## 1. INTRODUCTION

Cowichan Lake Recreational Community Inc. (CLRC) is located at 8389 Saseenos Road. The shared interest development is located on 4 parcels located in Youbou BC, adjacent to Cowichan Lake. The property is occupied by 60 units which are a combination of mobile homes and recreational vehicles. The property has no record of the existing sewage treatment and disposal system with Island Health, and the owners have raised concerns with respect to the condition and compliance of the various systems located on the property. During peak season, there are often odours; backed up sewers, most recently occurring over the August long weekend; and flooding of the sewer system tanks during high water events.

MSR Solution has been retained to provide engineering oversight and assist in bringing the sewage treatment and disposal systems up to current Regulatory requirements. It is understood that CLRC is desirous of upgrading the water system as well.

## 2. DESIGN FLOWS

The 60 lots on the property are a mix of mobile homes and fully serviced RV pads. The SPM uses a Daily Design Flow (DDF) of 300 L per person for a mobile home, which using a peak summer average of 3 people per unit would be 900 L/day. The SPM does not specifically reference flows for long term, fully serviced RV pads. To be conservative, the mobile homes design flow has been estimated at 350 L/person/day, with 3 people per mobile home. The additional design flow can also be attributed to inflow and infiltration to the existing infrastructure.

Metcalf and Eddy (M&E) uses a design value of 230 to 430 L/day per vehicle and 380 to 430 L/day for mobile homes. For the RV sites, a design flow of 380 L/day was used. This is like the SPM at 340 L/day DDF. We note the biological loading is very high for RV systems due to the low water use, and that is an impact to performance at the treatment plant, as well as discharging into the sewers. A summary of daily design flows for all the sites is shown below.

| Sites | No. of Sites | PPU | Flow/Person (L/Day) | Daily Design Flow (L/day) | Total Daily Design Flow |
|---|---|---|---|---|---|
| 1-7 | 7 | 3 | 350 | - | 7,350 |
| 8-14B | 8 | 3 | 350 | - | 8,400 |
| 15-16 | 2 | 3 | 350 | - | 2,100 |
| 18-22 | 5 | - | - | 380 | 1,900 |
| 23-45 | 23 | - | - | 380 | 8,740 |
| 46-60 | 15 | - | - | 380 | 5,700 |
| **Total** | **60** | | | | **34,190** |

The total daily design flow is greater than the SSR regulations of 22.7 $m^3$ per day. As such, one treatment train and disposal system can be designed. Should one treatment system be chosen, the system will fall under the Municipal Wastewater Regulation.

Alternatively, two separate treatment trains and disposal systems can be designed, both rated for approximately 18 $m^3$/day. Having two separate systems will allow each system to be registered with Island Health under two separate SSR filings. It also allows for an opportunity to phase the construction into two phases over subsequent years, or as determined based on site conditions and financial constraints.

As a comparison, the water consumption invoices were reviewed, and the period considered between April 15, 2020, to October 14, 2020 (182 days) with a total consumption of 1,677 m3, or 9200 Litres/day. It is important to note the time frame includes time outside of normal occupancy between the May long weekend, and September long weekend (106 days). As such, we suggest the average flow will be around 15,800 Litres per day, with the maximum day more than 32,000 L/day, generally in accordance with the theoretical design.

Winter data suggests there is still an average flow of 5,000 L/day, suggesting leaks in the water system. We understand it is desired to rectify this with a phased approach to the water line replacement as well.

## 3. COLLECTION SYSTEM AND LIFT STATIONS

The existing collection system will be combined with new infrastructure to collect sewage from each lot. Sewage will be transported to one of two lift stations or directly to the treatment plant via gravity sewers, where applicable.

The lift stations will pump sewage to the water treatment plant via 50 mm forcemains. Lift stations will be designed with additional reserve storage for power outages, and an outlet for a portable generator. The design of both lift stations will consider the effect of the high-water level and 200-year flood plain level for the determination of anti-floatation devices. Proposed Lift Station 1 and Lift station 2 are located adjacent to sites 52 and 39, respectively.

The existing collection system is unknown and should be confirmed during construction to ensure all units are connected and the system is adequately flood proofed. The proposed collection system is outlined below to achieve the best configuration.

| Sites | Lift Station | Treatment Train |
|---|---|---|
| 1-7 | LS1 | A |
| 8-14b | - | B |
| 15-16 | LS1 | A |
| 18-22 | - | A |
| 23-45 | LS2 | B |
| 46-60 | LS1 | A |
| | | |
| Treatment A Design Flow (L/Day): | | 17,050 |
| Treatment B Design Flow (L/Day): | | 17,140 |
| Lift Station 1 Design Flow (L/Day): | | 15,150 |
| Lift Station 2 Design Flow (L/Day): | | 8,740 |

LS1 will be equipped with duplex submersible pumps rated at 1.7 L/s at approximately 10 m TDH (27 USgpm @ 30 ft TDH), pumping to the septic tank via a 150 m long, 50 mm diameter forcemain. The sewage will be pumped at approximately 0.85 m/s through the forcemain. LS2 will be equipped with duplex submersible pumps rated at 1.3 L/s at approximately 7 m TDH (21 USgpm at 22 ft TDH), pumping to the septic tank via a 60 m long, 50 mm diameter forcemain. The sewage will be pumped at approximately 0.61 m/s through the forcemain.

After further discussions with CLRC, the configuration will be to optimize the foreshore and northern sites as priority to Phase A, and modifying to suite for Phase B.

Both lift stations can be installed with a Myers MW50, fitted with a 0.5 hp, 230V/1ph/60Hz motor, complete with a duplex control panel.

# 4. WASTEWATER TREATMENT PLANT

## 4.1. Treatment Requirements

A system constructed should be reliable and robust and allow for expansion as demand warrants without being detrimental to the operations. Several treatment options can be considered based on the experience of the eventual operators, while addressing the regulatory requirements. MSR has looked at options on sizing of the equipment and based on above discussion, two options have been considered as below:

- Duplex treatment plant with 18 $m^3$/d treatment capacity of each train + individual disposal field. This offers flexibility in that one unit can be deferred to later years, depending on need, and financial capacity. This will result in two Filings with Island Health with two separate systems.
- Simplex treatment plant with 36 m3/d treatment capacity + with two disposal field sized for 18 m3/d discharge. This will have construction savings and will require a Registration under the Municipal Wastewater Regulation.

The treatment process of both options remains the same. Membrane bioreactor (MBR) is an advanced wastewater treatment technology that combines the conventional suspended growth activated sludge process with membrane filtration, performing the critical solids/liquid separation function that is traditionally accomplished by gravity using secondary clarifiers. The difference in biomass concentration leads to much smaller reactor basins for the biological process. When combined with the elimination of secondary clarifiers, the overall footprint of the Membrane BioReactor (MBR) treatment plant is significantly reduced. The MBR system has the following distinct advantages:

- High Efficiency and Smaller Footprint
- High Effluent Quality and Operational Stability
- Less Sludge Production
- Operation Simplicity and Low Maintenance Requirement
- Higher loading rate to ground disposal to reduce that footprint

Based upon the specific effluent quality requirements, the following treatment process is proposed.

**Raw Sewage → Preliminary treatment for removal of solids by means of settling and effluent filters → Aerobic Tank → MBR Tank → Effluent to discharge**

## 4.2. PRELIMINARY TREATMENT

The collected raw sewage is directed by means of gravity and forcemain to the preliminary treatment (septic tank) to allow separation of solids and floatable debris from the sewage flow. The tank is provided with effluent filters to screen the particles >1 mm. Primary settling tanks offer:

- Lower lifecycle costs as passive treatment
- Minimal operating costs
- Requires offsite hauling and disposal of wet solids on an annual basis.

## 4.3. BIO-TREATMENT

The effluent of preliminary treatment flows to an Aerobic BioReactor. The flow moves through the fine screens into a tank where it is equipped with bubble diffuser to provide sufficient mixing of the incoming flow and oxygen to ensure effective biological digestion of the organic materials. Mixed Liquor stream will enter the second chamber/tank.

## 4.4. MEMBRANE FILTRATION MODULE TANK

The liquid phase of the mixed liquor (Permeate) is pulled through the membranes at a predetermined rate, or flux, established for each specific application and to the inlet of the drainage filed piping. The mixed liquor suspended solids (MLSS) are rejected and moved away from the membrane by the air scour and hydraulic action Surplus biomass generated by the conversion of BOD into cell mass is wasted periodically from the system, on an as-needed basis, as Waste Activated Sludge (WAS), for off-site disposal.

The design is based on waste strength of 600 mg/L BOD and TSS, and a design water temperature of 15 C from the septic tanks. The Mixed Liquor Suspended Solids (MLSS) concentration will vary in the reactor at 10,000 – 15,000 mg/L to enhance the ability of the ability of the biomass to effectively treat variable flow rates and strength, resulting in a better than Type 3 wastewater effluent quality at <10 mg/L BOD and TSS.

## 4.5. Why Membrane Filtration

Membrane filtration is considered in this application as it will consistently provide a high quality effluent, even under poor maintenance conditions. As a physical barrier, only clean water, with salts, and residual bacteria and viruses get through the process. The UV then destroys the bacteria and inactivates viruses. This treatment process can be expanded in future to offer nitrogen and phosphorous reduction at minor additional cost and modification.

There is insufficient area for conventional septic treatment systems and the resulting disposal field requirements, which are about 3 times the piping requirement compared to the proposed MBR. Further, the high quality of

effluent from the MBR process will reduce the disposal field area requirements by about 50%, compared to most secondary treatment processes.

## 5. Sewage Collection System

The lower portion of the park is susceptible to flooding, and infiltration into the sewer system, which has a negative impact to the treatment and disposal system. The collection system is nearing end of life and is recommended to be upgraded over time and replaced in areas subject to flooding.

## 6. Sewage Disposal System

The soils on the property are noted to be a silty loam with a percolation rate of around 15 mins/2.5 cm. This suggests a soil loading rate of 70 Litres/m2 under the SSR Standard Practice Manual or a total of 490 m2 of infiltrative surface area. We suggest two areas be set aside so there is no overlapping groundwater flow in the direction of the Lake. We have suggested at the entrance in the green space, as well as to locate under the parking area of the north driveway as noted on the drawings.

Effluent from the sewage treatment plant will be dosed to two disposal fields. The disposal fields will be equipped with an automatic distribution valve to ensure equal distribution.

Disposal Field 1 will be located north of lot #15 (1A) with 8 laterals, 34 m long: **OR** west of lot #16 (1B) with a total of 260 m of pipe on 3 m centres. The proposed field north of Lot #15 has 6 – 15 m laterals at 13 m spacing each on 3 m centres. Alternatively, the field will have about 260 m of pipe on 3 m centres if installed west of lot #16.

Disposal Field B will be located on the northern edge of the property with 6 – 15 m laterals at 3 m of spacing, in three sections, each 12-15 m apart.

The laterals are on 3 m centres and will be excavated 0.9 m wide and 1.5 m deep. They will be backfilled with coarse clean sand to within 0.6 m of the surface. Then a 0.3 m layer of pea gravel and a Schedule 80 distribution lateral and geotextile. Final backfill on the fields will be topsoil, or 19 mm clear crush gravel where parking can occur. A typical allowance for ground disposal systems would be 270 m of laterals at $150/m plus the excavation and replacement with a coarse sand/pea gravel material under the disposal system.

## 7. Scope of Supply and Pricing for the Wastewater Treatment

The scope of the proposed MBR treatment system will consist of the following works

- Primary Treatment Concrete Tank for inground installation by others, including crane for placing in the excavation
- Aeration and MBR Tank for inground installation by others, including crane for placing in the excavation
- Effluent Filters for installation by others in tanks
- Submersible Feed Forward Pump and Permeate Cycle Level Sensors

- Bioreactor module for installation in the tank along with aeration equipment
- Used Sea Container 10'x10' with blowers, permeate pumps, UV module, control panel and electrical panel and miscellaneous piping and fittings to the outside of the unit.
- Operation and Maintenance manuals
- Support during installation and commissioning (3 days on site)

The scope of works by the contractor (civil, mechanical and electrical) will generally consist of the following.

- All required permits to construct, install and operate the proposed wastewater treatment system.
- All site civil works, including excavations and tankage installations and concrete pad.
- Receiving, unloading and installation of WWTP deliverables.
- All mechanical and electrical connections to the treatment units including utility services, and all interconnection electrical wiring from the control panel to all mechanical components
- Supply and install of sewage lift stations and applicable piping to the treatment works
- Supply and installation of the sewage disposal fields and interconnecting piping
- Supply and installation of gravity sewer including cleanouts, manholes and service connections to each two lots.
- Supply and installation of 50 mm water distribution system included valves, standpipes, and service connections to each lot.

## 8. Order of Magnitude Costs

As a rule of thumb, costs for each modular home or trailer site is estimated at $11,000 to $13,000 for a new sewage treatment and disposal system, and when working in a confined area of existing services and an active site, costs will increase. Similarly, the costs to extend a sewage collection system, and water distribution system can be in the area of $4,500 to $6,500 per site. Based on the 60 units, and new water and sewer system will be from $930,000 to $1,170,000, plus engineering, taxes, and contingency.

The available funding is around $400,000 and the requirement for a special levy charge for additional funding, are considerations for phasing and scalability of the works. It is understood that the primary focus of works should be lots 23 – 45, 17 and 46 – 60 for a first phase, and upgrading the water distribution due to costs associated with ongoing leaks. The following outlines estimated costs based on a first phase with water and sewer in a combined trench (water on a higher bench), and one treatment train with a capacity of 18,000 Lpd.

| Item | Description | Units | Rate | Total |
|---|---|---|---|---|
| **WWTP Supply** | MBR at 18 m3/day | Lump sum | $140,000 | $140,000 |
| **WWTP Install** | Civil, mechanical and electrical | Allowance | $120,000 | $120,000 |
| **Disposal** | 270 m of laterals | 270 m | $150 | $40,500 |
| **Water Distribution** | 50 mm municipal poly pipe in benched combined trench | 300 m | $75 | $22,500 |

| | | | | |
|---|---|---|---|---|
| **Water Services** | Self draining standpipe | 38 | $750 | $28,500 |
| **Sewer** | 150 mm SDR 35 | 250 | $150 | $37,500 |
| **Sewer Cleanouts** | Surface accessible as per plumbing code | 7 | $1,500 | $10,500 |
| **Lift Stations** | Duplex grinder package plants installed | 2 | $45,000 | $90,000 |
| **Sewer Services** | 100 mm SDR 28 with inspection chamber for 2 RV sites | 20 | $1,000 | $20,000 |
| **Landscaping** | Final grading allowance (no paving) | Lump Sum | $10,500 | $10,500 |
| **Subtotal** | | | | $520,000 |
| **Engineering for Sewer Design for Filing under SSR with VIHA** | | | | $25,000 |
| **Engineering for Site Services including design, tendering and construction services** | | | | $65,000 |
| **Contingency Allowance (10%)** | | | | $60,000 |
| **Estimated Construction Costs for Phase 1 of works** | | | | $670,000 |

Estimated costs for a first phase to meet sewage and water upgrades requirements is estimated at $670,000. A reduced scope is not easily considered without likely impacts to ongoing summer high flow issues. There is the potential to postpone servicing Lots 23 – 31, with potential cost deferment of about $50,000, or postponing the water at deferment of about $50,000.

## 9. Summary

The CLRC is proposing a phased upgrade to the water and sewer systems to address water leaks and failing sewer systems because of aging infrastructure and impacts of leaking pipes, resulting in billing costs and emergency callouts to a sewage hauler. The first scope is proposed to be between $570,000 and $670,000 depending on any changes to servicing the lots 23 – 60, with additional future costs to complete the works.

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