

Qualicum Bay - Horne Lake Waterworks District
234 Lions Way
Qualicum Beach, BC V9K 2E2

October 5, 2018
File: 2231-34508-01
email: QBHLWater@shaw.ca

Attention: Leigh Campbell
Administrator

Dear Ms. Campbell

**Re: Capital Expenditure Charge Bylaw Updates:
2014 Water System Evaluation Report Update**

McElhanney Consulting Services Ltd (McElhanney) was retained by the Qualicum Bay Horne Lake Waterworks District (the District) to review and provide updates to the 2014 Water System Evaluation Report (MCSL, 2014).

The work was carried out in general accordance with our proposal dated February 20, 2018. Written authorization to proceed was provided by the District on March 8, 2018.

In general, the District would like to review the system upgrade projects identified in the 2014 Water System Evaluation Report and confirm adequate funds are being collected for future works identified. Preliminary report findings were presented to Trustees on August 28, 2018. Trustee comments were received and have been incorporated.

This update report should be read in-conjunction with the 2014 Water System Evaluation Report. The following 2014 report sections have been updated and for consistency report number remains the same:

3.0 WATER DEMAND

3.1 HISTORICAL WATER USE

All three wells are fitted with a meter located in the pump house. Flows are recorded daily and logged by the District XiO Cloud SCADA System since middle April 2015. The data has been downloaded from April 2015 to April 2018.

In addition, monthly flows from 2012 to 2017 were also provided by District staff. Some data gaps were noted, and for the period between April 2015 and April 2018. Refer to Appendix "A" for a summary of SCADA system meter records.

A summary of monthly consumption from 2012 to 2018 is presented in Figure 3.1.

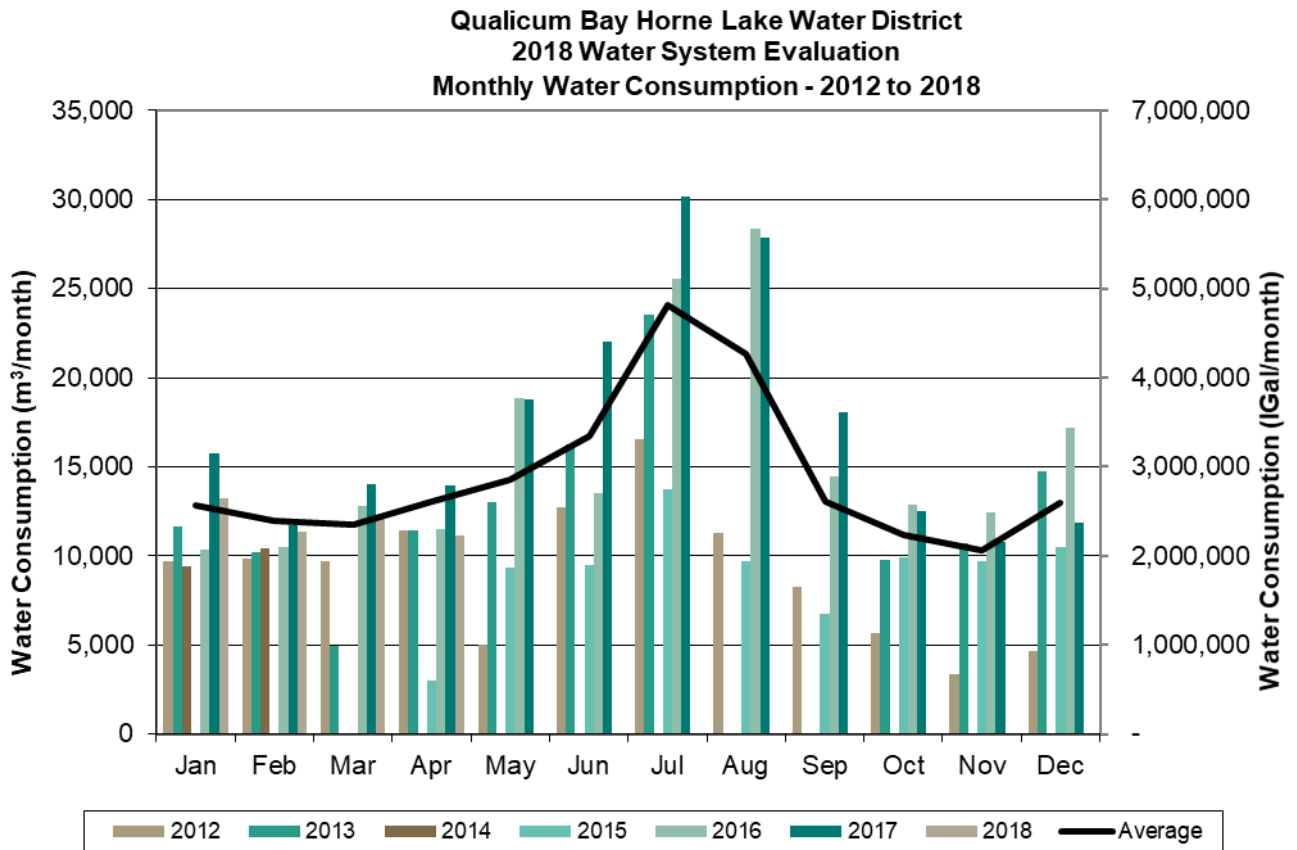


Figure 3.1 - 2012 to 2018 Water Consumption

Water consumption is lowest from October to April each year, while consumption rates are highest in June, July and August. Summertime water consumption is typically 2 times greater than wintertime consumption. This is consistent with the previous 2014 Report.

3.2 EXISTING POPULATION

The serviced population for the District is estimated to be 1,157 persons based on 559 households and an average household population of 2.07 persons (household information provided by the District). Population density is calculated based on statistics from the 2016 Census for both Qualicum Bay and Deep Bay/Bowser as presented in Table 3.1.

Area	Qualicum Bay 2016 Census Data	Deep Bay / Bowser 2016 Census Data	Qualicum Bay Horne Lake District Calculated
Population	438	1729	1,157
Total Private Dwellings	209	846	559
Population per Dwelling	2.10	2.04	2.07

Based on the information above, there is an estimated increase in calculated population of approximately 407 persons from the 2014 Report. This increase is due to growth in both the area and a more accurate count of secondary residents on single metered lots.

3.4 SYSTEM LOSSES

System losses were calculated by comparing meter readings at the well head with meter readings at lot services for the period 2009 to 2017. A summary of that comparison is presented in Table 3.2.

Year	Individual Meters m³	Well Reading m³	Losses m³	Percent Loss
2009	151,000	171,000	20,000	12%
2010	157,000	170,000	13,000	8%
2011	152,000	161,000	9,000	6%
Average from 2009 to 2011				8%
2013	163,000	--	--	--
2014	154,000	--	--	--
2015	175,000	--	--	--
2016	140,000	188,440	48,000	26%
2017	135,000	208,685	74,000	35%
Average from 2016 to 2017				30.5%

**Available well reading data were not integral for the whole year in 2013, 2014, 2015.*

From the 2014 Report, the average system loss were about 8% during 2009 to 2011. However, the current data shows an average of 30.5% over 2016 and 2017. This is an abnormal value.

It is noticed that the average individual metered flow for 2016 and 2017 dropped dramatically by approximately 13% compared to the average individual metered flow during 2009 to 2014. This suggests some flows in the system were not metered. The individual metered flow data should be review with the District.

3.5 SYSTEM DEMAND RATES

Water Demand for the system was calculated using available data from 2005 to 2017. Calculated rates are presented in Table 3.3.

Demand	Description	Demand Rate L/s	Daily Demand per Capita L/cap/day	Ratio to ADD
Average Day Demand ADD	Average rate of consumption in a given year. Based on well meter data from 2005 to 2011 and from 2016 to 2017	5.8	517	1.0
Maximum Day Demand MDD	Consumption for the single highest demand day of the year (July 15, 2015). MDD provides an indicator of the required well supply rate.	14.9	1328	2.6
Peak Hour Demand PHD	Consumption for the single highest demand hour per year. PHD is used to identify reservoir requirements.	*23.2	*2069	*4.0

*Calculated values based on typical ratios to ADD for similar communities.

Table 3.4 provides a comparison of the District's water system demand rates to a range of standards from other municipal water systems on Vancouver Island.

Standard	Average Day Demand L/c/day	Max Day Demand L/c/day	Peak Hour Demand L/c/day
City of Nanaimo	455	1135	1820
Capital Regional District	545	1363	1908
Master Municipal Construction Documents (MMCD)	600	1200	1800
Qualicum Bay Horne Lake District	517	1328	2069
City of Campbell River	635	2100	3000

Demand rates for the District are in the range of rates for other jurisdictions. In addition, the above tables indicate a decrease in demand when compared to the 2014 Report.

3.6 PROJECTED WATER DEMANDS

3.6.1 Maximum Future Population

The design population is calculated by multiplying population density (expressed as persons per dwelling unit or ppdu) and the number of services. Future domestic water demand is calculated based on the growth potential for the entire District service area. The population at “Build-out” is estimated based on the maximum allowable subdivision density as listed in the Regional District of Nanaimo’s Official Community Plan (Bylaw No. 1335).

There are currently 18 zones within the District and calculation of the Build-out population based on current zoning is presented in Table 3.5.

TABLE 3.5: MAXIMUM FUTURE POPULATION ESTIMATE					
Description	Zoning	Area	Min. Lot Size	Max. Residential Dwellings	Maximum Future Population At 2.07 persons/dwelling
		Ha	Ha		
Horne Lake Development	CD32Z	1.1	-	19	39
Qualicum Bay Seniors	CD41F	1.9	-	25 (assumed)	52
Crown and Anchor Campground	CD42	1.7	-	1	2
Commercial 1	CM1B	0.6	0.05 (residential)	12	25
Commercial 2	CM2M	0.3	0.1 (Office)	3	6
Commercial 4	CM4M	0.5	0.2	2	4
Commercial 5	CM5Z	27.5	0.16 (Retail)	200 (assumed)	414
Industrial 1	IN1M	5.7	0.5	-	
Industrial 2	IN2D	2.2	0.6	-	
Public Use 1	PU1M	10.6	0.1 (Public Utility)	-	
Public Use 6	PU6Z	46.1	-	-	
Recreation 1	RC1Z	3.2	1	-	
Resource Management 1	RM1V	187.2	0.5 (Aquaculture)	-	
Residential 1	RS1N	2.7	0.16	16	33
Residential 2	RS2M	145.1	0.2	725	1501
Residential 3	RS3M	3.5	0.2	17	35
Residential 6	RS6D	2.3	2	1	2
Rural 1	RU1Z	504.6	8	63	130
TOTAL					2244 persons

No changes to the Zoning have been noted since the 2014 Report. However, and overall increase in population is noted based on persons per dwelling.

3.6.2 Projected Population Growth

Table 3.6 provides a calculation of the recent historical population growth rate for Qualicum Bay and Deep Bay/Bowser based on statistics available from the Census of Canada website (<http://www12.statcan.gc.ca>).

TABLE 3.6: HISTORICAL POPULATION & GROWTH RATES					
Area	Description	Year			
		2001	2006	2011	2016
Qualicum Bay & Deep Bay/Bowser	Population	1682	1882	1947	2167
	Annual Growth Rate	-	2.3%	0.7%	2.2%
Average Annual Growth Rate – 2001 to 2016:					1.7%

Based on the RDN Regional Growth Strategy, historical growth rates and economic conditions, we have assumed the projected population growth rate of 2.0% per annum. The maximum “build out” population will be reached in approximately 34 years, or in the year 2052. This remains consistent with the 2014 Report.

3.6.3 Projected Water Demand

Projected domestic water demand for the next 20 years is presented in Table 3.7 and is based on the current zoning, rates of consumption, peaking factors and projected growth rate.

TABLE 3.7: PROJECTED POPULATION & WATER DEMANDS						
Years		0	5	10	15	20
Year		2017	2022	2027	2032	2037
Population		1157	1277	1410	1557	1719
ADD	L/day	600,000	660,000	730,000	800,000	890,000
	lgal/day	130,000	150,000	160,000	180,000	200,000
MDD	L/day	1,540,000	1,700,000	1,870,000	2,070,000	2,280,000
	lgal/day	330,000	390,000	410,000	460,000	510,000
PHD	L/day	2,400,000	2,640,000	2,920,000	3,200,000	3,560,000
	lgal/day	520,000	600,000	640,000	720,000	800,000

4.0 SYSTEM ANALYSIS

4.3 EXISTING DISTRIBUTION SYSTEM

The existing water model was updated to reflect system upgrades completed since 2014. Updated are the following:

- The existing 100 mm and 150 mm diameter AC lines on Leon and Kenmuir Road are replaced with a 250 mm diameter PVC main;
- Activated the twin line from the reservoir to the crossing of Horne Lake Road and railway Right of Way.

No other updates are noted.

4.3.2 Current System Performance

After the model was updated, three demand scenarios were run to evaluate the updated system performance. Results were compared to the criteria identified in the 2014 Report.

Demand Scenario 1 – Current System with Current Peak Hour Flow

The current peak hour flow is 23.2 L/s as per Table 3.3.

The results of the existing domestic Peak Hour Demand (PHD) analysis indicate the residual pressures in the system are above the minimum value of 275 kPa (40 psi). There are three areas with pressure less than 400 kPa (60 psi):

1. Linx Road (west end)
2. Cochrane Road (south end), and
3. Horne Lake Road (south of railway).

Compared to the 2014 Report, the flow in Dunsmuir Road was improved.

Demand Scenario 2 – Current System with Year 2037 Peak Hour Flow

The projected PHD in Year 2037 (20yrs) is estimated to be 3,560,000L/day or 41.2 L/s, representing a 78% increase over existing demands. The 20-Year PHD analysis provides residual pressures that are similar to current operation. Pressure is maintained above the 275 kPa (40 psi) minimum. There are five areas with pressure less than 400 kPa (60 psi). Three areas among the five areas are the same areas mentioned in Demand Scenario 1. The other two areas are:

1. Charlton Drive (west end) and
2. Dunsmuir Road (most southerly node).

Demand Scenario 3 – Current System with Year 2037 Maximum Day Demand and Residential Fire Demand

A fire flow of 60 L/s for single family residential development was used. In general, fire flow is not available at 60 L/s throughout the District. The available fire flow is less than 30 L/s for areas north of Qualicum First Nation.

Compared to the 2014 Report, the improvement is seen in areas on the Island Highway south of Draft Road. Fire flows are now more than 30 L/s. Previously, available fire flows in these areas were less than 30 L/s.

4.3.3 Modelling Summary

In summary, the existing system can meet Peak Hour Demand with satisfactory pressure under current and Year 2037 conditions. System improvements are required to meet minimum firefighting standards.

4.4 PROPOSED DISTRIBUTION SYSTEM IMPROVEMENTS

Improvement Scenario 1 – Retain Existing Layout and Increase Pipe Sizes

The following system improvements were previously proposed:

- Replace the existing 200 mm diameter line on Horn Lake Road from the rail road track south of Berkshire Road to Huson Road with a 300 mm diameter main. Total length of main replacement is 350 metres;
- Replace the existing 100 mm and 150 mm diameter AC lines on Leon, Kenmuir, Huson and Highway 19A with 250 mm diameter main to create a continuous loop. Total length of main replacement is 850 metres (*Leon and Kenmuir has been constructed*);
- Replace the existing 150 mm diameter line on Highway 19a from Kenmuir Road south to Van Isle Road with a 200 mm diameter main. Total length of main replacement is 1,100 metres; and,
- Replace the existing 150 mm diameter line on Highway 19A from Huson Road north to Charlton Road with a 250 mm diameter main. Total length of main replacement is 4,200 metres.

After the model was revised as per above improvements, the results indicate that the majority of the system is satisfied for Year 2037 Maximum Day Demand plus a residential Fire Demand of 60 L/s. For all the hydrants, the available fire flows are more than 45 L/s except for the hydrants located along Cochrane Road.

In order to improve the fire flow along Cochrane Road, it is recommended to replace the existing 100 mm diameter line along Cochrane Road and Welch Road with a 150 mm diameter main. Total length of main replacement is 485 metres.

Improvement Scenario 2 – Construct a Watermain on Bradshaw Road and Increase Pipe Sizes

The following system improvements were previously proposed:

- Install a new 200 mm diameter line on Bradshaw Road from Dunsmuir Road to Highway 19A. Total length of new main construction is 1,700 metres.
- Replace the existing 200 mm diameter line on Horn Lake Road from the rail road track south of Berkshire Road to Huson Road with a 300 mm diameter main. Total length of main replacement is 350 metres;
- Replace the existing 100 mm and 150 mm diameter AC lines on Leon, Kenmuir, Huson and Highway 19A with 200 mm diameter mains to create a continuous loop. Total length of main replacement is 850 metres (*Leon and Kenmuir has been constructed*);
- Replace the existing 150 mm diameter line on Highway 19A from Huson Road north to Charlton Road with a 200 mm diameter main. Total length of main replacement is 4,200 metres.

After the model was revised as per above improvements, the results indicate that the system in south of Qualicum First Nation is satisfied for Year 2037 Maximum Day Demand plus a residential Fire Demand of 60 L/s. However, the available fire flows north of Qualicum First Nation ranges from 34 L/s to 59 L/s.

In addition, similar to the results of Improvement Scenario 1, the available fire flows along Cochrane Road are less than 30 L/s. In order to improve the available fire flows, it is recommended to:

- Replace the existing 150 mm diameter line on Highway 19A from Huson Road north to Charlton Road with a 250 mm diameter main rather than 200mm main mentioned above. Total length of main replacement is 4,200 metres;
- Replace the existing 100 mm diameter line along Cochrane Road and Welch Road with a 150 mm diameter main. Total length of main replacement is 485 metres.

However, as indicated in the 2014 Report that the north end of the QBHL has a connection to the Bowser Waterworks District via a watermain that crosses the Nile River along Highway 19A.

This connection is provided with a normally closed valve that can be opened to provide flow in either direction in case of emergency.

If this manually operated valve could be replaced with a control valve that would open automatically under low pressure flow conditions, then the diameter of the proposed replaced water line on Highway 19A from Huson Road north to Charlton Road might still be 200mm.

5.0 CONCLUSIONS

A summary of conclusions is presented below:

1. Source water is potable without disinfection but has high manganese content. No change from the 2014 Report.
2. The District should plan for AC watermain replacement and adopt a program that includes the installation of larger replacement mains to improve system capacity. No change from the 2014 Report.
3. Average daily water consumption is 517 litres per capita per day. This represent a decrease from the 2014 Report. This consumption still remains within the range of other similar jurisdictions;
4. Summertime water consumption is approximately 2.0 times greater than wintertime consumption. This remains consistent with the 2014 Report.
5. The system currently serves approximately 1,157 people. That service population is projected to grow to 1,719 by Year 2037. The ultimate build-out population within the District based on the current Official Community Plan is 2244 people.
6. System loss was previously calculated at 8%, which indicated a “tight” distribution system. However, 2016 / 2017 data shows a significant increase. This could be attributed to data collection records.
7. The current well supply has adequate capacity to handle projected growth to Year 2037 for Maximum Daily Demand. This remains consistent with the 2014 Report.
8. The existing reservoirs do not have adequate storage capacity to service the Year 2037 population with fire storage for single family residential development.
9. Additional investigation is required to find the cause of high system head losses in the vicinity of Leon, Marshal and Dunsmuir Roads, and on Highway 19A between Lions Way and Charlton Road. No change from 2014 Report.

10. The existing distribution system can deliver Peak Hour Flows with satisfactory system pressures for both the current population and the projected Year 2037 population. This is consistent with 2014 Reporting.
11. The existing distribution system cannot deliver a fire flow of 60 l/s plus current Maximum Day Demand throughout the service area. This is consistent with 2014 Reporting.

6.0 RECOMMENDATIONS

Based on our review of the updated information provided, computer modelling and discussions with District Staff, we recommend the following system improvements. Each project has been assigned a schedule of priority focused on strengthening the system to improve domestic water supply and improve residential fire flows.

1. Project #1 – Groundwater Study

There is limited information on long term well capacity. Existing available information dates from 1993 to 2006 and is not formalized. As such, it is recommended a Groundwater Hydrologist is retained to undertake pumping tests of all three Wells and determine the safe long term well capacity.

2. Project #2 – Water Treatment Study

Undertake a Water Treatment Study of the water supply sources to determine options for manganese (Mn) removal. Currently levels are not related to health; however, rate payers are experiencing aesthetic issues.

3. Project #3 – Watermain Investigation

Investigate the following areas to identify the nature of high head losses inferred by hydrant flow test results:

- a. Leon, Marshall & Dunsmuir Roads, and
- b. Along the Island Highway, between Lions Way and Charlton Drive.

4. Project #4 – AC Watermain Condition Assessment

In the late 1960's over 7km of AC watermain was installed. This watermain is approaching approximately 40 years old. All systems deteriorate with age and use, however performance may not be affected until deterioration is well advanced. As such, we recommend the District undertake a condition assessment of the AC pipe to identify areas that need pipe replacement.

5. Project #5 – Horne Lake Road Watermain Upgrade (300mm)

A single 200mm AC line delivers water to system from the rail road track south of Berkshire Road to Huson Road. To increase hydraulic capacity this 250m long portion of line needs to be upgraded to 300mm.

6. Project #6 – AC Watermain Replacement Program

Based on the findings from the AC watermain condition assessment, we recommend the District implement an AC watermain replacement program to address the aging infrastructure. Due to the large amount of old AC pipe in use, planning should be undertaken to replace the critical portions of the main on a yearly basis to avoid a large capital costs.

Replacement in the following areas will also improve residential fire protection:

Project #6a – Island Highway Watermain Upgrade (250mm)

This portion of watermain was installed in the late 1960's and is the primary distribution piping to the north end of the District. Replacing the 150mm diameter piping with 250mm diameter will provide firefighting capacity to the northern end of the District.

7. Project #7 – Bradshaw Road Watermain (200mm)

Construction of the Bradshaw main will improve supply to the south end of the system and increase system redundancy by providing a second feed line to compliment the 150mm on the Island Highway. A boundary extension has recently been completed in this area which will allow the District to extend service.

8. Project #8 – Manganese and Iron Treatment System

Based on the findings from the Water Treatment Study, Mn treatment may be warranted. There is a wide variety of treatment systems available to water purveyors, as such various costs. However, the existing water supply and storage area can be utilized for the preferred system.

9. Project #9 – Cochrane & Welch Road Watermain Upgrade (150mm)

A single 100mm PVC line delivers water to system from to this area. To increase hydraulic capacity for fire protection this 485m long portion of line needs to be upgraded to 150mm.

10. Project #10 – Water Storage Reservoir

An additional 87,500 litres of storage will be required to accommodate 2037year MDD and Fire storage requirements.

7.0 CAPITAL EXPENDITURE PROGRAM

Table 7.1 provides a summary of the cost estimates with pro-rated allocation between Type A (Serve Existing Customers) and Type B (Serve Future Development).

TABLE 7.8: COST ESTIMATE APPROPRIATION		
Project Description	Type “A” Serve Existing Customers	Type “B” Serve Future Development
Project #1 – Groundwater Study	\$ 16,928.00	\$ 8,228.00
Project #2 – Water Treatment Study	\$ 17,412.00	\$ 8,463.00
Project #3 – Watermain Investigation	\$ 9,056.00	
Project #4 – AC Watermain Condition Assessment	\$ 48,516.00	
Project #5 – Horne Lake Road Water Upgrade	\$ 172,811.00	\$ 83,998.00
Project #6 – AC Watermain Replacement Program	\$ 2,175,053.00	\$ 1,057,224.00
Project #6a – Island Highway Watermain Upgrade	\$ 1,821,072.00	\$ 885,165.00
Project #7 – Bradshaw Road Watermain	\$ 589,097.00	\$ 286,341.00
Project #8 – Manganese and Iron Treatment System	\$ 449,803.00	\$ 218,635.00
Project #9 – Cochrane & Welch Road Watermain Upgrade	\$ 265,434.00	
Project #10 – Water Storage Reservoir		\$ 284,338.00
TOTAL	\$ 5,565,182.00	\$2,832,392.00

Table 7.2 below provides a detailed 5yr Capital Plan breakdown for the initial recommended works.

TABLE 7.9: 5 YEAR CAPITAL PLAN					
Project	2018	2019	2020	2021	2022
Project #1 – Groundwater Study	\$25,156.00				
Project #2 – Water Treatment Study		\$25,875.00			
Project #3 – Watermain Investigation		\$9,056.00			
Project #4 – AC Watermain Condition Assessment		\$48,516.00			
Project #5 – Horne Lake Road Watermain Upgrade			\$256,809.00		
Project #6 – AC Watermain Replacement Program				\$150,000.00	\$150,000.00
TOTAL	\$25,156.00	\$83,447.00	\$256,809.00	\$150,000.00	\$150,000.00

The 5yr Capital Plan can be revised to suit the availability of funds.

7.3 PROPOSED CAPITAL EXPENDITURE CHARGES

Proposed Capital Expenditure Charges (CEC) has been prepared to suit each development type as defined in By-law No. 151 (Amending bylaw 161). Bylaw 161 was passed on January 20th, 2016. Bylaw A copy of that bylaw has been included in the Appendix C.

The proposed CEC fees are based on the following assumptions:

- 20 year projection for all projects.

The following population projections have been used:

20YR

Population 2017 = 1,157 persons
 Population 2037 = 1,719 persons
 Population Increase = 562 persons

Total CEC's = \$ 2,832,392.00 / 562 persons = **\$5,040.00 per person**

Please note that existing CEC reserve monies have not been included in the above calculation. The total CEC per person could be reduced if reserve CEC funds are available.

8.0 CLOSURE

It has been a pleasure to work with the Qualicum Bay Horne Lake Water District. We trust this document meets your requirements. If you have any further inquiries, please do not hesitate to contact the undersigned at your earliest convenience.

Yours very truly,
McElhanney Consulting Services Ltd.



Chris Pogson, P.Eng
Branch Manager,
CPogson@mcelhanney.com

APPENDIX A

SCADA METER RECORDS

Year	2017											
	January	February	March	April	May	June	July	August	September	October	November	December
Date												
1	550,524	-	442,408	426,082	455,357	587,962	955,107	941,625	864,150	433,384	352,521	362,614
2	581,327	-	432,239	512,020	629,376	614,398	1,016,659	1,071,777	870,544	398,330	362,809	312,139
3	636,396	410,648	408,052	429,539	737,172	727,919	1,150,350	1,064,915	976,545	401,939	365,769	351,981
4	579,040	452,409	488,794	489,732	464,334	784,642	870,881	1,058,720	1,040,174	423,342	385,121	365,947
5	552,374	452,833	429,159	413,434	490,430	809,254	972,622	984,699	746,759	440,523	390,706	363,607
6	560,564	413,339	421,625	456,784	457,493	777,660	1,024,098	916,010	791,616	387,215	391,985	315,001
7	576,727	463,963	461,229	506,849	508,087	788,332	985,203	1,123,887	624,175	397,995	372,719	360,861
8	583,208	440,584	443,122	497,306	783,921	586,409	1,118,803	891,914	649,575	480,698	372,037	347,447
9	489,295	445,280	416,798	443,474	412,587	578,236	1,156,880	965,096	631,294	403,257	372,775	311,586
10	561,733	573,326	495,436	507,816	769,104	694,573	1,087,731	971,938	594,264	370,621	368,724	379,167
11	529,995	498,330	465,563	429,176	508,761	746,765	992,954	893,037	675,993	520,955	379,478	372,669
12	393,032	424,892	417,190	485,632	429,831	794,695	926,756	858,707	550,180	409,116	381,745	363,365
13	533,931	501,907	459,013	456,980	508,817	638,235	973,793	791,928	674,537	659,548	373,357	368,088
14	470,903	411,838	449,667	540,713	528,455	678,891	979,662	735,170	569,795	379,037	347,834	346,107
15	475,066	436,194	438,831	540,759	489,893	526,226	947,248	780,652	626,250	383,632	356,451	316,095
16	505,447	458,549	475,686	488,234	516,784	574,648	995,770	823,479	692,283	586,281	353,363	370,587
17	511,648	411,416	439,088	511,501	503,713	627,097	1,073,432	852,985	615,292	429,815	344,804	376,212
18	530,113	488,600	484,598	497,728	526,493	581,162	824,788	780,276	520,578	379,630	365,533	362,213
19	462,342	447,828	470,358	423,800	557,913	606,634	892,655	907,180	402,150	364,987	365,080	364,148
20	505,924	412,977	428,093	503,802	637,585	584,029	788,352	845,575	438,822	300,286	310,712	362,573
21	531,425	444,845	491,932	430,583	778,849	741,418	800,523	901,862	515,252	375,823	353,252	320,123
22	469,719	493,577	419,248	503,340	714,143	821,760	744,000	772,073	527,729	382,929	358,630	368,656
23	486,129	418,914	453,920	459,873	736,044	889,338	944,347	982,731	454,998	372,212	363,894	433,027
24	434,120	454,378	455,282	494,601	768,453	912,967	948,824	885,358	516,094	357,990	291,782	405,712
25	496,391	450,122	423,494	414,119	699,877	945,472	914,848	970,144	399,227	362,748	363,593	407,807
26	472,373	425,196	494,040	425,495	772,226	885,134	969,063	860,790	382,727	315,806	373,817	498,629
27	415,632	470,491	421,512	494,675	762,267	762,628	929,696	897,341	471,503	345,621	362,360	445,115
28	482,894	441,523	433,515	419,288	824,377	925,290	1,031,988	968,975	383,308	375,029	330,584	470,408
29	420,415	-	510,716	498,811	723,106	867,748	1,142,499	758,573	414,280	373,385	323,097	495,336
30	410,614	-	439,681	242,084	510,403	976,353	1,017,472	772,093	448,859	363,639	357,008	463,552
31	550,159	-	488,044	-	584,372	-	1,009,547	843,525	-	306,643	-	486,447
	15,759,460	11,743,959	13,998,333	13,944,230	18,790,223	22,035,875	30,186,551	27,873,035	18,068,953	12,482,416	10,791,540	11,867,219

Year	2016											
	January	February	March	April	May	June	July	August	September	October	November	December
Date												
1	426,954	415,412	381,031	438,024	522,946	586,189	769,003	1,088,052	505,218	321,264	267,717	402,156
2	352,719	309,231	654,789	463,988	244,470	608,448	804,031	773,010	530,808	372,061	376,708	438,541
3	178,336	328,335	391,274	473,639	419,413	341,913	973,459	812,753	586,666	217,342	382,875	471,917
4	297,931	387,912	324,944	385,153	489,028	408,398	751,175	934,783	635,571	402,726	382,745	514,176
5	212,276	337,771	349,868	324,266	593,966	283,138	755,866	895,959	507,521	309,462	401,524	456,689
6	291,857	413,778	309,932	350,024	606,481	453,917	778,803	831,269	442,953	322,363	423,642	496,320
7	246,466	408,374	323,949	333,348	531,074	423,642	651,129	954,692	443,768	568,958	402,128	531,744
8	216,312	440,734	304,093	325,159	638,626	278,245	686,259	739,396	556,037	396,455	441,657	543,633
9	190,121	325,724	335,949	371,604	680,052	402,477	646,788	687,951	551,996	459,957	445,003	611,768
10	216,003	365,460	342,911	408,553	574,405	275,455	604,279	810,484	544,224	560,206	405,961	584,161
11	231,877	283,519	447,748	341,603	726,182	322,337	645,357	858,843	604,322	428,414	414,714	608,587
12	235,483	301,345	404,055	351,477	695,883	309,298	560,272	1,076,233	524,998	575,866	434,582	693,580
13	265,844	376,475	424,775	342,356	779,224	353,896	682,415	1,056,871	528,213	367,580	473,458	625,033
14	232,328	319,071	415,199	323,637	643,828	296,286	911,761	1,068,427	548,914	387,978	411,108	573,369
15	251,584	318,470	381,609	363,690	695,760	222,759	990,908	964,495	650,269	392,018	407,857	601,986
16	459,893	357,738	445,049	366,474	675,623	294,936	770,678	941,669	594,585	398,534	425,911	610,475
17	400,692	333,929	382,372	371,393	606,414	405,427	793,019	1,002,598	529,664	395,371	469,330	648,613
18	506,508	319,813	456,062	192,874	622,546	242,143	690,958	1,019,368	499,978	381,927	390,442	671,741
19	444,379	329,619	454,803	428,916	599,939	244,610	680,696	1,120,961	539,082	448,485	462,051	742,594
20	405,153	318,642	386,134	401,200	590,268	373,718	791,974	1,133,530	376,138	541,034	422,712	533,466
21	414,162	333,125	426,379	407,076	697,187	302,705	874,059	985,484	395,531	522,420	452,095	511,039
22	347,768	399,493	457,303	363,100	769,611	305,275	878,375	812,851	334,525	518,400	417,778	522,345
23	459,080	320,667	438,891	416,752	821,460	499,711	946,554	975,802	437,119	479,215	417,038	556,632
24	382,309	331,954	430,753	324,762	645,012	627,704	999,499	973,940	392,505	508,335	392,344	514,881
25	379,138	455,678	482,157	373,112	706,322	638,125	1,023,741	1,087,917	398,782	504,754	667,075	532,133
26	369,895	426,514	436,551	397,366	647,929	778,989	953,017	1,003,739	400,636	319,652	302,937	535,131
27	418,935	316,606	446,619	468,207	506,324	732,872	948,523	984,772	356,370	445,302	330,052	542,180
28	378,402	378,064	491,334	414,064	488,850	814,995	971,648	816,789	312,682	298,033	366,059	541,805
29	361,721	516,443	423,564	521,539	532,095	839,163	1,011,119	704,164	376,442	360,205	446,109	534,045
30	434,105	-	447,666	452,696	565,595	881,932	950,434	669,710	363,620	318,353	386,898	524,076
31	364,199	-	401,449	-	560,997	-	1,062,529	581,620	-	357,311	-	505,970
	10,372,430	10,469,896	12,799,212	11,496,052	18,877,510	13,548,703	25,558,328	28,368,132	14,469,137	12,879,981	12,420,510	17,180,786

Year	2015											
	January	February	March	April	May	June	July	August	September	October	November	December
Date												
1	-	-	-	-	195,497	461,472	325,919	358,213	283,256	177,165	328,345	277,021
2	-	-	-	-	191,273	275,300	247,463	400,737	220,706	168,917	318,103	299,443
3	-	-	-	-	211,198	222,192	669,462	396,376	324,370	222,346	314,096	217,350
4	-	-	-	-	191,014	157,049	240,858	392,248	224,822	230,762	381,550	722,327
5	-	-	-	-	198,352	27,294	384,496	308,591	258,965	165,632	502,387	293,500
6	-	-	-	-	157,201	141,108	460,968	365,222	249,343	285,255	426,633	230,655
7	-	-	-	-	565,022	14,107	411,823	265,879	268,016	343,506	310,099	300,002
8	-	-	-	-	256,502	191,555	453,883	294,195	239,863	318,336	352,521	215,318
9	-	-	-	-	208,893	-	316,397	275,660	281,605	349,608	320,798	287,253
10	-	-	-	-	258,303	-	445,355	323,340	230,505	352,805	349,080	241,811
11	-	-	-	-	252,424	-	523,801	385,156	275,804	370,089	356,112	301,745
12	-	-	-	-	311,928	-	196,665	405,822	299,576	413,307	303,085	264,781
13	-	-	-	48,386	252,947	-	295,149	342,465	315,518	330,004	297,726	318,298
14	-	-	-	175,105	189,483	-	911,817	371,530	331,036	311,747	317,252	255,833
15	-	-	-	138,182	271,527	604,178	1,290,893	328,849	64,428	301,871	303,309	278,667
16	-	-	-	184,434	269,629	681,493	745,706	415,332	203,325	351,702	329,890	298,538
17	-	-	-	175,553	322,904	678,973	418,512	410,332	222,616	348,290	272,631	314,368
18	-	-	-	192,969	350,786	400,739	422,571	358,383	182,688	393,172	314,256	323,383
19	-	-	-	194,040	306,965	634,598	423,641	336,277	173,845	395,382	300,371	388,080
20	-	-	-	180,636	324,431	383,146	489,766	435,041	205,990	325,355	294,822	345,265
21	-	-	-	136,089	323,023	353,004	341,239	392,387	184,960	298,772	302,592	345,245
22	-	-	-	191,865	342,744	447,001	277,424	333,431	213,886	322,055	270,300	384,240
23	-	-	-	138,948	295,363	533,880	398,174	-	124,057	384,370	300,156	381,243
24	-	-	-	171,642	341,079	425,522	351,023	4,228	124,261	318,158	272,936	388,535
25	-	-	-	184,580	429,917	512,061	298,944	17,456	90,050	371,014	334,884	406,103
26	-	-	-	185,695	358,850	468,597	339,990	216,510	196,435	367,682	256,583	355,834
27	-	-	-	141,661	448,390	487,778	395,709	428,707	216,995	331,313	288,941	438,307
28	-	-	-	178,199	354,715	577,900	383,075	366,202	164,627	329,887	365,315	384,705
29	-	-	-	202,370	356,173	489,354	502,638	205,865	197,379	373,580	314,442	411,690
30	-	-	-	178,718	383,754	337,295	399,230	229,346	391,717	330,293	306,782	398,477
31	-	-	-	-	401,240	-	399,891	307,907	-	324,594	-	423,921
	-	-	-	2,999,072	9,321,527	9,505,596	13,762,482	9,671,687	6,760,644	9,906,969	9,705,997	10,491,938

APPENDIX B

COST ESTIMATES

CAPITAL EXPENDITURES

PROJECT # 1 - GROUNDWATER STUDY

ITEM	QTY	UNITS	RATE	COST
Conduct On-Site Pumping Tests	1	LS	\$ 8,500	\$ 8,500
On-Site Monitoring	1	LS	\$ 2,500	\$ 2,500
Reporting	1	LS	\$ 6,500	\$ 6,500
Sub Total				\$ 17,500
25% Contingency				\$ 4,375
TOTAL				\$ 21,875
15% Engineering				\$ 3,281
TOTAL				\$ 25,156

PROJECT # 2 - WATER TREATMENT STUDY

ITEM	QTY	UNITS	RATE	COST
Review Existing Information	1	LS	\$ 2,500	\$ 2,500
Review Treatment Options	1	LS	\$ 5,500	\$ 5,500
Prepare Construction Cost Estimate	1	LS	\$ 2,500	\$ 2,500
Reporting	1	LS	\$ 7,500	\$ 7,500
Sub Total				\$ 18,000
25% Contingency				\$ 4,500
TOTAL				\$ 22,500
15% Engineering				\$ 3,375
TOTAL				\$ 25,875

PROJECT # 3 - WATERMAIN INVESTIGATION

ITEM	QTY	UNITS	RATE	COST
Conduct Hydrant & Pressure Tests	1	LS	\$ 2,500	\$ 2,500
Monitor Reservoir & Water Meter	1	LS	\$ 800	\$ 800
Analyze in Water Model	1	LS	\$ 1,500	\$ 1,500
Reporting	1	LS	\$ 1,500	\$ 1,500
Sub Total				\$ 6,300
25% Contingency				\$ 1,575
TOTAL				\$ 7,875
15% Engineering				\$ 1,181
TOTAL				\$ 9,056

PROJECT # 4 - AC WATERMAIN CONDITION ASSESSMENT

ITEM	QTY	UNITS	RATE	COST
Collect Sample throughout system	15	ea	\$ 800	\$ 12,000
Laboratory Testing	15	ea	\$ 750	\$ 11,250
Reporting	1	LS	\$ 10,500	\$ 10,500
			Sub Total	\$ 33,750
			25% Contingency	\$ 8,438
			TOTAL	\$ 42,188
			15% Engineering	\$ 6,328
			TOTAL	\$ 48,516

PROJECT #5 - HORNE LAKE ROAD WATERMAIN UPGRADE (300mm)

ITEM	QTY	UNITS	RATE	COST
Remove Existing Main	350	m	\$ 80	\$ 28,000
300mm Main	350	m	\$ 310	\$ 108,500
300mm Gate Valve	3	ea	\$ 3,500	\$ 10,500
Tie to Existing Main	2	ea	\$ 2,800	\$ 5,600
Shoulder Gravel	80	cu.m.	\$ 85	\$ 6,800
Asphalt Paving	50	s.q.m	\$ 85	\$ 4,250
Traffic Control	1	LS	\$ 15,000	\$ 15,000
			Sub Total	\$ 178,650
			25% Contingency	\$ 44,663
			Sub Total	\$ 223,313
			15% Engineering	\$ 33,497
			TOTAL	\$ 256,809

PROJECT # 6 - AC WATERMAIN REPLACEMENT PROGRAM

ITEM	QTY	UNITS	RATE	COST
200mm Main	11,962	m	\$ 220	\$ 2,631,640
200mm Gate Valve	120	ea	\$ 2,200	\$ 264,000
Fire Hydrant Assemblies	90	ea	\$ 4,500	\$ 405,000
Air Release Valve	15	ea	\$ 3,500	\$ 52,500
Shoulder Gravel	340	cu.m.	\$ 85	\$ 28,900
Asphalt Paving	6,460	s.q.m	\$ 85	\$ 549,100
Traffic Control	1	LS	\$ 200,000	\$ 200,000
Sub Total				\$ 4,131,140
25% Contingency				\$ 1,032,785
TOTAL				\$ 5,163,925
15% Engineering				\$ 774,589
TOTAL				\$ 5,938,514
Less Project # 6a				\$ 2,706,238
TOTAL				\$ 3,232,276

PROJECT # 6A - ISLAND HIGHWAY WATERMAIN UPGRADE (250mm)

ITEM	QTY	UNITS	RATE	COST
Remove Existing Main	1000	m	\$ 80	\$ 80,000
250mm Main	4200	m	\$ 240	\$ 1,008,000
250mm Gate Valve	40	ea	\$ 2,500	\$ 100,000
Creek Crossing (Big Qualicum River)	1	LS	\$ 50,000	\$ 50,000
Fire Hydrant Assemblies	30	ea	\$ 4,500	\$ 135,000
Tie to Existing Main	7	ea	\$ 2,800	\$ 19,600
Shoulder Gravel	2500	cu.m.	\$ 85	\$ 212,500
Asphalt Paving	1500	s.q.m	\$ 85	\$ 127,500
Traffic Control	1	LS	\$ 150,000	\$ 150,000
Sub Total				\$ 1,882,600
25% Contingency				\$ 470,650
Sub Total				\$ 2,353,250
15% Engineering				\$ 352,988
TOTAL				\$ 2,706,238

PROJECT #7 - BRADSHAW ROAD WATERMAIN (200mm)

ITEM	QTY	UNITS	RATE	COST
200mm Main	1700	m	\$ 220	\$ 374,000
200mm Gate Valve	20	ea	\$ 2,200	\$ 44,000
Fire Hydrant Assemblies	12	ea	\$ 4,500	\$ 54,000
Air Release Valve	4	ea	\$ 3,500	\$ 14,000
Tie to Existing Main	2	ea	\$ 2,800	\$ 5,600
Shoulder Gravel	340	cu.m.	\$ 85	\$ 28,900
Asphalt Paving	100	s.q.m	\$ 85	\$ 8,500
Traffic Control	1	LS	\$ 80,000	\$ 80,000
Sub Total				\$ 609,000
25% Contingency				\$ 152,250
Sub Total				\$ 761,250
15% Engineering				\$ 114,188
TOTAL				\$ 875,438

PROJECT #8 - MANGANESE AND IRON TREATMENT SYSTEM

ITEM	QTY	UNITS	RATE	COST
Chlorine Injection System	1	LS	\$ 50,000	\$ 50,000
Manganese Filters	1	LS	\$ 200,000	\$ 200,000
Well Piping Configuration	1	LS	\$ 35,000	\$ 35,000
Electrical and Controls	1	LS	\$ 30,000	\$ 30,000
Building	1	LS	\$ 150,000	\$ 150,000
Subtotal				\$ 465,000
25% Contingency				\$ 116,250
Sub Total				\$ 581,250
15% Engineering				\$ 87,188
TOTAL				\$ 668,438

PROJECT #9 - COCHRANE & WELCH ROAD WATERMAIN UPGRADE (150MM)

ITEM	QTY	UNITS	RATE	COST
150mm Main	485	m	\$ 200	\$ 97,000
150mm Gate Valve	10	ea	\$ 1,600	\$ 16,000
Fire Hydrant Assemblies	4	ea	\$ 4,500	\$ 18,000
Air Release Valve	1	ea	\$ 3,500	\$ 3,500
Tie to Existing Main	2	ea	\$ 2,800	\$ 5,600
Shoulder Gravel	150	cu.m.	\$ 85	\$ 12,750
Asphalt Paving	80	s.q.m	\$ 85	\$ 6,800
Traffic Control	1	LS	\$ 25,000	\$ 25,000
Sub Total				\$ 184,650
25% Contingency				\$ 46,163
Sub Total				\$ 230,813
15% Engineering				\$ 34,622
TOTAL				\$ 265,434

PROJECT #10 - WATER STORAGE RESERVOIR

ITEM	QTY	UNITS	RATE	COST
Steel Bolted Tank (87,500L)	1	ea	\$ 180,000	\$ 180,000
150mm Gate Valve & Fittings	6	each	\$ 2,500	\$ 15,000
Tie to Existing Main	1	ea	\$ 2,800	\$ 2,800
Sub Total				\$ 197,800
25% Contingency				\$ 49,450
Sub Total				\$ 247,250
15% Engineering				\$ 37,088
TOTAL				\$ 284,338

APPENDIX C

BYLAW 151

QUALICUM BAY – HORNE LAKE WATERWORKS DISTRICT
BYLAW NO. 161

A bylaw to amend Bylaw No 151, being the Capital Expenditure Charge Bylaw (CEC Bylaw).

The Trustees of Qualicum Bay – Horne Lake Waterworks District ENACT AS FOLLOWS;

1. That the improvement district's Bylaw No 151, Capital Expenditure Charge Bylaw, passed by the Trustees on the 20th day of January, 2016 and registered by the Inspector of Municipalities on the 22nd day of February 2016, is hereby amended by replacing Schedule A as attached:
2. This bylaw may be cited as the Bylaw #161 Capital Expenditure Charge Amending Bylaw.

INTRODUCED and given a first reading by the Trustees on the 18^h day of January 2017.

RECONSIDERED and finally passed by the Trustees on the 15th day of March 2017.

Chair of the Trustees

I hereby certify that this is a true copy of Bylaw No. 161

Officer

SCHEDULE "A"

**BYLAW NO. 151
Amending Bylaw 161**

CAPITAL EXPENDITURE CHARGES (WATER FACILITIES)

Land Use	Basis of Assessment	Charge
A. Residential		
1) Single-family	Per Lot being created	\$ 3,338.00
2) Multi-family	Per unit to be constructed	\$ 3,338.00
3) Bare-Land Strata Development	Per dwelling unit	\$ 3,338.00
4) Trailer	Per pad or space built or provided for	\$ 2,503.00
B. Commercial	Per square meter of floor space created	\$20.00
	Minimum Charge of	\$ 3,338.00
C. Institutional	Per square meter of floor space created	\$20.00
	Minimum Charge of	\$ 3,338.00
D. Industrial	Per square meter of floor space created	\$20.00
	Minimum charge of	\$ 3,338.00