in the lower zone. The line that requires upgrading is on Eastside Road, between Mosley Place and 6th Avenue. The current 100 mm line causes system pressures at the east end of 6th Avenue to drop below 20 psi.

Railway Lane Main Upgrade

This project addresses a fire flow deficiency that affects hydrant #9 in the lower zone. The line that requires upgrading is on Railway Lane, north of 8th Avenue. The current 50 mm line does not allow the hydrant to deliver the required 60 L/s.

Hody Drive Main Upgrade

This project addresses a fire flow deficiency that affects hydrant #28 in the lower zone. The line that requires upgrading is on Hody Drive, between 587 Hody Drive and hydrant #27. The current configuration causes system pressures along a majority of Hody Drive to drop below 20 psi.

Birch Street Main Upgrade

This project addresses a fire flow deficiency that affects hydrant #26 in the lower zone. The line that requires upgrading is on Birch Street, south of the piping connection to 11th Avenue. The current configuration causes excessive main velocities, which can negatively affect connected services.

Barten Place Main Upgrade

This project addresses a fire flow deficiency that affects hydrant #32 in the lower zone. The line that requires upgrading is on Barten Place, after the connection to Maple Street. The current 100 mm line does not allow the hydrant to deliver the required 60 L/s.

Bassett Avenue Main Upgrade

This project addresses a fire flow deficiency that affects hydrant #53 in the lower zone. The line that requires upgrading is on Bassett Place, after the connection to Maple Street. The current 100 mm line does not allow the hydrant to deliver the required 60 L/s.

McLean Creek Main Upgrade

This project addresses a fire flow deficiency that affects hydrant #50 in the upper zone. The current configuration causes system pressures along northern end of Peachcliff Drive to drop below 20 psi. The line that is recommended to be upgraded is on McLean Creek Road, between Mallory Crescent and the connection to the reservoir main. Upsizing this line reduces head loss in the whole upper system, which increases pressures along Peachcliff Drive as well.

Well #6 Chlorine Treatment

This project is included for future planning purposes and is not required at this time. If future conditions should require chlorination in the upper zone, Well #6 is already set up for this purpose with additional space for equipment.

5.2. Recommended Operations & Maintenance Projects

Detailed Review of Records to Update GIS Mapping

To help future assessments of distribution system lifespan and budget for replacements, a thorough review to determine pipe materials and install dates is recommended. When drawings are not available for segments of pipe, previous engineering companies can also be contacted for additional information. If this option is not available, an on-site review of the conditions of unknown pipes may be necessary.

Domestic Service Connection Renewals

This project is based on recommendations from the *2018 Asset Assessment* completed by WSP. This report indicates that approximately 21 services per year will be reaching the end of their life (assuming a 60-year lifespan) in the next 7 years, with 38 services per year in the next 10 years after that. However, independent service renewal can be completed as required and does not require a major project. Additionally, as mains reach the end of their lifespan, service connections can be replaced as part of the overall project for the main replacement.

Hydrant Renewals

This project is based on recommendations from the *2018 Asset Assessment* completed by WSP. This report indicates that about 10 hydrants will be reaching the end of their life in the next 7 years, with 16 hydrants in the next 10 years after that. However, the report mentioned that adequate maintenance would extend the service life of the hydrants and the District has been completing annual inspections and maintenance on hydrants, so this estimate may prove to be an overestimation. Independent hydrant renewal can be completed as required and, as mains reach the end of their lifespan, relevant hydrants can also be replaced as part of the overall project for the main replacement.

6. FINANCIAL PLAN

This water master plan includes an analysis of the financial components of the District's operation. The objectives of this analysis are to make recommendations on the applicable CEC rates and create the capital projects recommended execution timeline. The economic model is based on the following components:

- OFID Revenue including Tolls and Taxes
- OFID Expenditures
- Transfers to Asset Replacement Fund and Capital Expenditure Reserve
- Current balances of the existing reserves
- Proposed projects and their estimated costs
- Project cost apportionment between existing users and future users

6.1. OFID Revenues

The current (2020) revenue information was provided by OFID and is summarized in Table 6.1. This data was the basis of all the budget calculations included in this section of the report.

Table 6.1: 2020 Revenue Data per OFID Financials

District Revenue -other	
Taxes	$452,000
Tolls	$297,841
Water on/off	$500
Cemetery Fees	$10,000
Developer deposits	-
Street Lighting	$26,000
Rental Income	-
2019 adjustments (one time only)	-
Total Operating Revenues	*$786,341*
Non-Operating Revenues	
GIC & TDR interest	$5,000
Interest Operating Account	$2,000
Penalties and interest on taxes	-
Misc. Income (Centennial Grant/Fortis)	$450
Capital funds interest	-
Total Non-Operating Revenues	*$7,450*
TOTAL REVENUE	***$793,791***

The revenue for future years was forecasted based on the anticipated new units to be part of the system and an 8% annual increase in taxes and tolls between 2021 and 2024 as indicated by OFID.

Table 6.2: Forecasted Revenue

	Total Revenue
Opening Balance (2020)	$793,791.00
2021	$867,893.63
2022	$1,030,655.26
2023	$1,163,505.96
2024	$1,292,561.67
2025	$1,421,894.94
2026	$1,438,090.34
2027	$1,454,285.74
2028	$1,470,481.13
2029	$1,486,676.53
2030	$1,502,871.93

6.2. OFID Expenses

The 2020 OFID annual expenses are summarized in Table 6.3, with future expenses forecasted based on a 1% annual increase in Table 6.4.

Table 6.3: 2020 Expense Data per OFID Financials

Total Operating Expenses	$97,000
Total Payroll Expenses	$326,987
Total General Administrative Expenses	$157,800
Total Expenses	***$581,787***

Table 6.4: Forecasted Expenses

	Total Expenses
Opening Balance (2020)	$581,787.00
2021	$587,604.87
2022	$593,480.92
2023	$599,415.73
2024	$605,409.89
2025	$611,463.98
2026	$617,578.62
2027	$623,754.41
2028	$629,991.95
2029	$636,291.87
2030	$642,654.79

6.3. Net Income and Transfers

The 2020 net income and transfers to the Asset Replacement Fund and to the Capital Expenditure Reserve are shown in Table 6.5 as provided by OFID. Additionally, the assumed transfers for these calculations are shown until 2030. The future transfers included in the model have been allocated based on expected net income and the proposed capital projects timeline.

Table 6.5: Net Income and Transfers

	Net Income	Transfer to Asset Replacement Fund	Transfer to Capital Expense Reserve
Opening Balance (2020)	$204,554.00	$86,138	$125,590
2021	$280,288.76	$5,000	$275,000
2022	$437,174.35	$5,000	$432,000
2023	$564,090.24	$200,000	$360,000
2024	$687,151.79	$290,000	$350,000
2025	$810,430.96	$350,000	$350,000
2026	$820,511.71	$350,000	$350,000
2027	$830,531.33	$350,000	$350,000
2028	$840,489.18	$350,000	$350,000
2029	$850,384.65	$350,000	$350,000
2030	$860,217.13	$350,000	$350,000

6.4. Proposed Capital Projects Timeline

Based on the decision-making tool developed using Microsoft Excel, the following timeline is proposed for the execution of the capital projects based on the project cost estimates, forecasted growth, and OFID resources. The tool allows the user to change the proposed year of execution of the projects and observe the effect on budgeting. The funding of the project affects the balance for the different reserves showing the performance of each reserve and the District's cash flow, as discussed in previous sections of this report.

Table 6.6: Proposed Project Timeline

Year	Project Number	Project Name	Year	Project Number	Project Name
2021	#1	Lower Zone Dedicated Main	2024	#6	7th Avenue Main Upgrade
	#4	Cascade Valve Relocation		#7	Hawthorne Cres. Main Upgrades
	#8	Mosley Place Blowoff		#9	14th Avenue Looped Main
2022	#10	New Water Source		#11	Eastside Road Main Upgrade
2023	#2	11th Ave Main Upgrade		#12	Railway Ln. Main Upgrade
	#3	Maple Street Main Upgrade	2025	#14	Birch Street Main Upgrade
	#5	Upper Zone Storage Expansion		#15	Barten Place Main Upgrade
	#13	Hody Drive Main Upgrade		#16	Bassett Avenue Main Upgrade
				#17	McLean Creek Main Upgrade

The proposed project timeline will allow OFID to immediately complete two of the six high priority projects. The economic model shows that there are funds to complete the required projects, under the proposed timeline, except for the Upper Zone Storage Expansion (Project 5).

There are alternatives to implement Project 5 that should be considered by OFID. The following should be considered before the project is executed or modified to address the requirements with the available resources:

1. Most of the capacity developed by this project will be for the use of future users, therefore it will be triggered by new development.
2. The new developer triggering the reservoir expansion might need to install spare capacity to meet future requirements of the District. The developer can recover the cost associated with the extra capacity through a Latecomer agreement with OFID. OFID will be responsible to collect the applicable latecomer fees and transfer the funds to the developer that paid for the extra capacity installed as part of the reservoir expansion.
3. There is a current deficit in the storage volume. The storage requirement is based on the MDD in the system. The used MDD is 2,400 L/ca/day as per the Subdivision Bylaw. This figure matches the flow records from OFID. The MDD can be lowered educating users on the use of water and/or implementing a metering program. Other municipalities in the region have successfully lowered their MDD to values in the range of 1,440 to 1,800 L/ca/day. A reduction in the MDD would result in a lower requirement for storage capacity. We anticipate that a potential reduction in the MDD will help with the current storage deficit, but the expansion of the storage capacity will be required to support additional development.

6.5. Reserves

Based on the proposed transfers and the withdrawals for execution of the proposed capital projects and the proposed timeline discussed above, the anticipated balance in the reserves is shown in Table 6.7.

Table 6.7: Future Account Balances at Year End

	Rate Payers Capital Reserve (CEC) Balance	Capital Expense Reserve Balance	Asset Replacement Balance
Opening Balance (2020)	$62,532.00	$341,716.58	$478,981.32
2021	$566,223.92	$133,145.46	$283,128.70
2022	$1,098,813.81	$374,675.46	$288,128.70
2023	-$172,162.67	$279,373.42	$175,963.09
2024	-$84,501.59	$591,619.82	$277,866.29
2025	$38,286.82	$941,619.82	$181,776.04
2026	$156,605.71	$1,291,619.82	$531,776.04
2027	$274,924.60	$1,641,619.82	$881,776.04
2028	$393,243.49	$1,991,619.82	$1,231,776.04
2029	$511,562.39	$2,341,619.82	$1,581,776.04
2030	$629,881.28	$2,691,619.82	$1,931,776.04

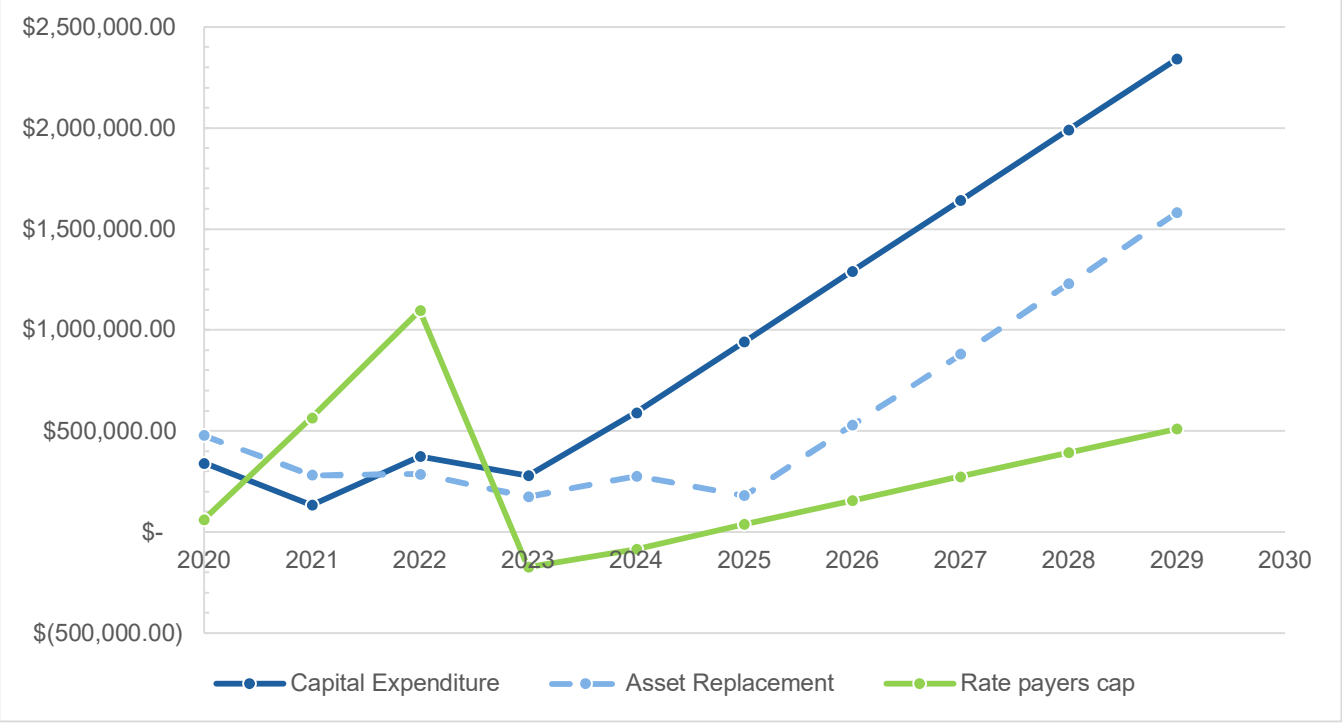


Figure 6.1: Anticipated Reserve Fund Balances

As indicated in Division 19 of the Local Government Act, local governments can impose by bylaw development cost charges for the purpose of providing funds to assist the local government to pay the capital costs of providing, constructing, altering or expanding water facilities.

The objective of collecting Capital Expenditure Charges (CEC) is to fund the portion of the capital projects that will benefit the future users of the water system. To determine the applicable CEC for the OFID proposed capital projects the following steps were carried out:

1. Completion of a cost estimate for the identified capital project
2. Assessment of the proposed project capacity
3. Assessment of the portion of the project that will benefit the existing users and future users
4. Calculation of the cost for future user per additional unit developed

The above methodology resulted in the CECs per Single Family Equivalent unit for each of the proposed capital projects presented in Table 6.8.

Table 6.8: Proposed OFID CEC Contributions

Priority	Project #	Year	Project Name	Project Estimate	CEC Projects	CEC/SFE
High Priority	Project #1	2021	Lower Zone Dedicated Main	$561,280	$140,320	$402
High Priority	Project #2	2023	11th Ave Main Upgrade	$60,550	$16,803	$48
High Priority	Project #3	2023	Maple Street Main Upgrade	$247,090	$176,807	$507
High Priority	Project #4	2021	Cascade Valve Relocation	$342,485	$85,621	$245
High Priority	Project #5	2023	Upper Zone Storage Expansion	$1,872,794	$1,417,492	$4,037
Moderate Priority	Project #6	2024	7th Avenue Main Upgrade	$35,540	$12,794	$37
Moderate Priority	Project #7	2024	Hawthorne Cres. Main Upgrades	$206,580	$74,369	$213
Moderate Priority	Project #8	2021	Mosley Place Blowoff	$6,600	-	-
Moderate Priority	Project #9	2024	14th Avenue Looped Main	$58,990	$21,236	$61
High Priority	Project #10	2022	New Water Source	$380,940	$190,470	$501
Low Priority	Project #11	2024	Eastside Road Main Upgrade	$86,590	$86,590	$248
Low Priority	Project #12	2024	Railway Ln. Main Upgrade	$33,140	-	-
Low Priority	Project #13	2023	Hody Drive Main Upgrade	$219,540	$21,405	$61
Low Priority	Project #14	2025	Birch Street Main Upgrade	$131,650	$12,836	$37
Low Priority	Project #15	2025	Barten Place Main Upgrade	$126,650	$16,324	$47
Low Priority	Project #16	2025	Bassett Avenue Main Upgrade	$143,750	$18,528	$53
Low Priority	Project #17	2025	McLean Creek Main Upgrade	$118,450	$26,722	$77
Totals				**$4,632,619**	**$2,318,317**	**$6,573**

Based on the proposed capital projects included in this water master plan, the recommended CEC per SFE for OFID is $6,573. It is recommended that this figure is used as the base to determine the applicable CEC rates for the development categories used by OFID.

Table 6.9 shows a summary of the current capital expenditure charges and development cost charges for other water utilities and municpalities in the Okanagan.

Table 6.9: Water CEC/DCC Rates in Various Municipalities/Water Districts

Name	Single Family (per home)	Apartment (per unit)	Commercial (per unit)[2]	Industrial (per unit)[2]
Kelowna*	$480-$3,730	$420-$1,045	$380-$1,430	N/A
GEID	$5,300	$2,650-$3,535	$5,300	$5,300
West Kelowna	$5,141	$1,075	$735	$1,469
Penticton*[1]	$3,816-$5,878	$304-$1,674	$590-$6,558	$581
Vernon*	$9,845-$20,691	$3,708-$5,405	$2,857-$4,080	$1,217-$1,730
OFID	$2,480-$3,720	$620	$2,480	$2,480
Peachland	$9,849	$7,230	$995	$1,661
Summerland	$1,257	$880-$1,257	$463	$78

*) Depends on which part of town development occurs
1) Based on 2007 bylaw, to be increased by possibly 40% in 2021
2) Based on an assumed 90 m^2 unit (floor space)
N/A) An adequate estimate is difficult to come by, based on how rates are structured

7. SUMMARY

This section summarizes the conclusions and recommendations derived from the preparation of this master plan.

7.1. Conclusions

The analysis of the OFID water distribution system, including the developed economic model, allows the following conclusions:

1. The OFID water distribution system is comprised of two pressure zones that use several groundwater sources with different characteristics. The water chemistry differences result in different requirements for each of the zones. The treatment requirements have implications on the processes required and the configuration of the distribution system.

2. The manganese concentration in Well #2 is above the MAC. The analyses carried out show that blending the water originated at Wells #2 and #5 will lower the manganese concentration to levels below the MAC. The analyses are based on the current pump capacity installed at both wells and historical observed manganese concentrations.

3. Previous events in the lower pressure zone resulted in the chlorination requirement for the zone. The implementation of the chlorination system resulted in two additional challenges: 1. Oxidation of manganese and iron that affect the aesthetic of the water delivered to the public. 2. Given the configuration of the distribution system, a deficit in the CT values required for proper inactivation of viruses before water is delivered to some of the users.

4. The current source capacity and licencing is appropriate for the existing demands but is not enough to support significant growth within the District.

5. Projections based on historical development in the region and within OFID showed very limited growth for OFID. The projections do not align with the information and communications received by OFID from potential developers. The anticipated growth within OFID is much higher than the original projections. Therefore, this report used a growth forecast based on the inquiries received by OFID.

6. OFID Staff and Board of Trustees are working with limited resources to implement the required solutions for the water distribution system. Their approach of prioritizing the required projects is the right solution given the limited economic resources. The efforts made by both the Board and Staff, in particular the transfers to the current reserves, to implement the required upgrades are commendable.

7. The proposed projects in this master plan bring benefits for both existing and future users of the system. It is important to identify the portion of the projects that will benefit the existing users for OFID to cover the associated cost. The future users will pay their fair portion of the projects through CEC. The master plan identifies the appropriate CEC rate per SFE for the proposed capital projects.

8. The flow records from OFID show that the MDD is in the range of 2,400 L/ca/d. This figure is high when compared to other water utilities in the region. Most of the water supply system components are sized based on MDD. A reduction on water consumption through education of the users will have a positive impact on the infrastructure requirements. A lower MDD will result in a reduction of the requirements of key capital projects.

9. An analysis on the storage capacity and requirements under the current configuration of the system shows that there is a deficit of 527 m^3. Implementation of projects #1 and #4 will reduce the deficit to 203 m^3. An additional deficit reduction can be achieved if the MDD in the District is lowered as previously discussed.

10. The key tool for the analysis of the water distribution system is the water distribution model. The model was reviewed and updated with the latest information available from OFID. New available information, like LiDAR from the Okanagan Basin Water Board, was used to increase the reliability of the model. There are options for increasing the accuracy of the model as discussed in the recommendations included in Section 7.2.

11. Cost estimates for the proposed capital projects are based on conceptual designs used for budgeting purposes. The cost estimates shall be revised once detailed designs are completed as quantities and requirements may vary from information presented in this report.

12. The anticipated timeline for the capital projects has the highest influence on the cash flow and reserve balances. The anticipated timeline was discussed with OFID Staff and some of the Board Trustees with the objective of obtaining positive cash flow and balances while implementing the required projects. The developed economic model is live document that should be revised frequently by OFID to confirm or adjust the assumptions made during its development.

13. Forecast of the future development is one of the main factors affecting the economic model. The figures adopted in the report are based on the best available information. The numbers adopted are conservative but there is no guarantee that development will happen at the anticipated rates. If development occurs faster than anticipated in this report, OFID will be in a stronger financial position allowing the completion of the projects sooner than what is shown in this report. Should the development happen at a slower rate, OFID will have to revisit the proposed project timeline and re-schedule the projects.

14. There are several projects related to fire protection improvements identified in this report. These projects have been rated as medium priority as the benefits obtained by their implementation are less than the high priority rated projects. High priority projects will positively affect most of the population in OFID.

15. The economic model shows that the most challenging project to fund will be the Upper Reservoir Expansion. This is due to the cost of the project and the high percentage to be covered by future users (CEC). This project will be triggered by future development and might require the implementation of a latecomer agreement or other arrangements to secure the funding required. The economic model shows that there are not enough resources for its implementation, but the model does not capture other funding avenues that might be available to the District. This report is a guide and as such can be adjusted to reflect the actual conditions when a capital project will be initiated.

7.2. Recommendations

We present the following recommendations based on the analyses completed:

1. Adopt this water master plan and the proposed capital projects as a guide for the works to be completed by the District over the next five years.
2. Implement Project #1 – Lower Zone Dedicated Main, as soon as possible to address the high manganese content in the water delivered to the lower zone. This project will also address the current issues with insufficient CT for inactivation of viruses by chlorine disinfection.
3. It is recommended that Project #4 – Cascade Valve Relocation be implemented after completion of Project #1. This project will provide significant redundancy to the lower zone and will free up storage capacity in the lower zone to be used for demand balancing.
4. Continuously monitor the manganese content in the water drawn from Well #2. Once Project #1 is implemented, it is important to monitor the manganese concentration in the water leaving the lower reservoir. It is anticipated that chlorine will oxidize some of the manganese this will precipitate within the dedicated main to the lower reservoir and within the lower reservoir.
5. Adopt the recommended CEC rate included in this report and work toward updating the applicable bylaw for CEC collection.
6. Implement educational campaigns and strategies to reduce the water consumption within the District. Should significant demand reduction occur, re-assess the MDD and the capacity requirements, mainly the storage requirements and source capacity. A reduction in the demand will free up capacity for new developments that will bring additional resources to implement the projects that will allow additional future growth.
7. Use the developed economic model to monitor the assumptions made and make the appropriate adjustments to the proposed capital projects timeline. It is recommended that the project timeline be revisited frequently to analyze the available resources for projects implementation.
8. Implement communication channels with consultants in charge of maintaining the water distribution model and GIS mapping to update the information reflecting changes that occur in the field. It is critical to include new units added to the system for reliability of the water model.
9. Work closely with approval authorities to keep them informed of the system performance and proposed upgrades. A fluid communication will result in less effort to achieve the desired results.
10. Implement a centralized filing system for all information relevant to the District and continue to use GIS for easy access to information required in the daily operation of the system.
11. It is recommended to meet with representatives of the Regional District of Okanagan-Similkameen to discuss the plans for the OFID area and explore opportunities for accessing funding for projects that will promote growth in the area.
12. Continue the hydrant maintenance program and try to extend the life span of the installed hydrants.

APPENDIX A – FIGURES

Figure A1- Anticipated Primary Growth Areas

Figure A2 – Existing Agricultural/Park Land wthin Boundary

Figure A3 – Fire Protection Only Areas

Figure A4 – Remaining Service Life of Mains

Figure A5 – Zoning

Figure A6 – OFID Jurisdictional Boundary

Figure A7 – Land Development Constraints

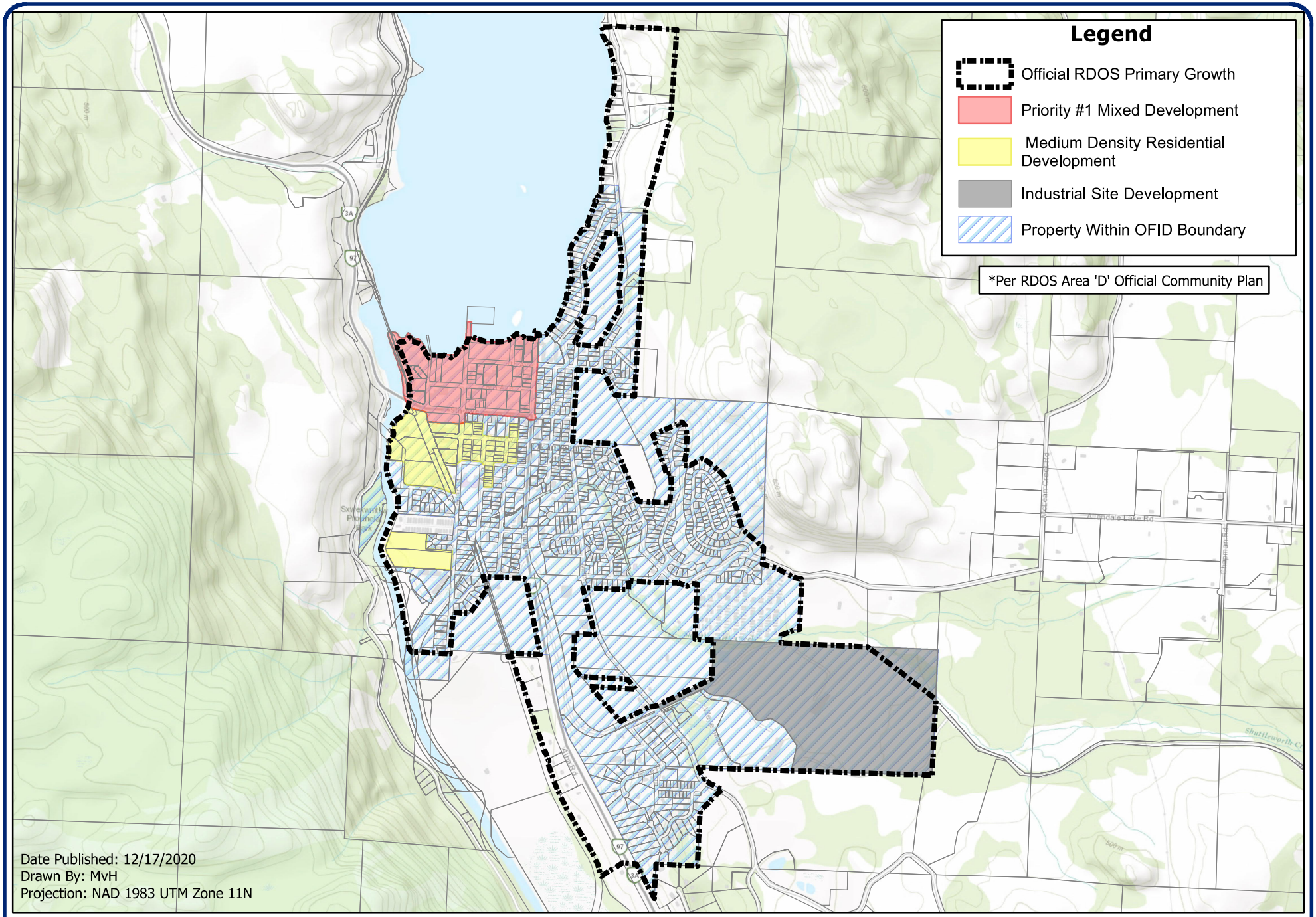


Figure A1

Anticipated Primary Growth Areas

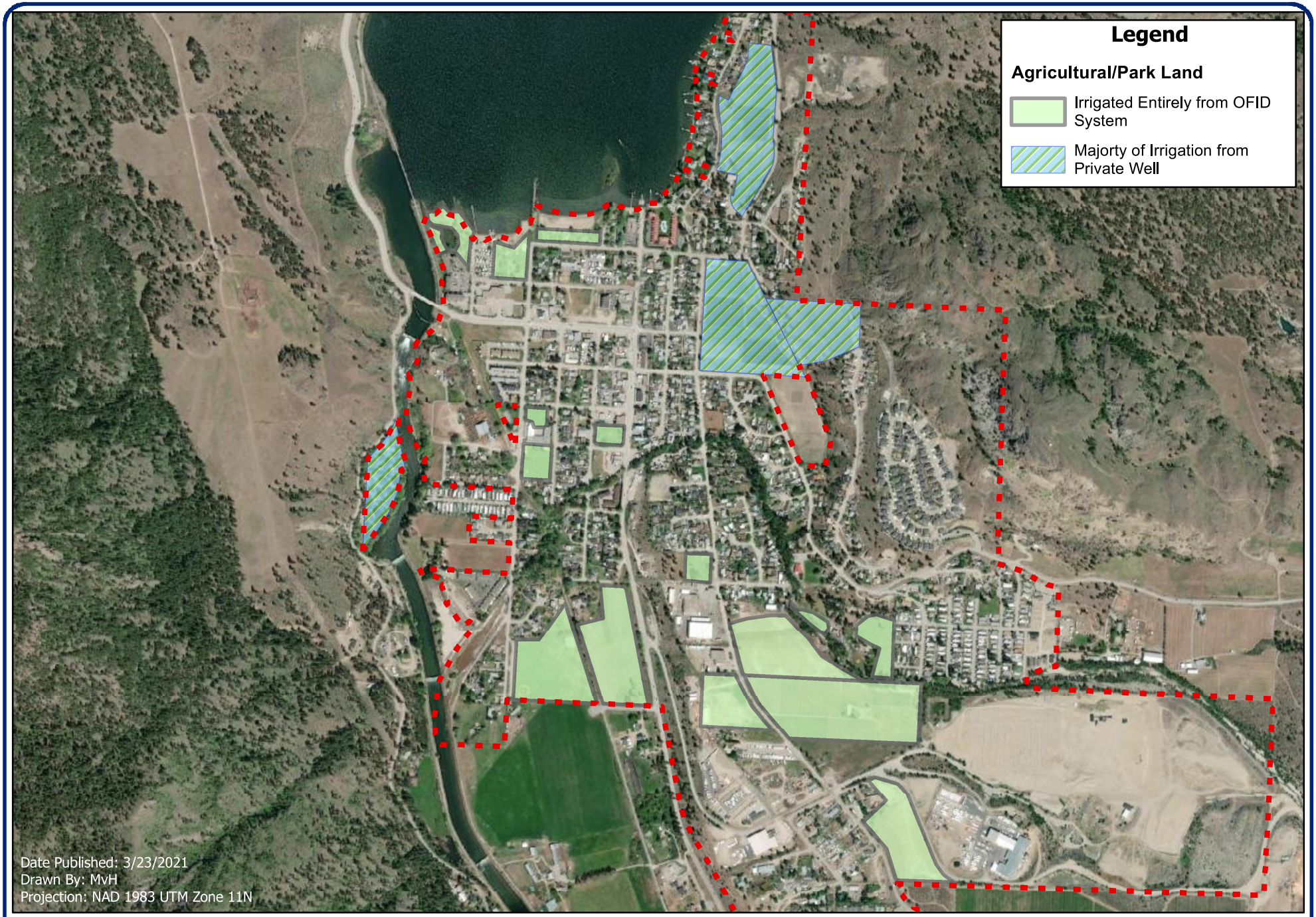
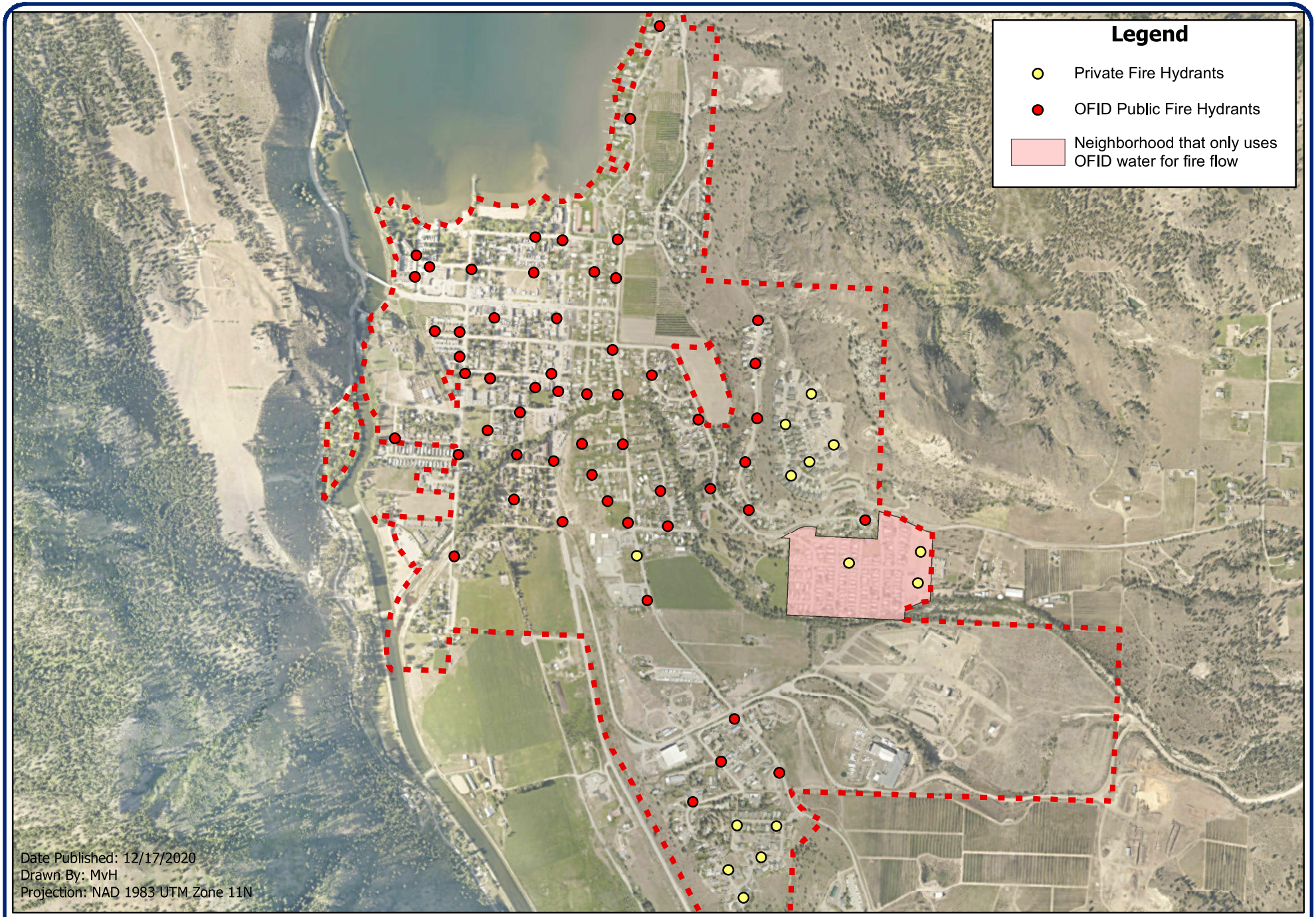


Figure A2
Existing Agricultural/Park Land within Boundary

CTQ

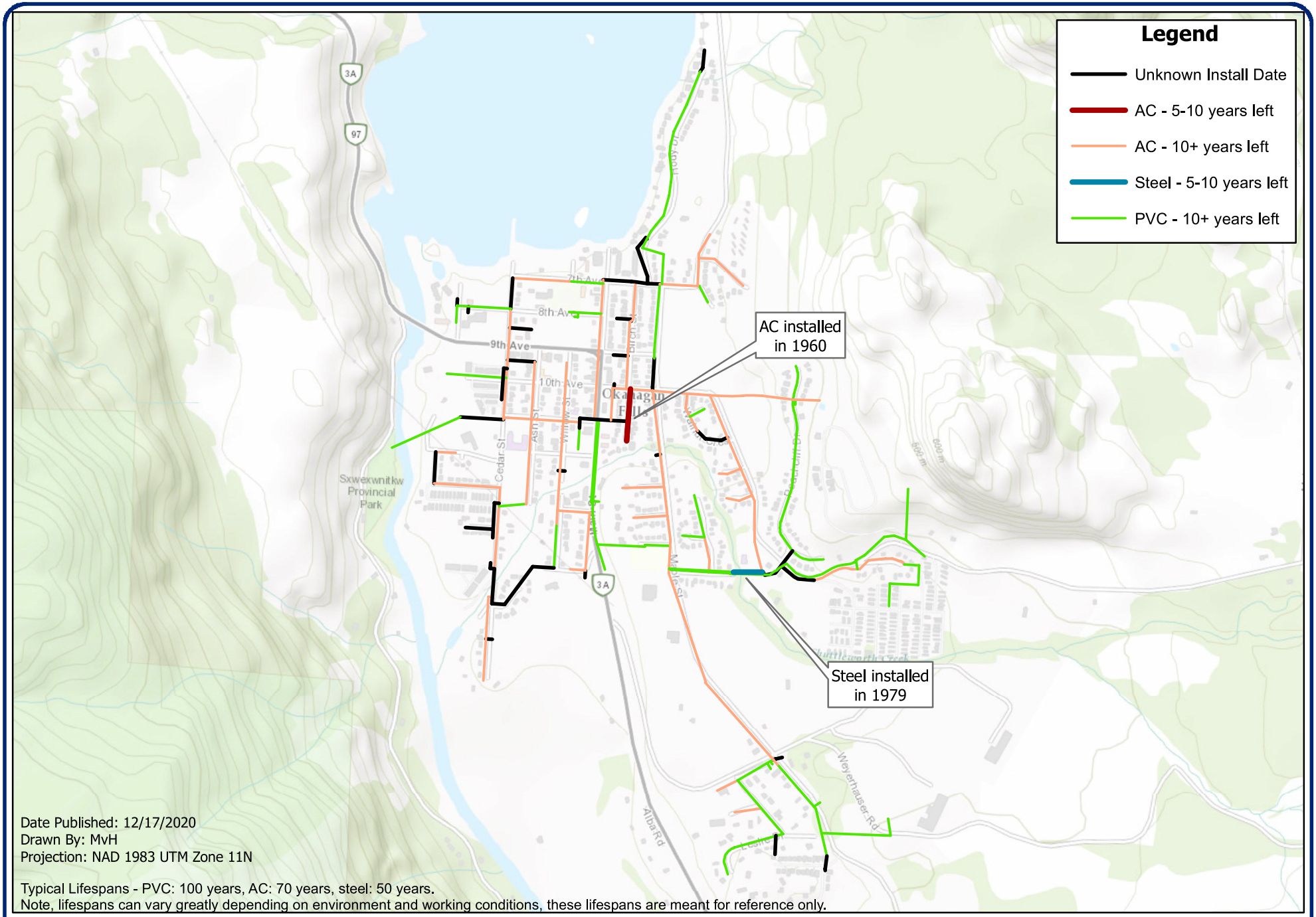


OFID Okanagan Falls Irrigation District

Figure A3

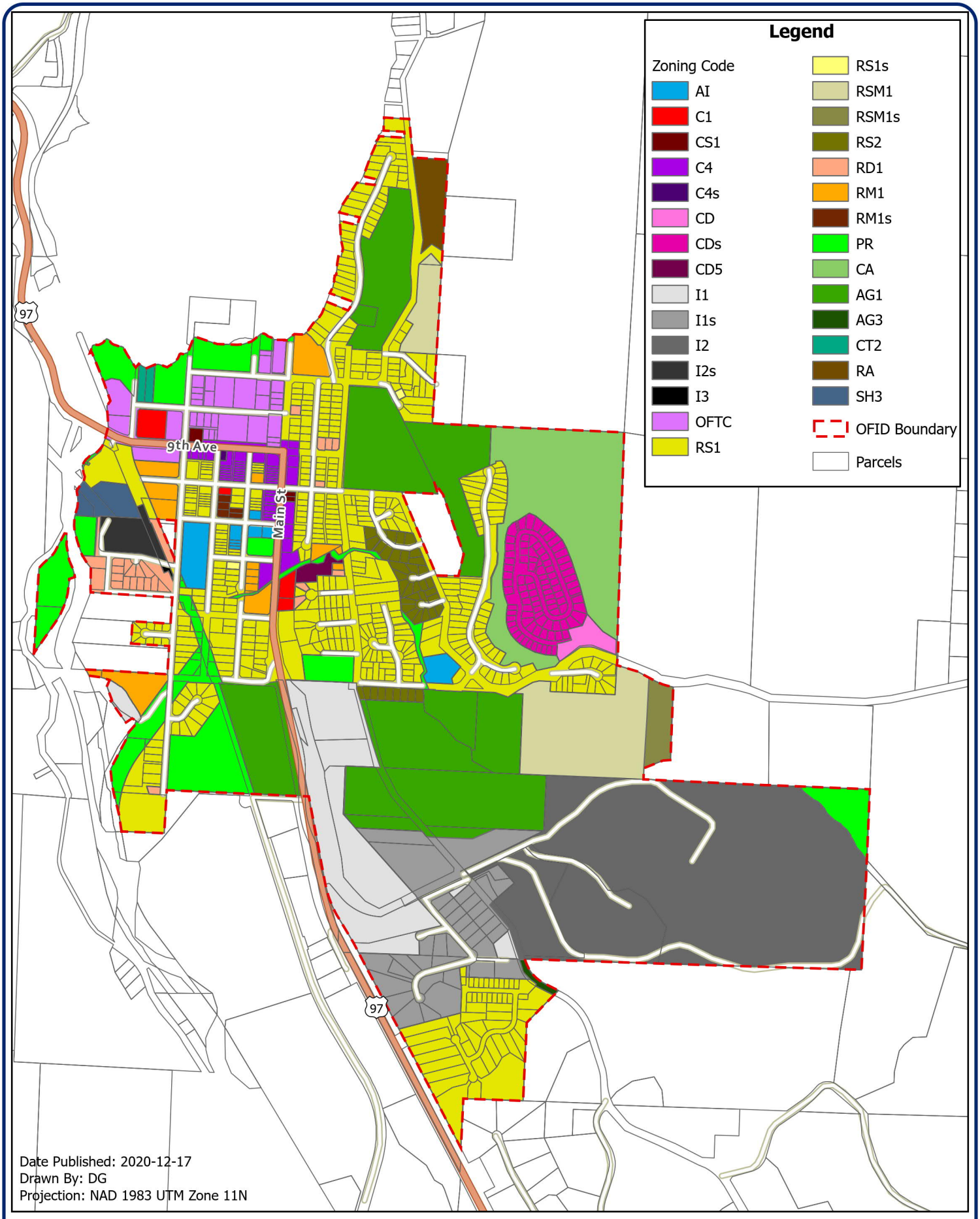
Fire Protection Only Areas (No Domestic or Irrigation)

CTQ



Okanagan Falls Irrigation District

Figure A4
Remaining Service Life of Mains



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Scale 1:15,000 (8.5" x 11")

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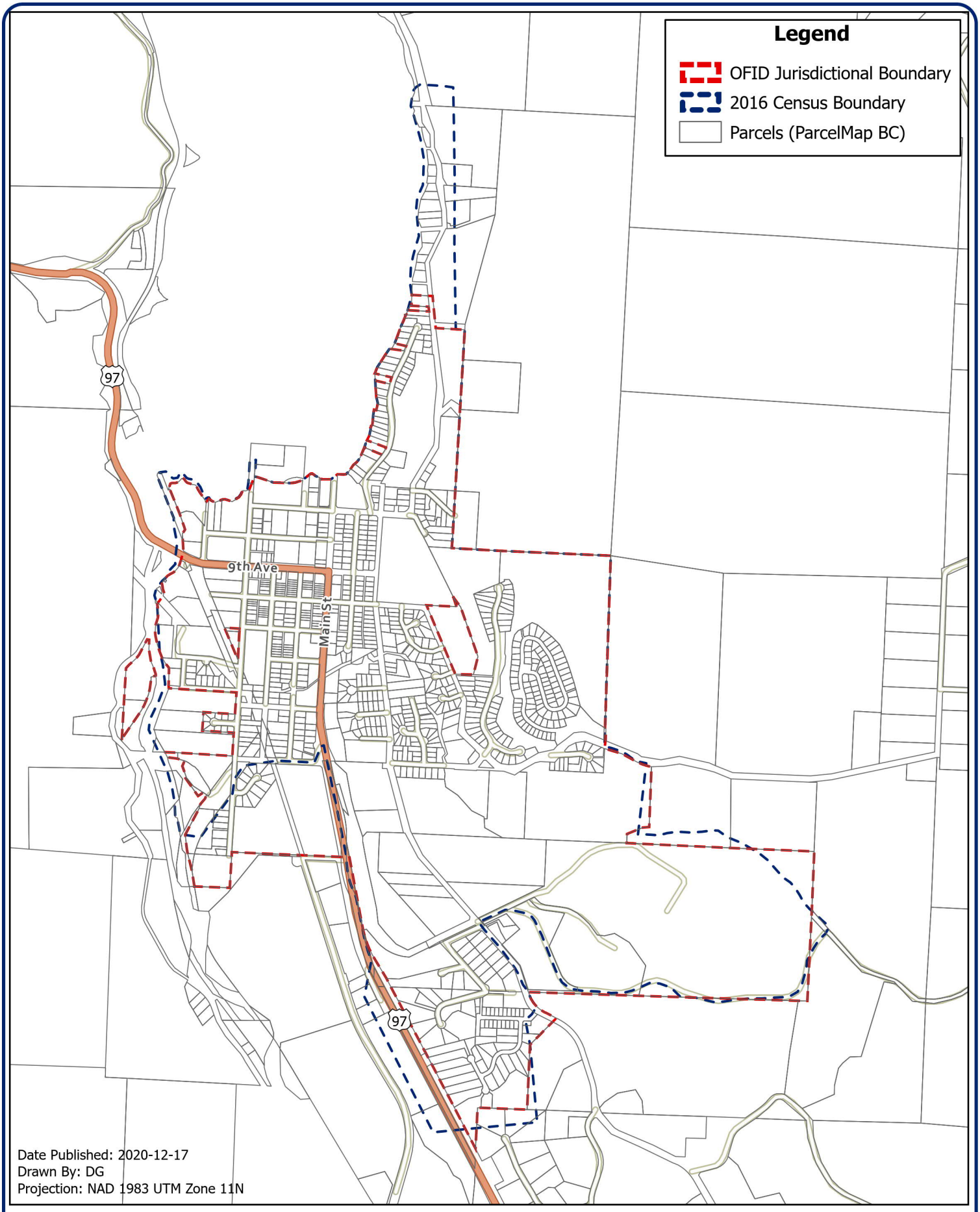
OFID Okanagan Falls Irrigation District

Figure A5
Zoning

CTQ



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Okanagan Falls Irrigation District

Figure A6

OFID Jurisdictional Boundary

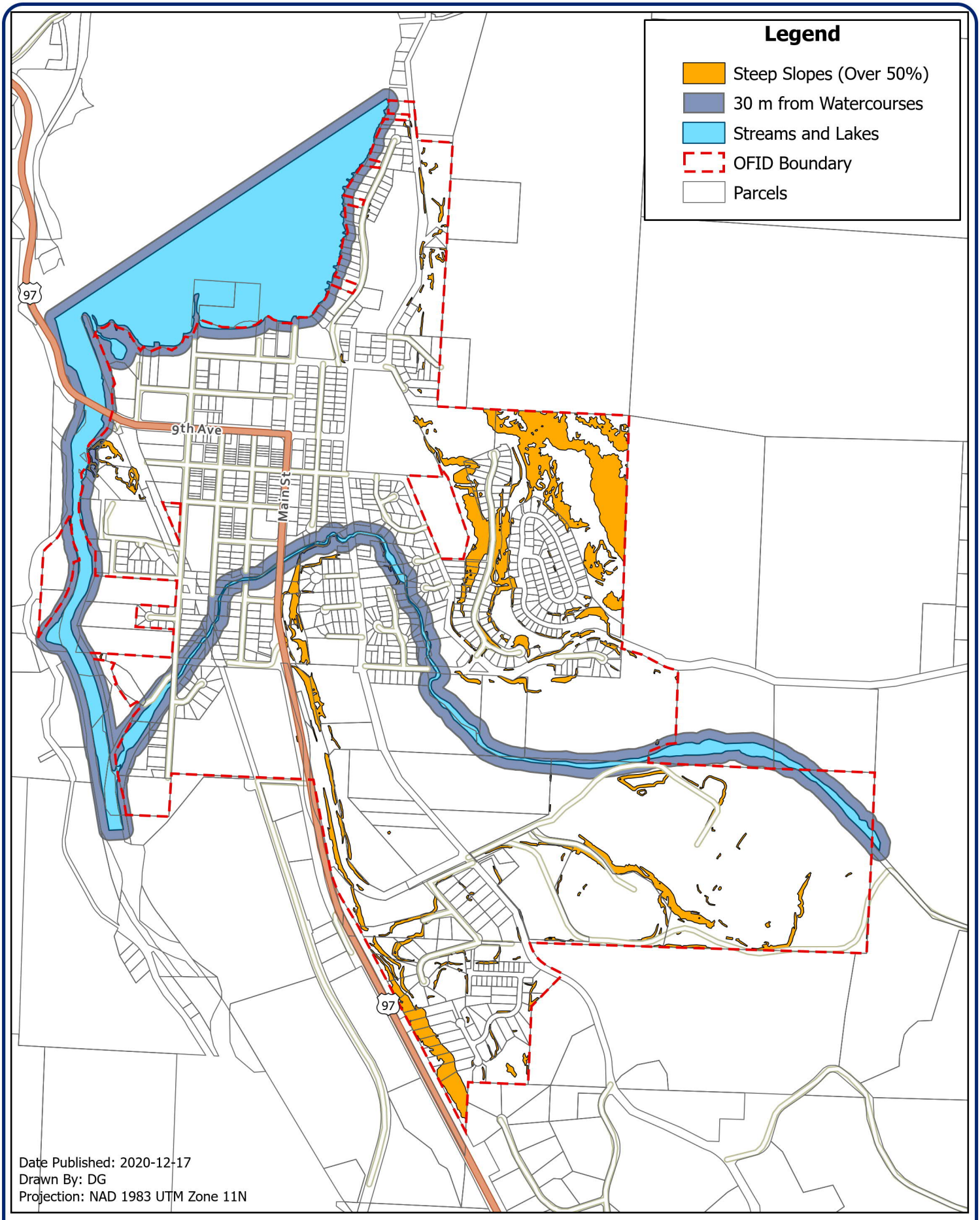


Figure A7

Land Development Constraints

Steep Slopes and Proximity to Watercourses

CTQ

APPENDIX B – CAPITAL PROJECTS

Previous 2016 Report Projects

Proposed Projects

Previous Projects from 2016 Water System Capital Expenditure Charges Report			
Priority	**Project Number**	**Project Name**	**Comments**
High	OR-1	Asset Management Plan	Completed in 2018
High	OR-2	Operation/Maintenance Manual	Ongoing, has been started by OFID
High	OR-3	As-Built records of all infrustructure	GIS mapping of all infrustructure is completed and updated regularly
High	DIS-1	Parallel 250mm on McLean Creek Road	Completed in 2017
High	DIS-2	Parallel 150mm on Ferguson Place	New single 200mm installed in 2020
Medium	DIS-3	Parallel 200mm mains on Cedar Street	Updated model did not show this was necessary
Medium	DIS-4	200mm on Maple from 7th to 10th Ave	Alternate solution adressed - See Project #3
Medium	DIS-5	Parallel 200mm on Maple from 14th Ave to Commercial Rd	Updated model did not show this was necessary
Medium	DIS-6	200mm on Eastside Road	Alternate solution adressed - See Project #11
Low	STR-1	Chlorination at each well and oversized pipelines	Alternate solution adressed - See Projects #1 and #4
Low	SR-1	Add 125 m3 of storage at Upper Reservoir	See Project #5
Low	DIS-7	200mm on Hody Drive	Alternate solution adressed - See Project #13
Low	DIS-8	150mm on 6th Avenue and Eastside Road	Updated model did not show this was necessary
Low	DIS-9	150mm on Cedar Street	Updated model did not show this was necessary

Okanagan Falls Irrigation District
Master Capital Projects List

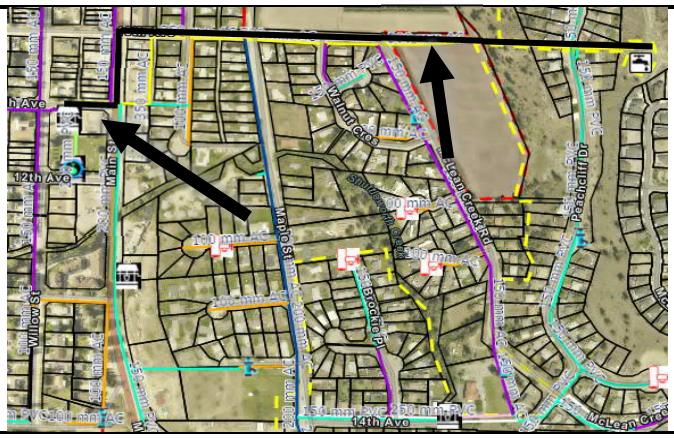
Priority	Project #	Year	Project Name	Project Estimate	Current Users	CEC Projects	CEC/SFE	Capital Replacement
High Priority	Project #1	2021	Lower Zone Dedicated Main	$ 561,280	$ 399,912	$ 140,320	$ 402	$ 21,048
High Priority	Project #2	2023	11th Ave Main Upgrade	$ 60,550	$ -	$ 16,803	$ 48	$ 43,747
High Priority	Project #3	2023	Maple Street Main Upgrade	$ 247,090	$ -	$ 176,807	$ 507	$ 70,283
High Priority	Project #4	2021	Cascade Valve Relocation	$ 342,485	$ 77,059	$ 85,621	$ 245	$ 179,805
High Priority	Project #5	2023	Upper Zone Storage Expansion	$ 1,872,794	$ 455,302	$ 1,417,492	$ 4,037	$ -
Moderate Priority	Project #6	2024	7th Avenue Main Upgrade	$ 35,540	$ -	$ 12,794	$ 37	$ 22,746
Moderate Priority	Project #7	2024	Hawthorne Cres. Main Upgrades	$ 206,580	$ -	$ 74,369	$ 213	$ 132,211
Moderate Priority	Project #8	2021	Mosley Place Blowoff	$ 6,600	$ 6,600	$ -	$ -	$ -
Moderate Priority	Project #9	2024	14th Avenue Looped Main	$ 58,990	$ 37,754	$ 21,236	$ 61	$ -
High Priority	Project #10	2022	New Water Source	$ 380,940	$ 190,470	$ 190,470	$ 501	$ -
Low Priority	Project #11	2024	Eastside Road Main Upgrade	$ 86,590	$ -	$ 86,590	$ 248	$ -
Low Priority	Project #12	2024	Railway Ln. Main Upgrade	$ 33,140	$ -	$ -	$ -	$ 33,140
Low Priority	Project #13	2023	Hody Drive Main Upgrade	$ 219,540	$ -	$ 21,405	$ 61	$ 198,135
Low Priority	Project #14	2025	Birch Street Main Upgrade	$ 131,650	$ -	$ 12,836	$ 37	$ 118,814
Low Priority	Project #15	2025	Barten Place Main Upgrade	$ 126,650	$ -	$ 16,324	$ 47	$ 110,326
Low Priority	Project #16	2025	Bassett Avenue Main Upgrade	$ 143,750	$ -	$ 18,528	$ 53	$ 125,222
Low Priority	Project #17	2025	McLean Creek Main Upgrade	$ 118,450	$ -	$ 26,722	$ 77	$ 91,728
Totals				$ 4,632,619	$ 1,167,097	$ 2,318,317	$ 6,573	$ 1,147,205

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2021

PROJECT NO: **Project #1**

PROJECT NAME: **Lower Zone Dedicated Main**



This project increases chlorine contact time and blends water from both lower zone wells. The 250mm line will be located along Main Street and 10th Avenue, with a 200mm line running to Well #2.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 25,000	$ 25,000
200mm PVC Main	90	Lineal Meters	$ 225	$ 20,250
200mm Gate Valve	1	Each	$ 2,800	$ 2,800
250mm PVC Main	850	Lineal Meters	$ 280	$ 238,000
250mm Gate Valve	1	Each	$ 3,000	$ 3,000
Conversion of Existing 150mm Main	1	Lump Sum	$ 5,000	$ 5,000
Water Services	7	Each	$ 2,500	$ 17,500
Tie-ins	3	Each	$ 2,500	$ 7,500
Pavement Restoration	1	Lump Sum	$ 64,900	$ 64,900
Hydrants	1	Each	$ 6,500	$ 6,500
Subtotal , Construction Cost Estimate				**$ 390,450**
Project Administration & Engineering	15%			$ 58,570
Base Capital Cost				$ 449,020
Contingency Allowance	25%			$ 112,260
TOTAL CAPITAL COST ESTIMATE (*)				**$ 561,280**

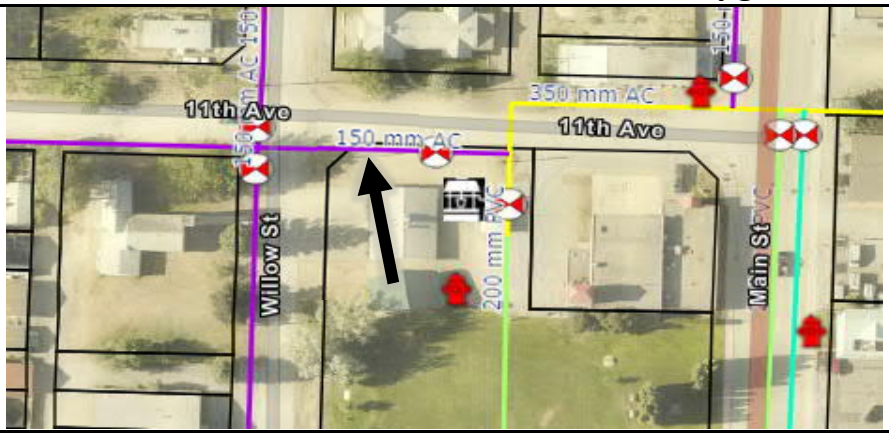
Cost Benefit Assessment	Current Users	CEC Project	Asset Replacement
Apportionment	71%	25%	4%
Capital Value Apportionment	$ 399,912	$ 140,320	$ 21,048
Applicable CEC per SFE		$ 402	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2023

PROJECT NO: **Project #2**

PROJECT NAME: **11th Ave Main Upgrade**



On 11th Avenue, between Well #2 and Willow Street, increase the diameter of the existing 150mm AC pipe to a 200mm PVC. This project addresses deficiencies in fire flow through much of the lower pressure zone. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 3,370	$ 3,370
200mm PVC Main	55	Lineal Meters	$ 250	$ 13,750
200mm Gate Valve	2	Each	$ 2,500	$ 5,000
Tie-ins	2	Each	$ 5,000	$ 10,000
Road restoration	1	Lump Sum	$ 10,000	$ 10,000

Subtotal , Construction Cost Estimate		**$ 42,120**
Project Administration & Engineering	15%	$ 6,320
Base Capital Cost		$ 48,440
Contingency Allowance	25%	$ 12,110
TOTAL CAPITAL COST ESTIMATE (*)		**$ 60,550**

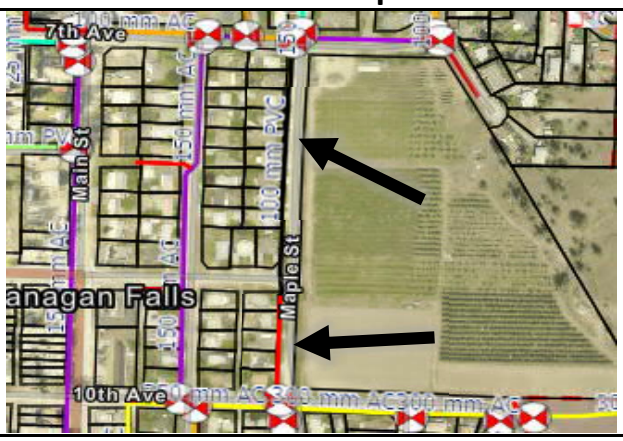
Cost Benefit Assessment	Current Users	CEC Project	Asset Replacement
Apportionment	0%	28%	72%
Capital Value Apportionment	$ -	$ 16,803	$ 43,747
Applicable CEC per SFE		$ 48	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2023

PROJECT NO: **Project #3**

PROJECT NAME: **Maple Street Main Upgrade**



On Maple Street, between 7th Avenue and 10th Avenue, increase the diameter of the existing 38mm and 100mm PVC pipe to a 150mm PVC. This project addresses deficiencies in fire flow through the northern side of the lower pressure zone. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 12,730	$ 12,730
150mm PVC Main	340	Lineal Meters	$ 200	$ 68,000
150mm Gate Valve	1	Each	$ 2,250	$ 2,250
Water Services	16	Each	$ 2,500	$ 40,000
Tie-ins	2	Each	$ 2,500	$ 5,000
Pavement Restoration	1	Lump Sum	$ 37,400	$ 37,400
Hydrants	1	Each	$ 6,500	$ 6,500

Subtotal , Construction Cost Estimate		**$ 171,880**
Project Administration & Engineering	15%	$ 25,790
Base Capital Cost		$ 197,670
Contingency Allowance	25%	$ 49,420
TOTAL CAPITAL COST ESTIMATE (*)		**$ 247,090**

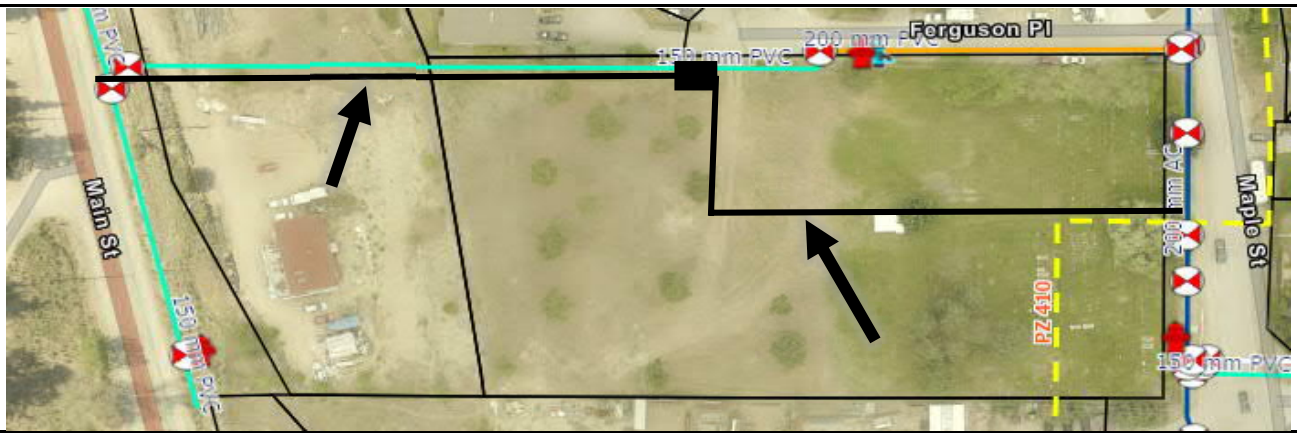
Cost Benefit Assessment	Current Users	CEC Project	Asset Replacement
Apportionment	0%	72%	28%
Capital Value Apportionment	$ -	$ 176,807	$ 70,283
Applicable CEC per SFE		$ 507	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2021

PROJECT NO: **Project #4**

PROJECT NAME: **Cascade Valve Relocation**



As discussed in the Water Master Plan, this is the cost to complete chlorination upgrades at the cascade valve, moving the cascade valve location, and bringing it to an above-ground structure

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 15,000	$ 15,000
Aboveground structure and piping at cascade valve	1	Lump Sum	$ 115,000	$ 115,000
Chlorination at new cascade valve	1	Lump Sum	$ 50,000	$ 50,000
Installation of 200mm main to tie-in with dedicated main	265	Lineal Meters	$ 225	$ 59,625
Tie-ins	2	Each	$ 2,500	$ 5,000

Subtotal , Construction Cost Estimate		**$ 244,625**
Project Administration & Engineering	12%	$ 29,360
Base Capital Cost		$ 273,985
Contingency Allowance	25%	$ 68,500
TOTAL CAPITAL COST ESTIMATE (*)		**$ 342,485**

Cost Benefit Assessment	Current Users	CEC Project	Asset Replacement
Apportionment	23%	25%	53%
Capital Value Apportionment	$ 77,059	$ 85,621	$ 179,805
Applicable CEC per SFE		$ 245	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2023

PROJECT NO: **Project #5**

PROJECT NAME: **Upper Zone Storage Expansion**

As discussed in the Water Master Plan, this is the cost to increase storage in the upper zone by ading a third cell of the same size as the two existing cells (additional 568 m^3 of storage)

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 40,000	$ 40,000
Expansion at upper reservoir - new third cell	1	Lump Sum	$ 1,353,434	$ 1,353,434
Subtotal , Construction Cost Estimate				**$ 1,393,434**
Project Administration & Engineering	12%			$ 167,220
Base Capital Cost				$ 1,560,654
Contingency Allowance	20%			$ 312,140
TOTAL CAPITAL COST ESTIMATE (*)				**$ 1,872,794**

Cost Benefit Assessment	Current Users	CEC Project	Asset Replacement
Apportionment	24%	76%	0%
Capital Value Apportionment	$ 455,302	$ 1,417,492	$ -
Applicable CEC per SFE		$ 4,037	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2024

PROJECT NO: **Project #6**

PROJECT NAME: **7th Avenue Main Upgrade**

On 7th Avenue, between Hody Drive and Maple Street, increase the diameter of the existing 100mm AC pipe to a 150mm PVC. This project addresses deficiencies in fire flow through the northern side of the lower pressure zone. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 2,220	$ 2,220
150mm PVC Main	45	Lineal Meters	$ 200	$ 9,000
100mm Gate Valve (on Hody Drive)	1	Each	$ 2,000	$ 2,000
Tie-ins	2	Each	$ 3,000	$ 6,000
Road Restoration	1	Lump Sum	$ 5,500	$ 5,500

Subtotal , Construction Cost Estimate		**$ 24,720**
Project Administration & Engineering	15%	$ 3,710
Base Capital Cost		$ 28,430
Contingency Allowance	25%	$ 7,110
TOTAL CAPITAL COST ESTIMATE (*)		**$ 35,540**

Cost Benefit Assessment	Current Users	CEC Project	Asset Replacement
Apportionment	0%	36%	64%
Capital Value Apportionment	$ -	$ 12,794	$ 22,746
Applicable CEC per SFE		$ 37	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2024

PROJECT NO: **Project #7**

PROJECT NAME: **Hawthorne Cres. Main Upgrades**

On Hawthorne Cres and Cedar St, increase the diameter of the existing 150mm and 100mm AC pipes to 200mm PVC. This project addresses deficiencies in fire flow in this neighbourhood. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 10,060	$ 10,060
200mm PVC Main	270	Lineal Meters	$ 250	$ 67,500
200mm Gate Valve	2	Each	$ 2,500	$ 5,000
Tie-ins	3	Each	$ 2,500	$ 7,500
Road Restoration	1	Lump Sum	$ 29,700	$ 29,700
Water service	7	Each	$ 3,000	$ 21,000
Hydrant	2	Each	$ 6,500	$ 13,000

Subtotal , Construction Cost Estimate		**$ 143,700**
Project Administration & Engineering	15%	$ 21,560
Base Capital Cost		$ 165,260
Contingency Allowance	25%	$ 41,320
TOTAL CAPITAL COST ESTIMATE (*)		**$ 206,580**

Cost Benefit Assessment	Current Users	CEC Project	Asset Replacement
Apportionment	0%	36%	64%
Capital Value Apportionment	$ -	$ 74,369	$ 132,211
Applicable CEC per SFE		$ 213	

CAPITAL PLAN:	2020-2025
PROPOSED IMPLEMENTATION YEAR:	2021
PROJECT NO:	**Project #8**
PROJECT NAME:	**Mosley Place Blowoff**

This project provides a blowoff at the end of Mosley Place, to allow flushing the dead-end line.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
Blowoff	1	Each	$ 6,000	$ 6,000
Subtotal , Construction Cost Estimate				**$ 6,000**
Project Administration & Engineering	0%			$ -
Base Capital Cost				$ 6,000
Contingency Allowance	10%			$ 600
TOTAL CAPITAL COST ESTIMATE (*)				**$ 6,600**

Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	100%	0%	0%
Capital Value Apportionment	$ 6,600	$ -	$ -
Applicable CEC per SFE		$ -	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2024

PROJECT NO: **Project #9**

PROJECT NAME: **14th Avenue Looped Main**

Install a 150 mm PVC main looping the system between Willow Street and Main Street. This project addresses deficiencies in fire flow in the southern side of the lower pressure zone. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 3,280	$ 3,280
150mm PVC Main	100	Lineal Meters	$ 200	$ 20,000
Tie-ins	2	Each	$ 2,500	$ 5,000
150mm Gate Valve	1	Each	$ 2,250	$ 2,250
Pavement Restoration	1	Lump Sum	$ 10,500	$ 10,500

Subtotal , Construction Cost Estimate		**$ 41,030**
Project Administration & Engineering	15%	$ 6,160
Base Capital Cost		$ 47,190
Contingency Allowance	25%	$ 11,800
TOTAL CAPITAL COST ESTIMATE (*)		**$ 58,990**

Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	64%	36%	0%
Capital Value Apportionment	$ 37,754	$ 21,236	$ -
Applicable CEC per SFE		$ 61	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2022

PROJECT NO: **Project #10**

PROJECT NAME: **New Water Source**

Develop a new water well to increase source capacity to service future growth

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 15,000	$ 15,000
Well development c/w pumping capacity	1	Lump Sum	$ 250,000	$ 250,000

Subtotal , Construction Cost Estimate		**$**	**265,000**
Project Administration & Engineering	15%	$	39,750
Base Capital Cost		$	304,750
Contingency Allowance	25%	$	76,190
TOTAL CAPITAL COST ESTIMATE (*)		**$**	**380,940**

Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	50%	50%	0%
Capital Value Apportionment	$ 190,470	$ 190,470	$ -
Applicable CEC per SFE		$ 501	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2024

PROJECT NO: **Project #11**

PROJECT NAME: **Eastside Road Main Upgrade**

On Eastside Road, between Mosley Place/7th Avenue and 6th Avenue, increase the diameter of the existing 100mm PVC pipe to a 150mm PVC. This project addresses deficiencies in future fire flow, once growth occurs in the downtown area (per the report). The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 4,460	$ 4,460
150mm PVC Main	92	Lineal Meters	$ 200	$ 18,400
150mm Gate Valve	1	Each	$ 2,250	$ 2,250
Water Services	8	Each	$ 2,500	$ 20,000
Tie-ins	2	Each	$ 2,500	$ 5,000
Pavement Restoration	1	Lump Sum	$ 10,120	$ 10,120

Subtotal , Construction Cost Estimate		**$ 60,230**
Project Administration & Engineering	15%	$ 9,040
Base Capital Cost		$ 69,270
Contingency Allowance	25%	$ 17,320
TOTAL CAPITAL COST ESTIMATE (*)		**$ 86,590**

Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	0%	100%	0%
Capital Value Apportionment	$ -	$ 86,590	$ -
Applicable CEC per SFE		$ 248	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2024

PROJECT NO: **Project #12**

PROJECT NAME: **Railway Ln. Main Upgrade**

On 7th Avenue, just north of 8th Avenue, increase the diameter of the existing 50mm PVC pipe to a 150mm PVC. This project addresses deficiencies in fire flow at FH #9. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 2,300	$ 2,300
150mm PVC Main	25	Lineal Meters	$ 200	$ 5,000
Tie-in	1	Each	$ 2,500	$ 2,500
Hydrant	1	Each	$ 6,500	$ 6,500
Pavement Restoration	1	Lump Sum	$ 4,500	$ 4,500
150mm Gate Valve	1	Each	$ 2,250	$ 2,250

Subtotal , Construction Cost Estimate		**$ 23,050**
Project Administration & Engineering	15%	$ 3,460
Base Capital Cost		$ 26,510
Contingency Allowance	25%	$ 6,630
TOTAL CAPITAL COST ESTIMATE (*)		**$ 33,140**

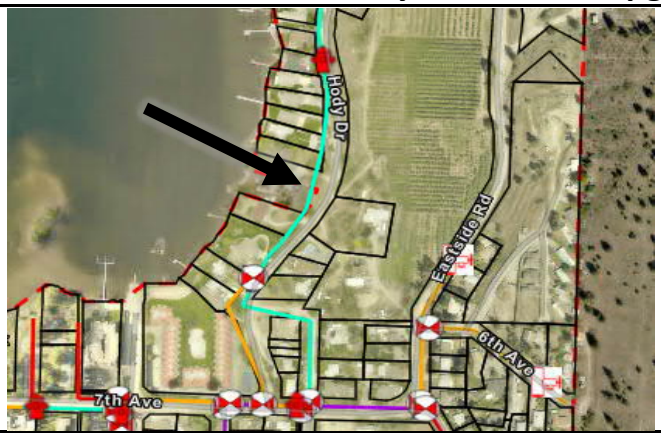
Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	0%	0%	100%
Capital Value Apportionment	$ -	$ -	$ 33,140
Applicable CEC per SFE		$ -	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2023

PROJECT NO: **Project #13**

PROJECT NAME: **Hody Drive Main Upgrade**



On Hody Drive, between 584 Hody Dr. and FH #27, increase the diameter of the existing 150mm PVC pipe to a 200mm PVC. This project addresses deficiencies in fire flow at FH #9. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 12,220	$ 12,220
200mm PVC Main	280	Lineal Meters	$ 250	$ 70,000
200mm Gate Valve	1	Each	$ 2,500	$ 2,500
Water Services	14	Each	$ 2,500	$ 35,000
Pavement Restoration	1	Lump Sum	$ 28,000	$ 28,000
Tie-in	2	Each	$ 2,500	$ 5,000
Subtotal , Construction Cost Estimate				**$ 152,720**
Project Administration & Engineering	15%			$ 22,910
Base Capital Cost				$ 175,630
Contingency Allowance	25%			$ 43,910
TOTAL CAPITAL COST ESTIMATE (*)				**$ 219,540**

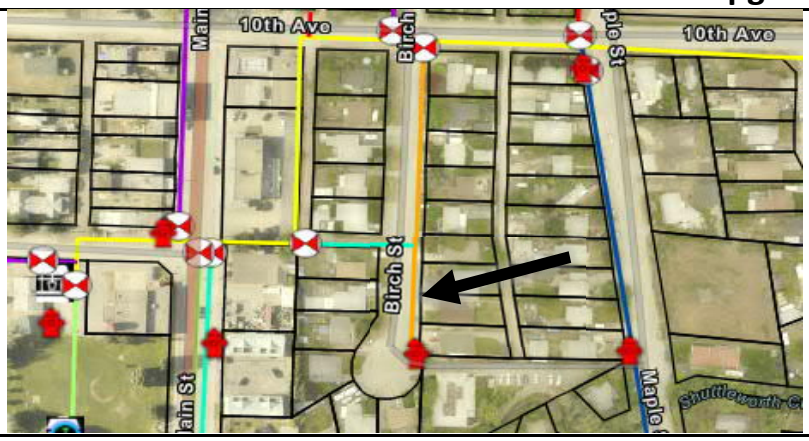
Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	0%	10%	90%
Capital Value Apportionment	$ -	$ 21,405	$ 198,135
Applicable CEC per SFE		$ 61	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2025

PROJECT NO: **Project #14**

PROJECT NAME: **Birch Street Main Upgrade**



On Birch Street, south of the connection to 11th Avenue, increase the diameter of the existing 100mm AC pipe to a 150mm PVC. This project addresses deficiencies in fire flow at FH #26. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 7,330	$ 7,330
150mm PVC Main	70	Lineal Meters	$ 200	$ 14,000
Tie-in	1	Lump Sum	$ 2,500	$ 2,500
Hydrant	1	Each	$ 6,500	$ 6,500
Water Services	21	Each	$ 2,500	$ 52,500
Pavement Restoration	1	Lump Sum	$ 8,750	$ 8,750

Subtotal , Construction Cost Estimate		**$ 91,580**
Project Administration & Engineering	15%	$ 13,740
Base Capital Cost		$ 105,320
Contingency Allowance	25%	$ 26,330
TOTAL CAPITAL COST ESTIMATE (*)		**$ 131,650**

Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	0%	10%	90%
Capital Value Apportionment	$ -	$ 12,836	$ 118,814
Applicable CEC per SFE		$ 37	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2025

PROJECT NO: **Project #15**

PROJECT NAME: **Barten Place Main Upgrade**

On Barten Place, west of Maple Street, increase the diameter of the existing 100mm AC pipe to a 150mm PVC. This project addresses deficiencies in fire flow at FH #32. The tasks to be completed are listed below.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
General Requirements	1	Lump Sum	$ 7,050	$ 7,050
150mm PVC Main	114	Lineal Meters	$ 200	$ 22,800
Tie-in	1	Lump Sum	$ 2,500	$ 2,500
Hydrant	1	Each	$ 6,500	$ 6,500
Water Services	14	Each	$ 2,500	$ 35,000
Pavement Restoration	1	Lump Sum	$ 14,250	$ 14,250

Subtotal , Construction Cost Estimate		**$ 88,100**
Project Administration & Engineering	15%	$ 13,220
Base Capital Cost		$ 101,320
Contingency Allowance	25%	$ 25,330
TOTAL CAPITAL COST ESTIMATE (*)		**$ 126,650**

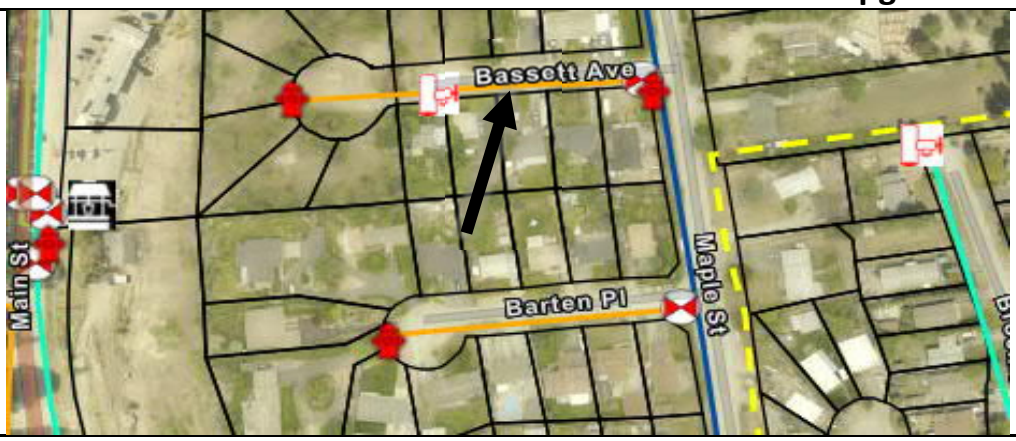
Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	0%	13%	87%
Capital Value Apportionment	$ -	$ 16,324	$ 110,326
Applicable CEC per SFE		$ 47	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2025

PROJECT NO: **Project #16**

PROJECT NAME: **Bassett Avenue Main Upgrade**



On Bassett Avenue, west of Maple Street, increase the diameter of the existing 100mm AC pipe to a 150mm PVC. This project addresses deficiencies in fire flow at FH #53. The tasks to be completed are listed below.

Capital Cost Estimate	Quantity	Unit	Unit Price	Extension
General Requirements	1	Lump Sum	$ 8,000	$ 8,000
150mm PVC Main	140	Lineal Meters	$ 200	$ 28,000
Tie-in	1	Lump Sum	$ 2,500	$ 2,500
Hydrant	1	Each	$ 6,500	$ 6,500
Water Services	15	Each	$ 2,500	$ 37,500
Pavement Restoration	1	Lump Sum	$ 17,500	$ 17,500

Subtotal , Construction Cost Estimate		**$ 100,000**
Project Administration & Engineering	15%	$ 15,000
Base Capital Cost		$ 115,000
Contingency Allowance	25%	$ 28,750
TOTAL CAPITAL COST ESTIMATE (*)		**$ 143,750**

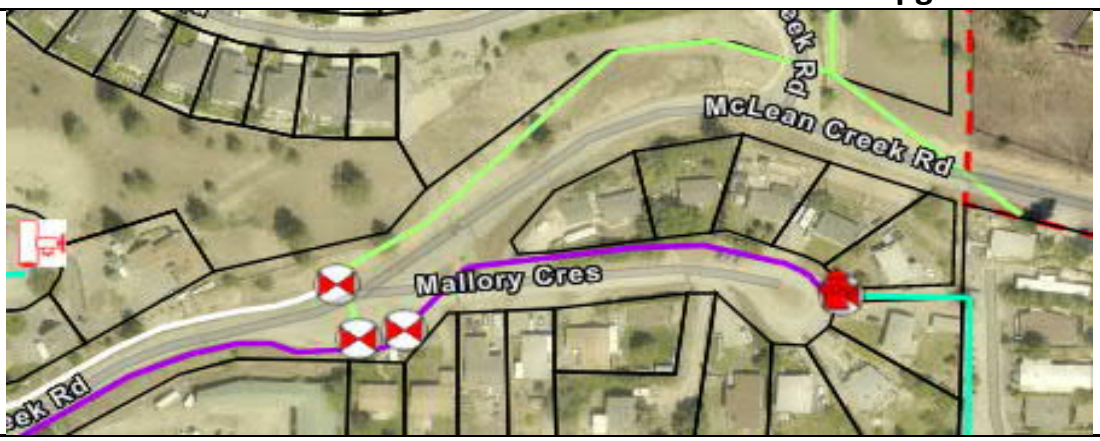
Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	0%	13%	87%
Capital Value Apportionment	$ -	$ 18,528	$ 125,222
Applicable CEC per SFE		$ 53	

CAPITAL PLAN: 2020-2025

PROPOSED IMPLEMENTATION YEAR: 2025

PROJECT NO: **Project #17**

PROJECT NAME: **McLean Creek Main Upgrade**



On McLean Creek Road, between Mallory Cres and the connection to the reservoir main, increase the diameter of the existing 200mm PVC pipe to a 250mm PVC. This project addresses deficiencies in fire flow at FH #50 and reduces losses for all the upper zone. The tasks to be completed are listed below.

Capital Cost Estimate	**Quantity**	**Unit**	**Unit Price**	**Extension**
General Requirements	1	Lump Sum	$ 6,600	$ 6,600
250mm PVC Main	200	Lineal Meters	$ 280	$ 56,000
250mm Gate Valve	1	Each	$ 2,800	$ 2,800
Tie-in	2	Each	$ 3,000	$ 6,000
Surface Restoration	1	Lump Sum	$ 11,000	$ 11,000

Subtotal , Construction Cost Estimate		**$ 82,400**
Project Administration & Engineering	15%	$ 12,360
Base Capital Cost		$ 94,760
Contingency Allowance	25%	$ 23,690
TOTAL CAPITAL COST ESTIMATE (*)		**$ 118,450**

Cost Benefit Assessment	Current Users	CEC Project	New Development
Apportionment	0%	23%	77%
Capital Value Apportionment	$ -	$ 26,722	$ 91,728
Applicable CEC per SFE		$ 77	

APPENDIX C – ECONOMIC MODEL

Data Input Tables

Project Cash Flow

Okanagan Falls Irrigation District - Data Input

Additional Number of Units	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Single Family Residential Lots		20.00	10.00	10.00	10.00	5.00	5.00	5.00	5.00	5.00
Multi-Family Residential Units	120.00	120.00	60.00	50.00	30.00	20.00	20.00	20.00	20.00	20.00
Industrial/Commercial Institutional	31.00	10.00	5.00	-	-	-				
Agricultural Irrigation (ha) Grade A	-	-	-	-	-	-				
Single Family Equivalent	111	110	55	43	30	18	18	18	18	18

Total Number of Units	Opening Balance										
Single Family Residential Lots	717.00	717.00	737.00	747.00	757.00	767.00	772.00	777.00	782.00	787.00	792.00
Multi-Family Residential Units	397.00	517.00	637.00	697.00	747.00	777.00	797.00	817.00	837.00	857.00	877.00
Industrial/Commercial Institutional	47.00	78.00	88.00	93.00	93.00	93.00	93.00	93.00	93.00	93.00	93.00
Agricultural Irrigation (ha) Grade A	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24	33.24
Single Family Equivalent	1051	1162	1272	1327	1370	1400	1418	1437	1455	1473	1492

Tax Rates - Expected Increase (%)										
Single Family	0.00%	8.00%	8.00%	8.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Multi Family	0.00%	8.00%	8.00%	8.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Industrial/Commercial/Institutional	0.00%	8.00%	8.00%	8.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Agriculture Irrigation (ha)	0.00%	8.00%	8.00%	8.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Tax Rates	Opening Rates										
Single Family	$ 264.08	$ 264.08	$ 285.21	$ 308.02	$ 332.66	$ 359.28	$ 359.28	$ 359.28	$ 359.28	$ 359.28	$ 359.28
Multi Family	$ 264.08	$ 264.08	$ 285.21	$ 308.02	$ 332.66	$ 359.28	$ 359.28	$ 359.28	$ 359.28	$ 359.28	$ 359.28
Industrial/Commercial/Institutional	$ 1,525.00	$ 1,525.00	$ 1,647.00	$ 1,778.76	$ 1,921.06	$ 2,074.75	$ 2,074.75	$ 2,074.75	$ 2,074.75	$ 2,074.75	$ 2,074.75
Agriculture Irrigation (ha)	$ 2,600.00	$ 2,600.00	$ 2,808.00	$ 3,032.64	$ 3,275.25	$ 3,537.27	$ 3,537.27	$ 3,537.27	$ 3,537.27	$ 3,537.27	$ 3,537.27

Toll Rates - Expected Increase (%)										
Single Family	0.00%	8.00%	8.00%	8.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Multi Family	0.00%	8.00%	8.00%	8.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Industrial/Commercial/Institutional	0.00%	8.00%	8.00%	8.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Agriculture Irrigation (ha)	0.00%	8.00%	8.00%	8.00%	8.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Toll Rates	Opening Rates										
Single Family	$ 216.70	$ 216.70	$ 234.04	$ 252.76	$ 272.98	$ 294.82	$ 294.82	$ 294.82	$ 294.82	$ 294.82	$ 294.82
Multi Family	$ 210.93	$ 210.93	$ 227.80	$ 246.03	$ 265.71	$ 286.97	$ 286.97	$ 286.97	$ 286.97	$ 286.97	$ 286.97
Industrial/Commercial/Institutional	$ 455.00	$ 455.00	$ 491.40	$ 530.71	$ 573.17	$ 619.02	$ 619.02	$ 619.02	$ 619.02	$ 619.02	$ 619.02
Agriculture Irrigation (ha)	$ 1,105.00	$ 1,105.00	$ 1,193.40	$ 1,288.87	$ 1,391.98	$ 1,503.34	$ 1,503.34	$ 1,503.34	$ 1,503.34	$ 1,503.34	$ 1,503.34

Revenue Forecast

District Revenue -other	2020 - Per Financials	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Taxes	$ 452,000.00	$ 531,248.72	$ 630,147.51	$ 711,014.72	$ 787,855.78	$ 865,255.36	$ 874,237.31	$ 883,219.26	$ 892,201.20	$ 901,183.15	$ 910,165.10
Tolls	$ 297,841.00	$ 336,644.91	$ 400,507.75	$ 452,491.24	$ 504,705.89	$ 556,639.58	$ 563,853.03	$ 571,066.48	$ 578,279.93	$ 585,493.38	$ 592,706.82
Water on/off	$ 500.00										
Cemetery Fees	$ 10,000.00										
Developer deposits	$ -										
Street Lighting	$ 26,000.00										
Rental Income	$ -										
2019 adjustments (one time only)	$ -										
Total Operating Revenues	$ 786,341.00	$ 867,893.63	$ 1,030,655.26	$ 1,163,505.96	$ 1,292,561.67	$ 1,421,894.94	$ 1,438,090.34	$ 1,454,285.74	$ 1,470,481.13	$ 1,486,676.53	$ 1,502,871.93

Non-Operating Revenues		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
GIC & TDR interest	$ 5,000.00										
Interest Operating Account	$ 2,000.00										
Penalties and interest on taxes	$ -										
Misc. Income (Centennial Grant/Fortis)	$ 450.00										
Capital funds interest	$ -										
Total Non-Operating Revenues	$ 7,450.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL REVENUE	$ 793,791.00	$ 867,893.63	$ 1,030,655.26	$ 1,163,505.96	$ 1,292,561.67	$ 1,421,894.94	$ 1,438,090.34	$ 1,454,285.74	$ 1,470,481.13	$ 1,486,676.53	$ 1,502,871.93
		1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Total Operating Expenses	$ 97,000.00	$ 97,970.00	$ 98,949.70	$ 99,939.20	$ 100,938.59	$ 101,947.97	$ 102,967.45	$ 103,997.13	$ 105,037.10	$ 106,087.47	$ 107,148.35
Total Payroll Expenses	$ 326,987.00	$ 330,256.87	$ 333,559.44	$ 336,895.03	$ 340,263.98	$ 343,666.62	$ 347,103.29	$ 350,574.32	$ 354,080.07	$ 357,620.87	$ 361,197.07
Total General Administrative Expenses	$ 157,800.00	$ 159,378.00	$ 160,971.78	$ 162,581.50	$ 164,207.31	$ 165,849.39	$ 167,507.88	$ 169,182.96	$ 170,874.79	$ 172,583.54	$ 174,309.37
Total Expenses	$ 581,787.00	$ 587,604.87	$ 593,480.92	$ 599,415.73	$ 605,409.89	$ 611,463.98	$ 617,578.62	$ 623,754.41	$ 629,991.95	$ 636,291.87	$ 642,654.79
Net Income	$ 204,554.00	$ 280,288.76	$ 437,174.35	$ 564,090.24	$ 687,151.79	$ 810,430.96	$ 820,511.71	$ 830,531.33	$ 840,489.18	$ 850,384.65	$ 860,217.13
Transfer to Asset Replacement Fund	$ 86,138.00	$ 5,000.00	$ 5,000.00	$ 200,000.00	$ 290,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00
Transfer to Capital Exp Reserve	$ 125,590.00	$ 275,000.00	$ 432,000.00	$ 360,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00

Rate Payers Cap Reserve	Opening Balance	$62,532.00	$566,223.92	$1,098,813.81	-$172,162.67	-$84,501.59	$38,286.82	$156,605.71	$274,924.60	$393,243.49	$511,562.39
Capital Reserve (CEC)	$ 62,532.00										
Received from new development	$ -	$ 729,633.17	$ 723,059.90	$ 361,529.95	$ 282,650.69	$ 197,198.15	$ 118,318.89	$ 118,318.89	$ 118,318.89	$ 118,318.89	$ 118,318.89
Transfers in from external funding sources											
Interest Earned (Excludes present year CEC's)											
CEC Revenue from New Development											
Debt Servicing											
CEC Project Expenditures		-$ 225,941.25	-$ 190,470.00	-$ 1,632,506.43	-$ 194,989.60	-$ 74,409.75	$ -	$ -	$ -	$ -	$ -
Rate Payer Cap Reserve Balance Before Interest and Finance	$ 62,532.00	$ 566,223.92	$ 1,098,813.81	-$ 172,162.67	-$ 84,501.59	$ 38,286.82	$ 156,605.71	$ 274,924.60	$ 393,243.49	$ 511,562.39	$ 629,881.28
CEC Reserve Balance Earning Interest											
Amount of Finance											
Rate Payer Cap Reserve Balance at End of Year	$ 62,532.00	$ 566,223.92	$ 1,098,813.81	-$ 172,162.67	-$ 84,501.59	$ 38,286.82	$ 156,605.71	$ 274,924.60	$ 393,243.49	$ 511,562.39	$ 629,881.28

Capital Exp Reserve	Opening Balance	$341,716.58	$133,145.46	$374,675.46	$279,373.42	$591,619.82	$941,619.82	$1,291,619.82	$1,641,619.82	$1,991,619.82	$2,341,619.82
General Reserve	$ 216,126.58										
Transfer from Operations	$ 125,590.00	$ 275,000.00	$ 432,000.00	$ 360,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00
Transfers in from external funding sources											
Interest Earned											
Debt Servicing											
CEC Project Expenditures		-$ 483,571.13	-$ 190,470.00	-$ 455,302.03	-$ 37,753.60	$ -	$ -	$ -	$ -	$ -	$ -
Capital Expense Reserve Balance before Interest and Finance	$ 341,716.58	$ 133,145.46	$ 374,675.46	$ 279,373.42	$ 591,619.82	$ 941,619.82	$ 1,291,619.82	$ 1,641,619.82	$ 1,991,619.82	$ 2,341,619.82	$ 2,691,619.82
CEC Reserve Balance Earning Interest											
Amount of Finance											
Capital Exp Reserve Balance at End of Year	$ 341,716.58	$ 133,145.46	$ 374,675.46	$ 279,373.42	$ 591,619.82	$ 941,619.82	$ 1,291,619.82	$ 1,641,619.82	$ 1,991,619.82	$ 2,341,619.82	$ 2,691,619.82

Asset Replacement Fund	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Opening Balance	$ 478,981.32	$ 283,128.70	$ 288,128.70	$ 175,963.09	$ 277,866.29	$ 181,776.04	$ 531,776.04	$ 881,776.04	$ 1,231,776.04	$ 1,581,776.04
Additions										
Allocation/Transfer from Operating	$ 5,000.00	$ 5,000.00	$ 200,000.00	$ 290,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00
External Sources										
Interest Earned (Excludes present year CEC's)										
Total Additions	$ 5,000.00	$ 5,000.00	$ 200,000.00	$ 290,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00
Deductions										
Project Allocations/Expenditure	$ 200,852.63	$ -	$ 312,165.60	$ 188,096.80	$ 446,090.25	$ -	$ -	$ -	$ -	$ -
Total Deductions	$ 200,852.63	$ -	$ 312,165.60	$ 188,096.80	$ 446,090.25	$ -	$ -	$ -	$ -	$ -
Ending Balance	$ 283,128.70	$ 288,128.70	$ 175,963.09	$ 277,866.29	$ 181,776.04	$ 531,776.04	$ 881,776.04	$ 1,231,776.04	$ 1,581,776.04	$ 1,931,776.04

Cash Flow

			Opening Balance	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Opening Balance				$ 73,860.23	$ 73,860.23	$ 354,148.99	$ 791,323.34	$ 1,355,413.57	$ 2,042,565.36	$ 2,852,996.32	$ 3,673,508.03	$ 4,504,039.36	$ 5,344,528.54
Cash In-flows													
Receipts from Revenue					$ 867,893.63	$ 1,030,655.26	$ 1,163,505.96	$ 1,292,561.67	$ 1,421,894.94	$ 1,438,090.34	$ 1,454,285.74	$ 1,470,481.13	$ 1,486,676.53
CEC Rate Payer (transfers from CEC Pool)					$ 225,941.25	$ 190,470.00	$ 1,632,506.43	$ 194,989.60	$ 74,409.75	$ -	$ -	$ -	$ -
Capital Exp Reserve					$ 483,571.13	$ 190,470.00	$ 455,302.03	$ 37,753.60	$ -	$ -	$ -	$ -	$ -
Asset Replacement (Transfer from Asset Replacement Fund)					$ 200,852.63	$ -	$ 312,165.60	$ 188,096.80	$ 446,090.25	$ -	$ -	$ -	$ -
Total Cash In				$ -	$ 1,778,258.63	$ 1,411,595.26	$ 3,563,480.03	$ 1,713,401.67	$ 1,942,394.94	$ 1,438,090.34	$ 1,454,285.74	$ 1,470,481.13	$ 1,486,676.53
Cash Out-Flows													
Operating Expenses					$ 587,604.87	$ 593,480.92	$ 599,415.73	$ 605,409.89	$ 611,463.98	$ 617,578.62	$ 623,754.41	$ 629,991.95	$ 636,291.87
Project #1 - Lower Zone Dedicated Main	CEC Projects	2021			$ 140,320.00								
Project #2 - 11th Ave Main Upgrade	CEC Projects	2023					$ 16,802.63						
Project #3 - Maple Street Main Upgrade	CEC Projects	2023					$ 176,806.62						
Project #4 - Cascade Valve Relocation	CEC Projects	2021			$ 85,621.25								
Project #5 - Upper Zone Storage Expansion	CEC Projects	2023					$ 1,417,492.04						
Project #6 - 7th Avenue Main Upgrade	CEC Projects	2024						$ 12,794.40					
Project #7 - Hawthorne Cres. Main Upgrades	CEC Projects	2024						$ 74,368.80					
Project #8 - Mosley Place Blowoff	CEC Projects	2021			$ -								
Project #9 - 14th Avenue Looped Main	CEC Projects	2024						$ 21,236.40					
Project #10 - New Water Source	CEC Projects	2022				$ 190,470.00							
Project #11 - Eastside Road Main Upgrade	CEC Projects	2024						$ 86,590.00					
Project #12 - Railway Ln. Main Upgrade	CEC Projects	2024						$ -					
Project #13 - Hody Drive Main Upgrade	CEC Projects	2023					$ 21,405.15						
Project #14 - Birch Street Main Upgrade	CEC Projects	2025							$ 12,835.88				
Project #15 - Barten Place Main Upgrade	CEC Projects	2025							$ 16,323.78				
Project #16 - Bassett Avenue Main Upgrade	CEC Projects	2025							$ 18,527.78				
Project #17 - McLean Creek Main Upgrade	CEC Projects	2025							$ 26,722.32				
Total CEC (Rate Payers Account)					**$ 225,941.25**	**$ 190,470.00**	**$ 1,632,506.43**	**$ 194,989.60**	**$ 74,409.75**	**$ -**	**$ -**	**$ -**	**$ -**
Project #1 - Lower Zone Dedicated Main	Current Users	2021			$ 399,912.00								
Project #2 - 11th Ave Main Upgrade	Current Users	2023					$ -						
Project #3 - Maple Street Main Upgrade	Current Users	2023					$ -						
Project #4 - Cascade Valve Relocation	Current Users	2021			$ 77,059.13								
Project #5 - Upper Zone Storage Expansion	Current Users	2023					$ 455,302.03						
Project #6 - 7th Avenue Main Upgrade	Current Users	2024						$ -					
Project #7 - Hawthorne Cres. Main Upgrades	Current Users	2024						$ -					
Project #8 - Mosley Place Blowoff	Current Users	2021			$ 6,600.00								
Project #9 - 14th Avenue Looped Main	Current Users	2024						$ 37,753.60					
Project #10 - New Water Source	Current Users	2022				$ 190,470.00							
Project #11 - Eastside Road Main Upgrade	Current Users	2024						$ -					
Project #12 - Railway Ln. Main Upgrade	Current Users	2024						$ -					
Project #13 - Hody Drive Main Upgrade	Current Users	2023					$ -						
Project #14 - Birch Street Main Upgrade	Current Users	2025							$ -				
Project #15 - Barten Place Main Upgrade	Current Users	2025							$ -				
Project #16 - Bassett Avenue Main Upgrade	Current Users	2025							$ -				
Project #17 - McLean Creek Main Upgrade	Current Users	2025							$ -				
Total Existing Users (Cap Expenditure CEC)					**$ 483,571.13**	**$ 190,470.00**	**$ 455,302.03**	**$ 37,753.60**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**

				2021	2022	2023	2024	2025	2026	2027	2028	2029
Project #1 - Lower Zone Dedicated Main	Capital Replacement	2021		$ 21,048.00								
Project #2 - 11th Ave Main Upgrade	Capital Replacement	2023				$ 43,747.38						
Project #3 - Maple Street Main Upgrade	Capital Replacement	2023				$ 70,283.38						
Project #4 - Cascade Valve Relocation	Capital Replacement	2021		$ 179,804.63								
Project #5 - Upper Zone Storage Expansion	Capital Replacement	2023				$ -						
Project #6 - 7th Avenue Main Upgrade	Capital Replacement	2024					$ 22,745.60					
Project #7 - Hawthorne Cres. Main Upgrades	Capital Replacement	2024					$ 132,211.20					
Project #8 - Mosley Place Blowoff	Capital Replacement	2021		$ -								
Project #9 - 14th Avenue Looped Main	Capital Replacement	2024					$ -					
Project #10 - New Water Source	Capital Replacement	2022			$ -							
Project #11 - Eastside Road Main Upgrade	Capital Replacement	2024					$ -					
Project #12 - Railway Ln. Main Upgrade	Capital Replacement	2024					$ 33,140.00					
Project #13 - Hody Drive Main Upgrade	Capital Replacement	2023				$ 198,134.85						
Project #14 - Birch Street Main Upgrade	Capital Replacement	2025						$ 118,814.13				
Project #15 - Barten Place Main Upgrade	Capital Replacement	2025						$ 110,326.22				
Project #16 - Bassett Avenue Main Upgrade	Capital Replacement	2025						$ 125,222.22				
Project #17 - McLean Creek Main Upgrade	Capital Replacement	2025						$ 91,727.68				
Total Asset Replacement				**$ 200,852.63**	**$ -**	**$ 312,165.60**	**$ 188,096.80**	**$ 446,090.25**	**$ -**	**$ -**	**$ -**	**$ -**
Total Cash Out Flow			$ -	$ 1,497,969.87	$ 974,420.92	$ 2,999,389.79	$ 1,026,249.89	$ 1,131,963.98	$ 617,578.62	$ 623,754.41	$ 629,991.95	$ 636,291.87
Cash Ending			$ 73,860.23	$ 354,148.99	$ 791,323.34	$ 1,355,413.57	$ 2,042,565.36	$ 2,852,996.32	$ 3,673,508.03	$ 4,504,039.36	$ 5,344,528.54	$ 6,194,913.19

CEC Rate Payer Reserve

		2021	2022	2023	2024	2025	2026	2027	2028	2029
Opening Balance	$ 62,532.00	$ 62,532.00	$ 566,223.92	$ 1,098,813.81	-$ 172,162.67	-$ 84,501.59	$ 38,286.82	$ 156,605.71	$ 274,924.60	$ 393,243.49
Additions										
CEC Revenue from New Development		$ 729,633.17	$ 723,059.90	$ 361,529.95	$ 282,650.69	$ 197,198.15	$ 118,318.89	$ 118,318.89	$ 118,318.89	$ 118,318.89
External Sources		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Earned (Excludes present year CEC's)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Debt Servicing (Total of All Debt)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Additions		$ 729,633.17	$ 723,059.90	$ 361,529.95	$ 282,650.69	$ 197,198.15	$ 118,318.89	$ 118,318.89	$ 118,318.89	$ 118,318.89
Deductions										
Project Allocations/Expenditure		$ 225,941.25	$ 190,470.00	$ 1,632,506.43	$ 194,989.60	$ 74,409.75	$ -	$ -	$ -	$ -
Total Deductions		$ 225,941.25	$ 190,470.00	$ 1,632,506.43	$ 194,989.60	$ 74,409.75	$ -	$ -	$ -	$ -
Ending Balance	$ 62,532.00	$ 566,223.92	$ 1,098,813.81	-$ 172,162.67	-$ 84,501.59	$ 38,286.82	$ 156,605.71	$ 274,924.60	$ 393,243.49	$ 511,562.39

Capital Exp Reserve

Opening Balance	$ 216,126.58	$ 341,716.58	$ 133,145.46	$ 374,675.46	$ 279,373.42	$ 591,619.82	$ 941,619.82	$ 1,291,619.82	$ 1,641,619.82	$ 1,991,619.82
Additions										
Transfer from Operations	$ 125,590.00	$ 275,000.00	$ 432,000.00	$ 360,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00
External Sources	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Earned (Excludes present year CEC's)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Debt Servicing (Total of All Debt)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Additions	$ 125,590.00	$ 275,000.00	$ 432,000.00	$ 360,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00
Deductions										
Project Allocations/Expenditure	$ -	$ 483,571.13	$ 190,470.00	$ 455,302.03	$ 37,753.60	$ -	$ -	$ -	$ -	$ -
Total Deductions	$ -	$ 483,571.13	$ 190,470.00	$ 455,302.03	$ 37,753.60	$ -	$ -	$ -	$ -	$ -
Ending Balance	$ 341,716.58	$ 133,145.46	$ 374,675.46	$ 279,373.42	$ 591,619.82	$ 941,619.82	$ 1,291,619.82	$ 1,641,619.82	$ 1,991,619.82	$ 2,341,619.82

Asset Replacement Fund			2021	2022	2023	2024	2025	2026	2027	2028	2029
	Opening Balance	$ 478,981.32	$ 478,981.32	$ 283,128.70	$ 288,128.70	$ 175,963.09	$ 277,866.29	$ 181,776.04	$ 531,776.04	$ 881,776.04	$ 1,231,776.04
Additions											
Allocation/Transfer from Operating		$ -	$ 5,000.00	$ 5,000.00	$ 200,000.00	$ 290,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00
External Sources		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Earned (Excludes present year CEC's)		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Additions		$ -	$ 5,000.00	$ 5,000.00	$ 200,000.00	$ 290,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00	$ 350,000.00
Deductions											
Project Allocations/Expenditure		$ -	$ 200,852.63	$ -	$ 312,165.60	$ 188,096.80	$ 446,090.25	$ -	$ -	$ -	$ -
Total Deductions		$ -	$ 200,852.63	$ -	$ 312,165.60	$ 188,096.80	$ 446,090.25	$ -	$ -	$ -	$ -
Ending Balance		$ 478,981.32	$ 283,128.70	$ 288,128.70	$ 175,963.09	$ 277,866.29	$ 181,776.04	$ 531,776.04	$ 881,776.04	$ 1,231,776.04	$ 1,581,776.04

APPENDIX D – WATER MODEL DATA

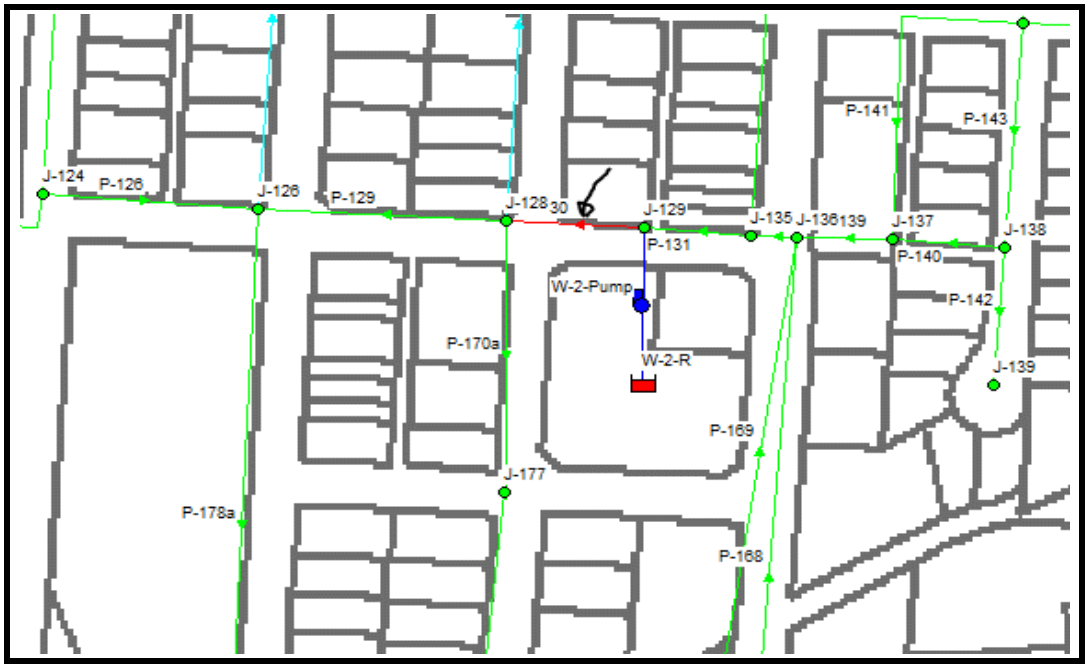
Summary of Model Deficiencies

Summary of Model Deficiencies

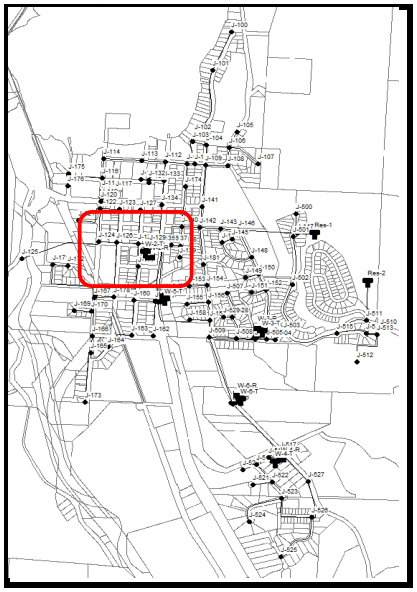
HIGH PRIORITY ITEM

Deficiency Number: #1
Model Conditions: MDD, FF = 60L/s at various FHs
Deficiency Location: 150mm AC on 11th Ave east of Willow St , near Well #2

Location Map:



Key Map:



Description of Issue:
P-130 has velocities over 4 m/s when the following FHs run at 60 L/s: FH #1, #2, #3, #4, #5, #6, #7, #11, #12, #13, #14, and #16.

Possible Solution(s) to Issue:
1) Upsizing P-130 to a 200mm to reduce velocities.

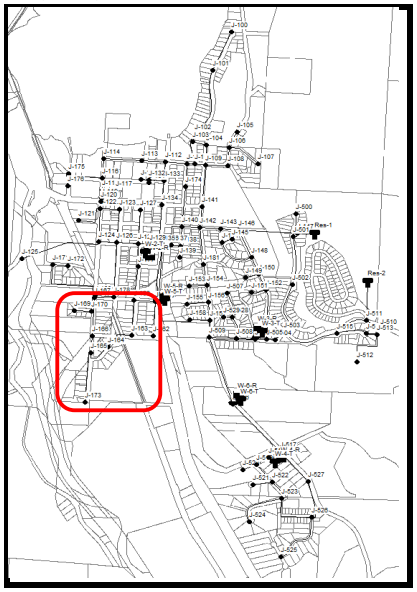
Summary of Model Deficiencies

MEDIUM PRIORITY ITEM

Deficiency Number: #2
Model Conditions: MDD, FF = 60L/s at FH #1 (J-165) or #17 (J-163)
Deficiency Location: Line velocities on Cedar St between 13th/14th
Low pressures at end of Cedar Street

Location Map:

Key Map:



Description of Issue:
When fire hydrant #1 or #17 runs at 60 L/s, P-177 and P-173 have velocities over 4 m/s. Also, the pressure at J-173 (south end of Cedar) drops below 20 psi when FH #1 runs.

Possible Solution(s) to Issue:
1) Upsizing either P-177 or P-173 to a 150mm (both are 100mm). Only one needs to be resized to correct the velocities and low pressures.

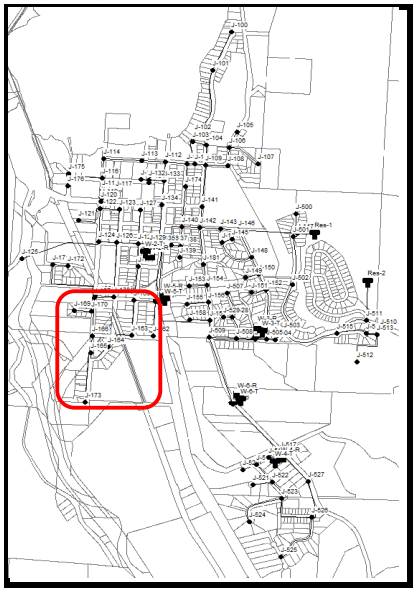
Summary of Model Deficiencies

MEDIUM PRIORITY ITEM

Deficiency Number: #3
Model Conditions: MDD, FF = 60L/s at FH #1 (J-165) or #17 (J-163)
Deficiency Location: Line velocities on Willow St between 13th/14th
Low pressures at end of Cedar Street

Location Map:

Key Map:



Description of Issue:
When fire hydrant #1 or #17 runs at 60 L/s, P-177 and P-173 have velocities over 4 m/s. Also, the pressure at J-173 (south end of Cedar) drops below 20 psi when FH #1 runs.

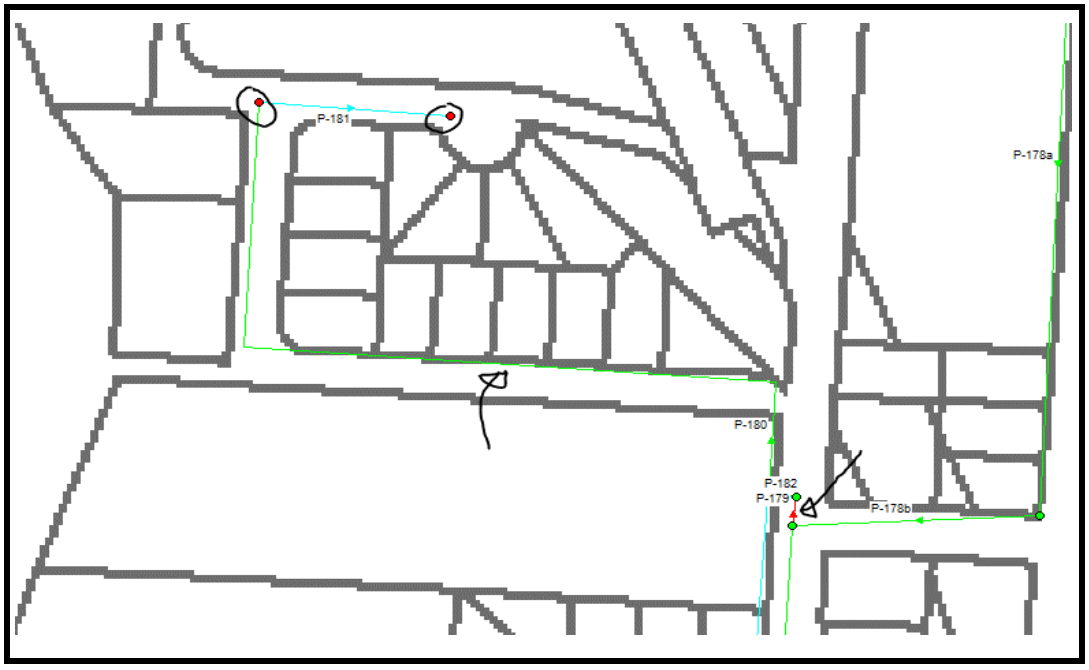
Possible Solution(s) to Issue:
1) Upsizing either P-177 or P-173 to a 150mm (both are 100mm). Only one needs to be resized to correct the velocities and low pressures.

Summary of Model Deficiencies

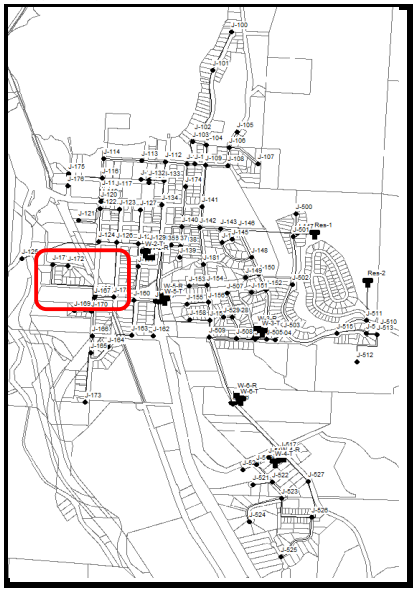
MEDIUM PRIORITY ITEM

Deficiency Number: #4
Model Conditions: MDD, FF = 60L/s at FH #3 (J-171)
Deficiency Location: Line velocities on short 100mm line (P-179) on Cedar St
Low pressures at lots along Hawthorne Cres.

Location Map:



Key Map:



Description of Issue:
When fire hydrant #3 runs at 60 L/s, the pressure at J-171 and J-172 (west side of Hawthorne Cres) drops below 20 psi. This area is on P-180, a 150mm AC pipe, and is connected to the rest of the system by P-179, a 100mm AC pipe. FH #2 and #3 both cause high velocities in P-179.

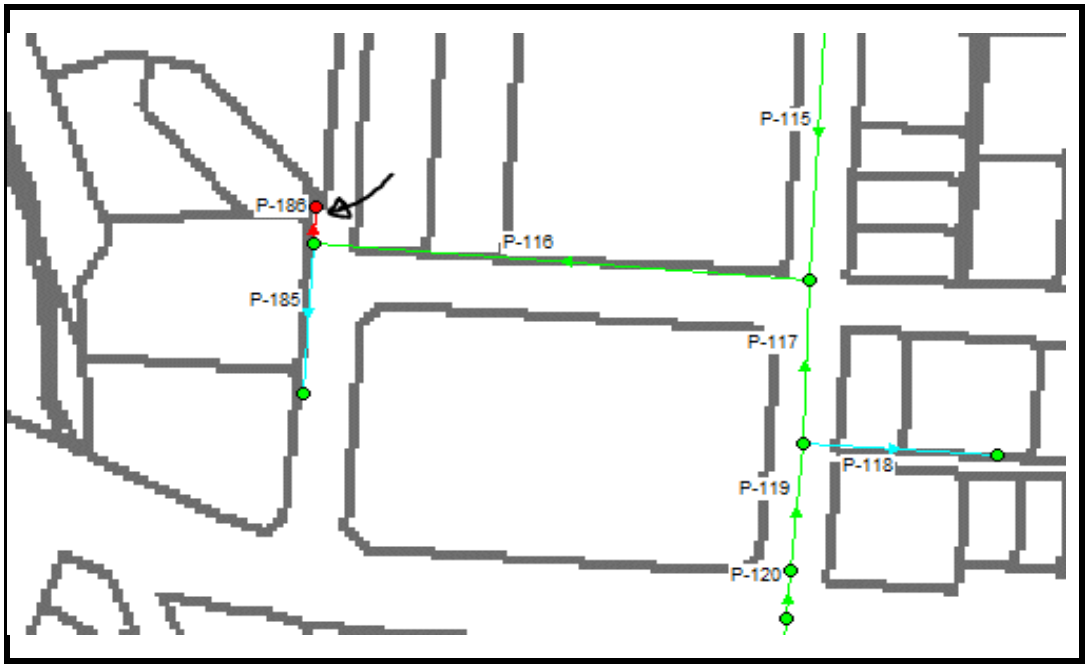
Possible Solution(s) to Issue:
1) Upsizing P-180 to 200mm along Hawthorne Cres and Cedar St & upsizing P-179 to 200mm just south on Cedar Street

Summary of Model Deficiencies

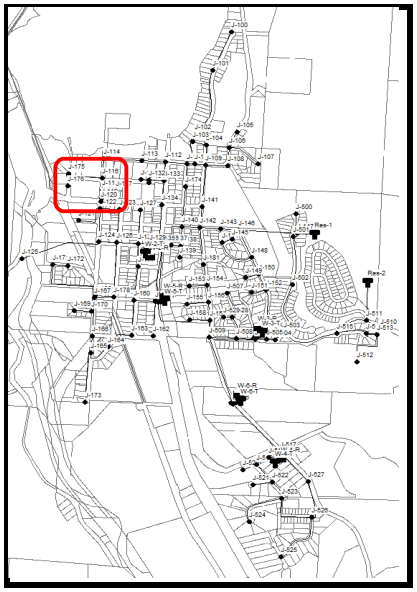
LOW PRIORITY ITEM

Deficiency Number: #5
Model Conditions: MDD, FF = 60L/s at FH #9 (J-175)
Deficiency Location: Line velocities on Railway Ln, 50mm PVC (P-186)
Hydrant #9 unable to deliver 60 L/s

Location Map:



Key Map:



Description of Issue:
When fire hydrant #9 runs, the current 50mm line is unable to deliver 60 L/s.

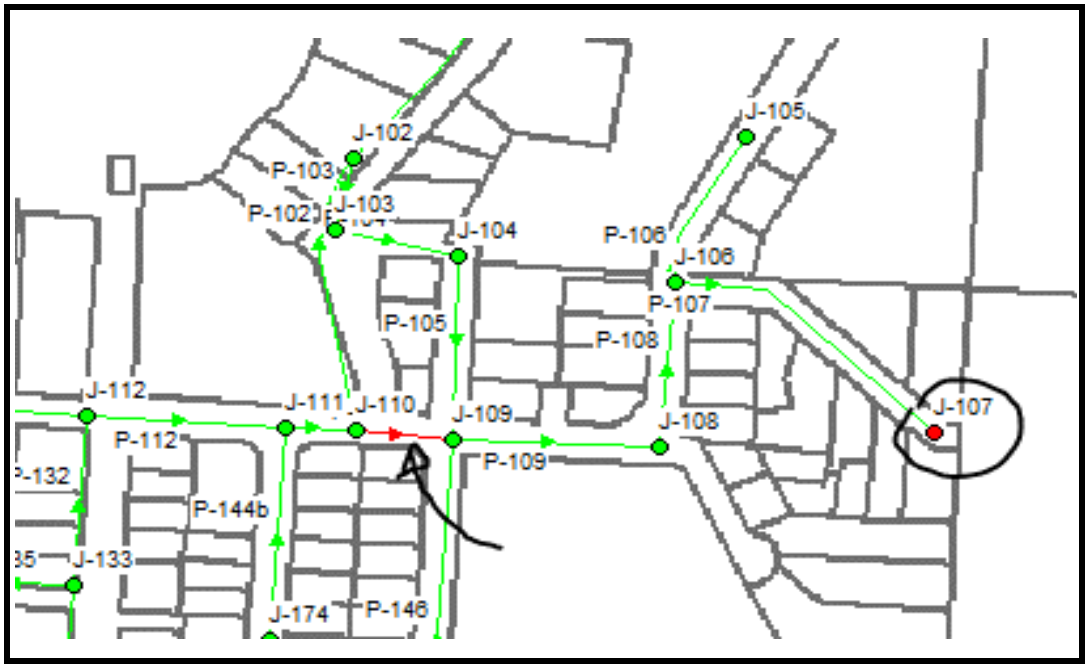
Possible Solution(s) to Issue:
1) Upsizing to a 150mm. This is an adequate size to avoid excessive velocities as well.

Summary of Model Deficiencies

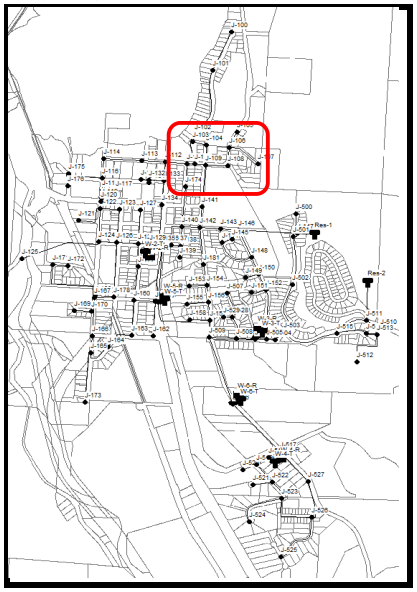
MEDIUM PRIORITY ITEM

Deficiency Number: #6
Model Conditions: MDD, FF = 60L/s at FH #24 (J-109) or FH #27 (J-101)
Deficiency Location: Line velocities on 7th Ave, 100mm PVC (P-110)
Low pressures at east side of 6th Ave

Location Map:



Key Map:



Description of Issue:
When fire hydrant #24 or #27 runs at 60 L/s, P-110 has velocities over 4 m/s. Also, the pressure at J-107 (east end of 6th Ave) drops below 20 psi.

Possible Solution(s) to Issue:
1) Upsizing to a 150mm to reduce velocities. This also solves the low pressure, when done in conjuction with upsizing P-147 (see deficiency #7).

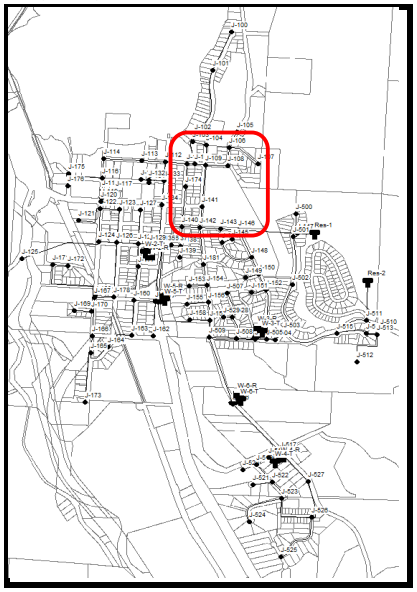
Summary of Model Deficiencies

HIGH PRIORITY ITEM

Deficiency Number: #7
Model Conditions: MDD, FF = 60L/s at various FHs
Deficiency Location: Low pressures at east side of 6th Ave, can be aided by upsizing P-147 on Maple St near 10th Ave (a 38mm PVC)

Location Map:

Key Map:



Description of Issue:
When fire hydrant #24, #27 or #28 runs at 60 L/s, the pressure at J-107 (east end of 6th Ave) drops below 20 psi. When FH #29 runs, the surrounding line velocities are high and the current 38mm line is unable to deliver 60 L/s.

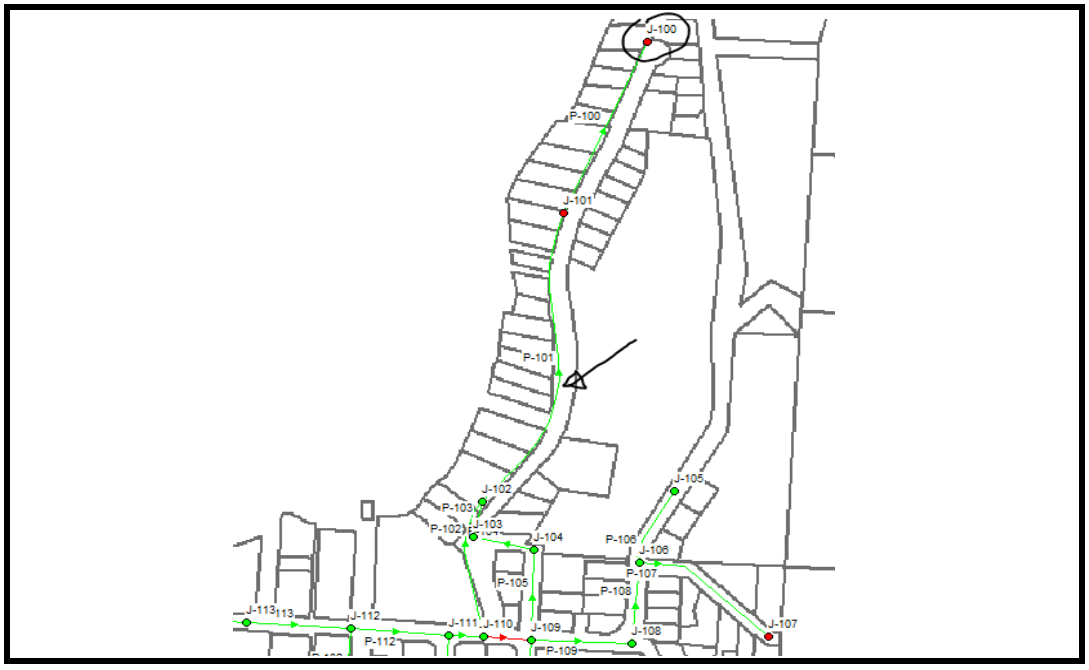
Possible Solution(s) to Issue:
1) Upsizing P-147 to a 150mm. This solves the low pressure, and high velocities when FH #29 is run.

Summary of Model Deficiencies

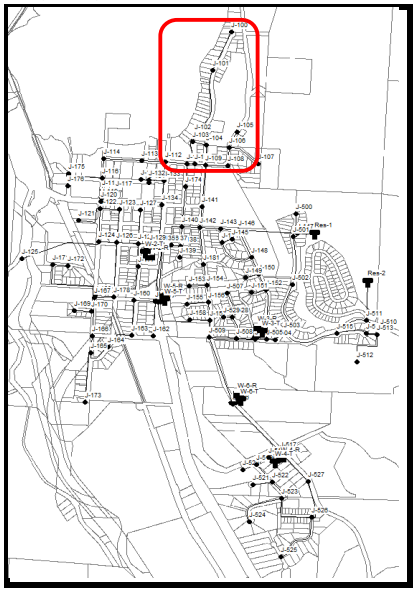
LOW PRIORITY ITEM

Deficiency Number: #8
Model Conditions: MDD, FF = 60L/s at FH #28 (J-100)
Deficiency Location: Low pressures at north of Hody Dr, can be aided by upsizing P-101 (a 150mm PVC) on Hody between the doubled line and FH #27

Location Map:



Key Map:



Description of Issue:
When fire hydrant #28 runs at 60 L/s, the pressures along a majority of Hody Drive drop below 20 psi.

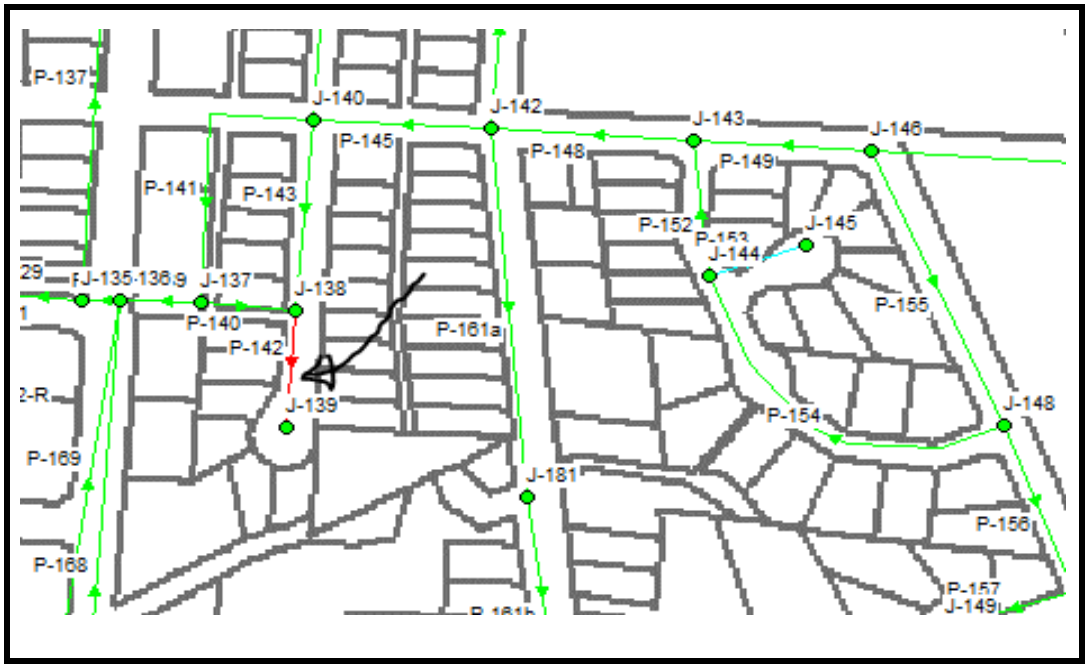
Possible Solution(s) to Issue:
1) Upsizing P-101 to a 200mm. This solves the low pressure when done in conjuction with upsizing P-147 (see deficiency #7).

Summary of Model Deficiencies

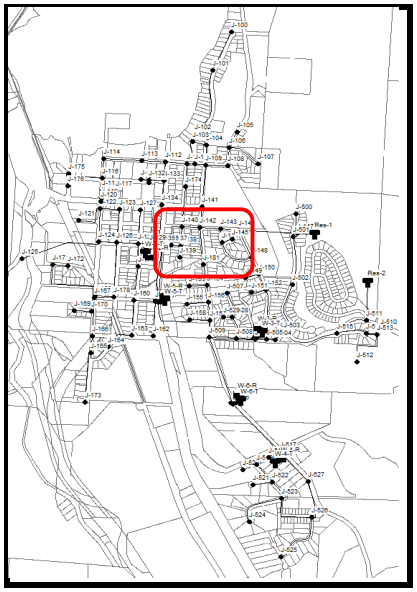
LOW PRIORITY ITEM

Deficiency Number: #9
Model Conditions: MDD, FF = 60L/s at FH #26 (J-139)
Deficiency Location: Line velocities south end of Birch St, 100mm AC (P-142)

Location Map:



Key Map:



Description of Issue:
When fire hydrant #26 runs at 60 L/s, P-142 has velocities over 4 m/s. There are no pressures below 20 psi because of this deficiency.

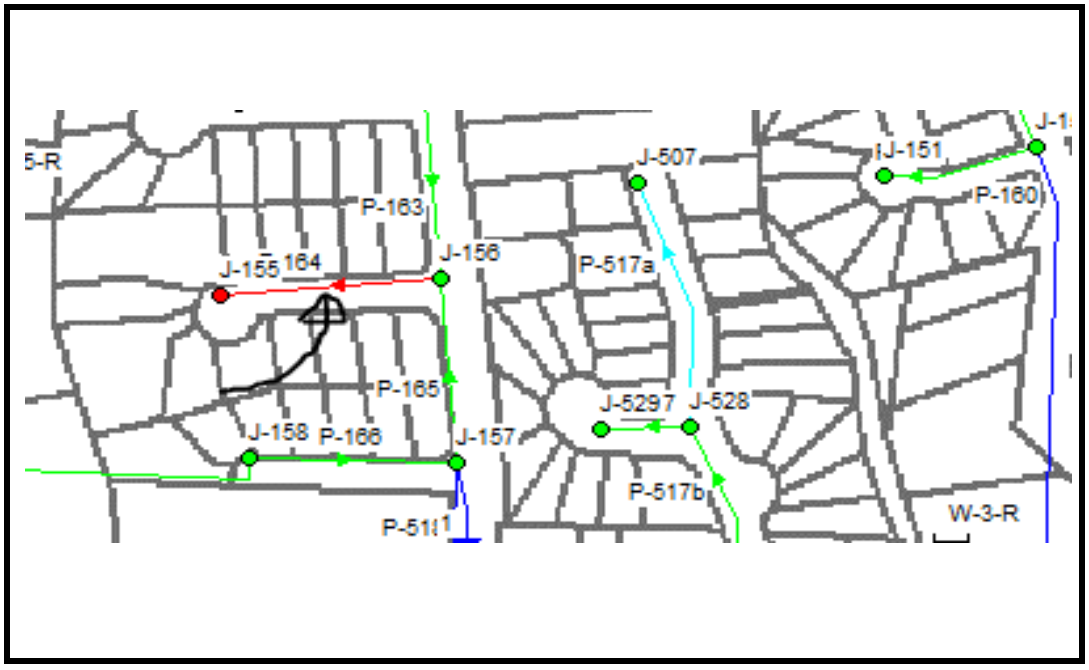
Possible Solution(s) to Issue:
1) Upsizing P-142 to a 150mm to reduce velocities.

Summary of Model Deficiencies

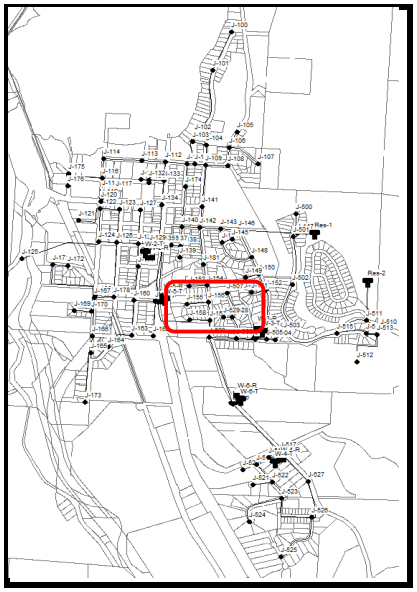
LOW PRIORITY ITEM

Deficiency Number: #10
Model Conditions: MDD, FF = 60L/s at FH #32 (J-155)
Deficiency Location: Line velocities on Barten Pl, 100mm AC (P-164)
Hydrant #32 unable to deliver 60 L/s

Location Map:



Key Map:



Description of Issue:
When fire hydrant #32 runs, the current 100mm line is unable to deliver 60 L/s.

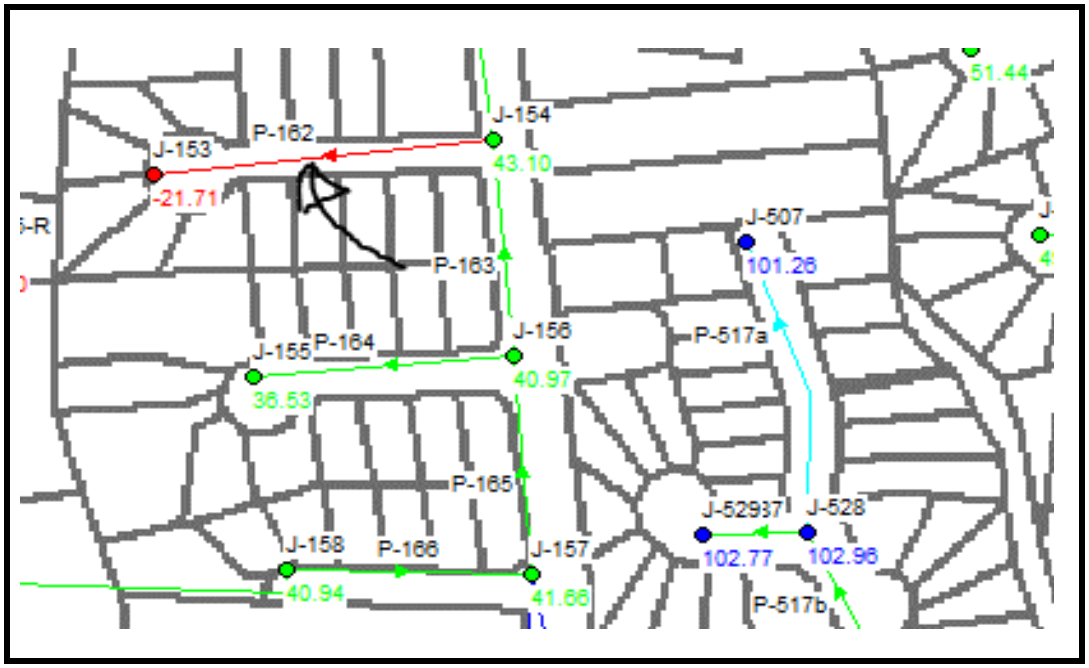
Possible Solution(s) to Issue:
1) Upsizing to a 150mm. This is an adequate size to avoid excessive velocities as well.

Summary of Model Deficiencies

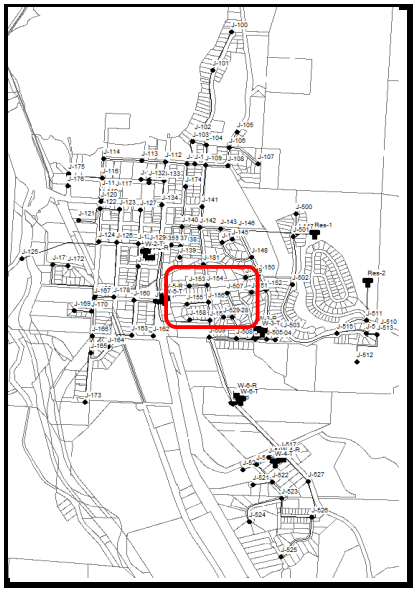
LOW PRIORITY ITEM

Deficiency Number: #11
Model Conditions: MDD, FF = 60L/s at FH #53 (J-153)
Deficiency Location: Line velocities on Basset Ave, 100mm AC (P-162)
Hydrant #53 unable to deliver 60 L/s

Location Map:



Key Map:



Description of Issue:
When fire hydrant #53 runs, the current 100mm line is unable to deliver 60 L/s.

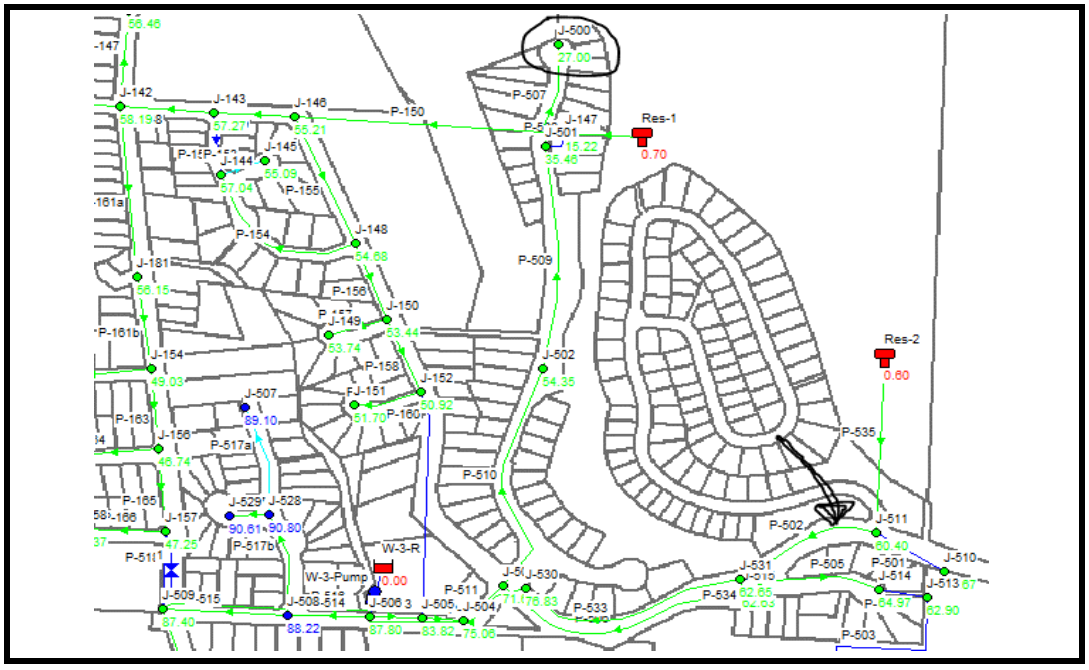
Possible Solution(s) to Issue:
1) Upsizing to a 150mm. This is an adequate size to avoid excessive velocities as well.

Summary of Model Deficiencies

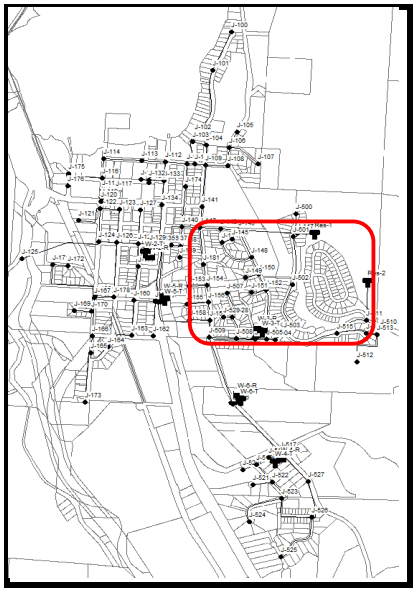
LOW PRIORITY ITEM

Deficiency Number: #12
Model Conditions: MDD, FF = 60L/s at FH #50 (J-500)
Deficiency Location: Low pressures at north of Peachcliff Drive, can be aided by upsizing P-502 (a 200mm PVC) on McLean Creek.

Location Map:



Key Map:

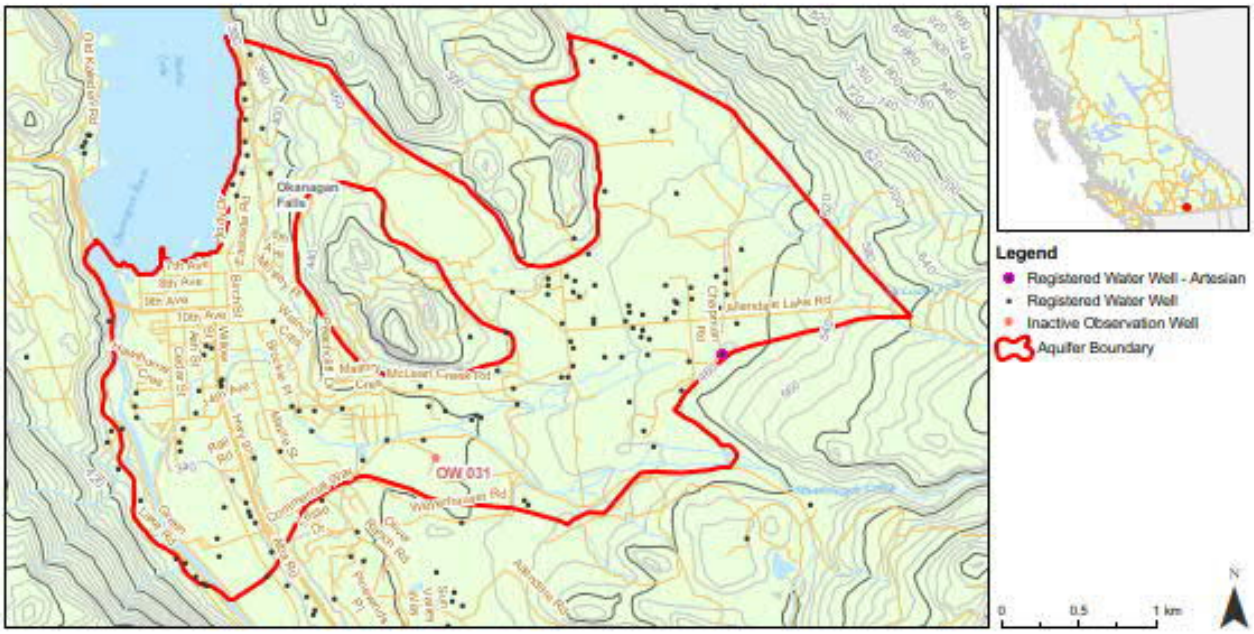


Description of Issue:
When fire hydrant #50 runs, pressures in the north end of Peachcliff Drive drop below 20 psi. Upsizing the main on McLean Creek provides a better solution to the issue then upsizing lines along Peachliff Drive.

Possible Solution(s) to Issue:
1) Upsizing P-502 to a 250mm. This fixes low pressures in a short distance and benefits the entire upper zone.
2) Alternatively, the first segment of 150mm PVC before FH #47 on Peachcliff can be upsized to 200mm.

APPENDIX E – AQUIFER DATA SHEETS

Aquifer #264

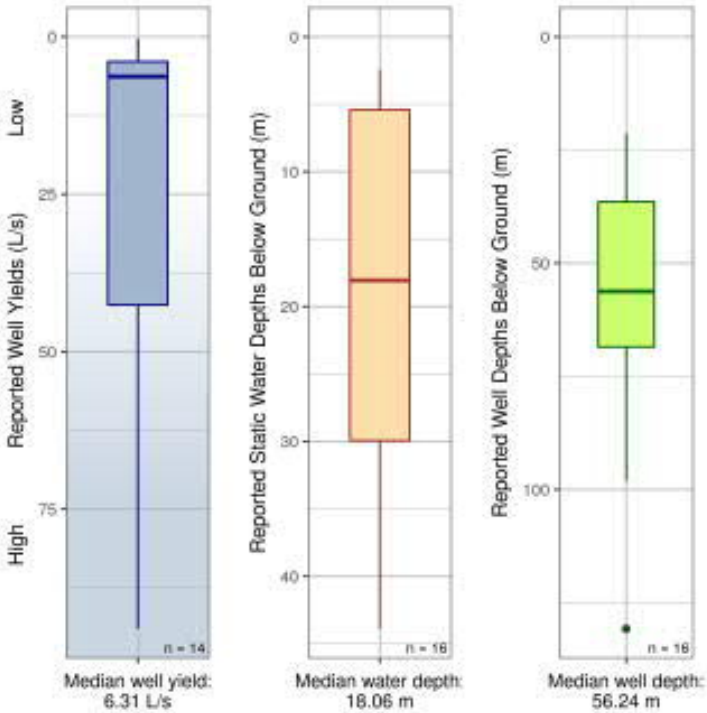


Aquifer Description (Mapping Report - 1997): Unconfined glacio-fluvial outwash or ice contact sand and gravel aquifers generally formed near or at the end of the last period of glaciation (sub-type = 4a).

Aquifer Details

Region	Thompson-Okanagan
Water District	Penticton
Aquifer Area	9.1 km^2
No. Wells Correlated to Aquifer	16
Vulnerability to Contamination	Moderate
Productivity	Moderate
Aquifer Classification	IIB
Hydraulic Connectivity[1]	Likely
Aquifer Stress Index	More stressed (high certainty)
No. Water Licences Issued to Wells	11
Observation Wells (**Active**, Inactive)	None

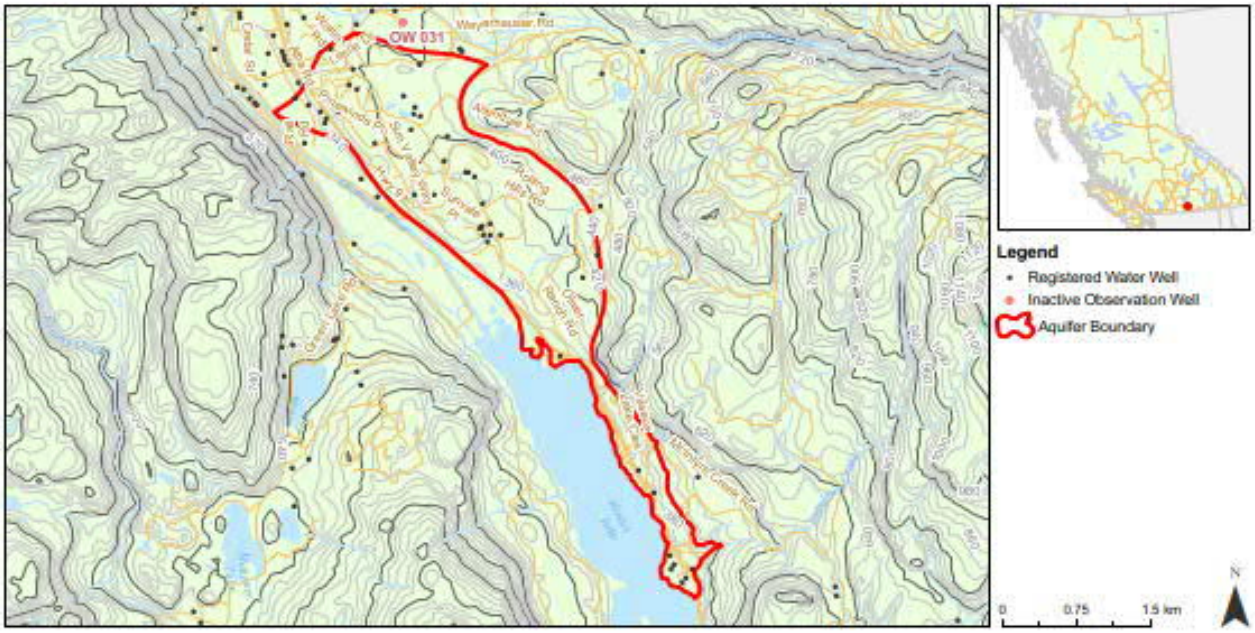
[1] Based on broad regional assessment



Detailed methods for all figures are described in the companion document (Aquifer Factsheet - Companion Document.pdf).

Factsheet generated: 2020-08-06. Aquifers online: https://apps.nrs.gov.bc.ca/gwells/aquifers.

Aquifer #265

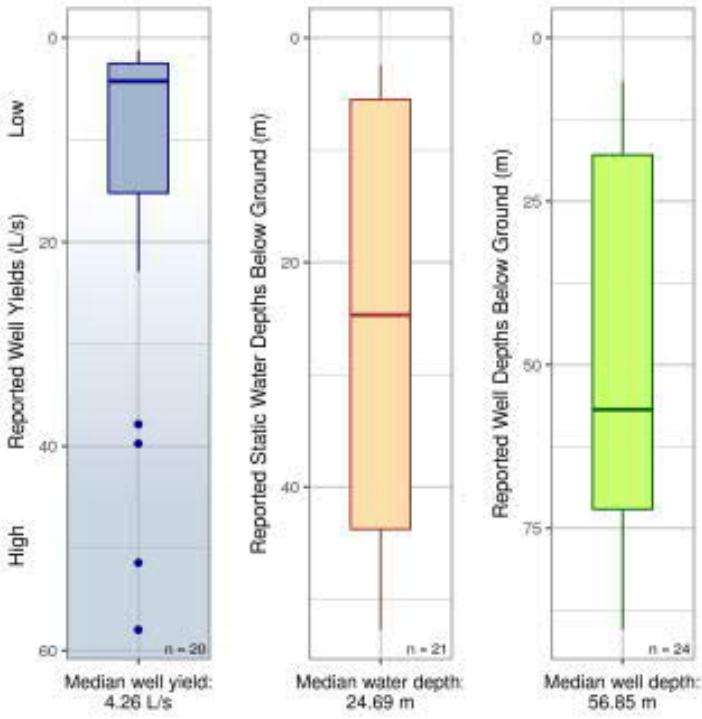


Aquifer Description (Mapping Report - 2016): Predominantly unconfined fluvial or glacio-fluvial sand and gravel Aquifers found along major rivers of higher stream order with the potential to be hydraulically influenced by the river (subtype = 1a).

Aquifer Details

Region	Thompson-Okanagan
Water District	Penticton
Aquifer Area	5.4 km²
No. Wells Correlated to Aquifer	25
Vulnerability to Contamination	High
Productivity	High
Aquifer Classification	IIIA
Hydraulic Connectivity[1]	Likely
Aquifer Stress Index	More stressed (high certainty)
No. Water Licences Issued to Wells	10
Observation Wells (**Active**, Inactive)	None

[1] Based on broad regional assessment



Detailed methods for all figures are described in the companion document (Aquifer Factsheet - Companion Document.pdf).

Factsheet generated: 2020-08-06. Aquifers online: https://apps.nrs.gov.bc.ca/gwells/aquifers.

APPENDIX F – WATER QUALITY TESTING RESULTS

Water Quality Data Summary by Source

Recent Well 2 Manganese Results

Okanagan Falls Irrigation District
Chemical Analysis Results

WELL #2

	Term	Standard	Result Mar-20	Result Oct-19	Result Mar-19	Result Mar-18	Result Mar-17	Result Mar-16	Result Mar-15	Result Mar-14	Result Mar-13	Result Mar-12	Result Mar-11
Anions													
Chloride	AO	<250	2.43	**2.86**	**2.54**	3.75	8.88	2.67	5.61	2.87	3.20	3.00	3.91
Fluoride	**MAC**	1.50	0.44	**0.26**	**0.33**	0.39	0.18	0.32	0.31	0.34	0.25	0.35	0.36
Nitrogen, Nitrate as N	**MAC**	10.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.040
Nitrogen, Nitrite as N	**MAC**	1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate	AO	<500	33.6	**34.1**	**34.9**	35.5	39.0	35.3	35.1	32.5	35.1	32.8	35.2
Calculated Parameters													
Hardness, Total as CaC03	N/A		209	**199**	**172**	196	228	193	217	199	208	196	199
Langelier Index		N/A	0.5	**0.7**	**0.7**	0.6							
Solids, Total Dissolved	AO	<500	250	**238**	**229**	237	282	234	254	236	243	234	242
General Parameters													
Alkalinity, total as CaC03	N/A		203	**190**	**193**	184	219	186	195	209	189	189	185
Colour, True	AO	<15	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	N/A		399	**389**	**404**	409	498	419	456	414	419	418	416
Cyanide, total	**MAC**	0.2000	0.0030	<0.0020	<0.0020	<0.0020	<0.0020	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
pH	RANGE	7.0-10.5	7.80	**8.10**	**8.12**	8.03	8.03	8.05	8.03	7.93	8.04	8.03	8.14
Turbidity	OG	<1.00	0.12	**0.13**	**0.11**	0.13	0.15	0.10	0.20	<0.10	0.10	<0.10	0.30
UV Transmittance @ 254			Not tested after 2016					97.7	96.9	99.7	98.0	97.4	97.4
Microbiological Parameters													
Coliforms	**MAC**	0	<1	<1	<1								
E. coli	**MAC**	0	<1	<1	<1								
Total Metals													
Aluminum	OG	<0.1	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.2500
Antimony	**MAC**	0.00600	<0.00020	<0.00020	<0.00020	<0.00020	<0.00010	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00500
Arsenic	**MAC**	0.01000	0.00282	**0.00277**	**0.00259**	0.00136	0.00090	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.02500
Barium	**MAC**	1.000	0.145	**0.145**	**0.118**	0.109	0.115	0.130	0.120	0.120	0.130	0.130	<0.250
Boron	**MAC**	5.0000	0.0106	**0.0105**	**0.0080**	0.0131	0.0150	0.0500	0.0500	<0.0400	<0.0400	<0.0400	<0.2000
Cadmium	**MAC**	0.005000	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000500
Calcium	N/A		66.9	**62.6**	**53.0**	62.3	72.8	61.4	69.0	63.1	66.0	62.0	63.1
Chromium	**MAC**	0.05000	0.00096	<0.00050	<0.00050	<0.00050	<0.00050	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.025000
Cobalt	N/A		<.000009	<0.00010	<.000010								
Copper	**MAC**	2.00000	0.00090	<0.00040	**0.00236**	0.00317	0.00400	<0.00200	0.00400	0.00300	0.00400	0.00300	<0.01000
Iron	AO	<0.300	0.023	**0.017**	**0.022**	0.038	0.030	<0.100	<0.100	<0.100	<0.100	<0.100	<0.500
Lead	**MAC**	0.00500	<0.00020	<0.00020	<0.00020	0.00021	0.00020	<0.00100	<0.00100	<0.00100	0.00100	<0.00100	<0.00500
Magnesium	N/A		10.20	**10.20**	**9.56**	9.80	11.20	9.70	10.80	10.00	10.30	10.00	9.94
Manganese	**MAC**	0.12	**0.180**	**0.159**	**0.128**	0.004	0.003	0.023	0.010	<0.00200	<0.00200	<0.00200	<0.01000
Mercury	**MAC**	0.001000	<0.000010	<0.000010	<0.000010	<0.000040	<0.000020	<0.000020	<0.000020	<0.000200	<0.000200	<0.000200	<0.001000
Molybdenum	N/A		0.00218	**0.00219**	**0.00249**								
Nickel	N/A	N/A	<0.00040	<0.00040	<0.00040	<0.00040	<0.00020	<0.00200	<0.00200	<0.00200	<0.00200	<0.00200	<0.01000
Potassium	N/A	N/A	3.25	**3.07**	**2.69**	2.89	3.12	2.80	3.20	2.60	2.80	2.90	2.98
Selenium	**MAC**	0.05000	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.02500
Sodium	AO	<200.00	9.07	**9.34**	**8.63**	10.70	13.30	8.70	11.80	9.80	10.30	9.60	10.10
Strontium		7.0000	0.5650	**0.5740**	**0.4890**								
Uranium	**MAC**	0.020000	0.000937	**0.000892**	**0.000764**	0.001360	0.003460	0.000800	0.001900	0.000900	0.000900	0.000700	<0.001000
Zinc	AO	<5.0000	0.0052	<0.0040	<0.0040	<0.0040	0.0070	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.2000

Health Canada Drinking Water Quality Guidelines Terms

AO Asthetic Objective

MAC Maximum Acceptable Concentration

OG Operational Guideline

HT1 The sample was prepared and/or analyzed past the recommended holding time

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

Bold Results in **Bold** indicate values that are above CARO's method reporting limits

Red Any results that are avove regulatory limits are in red

Okanagan Falls Irrigation District
Chemical Analysis Results

WELL #3

	Term	Standard	Result March '20	Result Oct '19	Result May '19	Result Mar '18	Result Mar '17	Result Mar '16	Result Mar '15	Result Mar '14	Result Mar '13	Result Mar '12
Anions										N/A		
Chloride	AO	<250	**10.80**	**10.60**	**9.83**	10.20	10.80	9.13	9.20		9.12	8.62
Fluoride	**MAC**	1.50	**0.27**	**0.17**	**0.19**	0.20	0.13	0.14	0.15		0.11	0.14
Nitrogen, Nitrate as N	**MAC**	10.000	**0.547**	**0.626**	**0.835**	1.090	0.444	0.792	0.804		0.642	0.806
Nitrogen, Nitrite as N	**MAC**	1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010		<0.010	<0.01
Sulfate	AO	<500	**30.9**	**30.3**	**28.1**	26.4	32.3	26.6	31.0		31.8	18.6
Calculated Parameters												
Hardness, Total as CaC03	N/A		**221.000**	**206.000**	**202.000**	239.000	226.000	191.000	214.000		221.000	213.000
Langelier Index		N/A	**0.6**	**0.2**	**0.7**	0.6						
Solids, Total Dissolved	AO	<500	**277**	**252**	**265**	280	274	243	255		256	246
General Parameters										N/A		
Alkalinity, total as CaC03	N/A		**222**	**194**	**221**	219	212	194	192		207	210
Colour, True	AO	<15	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0
Conductivity	N/A		**443**	**486**	**439**	482	483	445	457		471	456
Cyanide, total	**MAC**	0.2000	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0100	<0.0100		<0.0100	<0.0100
pH	RANGE	7.0-10.5	**7.89**	**7.52**	**8.03**	7.84	7.96	7.71	7.90		7.77	7.67
Turbidity	OG	<1.00	**0.11**		<0.10	2.16	0.48	5.20	2.90		0.30	2.50
UV Transmittance @ 254	Not tested after 2016							98.3	98.5		98.6	98.2
Microbiological Parameters												
Coliforms	**MAC**	0	<1	<1	<1							
E. coli	**MAC**	0	<1	<1	<1							
Total Metals										N/A		
Aluminum	OG	<0.1	<0.0050	<0.0050	<0.0050	<0.0050	0.0070	<0.0500	<0.0500		<0.0500	<0.0500
Antimony	**MAC**	0.00600	<0.00020	<0.00020	<0.00020	<0.00020	0.00010	<0.00100	<0.00100		<0.00100	<0.00100
Arsenic	**MAC**	0.01000	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00500	<0.00500		<0.00500	<0.00500
Barium	**MAC**	1.0000	**0.0616**	**0.0572**	**0.0601**	0.0615	0.0610	0.0600	0.0600		0.0600	0.0600
Boron	**MAC**	5.0000	<0.00500	**0.0100**	**0.0075**	0.0122	0.0100	0.0400	<0.0400		<0.0400	<0.0400
Cadmium	**MAC**	0.005000	**0.000043**	**0.000029**	**0.000031**	0.000036	0.000040	<0.000100	<0.000100		<0.000100	<0.000100
Calcium	N/A		**70.20**	**64.30**	**62.70**	75.90	71.50	59.90	67.70		69.00	67.00
Chromium	**MAC**	0.05000	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00500	<0.00500		<0.00500	<0.00500
Cobalt	N/A		<0.00010	<0.00010	<0.00010							
Copper	**MAC**	2.00000	**0.00070**	**0.00055**	**0.00054**	0.00189	0.00350	0.00300	0.00300		0.00300	0.00300
Iron	AO	<0.300	<0.010	<0.010	<0.010	0.217	0.100	0.340	0.590		<0.100	0.200
Lead	**MAC**	0.00500	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	<0.00100	<0.00100		<0.00100	<0.00100
Magnesium	N/A		**11.200**	**10.900**	**10.900**	11.900	11.500	10.100	10.900		11.600	11.100
Manganese	**MAC**	0.12000	**0.00037**	**0.00030**	**0.00039**	0.00527	0.00160	0.00400	0.00900		<0.00200	0.00900
Mercury	**MAC**	0.001000	<0.000009	<0.000010	<0.000010	<0.000040	<0.000020	<0.000020	<0.000020		<0.000200	<0.000200
Molybdenum	N/A		**0.00095**	**0.00097**	**0.00087**							
Nickel	N/A	N/A	**0.00051**	**0.00047**	**0.00052**	0.00042	0.00050	<0.00200	<0.00200		<0.00200	<0.00200
Potassium	N/A	N/A	**2.98**	**2.76**	**2.61**	2.98	3.05	2.60	2.80		3.00	2.70
Selenium	**MAC**	0.05000	**0.00209**	**0.00219**	**0.00269**	0.00253	0.00270	<0.00500	<0.00500		<0.00500	<0.00500
Sodium	AO	<200.00	**12.60**	**12.30**	**12.60**	14.40	13.20	12.00	12.60		13.30	11.90
Strontium		7.0000	**0.5640**	**0.5660**	**0.5570**							
Uranium	**MAC**	0.020000	**0.003220**	**0.002940**	**0.002790**	0.002870	0.003410	0.002300	0.002200		0.003400	0.002000
Zinc	AO	<5.0000	<0.0040	<0.0040	<0.0040	0.0102	0.0190	<0.0400	<0.0400		<0.0400	<0.0400

Health Canada Drinking Water Quality Guidelines Terms

AO	Asthetic Objective
MAC	Maximum Acceptable Concentration
OG	Operational Guideline

HT1	The sample was prepared and/or analyzed past the recommended holding time
HT2	The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended

Bold	Results in **Bold** indicate values that are above CARO's method reporting limits
Red	Any results that are avove regulatory limits are in red

Okanagan Falls Irrigation District
Chemical Analysis Results

Well #4

	Term	Standard	Result March '20	Result Mar '19	Result Mar '18	Result Mar '17	Result Mar '16	Result Mar '15	Result Mar '14	Result Mar '13	Result Mar '12	Result Mar '11
Anions												
Chloride	AO	<250		**3.60**	6.50	10.60	11.30	4.42	3.44	4.77	3.51	6.88
Fluoride	**MAC**	1.50	**No**	**0.21**	0.29	0.14	0.15	0.26	0.25	0.18	0.28	0.19
Nitrogen, Nitrate as N	**MAC**	10.000	**2020**	**0.252**	0.465	0.954	0.829	0.327	0.150	0.213	0.178	0.600
Nitrogen, Nitrite as N	**MAC**	1.000	**Testing**	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate	AO	<500		**33.5**	36.1	30.4	25.7	34.7	32.6	34.0	32.6	33.6
Calculated Parameters												
Hardness, Total as CaC03	N/A			**248.000**	251.000	200.000	173.000	287.000	250.000	246.000	239.000	223.000
Langelier Index		N/A		**0.9**	0.7							
Solids, Total Dissolved	AO	<500		**298**	293	254	226	301	279	283	274	274
General Parameters												
Alkalinity, total as CaC03	N/A			**257**	231	194	174	232	228	228	230	206
Colour, True	AO	<15		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	N/A			**519**	504	455	416	510	495	492	491	463
Cyanide, total	**MAC**	0.2000		<0.0020	<0.0020	<0.0020	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
pH	RANGE	7.0-10.5		**8.02**	7.90	7.88	7.78	8.09	7.97	7.99	8.05	7.92
Turbidity	OG	<1.00		**0.11**	0.24	2.08	0.90	0.10	0.10	0.10	0.20	0.10
UV Transmittance @ 254	Not tested after 2016						98.4	98.5	98.9	99.1	98.2	97.1
Microbiological Parameters												
Coliforms	**MAC**	0		<1								
E. coli	**MAC**	0		<1								
Total Metals												
Aluminum	OG	<0.1		<0.0050	<0.0050	<0.0050	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.2500
Antimony	**MAC**	0.00600		<0.00020	<0.00020	<0.00010	0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00500
Arsenic	**MAC**	0.01000		**0.00095**	<0.00050	<0.00050	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.02500
Barium	**MAC**	1.000		**0.0943**	0.0665	0.0560	<0.0500	0.1000	0.0900	0.0900	0.1000	<0.2500
Boron	**MAC**	5.0000		**0.0070**	0.0094	0.0090	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.2000
Cadmium	**MAC**	0.005000		**0.000017**	0.000015	0.000020	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000500
Calcium	N/A			**80.00**	80.60	61.60	53.90	96.90	82.30	80.00	78.00	71.30
Chromium	**MAC**	0.05000		<0.00050	<0.00050	<0.00050	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.02500
Cobalt	N/A			<0.00010								
Copper	**MAC**	2.00000		**0.04620**	0.01180	0.02170	0.01700	0.01000	0.00300	0.00400	0.00700	0.01210
Iron	AO	<0.300		**0.013**	0.017	0.260	<0.100	<0.100	<0.100	<0.100	<0.100	<0.500
Lead	**MAC**	0.00500		**0.00375**	0.00087	0.00320	0.00200	0.00100	<0.00100	<0.00100	0.00100	<0.00500
Magnesium	N/A			**11.700**	11.900	11.200	9.400	11.100	10.800	11.300	10.700	11.000
Manganese	**MAC**	0.12000		**0.00112**	0.00039	0.00930	<0.00200	<0.00200	<0.00200	<0.00200	<0.00200	<0.01000
Mercury	**MAC**	0.001000		<0.000010	<0.000040	<0.000020	<0.000020	<0.000020	<0.002000	<0.000200	<0.000200	<0.001000
Molybdenum	N/A			**0.00146**								
Nickel	N/A	N/A		**0.00058**	<0.00040	0.00040	<0.00200	<0.00200	<0.00200	<0.00200	<0.00200	<0.01000
Potassium	N/A	N/A		**3.08**	2.94	2.90	2.50	3.00	2.70	3.00	3.00	3.01
Selenium	**MAC**	0.05000		**0.00113**	0.00148	0.00080	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.02500
Sodium	AO	<200.00		**8.45**	11.60	14.40	12.90	8.20	7.80	10.10	7.70	12.60
Strontium		7.0000		**0.6500**								
Uranium	**MAC**	0.020000		**0.002620**	0.003890	0.004660	0.003200	0.002200	0.002000	0.002200	0.002000	0.003690
Zinc	AO	<5.0000		**0.0179**	0.0192	0.0440	0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.2000

Health Canada Drinking Water Quality Guidelines Terms

AO	Asthetic Objective
MAC	Maximum Acceptable Concentration
OG	Operational Guideline

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

Bold	Results in **Bold** indicate values that are above CARO's method reporting limits
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Okanagan Falls Irrigation District
Chemical Analysis Results

WELL #5

	Term	Standard	Result March '20	Result Oct '19	Result Mar '19	Result Mar '18	Result Mar '17	Result Mar'16	Result Mar'15	Result Mar '14	Result Mar '13	Result Mar '12	Result Mar '11
Anions													
Chloride	AO	<250	**9.66**	**8.93**	**7.83**	6.42	25.40	3.84	5.41	4.33	4.59	3.40	4.60
Fluoride	**MAC**	1.50	**0.17**	**0.21**	**0.18**	0.29	0.17	0.20	0.24	0.21	0.13	0.22	0.22
Nitrogen, Nitrate as N	**MAC**	10.000	**0.416**	**0.332**	**0.287**	0.051	0.231	<0.010	<0.010	0.057	0.032	<0.010	0.100
Nitrogen, Nitrite as N	**MAC**	1.000	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate	AO	<500	**36.3**	**35.1**	**37.8**	38.3	37.3	34.5	33.0	32.1	34.0	31.0	34.0
Calculated Parameters													
Hardness, Total as CaC03	N/A		**236**	**235**	**222**	235	229	259	227	215	232	209	235
Langelier Index		N/A	**0.8**	**0.5**	**0.8**	0.8							
Solids, Total Dissolved	AO	<500	**304**	**295**	**287**	278	314	278	265	259	273	250	283
General Parameters													
Alkalinity, total as CaC03	N/A		**250**	**242**	**233**	213	228	208	208	209	217	205	219
Colour, True	AO	<15	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	N/A		**488.0**	**532.0**	**505.0**	474.0	563.0	458.0	468.0	466.0	473.0	451.0	472.0
Cyanide, total	**MAC**	0.2000		<0.0020	<0.0020	<0.0020	<0.0020	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
pH	RANGE	7.0-10.5	**7.96**	**7.66**	**8.04**	8.04	8.05	7.96	8.05	7.87	7.98	7.97	8.01
Turbidity	OG	<1.00	**0.34**	**22.10**	**0.31**	0.33	0.80	5.70	2.10	0.40	0.70	1.30	0.30
UV Transmittance @ 254	Not tested after 2016							98.7	96.5	98.2	98	97.5	98.2
Microbiological Parameters													
Coliforms	**MAC**	0	<1	<1	<1								
E. coli	**MAC**	0	<1	<1	<1								
Total Metals													
Aluminium	OG	<0.1	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.2500
Antimony	**MAC**	0.00600	<0.00020	<0.00020	<0.00020	<0.00020	<0.00010	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00500
Arsenic	**MAC**	0.01000	**0.00084**	**0.00083**	**0.00103**	0.00081	0.00080	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.02500
Barium	**MAC**	1.000	**0.1050**	**0.0963**	**0.0917**	0.0897	0.0980	0.0900	0.0800	0.0800	0.0800	0.0900	<0.2500
Boron	**MAC**	5.0000	**0.0488**	**0.0080**	**0.0089**	0.0086	0.0120	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.2000
Cadmium	**MAC**	0.005000	<0.000009	<0.000010	<0.000010	0.000011	<0.000010	<0.000100	<0.000100	<0.000100	<0.000100	<0.000100	<0.000500
Calcium	N/A		**74.90**	**74.20**	**68.80**	75.50	73.00	84.40	72.30	68.70	74.00	67.00	75.80
Chromium	**MAC**	0.05000	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.02500
Cobalt	N/A		<0.00010	<0.00010	<0.00010								
Copper	**MAC**	2.00000	0.00085	<0.00040	**0.00184**	0.00218	0.00590	0.00700	0.00300	<0.00200	0.00800	<0.00200	<0.01000
Iron	AO	<0.300	**0.078**	**0.094**	**0.077**	0.086	0.160	0.720	0.240	<0.100	<0.100	0.200	<0.500
Lead	**MAC**	0.00500	**0.00086**	**0.00043**	**0.00030**	0.00037	0.00040	<0.00100	<0.00100	<0.00100	<0.00100	<0.00100	<0.00500
Magnesium	N/A		**11.900**	**11.900**	**12.200**	11.300	11.300	11.700	11.200	10.600	11.300	10.300	11.200
Manganese	**MAC**	0.12000	**0.02520**	**0.02650**	**0.02570**	0.02640	0.02530	0.08800	0.10200	0.02900	0.04000	0.03800	0.02720
Mercury	**MAC**	0.001000	<0.000009	<0.000010	<0.000010	<0.000040	<0.000020	<0.000020	<0.000020	<0.000200	<0.000200	<0.000200	<0.001000
Molybdenum	N/A		0.00130	0.00131	**0.00161**								
Nickel	N/A	N/A	<0.0004	<0.00040	<0.00040	<0.00040	0.00030	<0.00200	<0.00200	<0.00200	<0.00200	<0.00200	<0.01000
Potassium	N/A	N/A	**3.00**	**2.94**	**3.05**	2.89	3.12	3.10	3.00	2.60	2.90	2.80	3.04
Selenium	**MAC**	0.05000	**0.00087**	**0.00059**	**0.00066**	<0.00050	0.00050	<0.00500	<0.00500	<0.00500	<0.00500	<0.00500	<0.02500
Sodium	AO	<200.00	**13.30**	**13.50**	**13.80**	13.00	23.70	13.80	13.00	12.30	13.10	11.90	12.90
Strontium		7.0000	**0.6400**	**0.6360**	**0.6040**								
Uranium	**MAC**	0.020000	**0.004030**	**0.003460**	**0.003410**	0.003010	0.003180	0.002500	0.003100	0.002700	0.002700	0.002000	0.002890
Zinc	AO	<5.0000	0.0050	<0.0040	**0.0076**	<0.0040	<0.0040	<0.0400	<0.0400	<0.0400	<0.0400	<0.0400	<0.2000

Health Canada Drinking Water Quality Guidelines Terms

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Okanagan Falls Irrigation District
Chemical Analysis Results

WELL #6

	Term	Standard	Result March '20	Result Oct '19	Result Mar '19	Result May '18	Result Mar '18	Result Mar '17	Result Aug '16	Result Mar '16	Result May '15
Anions											
Chloride	AO	<250	**10.60**	**10.90**	**12.20**		10.60	10.40	11.20	11.20	12.10
Fluoride	**MAC**	1.50	**0.14**	**0.12**	**0.16**		0.23	0.12	0.14	0.14	0.15
Nitrogen, Nitrate as N	**MAC**	10.000	**0.908**	**0.962**	**0.978**		1.140	0.968	0.827	0.836	0.902
Nitrogen, Nitrite as N	**MAC**	1.000	<0.010	<0.010	<0.010		<0.010	<0.010	<0.010	<0.010	<0.010
Sulfate	AO	<500	**27.8**	**26.2**	**27.1**		31.0	30.2	28.1	25.3	24.4
Calculated Parameters											
Hardness, Total as CaC03	N/A		**175**	**172**	**179**		219	206	196	176	178
Langelier Index		N/A	**0.2**	**0.2**	**0.2**		0.3				
Solids, Total Dissolved	AO	<500	**231**	**223**	**233**		265	258	242	224	224
General Parameters											
Alkalinity, total as CaC03	N/A		**179**	**168**	**177**		197	198	188	170	164
Colour, True	AO	<15	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	N/A		**179**	**380**	**415**		451	465	442	409	383
Cyanide, total	**MAC**	0.2000	<0.0020	<0.0020	<0.0020		<0.0020	<0.0020	<0.0020	<0.0100	<0.0100
pH	RANGE	7.0-10.5	**7.65**	**7.74**	**7.70**		7.60	7.76	7.56	7.53	7.75
Turbidity	OG	<1.00	<0.10	<0.10	**0.11**		0.29	0.11	<0.10	0.50	1.50
UV Transmittance @ 254	Not tested after 2016									98.7	98.5
Microbiological Parameters											
Coliforms	**MAC**	0	<1	<1	<1						
E. Coli	**MAC**	0	<1	<1	<1						
Total Metals											
Aluminum	OG	<0.1	<0.0050	<0.0050	<0.0050		<0.0050	<0.0050	<0.0050	<0.0500	<0.0500
Antimony	**MAC**	0.00600	<0.00020	**0.00030**	<0.00020		0.00115	<0.00010	<0.00010	0.00100	<0.00100
Arsenic	**MAC**	0.01000	<0.00050	<0.00050	**0.00052**		<0.00050	<0.00050	<0.00050	<0.00500	<0.00500
Barium	**MAC**	1.000	**0.0516**	**0.0481**	**0.0524**		0.0556	0.0580	<0.0500	<0.0500	<0.0500
Boron	**MAC**	5.0000	**0.0386**	**0.0106**	**0.0090**		0.0086	0.0090	<0.0400	<0.0400	0.0800
Cadmium	**MAC**	0.005000	**0.000014**	**0.000014**	**0.000011**		0.000018	<0.000010	<0.000100	0.001800	<0.000100
Calcium	N/A		**53.60**	**52.90**	**53.20**		68.10	63.50	58.40	54.50	54.90
Chromium	**MAC**	0.05000	<0.00050	<0.00050	<0.00050		<0.00050	<0.00050	<0.00050	0.04000	<0.00500
Cobalt	N/A		<0.00010	<0.00010	<0.00010						
Copper	**MAC**	2.00000	**0.00576**	**0.00785**	**0.00682**		0.01260	0.00930	0.02800	0.01100	0.00300
Iron	AO	<0.300		<0.010	<0.010		0.020	0.020	<0.100	0.160	0.260
Lead	**MAC**	0.00500	**0.00024**	**0.00029**	**0.00024**	0.00029	0.02020	0.00080	0.00130	0.00200	<0.00100
Magnesium	N/A		**9.850**	**9.750**	**11.100**		11.900	11.400	9.820	9.800	10.000
Manganese	**MAC**	0.12000	**0.00026**	**0.00081**	**0.00029**		0.00056	0.00030	<0.00200	0.00300	0.00600
Mercury	**MAC**	0.001000		0.000010	<0.000010		<0.000040	<0.000020	<0.000020	<0.000020	<0.000020
Molybdenum	N/A		**0.00104**	**0.00099**	**0.00106**						
Nickel	N/A	N/A		<0.00040	<0.00040		<0.00040	0.00020	<0.00200	0.02100	<0.00200
Potassium	N/A	N/A	**2.60**	**2.69**	**2.80**		2.82	2.93	2.38	2.50	2.60
Selenium	**MAC**	0.05000	**0.00107**	**0.00078**	**0.00078**		0.00104	0.00110	0.00500	<0.00500	<0.00500
Sodium	AO	<200.00	**13.60**	**13.80**	**14.50**		15.60	14.30	13.70	13.10	16.00
Strontium		7.0000	**0.4960**	**0.5100**	**0.5130**						
Uranium	**MAC**	0.020000	**0.003440**	**0.003340**	**0.003300**		0.004600	0.004460	0.004100	0.003100	0.003000
Zinc	AO	<5.0000	**0.0043**	**0.0060**	**0.0051**		0.0063	0.0110	<0.0400	<0.0400	<0.0400

Health Canada Drinking Water Quality Guidelines Terms

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CERTIFICATE OF ANALYSIS

REPORTED TO	Okanagan Falls Irrigation District P.O. Box 110 Okanagan Falls, BC V0H 1R0		
ATTENTION	Travis	**WORK ORDER**	0070194
PO NUMBER		**RECEIVED / TEMP**	2020-07-03 10:00 / 9°C
PROJECT	General Potability	**REPORTED**	2020-07-09 13:16
PROJECT INFO			

Introduction:

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

Big Picture Sidekicks

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

We've Got Chemistry

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

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

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

Authorized By:

Alana Crump
Team Lead, Client Service

TEST RESULTS

REPORTED TO	Okanagan Falls Irrigation District	**WORK ORDER**	0070194
PROJECT	General Potability	**REPORTED**	2020-07-09 13:16

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Lower Zone Source Well 2 Interior Tap (0070194-01) | Matrix: Water | Sampled: 2020-07-02 09:30						
Total Metals						
Manganese, total	**0.167**	MAC = 0.12	0.00020	mg/L	2020-07-08	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Okanagan Falls Irrigation District	**WORK ORDER**	0070194
PROJECT	General Potability	**REPORTED**	2020-07-09 13:16

Analysis Description	Method Ref.	Technique	Accredited	Location
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

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

Glossary of Terms:

RL	Reporting Limit (default)
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
EPA	United States Environmental Protection Agency Test Methods

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing. The quality control (QC) data is available upon request

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager:acrump@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline (s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

CERTIFICATE OF ANALYSIS

REPORTED TO	Okanagan Falls Irrigation District P.O. Box 110 Okanagan Falls, BC V0H 1R0		
ATTENTION	Travis	**WORK ORDER**	0080283
PO NUMBER		**RECEIVED / TEMP**	2020-08-05 10:00 / 10°C
PROJECT	General Potability	**REPORTED**	2020-08-11 13:11
PROJECT INFO		**COC NUMBER**	B91749

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

Authorized By:

Alana Crump
Team Lead, Client Service

TEST RESULTS

REPORTED TO	Okanagan Falls Irrigation District	**WORK ORDER**	0080283
PROJECT	General Potability	**REPORTED**	2020-08-11 13:11

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Lower Zone Source Well 2 Interior Tap (0080283-01) | Matrix: Water | Sampled: 2020-08-04 09:30						
Total Metals						
Manganese, total	0.153	MAC = 0.12	0.00020	mg/L	2020-08-10	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Okanagan Falls Irrigation District	**WORK ORDER**	0080283
PROJECT	General Potability	**REPORTED**	2020-08-11 13:11

Analysis Description	Method Ref.	Technique	Accredited	Location
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

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

Glossary of Terms:

RL	Reporting Limit (default)
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
EPA	United States Environmental Protection Agency Test Methods

Guidelines Referenced in this Report:

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General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing. The quality control (QC) data is available upon request

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager:acrump@caro.ca

Please note any regulatory guidelines applied to this report are added as a convenience to the client, at their request, to help provide some initial context to analytical results obtained. Although CARO makes every effort to ensure accuracy of the associated regulatory guideline(s) applied, the guidelines applied cannot be assumed to be correct due to a variety of factors and as such CARO Analytical Services assumes no liability or responsibility for the use of those guidelines to make any decisions. The original source of the regulation should be verified and a review of the guideline (s) should be validated as correct in order to make any decisions arising from the comparison of the analytical data obtained to the relevant regulatory guideline for one's particular circumstances. Further, CARO Analytical Services assumes no liability or responsibility for any loss attributed from the use of these guidelines in any way.

CERTIFICATE OF ANALYSIS

REPORTED TO	Okanagan Falls Irrigation District P.O. Box 110 Okanagan Falls, BC V0H 1R0		
ATTENTION	Travis	**WORK ORDER**	0090244
PO NUMBER		**RECEIVED / TEMP**	2020-09-02 10:10 / 6°C
PROJECT	General Potability	**REPORTED**	2020-09-08 09:31
PROJECT INFO		**COC NUMBER**	B93735

Introduction:

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

Big Picture Sidekicks

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

We've Got Chemistry

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

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

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

Authorized By:

Alana Crump
Team Lead, Client Service

TEST RESULTS

REPORTED TO	Okanagan Falls Irrigation District	**WORK ORDER**	0090244
PROJECT	General Potability	**REPORTED**	2020-09-08 09:31

Analyte	Result	Guideline	RL	Units	Analyzed	Qualifier
Lower Zone Source Well 2 Interior Tap (0090244-01) | Matrix: Water | Sampled: 2020-09-01 09:30						
Total Metals						
Manganese, total	**0.172**	MAC = 0.12	0.00020	mg/L	2020-09-05	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Okanagan Falls Irrigation District	**WORK ORDER**	0090244
PROJECT	General Potability	**REPORTED**	2020-09-08 09:31

Analysis Description	Method Ref.	Technique	Accredited	Location
Total Metals in Water	EPA 200.2 / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	✓	Richmond

Glossary of Terms:

RL	Reporting Limit (default)
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
EPA	United States Environmental Protection Agency Test Methods

Guidelines Referenced in this Report:

Guidelines for Canadian Drinking Water Quality (Health Canada, June 2019)

Note: In some cases, the values displayed on the report represent the lowest guideline and are to be verified by the end user

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