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REPORT

Cowichan Bay Waterworks District

2021 Water System Master Plan Update

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EXECUTIVE SUMMARY

Associated Engineering (Associated) has been retained by the Cowichan Bay Waterworks District (CBWD) to provide a Water System Master Plan Update. The CBWD trustees wish to begin an asset renewal program but want to identify where funding is best spent in order to make the most of each investment. Identification of critical infrastructure and system shortcomings is required to help the CBWD make sound financial decisions. This Water System Master Plan document has been developed to provide the trustees an understanding of their current and future system needs to guide the decision-making process.

EXISTING WATER SYSTEM

CBWD operates a water supply and distribution system which services the area of Cowichan Bay and Electoral Areas C & D of the Cowichan Valley Regional District (CVRD). A recent extension provides water to the Tommy Road area of the Cowichan Tribes' Est-Patrolas 4 Reserve. The CBWD distribution system consists of approximately 20 km of watermain, 80 hydrants, and 1100 connections. The water source is four groundwater wells; two located at the Valleyview Center, one at the CBWD office, and another northwest of the main service area. Three above ground storage reservoirs supply two pressure zones which are maintained by pressure reducing valve stations. A booster pump station is located near the office reservoir and a new booster pump station is currently under construction near the Ordano Reservoir.

The Valleyview Wells are the main water source for CBWD. Valleyview Well #2 was constructed in 1996 by the owners of the Valleyview Center, a shopping center near Cowichan Bay in Electoral Area C. In 2009, responsibility for the well (Well Identification Number WIN 13088) was taken over by CBWD and it was connected to the existing distribution system. A second well (WIN 38473, Valleyview Well #1) was developed in this location in 2014 due to a reduction in the production capacity of Well #2. The Office Well (WIN 13062) is located on the same site as the CBWD office, on Pavenham Road, and serves as a backup to the Valleyview wells. The well was constructed in 1956 and is equipped with a 6.3 L/s 20 hp submersible well pump. Water from the well is pumped through manganese greensand filters to remove iron and manganese prior to distribution. The system also uses potassium permanganate for oxidation prior to filtration, and sodium hypochlorite for disinfection. The Kidd Well (WIN 54536) is located at 2284 Cowichan Bay Road, nearly 2 km away from the center of the Cowichan Bay community. The well was drilled in 1985 with a reported capacity of 17.1 L/s. It is reported that due to sulfur dioxide in the well water, aeration was installed at the Kidd Well location, along with chlorination for disinfection. The aeration system is not currently in use, and due to aesthetic complaints from customers the Kidd Well has not been used for several years.

Treated water for the CBWD service area is stored in three storage reservoirs. The Office Reservoir is an above-ground steel reservoir constructed in 1980, with a total storage volume of 545 m^3. The reservoir provides water storage for Pressure Zone 1 (PZ1) and has a top water level (TWL) of 73.0m. The Telegraph Reservoir is an above-ground steel reservoir constructed in 1997, with a total storage volume of 734 m^3. The reservoir provides water storage for PZ2 and has a TWL of 127.0m. The Ordano Road Reservoir is an above-ground steel reservoir constructed in 2015, with a storage volume of 1,568 m^3. The reservoir has a TWL of 100.9 and provides water storage for PZ2 via the adjacent booster pump station.

Treated water from the groundwater wells is distributed to users on the CBWD system through two pressures zones. Pressure Zone 1 (PZ1) generally encompasses the area north the CBWD office, or properties below 45 m in elevation.

Pressure Zone 2 (PZ2) encompasses the service area south of the CBWD office, which is generally higher than 45 m in elevation. Water flow from PZ2 into PZ1 is controlled by two pressure reducing valves (PRVs), located on Pritchard Road and Cowichan Bay Road. Both PRVs are set at a hydraulic grade of 73 m to allow flow from PZ2 into PZ1 in the case of emergency or fire.

A booster pump station is installed at the Office Road reservoir site. The booster pump capacity is 9.5 L/s at 70 m TDH and the pump station is operated as a duplex facility (pumps operate in parallel and alternate duty) which allow pumping from PZ1 to PZ2. In order to meet fire flow requirements in PZ2 and improve turnover within the Ordano Reservoir, a booster station is under construction on the reservoir site.

The watermain network ranges in age from 1958 to current and comprises approximately 20 km of pipe between 50 and 250 mm in diameter. A significant portion of the underground water system was originally constructed using asbestos cement (AC) pipes, and most of the recent piping is polyvinyl chloride (PVC).

POPULATION AND WATER DEMAND PROJECTIONS

The planning horizon for this plan is 20 years; 2021 to 2041. Associated reviewed the Cowichan Bay Official Community Plan (OCP) Bylaw 4270 and Area D Cowichan Bay Local Area Plan by Cowichan Valley Regional District (CVRD) to collect information on projected growth in the area. The OCP reported the 2016 population of Electoral Area D was 3,153 people over 1,433 households, which is approximately 2.2 persons per household. Data from the 2021 Census was not available at the time of writing this report, but using the 1% growth rate in the OCP, it can be estimated that the 2021 population of Electoral Area D would be approximately 3280 people in 2021, and 1491 households. Comparing this to the current list of residential connections suggests that CBWD currently services approximately 65% of the households located in Electoral Area D, for a 2021 service population of 2279 persons.

To estimate the future population to be serviced by CBWD, the current population of 2279 people was subjected to the OCP annual growth rate of 1% per year for 20 years. As can be seen in Table 1, this results in a population increase of 502 people serviced by CBWD in 2041. Based on the OCP assumption that the average density will remain the same as current, that represents an increase of 209 units over 20 years. A number of development proposals make up the majority of the locations for where growth is expected, but the OCP also identified two potential locations that could be available for development into the future.

Table 1
Population Projections over Planning Horizon

Year	Projected Population (persons)	Growth During Period (persons)	Equivalent Housing Units
2021 (current)	2279	-	947
2026 (5-Year)	2395	116	48
2031 (10-Year)	2517	122	51
2041 (20-Year)	2780	263	109
	Total	502	209

Based on a per capita demand of 350 Litres per capita per day (LCD), a maximum day factor of 2 times average day demand, and the population projections outlined in the table above, water demand projections for the study period were developed and are summarized in Table 2 below.

Table 2
Water Demand Projections by Year and Pressure Zone

	2021			2026			2041		
	ADD (L/s)	MDD (L/s)	PHD (L/s)	ADD (L/s)	MDD (L/s)	PHD (L/s)	ADD (L/s)	MDD (L/s)	PHD (L/s)
Single Family	1.9	3.3	7.6	2.2	4.4	8.9	2.4	4.8	9.7
Town House	0.3	0.5	1.1	0.3	0.6	1.3	0.3	0.6	1.3
Condominium	0.4	0.7	1.6	0.4	0.9	1.8	0.4	0.9	1.8
Subtotal PZ1	*2.6*	*4.4*	*10.4*	*3.0*	*6.0*	*12.0*	*3.2*	*6.4*	*12.8*
Single Family	5.3	9.0	21.2	6.4	12.9	25.7	7.8	15.5	31.0
Town House	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Condominium	0.3	0.5	1.1	0.0	0.0	0.1	0.3	0.6	1.2
Subtotal PZ2	*5.6*	*9.5*	*22.3*	*6.5*	*12.9*	*25.8*	*8.1*	*16.1*	*32.3*
Total	8.2	13.9	32.7	9.4	18.9	37.8	11.3	22.5	45.1

RECOMMENDED CAPITAL PROJECTS

Based on the projected service population, the current system was evaluated to identify projects that should be completed to support future growth and development in the area. These projects are listed in Table 3 below, along with an opinion of probable costs has been developed for each of the recommended upgrades, based on recent experience with similar projects in the area. The total projected cost for the capital works upgrades over the entire 20-year period is $11.6 Million. This amount is in 2021 dollars and does not include works required to support new developments outside of the areas considered. Significant escalation has been observed in recent years for construction of these type of works, and it is recommended that an update to this opinion of probable costs be obtained within 3-5 years, when costs are hopefully more stable.

Table 3
Opinion of Probable Costs

Project Description	Construction Cost [3] (2021$)	Contingency (40%)	Total Cost (2021$)
General			
Engineering Studies[1,2]	500,000	200,000	700,000
Demolish Abandoned Structures (Reservoirs, Buildings)	250,000	100,000	350,000
Subtotal General			*1,050,000*
Water Supply			
New Water Source	460,000	184,000	644,000
Source Water Protection Plan[1]	30,000	12,000	42,000
Decommission Kidd Well	50,000	20,000	70,000
Subtotal Water Supply			*756,000*
Distribution System			
Marine Village Flow Improvements			
Cowichan Bay Road (Marine Village) -200 mm	981,000	393,000	1,374,000
Cowichan Bay Road (Glen to Longwood) - 200 mm	112,000	45,000	157,000
Wilmot Road (Pritchard to Cowichan Bay Rd) -150 mm	235,000	94,000	329,000
Subtotal Marine Village Fire Flow			*1,860,000*
Telegraph Road Improvements			
Telegraph Road Booster Station	700,000	280,000	980,000
Wood Road – 150 mm	233,000	94,000	327,000
Nelson Road – 150 mm	112,000	45,000	157,000
Sears Road – 150 mm	282,000	113,000	395,000
Subtotal Telegraph Road Improvements			*1,859,000*
Residential Fire Flow Improvements			
Bicks Road – 150 mm	142,000	57,000	199,000
Wessex Road – 150 mm	350,000	140,000	490,000
Subtotal Residential Fire Flow			*689,000*
AC Pipe Replacement			
George Road (Ordano to Wilmot) - 150 mm	335,000	134,000	469,000
McGill Road (Ordano to Austin) - 150 mm	370,000	148,000	518,000

Project Description	Construction Cost [3] (2021$)	Contingency (40%)	Total Cost (2021$)
Pritchard Road (Wilmot to Cowichan Bay Rd) - 150mm	279,000	112,000	391,000
Longwood Road – 150 mm	402,000	161,000	563,000
Austin Place (McGill to Cowichan Bay Road) - 200 mm	248,000	100,000	348,000
Pavenham (McGill to Wilmot) - 150 mm	309,000	124,000	433,000
Glen Road (McGill to Cowichan Bay Road) - 150 mm	313,000	126,000	439,000
Glen Road (McGill to terminus) – 150 mm	283,000	114,000	397,000
Alder Glen Road – 150 mm	272,000	109,000	381,000
Willowglen Place – 150 mm	142,000	57,000	199,000
Maple Glen Place – 150 mm	142,000	57,000	199,000
Fenwick Road - 150 mm	191,000	77,000	268,000
Pritchard Road (Wilmot to Pritchard) – 150 mm	263,000	106,000	369,000
Wilmot Road (George Road to Falcon Cres) – 150 mm	243,000	98,000	341,000
Subtotal AC Pipe Replacement			*5,315,000*
		TOTAL	$11,600,000

1. Projects are not construction projects, but are important to include in long-term planning
2. Engineering studies assumed at $25,000 per year over 20 years.
3. All shown in 2021 dollars. Significant escalation experienced in recent years.

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LIST OF ABBREVIATIONS

AC	Asbestos Cement
ADD	Average Day Demand
CBWD	Cowichan Bay Waterworks District
CVRD	Cowichan Valley Regional District
ESSD	CBWD Engineering Specifications & Standard Drawings
FF	Fire Flow
FUS	Fire Underwriters Survey
GARP	Groundwater at Risk of Containing Pathogens
GCDWQ	Guidelines for Canadian Drinking Water Quality
LCD	Liters per Capita per Day
MDD	Maximum Day Demand
MDD + FF	Maximum Day Demand plus Fire Flow
MMCD	Master Municipal Contract Documents
OCP	Official Community Plan
PHD	Peak Hour Demand
PRV	Pressure Reducing Valve
PZ1	Pressure Zone 1
PZ2	Pressure Zone 2
SI	International System of Units
TWL	Top Water Level
WIN	Well Identification Number

1 INTRODUCTION

Associated Engineering (Associated) has been retained by the Cowichan Bay Waterworks District (CBWD) to provide a Water System Master Plan Update. The CBWD trustees wish to begin an asset renewal program but want to identify where funding is best spent in order to make the most of each investment. Identification of critical infrastructure and system shortcomings is required to help the CBWD make sound financial decisions. This Water System Master Plan document has been developed to provide the trustees an understanding of their current and future system needs to guide the decision-making process.

1.1 Scope

The scope of the master plan was developed to provide a well thought out plan that incorporates the existing asset replacement schedule and provides a solid path forward for CBWD. The scope of this project consists of the following tasks:

- Update of the existing asset inventory;
- Development of design criteria based on CBWD specifications and other relevant design standards;
- Review of the existing system capacity and identification of projects to address system shortfalls;
- Commentary on water supply reliability under drought, climate change, and forest fire effects;
- Brief review of available and treated water quality data against the *Guidelines for Canadian Drinking Water Quality*, and recommendation of required upgrades;
- Review of proposed developments and projected growth and identification of projects to support continued development within CBWD boundaries;
- Development of a 20-Year Capital Works Plan which identifies critical projects, considers required renewal projects, and provides recommendations for prioritization; and
- Submission of a Master Plan Update report.

1.2 Data Collection

As part of developing this document, Associated reviewed the following documents:

- Engineering Specifications & Standard Drawings. Cowichan Bay Waterworks District (CBWD). February 2016.
- MMCD Design Guidelines 2014. Master Municipal Construction Documents Association. 2014.
- Official Community Plan for the Electoral Areas – Adopted Bylaw No. 4270. Cowichan Valley Regional District. Accessed online November 2021.
- Electoral Area D – Cowichan Bay – Zoning Bylaw No. 3705. Cowichan Valley Regional District. Accessed online November 2021.
- The CVRD Web Map. Cowichan Valley Regional District. Accessed online November 2021. (GIS layers)
- CBWD Customer Lists.
- Water quality data for that Office Well and Valleyview wells July 2020 and January 2018 (Office Well only).
- Well 38473 Hydrogeological Assessment Report (2013). Thurber Engineering Ltd.
- Well pumping records from 2018 to 2021.
- Hydrant test reporting from 2021.
- Ordano Booster Pump Station Design Report (2021). Cowichan Engineering Services Ltd.

- Various CBWD Record Drawings.
- 2019 CBWD Base EPAnet model.
- March 2020 CBWD Asset Management schedule.

1.3 Report Structure

For ease of reading, many of the figures in this report have been created in a larger size and can be found in Appendix A rather than directly within the report body itself.

In general, this document reports values in SI Units however, pressures are generally reported in psi. While this is not the standard SI unit, it is a very convenient and accepted practice for water distribution systems.

2 EXISTING WATER SYSTEM

CBWD operates a water supply and distribution system which services the area of Cowichan Bay and Electoral Areas C & D of the Cowichan Valley Regional District (CVRD). A recent extension provides water to the Tommy Road area of the Cowichan Tribes' Est-Patrolas 4 Reserve. The CBWD distribution system consists of approximately 20 km of watermain, 80 hydrants, and 1100 connections. The water source is four groundwater wells; two located at the Valleyview Center, one at the CBWD office, and another northwest of the main service area. Three above ground storage reservoirs supply two pressure zones, which are maintained by pressure reducing valve stations. A booster pump station is located near the office reservoir; a new booster pump station is currently under construction near the Ordano Reservoir. A map of the existing water system can be found on Figure 2-1 in Appendix A.

2.1 Asset Inventory

As part of the master plan, an inventory of system assets was collected to document the system condition and operation at the time of writing this report. The asset inventory can be found in Appendix B and the components are described in more detail below.

CBWD has a number of abandoned buildings; the George Road well building, the Ordano Road old valve building, and the old Valleyview site. These items have not been included in the asset inventory as they no longer provide value to CBWD but have been included in the Capital Plan.

2.2 Water Supply and Treatment

CBWD supplies water to consumers through four groundwater wells in the area:

- Two Valleyview Wells;
- The Office Well, and
- The Kidd Well.

The Valleyview Wells are the main water source for CBWD. Valleyview Well #2 was constructed in 1996 by the owners of the Valleyview Center, a shopping center near Cowichan Bay in Electoral Area C. In 2009, responsibility for the well (WIN 13088) was taken over by CBWD and it was connected to the existing distribution system. The well was developed with a capacity of 31 L/s but currently operates at a reduced rate due to issues with sand production. A second well (WIN 38473) was developed in this location in 2014 due to a reduction in the production capacity of Well #2. Well #1 was developed with a long-term capacity of 38 L/s but is currently pumped at 12 L/s due to the well pump sizing. The hydrogeology report suggested that both wells could be used simultaneously. The nearby pump control building includes a disinfection system which was upgraded in 2021 to allow for individual dosing of each of the wells.

The Office Well (WIN 13062) is located on the same site as the CBWD office, on Pavenham Road. The well was reportedly constructed in 1956 and approved 1978 and is equipped with a 6.3 L/s 20 hp submersible well pump. Water from the well is pumped through manganese greensand filters to remove iron and manganese prior to distribution. The system also uses potassium permanganate for oxidation prior to filtration, and sodium hypochlorite for disinfection. This well is occasionally used to supply the system under high demand scenarios and is currently turned on once per month for one day for maintenance purposes.

The Kidd Well (WIN 54536) is located at 2284 Cowichan Bay Road, nearly 2 km away from the center of the Cowichan Bay community. The well was drilled in 1985 with a reported capacity of 17.1 L/s. It is reported that due to sulfur dioxide in the well water, aeration was installed at the Kidd Well location, along with chlorination for disinfection. The aeration system is not currently in use, and due to aesthetic complaints from customers the Kidd Well has not been used for several years. Based on age, all components of the Kidd Well facility are nearing the end of their useful life. Operations reports that the electrical equipment at Kidd Well is now too outdated to even start the well.

The George Road well (WIN 13061) has been decommissioned. The building remains but is only used for water sampling.

CBWD endeavors to maintain a free chlorine residual of 0.2 mg/L within the distribution system. Chlorine dosing at each well site is adjusted to maintain this residual.

2.3 Water Distribution

Treated water from the groundwater wells is distributed to users on the CBWD system through two pressure zones.

- Pressure Zone 1 – Lower pressure zone, supplied by the Office Well and Kidd Well (which is not currently in use); and
- Pressure Zone 2 – Upper pressure zone, supplied by the Valleyview Wells

Pressure Zone 1 (PZ1) generally encompasses the area north the CBWD office, or properties below 45 m in elevation. The hydraulic grade of PZ1 is set by the Office Reservoir at 73.0 m, which is equivalent to the Office Reservoir top water level (TWL). Pressure Zone 2 (PZ2) encompasses the service area south of the CBWD office, which is generally higher than 45 m in elevation. The hydraulic grade of PZ2 is set at 127.0m, based on the TWL of the Telegraph Road Reservoir. Water flow from PZ2 into PZ1 is controlled by two pressure reducing valves (PRVs), located on Wilmot Road and Cowichan Bay Road. Both PRVs are set at a hydraulic grade of 73 m to allow flow from PZ2 into PZ1 in the case of emergency or fire.

A booster pump station is installed at the Pavenham Road reservoir site. The booster pump capacity is 9.5 L/s at 70 m TDH and the pump station is operated as a duplex facility (pumps operate in parallel and alternate duty) which allow pumping from PZ1 to PZ2. This flowrate is not adequate to provide fire flows in PZ 2.

The watermain network ranges in age from 1958 to current and comprises approximately 20 km of pipe between 50 and 250 mm in diameter. A significant portion of the underground water system was originally constructed using asbestos cement (AC) pipes. The AC piping is considered to have a life of 50 years, and essentially all such infrastructure is now operating on “borrowed time”. The cost of replacing AC water mains is significant and is usually covered by a replacement program funded by reserve funds. The replacement program is usually assessed on a case by case basis subject to repair history, frequency and age of pipe.

2.4 Potable Water Storage

Treated water for the CBWD service area is stored in three storage reservoirs:

- The Office Reservoir,
- The Telegraph Road Reservoir, and
- The Ordano Road Reservoir.

The Office Reservoir is an above-ground steel reservoir constructed in 1980, with a total storage volume of 545 m^3. The reservoir provides water storage for PZ1 and has a TWL of 73.0m. Office reservoir operational levels are between 85 and 95%. The reservoir is normally filled from the Telegraph Reservoir through an altitude valve located near the office but can also be filled from Pressure Zone 1 wells during periods of high demand. The electrical systems at the Office Reservoir require upgrading. An abandoned concrete reservoir has been disconnected but remains at the site; this facility should be properly decommissioned.

The Telegraph Reservoir is an above-ground steel reservoir constructed in 1997, with a total storage volume of 734 m^3. The reservoir provides water storage for PZ2 and has a TWL of 127.0m. Valleyview Well pumps are set to start when the Telegraph Reservoir is below 85% full and turn off when 95% full. The reservoir is normally filled by the Valleyview Wells; both pumps run simultaneously to fill the reservoir. The reservoir is very tall and narrow (29.6 m in height and 5.6 m in diameter), which can result in significant drops in water levels during periods of demand, causing fluctuations in system supply pressures. Surrounding elevations and seismic requirements prevent the TWL of the Telegraph Reservoir from being raised. The reservoir can also be filled from PZ1 using the booster station location at the Office Reservoir site.

The Ordano Road Reservoir is an above-ground steel reservoir constructed in 2015, with a storage volume of 1,568 m^3. The reservoir provides water storage for PZ2 and has a TWL of 100.9 m. The reservoir is normally filled by the Valleyview Wells and the Telegraph Reservoir through an altitude valve. Although in PZ2, the Ordano Road Reservoir has TWL of 100.9 m. The TWL was limited to this height due to the ground elevation (88.5 m) and seismic limitations. As this reservoir is in PZ 2, the reservoir filling level is controlled by an altitude valve that stops the filling process once the TWL has been reached, which currently results in some water quality challenges due to limited replacement of water in operation.

In order to meet fire flow requirements in PZ2 and improve turnover within the Ordano Reservoir, a booster station is under construction on the reservoir site. The station is capable of pumping 27 L/s to 127 m to meet the maximum day and 133 L/s for fire flows. The Ordano Booster Pump Station project is development driven but will supplement fire flow for users in PZ2.

3 DESIGN CRITERIA

The following sections outline the criteria that must be met by the CBWD water system, both now and into the future. This information provides a baseline to compare against system performance in order to identify required upgrades and projects to support the system as it grows.

As part of the master planning process, the most recent CBWD Engineering Specifications & Standard Drawings (ESSD) were reviewed. The ESSD documents provide a basis for design and construction of water infrastructure in CBWD; the most current version was issued in February of 2016. The specifications set out a number of criteria to be met by the water system; the information pertinent to the master planning process is summarized in the sections below. Additional standards and design guidelines have also been referenced where applicable and where the ESSD documents do not address design criteria.

Appendix C includes detailed calculations for determination of design criteria.

3.1 Planning Horizon

The planning horizon for this plan is 20 years; 2021 to 2041. Projects for the planning horizon will be categorized into two timeframes:

- Short-term (0 to 5 years); and
- Medium to long-term (6 to 20 years).

3.2 Service Population

Population growth is a fundamental part of design for water and wastewater infrastructure. The local economy, government policies, birth/death rates, tourism, migration, and other factors can all impact the population of a community. However, in order to understand the potential future water system requirements, an understanding of potential growth in the area must be developed. The following sections outline the steps taken to develop a service population for the planning horizon.

3.2.1 Population Density

The CBWD ESSD sets out the following criteria for establishing design population for any new development.

Table 3-1
Population Densities by Land Use (Residential)

Land Use	Description	Average Occupancy
Low Density	Residential development with a gross density of less than 20 units/hectare	2.6 persons/unit
Medium Density	Residential development with a gross density of more than 20 units/hectare and less than 50 units per hectare	2.0 persons/unit
High Density	Residential development with a gross density of more than 50 units/hectare	1.4 persons/unit

The CVRD OCP suggests that average household size in the area serviced by CBWD (Area D) is shrinking due to changing demographics and an aging population; the average household size has decreased from 2.4 persons per

household in 2006 to 2.2 persons per household in 2016, where it is expected to stay. Due to the changing demographics of the area, CBWD may wish to consider re-evaluating ESSD population densities against the updated information collected recently by the Cowichan Valley Regional District, when the ESSD are next updated.

3.2.2 Current Customer Base

The CBWD provides potable water to a variety of customers within the CBWD Service Area, which comprises the area shown in Figure 3-1 in Appendix A. Note that some of the figures cover only the northernmost areas of the CBWD service area however, these maps cover the majority of the service population and growth expected in the system, with the exception of the Tommy Road subdivision and the Valleyview well site.

Based on CBWD customer records, as of July 12, 2021, there were 1117 connections to the water system, 947 of which are residential. Table 3-2 provides the equivalent expected population associated with the current connections and the population densities outlined in Section 3.2.1.

There are a number of commercial properties serviced by CBWD; these are mainly found along Cowichan Bay Road waterfront and at the Valleyview Centre. Additionally, Bench Elementary School is the main institutional use in the area. However, for the purposes of this study, only residential units will be considered to have an equivalent population as the majority of the service area is residential, and per capita demands typically account for overall water usage in a community. Fire flows will be addressed separately for commercial, institutional, and industrial users.

Table 3-2
CBWD Current Residential Connections and Estimated Equivalent Population

Connection Type	Number of Connections	Population Density	Equivalent Population
Single Family	774	2.6	2012
Town House	40	2.0	80
Condominium	133	1.4	186
Total	947		2279
	Average Population Density	2.4	

3.2.3 Population Projections

The Cowichan Bay Official Community Plan (OCP) Bylaw 4270 and Area D Cowichan Bay Local Area Plan by Cowichan Valley Regional District (CVRD) were developed to guide decisions on land use and planning activities in the area, providing land use mapping and potential growth areas within the Electoral Areas. AE reviewed the CVRD OCP to collect information on projected growth in the area. The OCP reported the 2016 population of Electoral Area D was 3,153 people over 1,433 households, which is approximately 2.2 persons per household. Data from the 2021 Census was not available at the time of writing this report, but using the 1% growth rate in the OCP, it can be estimated that the 2021 population of Electoral Area D would be approximately 3280 people in 2021, and 1491 households. Comparing this to the current list of residential connections in Table 3-2 suggests that CBWD currently services approximately 65% of the households located in Electoral Area D.

To estimate the future population to be serviced by CBWD, the current population of 2279 people was subjected to the OCP annual growth rate of 1% per year for 20 years. As can be seen in Table 3-3, this results in a population

increase of 502 people serviced by CBWD in 2041. Based on the OCP assumption that the average density will remain the same as current, that represents an increase of approximately 210 units over 20 years.

Table 3-3
Population Projections over Planning Horizon

Year	Projected Population (persons)	Growth During Period (persons)	Equivalent Housing Units
2021 (current)	2279	-	947
2026 (5-Year)	2395	116	48
2031 (10-Year)	2517	122	51
2041 (20-Year)	2780	263	109
	Total	502	209

Also important to a water system is not just how much growth will occur, but where it will occur. Projecting the location for growth is difficult at best, so a number of sources were used to try to understand where growth is most likely to happen. The next sections deal with the various types of development expected.

3.2.3.1 Future Developments

CBWD's development process results in approvals of connections that may not be connected immediately but represent a very likely area for growth. Table 3-4 outlines the developments currently approved by CBWD that expect further growth during the planning horizon. Note that "Misc Approved" represents those locations that are servicing an empty lot but included in the tax roll. Note that not all projects have been approved to date but are in the approval process.

Table 3-4
Future Developments

Development Name	Development Type	Expected Number of Units	
		Pressure Zone 1	Pressure Zone 2
Tommy Road Subdivision (Future)	Single Family Residential	0	5
Canoe Shed	Single Family Residential	4	0
Jack Road (Future)	Single Family Residential	15	0
Wilmot Road	Single Family Residential	0	15
Cowichan Bay Estates Phase III	Single Family Residential	0	40
Misc Approved	Single Family Residential	8	6
	Total	27	66

3.2.3.2 Land Use

For future growth that can't be identified in developments that have already been approved, the CVRD OCP was reviewed. The Local Area Plan for Area D included a land use plan (included as Figure 3-2 in Appendix A.) The

mapping identifies areas for each type of growth, which can provide guidance for projecting the locations for growth by CBWD.

The OCP suggests that the majority of the areas serviceable by CBWD falls within the following land use designations:

- Marine Village (commercial/light industrial)
- Village Residential – Pressure Zone 1 east of Wessex Road, and Pressure Zone 1 west of Wilmot Road
  - Ground-oriented dwellings such as single detached dwellings, secondary suites, duplexes and low-rise multi-unit residential development
- Rural Village Residential – Pressure Zone 2 east of Wilmot Road, north of Ordano Road and east of Cowichan Bay Road around Longwood Road
  - Single detached dwellings, secondary suites, detached accessory dwellings, cluster development and mobile homes
- Cluster Residential – east of Cowichan Bay Road
  - Intensive residential cluster development in small dwelling groups, arranged around a common space area
- Four Ways Rural Village
  - Mixed-use area i.e. low-rise mixed-use developments that include ground floor commercial uses and residential uses above

The OCP also identifies future areas requiring servicing to support growth. Figure 3-3 in Appendix A outlines the areas in the OCP identified as needing water servicing into the future. In general, there is a small amount of rural residential development along Cowichan Bay Road on the way to Kidd Road Well that may require servicing, but the majority of the development is in Pressure Zone 2. Areas that may be readily serviceable by CBWD include:

- The Cluster Residential parcel located near the Cowichan Bay Road PRV, north of Longwood Road;
- The Cluster Residential parcel between the Four Ways Subdivision and Lanes Road; and
- The parcel zones Rural Village Residential at the northwest and southwest corners of Cowichan Bay Road and Telegraph Road.

Based on ease of access and development, it is expected that that the cluster residential by the Cowichan Bay PRV (from hereon referred to as the “East Cowichan Development”) and cluster residential between the Four Ways Subdivision and Lanes Road (from hereon referred to as the “Four Ways East Development”) will see the most development over the next 20 years. The East Cowichan Development can likely support approximately 20 single-family residences. The Four Ways East Development will be considered able to support the remainder of the identified growth. These two areas are considered growth nodes for future growth, as there is no further information to identify what development in these areas might look like.

While growth is not being attributed directly to commercial or industrial areas, existing areas will be considered to develop further, requiring CBWD to ensure that minimum service requirements can be met. For these locations, the biggest concern is typically the availability of fire flow.

3.2.3.3 Growth Nodes

Based on the land use mapping, projected growth rate of 1%, and anticipated but not yet connected developments, it can be calculated by difference that new growth nodes will service an additional 116 new single-family homes by

2041. The growth has been distributed between the two growth nodes identified and is summarized in the table below.

Table 3-5
Growth Nodes

	2026		2041	
	PZ1	PZ2	PZ1	PZ2
Approved Developments				
Tommy Road Subdivision (Future)	0	1	0	5
Canoe Shed	1	0	4	0
Jack Road (Future)	4	0	15	0
Wilmot Road	0	4	0	15
Cowichan Bay Estates Phase III	0	10	0	40
Misc Approved	2	2	8	6
Growth Nodes	0	0	0	0
East Cowichan Development	0	5	0	20
Four Ways East Development	0	24	0	96
Total	7	45	27	182

3.3 Water Demands

Per capita water demands are used to evaluate overall system demands and determine water quantities required for servicing. As per the ESSD documents, design water demand for CBWD are to be based on the values below.

Residential:

- Average Day Demand (ADD) - 500 Litres per capita per day (LCD)
- Maximum Day Factor - 2.2 x ADD
- Maximum Day Demand (MDD) - 1,100 LCD
- Peak Hour Demand - 4 x ADD
- Peak Hour Demand (PHD) - 2,000 LCD

Commercial and industrial demands are determined on an individual basis. Maximum day demand shall be calculated using the same maximum day factor as residential (MDD = 2.2 x ADD). It is generally assumed that there is no peak hour for commercial or industrial demands.

MMCD recommends a lower per capita demand for metered developments:

- Average Day Demand (ADD) - 300 LCD
- Maximum Day Demand (MDD) - 600 LCD (2x ADD)
- Peak hour demand (PHD) - 900 LCD (3x ADD)

MMCD increases the average day demand to 450 LCD for developments that are not metered but maintains the same maximum day and peak hour factors. Given the relatively small size of the CBWD system, it is reasonable to use the higher values in the ESSD while recognizing that these are likely to be somewhat conservative estimates. These "typical" design demands are compared to measured usage in the following section.

3.3.1 Current Water Demands

In order to understand what the system may need in the future, it is important to understand what the system is currently using. A review was done of the overall system water usage data from 2018 to 2021; limited data was available for this analysis. Table 3-6 compares the water produced by the CBWD wells to the water invoiced to consumers.

Table 3-6
System Water Production 2018-2021

Year	Water Production (m^3)	Water Invoiced (m^3)	Non-Revenue Water (m^3)	Non-Revenue Water (% of total)
2018	268,971	253,563	15,408	6%
2019	257,839	228,872	28,967	11%
2020	273,503	239,738	33,765	12%
2021[1]	142,184	115,834	26,350	19%
			AVERAGE	12%

1. January 1 to June 30

It is worth noting that there seems to have been a significant increase in non-revenue water in the first half of 2021. System flushing is typically done in the spring which may skew the numbers. However, it is recommended that CBWD continue monitoring non-revenue water on a regular basis as it can be an indicator of larger leaks or other problems in the system.

Table 3-7 summarizes the water production from the Valleyview wells in additional detail, from 2018 to 2021. As mentioned above, data covering part of the year may skew the results by representing only the high or low usage portions of the year; in this case both 2018 and 2021 data are for partial years. Looking solely at 2019 and 2020, it appears that water usage has remained relatively steady, which is what would be expected with the predicted (1%) growth rate.

Table 3-7
Valleyview Well Production 2018-2021

Year	Annual Water Production (m^3)			Daily Water Production (m^3)		
	Valleyview Well 2	Valleyview Well 1	Total Valleyview	Maximum	Average	Maximum Day Factor
2018[1]	54,390	22,234	76,624	945.1	633.3	1.5

Year	Annual Water Production (m^3)			Daily Water Production (m^3)		
	Valleyview Well 2	Valleyview Well 1	Total Valleyview	Maximum	Average	Maximum Day Factor
2019	186,004	90,745	276,749	1,365.4	758.2	1.8
2020	184,515	87,163	271,678	1,291.5	744.3	1.7
2021[2]	145,362	60,789	206,151	1,545.1	866.2	1.8

1. September 1 to December 31
2. January 1 to June 30

The detailed analysis can be found in Appendix C, but in general, the review allowed for the following observations to be made:

- Based on 2018, water production is mostly provided by Valleyview Well #1 (66%), followed by Valleyview Well #2 (31%) and is supplemented by the Office Well (3%). No water is produced by Kidd Well;
- Based on Valleyview Well production data, water usage remains relatively steady, which is to be expected with minimal growth; and
- A significant amount of non-revenue water occurs within the system. This can be attributed to flushing, fire department usage, leaks, meter inaccuracies, and residual maintenance at the Kidd Well location. This percentage averages 12% of the total produced water volume from 2018 to 2021.

A per capita usage was calculated based on the assumptions above, an estimated 2021 population of 2,279 persons (as per Section 3.2.2), and an assumed past growth rate of 1%. The results can be seen in Table 3-8.

Table 3-8
Calculated Equivalent Per Capita Usage

Year	Annual Water Production (m3)	Average Daily Demand (L/s)	Estimated Population[1]	Average Per Capita Demand (LCD)	Maximum Per Capita Demand[2] (LCD)
2018	268,971	8.5	2,211	333	667
2019	257,839	8.2	2,233	316	633
2020	273,503	8.7	2,256	332	664
2021	142,184	6.9	2,279	262	524
			AVERAGE	311	622

1. Calculated back from 2021 using a 1% annual growth rate.
2. Based on an assumed MDF of 2.0.

The data suggests that the current CBWD ESSD values of 500 LCD for ADD and 1100 LCD for MDD may be significantly higher than the actual usage of the community; instead the actual usage values appear to be closer to the MMCD design flows of 300 LCD for ADD and 600 LCD for MDD. As water conservation and water metering becomes more widespread, per capita water usage has been dropping. Using demand projections that are significantly higher than actual usage can result in planning for system components that are much larger than what is required. For the purposes of this plan, a reduced per capita ADD of 350 LCD is proposed. This reduction is made alongside a change in the way source reliability is considered, discussed in Section 3.4.1 of this report. These two changes

represent a change in how system redundancy is provided for and will tend to have counterbalancing effects. It is recommended that this change in approach be incorporated into the ESSD when it is next revised.

3.3.2 Water Demand Projections

Based on the base water demands developed in Section 3.3.1 and the population projections developed in Section 3.2.4, the following water demands were developed to represent the future demands that CBWD may need to service in the next 20 years. Tables 3-9 and 3-10 summarize the water projections that will be used to inform the Master Plan. Note that the existing 2021 demand is based on actual usage instead of design values. Based on the water usage data, future projections used a reduced per capita rate of 350 LCD, and a maximum day factor of 2 times average day demand.

Table 3-9
Water Demand Projections

	2021			2026			2041		
	ADD (L/s)	MDD (L/s)	PHD (L/s)	ADD (L/s)	MDD (L/s)	PHD (L/s)	ADD (L/s)	MDD (L/s)	PHD (L/s)
Single Family	1.9	3.3	7.6	2.2	4.4	8.9	2.4	4.8	9.7
Town House	0.3	0.5	1.1	0.3	0.6	1.3	0.3	0.6	1.3
Condominium	0.4	0.7	1.6	0.4	0.9	1.8	0.4	0.9	1.8
Subtotal PZ1	*2.6*	*4.4*	*10.4*	*3.0*	*6.0*	*12.0*	*3.2*	*6.4*	*12.8*
Single Family	5.3	9.0	21.2	6.4	12.9	25.7	7.8	15.5	31.0
Town House	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Condominium	0.3	0.5	1.1	0.0	0.0	0.1	0.3	0.6	1.2
Subtotal PZ2	*5.6*	*9.5*	*22.3*	*6.5*	*12.9*	*25.8*	*8.1*	*16.1*	*32.3*
Total	8.2	13.9	32.7	9.4	18.9	37.8	11.3	22.5	45.1

Table 3-10
Water Demand Summary

Year	System Demands (L/s)		
	ADD	MDD	PHD
2021	8.2	13.9	32.7
2026	9.4	18.9	37.8

Year	System Demands (L/s)		
	ADD	MDD	PHD
2041	11.3	22.5	45.1

3.4 System Design

In addition to determining the volumes of water that users of the system will demand, there are other design criteria that should be considered during a planning exercise. More information can be found in the sections below.

3.4.1 Capacity of System Components

Typically, average day and maximum day demands should be met by water supply and treatment systems, while peak hour and fire demand are typically met by providing storage facilities. This ensures that available supply can meet system demands, even during the summer months when demands are high.

For source water, the ESSD states that the water supply source for ground water wells should be capable of providing maximum day demand for the population to be serviced. This provides ongoing supply for users but doesn't account for redundancy in case of emergency conditions.

The 10 States Standards are often used to provide guidance where other standards aren't available. The 10 States Standards suggest that the source quantity should be capable of meeting or exceeding the design maximum day demand with the largest producing well out of service. This additional capacity is sometimes referred to as "firm capacity" and ensures that users of the system don't see an interruption in service even if one well is unavailable. With the reduced demands proposed in Section 3.3.1 it is appropriate to also adopt this increased reliability requirement.

3.4.2 Water Quality

Island Health defines that water delivered for drinking water purposes must "be free of pathogenic organisms and their indicators and deleterious chemical substances including radioactive materials. In additional, the water should have acceptable colour, odour and taste." Reference documents include the Drinking Water Protection Act, the Drinking Water Protection Regulation and the current GCDWQ.

The level of treatment required for microbiological parameters depends on the type of water source, however disinfection is required for all sources. If needed, additional treatment may be required to meet the regulations.

3.4.3 System Water Pressures

In order to maintain pressure in homes in the service area, standards for minimum water pressures have been developed. Maximum recommended water pressures have also been included to protect infrastructure. As per the ESSD, the following are the design water pressures that the system should strive to meet:

- Maximum pressure - 700 kPa (100 psi)
- Minimum pressure at MDD - 275 kPa (40 psi)
- Minimum pressure at PHD - 240 kPa (35 psi)
- Minimum residual pressure at MDD + Fire at Hydrant - 150 kPa (22 psi) *

**ESSD state 140 kPa but FUS (see next section) states 150 kPa. In practice it will be difficult to distinguish between these two numbers.*

Building with pressures greater than 80 psi are required to have individual pressure reducing valves.

3.4.4 Fire Flow Availability

The CBWD ESSD has adopted that required fire flows shall be in accordance with the latest release of "Water Supply for Public Fire Protection" as published by the Fire Underwriter's Survey (FUS). Fire flow calculations for individual buildings are based on building construction type, area, contents, fire protection (sprinklers) and proximity to other structures. For the purposes of this document, the minimum requirements stated in the ESSD documents are used for evaluating future growth. In general, these are equal to or greater than the FUS requirements, and on a system-wide basis they are a reasonable proxy for FUS flows. The minimum flows can be seen in Table 3-11.

Table 3-11
Minimum Fire Flows

Development Type	Flow (L/s)	Duration (hours)
Single Family Housing	60	1.50
Churches, Apartments, Townhouses	90	2.00
Commercial (> 1,500 m^2)	150	2.00
Institutional (> 1,500 m^2)	150	2.00
Light Industrial (> 4,500 m^2)	225	3.00

During a fire situation, the system shall be designed to supply the required fire flow in addition to the maximum daily demand delivered with a minimum residual pressure of 150 kPa (22 psi). The maximum allowable design velocity under fire flow conditions should be 3.5 m/s.

3.4.5 Hydrant Spacing

As per the ESSD, hydrant distribution shall be in general conformance with the "Water Supply for Public Fire Protection" as published by Fire Underwriters Survey and in accordance with the values in Table 3-12. In general, the ESSD values are lower (more conservative) than FUS.

Table 3-12
Maximum Hydrant Spacing

Zoning	Maximum Hydrant Spacing
Single family residential areas with more than 3 m separation between houses.	150 m
Single family residential areas with less	90 m

Zoning	Maximum Hydrant Spacing
than 3 m separation between houses	
Townhouses or multi-family and other medium density areas	90 m
Institutional, commercial, industrial, apartments and other high-density areas.	90 m

3.4.6 Storage Capacity

Reservoir storage serves a number of purposes, including buffering for peak flow periods and fire flow storage. Reservoir capacity should be calculated by the following formula:

Total Storage Volume = A + B + C

Where:

A = Fire Storage (defined by Fire Underwriters Survey guide)
B = Equalization Storage (25% of Maximum Day Demand)
C = Emergency Storage (25% of A + B)

Storage capacity based on design horizon is calculated later in the report.

4 WATER SUPPLY

CBWD is fully supplied by groundwater sources. The following sections evaluate the capabilities of the existing water supply system to meet the needs of the system into the future. During this review of the water supply, it was noted that limited data were available beyond those required to demonstrate adequate water quality in the system. It is recommended that the District's data collection practices be reviewed so that appropriate information is available for future reviews and to improve the decisions that are based on them.

4.1 Source Capacity

As noted in the design criteria, water sources should be capable of meeting maximum day demand for the population being served. The availability of raw water is key to the success of a water system. A summary of the reported source capacities is shown on Table 4-1 as follows.

Table 4-1
Reported Source Capacities

Well Name	Well Yield (L/s)	Pumping Capacity (L/s)
Kidd[1]	0.0	0.0
Office	10.0[3]	6.3
Valleyview #1[2]	38.0	12.0
Valleyview #2	6.0	6.0
Total	**54.0**	**24.3**
Total with Largest Well Out of Service	**16.0**	**12.3**

1. Not in use due to quality concerns
2. Based on pump size; well yield rated at 38 L/s
3. Assumed; no confirmation in available data

Based on the information available, both the existing maximum day demand of 13.9 L/s and the 20-year maximum day demand of 22.6 L/s can be met by the volume available from the three operational wells, assuming all wells are working to meet demands. CBWD should increase the diversity and/or capacity of sources in order to provide firm capacity (i.e. with the largest well out of service) that meets the maximum day demand.

4.2 Source Quality

Water quality data from 2020 was provided for the Office Well and both Valleyview Wells for this review. The full data set reviewed can be found in Appendix D.

As there is no available data to determine whether the wells are considered groundwater at risk of containing pathogens (GARP), it has been assumed that initial screenings have concluded that they are non-GARP. A non-GARP source has a reduced amount of water treatment that is required to adequately treat the water source as compared to a surface water source.

A review of the available data suggests that the water from both Valleyview Wells is of good quality and require only disinfection prior to distribution.

The Office Well data includes high values for iron (1.89 mg/L) and manganese (0.285 mg/L). According to the *Guidelines for Canadian Drinking Water Quality* produced by Health Canada the aesthetic objective for iron in drinking water is less than or equal to 0.3 mg/L and the maximum acceptable concentration for manganese is 0.12 mg/L. While there is a manganese greensand system installed for treatment of water from this well, without additional water quality data, it is unclear as to whether the system is adequately treating the water to within drinking water guidelines. A sample of the treated water downstream of the greensand filtration should be tested to determine if the treatment is treating the raw water to within potable water standards.

The Langelier saturation index calculation for each source suggests that the water from all wells is not scale forming under typical conditions and would be considered moderately aggressive. This can impact the life of pipe and fittings in the distribution system by increasing the corrosion potential, particularly in AC pipe. Treatment is not required, but this should be considered when estimating service life for piping in the system.

Water quality from Kidd Well is reportedly so poor that its use results in taste and odor complaints. Recent flooding in the District also demonstrated that the location of this well is at risk due to surface water. This well should either be significantly upgraded to make it useable or abandoned properly. Based on the available information abandonment may be the preferred option.

4.3 Treated Water Quality

Limited data was available to review treated water quality. The available treated water quality is included in Appendix D and shows no concerns with the quality of water being distributed to customer. Chlorine residuals are monitored and recorded weekly and meet requirements. Bacteria sampling results and frequency have been reported to be satisfactory.

4.4 Source Sustainability

As climate change effects become more prominent, it is becoming more important than ever to look at the long-term sustainability of water sources and water supply reliability under drought, flooding, forest fire, and other climate change effects. Risks to source include climate change and emergency events, but also potential contamination.

Significant research has gone into identifying the impacts of climate change on groundwater; Simon Fraser University has even supported a research program for many years. The following are some of the potential impacts of climate change on aquifers in BC:

- Higher temperatures may increase the rate of evapotranspiration
- Changing vegetation can impact evaporation and absorption processes
- Loss of winter snowpack can influence groundwater recharge
- Hotter, drier summers can increase agricultural demands, which can reduce aquifer volumes and well static levels
- Rising tides can impact the quality of aquifers as the position of saltwater-freshwater interface shifts
- Heavy rain events and drought can reduce groundwater recharge as the ground can't absorb the precipitation properly
- Extreme events can impact access to wells and runoff around wells
- Water quality can change as sources change

- Changing conditions can lead to issues with slope stability, impacting supply piping and other infrastructure

In general, groundwater sources are less likely to be significantly impacted by the changing climate and emergency events such as forest fires compared to surface water. However, protection of the source and understand of source risks are key to ensuring longevity. Source water protection plans help to identify and evaluate threats to drinking water safety and sustainability, and to develop recommendations to reduce risks and improve the resiliency of the water supply, which includes evaluating the potential effects of climate change. It is recommended that CBWD develop a source water protection plan to ensure the longevity of their sources.

5 WATER DISTRIBUTION SYSTEM

The CBWD distribution system is comprised of a network of pipes over two pressure zones. The distribution system is responsible for moving water from the source to storage and consumers, and must be sized to handle all required flows.

5.1 Model Update

As part of the Master Plan, the existing EPAnet model was imported into WaterCAD Connect and updated to match current conditions and with updated demands. The existing model was compared to the most recent mapping for CBWD and updated accordingly. This process is technically focused and provides a tool for use in projecting the behaviour of the water system now and into the future. The following sections outline the model update in more detail.

5.1.1 Data Update

The following data was updated within the model for each segment of pipe:

- Length;
- Diameter;
- Year of Installation;
- Pressure Zone; and
- Material.

Ordano Pump Station was added to the model to allow for future scenarios to include the operation of this new infrastructure. Recent upgrades and additions to the system were checked against the model and updated as required.

The pipe material friction factor was updated throughout the model. This pipe "roughness" coefficient, the Hazen-Williams 'C' factors, was assigned to each mainline element within the network based on its material type. Table 5-1 below provides the C-factors used for the model.

Table 5-1
Pipe Roughness by Material

Pipe Material		Hazen Williams C-Factor
PVC	Polyvinyl Chloride/C900	140
AC	Asbestos Cement/Transite	110
PE	Polyethylene	140

It should be noted that the factors were adjusted by pipe material only. This provides an adequate overview of the system for this purpose.

A cursory model review was completed that involved comparing the pressure data collected from the various system hydrants to the pressures calculated by the model. The review showed that there seems to be some significant discrepancies between actual conditions and those predicted by the model; this is likely due to the need for model calibration. It is recommended that CBWD complete a system data collection and model calibration exercise to build confidence in the model and identify potential system conditions such as partially closed valves.

5.1.2 Assigning Water Demands

Residential water demands were evenly distributed across the model; multifamily, commercial and institutional demands added at closest node. Leakage is not explicitly shown as a demand but was part of the consumptive use measurements. Currently, any water loss experienced by the system is built into the residential demands.

5.1.3 Scenario Development

The modelling process was used to assist in determining any capital needs and suggested operational changes to the current water system and its operation. To meet these needs, a series of modelling scenarios were developed to address a variety of hydraulic, growth, operational and development questions that arose during this process. The scenarios examined in this analysis include:

- 2021 Existing System
  - ADD
  - MDD
  - MDD + FF
  - PHD
- 2026 Existing System (+5 years, Ordano Pump Station included)
  - ADD
  - MDD
  - MDD + FF
  - PHD
- 2041 Existing System (+20 years)
  - ADD
  - MDD
  - MDD + FF
  - PHD

Steady-state models predict behavior in a water distribution system during a hypothetical condition where the effects of all changes in the operation and demands of the system have stopped. These scenarios can be thought of as a “snapshot” in time for the distribution system.

For each of the steady state scenarios, the system was set to simulate normal operating conditions for the estimated flows. These scenarios were run without the use of diurnal demand patterns, and instead used a factor of 1.0 for all system demands.

In general, steady state models are used to solve infrastructure related design problems. Maximum day steady state scenarios are used to study normal system operation and production and pumping requirements for the system. Peak hour steady state scenarios are used to design piping for large systems and examine tank filling capabilities for system pumps. The scenario including fire flow provides a rapid method of assessing which hydrants will be able to provide the design flowrate in case of emergency.

5.2 Distribution System Capacity Analysis

The distribution system analysis was completed using the newly updated WaterCAD model. Figures produced as part of the analysis can be found in Appendix E.

5.2.1 Existing System Analysis

To determine the ability of the existing system to meet current system demands, the 2021 scenarios were run and analyzed. Since the Ordano booster station is not yet completed, this scenario did not include that infrastructure. As such, it was known before running the scenario that there would be concerns with providing fire flow for properties in PZ 2 higher than 74 m in elevation.

The results can be found in Figures 5-1, 5-2, 5-3, and 5-4.

The existing system demand analyses show issues with supply pressures consistently being less than 40 psi in the area around the Telegraph Reservoir, just south of the Office reservoir, and at the end of the line on Hillbank. These issues are based on the reservoir TWLs.

The fire flow scenarios show issues with fire flow at multiple locations in the system. As the Ordano Booster pump station is being constructed partially to address these concerns, this will be further evaluated during the 2026 scenarios. Figure 5-4 shows the available fire flow at hydrants in the system during periods of maximum demand.

5.2.2 2026 System Analysis

To determine the ability of the existing system to meet short-term (5-year) demands, the 2026 scenarios were run and analyzed. Since the Ordano booster station is expected to be completed within the next year, this scenario included the booster. The model included a booster pump capable of 27 L/s at 39.8 m TDH for additional supply during normal conditions, and a fire pump capable of 133 L/s at 32.3 m TDH. It was assumed that the booster pump would be on for maximum day and peak hour scenarios, and that the fire pump would operate during fire flow scenarios.

The results can be found in Figures 5-5, 5-6, 5-7, and 5-8.

As can be seen in Figure 5-6, the Ordano Booster Station will have the ability to increase supply volume and pressures in the area of Pressure Zone 2 north of the Ordano Reservoir but does not provide any additional pressure to the residential area around Telegraph Reservoir. Figure 5-8 shows the available fire flow in the system increases significantly in Pressure Zone 2 with the addition of the Ordano Booster Station but fire flow to the residential area around Telegraph Road remains deficient. To provide adequate operating pressure and increase available fire flow, a booster pump station is recommended for this neighborhood. This upgrade will need to coincide with replacement of the 100 mm diameter asbestos cement watermains on Woods Road, Sears Road, and Nelson Road to provide adequate fire flow to this area.

While the Ordano booster pump station increases the amount of flow to many areas of the system, the commercial area of Marine Village is still unable to provide adequate fire flow, as is the area around the five existing multifamily developments (Mariner Ridge, Villas on the Bay, The Landing, Cowichan Bay Arms, and the Cannery). In order to address these fire flow concerns, a number of upgrade projects are recommended to help move water from Pressure Zone 2 into the Marine Village and lower PZ1 area:

- Upgrade the watermain on Cowichan Bay Road from the Cannery to Botwood Road. Much of this main is 100mm asbestos cement pipe installed in 1958 and needs to be replaced regardless. A 200 mm diameter main in this location will help provide the required 150 L/s of fire flow to the commercial users in Marine Bay;
- Upgrade the existing 150 mm watermain on Cowichan Bay Road, from Glen Rd to Longwood Road to 200 mm. This small portion of pipe is 100 mm AC installed in 1964, and its size reduces the flow that can pass through the Cowichan Bay Road PRV station; and
- Upgrade the existing 100 mm diameter AC watermain on Wilmot Road, from Pritchard Road to Cowichan Bay Road, to 150 mm. This watermain upgrade will increase the amount of fire flow available to nearby multifamily developments.

Hillbank Road, the area of Cowichan Bay Road east of the village, Wessex Road and Bicks Road also have fire flow issues. Upgrades to the 50 mm piping on Wessex Road (installation date unknown) and the 100 mm piping on Bicks Road (installed in 1986) will help address these end of line fire flow issues. Hillbank Road and the area of Cowichan Bay Road east of the village would require booster pumping during fire scenarios.

5.2.3 2041 System Analysis

To determine the ability of the existing system to meet long-term (20-year) demands, the 2041 scenarios were run. These scenarios incorporate the 20-year growth projections, and all of the upgrades recommended in Section 5.2.3.

The results can be found in Figures 5-9, 5-10, 5-11, and 5-12.

These maps show that the upgrades recommended to meet the current and short-term fire flow and supply pressure issues in the system will be adequate to supply the system for the 20-year growth period.

5.3 Water Storage Capacity

Table 5-2 summarizes the treated water storage available in the CBWD system.

Table 5-2
Available Water Storage

Reservoir	Volume (L)
Office (PZ1)	545,000
Ordano (PZ2)	1,568,000
Telegraph Road (PZ2)	734,000
Total	2,847,000

As can be seen in Table 5-3, the system has adequate storage for the 20-year planning horizon, requiring no additional storage at this time. Note that this calculation assumes that there is no light industrial development in the CBWD service area, which would likely require the construction of additional storage.

Table 5-3
Storage Requirements by Pressure Zone

	2021		2026		2041	
	Volume Required (L)	Surplus/ (Deficit) (L)	Volume Required (L)	Surplus/ (Deficit) (L)	Volume Required (L)	Surplus/ (Deficit) (L)
PZ 1						
Residential SF Rate at 60 L/s	682,000	2,165,000	725,000	2,122,000	735,000	2,112,000
Residential MF Rate at 90 L/s	1,170,000	1,677,000	1,212,000	1,635,000	1,223,000	1,624,000
Institutional (School) at 150 L/s	1,320,000	1,527,000	1,362,000	1,485,000	1,373,000	1,474,000
Commercial/Retail at 150 L/s	1,170,000	1,677,000	1,212,000	1,635,000	1,223,000	1,624,000
PZ 2						
Residential Rate at 60 L/s	819,000	1,483,000	911,000	1,391,000	999,000	1,303,000
Residential MF Rate at 90 L/s	1,307,000	995,000	1,399,000	903,000	1,486,000	816,000
Institutional at 150 L/s	1,457,000	845,000	1,549,000	753,000	1,636,000	666,000
Commercial/Retail at 150 L/s	1,307,000	995,000	1,399,000	903,000	1,486,000	816,000

6 CAPITAL WORKS PLAN

Based on the evaluation of the system as presented in the sections above, a list of recommendations has been created for the system. A visual representation of the capacity based recommended upgrades can be seen in Figure 6-1 in Appendix F.

The Improvement District Manual outlines the items that should be included in a capital works plan. It states that *"All costs that would normally be capitalized in the financial accounts of the improvement district may be included in the calculation of CECs. Such costs include planning, engineering and the legal costs related directly or indirectly to the development. Additional costs such as interim financing, administration and a provision for contingencies may also be included where appropriate."* A number of recommendations have been developed as part of this study that do not necessarily meet the definition of items that should be included in a capital plan but are still important for CBWD to consider. These items have been included in the capital works plan, but as items that support the ongoing operation of the entire CBWD system, not just future development.

6.1 General

Based on the findings of this review, a number of recommendations have been made:

- Collect data and update the ESSD to reflect changing demographics, water usage, and approach to water supply capacity;
- Monitor non-revenue water usage to identify system issues and reduce overall system costs;
- Evaluate the existing system at Pavenham to determine if the old reservoir has been properly abandoned;
- Complete a water quality review for the distribution system, including an evaluation of chlorine contact time for the existing sources; and
- Complete a model calibration exercise to increase confidence in the model results and continue use of the model as a design tool.

These and other studies are an important part of understanding the system operation and optimizing its performance. A placeholder has been added to the Capital Works Plan as “Engineering Studies” to support completion of these and other similar tasks.

CBWD has a number of abandoned buildings; the George Road well building, the Ordano Road old valve building, and the old Valleyview site. These buildings should be demolished as funding is available.

6.2 Water Supply Upgrades

The following upgrades are recommended for the water supply system.

6.2.1 New Water Source

The system does not currently have adequate water supply to provide maximum day demand with the largest well out of service (i.e. firm capacity). It is recommended that CBWD investigate and complete another groundwater well, potentially in the Valleyview area (due to the reported aquifer capacity and production rates of existing wells). The recommended capacity of the new well is at least 17 L/s. This volume would allow the 2041 MDD to be met by the Valleyview aquifer during normal operating conditions, and by a combination of the Valleyview Wells and the Office well if the new well is out of service.

6.2.2 Source Water Protection Plan

The Valleyview source provides high quality water requiring minimal treatment to the CBWD system, however this could change if the aquifer became contaminated. It is recommended that CBWD complete a source water protection plan to identify potential source contamination. A Source Water Protection Plan is a risk-based assessment of hazards that may threaten a water source. Outcomes of this work may lead to additional projects that should be included in the Master Plan and may include working with CVRD to put policies into place that will protect the quality of the source.

6.2.3 Decommission Kidd Well

Kidd Well produces water that does not meet drinking water objectives, is aesthetically unpleasing, and would require significant upgrades to operate as designed. Once it has been confirmed that future flows can be provided by the Valleyview and Office sources, the Kidd Well should be decommissioned. Decommissioning should include the groundwater well, the building, and the portion of watermain between the well connection and last service connection. Consideration for ongoing flushing of this line should be included in the decommissioning design.

6.3 Water Storage Upgrades

No water storage upgrades are required.

6.4 Distribution System Upgrades

The following upgrades are recommended for the water distribution system.

6.4.1 Marine Village Fire Flow Improvements

The following upgrades will increase the available fire flow to the commercial users in the Marine Village area.

Cowichan Bay Road (Cannery to Botwood Rd)

The existing 100mm AC main on Cowichan Bay Road between the Cannery and Botwood Lane was constructed in 1958. It is nearing the end of its useful life and is a significant flow restriction in the Marine Village area. Replacing this main with a new 200 mm watermain is an important step in securing the safety of the CBWD distribution system. This upgrade is part of the series of waterman improvements that are required to provide enough capacity (150 L/s) for fire and MDD flow to the marine commercial area as well as those properties on route that may be redeveloped or become new developments. This project also supports the AC replacement program.

Cowichan Bay Road (Glen Rd to Longwood Rd)

Upgrading the existing 150 mm watermain on Cowichan Bay Road, from Glen Rd to Longwood Road to 200 mm diameter pipe is recommended. This small portion of pipe is 100 mm AC installed in 1964, and its size reduces the flow that can pass through the Cowichan Bay Road PRV station. Upsizing this small portion of main will increase the flow that can be provided from Telegraph Reservoir and Valleyview Wells to the Marine Village area. This project also supports the AC replacement program.

Wilmot Road

To upgrade the amount of fire flow available for the existing multifamily developments on Wilmot and Pritchard Roads to at least 90 L/s, the existing 100 mm diameter AC watermain on Wilmot Road should be upgraded to 200 mm, from Pritchard Road to Cowichan Bay Road. This watermain upgrade will increase the amount of fire flow available to the existing multifamily developments and have the additional benefit of being able to provide more water to the light industrial users as well. This project also supports the AC replacement program.

6.4.2 Telegraph Road Improvements

Residents around Telegraph Road experience ongoing issues with supply pressures under all system conditions and are supplied with inadequate fire flow. The following recommendations will support increased pressure in this area.

Sears, Nelson and Woods Roads

The Sears, Nelson, and Woods Roads watermains are all 100 mm diameter AC and were installed in 1971. The watermains are undersized to carry adequate fire flow to support the current residential development in that area. Upsizing the watermains will support the AC replacement program and allow for additional domestic fire flows to be carried to hydrants in the area.

Telegraph Booster Station

To increase domestic pressures around the Telegraph Reservoir, a booster station should be installed. This pump station will boost pressures from the Telegraph Reservoir to supply nearby users additional pressure under day to day conditions and will also support the provision of residential fire flow to the area. The pump station should have two pumping systems; a booster pump system sized for domestic flows that increases pressure by up to 30 psi, and a fire flow pump that increases fire flow to a minimum of 60 L/s. There is potential that this kind of system could be prefabricated, but additional design is required.

6.4.3 Residential Fire Flow Improvements

Bicks Road

The hydrant on Bicks Road does not have adequate flow; flow is restricted due to the line being only 100 mm in diameter. Upgrading this 1986 PVC main to 150 mm in diameter is required to allow for a minimum of 60 L/s at this hydrant.

Wessex Road

Hydrant 1-H-6 on Wessex Road does not have adequate flow; flow is restricted due a portion of the looped line being only 50 mm in diameter. Upgrading this 1968 AC main to 150 mm in diameter is required to allow for a minimum of 60 L/s at this hydrant. This project also supports the AC replacement program.

6.4.4 Asbestos Cement Replacement Program

In addition to the recommendations above, there are a number of AC pipes that should be replaced during the planning period due to reaching their end of life. These include:

- George Road (Ordano to Wilmot - 150 mm): 330 m of 100 mm AC pipe installed in 1965;
- McGill Road (Ordano to Austin - 150 mm): 370 m of 150 mm AC pipe installed in 1974;

- Pritchard Road (Wilmot to Cowichan Bay – 150 mm): 300 m of 150 mmm AC pipe installed in 1980;
- Longwood Road (150 mm): 480 m of 100 mm AC pipe installed in 1970;
- Austin Place (McGill to Cowichan Bay Road 150 mm): 250 m of 100 mm AC pipe installed in 1972;
- Pavenham Road (McGill to Wilmot 150 mm): 375 m of 150 mm AC pipe installed in 1964;
- Glen Road (McGill to Cowichan Bay Road 150mm): 350 m of 100 mm AC pipe installed in 1974;
- Glen Road (McGill to terminus 150 mm): 320 m of 100 mm AC pipe installed in 1964;
- Alder Glen Road (150mm): 310 m of 150 mm AC pipe installed in 1974;
- Willowglen Place (150 mm): 150 m of 150 mm AC pipe installed in 1976;
- Maple Glen Place (150 mm): 150 m of 150 mm AC pipe installed in 1976;
- Fenwick Road (150 mm): 210 m of 100 mm AC pipe installed in 1972
- Pritchard Road (Wilmot to Pritchard near Stephanie's Stroll) (150 mm): 300 m of 150 mm AC pipe installed in 1980
- Wilmot Road (George Road to Falcon Cres) (150 mm): 275 m of 150 mm AC pipe and 170 m of 50 mm PE pipe

6.5 Opinion of Probable Costs

An opinion of probable costs has been developed for each of the recommended upgrades, based on recent experience with similar projects in the area. Table 6-1 below summarizes the projected project costs. The total projected cost for the capital works upgrades over the entire 20-year period is $11.6 Million. This amount is in 2021 dollars and does not include works required to support new developments outside of the areas considered. Significant escalation has been observed in recent years for construction of these type of works, and it is recommended that an update to this opinion of probable costs be obtained within 3-5 years, when costs are hopefully more stable. A summary table of project costs and allocation to future development can be found in Appendix F.

Table 6-1
Opinion of Probable Costs

Project Description	Construction Cost [3] (2021$)	Contingency (40%)	Total Cost (2021$)
General			
Engineering Studies[1,2]	500,000	200,000	700,000
Demolish Abandoned Structures (Reservoirs, Buildings)	250,000	100,000	350,000
Subtotal General			*1,050,000*
Water Supply			
New Water Source	460,000	184,000	644,000
Source Water Protection Plan[1]	30,000	12,000	42,000
Decommission Kidd Well	50,000	20,000	70,000
Subtotal Water Supply			*756,000*

Project Description	Construction Cost [3] (2021$)	Contingency (40%)	Total Cost (2021$)
Distribution System			
Marine Village Flow Improvements			
Cowichan Bay Road (Marine Village) -200 mm	981,000	393,000	1,374,000
Cowichan Bay Road (Glen to Longwood) - 200 mm	112,000	45,000	157,000
Wilmot Road (Pritchard to Cowichan Bay Rd) -150 mm	235,000	94,000	329,000
Subtotal Marine Village Fire Flow			*1,860,000*
Telegraph Road Improvements			
Telegraph Road Booster Station	700,000	280,000	980,000
Wood Road – 150 mm	233,000	94,000	327,000
Nelson Road – 150 mm	112,000	45,000	157,000
Sears Road – 150 mm	282,000	113,000	395,000
Subtotal Telegraph Road Improvements			*1,859,000*
Residential Fire Flow Improvements			
Bicks Road – 150 mm	142,000	57,000	199,000
Wessex Road – 150 mm	350,000	140,000	490,000
Subtotal Residential Fire Flow			*689,000*
AC Pipe Replacement			
George Road (Ordano to Wilmot) - 150 mm	335,000	134,000	469,000
McGill Road (Ordano to Austin) - 150 mm	370,000	148,000	518,000
Pritchard Road (Wilmot to Cowichan Bay Rd) - 150mm	279,000	112,000	391,000
Longwood Road – 150 mm	402,000	161,000	563,000
Austin Place (McGill to Cowichan Bay Road) - 200 mm	248,000	100,000	348,000
Pavenham (McGill to Wilmot) - 150 mm	309,000	124,000	433,000
Glen Road (McGill to Cowichan Bay Road) - 150 mm	313,000	126,000	439,000
Glen Road (McGill to terminus) – 150 mm	283,000	114,000	397,000
Alder Glen Road – 150 mm	272,000	109,000	381,000
Willowglen Place – 150 mm	142,000	57,000	199,000
Maple Glen Place – 150 mm	142,000	57,000	199,000
Fenwick Road - 150 mm	191,000	77,000	268,000
Pritchard Road (Wilmot to Pritchard) – 150 mm	263,000	106,000	369,000
Wilmot Road (George Road to Falcon Cres) – 150 mm	243,000	98,000	341,000

Project Description	Construction Cost [3] (2021$)	Contingency (40%)	Total Cost (2021$)
Subtotal AC Pipe Replacement			*5,315,000*
		TOTAL	$11,600,000

1. Projects are not construction projects, but are important to include in long-term planning
2. Engineering studies assumed at $25,000 per year over 20 years.
3. All shown in 2021 dollars. Significant escalation experienced in recent years.

6.6 Project Prioritization

Prioritizing projects allows CBWD to have a roadmap of system improvements to follow. Project were prioritized according to the following methodology:

- Projects that impact water quality and could impact human health were considered of higher priority;
- Projects that addressed current system shortfalls were considered of higher priority than those to support future growth;
- Projects that support the overall system operation (i.e. water quality) were considered of higher priority than those that improved only a small part of the service area;
- Projects that needed to be completed to support other projects were considered of higher priority than those that did not influence other projects;
- For distribution piping upgrades, piping that improved flow to areas of the system with a deficiency were considered higher priority than those which did not improve a system deficiency.
- For distribution piping upgrades, older pipes were considered more at risk of failure and were considered higher priority than newer pipes; and
- For distribution piping upgrades, piping servicing a higher number of customers (directly or indirectly) was considered higher priority than piping servicing a relatively small number of customers.

As such, the list of project priorities seen in Table 6-2 was developed. Each project also has a listed reason for its ranking in the list. Note that development scenarios or system failures may occur, or new information may come available that may alter the rankings shown below.

Table 6-2
Project Prioritization

	Project	Reason for Ranking
1	*System Water Quality Review (Year 1 Engineering Study)**	Human Health, Complete ahead of new source
2	Cowichan Bay Road (Marine Village)	Pipe Age, Existing Deficiency, Area Serviced (Marine Bay)
3	Cowichan Bay Road (Glen to Longwood)	Pipe Age, Existing Deficiency, Area Serviced (Marine Bay)
4	New Water Source	Entire System, Existing Deficiency
5	*Source Water Protection Plan**	Protection of source

	Project	Reason for Ranking
6	Decommission Kidd Well	Protection of source
7	Wilmot Road (Pritchard to Cowichan Bay)	Pipe Age, Existing Deficiency, Area Serviced (Marine Bay)
8	Wood Road	Pipe Age, Existing Deficiency, Complete ahead of booster station
9	Sears Road	Pipe Age, Existing Deficiency, Complete ahead of booster station
10	Nelson Road	Pipe Age, Existing Deficiency, Complete ahead of booster station
11	Telegraph Booster Station	Existing deficiency, Small area Serviced
12	Wessex Road	Pipe Age, Existing deficiency
13	Pavenham Road	Pipe Age/Material
14	George Road (Ordano to Wilmot)	Pipe Age/Material
15	Longwood Road	Pipe Age/Material
16	Austin Place	Pipe Age/Material
17	Fenwick Road	Pipe Age/Material
18	Mcgill Road (Ordano to Austin)	Pipe Age/Material
19	Glen Road (McGill to Cowichan Bay Road)	Pipe Age/Material
20	Glen Road(McGill to terminus)	Pipe Age/Material
21	Alder Glen Road	Pipe Age/Material
22	Willowglen Place	Pipe Age/Material
23	Maple Glen Place	Pipe Age/Material
24	Pritchard Road (Wilmot to Cowichan Bay)	Pipe Age/Material
25	Pritchard Road (Wilmot to Pritchard near Stephanie's Stroll)	Pipe Age/Material
26	Wilmot Road (George Road to Falcon Cres)	Pipe Age/Material
27	Bicks Road	Existing deficiency, Small area serviced
28	Demolish Abandoned Structures	Not a critical path item
	Engineering Studies ($35K/year, Item 2 applies for 2022)	As required

*Projects are not construction projects, but are important to include in long-term planning

6.7 Capital Expenditure Charges

Based on the Capital Plan noted above, the following Capital Expenditure Charges were calculated. Note that these charges are calculated by evaluation the capital cost of projects supporting development divided by the expected number of units/lots to be developed. The total projected cost of infrastructure to service development into the future is $1.3 Million, for a population increase of approximately 500 people. Table 6-3 outlines the proposed capital expenditure charge by land type. Refer to Appendix F for a breakdown of the capital works cost allocation between existing and future development.

Table 6-3
Recommended Capital Expenditure Charges by Land Type

	Land Type	Criteria	Cost (2021$)
A	Residential		
	Single Family Residential	Per Lot being created or included	$6,736.76
	Two Family Residential	Per residential unit per lot created or included	$6,736.76
	Three Family Residential	Per residential unit per lot created or included	$6,736.76
	Medium Density Residential	Per residential, mobile home, townhouse, low rise condominium/apartment unit created where gross density is greater than 20 Units per Hectare and less than 50 Units per hectare	$5,700.33
	High Density Residential	Per residential unit with gross density greater than 50 units per hectare	$3,886.59
B	Commercial	per each square metre of gross floor area	$33.68
C	Institutional Residential	per bed	$2,526.28
D	Institutional	per each square metre of gross floor area	$5.61
E	Industrial	per each square meter of gross floor area	$33.68
F	Marina (full service)	per slip	$1,036.42
G	Campground (Central Services)	per Central Service Building	$2,072.85
H	RV Park (Full Service)	per site	$1,036.42

CLOSURE

This report was prepared for the Cowichan Bay Waterworks District to identify water system improvements required to support the operation of the system for the next 20 years.

The services provided by Associated Engineering (B.C.) Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Associated Engineering (B.C.) Ltd.
Engineers & Geoscientists BC Permit Number 1000163

Respectfully submitted,
Associated Engineering (B.C.) Ltd.

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Project Manager

2022-11-17

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APPENDIX A - REPORT FIGURES

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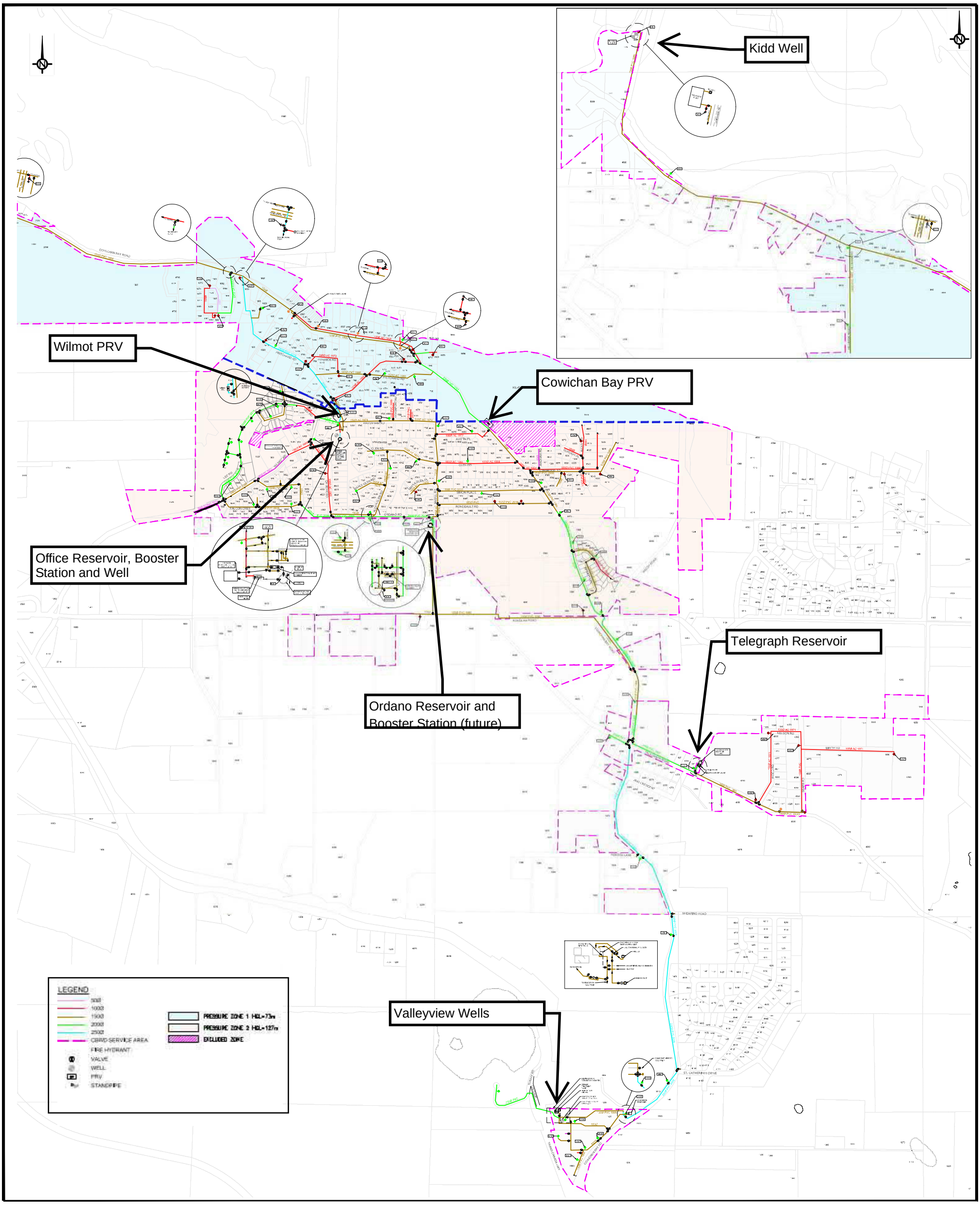

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SCALE	NOT TO SCALE
APPROVED	R.CASEMENT
DATE	20211130
DESCRIPTION	ISSUED FOR REVIEW

Figure 2-1

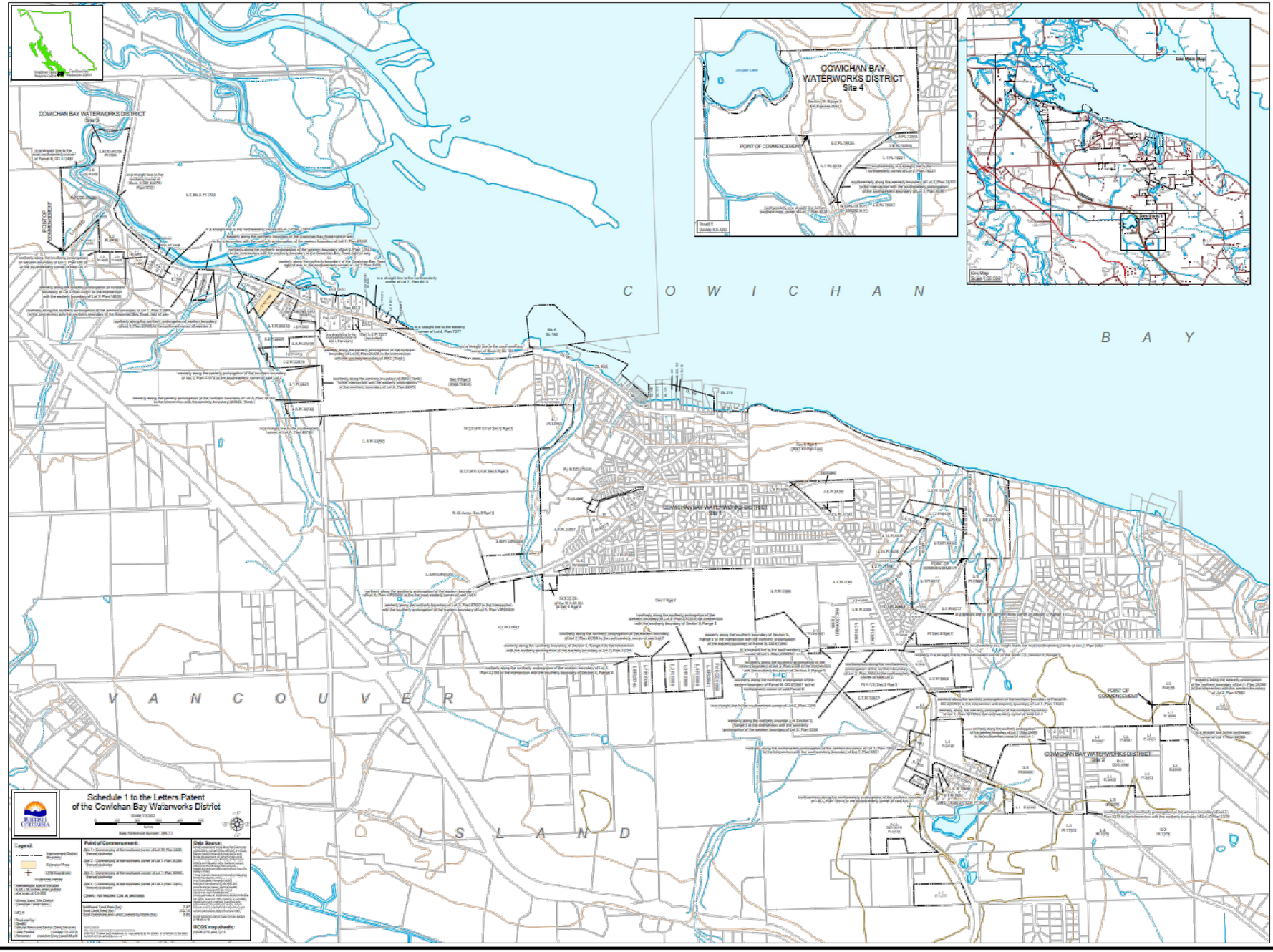
Cowichan Bay Water District
Water System Master Plan Update

Existing Water System

Notes: drawing to scale only when plotted to full size (ex A0 - 33x47)

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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Platinum member

AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC02
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 3-1

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

EXSISTING SERVICE AREA
(TAKEN FROM GEOBC)

IF NOT 25 mm ADJUST SCALES
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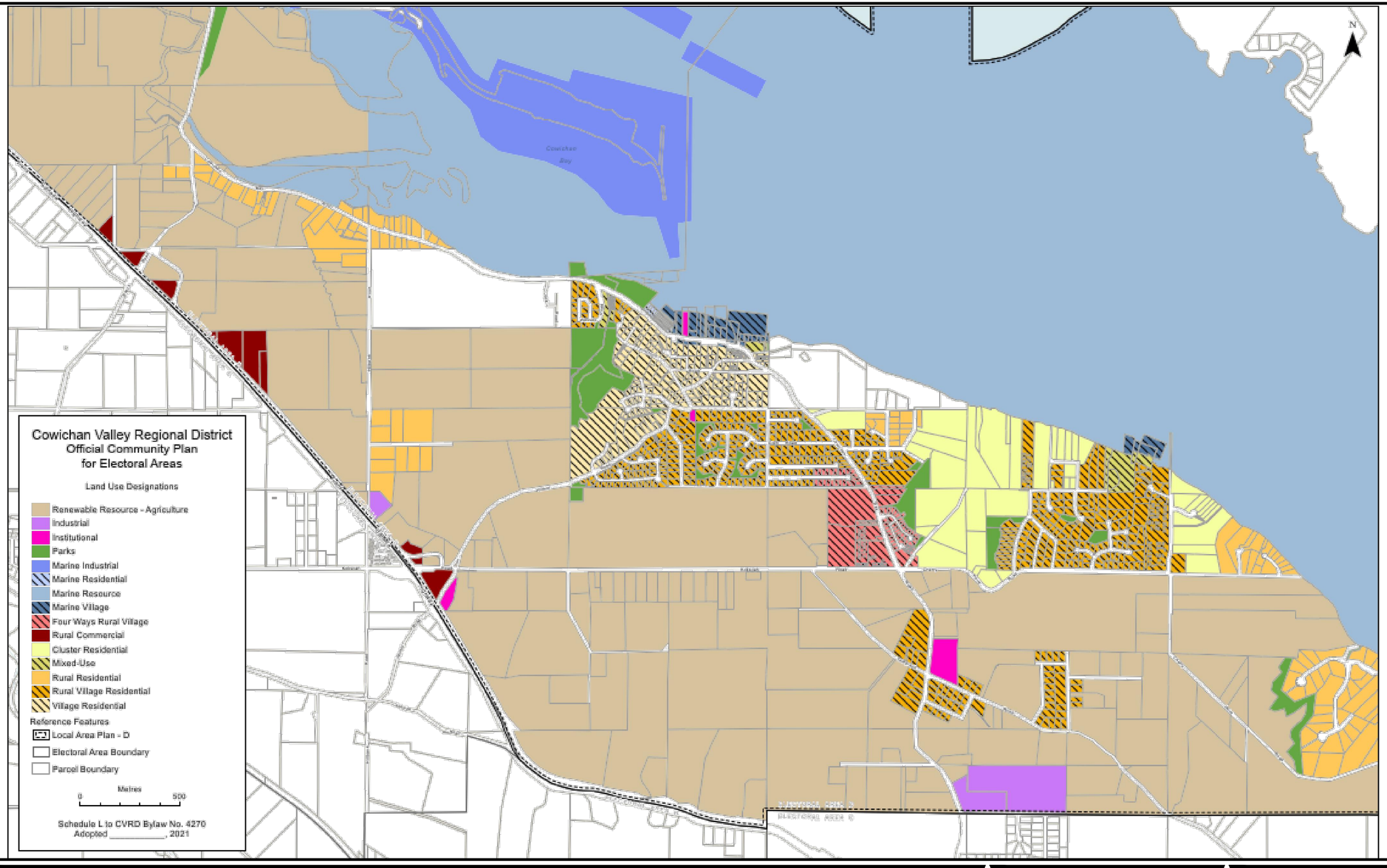
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



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AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC02
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 3-2

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

LAND USE DESIGNATORS
(TAKEN FROM CVRD OCP)

IF NOT 25 mm ADJUST SCALES
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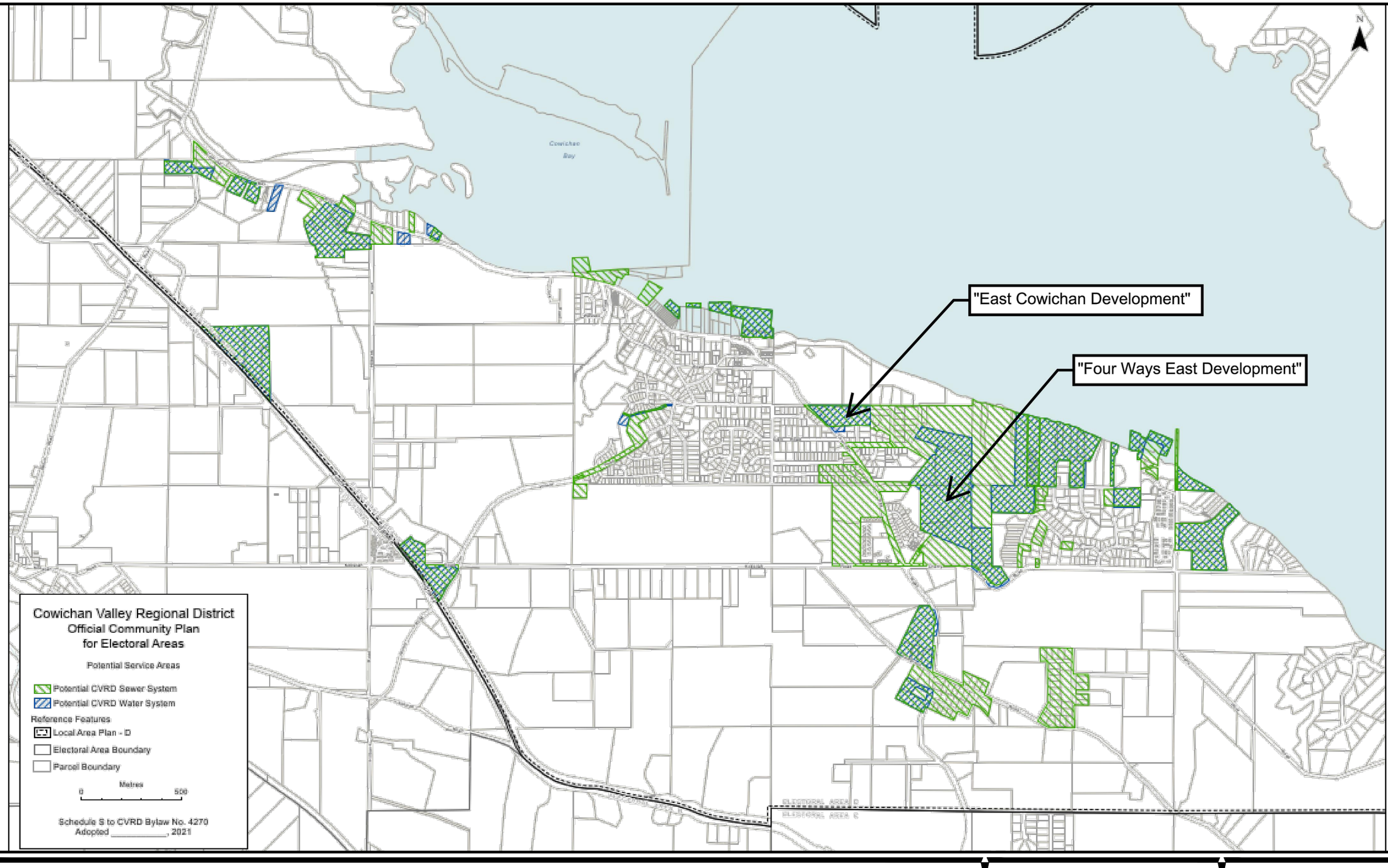

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Associated Engineering

CANADA'S BEST MANAGED COMPANIES
Platinum member

AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC02
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 3-3

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

POTENTIAL SERVICE AREAS
(TAKEN FROM CVRD OCP)

APPENDIX B - ASSET INVENTORY

CBWD Master Plan
Asset Inventory
R. Casement
Nov 1/21

Asset Type	Pressure Zone/Pipe Size	Asset	Quantity	Unit	Year Constructed	Material	Capacity	Operational Considerations
Source	PZ1	Kidd Well (WIN 54536)	1	Item	1985		unknown	Not in use
		Kidd Well - Pump Assembly	1	Item	2003		17.1 L/s	Not in use; poor condition of electrical components reported
		Kidd Well - Building	1	Item	1985			
		Kidd Well - Treatment	1	Item	1985			Aeration towers (sulphur dioxide) & chlorination
		Kidd Well - Control System	1	Item	1985			
		Office Well (WIN 13062)	1	Item	1978		6.3 L/s	Used during peaking periods
		Office Well - Pump Assembly	1	Item	2013		10 L/s	
		Office Well - Building	1	Item	1975			
		Office Well - Treatment	1	Item	1994			Greensand filtration & chlorination
		Office Well - Control System	1	Item	1985			
	PZ2	Valleyview Well #1 (WIN 38473)	1	Item	2014		38 L/s	Main source for CBWD; pumps to fill Telegraph Reservoir
		Valleyview Well #1 - Pump Assembly	1	Item	2014		12 L/s	
		Valleyview Well #2 (WIN 13088)	1	Item	1996		31 L/s	Main source for CBWD; pumps to fill Telegraph Reservoir
		Valleyview Well #2 - Pump Assembly	1	Item	2010		6 L/s	
		Valleyview - Control System	1	Item	2010			
Storage	PZ1	Office Reservoir	1	Item	1980		545 m^3	
	PZ2	Telegraph Reservoir	1	Item	1997		734 m^3	
	PZ2	Ordano Reservoir	1	Item	2015		1568 m^3	
Distribution	N/A	Wilmot PRV	1	Item	2015			Setpoint: 73 m
		Cowichan Bay PRV	1	Item	2015			Setpoint: 73 m
	PZ1	Pavenham Booster Station	1	Item	2008			
		Pavenham Booster Pumps	1	Item	2012		9.45 L/s @ 70m	Pumps from PZ 1 to PZ 2
	100 mm pipe	Old C.B. Road	979	lin.m.	1958	AC		
		Wessex	390	lin.m.	1964	AC		
		Davenport	68	lin.m.	2000	PVC		
		Kennedy	90	lin.m.	2000	PVC		
		Glen	362	lin.m.	1974	AC		
		Austin	169	lin.m.	1972	AC		
		Longwood	480	lin.m.	1970	AC		
		George	774	lin.m.	1965	AC		
		Pavenham	405	lin.m.	1964	AC		
		Fenwick	201	lin.m.	1972	AC		
		Wood/Nelson/Sears	700	lin.m.	1971	AC		
		VV-Reservoir Recharge	305	lin.m.	1997	PVC		
		VV-Bldg. #2 Connection	12	lin.m.	1997	PVC		
	150 mm pipe	Kidd	2,743	lin.m.	1985	PVC		
		Pritchard	469	lin.m.	1968	AC		
		Pritchard	444	lin.m.	1980	PVC		

Asset Type	Pressure Zone	Asset	Quantity	Unit	Year Constructed	Material	Capacity	Operational Considerations
Distribution	150 mm pipe	Pritchard	99	lin.m.	1985	PVC		
		Wilmot	150	lin.m.	1985	PVC		
		Pavenham	405	lin.m.	1977	IPS		
		McGill	853	lin.m.	1974	AC		
		Glen	887	lin.m.	1974	AC		
		Cowbay	231	lin.m.	1972	AC		
		Ordano	765	lin.m.	2006	PVC		
		Field	538	lin.m.	1985	IPS		
		Koksilah	1,199	lin.m.	1997	PVC		
		Longwood	465	lin.m.	2003	PVC		
		Cowbay	240	lin.m.	1985	PVC		
		Telegraph	270	lin.m.	1997	PVC		
		Mindy	375	lin.m.	1997	PVC		
		VV- Main Distribution	279	lin.m.	1997	PVC		
		VV-Booster Supply Line	287	lin.m.	2003	PVC		
		VV-Bldg. #6/ #7 Connection	30	lin.m.	1985	PVC		
		VV-Lateral to Bldg. #1	91	lin.m.	1997	PVC		
		VV-Lateral to Bldg. #3 #4 #5	191	lin.m.	1997	PVC		
	200 mm pipe	Ordano	656	lin.m.	2006	PVC		
		School Line	605	lin.m.	1997	PVC		
		Cow Bay Road (Park Place)	700	lin.m.	2010	PVC		
		Cow Bay Road 200mm extention	140	lin.m.	2010	PVC		
		Wessex road (CB Rd up to the first hydrant)	240	lin.m.	2015	PVC		
Land/SRW	N/A	Valleyview Wells, Cowichan Bay Road						
		Pavenham Road Reservoir and Well						
		Kidd Well, Cowichan Bay Road						
		Telegraph Reservoir, Telegraph Road						
		Ordano Reservoir and Booster						
		George Road Well, George road						
		Lot 6						

APPENDIX C - DESIGN CRITERIA DATA

CBWD Master Plan
Customer List
R. Casement
11/1/2021

		Pressure Zone 1				Pressure Zone 2						
	Physical Address	# of SF Units	# of TH Units	# of Condo Units	# of Com Units	# of SF Units	# of TH Units	# of Condo Units	# of Com Units	Future Residential	Future Commercial	Notes
	TAX ROLL ADDRESSES											
1	2254 COWICHAN BAY RD	1										
2	2254 MATTIN RD	1										
3	4920 BENCH RD	1										
4	2260 COWICHAN BAY RD	1										
5	2258 COWICHAN BAY RD	1										
6	2256 COWICHAN BAY RD	1										
7	2041 COWICHAN BAY RD	1										
8	2061 COWICHAN BAY RD	1										
9	2055 COWICHAN BAY RD	1										
10	2049 COWICHAN BAY RD	1										
11	2045 COWICHAN BAY RD	1										
12	2021 COWICHAN BAY RD	1										
13	2080 COWICHAN BAY RD	1										
14	2070 COWICHAN BAY RD	1										
15	2060 COWICHAN BAY RD	1										
16	2054 COWICHAN BAY RD	1										
17	2050 COWICHAN BAY RD	1										
18	2030 COWICHAN BAY RD	1										
19	2024 COWICHAN BAY RD	1										
20	4810 HILLBANK RD	1										
21	4740 HILLBANK RD	1										
22	4790 HILLBANK RD	1										
23	4786 HILLBANK RD	1										
24	2150 COWICHAN BAY RD	1										
25	2166 COWICHAN BAY RD	1										
26	2115 COWICHAN BAY RD	1										
27	2105 COWICHAN BAY RD	1										
28	2190 COWICHAN BAY RD	1										
29	2184 COWICHAN BAY RD	1										
30	2186 COWICHAN BAY RD	1										
31	2188 COWICHAN BAY RD	1										
32	2125 COWICHAN BAY RD	1										
33	2108 COWICHAN BAY RD	1										
34	L2P81134									1		1 SF PZ 1 FUTURE
35	2100 COWICHAN BAY RD	1										
36	4836 HILLBANK RD	1										
37	2230 COWICHAN BAY RD	1										
38	2240 COWICHAN BAY RD	1										
39	4905 BENCH RD	1										
40	2242 COWICHAN BAY RD	1										
41	1885 WILMOT RD					2						
42	2075 COWICHAN BAY RD	1										

43	2065 COWICHAN BAY RD	1										
44	1750 KOKSILAH RD					1						
45	1730 KOKSILAH RD					1						
46	1710 KOKSILAH RD					1						
47	1720 KOKSILAH RD					1						
48	1790 KOKSILAH RD					1						
49	1780 KOKSILAH RD					1						
50	1785 WILMOT RD					1						
51	1795 WILMOT RD					1						
52	1779 WILMOT RD					1						
53	1781 WILMOT RD					1						
54	1821 WILMOT RD					1						
55	1825 WILMOT RD					1						
56	1770 WILMOT RD					1						
57	1772 WILMOT RD					1						
58	1794 WILMOT RD					1						
59	1786 WILMOT RD					1						
60	1796 WILMOT RD					1						
61	1790 WILMOT RD					1						
62	1792 WILMOT RD					1						
63	4699 GEORGE RD					1						
64	4695 GEORGE RD					1						
65	1800 WILMOT RD					1						
66	1774 WILMOT RD					1						
67	4691 GEORGE RD					1						
68	1750 PAVENHAM RD					1						
69	1740 PAVENHAM RD					1						
70	1730 PAVENHAM RD					1						
71	1734 PAVENHAM RD					1						
72	1738 PAVENHAM RD					1						
73	1728 PAVENHAM RD					1						
74	1726 PAVENHAM RD					1						
75	1726B PAVENHAM RD					1						
76	1900 VEE RD					1						
77	1896 VEE RD					1						
78	1892 VEE RD					1						
79	1888 VEE RD					1						
80	1884 VEE RD					1						
81	1880 VEE RD					1						
82	4681 GEORGE RD					1						
83	4685 GEORGE RD					1						
84	4677 GEORGE RD					1						
85	4675 GEORGE RD					1						
86	4665 GEORGE RD					1						
87	4690 GEORGE RD					1						
88	4680 GEORGE RD					1						
89	4670 GEORGE RD					1						
90	4660 GEORGE RD					1						
91	4658 GEORGE RD					1						

92	4640 GEORGE RD					1						
93	4630 GEORGE RD					1						
94	4620 GEORGE RD					1						
95	4625 GEORGE RD					1						
96	4635 GEORGE RD					1						
97	4645 GEORGE RD					1						
98	4655 GEORGE RD					1						
99	1768 WILMOT RD					1						
100	1720 PAVENHAM RD					1						
101	1724 PAVENHAM RD					1						
102	1716 PAVENHAM RD					1						
103	1710 PAVENHAM RD					1						
104	1708 PAVENHAM RD					1						
105	4676 MCGILL RD					1						
106	4672 MCGILL RD					1						
107	1805 WILMOT RD					1						
108	1797 WILMOT RD					1						
109	4610 GEORGE RD					1						
110	4600 GEORGE RD					1						
111	4615 GEORGE RD					1						
112	1749 ORDANO RD					1						
113	4617 GEORGE RD					1						
114	4601 GEORGE RD					1						
115	4668 MCGILL RD					1						
116	4664 MCGILL RD					1						
117	4660 MCGILL RD					1						
118	1860 WILMOT RD					1						
119	1701 GLEN RD					1						
120	1705 GLEN RD					1						
121	1709 GLEN RD					1						
122	1711 GLEN RD					1						
123	1715 GLEN RD					1						
124	1854 WILMOT RD					1						
125	1719 GLEN RD					1						
126	1721 GLEN RD					1						
127	1725 GLEN RD					1						
128	1727 GLEN RD					1						
129	1729 GLEN RD					1						
130	1731 GLEN RD					1						
131	1724 GLEN RD					1						
132	1720 GLEN RD					1						
133	1716 GLEN RD					1						
134	1714 CEDAR GLEN PL					1						
135	1712 CEDAR GLEN PL					1						
136	1710 CEDAR GLEN PL					1						
137	1708 CEDAR GLEN PL					1						
138	1706 CEDAR GLEN PL					1						
139	1704 GLEN RD					1						
140	1700 GLEN RD					1						

141	1733 GLEN RD					1						
142	1735 GLEN RD					1						
143	1737 GLEN RD					1						
144	1739 GLEN RD					1						
145	1741 GLEN RD					1						
146	1740 GLEN RD					1						
147	1738 GLEN RD					1						
148	1736 GLEN RD					1						
149	1734 GLEN RD					1						
150	1732 GLEN RD					1						
151	1730 GLEN RD					1						
152	4650 ALDER GLEN RD					1						
153	4646 ALDER GLEN RD					1						
154	4644 ALDER GLEN RD					1						
155	1731 MAPLE GLEN PL					1						
156	1733 MAPLE GLEN PL					1						
157	1735 MAPLE GLEN PL					1						
158	1739 MAPLE GLEN PL					1						
159	1740 MAPLE GLEN PL					1						
160	1738 MAPLE GLEN PL					1						
161	1734 MAPLE GLEN PL					1						
162	1732 MAPLE GLEN PL					1						
163	1730 MAPLE GLEN PL					1						
164	4638 ALDER GLEN RD					1						
165	4632 ALDER GLEN RD					1						
166	4620 ALDER GLEN RD					1						
167	1735 ORDANO RD					1						
168	1737 ORDANO RD					1						
169	1741 ORDANO RD					1						
170	1745 ORDANO RD					1						
171	1727 ORDANO RD					1						
172	4625 ALDER GLEN RD					1						
173	4635 ALDER GLEN RD					1						
174	4639 ALDER GLEN RD					1						
175	4641 ALER GLEN RD					1						
176	4643 ALDER GLEN RD					1						
177	4645 ALDER GLEN RD					1						
178	4647 ALDER GLEN RD					1						
179	4649 ALDER GLEN RD					1						
180	4651 ALDER GLEN RD					1						
181	4644 MCGILL RD					1						
182	4640 MCGILL RD					1						
183	1705 WILLOW GLEN PL					1						
184	1703 WILLOW GLEN PL					1						
185	1701 WILLOW GLEN PL					1						
186	1699 WILLOW GLEN PL					1						
187	1697 WILLOW GLEN PL					1						
188	1693 WILLOW GLEN PL					1						
189	1690 WILLOW GLEN PL					1						

190	1692 WILLOW GLEN PL					1						
191	1698 WILLOW GLEN PL					1						
192	1710 WILLOW GLEN PL					1						
193	1680 WILLOW GLEN PL					1						
194	4608 MCGILL RD					1						
195	4606 MCGILL RD					1						
196	4604 MCGILL RD					1						
197	1705 ORDANO RD					1						
198	1709 ORDANO RD					1						
199	1711 ORDANO RD					1						
200	1713 ORDANO RD					1						
201	1715 ORDANO RD					1						
202	1717 ORDANO RD					1						
203	1719 ORDANO RD					1						
204	1721 ORDANO RD					1						
205	1736 MAPLE GLEN PL					1						
206	1800 FALCON CRES					1						
207	1804 FALCON CRES					1						
208	1810 FALCON CRES					1						
209	1814 FALCON CRES					1						
210	1818 FALCON CRES					1						
211	1822 FALCON CRES					1						
212	1826 FALCON CRES					1						
213	1830 FALCON CRES					1						
214	1834 FALCON CRES					1						
215	1840 FALCON CRES					1						
216	1844 FALCON CRES					1						
217	1848 FALCON CRES					1						
218	1852 FALCON CRES					1						
219	1858 FALCON CRES					1						
220	1862 FALCON CRES					1						
221	1866 FALCON CRES					1						
222	1870 FALCON CRES					1						
223	1874 FALCON CRES					1						
224	1878 FALCON CRES					1						
225	1890 FALCON CRES					1						
226	1896 FALCON CRES					1						
227	1900 FALCON CRES					1						
228	1904 FALCON CRES					1						
229	1910 FALCON CRES					1						
230	1914 FALCON CRES					1						
231	1918 FALCON CRES					1						
232	1922 FALCON CRES					1						
233	1928 FALCON CRE					1						
234	1932 FALCON CRES					1						
235	1936 FALCON CRES					1						
236	1944 FALCON CRES					1						
237	1954 FALCON CRES					1						
238	1960 FALCON CRES					1						

239	1964 FALCON CRES					1						
240	1968 FALCON CRES					1						
241	1972 FALCON CRES					1						
242	1976 FALCON CRES					1						
243	1982 FALCON CRES					1						
244	1988 FALCON CRES					1						
245	1992 FALCON CRES					1						
246	1998 FALCON CRES					1						
247	1991 FALCON CRES					1						
248	1975 FALCON CRES					1						
249	1969 FALCON CRES					1						
250	1965 FALCON CRES					1						
251	1959 RAPTOR PL					1						
252	1955 RAPTOR PL					1						
253	1951 RAPTOR PL					1						
254	1949 RAPTOR PL					1						
255	1945 RAPTOR PL					1						
256	1941 RAPTOR PL					1						
257	1937 FALCON CRES					1						
258	1933 FALCON CRES					1						
259	1929 FALCON CRES					1						
260	1923 FALCON CRES					1						
261	1917 FALCON CRES					1						
262	1913 FALCON CRES					1						
263	1907 FALCON CRES					1						
264	1901 FALCON CRES					1						
265	1867 FALCON CRES					1						
266	1861 FALCON CRES					1						
267	1855 FALCON CRES					1						
268	1835 FALCON CRES					1						
269	1829 FALCON CRES					1						
270	1825 FALCON CRES					1						
271	1819 FALCON CRES					1						
272	1813 FALCON CRES					1						
273	1809 FALCON CRES					1						
274	1805 FALCON CRES					1						
275	1810 PRITCHARD RD	1										
276	L3 PL8219 PRITCHARD RD									1		1 SF PZ1 FUTURE
277	1755 WILMOT RD	1										
278	1790 PRTICHARD RD	1										
279	1786 PRITCHARD RD	1										
280	1785 VEE RD					1						
281	1795 VEE RD					1						
282	1798 VEE RD					1						
283	1790 VEE RD					1						
284	1780 VEE RD					1						
285	1776 PRITCHARD RD	1										
286	1772 PRITCHARD RD	1										
287	1830 PRITCHARD RD	1										

288	1759 WILMOT RD					1						
289	1767 WILMOT RD					1						
290	1765 WILMOT RD					1						
291	1770 PRITCHARD RD	1										
292	1766 PRITCHARD RD	1										
293	1818 PRITCHARD RD	1										
294	1820 PRITCHARD RD	1										
295	1822 PRITCHARD RD	1										
296	1824 PRITCHARD RD	1										
297	1775 VEE RD					1						
298	1779 VEE RD					1						
299	1757 WILMOT RD	1										
300	1762 WILMOT RD					1						
301	1766 WILMOT RD					1						
302	1745 PAVENHAM RD					1						
303	1740 WILMOT RD	1										
304	1744 WILMOT RD	1										
305	1748 WILMOT RD	1										
306	1752 WILMOT RD	1										
307	1760 WILMOT RD	1										
308	1758 WILMOT RD	1										
309	1732 PRITCHARD RD	1										
310	1730 PRITCHARD RD	1										
311	1825 VEE RD					1						
312	1819 VEE RD					1						
313	1815 VEE RD					1						
314	1811 VEE RD					1						
315	4676 CASPIAN PL					1						
316	4680 CASPIAN PL					1						
317	4686 CASPIAN PL					1						
318	4681 CASPIAN PL					1						
319	4675 CASPIAN PL					1						
320	1809 VEE RD					1						
321	1805 VEE RD					1						
322	4665 MALLARD WAY					1						
323	4659 MALLARD WAY					1						
324	4655 MALLARD WAY					1						
325	4649 MALLARD WAY					1						
326	4645 MALLARD WAY					1						
327	4639 MALLARD WAY					1						
328	4635 MALLARD WAY					1						
329	4629 MALLARD WAY					1						
330	4625 MALLARD WAY					1						
331	4619 MALLARD WAY					1						
332	4615 MALLOARD WAY					1						
333	4609 MALLARD WAY					1						
334	4640 MALLARD WAY					1						
335	4636 MALLARD WAY					1						
336	4630 MALLARD WAY					1						

337	4626 MALLARD WAY					1						
338	4620 MALLARD WAY					1						
339	4616 MALLARD WAY					1						
340	1791 WILMOT RD					1						
341	1789 WILMOT RD					1						
342	1735 PAVENHAM RD					1						
343	1733 PAVENHAM RD					1						
344	1738 WILMOT RD	2										
345	1722 PRITCHARD RD	1										
346	1726 PRITCHARD RD	1										
347	1722A PRITCHARD RD	1										
348	1724 PRITCHARD RD	1										
349	1729 PAVENHAM RD					1						
350	4666 DAVENPORT RD					1						
351	4672 DAVENPORT RD					1						
352	4676 DAVENPORT RD					1						
353	4680 DAVENPORT RD					1						
354	4682 DAVENPORT RD					1						
355	1716 PRITCHARD RD					1						
356	4676 KENNEDY LN					1						
357	4670 KENNEDY LN					1						
358	1719 PAVENHAM RD					1						
359	1721 PAVENHAM RD					1						
360	1723 PAVENHAM RD					1						
361	4667 DAVENPORT RD					1						
362	4671 DAVENPORT RD					1						
363	4675 DAVENPORT RD					1						
364	4677 DAVENPORT RD					1						
365	1720 PRITCHARD RD	1										
366	1705 PAVENHAM RD					1						
367	1707 PAVENHAM RD					1						
368	1701 PAVENHAM RD					1						
369	1711 PAVENHAM RD					1						
370	4671/4673 KENNEDY LN					2						
371	1728 PRITCHARD RD	1										
372	1760 PRITCHARD RD	1										
373	1764 PRTICHARD RD	1										
374	1751 WILMOT RD	1										
375	1754 PRITCHARD RD	1										
376	1746 PRITCHARD RD	1										
377	1750 PRITCHARD RD	1										
378	1748 PRITCHARD RD	1										
379	1749 WILMOT RD	1										
380	1745 WILMOT RD	1										
381	L1P5479									1		1 SF PZ1 FUTURE
382	1779 [ROTCJARD RD	1										
383	1785 PRITCHARD RD	1										
384	1793 PRITCHARD RD	1										
385	1795 PRITCHARD RD	1										

386	1799 PRITCHARD RD	1										
387	1801 PRITCHARD RD	1										
388	1782 FENWICK RD	1										
389	1784 FENWICK RD	1										
390	1841 PRITCHARD RD	1										
391	1841B PRITCHARD RD									1		1 SF PZ1 FUTURE
392	1820 GILLIS RD	1										
393	L1P58773									1		1 SF PZ1 FUTURE
394	1778 FENWICH RD	1										
395	1776 FENWICK RD	1										
396	1700 PRITCHARD ROAD		28									Mariner Ridge 28 unit condo
424	1670 BOTWOOD LANE			14								Villas on the Bay 14 unit condo
438	1682 BOTWOOD LANE				1							
439	1711-1717 WILMOT RD		12									The Landing 12 unit condo
451	1715 PRITCHARD RD			40								Cowichan Bay Arms 40 unit condo
491	1659 COWICHAN BAY RD	1										
492	1721 WILMOT RD	1										
493	1723 WILMOT RD	1										
494	1695 COWICHAN BAY RD				1							
495	1681 COWICHAN BAY RD				63							Oceanfront Suites - 63 unit
496	LOT A, PLAN EPP13784									1		1 SF PZ1 FUTURE
497	1705 COWICHAN BAY RD	3			4							
498	1722 WILMOT RD	1										
499	1720 WILMOT RD	1										
500	1719 PRITCHARD RD	1										
501	1721 PRITCHARD RD	1										
502	1727 PRITCHARD RD	1										
503	1725 PRITCHARD RD	1										
504	1729 PRITCHARD RD	1										
505	L4P3057 - COWICHAN BAY RD				1							
506	1781B FENWICK RD	1										
507	1773 FENWICK RD									1		1 SF PZ1 FUTURE
508	1767 FENWICK RD				1							
509	1770 FENWICK RD	1										
510	1775 PRITCHARD RD	1										
511	1765 PRITCHARD RD	1										
512	1761 PRITCHARD RD	1										
513	1755 PRITCHARD RD	1										
514	1757 FENWICK RD	1										
515	1747 PRITCHARD RD	1										
516	L12P3309-COWICHAN BAY RD				1							
517	1745 PRITCHARD RD	1										
518	1741 PRTICHARD RD	1										
519	1737 PRITCHARD RD	1										
520	1731 WILMOT RD	1										
521	LOT 1 PL82840 PRITCHARD RD									1		1 SF PZ1 FUTURE
522	1735 WILMOT RD	1										
523	1739 WILMOT RD	1										
524	1725 WILMOT RD	1										

525	1845 PRITCHARD RD	1										
526	1830 GILLIS RD				1							
527	1817 PRTICHARD RD	1										
528	1829 GILLIS RD	1										
529	1842 PRITCHARD RD	1										
530	1867 PRITCHARD RD	1										
531	1863 PRITCHARD RD	1										
532	1859 PRITCHARD RD	1										
533	1853 PRITCHARD RD	1										
534	1838 COWICHAN BAY RD			25								The Cannery 25 unit condo
559	1831 GILLIS RD	1										
560	1815 PRITCHARD RD	1										
561	1813 PRITCHARD RD	1										
562	1809 PRITCHARD RD	1										
563	1888 WESSEX RD	1										
564	1886 WESSEX RD	1										
565	1884 WESSEX RD	1										
566	1882 WESSEX RD	1										
567	1880 WESSEX RD	1										
568	1878 WESSEX RD	1										
569	1876 WESSEX RD	1										
570	1874 WESSEX RD	1										
571	1872 WESSEX RD	1										
572	1870 WESSEX RD	1										
573	1868 WESSEX RD	1										
574	1866 WESSEX RD	1										
575	1864 WESSEX RD	1										
576	1862 WESSEX RD	1										
577	1860 WESEX RD	1										
578	1858 WESSEX RD	1										
579	1859 WESSEX RD	1										
580	1887 WESSEX RD	1										
581	1875 WESSEX RD	1										
582	1846 WESSEX RD				29							Wessex Inn - 29 unit motel
583	1500 COWICHAN BAY RD					1						
584	4401 TELEGRAPH RD					1						
585	4395 TELEGRAPH RD					1						
586	1490 COWICHAN BAY RD					1						
587	4400 TELEGRAPH RD					1						
588	4394 TELEGRAPH RD					1						
589	1511 COWICHAN BAY RD					1						
590	1515 COWICHAN BAY RD									1		1 SF PZ 2 FUTURE
591	1515B COWICHAN BAY RD					1						
592	1585 KOKSILAH RD					1						
593	1615 KOKSILAH RD								1			
594	1540 COWICHAN BAY RD							54	1			
595	1569 COWICHAN BAY RD					1						
596	1579 COWICHAN BAY RD					1						
597	1575 COWICHAN BAY RD					1						

598	1531 COWICHAN BAY RD					1						
599	1513 REGATTA PL					1						
600	1511 REGATTA PL					1						
601	1515 REGATTA PL					1						
602	1517 REGATTA PL					1						Four Ways RV Park
603	4551 BUENA VISTA PL					1						
604	4549 BUENA VISTA PL					1						
605	4547 BUENA VISTA PL					1						
606	4545 BUENA VIST PL					1						
607	4546 BUENA VISTA PL					1						
608	4541 BUENA VISTA PL					1						
609	4537 BUENA VISTA PL					1						
610	4535 BUENA VISTA PL					1						
611	4533 BUENA VISTA PL					1						
612	4531 BUENA VISTA PL					1						
613	4529 BUENA VISTA PL					1						
614	4527 BUENA VISTA PL					1						
615	4525 BUENA VISTA PL					1						
616	4523 BUENA VISTA PL					1						
617	4521 BUENA VISTA PL					1						
618	4520 BUENA VISTA PL					1						
619	4522 BUENA VISTA PL					1						
620	4524 BUENA VISTA PL					1						
621	4526 BUENA VISTA PL					1						
622	4528 BUENA VISTA L					1						
623	1523 REGATTA PL					1						
624	1525 REGATTA PL					1						
625	4530 BUENA VISTA PL					1						
626	4532 BUENA VISTA PL					1						
627	1533 REGATTA PL					1						
628	4536 BUENA VISTA PL					1						
629	1538 REGTATTA PL					1						
630	1536 REGATTA PL					1						
631	1534 REGATTA PL					1						
632	1532 REGATTA PL					1						
633	1530 REGATTA PL					1						
634	1528 REGATTA PL					1						
635	1526 REGATTA PL					1						
636	1524 REGATTA PL					1						
637	1522 REGATTA PL					1						
638	1520 REGATTA PL					1						
639	1606 GLEN RD					1						
640	1600 COWICHAN BAY RD					1						
641	4663 MCGILL RD					1						
642	1695 GLEN RD					1						
643	1685 GLEN RD					1						
644	1675 GLEN RD					1						
645	1665 GLEN RD					1						
646	1655 GLEN RD					1						

647	1645 GLEN RD					1						
648	1635 GLEN RD					1						
649	1625 GLEN RD					1						
650	1610 COWICHAN BAY RD					1						
651	1615 GLEN RD					1						
652	1696 GLEN RD					1						
653	1690 GLEN RD					1						
654	1680 GLEN RD					1						
655	1670 GLEN RD					1						
656	1660 GLEN RD					1						
657	1650 GLEN RD					1						
658	16740 GLEN RD					1						
659	1630 GLEN RD					1						
660	1620 GLEN RD					1						
661	L1P39955								1			
662	4611 MCGILL RD					1						
663	1621 GLEN RD					1						
664	4645 WADHAM RD					1						
665	4635 HADHAM RD					1						
666	1581 LONGWOOD RD					1						
667	4631 WADHAM RD					1						
668	1607 COWICHAN BAY RD					1						
669	4640 WADHAM RD					1						
670	1575 LONGWOOD RD					1						
671	1565 LONGWOOD RD					1						
672	1555 LONGWOOD RD					1						
673	1550 GORDON PL					1						
674	1560 GORDON PL					1						
675	1570 GORDON PL					1						
676	1580 GORDON PL					1						
677	1505 LONGWOOD RD					1						
678	1535 LONGWOOD RD					1						
679	1525 LONGWOOD RD					1						
680	1515 LONGWOOD RD					1						
681	1545 LONGWOOD RD					1						
682	4635 BICKS RD					1						
683	4645 BICKS RD					1						
684	4665 BICKS RD					1						
685	4655 BICKS RD					1						
686	1500 LONGWOOD RD					1						
687	1611 COWICHAN BAY RD					1						
688	4650 WADHAM RD					1						
689	1510 LONGWOOD RD					1						
690	1530 LONGWOOD RD					1						
691	1585 COWICHAN BAY RD					1						
692	1591 COWICHAN BAY RD					1						
693	1589 COWICHAN BAY RD					1						
694	1587 COWICHAN BAY RD					1						
695	4665 MCGILL RD					1						

696	4669 MCGILL RD					1						
697	4675 MCGILL RD					1						
698	4677 MCGILL RD					1						
699	1685 AUSTIN PL					1						
700	1680 AUSTIN PL					1						
701	1670 AUSTIN PL					1						
702	1675 AUSTIN PL					1						
703	1665 AUSTIN PL					1						
704	1660 AUSTIN PL					1						
705	1650 AUSTIN PL					1						
706	1655 AUSTIN PL					1						
707	1645 AUSTIN PL					1						
708	1646 AUSTIN PL					1						
709	1630 AUSTIN PL					1						
710	1627 AUSTIN PL					1						
711	1622 COWICHAN BAY RD					1						
712	1620 COWICHAN BAY RD					1						
713	1616 COWICHAN BAY RD					1						
714	1614 COWICHAN BAY RD					1						
715	1590 GORDON PL					1						
716	1555 GORDON PL					1						
717	1560 DEIGHTON RD					1						
718	1653 SIMON PL					1						
719	1645 SIMON PL					1						
720	1641 SIMON PL					1						
721	1637 SIMON PL					1						
722	1633 SIMON PL					1						
723	1631 SIMON PL					1						
724	1627 SIMON PL					1						
725	1623 SIMON PL					1						
726	1619 SIMON PL					1						
727	1617 SIMON PL					1						
728	1615 SIMON PL					1						
729	1611 SIMON PL					1						
730	1607 SIMON PL					1						
731	1605 SIMON PL					1						
732	1601 SIMON PL					1						
733	1595 SIMON PL					1						
734	1591 SIMON PL					1						
735	1589 SION PL					1						
736	1667 RONDEAULT RD					1						
737	1663 RONDEAULT RD					1						
738	1659 RONDEAULT RD					1						
739	1655 RONDEAULT RD					1						
740	1651 RONDEAULT RD					1						
741	1647 RONDEAULT RD					1						
742	1643 RONDEAULT RD					1						
743	1637 RONDEAULT RD					1						
744	1635 RONDEAULT RD					1						

745	1631 RONDEAULT RD					1						
746	1627 RONDEAULT RD					1						
747	1626 RONDEAULT RD					1						
748	1630 RONDEAULT RD					1						
749	1634 RONDEAULT RD					1						
750	1638 RONDEAULT RD					1						
751	1642 RONDEAULT RD					1						
752	1646 RONDEAULT RD					1						
753	1648 RONDEAULT RD					1						
754	1652 RONDEAULT RD					1						
755	1658 RONDEAULT RD					1						
756	1662 RONDEAULT RD					1						
757	4601 MCGILL RD					1						
758	1618 RONDEAULT RD					1						
759	1614 RONDEAULT RD					1						
760	L3 RONDEAULT RD									1		1 SF PZ2 future
761	1606 RONDEAULT RD					1						
762	1602 RONDEAULT RD					1						
763	1598 RONDEAULT RD					1						
764	L7 RONDEAULT RD									1		1 SF PZ2 future
765	1588 RONDEAULT RD					1						
766	1584 RONDEAULT RD					1						
767	1590 COWICHAN BAY RD					1						
768	1578 RONDEAULT RD					1						
769	1575 RONDEAULT RD					1						
770	L13 RONDEAULT RD									1		1 SF PZ2 future
771	1583 RONDEAULT RD					1						
772	1587 RONDEAULT RD					1						
773	1591 RONDEAULT RD					1						
774	1599 RONDEAULT RD					1						
775	1603 RONDEAULT RD					1						
776	1607 RONDEAULT RD					1						
777	1611 RONDEAULT RD					1						
778	1615 RONDEAULT RD					1						
779	1619 RONDEAULT RD					1						
780	1522 LONGWOOD RD					1						
781	4613 LINCOLNSHIRE RD					1						
782	1542 LONGWOOD RD					1						
783	1540 LONGWOOD RD					1						
784	1536 LONGWOOD RD					1						
785	4614 LINCOLNSHIRE PL					1						
786	4608 LINCOLNSHIRE PL					1						
787	4601 LINCOLNSHIRE PL					1						
788	4605 LINCOLNSHIRE PL					1						
789	4609 LINCOLNSHIRE PL					1						
790	1592 LONGWOOD RD					1						
791	1590 LONGWOOD RD					1						
792	1586 LONGWOOD RD					1						
793	1582 LONGWOOD RD					1						

794	4615 CASA LINDA PL					1						
795	4616 CASA LINDA PL					1						
796	4612 CASA LINDA PL					1						
797	4610 CASA LINDA PL					1						
798	4606 CASA LINDA PL					1						
799	4602 CASA LINDA PL					1						
800	4609 CASA LINDA PL					1						
801	4605 CASA LINDA PL					1						
802	1588 LONGWOOD RD					1						
803	4620 CASA LINDA PL					1						
804	1605 LONGWOOD RD					1						
805	4630 WADHAM RD					1						
806	1610 GLEN RD					1						
807	1610B GLEN RD									1		1 SF PZ2 future
808	1260 CHERRY POINT RD									1		1 SF PZ2 future
809	1311 MINDY RD					1						
810	1300 MINDY RD					1						
811	4407 SEARS RD					1						
812	1323 MINDY RD					1						
813	1325 MINDY RD					1						
814	1340 MINDY RD					1						
815	1366 MINDY RD					1						
816	4375 SEARS RD					1						
817	4367 SEARS RD					1						
818	4361 SEARS RD					1						
819	4371 SEARS RD					1						
820	4352 TELEGRAPH RD					1						
821	4373 TELEGRAPH RD					1						
822	4371 TELEGRAPH RD					1						
823	4339 TELEGRAPH RD					1						
824	4369 TELEGRAPH RD					1						
825	4367 TELEGRAPH RD					1						
826	4335 TELEGRAPH RD					1						
827	4365 TELEGRAPH RD					1						
828	1393 NELWON RD					1						
829	1389 NELSON RD					1						
830	1385 NELSON RD					1						
831	1373 NELSON RD					1						
832	4410 SEARS RD					1						
833	4395 WOORD RD					1						
834	4389 WOOD RD					1						
835	4383 WOOD RD					1						
836	4377 WOOD RD					1						
837	4371 WOOD RD					1						
838	4365 WOOD RD					1						
839	4359 WOOD RD					1						
840	4353 WOOD RD					1						
841	4331 TELEGRAPH RD					1						
842	4329 TELEGRAPH RD					1						

843	4327 TELEGRAPH RD					1						
844	4352 SEARS RD					1						
845	4358 SEARS RD					1						
846	4364 SEARS RD					1						
847	4396 SEARS RD					1						
848	1264 CHERRY POINT RD					1						
849	1400 COWICHAN BAY RD								27			Valleyview Center
850	1719 COWICHAN BAY RD										2	2 Comm units PZ1 - FUTURE
	SUBTOTAL	151	40	79	102	558	0	54	30	14	2	
	TAXES IN WATER BILL											
1	1912 COWICHAN BAY RD	1										
2	4771 JACK RD	1										
3	4776 JACK RD	1										
4	4780 JACK RD	1										
5	4764 JACK RD	1										
6	4761 JACK RD	1										
7	1549 DEIGHTON RD	1										
8	2018 COWICHAND BAY RD	1										
9	4756 JACK RD	1										
10	1545 DEIGHTON RD	1										
11	2014 COWICHAN BAY RD	1										
12	1440 COWICHAN BAY RD					1						
13	1441 COWICHAN BAY RD					1						
14	1445 COWICHAN BAY RD					1						
15	TOMMY RD					6						
1	1789 COWICHAN BAY RD	1										
2	1795 COWICHAN BAY RD	1										
3	1797 COWICHAN BAY RD	1										
4	1779 COWICHAN BAY RD	1										
5	1801 COWICHAN BAY RD	1										
6	1785 COWICHAN BAY RD	1										
7	1775 COWICHAN BAY RD	1										
8	1783 COWICHAN BAY RD	1										
9	1787 COWICHAN BAY RD	1										
10	1781 COWICHAN BAY RD	1										
11	1777 COWICHAN BAY RD	1										
12	1783B COWICHAN BAY RD	1										
13	1791 COWICHAN BAY RD	1										
14	1845 COWICHAN BAY RD	1										
1	4539 BUENA VISTA PL					1						
2	1880 WILMOT RD					1						
3	1825 COWICHAN BAY RD	3										
4	1845 COWICHAN BAY RD	1										
1	1501 COWICHAN BAY RD											Bench School (Institutional)
1	1759 COWICHAN BAY RD	2			3							
2	1699 COWICHAN BAY RD				1							
3	1761 COWICHAN BAY RD				2							
4	1745 COWICHAN BAY RD	5			2							
5	1751 COWICHAN BAY RD	2			4							

6	1721 COWICHAN BAY RD	2			8							
7	1725 COWICHAN BAY RD	4			7							
8	1765 COWICHAN BAY RD				2							
9	1759 COWICHAN BAY RD	2			1							
10	1765 COWICHAN BAY RD	6			3							
11	1793 COWICHAN BAY RD				1							
	SUBTOTAL	52	0	0	34	11	0	0	0	0	0	
NON CHARGE WATER												
	2274 COWICHAN BAY RD				1							
	2280 COWICHAN BAY RD	1										
	2284 COWICHAN BAY RD	1										
	VALLEYVIEW WWTP								1			
	1760B PAVENHAM RD								1			
	SUBTOTAL	2	0	0	1	0	0	0	2	0	0	
	TOTALS	**205**	**40**	**79**	**137**	**569**	**0**	**54**	**32**	**14**	**2**	

CBWD Master Plan
Connected Users
R. Casement
11/1/2021

Population Densities by Land Use (Residential)

Based on CBWD Specifications

Land Use	Average Occupancy Rate		
Single Family (Low Density)	2.6	persons per	unit
Townhouse (Medium Density)	2.0	persons per	unit
Condominium (Condomium)	1.4	persons per	unit

Connected User (Connections) as of July 2021

Land Use	PZ I	PZ II	Total
Residential			
Single Family	205	569	774
Town House	40	0	40
Condominium	79	54	133
Sub Total	324	623	947
Commercial			
Commercial Units (Including hotel rooms, businesses)	137	32	169
Sub Total	137	32	169
Institutional			
Bench Elementary School		1	1
Sub Total	0	1	1
Totals	598	687	1117

Equivalent Population as of July 2021

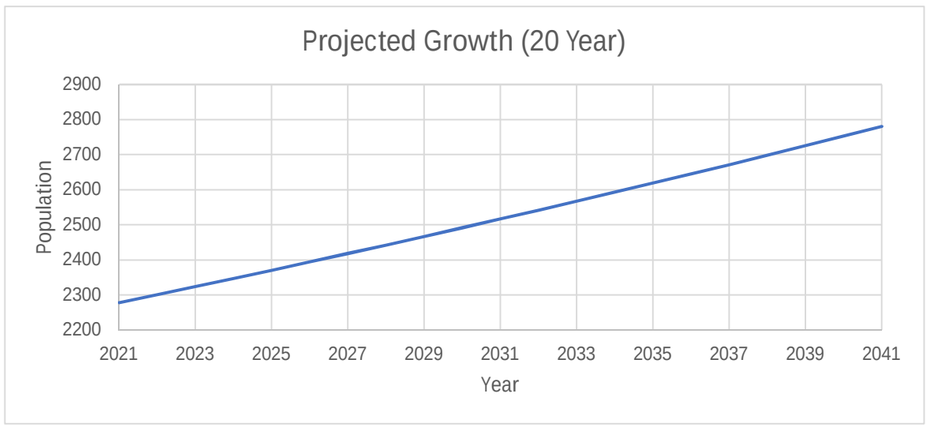
Land Use	PZ I	PZ II	Total
Residential			
Single Family	533	1479	2012
Town House	80	0	80
Condominium	111	76	186
Total	724	1555	2279

CBWD Master Plan
Projected Growth Rate
R. Casement
11/1/2021

2021 Connected Users	2279
Projected Annual Growth Rate	1%

Year	Projected Population	
2021	2279	
2022	2301	
2023	2324	
2024	2348	
2025	2371	
2026	2395	*5 Year*
2027	2419	
2028	2443	
2029	2467	
2030	2492	
2031	2517	*10 year*
2032	2542	
2033	2568	
2034	2593	
2035	2619	
2036	2645	
2037	2672	
2038	2699	
2039	2726	
2040	2753	
2041	2780	*20 year*

Total Projected Population Increase	502 people
Projected Population Increase	209 units (average density of 2.4 persons/unit)



CBWD Master Plan
Future Developments
R. Casement
11/1/2021

		Pressure Zone 1				Pressure Zone 2				
	Physical Address	# of SF Units	# of TH Units	# of Condo Units	# of Com Units	# of SF Units	# of TH Units	# of Condo Units	# of Com Units	Notes
1	Tommy Road Subdivision (Future)					5				
2	Canoe Shed	4								
3	Jack Road (Future)	15								
4	Wilmot Road					15				
5	Cowichan Bay Estates Phase III					40				
6	Misc Approved	8				6				
	Totals	27	0	0	0	66	0	0	0	

CBWD Master Plan
Potential Growth Areas
R. Casement
11/1/2021

Future Units as of July 2021

Land Use	PZ I	PZ II	Total
Tommy Road Subdivision (Future)	0	5	5
Canoe Shed	4	0	4
Jack Road (Future)	15	0	15
Wilmot Road	0	15	15
Cowichan Bay Estates Phase III	0	40	40
Misc Approved	8	6	14
Totals	27	66	93

Proposed 20- Year Unit Growth at Identified Growth Nodes

Land Use	PZ I	PZ II	Total
East Cowichan Development	0	20	20
Four Ways East Development	0	96	96
Totals	0	116	116

Growth Distribution over 5, 10 and 20 Year Planning Horizons

2026	Future Units			Projected Population		
Land Use	PZ I	PZ II	Total	PZ I	PZ II	Total
Future Developments						
Tommy Road Subdivision (Future)	0	1	1	0	3	3
Canoe Shed	1	0	1	2	0	2
Jack Road (Future)	4	0	4	9	0	9
Wilmot Road	0	4	4	0	9	9
Cowichan Bay Estates Phase III	0	10	10	0	24	24
Misc Approved	2	2	4	5	4	8
Subtotal	7	17	23	16	40	56
Growth Nodes						
East Cowichan Development	0	5	5	0	12	12
Four Ways East Development	0	24	24	0	57	57
Subtotal	0	29	29	0	69	69
Total	7	45	52	16	109	125

2031	Future Units			Projected Population		
Land Use	PZ I	PZ II	Total	PZ I	PZ II	Total
Future Developments						
Tommy Road Subdivision (Future)	0	3	3	0	6	6
Canoe Shed	2	0	2	5	0	5
Jack Road (Future)	8	0	8	18	0	18
Wilmot Road	0	8	8	0	18	18
Cowichan Bay Estates Phase III	0	20	20	0	48	48
Misc Approved	4	3	7	10	7	17
Subtotal	14	33	47	32	79	112
Growth Nodes						
East Cowichan Development	0	10	10	0	24	24

Four Ways East Development	0	48	48	0	115	115
Subtotal	0	58	58	0	139	139
Total	14	91	104	32	218	251

2041	Future Units			Projected Population		
Land Use	PZ I	PZ II	Total	PZ I	PZ II	Total
Future Developments						
Tommy Road Subdivision (Future)	0	5	5	0	12	12
Canoe Shed	4	0	4	10	0	10
Jack Road (Future)	15	0	15	36	0	36
Wilmot Road	0	15	15	0	36	36
Cowichan Bay Estates Phase III	0	40	40	0	96	96
Misc Approved	8	6	14	19	14	34
Subtotal	27	66	93	65	159	224
Growth Nodes						
East Cowichan Development	0	20	20	0	48	48
Four Ways East Development	0	96	96	0	230	230
Subtotal	0	116	116	0	278	278
Total	27	182	209	65	437	502

CBWD Master Plan
Water Usage 2018-2021
Section 3.3
R. Casement
11/1/2021

System Production 2018

	2018 Water Production (m^3)				
	Valleyview #2	Valleyview #1	Office	Kidd Well	Total Water
Jan	5719.8	12069.1	0	0	17788.9
Feb	7693.6	8816.8	2353.9	0	18864.3
Mar	5830.5	12650	3.6	0	18484.1
Apr	5827.7	12721.1	0	0	18548.8
May	8685.9	18861.1	272.7	0	27819.7
Jun	8698.7	19898.2	451.2	0	29048.1
Jul	10512.7	22842.2	3713	0	37067.9
Aug	9259.2	20392.6	164.6	0	29816.4
Sep	6376.17	14207	0	0	20583.17
Oct	5859.5	12866	542.2	0	19267.7
Nov	5185.1	11088.4	0.3	0	16273.8
Dec	3837.7	11570.7	0	0	15408.4
TOTAL ANNUAL (m3)	83486.57	177983.2	7501.5	0	268971.27
Average (m3/day)	228.7	487.6	20.6	0.0	736.9
Average (L/s)	2.6	5.6	0.2	0.0	8.5
Average % of Total	31%	66%	3%	0%	100%

Valleyview Well Production 2018-2021

	Annual Water Production (m^3)			Daily Water Production (m^3)			Change in Average Usage From Previous Year (%)	Notes
	Valleyview Well 2	Valleyview Well 1	Total Valleyview	Maximum	Average	Maximum Day Factor		
2018	54,390	22,234	76,624	945.1	633.3	1.49	-	Sept 1- Dec 31 - 121 days
2019	186,004	90,745	276,749	1,365.4	758.2	1.80	20%	
2020	184,515	87,163	271,678	1,291.5	744.3	1.74	-2%	
2021	145,362	60,789	206,151	1,545.1	866.2	1.78	16%	Jan 1 - Aug 27 -238 days
					AVERAGE	1.70	11%	

System Production 2018-2021

	Water Production (m3)	Water Invoiced (m3)	Non-Revenue Water (m3)	Non-Revenue Water (% total)	Notes
2018	268,971	253,563	15,408	6%	
2019	257,839	228,872	28,967	11%	
2020	273,503	239,738	33,765	12%	

2021	142,184	115,834	26,350	19%	Jan - June 30
			AVERAGE	12%	

Calculated Production by Well 2018-2021

	Water Production (m3)	Valleyview #1 - 31% (m3)	Valleyview #2 - 66%	Office Well - 3%	Kidd Well - 0%	Notes
2018	268,971	83,381	177,521	8,069	-	
2019	257,839	79,930	170,174	7,735	-	
2020	273,503	84,786	180,512	8,205	-	
2021	142,184	44,077	93,841	4,266	-	Jan - June 30

Calculated Equivalent Per Capita Usage

	Annual Water Production (m3)	Average Daily Demand (L/s)	Estimated Population1	Average Per Capita (LCD)	Maximum Per Capita2 (LCD)
2018	268,971	8.5	2,210.92	333	667
2019	257,839	8.2	2,233	316	633
2020	273,503	8.7	2,256	332	664
2021	142,184	6.9	2,279	262	524
			AVERAGE	311	622

1. Calculated from 2021 using a 1% annual growth rate
2. Based on an assumed MDF of 2.0

CBWD Master Plan
Water Demand Projections
R. Casement
11/1/2021

Demand Projection Criteria

Average Day Demand	350 LCD
MDF	2 x ADD
PHD	4 xADD

Project Water Usage - 5, 10 and 20 Year Horizon

		2021				2026				2031				2041			
		Equivalent Population	ADD (L/s)	MDD (L/s)	PHD (L/s)	Equivalent Population	ADD (L/s)	MDD (L/s)	PHD (L/s)	Equivalent Population	ADD (L/s)	MDD (L/s)	PHD (L/s)	Equivalent Population	ADD (L/s)	MDD (L/s)	PHD (L/s)
Pressure Zone 1 (HGL 73.0m)																	
Residential																	
Single Family	pop/unit	533	1.9	3.3	7.6	549	2.2	4.4	8.9	565	2.3	4.6	9.2	598	2.4	4.8	9.7
Town House	pop/unit	80	0.3	0.5	1.1	80	0.3	0.6	1.3	80	0.3	0.6	1.3	80	0.3	0.6	1.3
Condominum	pop/unit	111	0.4	0.7	1.6	111	0.4	0.9	1.8	111	0.4	0.9	1.8	111	0.4	0.9	1.8
	Total PZ1	724	2.6	4.4	10.4	740	3.0	6.0	12.0	756	3.1	6.1	12.3	789	3.2	6.4	12.8
Pressure Zone (HGL 127.0m)																	
Residential																	
Single Family	pop/unit	1479	5.3	9.0	21.2	1589	6.4	12.9	25.7	1698	6.9	13.8	27.5	1916	7.8	15.5	31.0
Town House	pop/unit	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
Condominum	pop/unit	76	0.3	0.5	1.1	4	0.0	0.0	0.1	76	0.3	0.6	1.2	76	0.3	0.6	1.2
	Total PZ2	1555	5.6	9.5	22.3	1592	6.5	12.9	25.8	1773	7.2	14.4	28.7	1992	8.1	16.1	32.3
	Total Connected	2279	8.2	13.9	32.7	2332	9.4	18.9	37.8	2529	10.2	20.5	41.0	2780	11.3	22.5	45.1

APPENDIX D - WATER QUALITY DATA

CBWD Master Plan
Water Quality
R. Casement
Nov 8/21

Analyte	Unit	Guideline			VALLEYVIEW WELL #1 RAW		VALLEYVIEW WELL #2 RAW	OFFICE WELL RAW	DISTRIBUTION(TREATED)	
		MAC	AO	OG	**Jan-18**	**Jul-20**	**Jul-20**	**Jul-20**	**Dec-15**	Jan-18
Anions										
Nitrite (N)	mg/L	1	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calculated Parameters	mg/L	-	-	-						
Total Hardness (CaCO3)	mg/L	-	-	-	66.9	86.9	63.7	120	75.2	80.7
Nitrate (N)	mg/L	10	-	-	0.125	0.336	0.179	<0.020	0.212	0.256
Total Organic Nitrogen (N)	mg/L	-	-	-	<0.020	<0.020	0.038	<0.020	<0.020	<0.020
Sulphide (as H2S)	mg/L	-	0.05	-		<0.0020	<0.0020	0.0067		
Transmittance at 254nm	%T/cm	-	-	-	>97.9	>97.7	>97.7	64.9		>97.9
Misc. Inorganics										
Conductivity	uS/cm	-	-	-	164	200	170	290	170	181
pH	pH	-	-	7.0:10.5	8.11	7.94	7.64	8.11	7.8	8.14
Total Organic Carbon (C)	mg/L	-	-	-	<0.50	<0.50	<0.50	1.9	<0.50	<0.50
Total Dissolved Solids	mg/L	-	-	-	98	130	98	170	93	103
Anions	mg/L	-	-	-						
Alkalinity (PP as CaCO3)	mg/L	-	-	-	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0
Alkalinity (Total as CaCO3)	mg/L	-	-	-	69.8	84	69	150	72.6	74.6
Bicarbonate (HCO3)	mg/L	-	-	-	85.2	100	84	190	88.6	91.1
Carbonate (CO3)	mg/L	-	-	-	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0
Dissolved Fluoride (F)	mg/L	1.5	-	-	0.058	0.052	0.061	0.17	0.056	0.056
Hydroxide (OH)	mg/L	-	-	-	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0
Total Sulphide	mg/L	-	0.05	-		<0.0018	<0.0018	0.0063		
Dissolved Chloride (Cl)	mg/L	-	250	-	6.2	9.8	7	3.2	7.5	8.1
Dissolved Sulphate (SO4)	mg/L	-	500	-	5.8	5.2	4.9	<1.0	6.45	5.7
Miscellaneous										
True Colour	Col. Unit	-	15	-	<5.0	<5.0	<5.0	6.3	<5	<5.0
UV absorbance (254nm)	AU/cm	-	-	-	<0.010	<0.010	<0.010	0.188		<0.010
Nutrients										
Total Ammonia (N)	mg/L	-	-	-	<0.020	<0.015	0.068	1.3	0.017	0.056
Nitrate plus Nitrite (N)	mg/L	-	-	-	0.125	0.336	0.179	<0.020	0.212	0.256
Total Nitrogen (N)	mg/L	-	-	-	0.143	0.341	0.284	1	0.221	0.292
Physical Properties										
Turbidity	NTU	see remark	see remark	see remark	<0.10	<0.10	<0.10	7.2	0.3	<0.10

Elements											
Total Mercury (Hg)	ug/L	1	-	-	<0.10	<0.0019	0.024	<0.0019	<0.010	<0.10
Total Metals by ICPMS										
Total Aluminum (Al)	ug/L	-	-	100	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Antimony (Sb)	ug/L	6	-	-	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Arsenic (As)	ug/L	10	-	-	1.77	1.58	1.85	4.1	1.64	1.61
Total Barium (Ba)	ug/L	1000	-	-	3.2	3.6	2.8	20	3.1	3.325
Total Beryllium (Be)	ug/L	-	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Bismuth (Bi)	ug/L	-	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Boron (B)	ug/L	5000	-	-	<50	<50	<50	<50	<50	<50
Total Cadmium (Cd)	ug/L	5	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Total Chromium (Cr)	ug/L	50	-	-	2.3	2.2	2.3	<1.0	2.3	2.2
Total Cobalt (Co)	ug/L	-	-	-	<0.20	<0.20	<0.20	<0.20	<0.50	<0.20
Total Copper (Cu)	ug/L	2000	1000	-	2.44	0.46	0.23	0.29	9.67	25.3
Total Iron (Fe)	ug/L	-	300	-	<5.0	<5.0	<5.0	1890	<5.0	<5.0
Total Lead (Pb)	ug/L	5	-	-	1.54	<0.20	0.41	<0.20	<0.20	2.12
Total Manganese (Mn)	ug/L	120	20	-	5.6	<1.0	3.7	**285**	<1.0	<1.0
Total Molybdenum (Mo)	ug/L	-	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Nickel (Ni)	ug/L	-	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Selenium (Se)	ug/L	50	-	-	0.39	0.19	0.35	<0.10	0.2	0.2
Total Silicon (Si)	ug/L	-	-	-	12200	10500	9480	12900	10900	10300
Total Silver (Ag)	ug/L	-	-	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.20
Total Strontium (Sr)	ug/L	7000	-	-	51.2	63	49.6	136	49.2	54.5
Total Thallium (Tl)	ug/L	-	-	-	<0.010	<0.010	<0.010	<0.010	<0.050	<0.010
Total Tin (Sn)	ug/L	-	-	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Total Titanium (Ti)	ug/L	-	-	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Total Uranium (U)	ug/L	20	-	-	0.1	0.21	<0.10	<0.10	0.14	0.16
Total Vanadium (V)	ug/L	-	-	-	7.2	6.4	7	<5.0	7.4	6.7
Total Zinc (Zn)	ug/L	-	5000	-	<5.0	<5.0	<5.0	6.5	6.5	<5.0
Total Zirconium (Zr)	ug/L	-	-	-	<0.10	<0.10	<0.10	<0.10	<0.50	<0.10
Total Calcium (Ca)	mg/L	-	-	-	18.7	19.3	14.7	30.7	17.1	18.7
Total Magnesium (Mg)	mg/L	-	-	-	8.29	9.41	6.57	10.5	7.86	8.29
Total Potassium (K)	mg/L	-	-	-	0.699	0.714	0.637	1.04	0.663	0.699
Total Sodium (Na)	mg/L	-	200	-	5.97	5.41	5.8	13.3	6	5.97
Total Sulphur (S)	mg/L	-	-	-	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Microbiological Param.										
Heterotrophic Plate Count	CFU/mL	-	-	-	<1	3	3	66	1	<1
Total Coliforms	CFU/100mL	0	-	-	0	0	0	0	<1	1
E. coli	CFU/100mL	0	-	-	0	0	0	0	<1	0
Calculated Parameters										
Langelier Index (@ 4.4C)	N/A	-	-	-	-0.771	-0.761	-1.26	-0.141	-1.01	-0.616
Langelier Index (@ 60C)	N/A	-	-	-	0.27	0.279	-0.214	0.9	0.03	0.425
Saturation pH (@ 4.4C)	N/A	-	-	-	8.85	8.7	8.9	8.25	8.8	8.76

Saturation pH (@ 60C)	N/A	-	-	-	7.84	7.66	7.85	7.21	7.76	7.72

No fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

Criteria A = Maximum Acceptable Concentration (MAC)
Criteria B = Aesthetic Objectives (AO)
Criteria C = Operational Guidance Values (OG)

APPENDIX E - MODEL FIGURES

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2021_Average_Day

Legend	
	Value (psi)
	<= 20.0
	<= 40.0
	<= 70.0
	<= 100.0
	> Other

LOW PRESSURES AT HIGH POINTS AROUND OFFICE RESERVOIR

Office Reservoir

AREA BELOW 40PSI DURING AVERAGE DAY DEMANDS

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Platinum member

AE PROJECT No.	2021-2190
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC01
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-1

COWICHAN BAY
WATERWORKS DISTRICT

SYSTEM PRESSURES
2021 AVERAGE DAY DEMAND

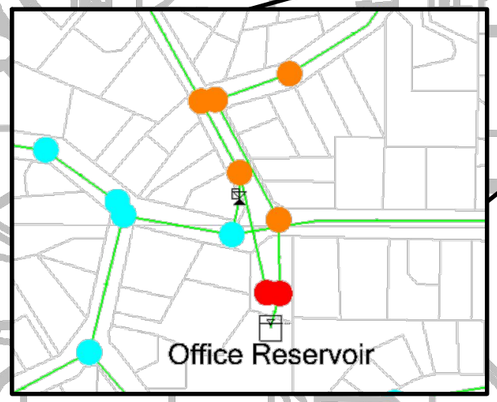
IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2021_Maximum_Day

Legend	
	Value (psi)
	<= 20.0
	<= 40.0
	<= 70.0
	<= 100.0
	> Other

LOW PRESSURES AT HIGH POINTS AROUND OFFICE RESERVOIR



AREA BELOW 40PSI DURING MAXIMUM DAY PRESSURES

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AE PROJECT No.	2021-2190
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC01
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-2

COWICHAN BAY
WATERWORKS DISTRICT

SYSTEMS PRESSURES
2021 MAXIMUM DAILY DEMAND

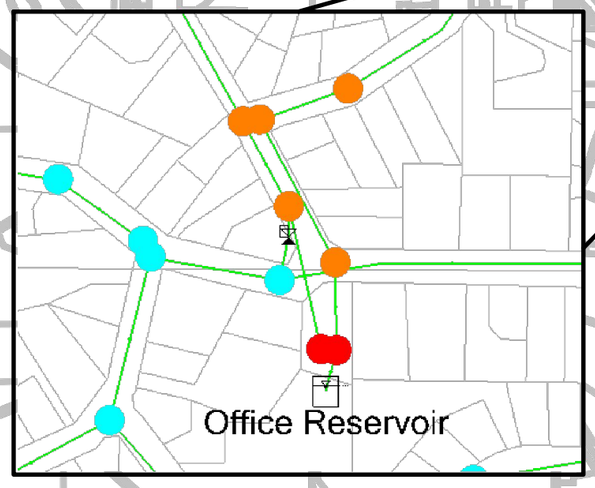
IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2021_Peak_Hour

Legend	
	Value (psi)
	<= 20.0
	<= 40.0
	<= 70.0
	<= 100.0
	> Other

LOW PRESSURE AT HIGH POINTS AROUND OFFICE RESERVOIR



AREA BELOW 40PSI DURING PEAK HOUR PRESSURES

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AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC01
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-3

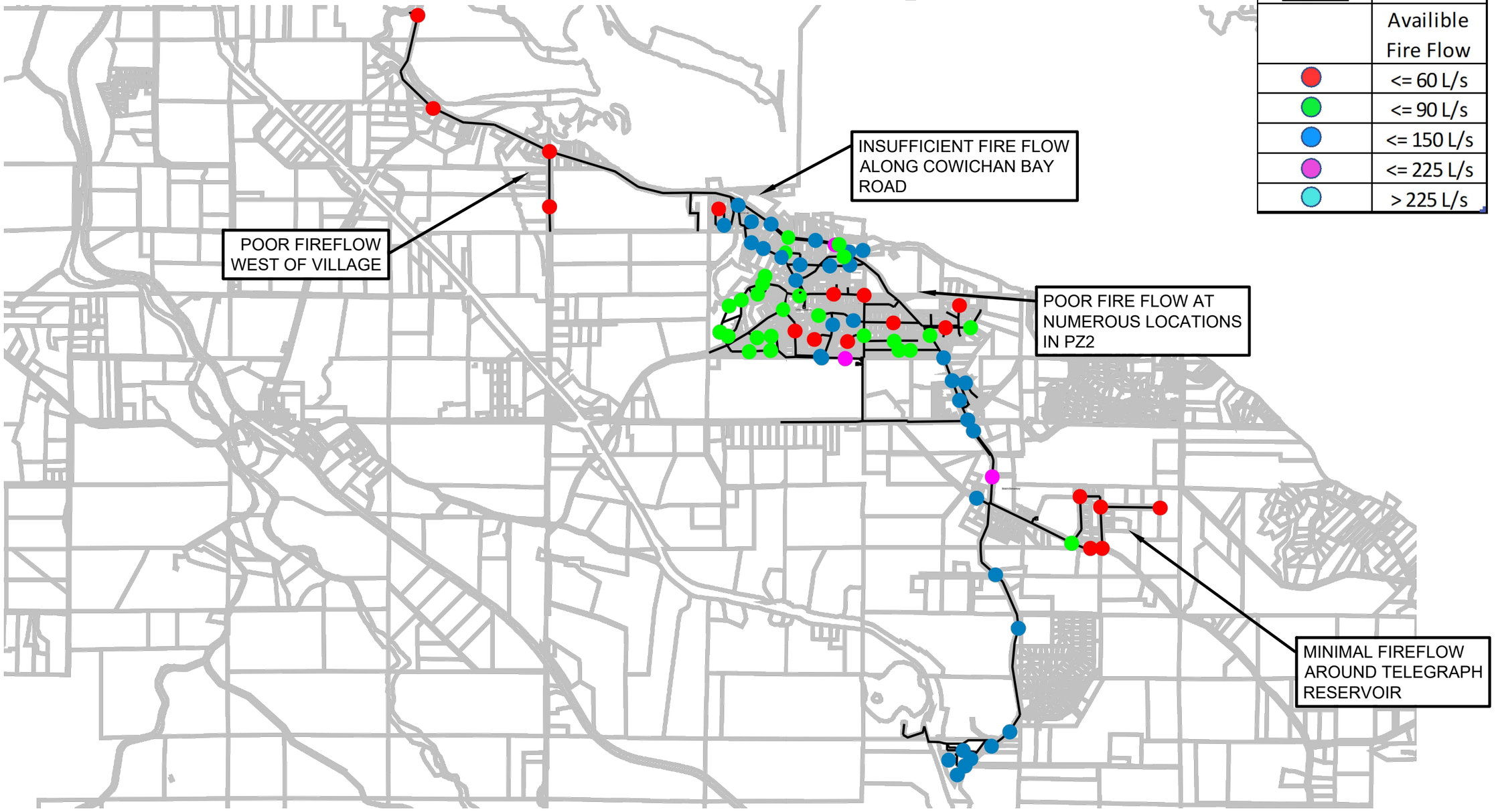
COWICHAN BAY
WATERWORKS DISTRICT

SYSTEMS PRESSURES
2021 PEAK HOUR DEMANDS

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2021_MDD+FF

Legend	
	Availible Fire Flow
	<= 60 L/s
	<= 90 L/s
	<= 150 L/s
	<= 225 L/s
	> 225 L/s



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AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC01
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-4

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

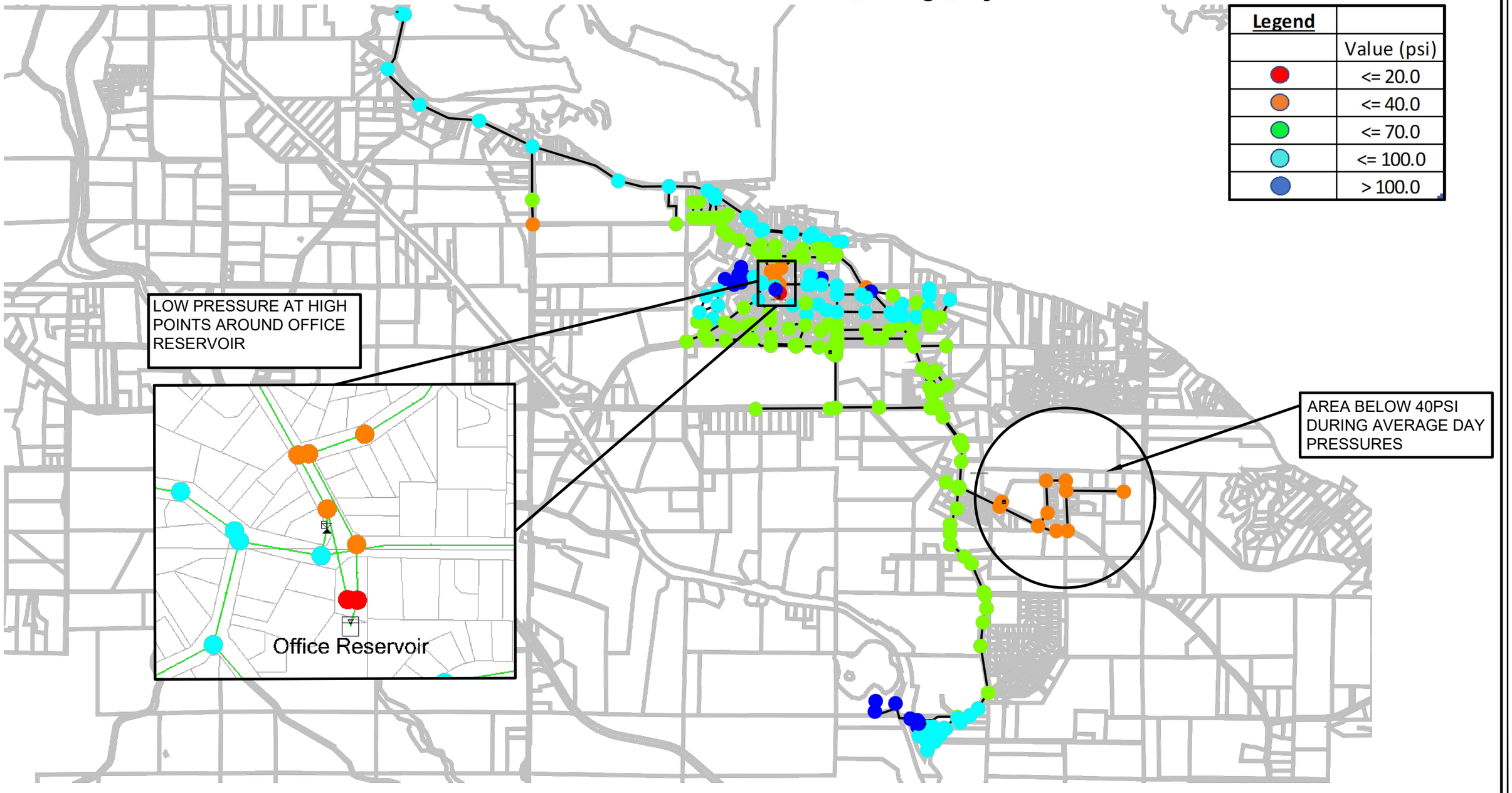
FIRE FLOW AVAILABILITY
2021 MAXIMUM DAY DEMAND

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2026_Average_Day

Legend	
	Value (psi)
	<= 20.0
	<= 40.0
	<= 70.0
	<= 100.0
	> 100.0



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AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC01
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-5

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

SYSTEM PRESSURES
2026 AVERAGE DAY DEMAND

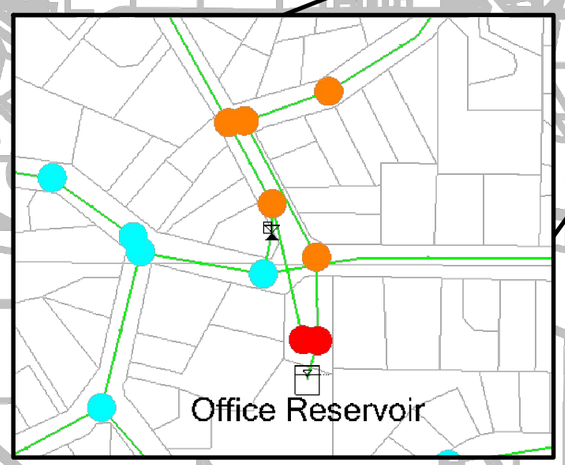
IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2026_Maximum_Day

Legend	
	Value (psi)
	<= 20.0
	<= 40.0
	<= 70.0
	<= 100.0
	> 100.0

LOW PRESSURE AT HIGH POINTS AROUND OFFICE RESERVOIR



AREA BELOW 40PSI DURING MAXIMUM DAY PRESSURES

PLOT DATE: 2021-12-01 3:31:57 PM
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AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC01
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-6

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

SYSTEM PRESSURES
2026 MAXIMUM DAY DEMAND
ORDANO BOOSTER PUMP RUNNING

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2026_Peak_Hour

Legend	Availible Fire Flow
	<= 60 L/s
	<= 90 L/s
	<= 150 L/s
	<= 225 L/s
	> 225 L/s

LOW PRESSURES AT HIGH POINTS AROUND OFFICE RESERVOIR

Office Reservoir

AREA BELOW 40PSI DURING PEAK HOUR PRESSURES

PLOT DATE: 2021-12-03 10:30:20 AM
SAVE DATE: 2021-12-03 10:29:50 AM SAVED BY: TARBELLB
DWG PATH: c:\users\tarbellb\documents\cowi master water plan\appendix e -model figures\cad edits\fig 5-7 - 2026_phd.dwg

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Platinum member

AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC03
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-7

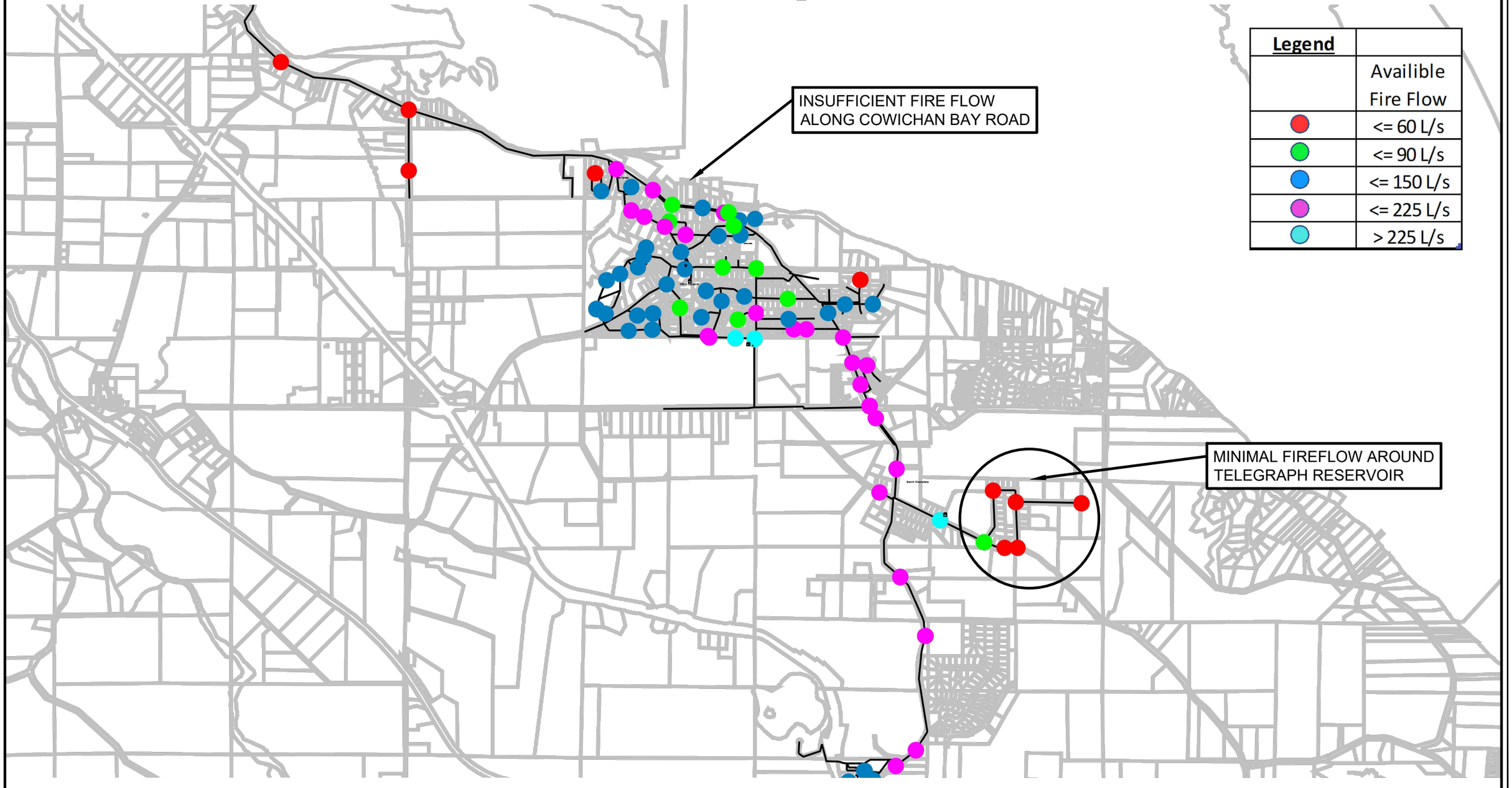
COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

SYSTEM PRESSURES
2026 PEAK HOUR DEMAND
ORDANO BOOSTER PUMP RUNNING

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2026_MDD+FF



Legend	
	Availible Fire Flow
	<= 60 L/s
	<= 90 L/s
	<= 150 L/s
	<= 225 L/s
	> 225 L/s

PLOT DATE: 2021-12-01 4:49:16 PM
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DWG PATH: c:\users\tarbellb\documents\cad models\ water plan\appendix e -model figures\cad edits\fig 5-8 - 2026_mddff-availflow.dwg

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AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC01
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-8

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

FIRE FLOW AVAILABILITY
2026 MAXIMUM DAY DEMAND
ORDANO FIRE PUMP RUNNING

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2041_Average_Day

Legend	
	Value (psi)
	<= 20.0
	<= 40.0
	<= 70.0
	<= 100.0
	> 100.0

IMPROVED OPERATING PRESSURES FROM BOOSTER PUMP

PLOT DATE: 2021-12-02 8:16:11 AM
SAVE DATE: 2021-12-01 5:00:27 PM SAVED BY: TARBELLB
DWG PATH: c:\users\tarbellb\documents\cowichan master plan\appendix e -model figures\cad edits\fig 5-9 - 2041_add.dwg

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BEST MANAGED COMPANIES CANADA
Platinum member

AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC01
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-9

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

SYSTEM PRESSURES
2041 AVERAGE DAY DEMANDS
UPGRADED SYSTEM

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2041_Maximum_Day

Legend	
	Value (psi)
	<= 20.0
	<= 40.0
	<= 70.0
	<= 100.0
	> 100.0

IMPROVED OPERATING PRESSURES FROM BOOSTER PUMP

PLOT DATE: 2021-12-02 8:30:48 AM
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DWG PATH: c:\users\tarbellb\documents\active\matrix water plant\appendix e -model figures\cad edits\fig 5-10 - 2041_mdd.dwg

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CANADA BEST MANAGED COMPANIES
Platinum member

AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC02
REV	
DESCRIPTION	ISSUED FOR REVIEW

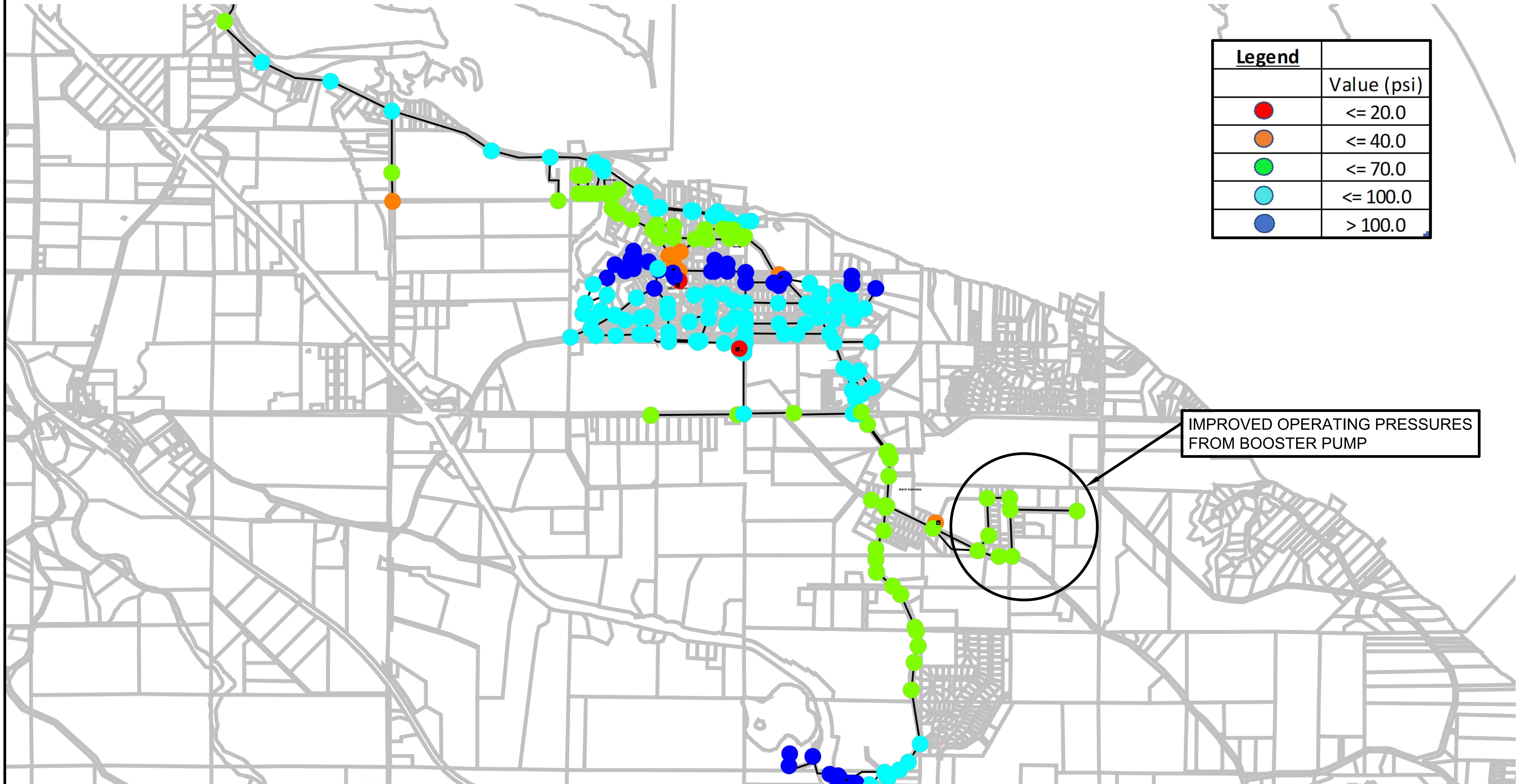
FIGURE 5-10

COWICHAN BAY WATER DISTRICT
WATER SYSTEMS MASTER PLAN UPDATE

SYSTEMS PRESSURES
2041 MAXIMUM DAY DEMAND
UPGRADED SYSTEM

IF NOT 25 mm ADJUST SCALES
25 mm
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2041_Peak_Hour



Legend	
	Value (psi)
(red)	<= 20.0
(orange)	<= 40.0
(green)	<= 70.0
(cyan)	<= 100.0
(blue)	> 100.0

PLOT DATE: 2021-12-02 8:40:54 AM
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DWG PATH: c:\users\tarbellb\documents\cbwb master water plan\appendix e -model figures\cad edits\fig 5-11 - 2041_phd.dwg

Associated Engineering

CANADA BEST MANAGED COMPANIES
Platinum member

AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC02
REV	
DESCRIPTION	ISSUED FOR REVIEW

FIGURE 5-11

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

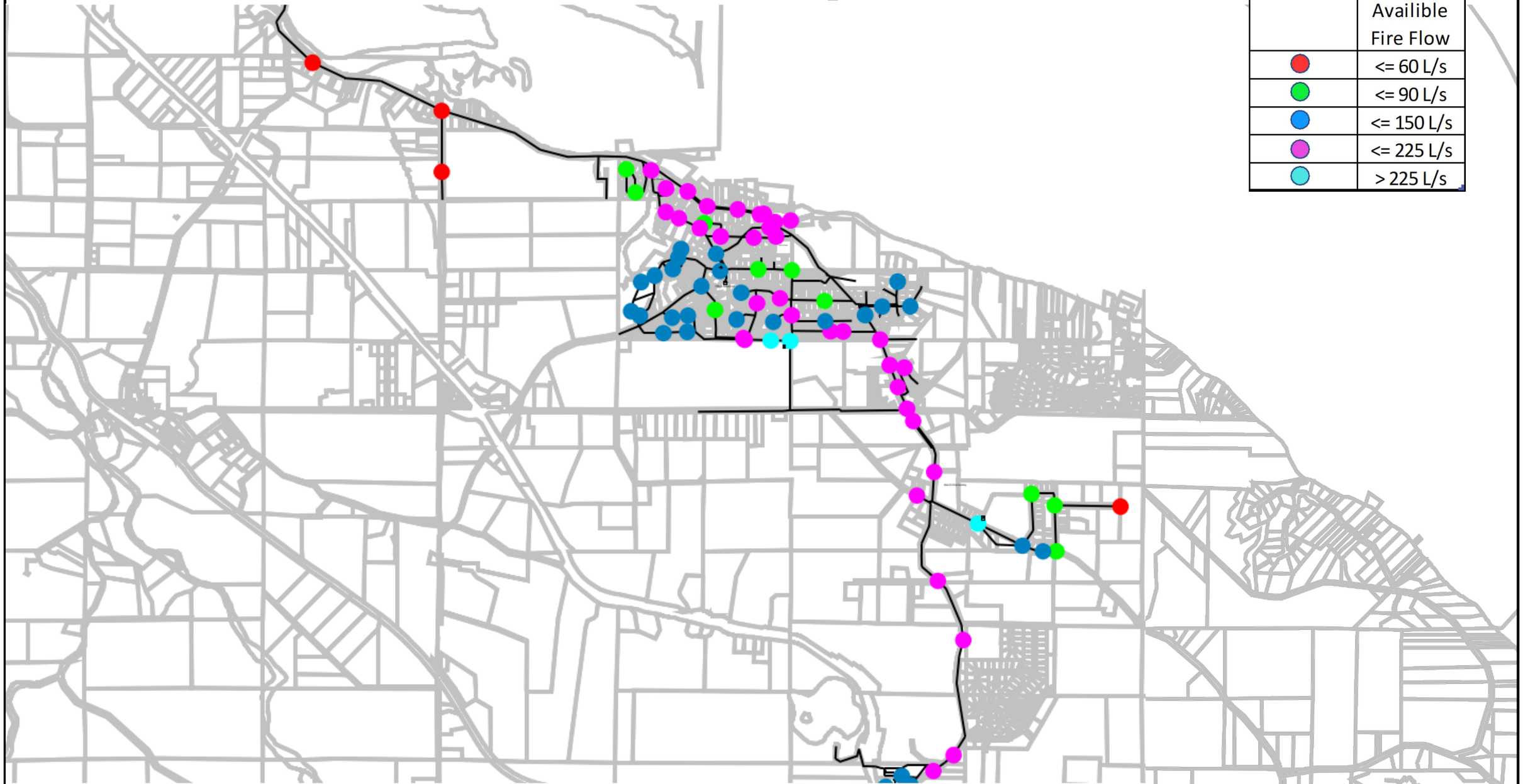
SYSTEM PRESSURES
2041 PEAK HOUR DEMAND
UPGRADED SYSTEM

IF NOT 25 mm ADJUST SCALES
25 mm

SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE

Scenario: 2041_MDD+FF

Legend	
	Availible Fire Flow
	<= 60 L/s
	<= 90 L/s
	<= 150 L/s
	<= 225 L/s
	> 225 L/s



PLOT DATE: 2021-12-02 8:48:38 AM
SAVE DATE: 2021-12-02 8:48:16 AM SAVED BY: TARBELLB
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Associated Engineering

BEST MANAGED COMPANIES
CANADA
Platinum member

AE PROJECT No.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R. CASEMENT
DATE	2021DEC02
REV	
DESCRIPTION	ISSUED FOR REVIEW

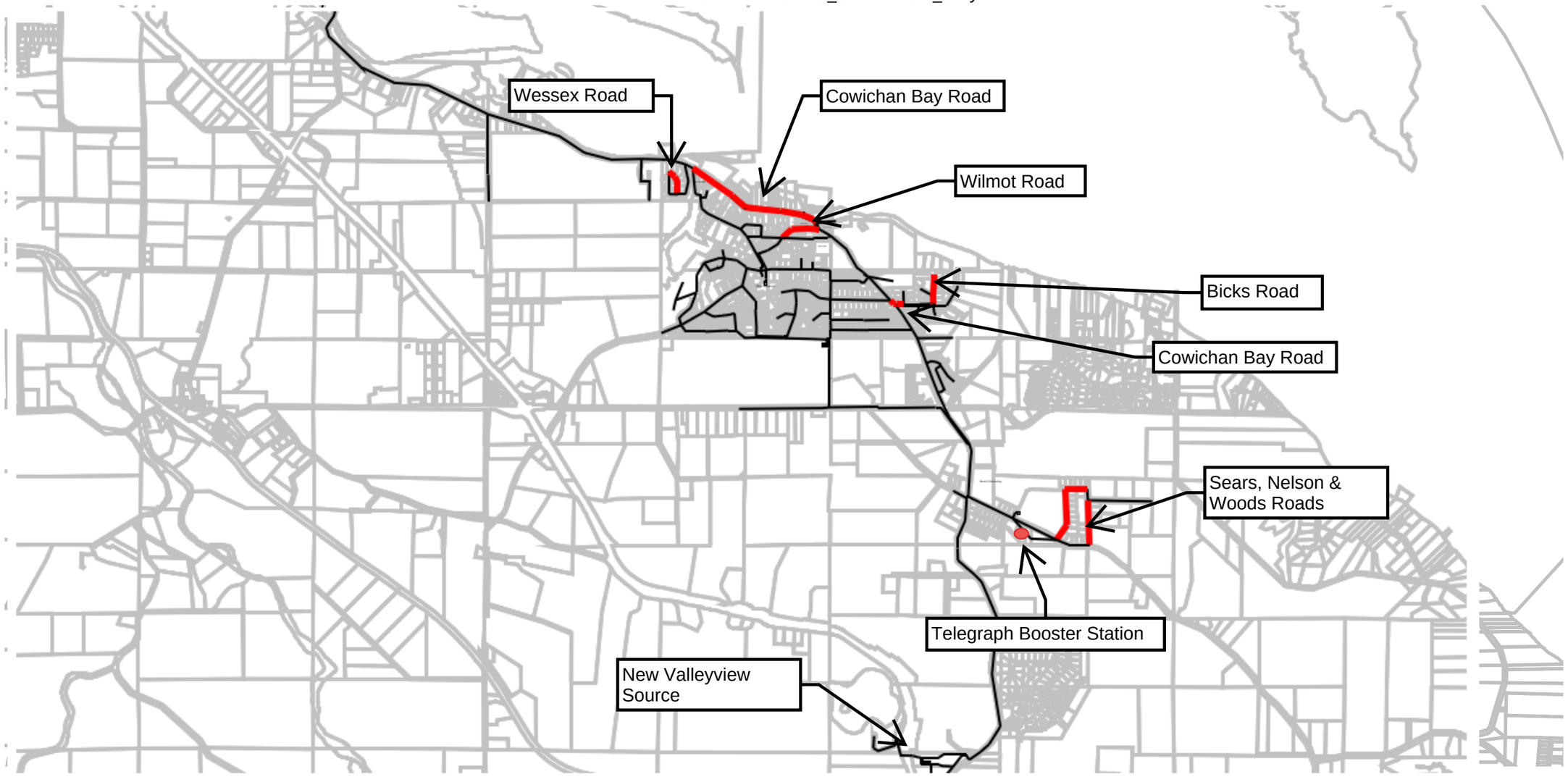
FIGURE 5-12

COWICHAN BAY WATER DISTRICT
WATER SYSTEM MASTER PLAN UPDATE

FIRE FLOW AVAILABILITY
2041 MAXIMUM DAY DEMAND
ORDANO FIRE PUMP RUNNING UPGRADED SYSTEM

APPENDIX F - CAPITAL WORKS SUMMARY AND MAPPING

Scenario: 2041_Maximum_Day



Associated Engineering

BEST MANAGED COMPANIES
Platinum member

AE PROJECT NO.	2021-2190-00
SCALE	NOT TO SCALE
APPROVED	R.CASEMENT
DATE	20211130
DESCRIPTION	ISSUED FOR REVIEW

Figure 6-1

Cowichan Bay Water District
Water System Master Plan Update

Recommended System Upgrades

CBWD Master Plan
Capital Projects Summary
R. Casement
April 10/22

Project Description	Construction Cost	Contingency	Total Cost	Allocation			
				Existing		Future Development	
		40%		%	$	%	$
General							
Engineering Studies*	500,000	200,000	700,000	100%	$ 700,000	0%	$ -
Demolish Abandoned Structures (Reservoirs, Buildings)	250,000	100,000	350,000	100%	$ 350,000	0%	$ -
Subtotal General			*1,050,000*		*1,050,000*		-
Water Supply							
New Water Source	460,000	184,000	644,000	50%	$ 322,000	50%	$ 322,000
Source Water Protection Plan*	30,000	12,000	42,000	100%	$ 42,000	0%	$ -
Decommission Kidd Well	50,000	20,000	70,000	100%	$ 70,000	0%	$ -
Subtotal Water Supply			*756,000*		*434,000*		*322,000*
Distribution System							
Marine Village Flow Improvements							
Cowichan Bay Road (Marine Village 200 mm)	981,000	393,000	1,374,000	50%	$ 687,000	50%	$ 687,000
Cowichan Bay Road (Glen to Longwood 200 mm)	112,000	45,000	157,000	50%	$ 78,500	50%	$ 78,500
Wilmot Road (Pritchard to Cowichan Bay Road 150 mm)	235,000	94,000	329,000	50%	$ 164,500	50%	$ 164,500
Subtotal Marine Village Fire Flow			*1,860,000*		*930,000*		*930,000*
Telegraph Road Improvements							
Telegraph Road Booster Station	700,000	280,000	980,000	100%	$ 980,000	0%	$ -
Wood Road (150 mm)	233,000	94,000	327,000	100%	$ 327,000	0%	$ -
Nelson Road (150 mm)	112,000	45,000	157,000	100%	$ 157,000	0%	$ -
Sears Road (150 mm)	282,000	113,000	395,000	100%	$ 395,000	0%	$ -
Subtotal Telegraph Road Improvements			*1,859,000*		*1,859,000*		-
Residential Fire Flow Improvements							
Bicks Road (150 mm)	142,000	57,000	199,000	100%	$ 199,000		$ -
Wessex Road (to 150 mm)	350,000	140,000	490,000	100%	490,000		$ -
Subtotal Residential Fire Flow			*689,000*		*689,000*		-
AC Pipe Replacement							
George Road (Ordano to Wilmot 150 mm)	335,000	134,000	469,000	100%	$ 469,000	0%	$ -
McGill Road (Ordano to Austin 150 mm)	370,000	148,000	518,000	100%	$ 518,000	0%	$ -
Pritchard Road (Wilmot to Cowichan Bay Rd 150 mm)	279,000	112,000	391,000	100%	$ 391,000	0%	$ -
Longwood Road (150 mm)	402,000	161,000	563,000	100%	$ 563,000	0%	$ -
Austin Place (McGill to Cowichan Bay Road 150 mm)	248,000	100,000	348,000	100%	$ 348,000	0%	$ -
Pavenham (McGill to Wilmot 150 mm)	309,000	124,000	433,000	100%	$ 433,000	0%	$ -
Glen Road (McGill to Cowichan Bay Road 150 mm)	313,000	126,000	439,000	100%	$ 439,000	0%	$ -
Glen Road(McGill to terminus 150 mm)	283,000	114,000	397,000	100%	$ 397,000	0%	$ -
Alder Glen Road (150 mm)	272,000	109,000	381,000	100%	$ 381,000	0%	$ -
Willowglen Road (150 mm)	142,000	57,000	199,000	100%	$ 199,000	0%	$ -
Maple Glen Place (150 mm)	142,000	57,000	199,000	100%	$ 199,000	0%	$ -
Fenwick Road (150 mm)	191,000	77,000	268,000	100%	$ 268,000	0%	$ -
Pritchard Road (Wilmot to Pritchard 150 mm)	263,000	106,000	369,000	100%	$ 369,000	0%	$ -
Wilmot Road (George Road to Falcon Cres 150 mm)	243,000	98,000	341,000	100%	$ 341,000	0%	$ -
Subtotal AC Pipe Replacement			*5,315,000*		*5,315,000*		-
	TOTALS		$ 11,600,000		$ 10,300,000		$ 1,300,000

*Not construction projects, but important to include in long-term planning