

TECHNICAL MEMO

To

Dean Chen, Project/Operation Manager Silva Bay Resort and Marina

From

Sean O'Connor, P.Eng.
McElhanney Ltd.

Re

Silva Bay Resort & Marina – 3383 South Road,
Gabriola Island, BC
Water Supply System Upgrades

Date

February 11, 2022

McElhanney Ltd (ML) was retained by Silvia Bay Resort and Marina (SBRM) to undertake detailed design of the water supply and treatment system required to support the proposed development located at 3383 South Road Gabriola Island, BC.

This memo has been prepared to provide an update on the supply, treatment, and distribution design completed to date.

1. Water System Demands

The Silva Bay Resort & Marina development includes a hotel building and restaurant during Phase 1. Future phases will also include a number of cabins, staff accommodations, among other potential buildings. To service the Silva Bay Resort & Marina now and into the future, several domestic demand scenarios have been taken into consideration. We have reviewed the estimated domestic demand scenarios based on per capita demands and land use information provided by the SBRM. A summary of estimated domestic water system demands is shown in Table 1.

Table 1: Estimated Domestic Water System Demands			
	Max Day Demand (L/s)	Peaking Factor	Peak Hour Flow (L/s)
Existing Buildings:	0.037	2	0.074
Ph1:	0.301		
Ex. + Ph1:	0.338	2	0.677
Ph2:	0.171		
Ex+Ph1+Ph2:	0.509	2	1.018
Shipyard:	0.027	2	0.054
Ex+Ph1+Ph2+ Shipyard:	0.536	2	1.072

Further to our initial per capita system demand estimates, the Civil Engineer & Mechanical Engineer have provided the design demands to be used for the water system. A summary of water system design demands provided is shown in Table 2.

Table 2: Estimated Water System Demands	
Parameter	Value
Existing Buildings *	0.04 L/s
Shipyard *	0.03 L/s
Phase 1: Maximum Day Demand **	0.28 L/s
Phase 2: Maximum Day Demand **	0.12 L/s
Total Build-Out: Maximum Day Demand **	0.47 L/s
Peak Hourly Demand **	0.94 L/s
Peak Plumbing Demand ***	8.0 L/s
Sprinkler Requirements **	31.5 L/s
Residual Pressure Requirements (Domestic Supply) ***	50 – 80 psi
Residual Pressure Requirements (Sprinkler Supply) ***	30 – 40 psi

* Information provided by Silva Bay Resort & Marina

** Information provided by Civil Engineer (Newcastle Engineering Ltd.)

*** Information provided by Mechanical Engineer (Rocky Point Engineering Ltd.)

Based on our review, the per capita demands (Table 1) are slightly higher than the design demands provided by the Civil Engineer (Table 2) for the water system. It is expected that this is due to the limited information that was made available to us.

As such, the design demands provided by the Civil Engineer & Mechanical Engineer for the water system were used for the design of the water treatment plant. The demands used for the design of the water treatment plant are summarized in Table 3.



Table 3: Water System Design Demands	
Parameter	Value
Current Phase (Existing Buildings + Shipyard + Phase 1) **	0.35 L/s
Total Build-Out: Maximum Day Demand **	0.47 L/s
Peak Hourly Demand **	0.94 L/s
Peak Plumbing Demand ***	8.0 L/s
Sprinkler Requirements **	31.5 L/s
Residual Pressure Requirements (Domestic Supply) ***	50 – 80 psi
Residual Pressure Requirements (Sprinkler Supply) ***	30 – 40 psi

2. Water Storage Requirements

One water storage reservoir will be installed on the Silva Bay Resort & Marina site to provide on-site storage for fire sprinkler storage and potable water equalization. This reservoir will provide a total storage volume of 155 m³. Based on the requirements of the NFPA 13-2013 standard, “Installation of Sprinkler Systems” as referenced in BCBC Sentence 3.2.5.12, and volume calculations made by Newcastle Engineering Ltd., this development will require 113.6 m³ of stored water available for the automatic sprinkler system. The stored water will be allocated as shown in Table 4.

Table 4: Water Storage Requirements *		
(A) Fire Storage (Sprinkler Flow):	31.55 L/s for 1 hour	113.6 m ³
(B) Domestic Equalization:	25% of MDD (0.47L/s)	10.1 m ³
(C) Emergency Storage:	25% of (A) + (B)	30.9 m ³
Total Required Storage:	(A) + (B) + (C)	154.7 m³
Total Storage Proposed:		155.0 m³

** Refer to McElhanney Technical Memo “Fire Protection Strategy” dated July 8, 2021, for additional details regarding water storage requirements.*



3. Water Supply System

The water supply source(s) must be capable of meeting the system's maximum day demand. The Peak Hour Demand and Fire Flow (Sprinkler Flow) demands are to be met by the water storage reservoirs.

The water treatment system was designed to meet the Max Day Demand of 0.47 L/s as outlined in Table 3 (Refer to Section 1, Water System Demands).

The water supply system (production wells) were compared to the demands outlined for the current phase and future phase as outlined in Table 3 (Refer to Section 1, Water System Demands).

3.1. EXISTING GROUNDWATER WELL

Silva Bay Resort & Marina has been operating one water supply well (Well No. 13370) since 1970. The well is located on Lot 2, Section 5, Gabriola Island Nanaimo District, Plan 23322 (Water Lot). The well is located approximately 600 m northwest of Silva Bay Resort and Marina, along North Road.

This well (Well No. 13370) is currently connected to the existing water storage cisterns on site with a 50mm diameter (material unknown) supply watermain.

It is proposed to divert this connection to the new water treatment plant with a 50mm diameter HDPE supply watermain. It is also proposed to install a flow control valve (Flowmatic 1" Flo-Trol, 5-GPM) in the off-site pump house (upstream of the pressure switch / pressure tank) to maintain flow in accordance with the sustainable yield.

Waterline Resources Inc. submitted an existing use application (Tracking # 100315657) to FLNRO on April 4, 2020, for a daily demand of 25 m³/d, for commercial use at the Resort and Marina.

Waterline also completed a well test at Well 13370 to support the existing use license application and infrastructure planning, for water system upgrades (piping, storage tanks etc.). The Waterline report "Supplemental Information Submission - For Water Sustainability Act Licence Application #100315657" dated November 13, 2020, provides the following recommendations:

- The existing well can supply the following:
 - Long-Term Sustainable Yield of 13.1 m³/day which equates to 0.15 L/s (annual)
 - Short-Term Sustainable Yield of 23.1 m³/d which equate to 0.27 L/s (peak season)
 - Maximum tested capacity is 0.60 L/s. This maximum flow is considered acceptable for short periods of time if 23.1 m³/day is not exceeded.

Based on information provided by Waterline, it is understood that Islands Trust has issued a cease operation on this well (Well No. 13370) due to a contravention of a local bylaw.



3.2. NEW GROUNDWATER WELL

Waterline Resources Inc. (Waterline) was retained to provide a technical assessment of an unlicensed water supply well (Well 25324) to meet licensing requirements of the BC Water Sustainability Act (WSA). Well 25324 is located on Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876 (the Site) and was drilled in August 1969 by Windecker Water Well Drilling. The Waterline report "Technical Assessment Report Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876 Gabriola Island, British Columbia" dated October 15, 2019, provides the following recommendations:

- The new well can supply the following:
 - Long-Term Sustainable Yield of 10.0 m³/day which equates to 0.12 L/s
 - Maximum tested capacity is 0.16 L/s. This maximum flow is considered acceptable for short periods of time if 10 m³/day is not exceeded.

It is proposed that this new well (Well No. 25324) will be connected to the new water treatment plant with a 50mm diameter HDPE supply watermain. It is also proposed to install a flow control valve (Flowmatic 1" Flo-Trol, 2-GPM) in the check valve chamber (upstream of the pressure switch / pressure tank) to maintain flow in accordance with the sustainable yield.

3.3. PRODUCTION WELL CAPACITY

The estimated production well capacity, based on the two proposed water supply wells, has been summarized in Table 5.

Table 5: Estimated Water Supply System Capacity		
Existing Well (Well No. 13370)		
Recommended Pumping Rate:	0.27 L/s	23.1 m ³ /d
Maximum Pumping Rate:	0.60 L/s	23.1 m ³ /d
New Well (Well No. 25324)		
Recommended Pumping Rate:	0.12 L/s	10 m ³ /d
Maximum Pumping Rate:	0.16 L/s	10 m ³ /d
Combined Wells		
Recommended Pumping Rate:	0.39 L/s	33.1 m ³ /d
Maximum Pumping Rate:	0.76 L/s	33.1 m ³ /d

The recommended pumping rate (combined flow including both production wells) is 0.39 L/s.

The design demand (MDD) for the Current Phase (Existing Buildings + Shipyard + Phase 1) is 0.35 L/s which can be serviced by the two production wells.



The design demand (MDD) for the Total Build-Out (Phase 1 + Phase 2) is 0.47 L/s which is greater than the recommended pumping rate of the combined wells. As such, the actual MDD of Phase 1 and the detailed estimate of Phase 2 MDD should be reviewed before proceeding with Phase 2 of the development.

4. Water Treatment System

4.1. GROUNDWATER CHEMISTRY

Waterline has provided a summary of the key groundwater quality results for Well No. 13370 and Well No. 25324 which are presented in Table 6 and Table 7 respectively.

The water quality results are compared with the Guideline for Canadian Drinking Water Quality (GCDWQ, Health Canada, 2019) to provide the reader with a reference to gauge its potability. The GCDWQ set standards based on aesthetic objectives (AOs) and on maximum acceptable concentrations (MACs). Complete groundwater quality tables and laboratory reports are included in Waterline reports for each well.

Table 6: Groundwater Quality Results - Well No. 13370					
Sample Location	Units	Guidelines		Well 13370	Well 13370
Sample Date		GCDWQ AO	GCDWQ MAC	2019-06-04 00:00	2020-09-13 00:00
Field Sample ID				Prelim Site Visit	72-hour CRPT
Lab ID				9060397-02	0091488-01
General Chemistry					
Colour	TCU	15	-	5.0	-
Conductivity (EC)	µS/cm	-	-	359	514
Total Dissolved Solids- Calculated	mg/L	500	-	227	270
Turbidity	NTU	0.1	-	1.65	-
pH		7-10.5	-	8.17	8.32
Major Ions					
Chloride (Cl)	mg/L	250	-	21.8	50
Iron (Fe)-Dissolved	mg/L	0.3	-	0.103	0.077
Manganese (Mn)-Dissolved	mg/L	0.02	0.12	0.016	0.0142
Sodium (Na)-Dissolved	mg/L	200	-	81.4	113
Sulphate (^{SO4})	mg/L	500	-	7.5	14.5



Table 7: Groundwater Quality Results - Well No. 25324					
Sample Location	Units	Guidelines		Well 25324	Well 25324
Sample Date		GCDWQ AO	GCDWQ MAC	2019-08-21	2019-09-06
Field Sample ID				25324	03190190906001
Lab ID				9082105-01	9090600-01
General Chemistry					
Colour	TCU	15	-	51	10
Conductivity (EC)	µS/cm	-	-	415	450
Total Dissolved Solids-Calculated	mg/L	500	-	240	248
Turbidity	NTU	0.1	-	115	4.38
pH		7-10.5	-	7.57	8.04
Major Ions					
Chloride (Cl)	mg/L	250	-	31.6	39.6
Iron (Fe)-Dissolved	mg/L	0.3	-	0.018	0.015
Manganese (Mn)-Dissolved	mg/L	0.02	0.12	0.0293	0.0179
Sodium (Na)-Dissolved	mg/L	200	-	92.9	90.8
Sulphate (^{SO4})	mg/L	500	-	12.2	13.7

4.2. WATER TREATMENT DESIGN

Treatment process equipment will be supplied by Universal Filter Group (UFG) and has been incorporated by McElhanney Ltd. into the design drawings, showing the layout and placement of the system within the building. The treatment system has been designed to reduce manganese and iron concentrations for aesthetic purposes, below the aesthetic objectives of 0.02 mg/L and 0.3 mg/L, respectively (Canadian Drinking Water Guidelines). It has also been designed to treat Turbidity to below the Maximum Allowable Concentration of 1.0 NTU for groundwater and will be able to treat up to 1.0 L/s (86 m³/day).

The treatment system includes two (2) dual media filters containing a combination of Greensand Plus and Filox-R media. Prior to filtration, there is a pre-oxidation process using chlorine. This will require the addition of a Blue-White chlorine metering pump in order to maintain a free chlorine residual at the surface of the filter media of 0.5 to 1.0 mg/L (as specified by UFG).

The system will be programmed to have one duty filter unit in service with one in standby mode, until one of the in-service units enters the backwash cycle. Backwash will be provided from water service at entrance to distribution system and will have a reduced pressure backflow preventor before connection to filters.



4.3. CHLORINATION

4.3.1. Chlorine for Pre-oxidation Process

UFG has provided estimated chlorine pumping rates to suit treatment process equipment. Pumping rate of 1.0 mg/L is estimated. UFG will provide support during the commissioning and performance testing stage to confirm required chlorination rates for this process. An Iron & Manganese Removal Facilities for Small Systems – Submittal Checklist will be completed once performance can be measured.

4.3.2. Chlorine for Disinfection

A minimum residual chlorine concentration of 0.2 mg/L must be maintained in all community water systems according to BC Design Guidelines for Rural Residential Community Water System (2012).

Chlorine pumping rate will be adjusted to provide 0.5 mg/L free chlorine after filtration which will provide chlorine residuals throughout the system. During the commissioning process, the chlorine dosage rate will be adjusted to suit chlorine requirements for pre-oxidation process and system chlorine residuals throughout the system.

4.3.3. Chlorine Monitoring

A chlorine analyzer has been included at the start of the distribution system so that operators can monitor chlorine levels entering the distribution system. It is also anticipated that operators will complete sampling/testing of water at end of distribution system as required by Island Health.

5. Distribution System

5.1. SMALL DISTRIBUTION PUMPS (DOMESTIC USE)

In order to provide operational system pressures of 50-80 psi, a booster pump system is required.

The small pump system will be configured for the regular domestic water use; the maximum day demand is 0.5L/s and the peak hour demand is 1.0 L/s. Two identical pumps (Grundfos CRE 3-8 A-FGJ-A-E-HQQE) have been selected to supply water to distribution system during normal operation. These pumps will be controlled by a Grundfos control panel complete with VFDs. The Grundfos control system will be programmed to have one duty pump and one standby pump.

5.1. LARGE DISTRIBUTION PUMPS (PEAK USE / SPRINKLER SYSTEM)

In order to provide adequate flow and pressures for Fire Protection (Sprinkler System) and peak plumbing demands, a second booster pump system is required.

The large pump system will be configured for the peak domestic water use and sprinkler requirements; the peak plumbing demand is 8.0 L/s and the sprinkler flow requirement is 31.5 L/s. Two identical pumps (Grundfos CRE 45-2 A-G-A-E-HQQE) have been selected to supply water to distribution system during peak domestic use and sprinkler flows. These pumps will be controlled by a Grundfos control panel



complete with VFDs. The Grundfos control system will be programmed to select number of pumps required based on system pressure requirements and system demands.

6. Proposed Sequence of Control

Refer to the process narrative (electrical design) for detailed sequence of operation. A summary of the sequence of operation is included below for reference.

Well Pump Control (Supply System)

1. Reservoir level drops and allows float valve to open
2. Water is released into reservoir from pressure tank(s) – one in existing offsite pump house and one on supply system in WTP
3. Well pumps are called to run
 - a. When pressure drops below 20 psi at WTP, pressure switch (PS 102) will call for well pump #2 to run (Well No. 25324)
 - b. When pressure drop below 30 psi at off-site pump house, pressure switch (PS - Existing) will call for well pump #1 to run (Well No. 13370)
4. Pumps will continue to run until:
 - a. Reservoir is filled to top water level and float valve closes
 - b. Pumps fill pressure tank(s) – one in existing offsite pump house and one on supply system in WTP
5. Well pumps are to stop
 - a. When pressure reaches 40 psi at WTP, pressure switch (PS 102) will call for well pump #2 to stop (Well No. 25324)
 - b. When pressure reaches 50 psi at off-site pump house, pressure switch (PS - Existing) will call for well pump #1 to stop (Well No. 13370)
6. Alarm conditions:
 - a. Well level transmitter (PDIR 102) will monitor water level in well and stop well #2 if water level is below LWL set point

Water Treatment System (Supply System)

1. Flow meter (fit) will monitor flow and send signal to chlorine dose pumps
2. Chlorine dosage to be flow based (from flow meter signal)
 - a. UFG filter package supplier to set chlorine dosage rates
3. UFG filter package to operate by local controller
 - a. UFG filter package supplier to commission filter package
4. Alarm conditions:
 - a. Chlorine dose pumps to provide local alarms at each unit
 - b. UFG filter package to provide local alarm at each unit



Grundfos Small System (Distribution System)

1. The small system will be the lead system
2. Grundfos control panel set points to be established to suit site conditions, anticipated operating conditions:
 - a. Operating set point for discharge pressure to be specified = 64 psi
 - b. Pumps are sized to provide regular domestic flows with VFD operation
 - c. If small system pump package recognizes low flows, it will operate on pressure band (+/- 10%) = 58 psi to 70 psi
 - d. Supplier to set low flow set point
 - e. One or two small pumps will operate to efficiently provide demand
 - f. If distribution system pressure drops below specified "low pressure" set point, the large system will be called to operate.
 - i. "Low pressure" set point = 50 psi
3. Alarm conditions:
 - a. Grundfos control panel to provide local alarms, including but not limited to:
 - i. Pump fault / External fault
 - ii. Over-pressure (Discharge over-pressure)
 - iii. Water shortage (Suction under-pressure)
 - iv. Under-voltage / over-voltage

Grundfos Large System (Distribution System)

1. The small system will remain on during large system operation
2. Grundfos control panel set points to be established to suit site conditions, anticipated operating conditions:
 - a. Operating set point for discharge pressure to be specified = 60 psi
 - b. Pumps are sized to provide max domestic flows & sprinkler flows with VFD operation
 - c. One or two small pumps will operate to efficiently provide demand
 - d. If large system pump package recognizes low flows, it will turn off and small system will continue to operate to meet demand as required
3. Alarm conditions:
 - a. Grundfos control panel to provide local alarms (similar to small system)

General Equipment (Distribution System)

1. Ultrasonic transmitter will monitor reservoir levels
 - a. Low level alarm to be set to warn when water level is below required capacity for sprinkler flow
2. Chlorine analyzer will monitor chlorine residual levels.
 - a. Operators can adjust chlorine dosage as required to suit site conditions



7. Closing

Should you have any questions or require additional information, please do not hesitate to contact us.

Sincerely,

McElhanney Ltd.

Prepared by:

Reviewed by:

Original signed and stamped

Original signed

Sean O'Connor, P.Eng.
Project Engineer

Chris Pogson, P.Eng.
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APPENDIX A

Statement of Limitations

Statement of Limitations

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