

ELANCO ENTERPRISES LTD.

Permit to Practice No: 1001505

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File: 355

June 23, 2026

Davies and McMorran Families.

5445 Campbell Road.

Hornby Island, B.C.

V0R 1Z0

Attention: Katherine Davies.

via e-mail

Re: Assessment of Potential for Reducing the setback Distance from a Sewage Effluent Dispersal Field to a Neighbour's well on 5445 Campbell Road Property, Hornby Island.

This is a revised version of a report issued on April 16, 2026. The revisions made were to correct the legal description on page 1 and in the middle of page 2, to refer to the Property Well as number 134397 and not 134397. Also, an updated version of the Ron McMurtrie & Associates wastewater system filing is included in Appendix B. The remainder of the report has not been changed.

As requested, the writer has conducted a hydrogeologic assessment of the area on and around the subject property and has reviewed the drawings prepared for siting of a proposed new Type 1 wastewater treatment and dispersal system on the subject property. The purpose of this assessment was to determine if it would be safe to locate the dispersal field at distance of less than 30m from a neighbour's well. The minimum allowable horizontal distances from a sewage effluent dispersal field and system tanks are set out on Table II-19 of the BC Ministry of Health's Sewerage System Standard Practice Manual (see a copy of the table in Appendix A.). However, as indicated in this hydrogeological assessment report, it was necessary and is considered safe, to reduce the horizontal distance from the dispersal field to the neighbour's well.

The Property

The 0.23 hectare property (the Property) is located at 5445 Campbell Road in the Sandpiper Subdivision area on Hornby Island (see Figs. 1 and 2). The legal description is Lot 215, Plan 224327, Section 1, Hornby Island, Nanaimo Land District, PID 003-011-305.

Work Carried out

This study involved visiting the site on September 11, 2025 and March 21st, 2026, reviewing available information on surficial geology and well logs and the wastewater treatment system plans prepared by Ron McMurtrie, P.Eng of Ron McMurtrie & Associates Consulting Engineers. This was followed by determining the extent of a well capture zone, potential contaminant migration pathways and assessing the potential for effluent leaving the dispersal field having an impact on a neighbour's well water quality.

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Setback Reduction for Proposed Effluent Dispersal Field from a Neighbour's Well -
Campbell Road, Hornby Island.

Topography and Drainage.

The Property slopes from Campbell Road to the back of the property at a slope of about 10% (see profile on Fig. 4). There are no well developed surface drainage channels on the Property.

Soils and Geology

Thirteen test pits were dug in the area of the proposed sewage effluent dispersal field (see locations on Fig. 3). This confirmed that the depths to bedrock ranged from 0.24 to 0.70 metres (m). A jar test confirmed that the soil overlying the bedrock comprised mostly of loam type soil. The regional soils map (1: 63,369 scale) prepared by the Canadian Department of Agriculture, mapped the local soils as Rough Mountainous Land (Rm) soils. This unit has variable drainage, is very stony and the soil thickness above bedrock is thin.

The regional bedrock geology map indicates that the sedimentary bedrock below the Property is a predominately a conglomerate with massive interbedded sandstone and minor mudstone which is mapped as Geoffrey Formation (see map and profile on Fig. 1).

Local Area Wells

The locations of wells in the area on and around the Property are indicated on Fig. 2. Most of the wells are mapped on the BC Provincial g-wells map. However, two of the wells mapped as part of this assessment are not indicated on the g-wells map and these have been identified as Wells A and B on Fig. 2.

The elevations of the water levels in the wells constructed in the area show a relatively consistent 8% gradient towards the ocean (see contour on Fig. 2 and profile on Fig. 4). The wells have estimated yields in the range 0.9 to 27 m³/day and depths ranged from 29.6 to 114.3 m (see Table I). The well on the Property (Well 134397) had the lowest estimated yield at 0.9 m³/day. The reported depth to static water level in Well 134397 at the time of its construction was 21.3m, however as this measurement was made soon after the well was constructed, it is estimated that due to the low yield it would have taken several hours for the true static water level to be established. It is estimated that the true depth to static level in this well would be about 15.5m below ground.

The depth to the water table below the effluent dispersal field is about 13m (see Fig. 4)

No log of the drilled well on the northern neighbour's property drilled well was available (Well A, see Photo 4 and Figs. 2 and 3). Also there was no log available for Well B.

Proposed Wastewater Treatment System

As set out in the report prepared by Ron McMurtrie, P.Eng. in support for a wastewater system filing document, the estimated maximum discharge will be 1,900 litres per day (L/d). The treated sewage effluent is to be discharged via a dosing system into a sand mound. The

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Setback Reduction for Proposed Effluent Dispersal Field from a Neighbour's Well -
Campbell Road, Hornby Island.

location and the extent of the sand mound is indicated on Figs. 2 and 3. The estimated hydraulic loading rate at the top of the sand mound is about 29 L/day/m² which is below the 40 L/day/m² maximum set out in the Standard Practice Manual for Type 1 effluent flowing into a sand mound. The hydraulic loading rate for Type 2 effluent discharging from the bottom of the sand mound into the natural loamy soil is also about 29 L/day/m² which is below the 50 L/day/m² maximum set out in the Standard Practice Manual. The design details for this dispersal field are set out in Appendix B.

Mr. McMurtrie conducted a pathogen reduction analysis using the 2005 Minnesota Pollution Control Agency's methodology and determined that by the time the effluent passed through the sand mound and 0.25m of loamy soil and reached the bedrock surface, little to no pathogens will be present in the effluent.

The depth to the water table in the fractured sedimentary bedrock below the dispersal field is about 13m (see Fig. 4), and passage through this fractured bedrock could potentially provide an opportunity for further removal of pathogens and contaminants in the discharge from the dispersal field.

As the size of the Property is relatively small, it is not feasible to locate the wastewater dispersal field in an area which meets the minimum standard horizontal separation distances to all wells in the area. For this reason, a capture zone analysis around one of the neighbour's wells was performed as set out in the next section.

Well Capture Zone Analysis.

As set out in the proposed wastewater system design, the north neighbour's well will be located about 22m from the dispersal field. While there is no log available for the construction of this 150mm diameter drilled well, the logs of the wells located south of the well provides an indication of its likely depth, nature of the bedrock penetrated and yield from the well. Using this information and a conservative daily volume of water pumped (1.5 m³/day) the extent of the capture zone for this well was estimated. As set out on Table II, this shows that the width of the zone is about 11m and the down slope distance is about 1.7m. This confirms that the capture zone does not extend under the dispersal field and that reducing the horizontal distance to the neighbour's well from the dispersal field from 30 to 22m will not pose a health hazard (see probable extent of the capture zone on Fig 2).

Conclusions

1. As the size of the Property is relatively small, it is not feasible to locate the wastewater dispersal field in an area which meets the minimum standard horizontal separation distances to all wells.

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Setback Reduction for Proposed Effluent Dispersal Field from a Neighbour's Well -
Campbell Road, Hornby Island.

2. The waste water treatment system, including the dispersal field and the underlying unsaturated sand, will remove most, if not all, of the organic and microorganisms from the sewage effluent prior to it reaching the bedrock surface.
3. The depth to the water table in the fractured sedimentary bedrock below the dispersal field is about 13m, and passage through these fractures could potentially provide an opportunity for further removal of pathogens and contaminants in the discharge from the dispersal field.
4. A capture zone analysis confirmed that the zone does not extend under the dispersal field. This confirmed that reducing the horizontal distance to the neighbour's well from the dispersal field from 30 to 22m will not pose a health hazard.

Limitations.

This investigation has been conducted using a standard of care consistent with that expected of scientific and engineering professionals undertaking similar work under similar conditions in B.C. No warranty is expressed or implied.

I trust that this sufficient for your present purposes.

Elanco Enterprises Ltd.

Yours very truly



Allan Dakin, P. Eng.

Senior Groundwater Engineer.



Cc Ron McMurtrie, Ron McMurtrie & Associates

Photos

Photos taken by A, Dakin while visiting the site on March 21, 2026

(See orientations on Fig 2)



Photo. 1 Proposed effluent dispersal mound area.



Photo 2. The Property well (Well 134397)



Photo. 3 A neighbour's well – under the green cap (Well 40536).

Tables

Table I
Information on Wells Located on Fig. 1

Well Tag Number	Construction Start Date	Address		Depth to (m)				Elevation (m-asl)					Yield
		No	Street	Bedrock	SWL	PWS	Bottom	Ground	Bedrock	SWL	PWS	Bottom	m ³ /day
40536	1-Sep-78	5575	Porpoise Crescent	1.2	na	48.8	48.8	18	16.8	na	-30.8	-30.8	2.7
40743	Oct-78		Porpoise Crescent	1.8	na	49.4	49.4	12	10.2	na	-37.4	-37.4	27.2
48328	20-Jun-81	5360	Campbell Road	0.3	5.5	42.7	45.7	26	25.7	20.5	-16.7	-19.7	21.7
49026	5-Sep-81	5400	Campbell Road	0.6	7.9	27.4	29.6	27	26.4	19.1	-0.4	-2.6	27.2
56013	20-May-86	5540	Harby Road	0.0	12.2	29.0	30.5	31	31.0	18.8	2.0	0.5	16.3
70583	27-Oct-92	5565	Porpoise Crescent	0.0	na	113	114.3	20	20.0	na	-92.8	-94.3	16.3
88715	2-Nov-05	5435	Porpoise Crescent	0.0	na	70.1	73.2	17	17.0	na	-53.1	-56.2	8.2
119842	12-Jun-89	5405	Porpoise Crescent	0.0	na	na	45.7	17	17.0	na	na	-28.7	na
134397	11-Dec-25	5445	Campbell Road	1.2	21.3	56.4	56.4	23	21.8	1.7	-33.4	-33.4	0.9
Well A	na	na	na	na	na	na	na	na	na	na	na	na	na
Well B	na	na	na	na	na	na	na	na	na	na	na	na	na

PWS = Principal water strike in a fracture

na = No information available

Property well

SWL = static water level at time of well construction

Notes

- 1) See locations of wells on Fig. 2
- 2) Well information with exception of ground elevations from BC Government g-wells database.
- 3) Ground elevations from Google Earth except well on Property that was surveyed.
- 4) All are 150mm diameter drilled wells.

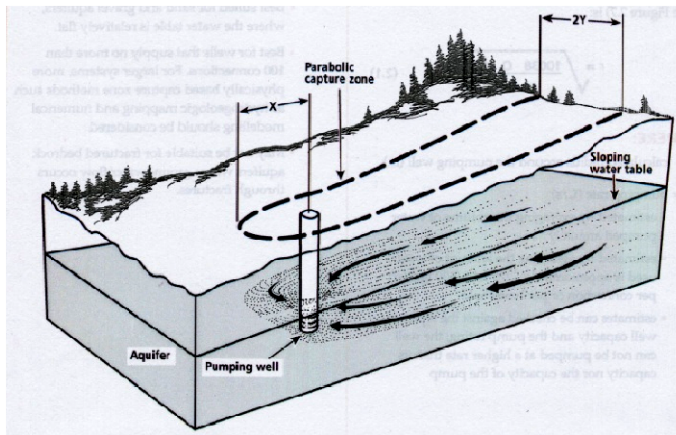
Table II

Capture Zone Analysis for Well A on 5405 Campbell Road Property

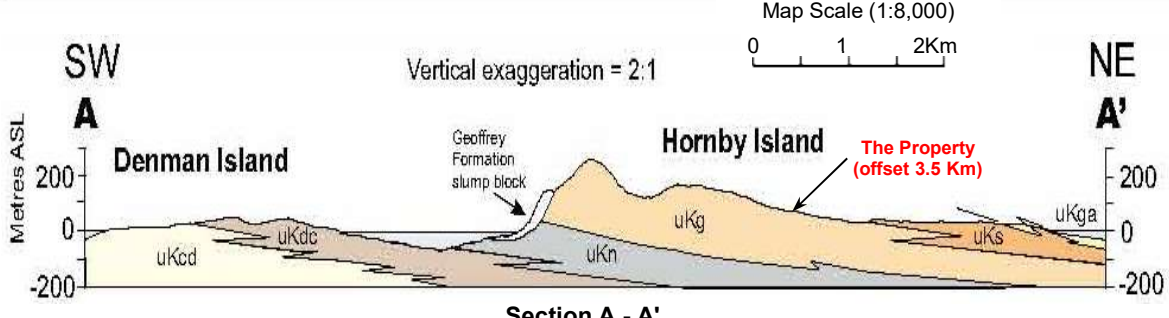
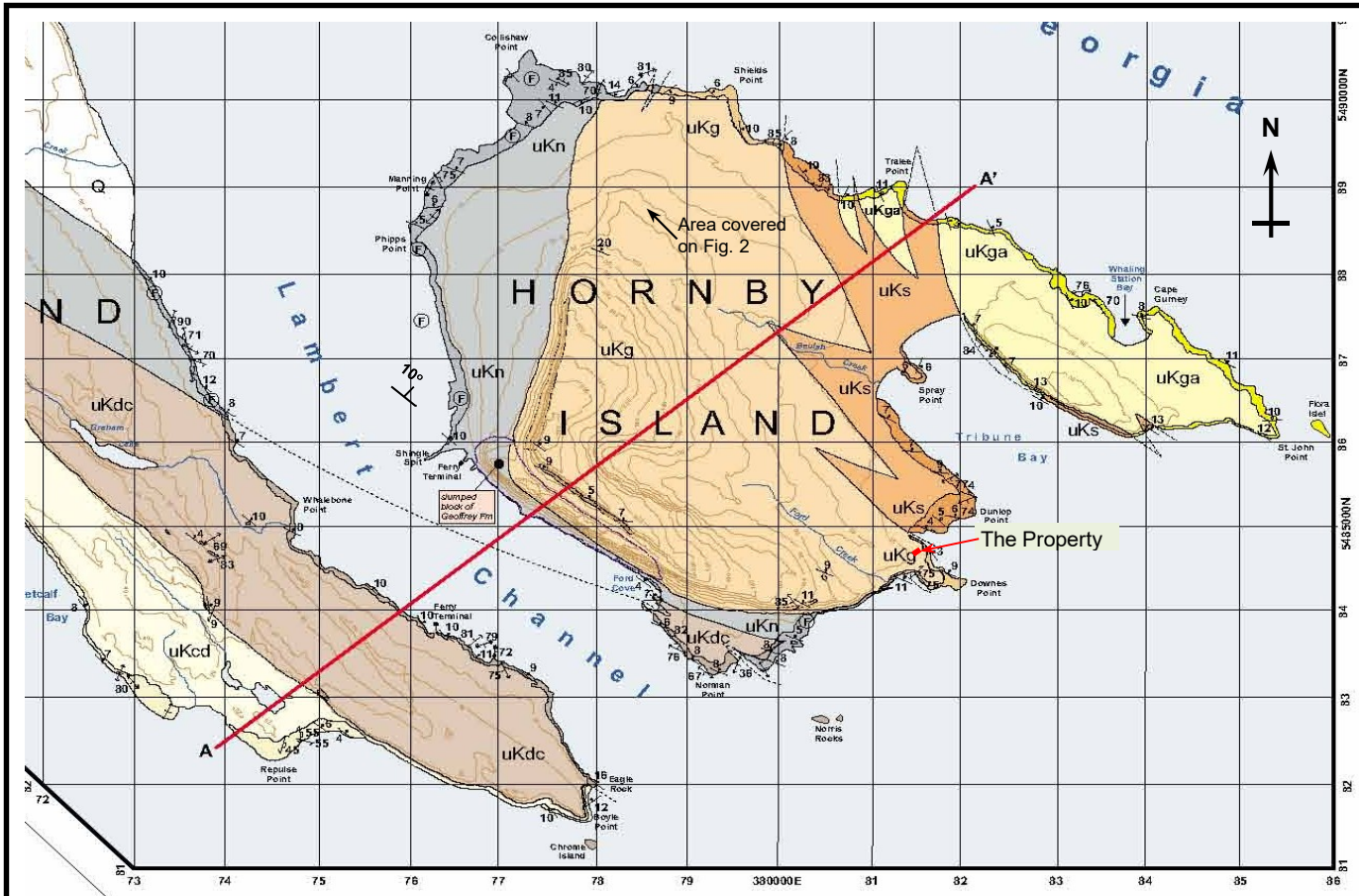
Formula	Symbol	Parameter	Note No	Value	Unit
$Y = Q/2T/i$	Q	Pumping rate	1	1.50	m ³ /d
				0.00002	m ³ /s
				0.017	L/s
				0.3	gpm
				398	gpd
	K	Hydraulic Conductivity	2	1.0E-06	m/s
T				Aquifer thickness	3
T	Transmissivity			2.0E-05	m ² /s
				1.7	m ² /d
	i	Gradient	4	0.08	
	Y	half width	5	5.43	m
	2Y	Width		10.85	m
$X = Y/\pi$	x	down distance	5	1.73	m

Notes:

- 1) Assumes a constant pumping rate based on the conservative water consumption value for a typical home.
- 2) Typical hydraulic conductivity of fractured sedimentary bedrock
- 3) Minimum aquifer thickness (see Fig. 4)
- 4) Average gradient between local area wells (see Fig. 4).
- 5) See dimension illustration below
- 6) No log of the well was available and depth was assumed to be similar to one of the shallowest wells.



Figures



uKg **uKg**
exposed covered

GEOFFREY FORMATION: Thick-bedded, channelized, clast-supported pebble-cobble conglomerate containing predominantly mafic and felsic extrusives and mafic intrusive clasts; in a matrix of medium-grained, light olive grey sandstone. Conglomerate is interbedded with medium- to coarse-grained, light olive grey, massive, parallel and current ripple laminated, thick-bedded sandstone (feldspathic litharenite); minor mudstone.


uKs **uKs**
exposed covered

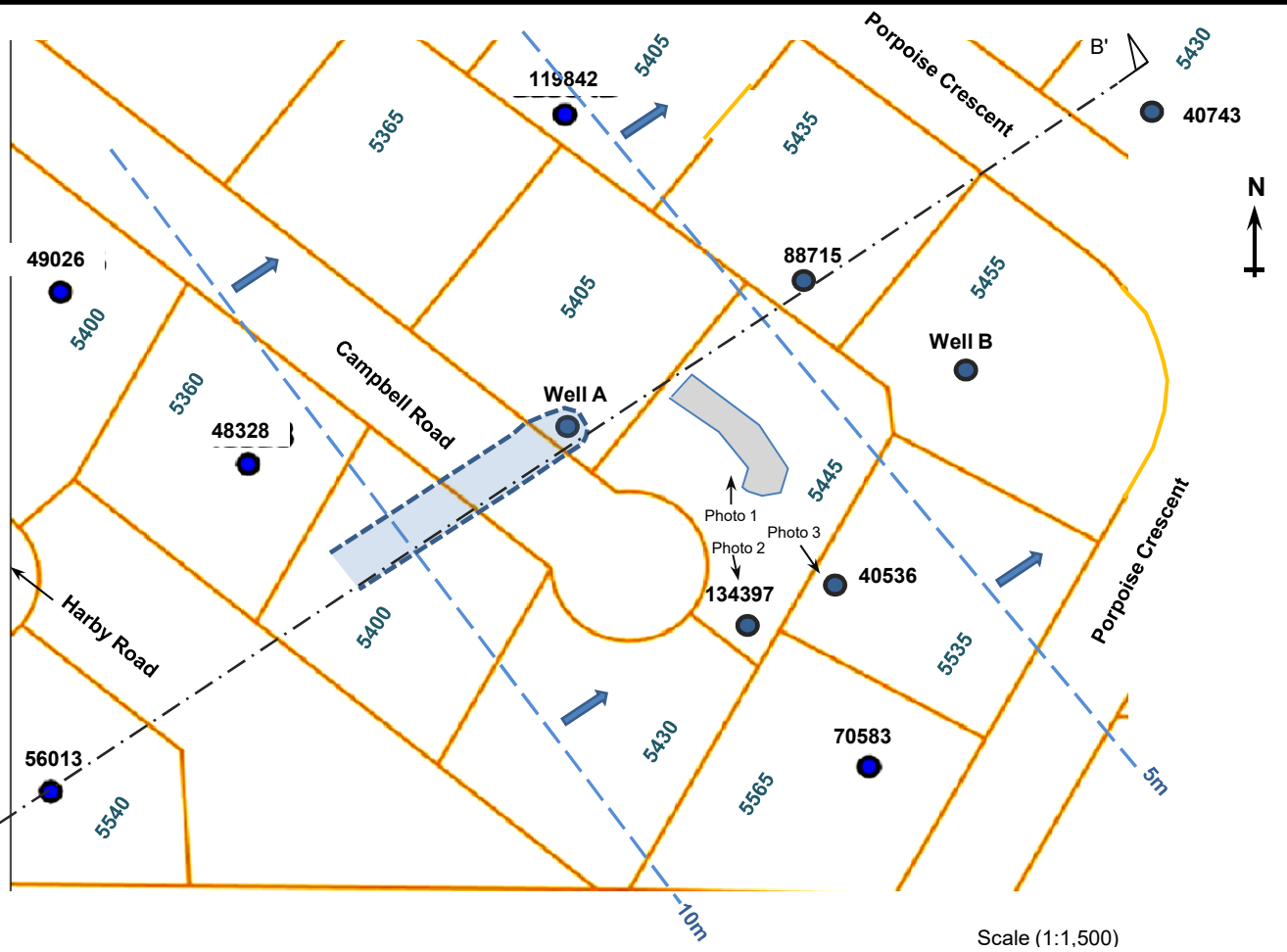
SPRAY FORMATION: Massive, olive grey mudstone (65%) intercalated with thin- to locally thick bedded, light olive grey, massive, parallel and current ripple laminated sandstone (feldspathic litharenite to lithic arkose arenite, 35%) containing 5-7% detrital mica.

uKga **uKga**
exposed covered

GABRIOLA FORMATION: Thick-bedded, channelized, clast-supported, pebble-cobble conglomerate containing predominantly mafic and felsic extrusive clasts; interbedded with medium-grained, poorly to moderately sorted, light olive grey, massive sandstone (feldspathic litharenite) with 5% detrital mica; minor mudstone

NOTES
1) Base map from Katnick, D.C. and Mustard, P.S. 2001

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Assessment of Setback Distance Between Wastewater Dispersal Field and Water Supply Well, 5445 Campbell Road, Hornby Island, B.C.	Regional Geology Map and Profile		Drawn: RAD	Date: Apr. 2026
			Approved: 	Fig. 1

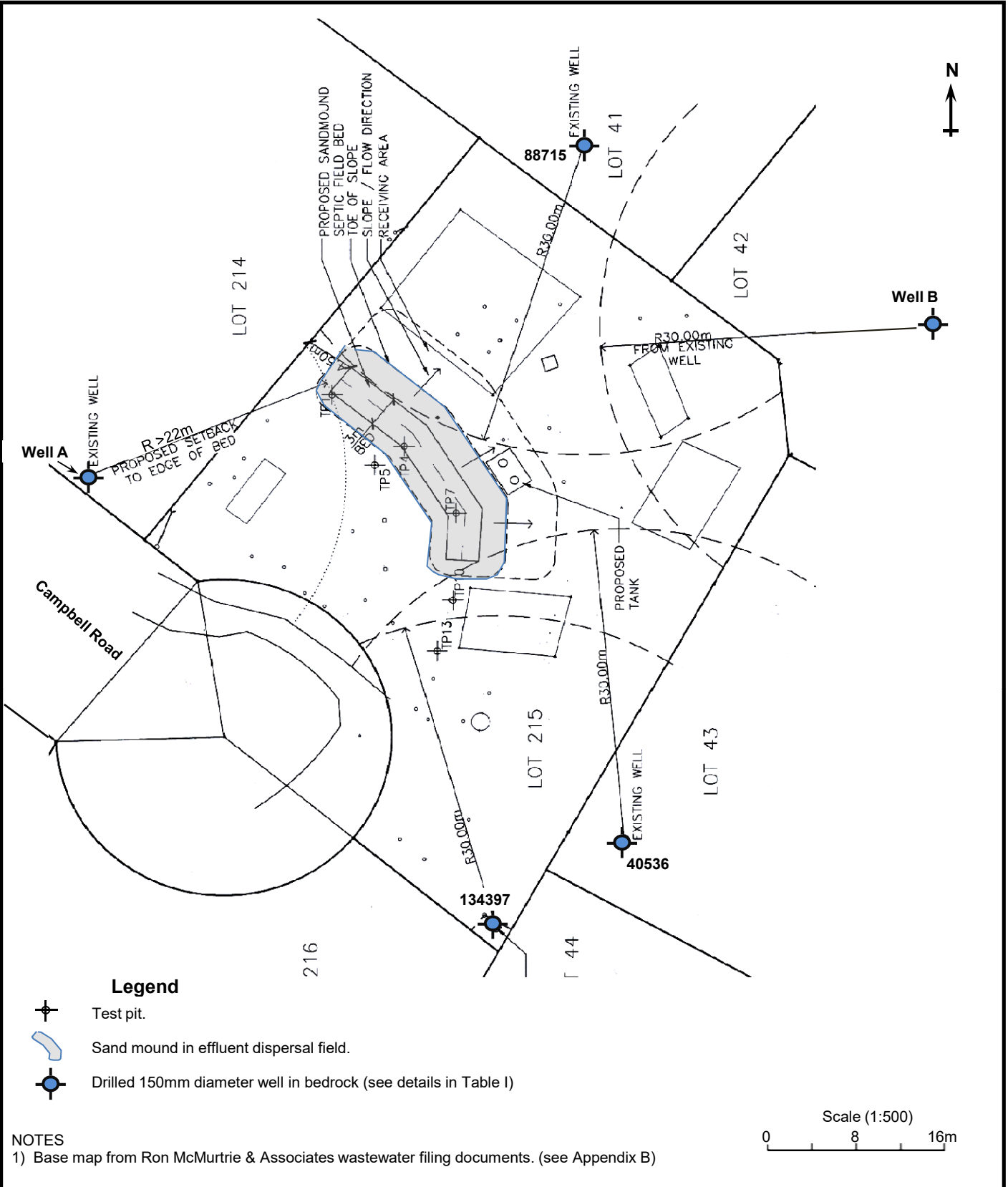


Legend

- Interpreted groundwater flow direction in bedrock aquifer.
- Approximate water table elevation (m-asl)
- Water well from MOE wells Database with indicated well tag number.
- Hydrogeologic Section (See Fig. 4)
- Potential extent of well capture zone around Well A (See calculations on Table II)
- Sand mound in effluent dispersal field.

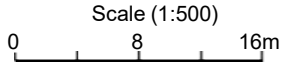
NOTES
 1) Base map from BC Ministry of Environment's g-wells data base.
 2) Well locations are approximate.

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<p>Assessment of Setback Distance Between Wastewater Dispersal Field and Water Supply Well, 5445 Campbell Road, Hornby Island, B.C.</p>	<p>Property Location Map.</p>		<p>Drawn: RAD Date: Apr. 2026 Approved: Fig. 2</p>

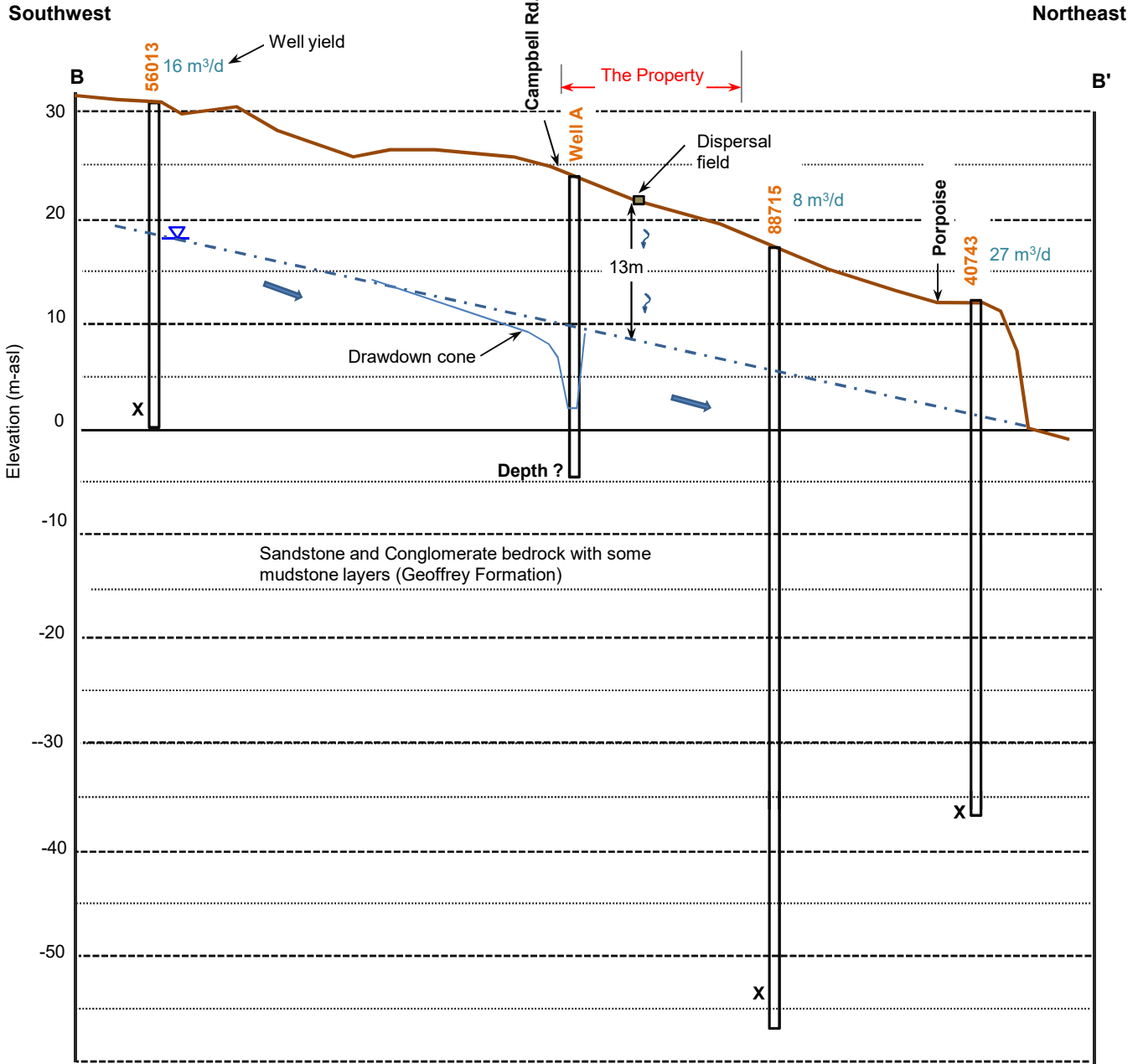


- Legend**
- Test pit.
 - Sand mound in effluent dispersal field.
 - Drilled 150mm diameter well in bedrock (see details in Table I)

NOTES
 1) Base map from Ron McMurtrie & Associates wastewater filing documents. (see Appendix B)



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<p>Assessment of Setback Distance Between Wastewater Dispersal Field and Water Supply Well, 5445 Campbell Road, Hornby Island, B.C.</p>	<p>Property Location Map.</p>	<p>Drawn: RAD</p>	<p>Date Apr. 2026</p>
		<p>Approved: </p>	<p>Fig. 3</p>



- Legend**
- Unsaturated water flow bedrock fractures
 - X** Principal water bearing fracture (PWS)
 - Interpreted groundwater flow direction
 - Well tag number (see data on Table I)
 - Well with indicated piezometric level
 - Unsaturated water flow in sand unit

Scale (1:2,000)
 0 30 60m
 Vertical exaggeration = 3.33

NOTES
 1) See location of section on Fig. 2 and details of wells on Table I.

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ELANCO ENTERPRISES LTD.
 Victoria, B.C. (250 744-1357)
 Permit to Practice No: 1001505

Assessment of Setback Distance Between Wastewater Dispersal Field and Water Supply Well, 5445 Campbell Road, Hornby Island, B.C.

HYDROGEOLOGICAL SECTION B - B'

Drawn: RAD	Date Apr. 2026
Approved: 	Fig. 4

Appendix A

Standard Practice Manual Guidelines for Horizontal Separation Distances and Information Required Where a Departure from the Guideline is Proposed.

Table II- 19. Minimum required horizontal separation distances

MINIMUM HORIZONTAL DISTANCE TO	FROM DISPERSAL SYSTEM	FROM WATERTIGHT TREATMENT OR PUMP TANK
	METRES	METRES
Water sources and wells		
Surface source of drinking water	30	15
Domestic water supply well ¹	30	30
Domestic water supply well, high pumping rate ²	60	30
Domestic water supply well, high pumping rate, in unconfined aquifer ²	90	30
Irrigation well or open loop geothermal well	15	7.5
Deep monitoring well or closed loop geothermal well ³	6	6
Shallow monitoring well ⁴	3	0
Drinking water lines and cisterns		
Drinking water suction line	30	15
Drinking water suction line, sleeved ⁵	7.5	3
Drinking water line, under pressure	3	3
Drinking water line, under pressure, sleeved ⁵	1	1
Drinking water supply cistern, below ground	15	3
Water bodies and surface breakout		
Permanent fresh water body ⁶	30	10
Intermittent fresh water body ⁷	15	10
Marine water body ⁸	15	7.5
Break-out point or downslope drain ⁹	7.5	0

Notes:

¹ For drinking water well, see the SSR s3.1 and Section II- 2.1.2.2 of this Manual for special considerations. Domestic water supply wells include excavated or dug wells.

² For definitions of "high pumping rate well" and "unconfined aquifer" see the glossary.

³ The horizontal separation to a deep monitoring well or to a closed loop geothermal well is based on a well with an annular seal that complies with the Ground Water Protection Regulation (GWPR). If the well does not comply with the GWPR, follow horizontal separation standards for drinking water wells.

⁴ The horizontal separation to a shallow monitoring well is based on a well which is shallower than 4.6 m and constructed with an annular seal that complies with the GWPR.

⁵ Sleeved water lines (suction or pressure) use continuous pipe sleeving within the normal standard HS to allow reduced HS, see Volume III for details.

Volume III Guidelines

III- 1 INTRODUCTION

This volume is intended to be used as a companion to Volume II (standards). It contains explanatory material to support the standards as well as guidelines for planning, installation and maintenance of onsite systems. This volume is not intended to be read without reference to Volume II.

The main headings of this volume correspond to main headings in Volume II (e.g. III-2.1 corresponds to II-2.1). In some cases minor headings in this volume may be stand-alone (e.g. III-4.1.3.1 does not have a corresponding section in Volume II).

This volume contains some simplified rationale statements; refer to Volume IV for further details of rationale and for the performance base used to develop the standards.

Nothing in this volume should be taken to overrule the standards set out in Volume II.

III- 1.1 Departure from Volume III guidelines

When departing from the **guidelines in this volume**, write out a rationale for that departure. In the rationale, explain the following:

- The reasons for departing from the SPM guidelines.
- Which SPM guideline is being varied or departed from.
- Why compliance with the guideline is deemed impractical.
- Reference to another source of standard practice or to a professional opinion that supports the alternative approach.
- Any other changes made to design or installation to compensate for the departure.
- How performance objectives have been considered.

III- 2 GENERAL GUIDELINES

III- 2.1 Existing systems and system repair

III- 2.1.1 EMERGENCY MEASURES

Notify the Health Authority of all situations that may present a health hazard (for example, sewage surfacing on the land or discharging into a body of water or a water supply). This allows the Health Authority to provide guidance on measures to prevent or contain the hazard.

Emergency measures to reduce a health risk could potentially include:

- Placing cover soil over a breakout area; or
- building a temporary dispersal trench or bed to divert flows during repair.

If it is not practical to reduce the risk from a malfunctioning system, then recommend to the owner that they use pump and haul until the system can be repaired.

Inform the owner that the system should be permanently repaired as soon as is feasible, and in any case within 12 months. The Health Authority may issue an order to repair sooner than 12 months, depending on the circumstances.

Appendix B

Wastewater System Filing Prepared by Ron McMurtrie, P.Eng.

Ron McMurtrie and Associates, Consulting Engineers

Wastewater System Specialists

Comox/Hornby Island, BC 250-335-2685

jasbreez@island.net

Client: Davies et al Job No: 0110 5445 Campbell Road, Hornby Island

Date: 2026-06-23

By: RM

PRELIMINARY DRAINFIELD DESIGN

Design Calculations

	<u>Design</u>	<u>Unit</u>	
Peak Design flow (DDF):	1,900	Lpd	
Peaking factor:	2.0		
Estim. Average flow (ADF):	950	Lpd	
Treated Effluent type:	Type 1	(Septic Tank)	

Drainfield Design:

Native Soil Vertical Separation (VS):

<i>Limiting Layer</i>	29	cm	<i>bedrock TP1</i>
SPM standard:	25	cm	sand mound

As-designed Vertical Separation

Trench depth:	-45	cm	mound sand
<i>Total VS, as-designed:</i>	74	cm	
SPM standard:	60	cm	micro-dose to sand mound

Loading rates as designed:

Mound Sand Surface

Effluent Type	1		
Length:	20	m	
Width:	3	m	
Infiltration Area:	60.0	sqm	
<i>Soil HLR (peak):</i>	31.7	Lpd/sqm	
SPM recommended:	40	Lpd/sqm	Type 1 to Mound Sand

Native Soil infiltration surface

Effluent Type	2		at base of sand mound
Length:	20	m	
Width:	3	m	
Infiltration Area:	60.0	sqm	
<i>Soil HLR (peak):</i>	31.7	Lpd/sqm	
SPM recommended:	50	Lpd/sqm	Type 2 to Loam Favourable

Hydraulic application rate (Dosing Frequency)

Pumping rate	215	lpm	
Pump ON time	0.5	minutes	
Dose volume	107.5	litres	
Number of fields	1.0		
Number of zones	1.0		

<i>Dose Frequency at DDF:</i>	18	<i>doses/day</i>	
SPM recommended:	18	doses/day	Micro dose 45cm mound sand
<i>Custom guided performance design - see pathogen reduction calculations attached</i>			
<u>Lineal loading rate</u>			
Bedrock slope	10	%	
Soil Depth	57	cm	Average in dispersal area
Soil Type	Loam	Favourable	
Contour Length	20	m	
<i>LLR (peak):</i>	<i>95</i>	<i>Lpd/m</i>	
SPM recommended maximum:	55	Lpd/m	
Custom recommended maximum	110	lpd/m	*Reference below
<i>*Higher Linear Loading Rates based on Water Table Mounding Measured during Full-scale Multi-day Testing", Payne and Ralston, 2024</i>			
<u>Horizontal Setback distances:</u>			
	FIELD		
<i>Well</i>	<i>>22*</i>	<i>m</i>	
SPM recommended:	30	m	
<i>*Well setback reduction - see attached report by A. Dakin, P.Eng.</i>			
<i>Potential Breakout</i>	<i>>7.5</i>	<i>m</i>	
SPM recommended:	7.5	m	
<i>Waterline</i>	<i>>3</i>	<i>m</i>	
SPM recommended:	3	m	
<i>Marine High Water</i>	<i>>150</i>	<i>m</i>	
SPM recommended:	15	m	
	TANK		
<i>Well</i>	<i>>30</i>	<i>m</i>	
SPM recommended:	30	m	
<i>Waterline</i>	<i>>3</i>	<i>m</i>	
SPM recommended:	3	m	
<i>Marine High Water</i>	<i>>150</i>	<i>m</i>	
SPM recommended:	7.5	m	

Ron McMurtrie and Associates, Consulting Engineers

Wastewater System Specialists

Comox/Hornby Island, BC 250-335-2685

jasbreez@island.net

Client: Davies et al
 Job No: 1110
 Project Address: 5445 Campbell Road, Hornby Island
 Date: 2026-06-08
 By: Ron McMurtrie, P.Eng.

<u>Pathogen Reduction in Unsaturated Soil</u>		
<i>Method: Design Guidance (Minnesota Pollution Control Agency, 2005).</i>		
<i>FCB = Fecal coliform bacteria (as indicator of pathogen density)</i>		
	Daily Design	
	Flow (DDF)	
	<u>1,900</u>	litres / day
Layer 1: C33 Mound Sand		
Mound Sand	<u>Sandy Soil Class</u>	
Pathogen density (FCB) in effluent:	<u>1,000,000</u>	CFU / 100 mL
Pathogens as a log value, top of Layer 1:	<u>6.00</u>	
Estimated reduction in FCB in clogging mat:	<u>2.0</u>	log reduction
Dosing frequency:	<u>18</u>	doses / day
Soil HLR:	<u>32</u>	mm / day
	<u>0.78</u>	US gpd / sqft
FCB reduction in unsaturated soil (from chart):	<u>0.18</u>	log / inch
Soil depth	<u>45</u>	cm
Log reduction of FCB in Layer 1:	<u>3.19</u>	log
Expected FCB density at bottom of Layer 1:	<u>0.81</u>	log
	<u>6.47</u>	CFU / 100 mL
Layer 2: Native Basal Soil		
Loam	<u>Loamy Soil Class</u>	
Pathogen density (FCB) in effluent:	<u>6.47</u>	CFU / 100 mL
Pathogens as a log value, top of Layer 2:	<u>0.81</u>	
Estimated reduction in FCB in clogging mat:	<u>0.0</u>	log reduction
Dosing frequency:	<u>18</u>	doses / day
Soil HLR:	<u>32</u>	mm / day
	<u>0.78</u>	US gpd / sqft
FCB reduction in unsaturated soil (from chart):	<u>0.22</u>	log / inch
Soil depth	<u>25</u>	cm
Log reduction of FCB in Layer 2:	<u>2.17</u>	log
Expected FCB density at bottom of Layer 1:	<u>-1.35</u>	log
	<u>0.044</u>	CFU / 100 mL
<u>Conclusion</u>		
<10 CFU/100ml at base of sand mound/top of native soil		
Approaches non-detectable at limiting layer = 25cm depth in native loam soil.		