

Furry Creek Updated Waterworks Master Plan

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1. INTRODUCTION

An original Rezoning Design brief was submitted to the SLRD in May 2019 and revised in September and November of 2019. The SLRD retained WSP to review details regarding, Water, Storm and Sanitary infrastructure. WSP requested a separate Master Plan for each utility. Creus submitted a separate Water Master Plan in March, 2020. WSP provided a review memo dated May 01, 2020 and a follow-up memo dated May 29, 2020. This report has been updated to address comments raised in the memo.

The Furry Creek lands are an assembly of private lands that were created in the early part of the last century and assembled together and sold to Tanac Lands in 1990. The lands are within the SLRD in Area D located approximately 30 km's North of West Vancouver and 15 km's south of Squamish. The original subject property comprises approximately 1036 acres and is just south of Britannia Beach along the Howe Sound. The project extents are shown in Figure 1 which is also included in Appendix 1: as a full-size plan.

Planning for the Furry Creek community began in 1990 following the purchase of the property by Tanabe Corporation of Japan under the Canadian company, Tanac Land Development Corporation. Since the lands are in an unincorporated area, an application was submitted to the Ministry of Transportation and Highways, and in 1991 Preliminary Layout Approval (PLA) was granted for a complete community comprising a golf course, up to 920 residential units, a 300 room resort or hotel, marina, commercial and community facilities. This PLA was reissued a number of times based on a number of studies including geotechnical studies by Thurber Engineering, Water studies by Thurber and Brown Erdman, road designs, sewage treatment studies, archeological reviews and foreshore and upland environmental assessments. The development areas were identified as Marina, Waterfront, Benchlands, Uplands, Northwest, Northeast, Mountain and Highlands. Currently there is 56 townhouse units in Oliver's Landing strata, an 8,000 ft² community building, 12-unit single family strata at Oceans Crest at the south entrance, 4 duplex lots (1 duplex built) and 90 single family lots as well as the Golf Course and clubhouse.

In 2017 Fine Peace Furry Creek Developments Ltd (FPFCD), the Canadian subsidiary of an international company active in the development of golf course and resort oriented residential communities, purchased the holdings of Burrard Group. In 2018, it acquired the Tanac Lands from Parklane Homes. FPFCD is determined to realize the original vision of a complete recreational/residential community at Furry Creek, with a variety of housing choices, neighbourhood village retail space, resort facilities, a residents'-only marina, community facilities and an extensive open space and trail network.

Creus Engineering Ltd. has been retained by FPFCD to provide a review of the civil servicing requirements for the above project which includes site access, water works, sanitary collection and treatment, stormwater, outside utilities, Canada post and solid waste management. One of the Principals of Creus had previously been an employee of Tanac during the development stages and had worked as a consultant for Tanac, Burrard Group and Parklane on the project.

The lands are part of an overall zoning proposal. Creus prepared a Master Plan in support of the zoning. This report formed part of that submission but has been segregated for convenience. The Appendix numbers have been maintained from the original reports.

Each subdivision requires approval of the Provincial Approving officer. The subdivision process would include referrals to all relevant regulatory authorities including CN rail when works are adjacent to rail, Ministry of Transportation and Infrastructure (MOTI) roads division for any public roads or roads accessing public road, BC hydro when adjacent to Hydro ROW, DFO and FLNRO in relation to environmental concerns, Vancouver Coastal Health (VCH) to confirm that the water system expansion is permitted for expansion and that the operating permit is in good standing and can accommodate the additional demand, Waste Management Branch to ensure that the WWTP permit is in good standing and that the additional flows can be accommodated by the permit. The SLRD has always played a significant role in any subdivision as the local governing authority but also as it related to SLRD being the agency that owns and manages the water system, the sanitary sewer system, streetlights, diking, public open space and fire protection. As such each subdivision will have to gain a significant number of permits and approvals from all levels of government including geotechnical sign offs, environmental approvals and confirmation of water and sewer servicing. It is a reality that all roads, services and subdivision will have to meet all provincial and federal regulation and be designed and constructed in accordance with the most recent version of the Electoral Area D subdivision and Development Servicing (Planned Communities) Bylaw No. 741, 2002.

This Master Plan will provide a review of the existing water infrastructure capacity. It will also define any special design requirements / offsite upgrades required to service the proposed development.

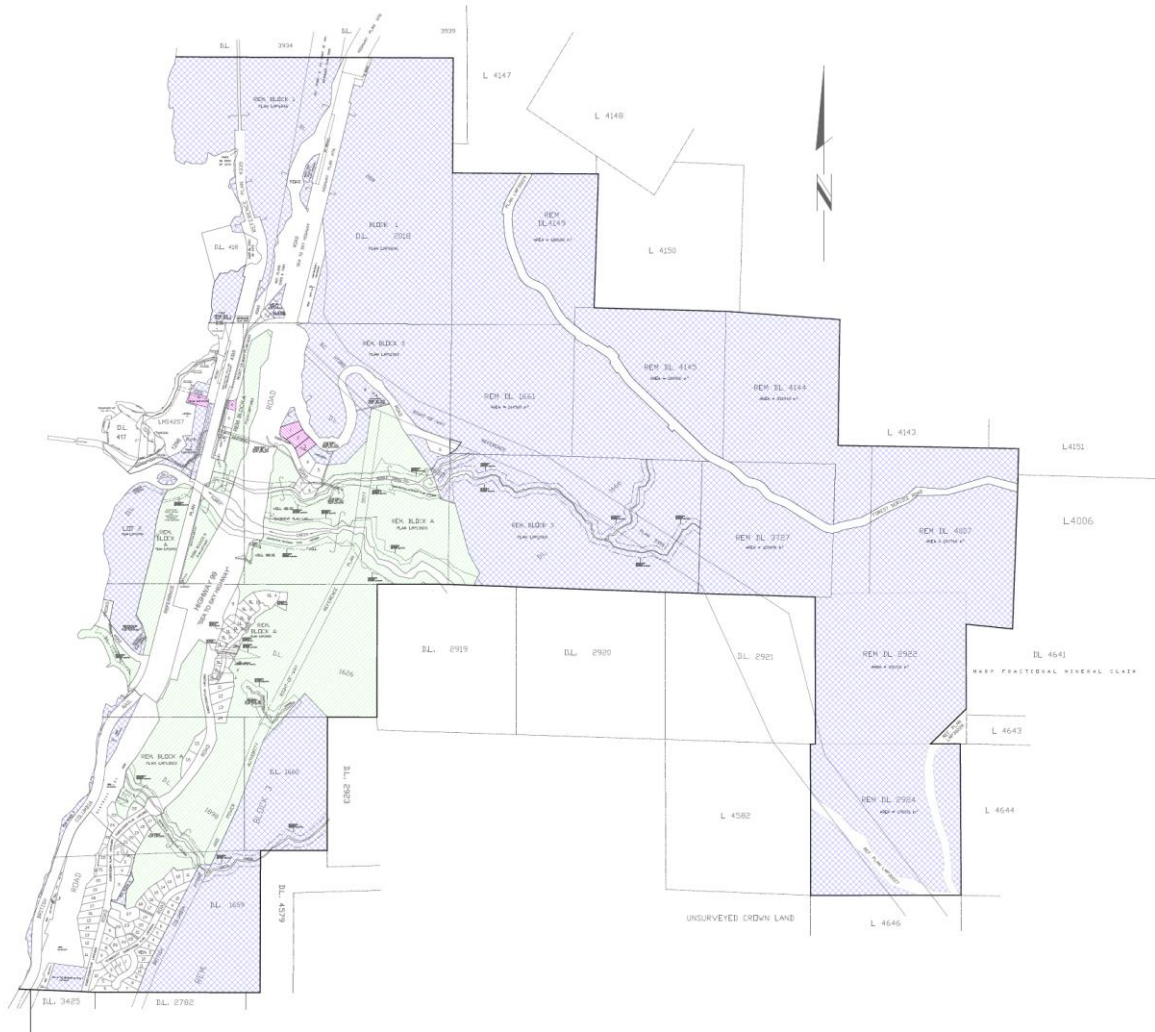


Figure 1: Context Legal plan from Bennett

2. WATER

Original studies for water supply were conducted by Brown Erdman starting in 1990, with further work by Thurber engineering. Since that time the water system has undergone ongoing study as well monitoring. There are monitoring wells on the property that are routinely checked to detect the presence of indicator chemicals that indicate migration of saltwater towards the wells. During the period that the irrigation well was being used exclusively for golf course irrigation needs with no regulation of pumping rates, indicator levels did rise but not to the point that levels in the P1 wells were compromised. Pressure was exerted on the golf course to abandon that irrigation well and move to surface water which was accomplished in 2008. Copies of key studies and information are included in Appendix 11: Hunter Laird reviewed water supply in their report of 2012.

The original Engineering planning was done by Westmar Consulting in their report of 1990. This was updated by Reid Crowther and Partners Limited (RCPL) in their Infrastructure Report of 1992. An independent assessment was done by Kerr Wood Leidal for SLRD in 1998 which listed recommended upgrades to the sewer and water system. Hunter Laird were retained and

prepared a “Waterworks Master Plan” dated April 2012. While the sewer and water layout has evolved somewhat, the general plan is consistent with what was previously intended going back to the 1992 reports. All of the system upgrades are standard construction requirements. The final location of booster pumps and reservoirs will be dictated by the heights and locations of the buildings. Further to this, Associated Engineering (AE) completed a report dated January 2008 to establish the design criteria for treatment of potable water from the Furry Creek surface water source. AE completed another report dated December 2016 to compare and evaluate options for the future Furry Creek water treatment plant, present feasibility-level treatment concepts and uses life cycle cost assessment to evaluate each of the treatment process options.

2.1. DEMAND AND SUPPLY

An independent water system including groundwater and surface water sources, pump stations, reservoirs and a treatment facility has been built to service the first residential neighbourhoods and golf club to meet both domestic and fire protection needs, as per Fire Underwriters requirements. This water infrastructure is owned by the SLRD. The SLRD funds the operation under a Local Area Bylaw which is detailed as Furry Creek Water Rates and Regulations Bylaw No. 1431-2016. The current water supply is from a well on Lot 8 within the first phase subdivision to the east of Furry Creek Drive and south of Furry Creek. The system will be expanded as required by the various regulatory agencies prior to approval of each subdivision to meet neighbourhood requirements. The existing well is adequate for the existing homes plus another 60 units, at which time a backup system will be required. VCH operating permit currently allows for 300 connections as included in Appendix 12:.

Water Supply Requirements are identified by SLRD and VCH. SLRD requirements are more conservative and the SLRD agreed to an overall residential occupancy being modified to 2.6 people per unit based on the intended land use and census data for the Howe Sound area. This was supported by the SLRD’s Master Plan reviewing engineering consultant, Dayton & Knight Consulting Engineers in their letter to the SLRD of June 3, 2008, Hunter Lairds report of April 2012 and AE report of January 2008. This was used in the design of the system to date.

The requirements are detailed in SLRD’s Subdivision and Development Services Bylaw No 741, 2002 which has been amended via Bylaw 953 in 2005 and updated in March of 2015. The update in March 2015 included a new provision that reduces the Domestic Demand where the average daily demand of an existing system is proven over a 3-year recent history to be less than 500 lcd. The design criteria detailed in (b) below can be used with the prior written approval of the Director of Utilities. As the existing consumption data shows values of less than 500 lcd the demand calculations below in Figure 2 and Figure 3 are based on the values in 3.1.4.2 (b). The key demand requirements are as follows:

3.1.4.2 Domestic Demand

(a) For developments tying into existing water systems:

Average Daily Demand	600 L/capita/day
Maximum Daily Demand	1,500 L/capita/day
Peak Hour Demand	2,700 L/capita/day

Where the average daily demand of an existing system is proven over a minimum 3-year recent history to be less than 500 lcd, the design criteria detailed in (b)

(b) For new developments with independent water systems:

Average Daily Demand	500 L/capita/day
Maximum Daily Demand	1,000 L/capita/day
Peak Hour Demand	2,000 L/capita/day

3.1.4.3 Occupancy of Residential Units

Single family	4 per unit
Duplex	4 per Unit
Multifamily	3 Per Unit

Actual values used have been amended and are detailed below.

3.1.4.4 Commercial, Industrial and Institutional Demand

Water demand for commercial, industrial and institutional uses will be based on the specific requirements of the use if known, or otherwise:

average flow over an 8-hour day	0.7 l/s/ha
maximum day demand	1.0 l/s/ha
peak hour demand	2.0 l/s/ha

The exact mix of multifamily and single-family development will evolve over the course of the development. It has been identified by Hunter Laird and Dayton and Knight that census data may provide a better estimate of occupancy per dwelling which is less than the current requirements. Subdivision will require that water supply is in place prior to approving subdivision. Commercial Requirement vary greatly by use. The existing golf course has a very seasonal flow. The current proposal contemplates apartment style multifamily as well as more ground orientated multifamily than the original development scenario which will tend to reduce per unit water consumption. As such hard numbers are not currently fixed but would be at the time of each subdivision. There is however a need to establish that there is viable source of water prior to rezoning.

As such we have made some conservative estimates on the breakdown of uses on the site to match the current zoning request. AE in their masterplan of 2008 recommend using an occupancy of 2.6 people per unit which was consistent with Dayton and Knights review of the Water Masterplan. The occupancy of 2.6 people per unit was established based on the intended land use distribution at the time of the 2008 Hunter Laird report and was approved by SLRD. The layout at the time had a much higher proportion of single family to multi family. It was also taking into account the average Area D population which is predominantly single family. It was derived from the recommended occupancies for the Community as follows:

- Single Family Detached – 3 per unit
- Multifamily attached (<5 stories) – 2.1

Based on the current proposed land use, the supply requirements below have been calculated using the recommended occupancies individually. There are some multifamily attached units in proposed zoning areas greater than 5 stories where the expected occupancies would be less than 2.1 with lower corresponding demand. For the purpose of this exercise these units were conservatively estimated at an occupancy of 2.1 as well. The Domestic Demand for average and max daily demand has been updated to reflect the most recent version of the SLRD bylaw as noted above. The results for maximum daily demand flow and average daily demand flow

were also run at the average occupancy of 2.6 per unit resulting in 3314 m³/day and 1806 l/s respectively. It is felt the 2.6 is overly conservative given the percentage of multi family but was calculated to check the redundancy of the design. Following a review, the supply requirements have been updated for both multi family and single family to have a 2.6 capita.

Maximum Daily Demand Flow						
Use	Description	Units	Capita	l/c/d	Supply Requirements	
					m ³ /day	l/s
Residential	SF	198	2.6	1000	514.8	5.96
Residential	MF	722	2.6	1000	1877.2	21.73
Non-Market Housing	Small MF	120	2.6	1000	312	3.61
Clubhouse	for flow see section 5 Hunter Laird Report 2012 Summer				250	2.89
Golf Maintenance Building	Limited use of washroom and washdown, actually included in the number above Included in overall golf course					
Oliver's Landing Community Building	Limited use actually included in the Clubhouse numbers from Hunter Lairds Calculation					
Resort Hotel	Units	120	2.6	1000	312	3.61
		Building (sq ft)	Lot (hec)	l/s/ha		
Commercial		20000	0.358	1	31	0.36
Community Commercial		50000	0.229	0.7	14	0.16
Marina	Very minimal with no services allowed 1/10th of a residential unit				3	0.035
Total Demand at Build Out					3314	38.35

Supply Sources					
Total Supply from Surface Water Source	Water license 122587 allows 887,315 m ³ per year and 5850 m ³ /day peak demand			5850	67.71
Existing Well P1, P2 and New WPID 51052	Max allowable yield from aquifer is 10 l/s			864	10.00
Total Available Supply				6714	77.71

Figure 2: Max Day Demands

Average Daily Demand Flow						
Use	Description	Units	Capita	l/c/d	Supply Requirements	
					m3/day	l/s
Residential	SF	198	2.6	500	257.4	2.98
Residential	MF	722	2.6	500	938.6	10.86
Non-Market Housing	Small MF	120	2.6	500	156	1.81
Clubhouse	for flow see section 5 Hunter Laird Report 2012 Summer				250	2.89
Golf Maintenance Building	Limited use of washroom and washdown, actually included in the number above Included in overall golf course					
Oliver's Landing Community Building	Limited use actually included in the Clubhouse numbers from Hunter Lairds Calculation					
Resort Hotel	Units	120	2.6	500	156	1.81
		Building (sq ft)	Lot (hec)	l/s/ha		
Commercial		20000	0.358	1	31	0.36
Community Commercial		50000	0.229	0.7	14	0.16
Marina	Very minimal with no services allowed 1/10th of a residential unit				3	0.035
Total Demand at Build Out					1806	20.90

Supply Sources					
Total Supply from Surface Water Source	Water license 122587 allows 887,315 m3 per year and 5850 m3/day peak demand			2431	28.14
Existing Well P1, P2 and New WPID 51052	Max allowable yield from aquifer is 10 l/s			864	10.00
Total Available Supply				3295	38.14

Figure 3: Average Day Demand

We have done further review to model what an annual scenario of 3 months of maximum demand and 9 months of Average demand would compare to the licensed water supply. It should be noted that the average already assumes periods of peak design, so this is somewhat of a redundant or conservative scenario.

3 Months of MDD and 9 Months ADD		m3/day	m3/year
3	Month of Max Day Demand	3313.83	302,387
9	Months of Average Day Demand	1805.83	494,346
		Total Yearly Demand	796,733
		Total Year Supply	892,571

Figure 4: 3 Months MDD and 9 Months ADD

We have also run the demand numbers based on the SLRD bylaw 741, 3.1.4.2 (a) Domestic Demand, which was used previously by Hunter Laird in 2012 and AE in 2008 as the Revised 2015 bylaw had not been released at the time of their analyses. The Results are as follows and still fall below the total available supply. Max Day Demand at build out equals 48.83 l/s and Average Day Demand at build out equals 21.60 l/s.

Western Water Associates Limited (WWAL) and Thurber Engineering have undertaken studies on the Aquifer for over 30 years. They have recently done investigations to determine the location for a future well that should provide the volumes necessary to serve another +/- 200 units and the required level of redundancy. This is in addition to the existing operating well and the surface water source that has already been licensed. The additional water supply is for flow required for units currently included in the VCH Operating Permit which allows the build out of Oliver's Landing and the Waterfront.

The drilling of two new wells was completed in consultation with SLRD, in the area of 18th hole of the golf course. The first well was drilling to the east of the existing 18th hole tees. This well encountered bedrock at a shallow elevation and was deemed to not have adequate depth to be a viable production well. Drilling of a second well was completed in April 24, 2019. Testing and assessment of the new well (Well Plate ID (WPID) 51052) located at the Furry Creek Golf Course and Country Club on the east side of the approach to the 18th hole was completed in September of 2020. WWAL has performed a 72-hour pump test of the new well starting on September 15, 2019 to confirm actual yield. WWAL worked with the SLRD to monitor levels in existing well P1 and other monitoring wells during the +/- 10-day period to thoroughly map the aquifer characteristics. This well is not intended to be relied upon to service the entire build out of the community. WWAL's report "Furry Creek WPID 51052 Well Assessment, dated February 2020" outlines that the aquifer can be pumped sustainably at 10 l/s on an annual basis. The existing well P1, in the same aquifer, can be pumped at rates up to 7 l/s, which leaves 3 l/s available to be pumped from other sources. It was found that the new well WPID 51052 long-term yield was estimated to be 3.7 l/s and that pumping should not exceed this on annual basis to mitigate against the potential for saltwater intrusion. Based on SLRD consumption rates, 10 l/s would be roughly adequate for 550 units. This will be refined further as part of the permitting process for the well involving SLRD, VCH and FLNRO and will depend on the mix of residential types and commercial uses. Those 3 agencies are part of the referral process that the Approving Officer will seek support from on any subdivision application. It is expected that ongoing aquifer monitoring for SLRD should be maintained as per the aquifer monitoring plan to improve the understanding on sustainable extraction rates for WPID 51052 and P1.

There is also a well on lot 4 to the east of the railway adjacent to fairway 17 of the golf course, this well is identified as TW06-03. This well is in a different aquifer than existing wells P1 and P2 as confirmed in Piteau and Associates report dated November 2007. This aquifer is estimated to have an average summer yield of 2.2 l/s and an average annual demand of 1.2 l/s. which was deduced based on I1 irrigation well still being operated. WWAL's "Furry Creek –

WPID 51052 Well Assessment, dated February 2020' concludes based on testing data that there was no impact on TW06-03 from pumping WPID 51052 at 8.8l/s for 48-hours, and no impact on P1 and TW06-03 from pumping WPID 51052 at 6.3l/s for 72 hours. TW06-03 well data has not been allowed for in the above supply source calculations and it may be developed as part of the system. If so, it would be able to serve in the range of approximately 80 units.

Further well analysis was done at the convergence of Phylliss Creek and Furry Creek. The silty nature of the soil precluded this from being a viable water source. There are potential further groundwater sources in the Uplands area as well as the Northeast. These are not required to meet the planned build out of the community but will be investigated as the development expands.

Furry Creek, the largest of the various creeks within the site has the largest watershed on Howe Sound. It is the current licensed source for golf course irrigation water. There is an additional water license 122587 File 2002892 on Furry Creek in the name of the SLRD for domestic water. It allows for 195,182,012 imperial gallons a year at a rate of not more than 893 gpm. This is equivalent to more than 67 l/sec for the peak day supply and 28.14 l/s for the average day supply as detailed in the tables above. This exceeds the demand at full build out. The max day demand at full build out is 38.35 l/s and the average day demand is 20.90 l/s at full build out. The surface water source, with treatment plant is intended to be developed and connected to the system in addition to the wells P1 and new well WPID 51052 as well as potential future groundwater sources.

The intake has been constructed with piping extended to lot 8, the location of well P1. The required treatment rate will be determined later in the development depending on the available groundwater sources. AE has prepared a series of concept design for a treatment plant to be placed on Lot 8. This surface source alone, could provide all the water needs for the community. The license for surface water is more than enough for the 1040 units plus golf course and resort use by itself. However, further groundwater sources will be investigated and expanded as the project develops to give a further factor of safety. The existing licensed water supply with the addition of wells P1, P2 and WPID 51052, totals 77.71 l/s max day supply and 38.14 l/s average day supply as detailed in the tables above. Actual water consumption will help to define expected lower actual consumption numbers.

AE prepared a Technical Memorandum No. 2 entitled "Furry Creek Water Treatment Plan Process Selection, Life Cycle Costs and Conceptual Arrangements" dated December 2016. This is contained in Appendix 11: along with other water studies supporting the supply of water. It is expected that groundwater investigation may continue to locate other sources and the surface water source may be reduced but the current needs of the full build out are covered by the licenses currently in place. AE provided a design that does fit on Lot 8, where the current well is. The SLRD approved that masterplan in August of 2012 subject to the site being proven to be adequate. Creus has identified below additional opportunities if the land size is larger than currently shown in the AE drawings.

It has been brought to Creus' attention that there were some concerns brought forward during the review of the AE Masterplan relating to the ability of the area of lot 8 to meet the spatial needs of the plant. AE gave a number of layouts that could be used that fit on the land. Fine Peace owns the golf course adjacent to lot 8 and could expand that lot if it is needed beyond the current design. The lot 9 site, 200 m south of the Furry Creek Intake is also available at the entrance intersection given the revised location and layout for the Community Centre and Village Centre at the SW corner of the intersection, kitty corner to Lot 9. This could provide the

necessary area if lot 8 is deemed not preferred. Fine Peace will provide a Covenant on 300 m² of golf course land approximately 15 m x 20 m south of lot 8 on the Golf course lands for future Water Treatment Expansion if required for the buildout and if Lot 9 is deemed less preferred. This will remain in place until such time as the final treatment plant design requirements are established.

A Golf course irrigation well was constructed on the far side of the Creek known as I1 and rated at 225 USGPM. It's use for irrigation has been discontinued since 2008. The intent at the time of the initial subdivision was that the irrigation well could be converted into an emergency backup for domestic water. While reports have indicated this is not suitable as an ongoing production well, this will be maintained as an emergency back up well. Additionally, the well is currently used to supplement Middle Creek to meet low flow conditions for fish habitat as an obligation of Furry Creek Power Project under an agreement between the power company and the golf course. The Golf Course irrigation is now sourced via a surface Water License #104289, off of Furry Creek held by the golf course. There is test well on lot 4 TW06-03, adjacent to the propane tank which draws from a separate aquifer. It is noted in the same letter mentioned above, to have yield on order of 1 to 2 l/s. The land is owned by Fine Peace. The potential to develop this well will depend on the overall water balance however the identified sources of P1, WPID 51052 and Furry Creek water licenses are currently adequate for build out.

2.2. WATER QUALITY

The existing groundwater supply has been tested on a yearly basis and consistently complies with the drinking water quality standards of the Canadian Safe Drinking Water Act. The risk of saltwater intrusion is continuing to be monitored but all evidence supports that it is retreating based on the reports contained in Appendix 11:. The current treatment is injected chlorine with no expectation this will change.

Raw water drawn from Furry Creek will require both filtration and disinfection. This is detailed in AE report on the surface water treatment included in Appendix 11:. There may be a requirement for circulation pumps and re-chlorination stations, however this is less likely with the higher percentage of expected multi-family units. This will be reviewed in detail at each phase of the development to determine if there is risk of not maintaining residual chlorine levels above 0.2 mg/L. Test ports will be integrated into the system in consultation with VCH to provide secure access for testing.

The raw surface water contains organic carbon varying seasonally from 0.6 to 4.0 mg/L with the majority present as dissolved organic carbon (DOC). Currently, specific treatment to reduce DOC is not included in the water treatment plant but the provision will be made in the plant design for the future addition of treatment, should the future operational data show the need for treatment in the Furry Creek distribution system. AE recommended not to include for the treatment of DOCs at this time but monitor and update as necessary. The proponent will monitor the system and perform tests to identify the need. This is discussed in detail in the AE report No.1 Furry Creek Water Treatment Plant Design Criteria dated January 2008 included in Appendix 11:.

Analysis of chemistry from water sample collected at the end of the new well test showed that the groundwater from WPID 51052 was within the guidelines for Canadian Drinking Water limits. WWAL will be documenting this in their report.

2.3. DISTRIBUTION AND STORAGE

The revised masterplan identifies the proposed extents of development that are generally consistent with intents of the previous masterplans. The total development under the original PLA was 920 units in single and multifamily set up, 300 room resort, golf course and commercial Marina. The current rezoning application indicates 920 market housing in single family as well as ground orientated and apartment style multi family, golf course and 120-unit resort with supporting commercial and community amenities. The Community elements range in elevation from 4.5 m to 370 m in the mountain area. A series of pump stations and reservoirs was identified by RCPL in their 1992 report and was updated in the Hunter Laird report of 2012. The current plan will require modification to the 2012 report. General description of the servicing layout is described below however the final location of booster pumps and reservoirs will be dictated by the heights, size, number and locations of the buildings. All of the system upgrades are standard construction requirements. We have detailed the needs of the various neighbourhoods generally below and there is an updated water servicing concept masterplan included in Appendix 10:. For the water storage requirements and pipe sizing the maximum build-out of the neighbourhoods has been updated and used to size the storage and pipe sizing. This is based on the most recent architectural layout and reflects an overall unit count of approximately 1600 dwellings. This unit count is in excess of max allowed units for the community per zoning but allows for units to be redistributed between neighbourhoods as well as potential future infill that might result from future zoning changes. The current expectation is that the total number of units is fixed at 920 market plus 120 non market along with resort, golf and commercial, the actual distribution between neighbourhoods may adjust over time and this has been allowed for in the conservative design approach. It is understood that each phase will require passing through a process of Development Permit, Subdivision and Building Permit. This will require sign off from VCH, SLRD and Waste Management Branch. Each unit will have to go through a process to prove out there is adequate servicing and that the lands are safe for their intended purpose. Final distribution, pump station and reservoir sizing would be done at the time of development when the building densities are known. An additional 10% for future growth is recommended at that time.

Water Supply Requirements are identified by MMCD, SLRD and FUS. SLRD requirements are more conservative and have been used in the design of the systems to date as amended by the agreed occupancy that was supported by the SLRD's Master Plan reviewing engineering consultant, Dayton & Knight Consulting Engineers in their letter to the SLRD of June 3, 2008. The Requirements are detailed in SLRD's Subdivision and Development Services Bylaw No 741, 2002 which has been amended via Bylaw 953 in 2005. All buildings within Furry Creek were required by the design guidelines initiated by the developer in 1993 to be sprinklered. SLRD required sprinkling under their Bylaw 879 in 2003. All buildings in the community will be sprinklered which affects fire flow and storage requirements. Fire separation would be used to limit the maximum size of building areas. Concrete will be used in buildings over 6 stories. Fire flow demand is to be based on the latest edition of "Water Supply for Public Fire Protection – A Guide to Recommended Practice", by the Fire Underwriters Survey (FUS) as prequalified by SLRD bylaw section 3.1.4.5 detailed below.

The key demand requirements are as follows:

3.1.4.5 Fire Flow Demand

1. Fire flow demand will be based on the latest edition of “Water Supply for Public Fire Protection – A Guide to Recommended Practice”, Fire Underwriters Survey.

2. The following minimum fire flows will be provided where the development is not protected by automatic fire sprinklers:

single family and duplex	60 l/s
2 story multifamily	90 l/s
3 story multifamily	120 l/s
1 or 2 story school	90 l/s
3 story school	120 l/s
commercial and institutional	150 l/s
industrial	200 l/s

3. If buildings are provided with automatic sprinkler systems protecting the entire building, the minimum fire flow may be reduced to the greater of:

(a) the minimum fire flow calculated in accordance with the Fire Underwrites Survey Guide allowing for automatic fire sprinklers; or

(b) the minimum flow required to support the automatic fire sprinkler systems plus all other water requirements for fire fighting purposes on the development.

4. If a water main is extended, it must be sized to provide the appropriate minimum fire flows to each existing land use fronting the extended main in accordance with the above, or, the size shall be based on the type of development permitted by the current zoning on each fronting property.

All of the development buildings, including dwelling units, are to have automatic sprinkler protection and apartment style multi family and large ground oriented multi family would have fully monitored alarm systems. Also, the zoning will require that buildings over 6 stories will be of concrete construction. The required fire flows have been calculated on the basis of the Underwriters Survey for the building areas and occupancies being serviced or the fire flows listed in 3.14.5.2, whichever is greater. These fire flows would be recalculated at the time of development to reflect the actual proposed development scenario as well as potential future infill development of 10%.

3.1.4.6 Water Pressure

maximum allowable pressure	1,035 kPa
minimum pressure at peak hour demand	300 kPa
minimum pressure with fire flow and maximum day demand	150 kPa

3.1.6.2. Reservoir Capacity

Reservoir capacity shall be not less than the greater of:

- the one-day average annual consumption for the service area, or
- the total Storage Requirement A+B+C where:

- A = Fire storage to meet the Fire Underwriters Survey Guidelines with not less than the fire flows for the highest fire demand in the service area as specified in these design criteria.
- B = Equalization Storage of 25% of maximum day demand of service area.
- C = Emergency Storage of 25% of A + B.

3.1.7 Pump Stations

Pump stations, where required, shall be designed to suit the particular circumstances. Pump stations shall be designed to meet maximum daily demand with the largest pump out of service and balancing storage on line.

The actual pipe sizing, reservoir sizing and elevations will be driven by the final layout of buildings, building size and building type. The current expectation is that the total number of units is fixed, however the actual distribution between neighbourhoods may adjust over time as well as the building size and type. It is understood that each phase will require passing through a process of Development Permit, Subdivision and Building Permit. At this time, it will be a requirement to prove out the adequacy of servicing and ensure the lands are safe for their intended purpose. The Masterplan does not include detailed calculations or design but does provide general expected sizing and demands in the communities. The size of reservoirs has been determined by the domestic demand for the servicing area based on assumed number of units as well as the largest area in a fire protection zone to SLRD standards. At the time of the reservoir design, detailed calculation will be made based on the number and type of units planned at that time. These will be determined as each new subdivision is brought forward.

The preliminary sizing of mains, booster and reservoir are shown in Figure 5, Figure 6 and Figure 8.

Oliver's Landing

The existing 56 townhouses are serviced by a watermain in existing Zone 1a-80 m HGL Zone fed by Reservoir 1 and reduced by PRV 1b & 1a. There is adequate storage and pressure to complete the remaining townhouse units on lot 1 as well as the mixed commercial/residential on lot 4 with no upgrades.

Lot 2, Waterfront South

Lot 2 is on the waterfront to the immediate south of Furry Creek. It will be accessed by a bridge from Oliver's Landing. To loop the system, the Oliver's Landing watermain will be extended across the bridge and connected with a watermain installed under the highway and the railway from the south entrance which was installed at the time of the interchange. The intent is to develop this area as a series of mid-rise apartments. There is adequate storage and pressure for this unit from the existing Reservoir 1 in the 1a-80 m HGL Zone.

Marina Neighbourhood (Hunter Laird Parcel 2)

The Marina Neighbourhood is immediately to the North of Oliver's Landing and is accessed by the public road that crosses the rail and has elevations from 5-20 metres. The watermain in the 80 HGL Zone is currently extended to the parcel edge. The proposed development is a series of mid to low rise apartment buildings. There is adequate storage and pressure for this unit from the existing Reservoir 1 in the 1a- 80 m HGL Zone.

Northwest (Hunter Laird Parcel 4)

The Northwest (NW) neighbourhood is in the Northwest Corner of the site west of the highway. It will have access off Howe Sound Drive via an intersection that was roughed in at the time of the interchange construction. This will be a combination of uses with the potential for duplex, resort, townhouse, low rise and mid-rise apartments. The elevations for development range from 35 metres to 150 m. A booster station will be required which was identified as Booster Station Number 4 in Hunter Laird Report. This is labelled as Booster Station 1, at an approximate elevation of 95 m. This may reside on lands owned by Fine Peace adjacent to Howe Sound Drive on the east or the west or in the MOTI ROW. Hunter Laird identified a future reservoir on Crown lands to the north. The current development plan is to extend a bridge across the highway from the NW to the Northeast (NE) to provide access to the NE neighbourhood. The watermain from the booster would be extended to a new reservoir in the NE labelled as Reservoir 2 with a TWL of approximately 195 m. PRV 2a may be required to regulate pressures to 125 m HGL in the lower portion of the NW and thus connected to zone 1. The remainder of the NW will be considered part of Zone 2. The Booster 2 will be sized to accommodate the MDD flows of the upper NW and all of NE per SLRD requirements. The final calculation will be updated as the details of the final development needs are established. Watermains will be designed to accommodate the greater of MDD or PHD plus Fire flow in the area per SLRD requirements.

Northeast

The Northeast (NE) lands are across the highway from the Northwest (NW) lands and immediately below the Mountain Neighbourhood. The lands were shown as being accessed from the Mountain area in previous planning exercise. Creus has met with MOTI to discuss the potential for a bridge crossing Highway 99 from the Northwest. It is viewed that this is more efficient from an access and servicing perspective and results in less clearing and earthworks. MOTI indicated they did not see an obvious reason not to consider this option and have requested that further design work be done. The NE neighbourhood would be serviced by Reservoir 2 and would be in the Zone 2-195 HGL zone.

Collector

The Collector Neighbourhood is the area along the currently dedicated Sea View Drive which provide access to Reservoir 1. The route was graded to allow for the installation of the watermain to the reservoir. This neighbourhood is proposed for a mix of uses including townhouse, low and mid-rise apartments, community space and fire hall. This land is within Zone 1 and has adequate pressure and flow from Reservoir 1 in Zone 1-125 HGL. Note there is a portion of the lands in the collector that have development potential that would be at the limits of the 125 m HGL. This could be addressed by having that main be from above Booster Station 3 and be looped back into the collector via PRV Station 3a.

Resort/Clubhouse

The final location and massing of the resort is still to be resolved. It is expected to be located within Zone 1. If it is massed as a large unit it may trigger a larger fire flow than is currently allowed. This can be addressed by adding a cell to the existing Reservoir 1 which was allowed for in the reservoir design and would be part of Zone 1-125HGL. If the resort is built after Reservoir 3 is constructed, that would not be necessary. As well if the waterfront is built-out

prior to another reservoir coming on line the existing Reservoir 1 could be slightly under capacity. Hunter Laird has indicated “ As increasing the size of the reservoir for the small amount of the shortfall (135 cu.m.) would not be practical and considering that the Golf Club House would not likely have a maximum day demand simultaneous with a fire at the Clubhouse, the current reservoir storage capacity is deemed adequate to service the lower pressure zone service areas. As soon as either Reservoir 2 or 3 is constructed, the small shortfall in capacity would be more than offset with the total combined capacity of the storage reservoirs.” This would be reviewed as each subdivision is brought forward this would be reviewed in detail.

Uplands (Hunter Laird Parcels 6 & 7)

The Uplands are above the existing Reservoir 1 along an extension of Sea View Drive on both the North and South sides of the Hydro Transmission ROW. There would be a Booster Station 3, approximate elevation 125 m in the area of the existing Reservoir 1 which would pump to a future Reservoir 3 with an approximate TWL of 280 m. This is proposed to have a separate high-pressure fill line for the first approximately 700 metres to avoid excessive number of booster pump stations. This would trigger the need for PRV 4 at approximate elevation of 180 m. The size of the reservoir would be dictated by the largest unit to be protected for fire protection. This would service Uplands South.

Booster Station 4 at approximately 250 m would pump to reservoir 4 at TWL of 400 m. Again, the first 500 m would be a dedicated high-pressure fill line to avoid excess booster stations. This is consistent with Hunter Laird recommendation of having pump station service two zones. This would service the units in Uplands North. In order to boost circulation a loop would be constructed between Uplands North and Uplands South which would trigger a PRV 4b at approximate elevation of 225 m.

Mountain

The Mountain area is immediately west of Uplands North with the highest developable area at an elevation up to 370 m. The area can be serviced by Reservoir 4 at TWL of 400, which would meet the fire protection demands.

Porteau Bluff Lands

There are 3 single family lots proposed at the southwest corner of Stonegate Drive and Furry Creek Drive. These are within Zone 1-125 TWL and have adequate pressure and flow from Reservoir 1.

Upper Benchlands (Hunter Laird Parcel 8)

The Upper Benchlands are located immediately east of the BC Hydro lines to the east of the existing Stonegate Neighbourhood with lands both north and south of South Creek. It is accessed by an extension of Stonegate Drive. There is an existing 250 mm main that was designed to be extended to service those properties. Stonegate is currently serviced by Booster station 1 on the south side of Stonegate Drive east of Furry Creek Drive. Depending on the final extents of development, this could service a first phase of units north of the creek immediately above the BC Hydro ROW at elevation of approximately 125 metres. If additional development is to proceed the booster station would be adapted to pump to a Reservoir 5. The location of Reservoir 5 would vary depending on the extent of the development. This may be serviced by an adapted Booster Station 1 or alternately if the development is more extensive, Booster

station 5 may be required. The addition of a reservoir will likely trigger the need for a PRV to protect the lower lots along Stone Gate drive. Its location would be driven by the location of the reservoir. The preliminary sizing of mains, booster and reservoir are shown in Figure 5, Figure 6 and Figure 8.

Future Study Areas

The original PLA indicated development in the Highlands Area at the East end of the property between Phyllis and Furry Creek. It would require an additional reservoir and require upgrades to Pump station 4. At the time of the Uplands Development, the pump station will be designed to accommodate future changes is that is viewed as viable. Alternately further development in the Mountain area is possible. This would not change the pump station, but could affect the size of Reservoir 4. This would be reviewed at the time of those developments.

General

The elevation gains will require 10 pressure zones depending on final configurations and development extents. These are to be managed with pressure reducing stations to keep distribution mains to within domestic pressure requirements. The actual fire flows, fire storage and duration of fire require the fixed size of units and number of buildings. These will be determined on a phase by phase basis.

Key pieces of infrastructure include the following reservoirs in Figure 5 below. The reservoir would be required to be designed per section 3.1.6.2 of the bylaw and include Fire Storage to meet FUS guidelines, Equalization storage of 25% of maximum day demand of service area and emergency storage of 25% Fire and Equalization. The final size and number of buildings is required to calculate the reservoir storage.

Infrastructure Element	Elevation (m)	Lands Served	Approx. Storage requirement (m3)
Existing Reservoir 1	TWL 125	Oliver’s, Benchlands, Porteau, Collector, Marina, Waterfront, Clubhouse	Existing 1475
Reservoir 1a	TWL 125	Only if Storage and Equalization requirements exceed the current capacity prior to further reservoir being added	+/- 545
Reservoir 2	TWL +/-195	Northwest and Northeast	+/-1205
Reservoir 3	TWL +/-280	Uplands South, Collector North	+/- 1235
Reservoir 4	TWL +/- 400	Uplands North, Mountain	+/-1164
Reservoir 5	TWL +/- 245	Upper Benchlands	+/- 1164

Figure 5: Reservoir Sizing

Pump stations will be designed to provide sufficient capacity to pump maximum daily flows of the built-out area and are shown in Figure 6 below. The Maximum day demands can not be determined until number of units and sizes are determined. The pump stations are arranged to cross no more than one pressure zone.

Infrastructure Element	Elevation (m)	Lands Serviced	Min Pump Capacity l/s	Vertical Head (m)	To Reservoir
Existing Booster 1	95	Stonegate	4.92		for Zone 5a and to future Booster 5
Booster 2	+/- 95	Northwest and North East	+/-4.5	100	Reservoir 2
Booster 3	125	Uplands South	+/- 7.8	155	Reservoir 3
Booster 4	250	Uplands North, Mountain	3.1	150	Reservoir 4
Booster 5	150	Upper Benchlands	+/-3.0	95	Reservoir 5

Figure 6: Booster Pump Capacity

To maintain the domestic distribution pressures Pressure Reducing Valve stations will be required as detailed below in Figure 7. Based on the current assumptions this would be required in the following locations.

The capacity of the PRV will be determined by the potential fire demand of the lower pressure zone which the PRV would feed. To calculate the flows the building sizing and final reservoir placement would be required.

Infrastructure Element	Elevation (m)	Lands Serviced	HGL(m)
PRV 1a, 1b	10	Existing, Oliver's, Marina, Waterfront	80
PRV 1c	10	Waterfront	80
PRV 1d	25	Lower Collector, if required	80
PRV 2a	95	NW Lower	125
PRV 2b	95	NW lower	125
PRV 3a	125	Lower Uplands South, Upper Collector	125
PRV 3b	175	Lower Uplands North and Upper Collector	225
PRV 4a	250	Uplands North	280
PRV 4b	240	Upland South Lower	225
PRV 4c	300	Uplands North Upper	325
PRV 5	150	Stonegate	245

Figure 7: PRV HGL

This would lead to the following Pressure zones in Figure 8 below.

Zone	HGL	Building Ground Elevation	Static Pressure Range	Neighbourhood	Backbone Main Distribution Size	Service by Reservoir
1a	80 m	5-36 m	450-750 kPa	Marina, Oliver's, Waterfront,	250	1
1	125 m	25-93 m	300-980 kPa	Clubhouse, Collector, Lower Benchlands	Ex.350 from Res.to 300 to 250	1
2	195 m	95-150 m	430-965 kPa	Northwest, Northeast	300	2
3a	225 m	125-180 m	440-980kPa	Upland South Lower and Upper Collector if required	300	3
3b	280 m	179-245 m	325-990 kPa	Uplands South	300	3
4a	325 m	240-275 m	490-830 kPa	Uplands North	300	4
4b	285 m	250-190 m	335-930 kPa	Uplands North	250	4
4c	400 m	320-365 m	330-780 kPa	Mountain	300	4
5a	180 m	80-125 m	535-980 kPa	First Phase of Upper Benchlands using the existing system	250	Existing Booster 1 Fire Pump
5b	245	160-215 m	350- 910 kPa	Upper Benchlands if reservoir is triggered	250	5

Figure 8: Pressure Zones and backbone Distribution Main sizing

2.4. FIRE PROTECTION

Furry Creek is served by the Britannia Beach Volunteer Fire Department (BBVFD), under the direction of Fire Chief David Rittberg. BBFD provides exterior structural fire suppression, vehicle fire response and interface fire assistance to Furry Creek under the authority of SLRD Establishing Bylaw 1032-2006. This service covers Britannia Beach, Furry Creek and the non-wildfire interface portions of Porteau Cove. The BBVFD boasts a healthy, 28-member roster. Of these, 5 members (including the Chief) reside at Furry Creek. There are currently discussions underway with Lions Bay and District of Squamish to provide Mutual Aid in the event of emergency need.

The existing SLRD owned water system is designed to meet FUS requirements for pressure, flow, volume, hydrant spacing and emergency service vehicle access. New phases of the community will continue to meet these requirements. The BBFVD is however, trained and equipped to pump and shuttle water for interface needs if required. The department is also trained to draft from any surface water sources, including the ocean, if necessary.

Under the terms of the Upland Covenant, the developer is obligated to provide a site and contribute to the funding of a future Fire Hall. The developer is also prepared to contribute to the

funding of new equipment, and training and support to provide firefighting services for taller buildings, as proposed within the community.

Furry Creek has historical precedence for sprinkler protection and it is required under sprinkler bylaw 879 – 2003 mandating fire sprinklers in all buildings including all existing buildings on site. Existing fire safety reports and bylaws are included in the Appendix 17:. The existing community enjoys a Dwelling Protection Grade (DPG) of 3A. It is understood that the intent would be not to lower the existing protection of resident, but also not unduly burden them financially.

A report by Jack Blair and Doug Dymond has been submitted to SLRD. Jack Blair is familiar with the site and had previously prepared a fire safety report for the SLRD in 2013. Their preliminary findings indicate that a Mutual Aid Agreement with the District of Squamish and possibly Village of Lions Bay should be entered as per the original intention at the start of the development. This has been met with generally positive feedback with both municipality Fire Chiefs. Concerns have been raised on expansion of the system to address taller buildings. Lot 4 in Oliver's landing is currently zoned for 4 stories. Porteau Cove has zoning for up to 6 stories. To meet fire requirements for building over 6 stories additional equipment and training is required as well as needing a new fire hall to meet distance requirements. Fine Peace has indicated a willingness to provide the financial resources required. There will also be a program to encourage staff to become members of the BBVFD. This does not address the forces' current exterior attack status and concerns in regards to expanding their obligation towards interior attack until certain thresholds are met.

Discussions have also taken place with the Sicamous Fire Department (FD) as to their operating guidelines for tall building response as they have a 7-storey building and are a very small department with just 1 paid member. The Sechelt FD is quite a small department and it has a 6-storey building within its jurisdiction. The Parksville FD has to deal with a 10-storey concrete building and the Big White FD has a 9 storey older building within its jurisdiction. Discussions will also take place with Harrison Hot Springs and other volunteer fire departments that must attend to taller buildings.

A number of additional fire safety design features were identified in the Jack Blair report and will be considered to help address possible fires in taller buildings. They include video cameras on each floor and intercoms on every 2 floors. In this way, when the FD arrives at the annunciator panel, they can see video of the floor in question and begin a size up and Incident Action Plan without going up to the floor. This could work very well at Furry Creek as the FD could implement some actions while awaiting Squamish FD and Lions Bay FD. The Blair report also identified the need to address interface fires and Fire Smart goals are addressed in the design guidelines that have been submitted to the city. In May of 2020, the SLRD has retained a fire consultant to review the proposed emergency services in the Howe Sound East area. Further Feedback was provided that resulted in concept plans for the Firehall to be located in the Collector neighbourhood.

3. CONCLUSION

The proposed zoning of the lands is largely consistent with the original plans, engineering and Preliminary Layout Approval. The development zones have not changed. The original vision for the community was 920 residential units in single and multi-family format, golf course, resort,

commercial amenities and a commercial marina. This has evolved to 920 residential market units, 120 additional non-market units, a commercial village centre and resort facilities.

All water supply and engineering reports have been updated. There is adequate licensed water supply for the build out and a design in place with tenure to lands to build it.

The Furry Creek development is consistent with the SLRD Official Community Plan (OCP) and Regional Growth Strategy. As per the OCP, "The objective for the Furry Creek Neighborhood is to continue to recognize the Planned Community designation, and encourage adequate provision of community facilities and public open space as development proceeds." The proposed development fits well within in this objective. The proposed development zones are consistent with the original planning and have the support of the environmental, geotechnical, traffic management, landscaping and civil infrastructure consultants in confirming they are suitable for their intended use.

The development as shown is viable and can be designed and constructed using standard engineering design and construction standards.

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4. APPENDICES

- Appendix 1: CONTEXT PLAN
- Appendix 9: REZONING PLANS
- Appendix 10: INFRASTRUCTURE AND ROAD PLANS
- Appendix 11: SUMMARY OF REPORTS ON WATER
- Appendix 12: VCH WATER PERMIT
- Appendix 17: FIRE PROTECTION STUDIES
- Appendix 23: SLRD RESPONSE MAY 01, 2020