



3060 Lake Road, Denman Island, BC V0R 1T0  
Tel : (250) 335-1864 Fax: (250) 335-1846  
Email: h2oenv@telus.net

January 26, 2016

H<sub>2</sub>O File: 14-12

Denman Community Land Trust Association  
3900 Lacon Road  
Denman Island, BC V0R 1T0

**Re: Wastewater Assessment for Development  
Section 18, Nanaimo Land District, Plan 6601N  
3730 Denman Road, Denman Island**

---

### **Introduction**

H<sub>2</sub>O Environmental Ltd. (H<sub>2</sub>O) was retained by the Denman Community Land Trust Association (DCLTA) to aid in the characterization of the soils and groundwater conditions of a proposed subdivision at the above legal address. The proposed subdivision will result in new Lot M and Lot M Remainder. The Lot M Remainder contains an existing residence, with a functioning wastewater dispersal system.

Domestic water for this area is supplied by private wells. Island Health requires a minimum of 1 ha for properties with private wells. Island Health does not recognize the ability of effluent treatment to allow for lots smaller than 1 ha.

### **Wastewater Considerations**

The proposed development onsite is four duplex units, each dwelling having one bedroom and being approximately 65 m<sup>2</sup> in area. The SPM<sup>1</sup> lists the daily design flow (DDF) as 700 litres per each unit. The total estimated effluent flow would be 5,600 litres per day from the duplex units.

At this time, the existing residence (2 bedrooms) is being included in the design of the wastewater system for planning purposes. This brings the total DDF up to 6,600 litres.

The average daily flow is estimated to be ½ the DDF. The DDF is used for design to allow for peak uses.

### **General Site Information**

The proposed lot is L shaped, with the long leg running north to south on the western portion of the existing lot and turning to the east at the base of the lot.

Regional topography consists of a gentle grade to the southwest, towards Baynes Sound. The subject lot sloped gently between 2% to 6%.

---

<sup>1</sup> Ministry of Health, *Sewerage System Standard Practices Manual*, Version 3, September 2014

There is a small watercourse running east to west located approximately in the centre of the property. The area approaching the watercourse from the north is a wet area in the winter and the testpits used in this evaluation were located at the north end of the proposed lots.

### **Methodology**

Four testpits were advanced on Lot M and two on Lot M Remainder. There is a functioning septic field for the existing home so only testpits verifying a wastewater reserve area were completed.

To measure the *in-situ* permeability of the soils, four permeameter tests were conducted by H<sub>2</sub>O on the Lot M and one on the remainder lot. Auger holes were advanced within the proposed wastewater dispersal area to a maximum depth of 40 centimetres (cm). The permeameter test consists of a calibrated tube filled with water which is inserted into the auger hole allowing the water to escape at a flow rate determined by the ability of the soil to transmit it away from the tube. The water flow out of the tube is measured and a hydraulic conductivity of the soil is calculated from the results.

Figure 1 showing locations of testpits and preliminary location of dispersal fields is attached to this report.

### **Lot M**

The general soil profile on Lot M is a thin layer of forest debris, underlain by dark brown loam to with 10% to 15% coarse fragments to approximately 15 cm to 18 cm. This layer was followed by a loamy sand layer which was loose, tan and saturated below 55 cm. Groundwater was encountered in all testpits and soil mottling, indicating seasonal high water table elevation, was observed in the testpits ranging from 55 to 60 cm depth.

The average measured field-saturated hydraulic conductivity ( $K_{fs}$ ) of the two tests on Lot M was 270 mm/day. Although there is no direct conversion to traditional percolation test rates, this is a range roughly equivalent to a 10 minute/2.54 cm percolation speed.  $K_{fs}$  is generally considered to be approximately  $\frac{1}{2}$  of the soil hydraulic conductivity,  $K$ .

Based on the assumed highest soil hydraulic conductivity of approximately 0.6 m/day, an assumed average hydraulic gradient of 0.05 (from measured onsite slope), and a soil porosity of 25%, the effluent velocity in the soils was calculated using the following equation:  $V = Ki/n$  where:  $K$  = hydraulic conductivity, ( $2 \times K_{fs}$ ),  $i$  = hydraulic gradient and  $n$  = the estimated porosity of the sandy soils.

The average velocity of groundwater in the soils on Lot M is calculated to be approximately 0.12 metres/day.

#### Lot M Remainder

The general soil profile on Lot M Remainder is similar to Lot M; a thin layer of forest debris, underlain by dark brown loam to approximately 15 cm to 18 cm underlain by a loamy sand which was loose, tan and saturated below 55 cm.

The measured field-saturated hydraulic conductivity of the one permeability test completed on Lot M Remainder was 248 mm/day.

#### **Wastewater Treatment Levels**

A Type 1 wastewater system is only septic tank treated effluent with total suspended solids (TSS) and five day biochemical demand (BOD<sub>5</sub>) on the order of 150-300 milligrams per litre (mg/L) and 150-250 mg/L, respectively. BOD<sub>5</sub> is a measure of the oxygen use of the microbes within the effluent.

Type 2 effluent reduces the effluent concentrations of TSS and BOD<sub>5</sub> to less than 45 mg/L.

Typically, fecal coliform concentrations from a septic tank range from 10<sup>3</sup> to 10<sup>4</sup> colony forming units (CFU) per 100 millilitres. Type 3 effluent standards call for TSS and BOD<sub>5</sub> to be <10 mg/L and reduction of the fecal coliforms to less than 400 CFU per 100 milliliters.

These bacterial standards are generally achieved with tertiary treatment, i.e. – a UV light or placement of a greater depth of engineered sand under the dispersal field (passive Type 3). Each higher level of treatment allows a significant reduction in the size of the dispersal field.

#### **Discussion**

Wet season water table elevations on Lot M and Lot M Remainder are approximately 55 cm below grade.

The groundwater velocity on lot M averages 0.12 m/day. The new wastewater system on Lot M will be located at the north end of the property, more than 60 metres from the watercourse. This indicates the travel time for the effluent to reach the watercourse will be more than 14 days. Fourteen days is the generally accepted time for full polishing and natural attenuation of Type 1 effluent in the native soils.

Due to the lower hydraulic conductivity of the soils, the elevated winter groundwater table and the sensitive nature of the project, H<sub>2</sub>O has prepared a preliminary design incorporating a passive Type 3 treatment for the wastewater system for the site.

The system would incorporate a 4,546 litre septic tank for each duplex unit, and all tanks would gravity feed, if achievable, to an 11,365 litre equalization tank. A Bionest BN 1250 Bioreactor in a 11,365 concrete tank would receive the effluent pumped from the equalization tank.

The Bionest is a suspended media treatment system which will produce effluent in the range of 10 mg/L BOD and 10 mg/L TSS. It incorporates numerous micro-pore aerators within the treatment chamber and a recirculation system to significantly reduce nitrogen in the effluent.

The effluent would then be gravity fed to a 11,365 litre concrete pump tank where it would be time dosed to the dispersal fields. The dispersal fields would use a pressurized distribution arrangement to optimize treatment in the existing soil conditions and avoid soil saturation. Time dosing spreads the application of effluent over an entire 24 hour period versus dosing the field only at peak time uses such as in the morning and evening.

Based on the new SPM, the dispersal fields for the development would be two sand mounds of approximately 38 metres in length east to west and approximately 2.2 metres wide each. The sand mounds would be separated by approximately 2.5 metres, north to south. The mounds would be approximately 90 cm in height when final grading was completed.

There is adequate area available for both primary and reserve disposal fields on Lot M and for a reserve field on the Lot M Remainder.

### **Conclusions**

Lot M is smaller than allowed by Island Health policies. Seasonal high groundwater elevation is approximately 55 to 60 cm below grade. H<sub>2</sub>O has designed a passive Type 3 wastewater system that will satisfy the intent of the Island Health policies regarding public health and environmental safety. The wastewater system will be able to safely collect, treat and disperse the effluent from the 8 planned duplex units.

Due to the soil characteristics and the grades onsite, the travel time is more than adequate to ensure there is minimum risk that the treated effluent will negatively impact the neighbouring properties or the onsite watercourse.

Type 3 treatment level through additional engineered sand below the dispersal mounds and nitrogen reduction in the Bionest treatment system will also mitigate negative effects on the watercourse and the receiving environment.



Remainder Lot M lot has sufficient soil and area to allow for a reserve dispersal field should the current dispersal field fail in the future. To alleviate that possibility,

estimated effluent flows from the existing residence have been incorporated into the design for the development.

**Closure**

H<sub>2</sub>O is pleased to provide you with this letter regarding the soil conditions on proposed Lots M and Lot M Remainder on Denman Road on Denman Island. Please call with any questions you may have regarding this information.

**H<sub>2</sub>O Environmental Ltd.**

Per:  

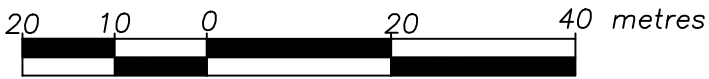
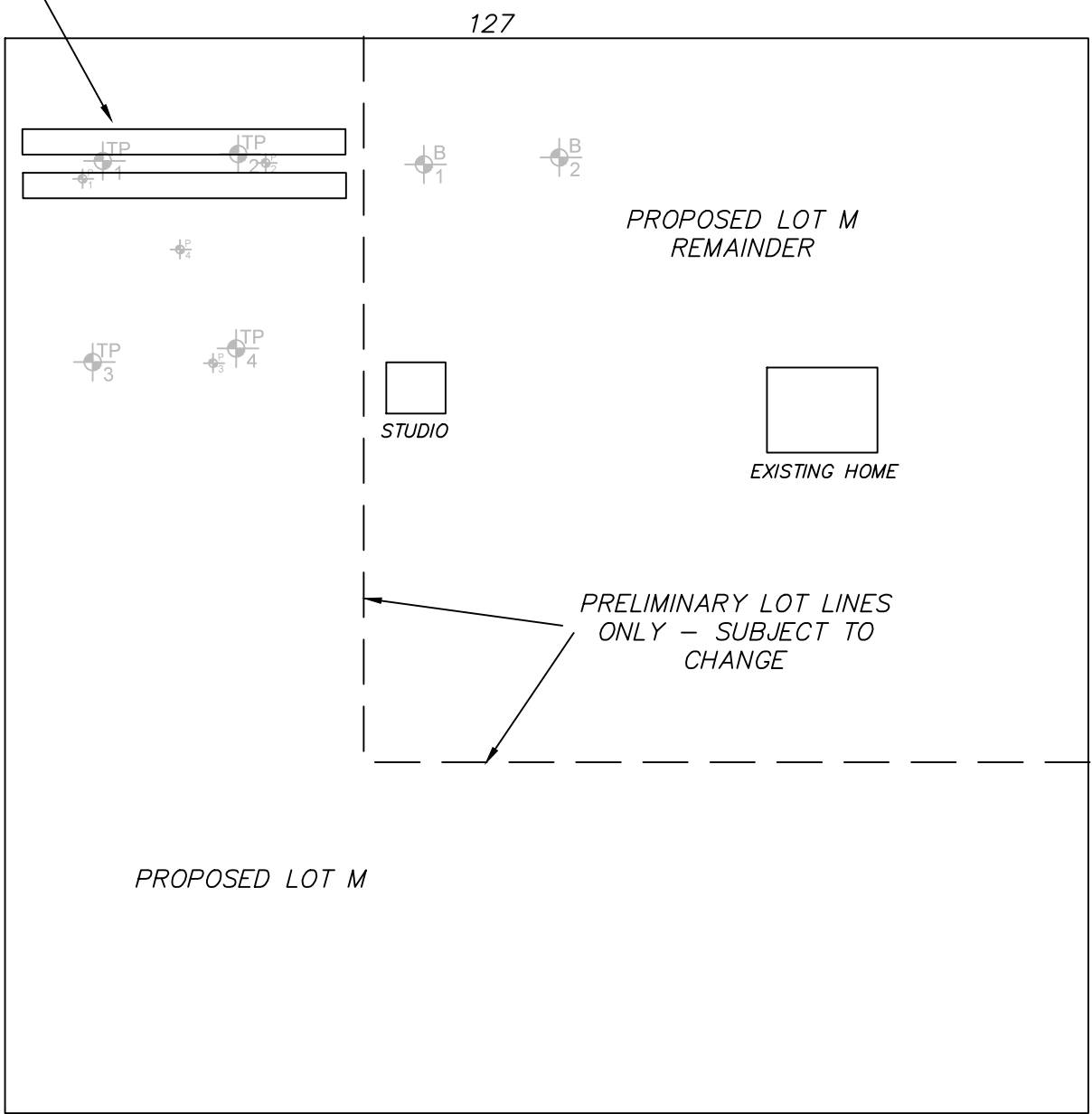
Steven M. Carballeira, P. Geo.

Attachments:  
Figure 1

**NOTES:**  
 1. Size and location of lot and buildings are approximate.  
 2. This drawing is not a legal boundary survey and should be used only for wastewater reference purposes.  
 3. All measurements in metres.



TWO SAND MOUND  
DISPERSAL FIELDS



	TITLE:	SITE PLAN WITH PRELIMINARY DISPERSAL FIELD LOCATION		DATE:	JAN. 22, 2016
	PROJECT:	WASTEWATER ASSESSMENT DENMAN ROAD, DENMAN ISLAND		DRAWN BY:	SMC
	CLIENT:	DCLTA		CHECKED BY:	SMC
				SCALE:	AS SHOWN
			PROJECT NO:	14-12	FIGURE 1