

June 29, 2009

H₂O File: 9-13

Mr. Rick Shellinck
P.O.Box 4
Merville, BC V0R 2M0

**Re: Soil Assessment for Wastewater
Areas A to E on District Lot 208, Quadra Island**

Introduction

H₂O Environmental Ltd. (H₂O) was retained by you to log and describe testpits for subdivision wastewater disposal purposes on several areas of the above referenced property (site). H₂O has prepared this letter to describe the onsite soils from the inspections completed on March 25 and April 8, 2009.

H₂O understands that this investigation is part of a proposal for site rezoning and the soil investigation has been completed to determine the feasibility of onsite soils for wastewater disposal.

Subdivision Requirements

The size of the wastewater areas are based on the estimated flows from the proposed homes, based on number of bedrooms and size of home¹. The Vancouver Island Health Authority (VIHA) regulates the length of disposal piping which determines the size of covenants for strata properties². The various strata subdivisions will consist of homes with not more than three bedrooms each. According to the *Subdivision Standards*, one half of the required disposal piping is to be installed and the area for the remainder to be set aside as reserve. The size of the covenants for each strata lot is described under each separate area below. The attached Figure 1 presents the various areas of proposed wastewater disposal and the lots with which they are associated.

¹ British Columbia Onsite Sewage Association - *The Sewerage System Standard Practice Manual (Version 2)*, 21 September, 2007, prepared for the Ministry of Health

² Vancouver Island Health Authority - *Subdivision Standards*, April 2009

Testpit and General Soil Description

The testpit numbers within each area may not be consecutive but are located within the area under discussion. Detailed testpit logs are attached to this letter report.

Area A - Area A is generally flat with a slight (<1%) grade both to the east and to the west. Six testpits (TP-4, 5, 6, 7, 13 & 14) and two permeability test locations (P-3 & P-7) were included in Area A.

The general soil profile of Area A consists of a thin sandy forest debris layer with organic materials which exhibited numerous rootlets and extended from approximately 2 cm to 10 cm. This is underlain by a medium grained sand and gravel which was loose, red and dry and extended to depths of up to 130 centimetres (cm) below grade. Roots were observed down to a maximum depth of 120 cm. A grey, coarse grained sand with some silt was encountered under the sand and gravel layer. This layer exhibited small cemented pockets of sand and was generally found to be dense below 140 cm.

The hydraulic conductivity of the soils in Area A ranged from 66 cm/day to 165 cm/day. These conductivities can be roughly equated with percolation times of 5 to 8 minutes per 2.54 cm. No standing water was observed in any of the testpits in Area A.

Area A is proposed for the disposal of wastewater from 13 strata lots located on fee simple Lot 6. This 13 lot strata subdivision will consist of homes with not more than three bedrooms each and will have a total estimated daily design flow of 17,720 litres. This volume of effluent will require approximately 590 m of disposal piping in the onsite sandy soils. One half of the disposal piping is to be installed and the area for the remainder to be set aside as reserve.

The area set aside for the wastewater disposal fields for Lot 6 measures 65 m across the slope and 25 m deep. Given a 65 m length for the wastewater disposal laterals, the width required for the full 590 m of disposal piping with a 3 m separation of laterals would be 24 m. Area A would fulfill the VIHA requirements for a sufficient wastewater designated covenant area for primary and reserve disposal fields.

Area B - Area B is located adjacent to the south of Area A and is also generally flat with a slight (<1%) grade both to the east and to the west. Five testpits (TP-8, 9, 10, 11 & 12) and three permeability test locations (P-4, P-5 & P-6) were included in Area B.

The general soil profile of Area B consists of a thin sandy forest debris layer with organic materials which exhibited numerous rootlets and extended from approximately 2 cm to 10 cm. This is underlain by a medium grained sand and gravel which was loose, red and dry and extended to depths of up to 120 cm (TP-9) below grade. Roots were observed down to a maximum depth of 120 cm. A grey, coarse grained sand with some silt was encountered under the sand and gravel layer. This layer exhibited small cemented pockets of sand and was generally found to be dense below 120 cm.

The hydraulic conductivity of the soils in Area B ranged from 74 cm/day to 115 cm/day. These conductivities can be roughly equated with percolation times of 6 to 8 minutes per 2.54 cm. Standing water was observed in TP-10 at approximately 145 cm.

Area B is proposed for the disposal of wastewater from 13 strata lots located on fee simple Lot 4. This 13 lot strata subdivision will consist of homes with not more than three bedrooms each and will have a total estimated daily design flow of 17,720 litres. This volume of effluent will require approximately 590 m of disposal piping in the onsite sandy soils.

The area set aside for the wastewater disposal fields for Lot 4 measures 45 m across the slope and 40 m deep. Given a 45 m length for the wastewater disposal laterals, the width required for the full 590 m of disposal piping with a 3 m separation of laterals would be 36 m. Area B would fulfill the VIHA requirements for a sufficient wastewater designated covenant area for primary and reserve disposal fields.

Area C - Area C has a grade downwards to the west/southwest of approximately 10%. Eight testpits (TP-20 through TP-27) and four permeability test locations (P-101 through P-104) were included in Area C.

The general soil profile of Area C consists of a thin sandy forest debris layer with organic materials which exhibited numerous rootlets and extended from approximately 2 cm to 20 cm. The forest debris layer is underlain by a fine to medium grained sand with some gravel and trace silt which was loose, red to tan and dry and extended to depths of up to 130 cm (TP-21) below grade. Roots were observed down to a maximum depth of 110 cm. A grey, coarse grained sand with some silt was encountered under the red to tan sand. This layer exhibited occasional cobbles to 30 cm and exhibited mottling at 130 cm (TP-21).

The hydraulic conductivity of the soils in Area C ranged from 107 cm/day to 453 cm/day. These conductivities can be roughly equated with percolation times of 1 to 5 minutes per 2.54 cm. Standing water was observed in TP-25 at approximately 140 cm below grade.

Area C is proposed for the disposal of wastewater from 14 strata lots located on fee simple Lot 7. This 14 lot strata subdivision will consist of homes with not more than three bedrooms each and will have a total estimated daily design flow of 19,000 litres. This volume of effluent will require approximately 633 m of disposal piping in the onsite sandy soils.

The area set aside for the wastewater disposal fields for Lot 7 measures 32 m across the slope and 52 m deep. Given a 32 m length for the wastewater disposal laterals, the width required for the full 633 m of disposal piping with a 2 m separation of laterals would be 40 m. Area C would fulfill the VIHA requirements for a sufficient wastewater designated covenant area for primary and reserve disposal fields.

Area D - Area D has a downwards grade of approximately 10% to the east. Five testpits (TP-35 through TP-39) and two permeability test locations (P-203 and P-204) were included in Area D.

The general soil profile of Area D consists of a sandy forest debris layer with organic materials which exhibited numerous rootlets and extended to a maximum depth of approximately 30 cm (TP-36 & TP-39). This is underlain by a medium grained sand with trace gravel and silt which was loose, red and dry and extended to depths of up to 135 cm (TP-39) below grade. Roots were observed down to a maximum depth of 130 cm (TP-39). A grey/green, coarse grained sand was encountered under the sand layer. This layer exhibited small cemented pockets of sand below 130 cm (TP-37).

The hydraulic conductivity of the soils in Area D ranged from 124 cm/day to 143 cm/day. These conductivities can be roughly equated with percolation times of 3 to 5 minutes per 2.54 cm. No standing water was observed in any of the testpits in Area D.

Area D is proposed for the disposal of wastewater from 10 strata lots located on fee simple Lot 2. This 10 lot strata subdivision will consist of homes with not more than three bedrooms each and will have a total estimated daily design flow of 13,600 litres. This volume of effluent will require approximately 453 m of disposal piping in the onsite sandy soils.

The area set aside for the wastewater disposal fields for Lot 2 measures 60 m across the slope and 30 m deep. Given a 60 m length for the wastewater disposal laterals, the width required for the full 453 m of disposal piping with a 3 m separation of laterals would be 24 m. Area D would fulfill the VIHA requirements for a sufficient wastewater designated covenant area for primary and reserve disposal fields.

Area E - Area E also has a downwards grade of approximately 10% to the east. Five testpits (TP-30 through TP-34) and two permeability test locations (P-201 and P-202) were included in Area E.

The general soil profile of Area E consists of a sandy forest debris layer with organic materials which exhibited numerous rootlets and extended to a maximum depth of approximately 25 cm (TP-31). This is underlain by a medium grained sand with gravel and trace silt which was loose, red and dry and extended to depths of up to 130 cm (TP-30 & TP-31) below grade. Roots were observed down to a maximum depth of 130 cm (TP-31, TP-32 & TP-34). A grey/green, coarse grained sand was encountered under the sand layer. This layer exhibited small cemented pockets of sand and soil mottling below 110 cm (TP-32).

The hydraulic conductivity of the soils in Area E ranged from 156 cm/day to 164 cm/day. These conductivities can be roughly equated with percolation times of 4 to 5 minutes per 2.54 cm. No standing water was observed in any of the testpits in Area E.

At this time, Area E is considered to be an additional potential wastewater disposal site.

Conclusions

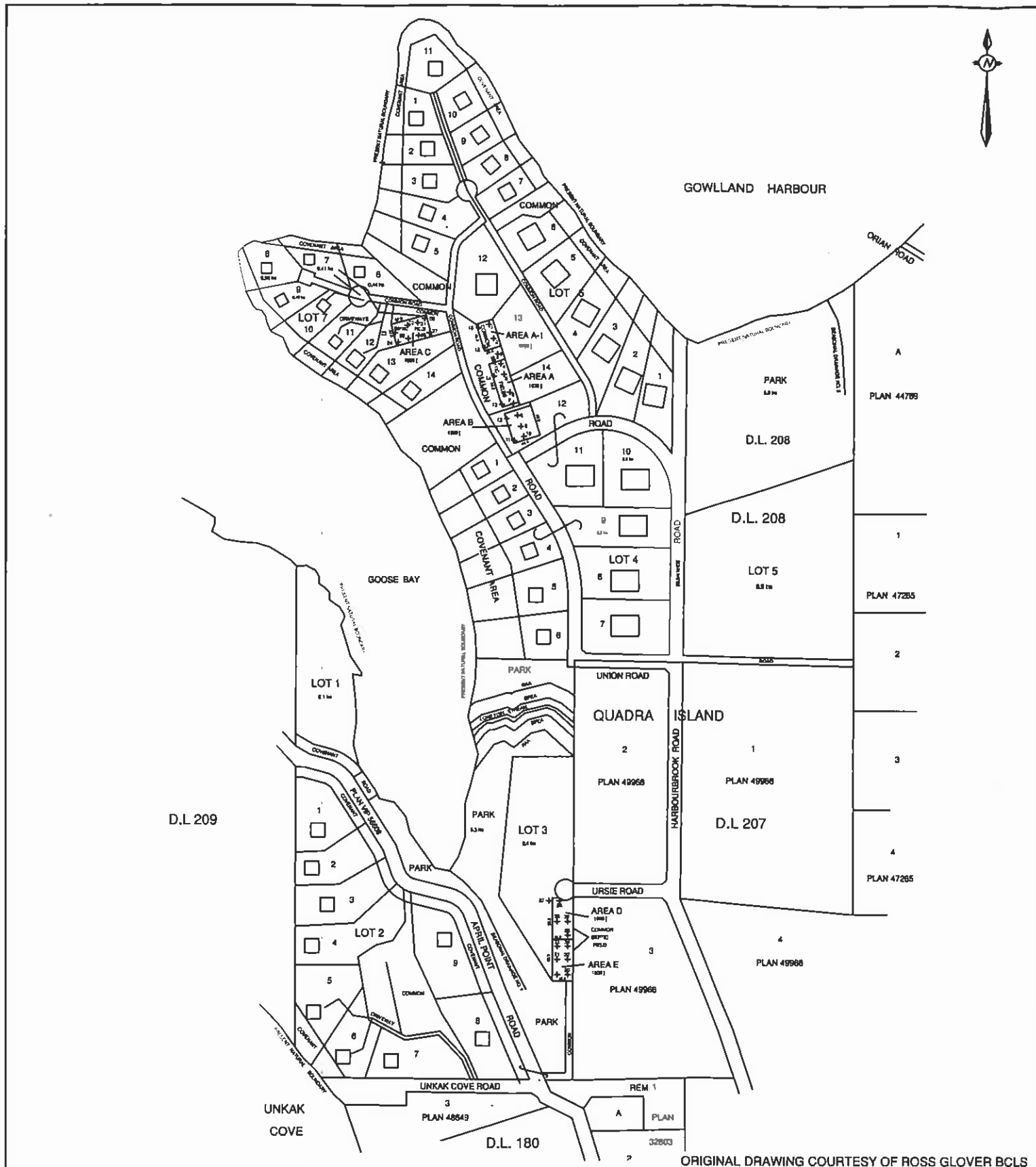
Areas A through E on District Lot 208 located on Quadra Island reviewed during this soil investigation meet VIHA criteria for strata subdivision.

Closure

We trust this information meets your needs at the present time and we look forward to being of service to you. Please contact the undersigned if you have any questions in the interim.

Sincerely,
H₂O Environmental Ltd.

Per.  *July 2, 2009*
Steven M. Carballera, P. Geol.



ORIGINAL DRAWING COURTESY OF ROSS GLOVER BCLS

	TITLE: SITE PLAN	DATE: JUNE 19, 2009	 H₂O ENVIRONMENTAL LTD. FIGURE 1
	PROJECT: SOIL INVESTIGATION FOR WASTEWATER DL 208, QUADRA ISLAND	DRAWN BY: SMC	
	CLIENT: R. SHELLINCK	CHECKED BY: SMC	
		SCALE: AS SHOWN PROJECT NO. 9-13	

Area A Test Pit Logs
R. Shellinck
District Lot 208
Excavated March 25, 2009

TEST PIT No.	DEPTH (cm)	DESCRIPTION
TP-4	0 – 4	SOD – organics, sandy, loose, brown, numerous rootlets
	4 – 102	SAND – some gravel, medium grained, loose, red, dry, roots to 96 cm, occasional cobbles, some organics
	102 – 140	SAND – trace silt, medium grained sand, grey, moist, dense below 140
TP-5	0 – 7	SOD – organics, sandy, loose, brown, numerous rootlets
	7 – 120	SAND – some gravel, medium grained, loose, red, dry, roots to 120 cm, occasional cobbles, some mottling at 120 cm
	102 – 140	SAND – trace silt, medium grained sand, grey, moist, dense below 140
TP-6	0 – 5	SOD – organics, sandy, loose, brown, numerous rootlets
	5 – 110	SAND – some gravel, medium grained, loose, red, dry, roots to 90 cm, occasional cobbles
	110 – 120	SAND – trace silt, medium grained sand, grey, moist, cemented pockets at 110 cm
TP-7	0 – 2	SOD – organics, sandy, loose, brown, numerous rootlets
	2 – 106	SAND – some gravel, medium grained, loose, red, dry, roots to 106 cm, occasional cobbles
	106 – 150	SAND – trace silt, medium grained sand, grey, moist, cemented pockets at 150 cm
TP-13	0 – 7	SOD – organics, sandy, loose, brown, numerous rootlets
	7 – 130	SAND – some gravel, medium grained, loose, red, dry, roots to 110 cm, occasional cobbles, mottling at 108 cm

**Area A Test Pit Logs
R. Shellinck
District Lot 208
Excavated March 25, 2009**

TEST PIT No.	DEPTH (cm)	DESCRIPTION
TP-14	0 – 10	SOD – organics, sandy, loose
	10 – 120	SAND – some gravel, medium grained, loose, red, dry, roots to 110 cm, occasional cobbles, mottling at 112 cm
	120 – 130	SAND, SILT, GRAVEL – coarse grained sand, grey, dense below 120 cm

**Area B Test Pit Logs
R. Shellinck
District Lot 208
Excavated March 25, 2009**

TEST PIT No.	DEPTH (cm)	DESCRIPTION
TP-8	0 – 2	SOD – organics, sandy, loose, brown, numerous rootlets
	2 – 104	SAND – some gravel, medium grained, loose, red, dry, roots to 90 cm, occasional cobbles
	102 – 110	SAND and GRAVEL – trace silt, medium grained sand, red to grey
	110 – 140	SAND – trace silt, medium grained sand, red to grey, mottled at 115 cm, hard below 140 cm
TP-9	0 – 2	SOD – organics, sandy, loose, brown, numerous rootlets
	2 – 120	SAND – some gravel, medium grained, loose, red, dry, roots to 120 cm, occasional cobbles
	110 – 120	- cemented pockets
	120 – 145	SAND – coarse grained sand, red, hard below 145 cm
TP-10	0 – 2	SOD – organics, sandy, loose, brown, numerous rootlets
	2 – 108	SAND – some gravel, medium grained, loose, red, dry, roots to 120 cm, occasional cobbles
	108 – 130	- minor mottling, roots to 130 cm
	130 – 150	SAND – coarse grained sand, red, standing water at 145 cm
TP-11	0 – 10	SOD – organics, sandy, loose
	10 – 120	SAND – some gravel, medium grained, loose, red, dry, roots to 70 cm, occasional cobbles
	120 – 130	SAND, SILT, GRAVEL – coarse grained sand, grey, hard below 120 cm

**Area B Test Pit Logs
R. Shellinck
District Lot 208
Excavated March 25, 2009**

TEST PIT No.	DEPTH (cm)	DESCRIPTION
TP-12	0 – 4	SOD – organics, sandy, loose
	4 – 105	SAND – some gravel, medium grained, loose, red, dry, roots to 95 cm
	105	- sand is wet
	110 – 115	SAND, SILT, GRAVEL – coarse grained sand, grey, hard below 110 cm

Area C Test Pit Logs
R. Shellinck
District Lot 208
Excavated March 25, 2009

TEST PIT No.	DEPTH (cm)	DESCRIPTION
TP-20	0 – 4	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	4 – 50	SAND – some gravel, trace silt, fine grained, loose, moist, light brown
	50 – 108	SAND and GRAVEL – medium grained sand, red, moist, roots to 105 cm, occasional cobbles
	108 – 115	SAND, GRAVEL, SILT – medium grained sand, grey, hard below 110 cm
TP-21	0 – 20	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	20 – 130	SAND – some gravel, fine to medium grained, loose, red to tan, dry, roots to 110 cm mottled at 130 cm
TP-22	0 – 5	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	5 – 56	SAND – some gravel, trace silt, fine to medium grained, loose, brown, dry, rootlets
	56 – 100	SAND – trace silt, medium grained sand, red, dry
	100 – 115	SAND – medium grained sand, grey, moist, roots to 110 cm
TP-23	0 – 10	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	10 – 105	SAND – some gravel, trace silt, medium grained, loose, red, dry, roots to 96 cm, occasional cobbles, some organics
	105 – 115	SAND – coarse grained sand, grey, mottled below 110
TP-24	0 – 5	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	5 – 100	SAND – trace gravel, trace silt, medium grained, loose, red, dry, roots to 90 cm, occasional cobbles

**Area C Test Pit Logs
R. Shellinck
District Lot 208
Excavated March 25, 2009**

TEST PIT No.	DEPTH (cm)	DESCRIPTION
	100 – 130	SAND – trace silt, coarse grained sand, grey, moist, wet below 130 cm
TP-25	0 – 5	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	5 – 110	SAND – trace gravel, trace silt, medium grained, loose, red, dry, roots to 100 cm
	110 – 140	SAND – trace silt, medium grained sand, grey, moist, standing water at 140 cm
TP-26	0 – 5	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	5 – 40	SAND – fine grained, loose, tan, dry, rootlets
	40 – 100	SAND - trace gravel, trace silt, medium grained, loose, red, dry, roots to 80 cm
TP-27	0 – 5	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	5 – 80	SAND – trace gravel, trace silt, medium grained, loose, red, dry, roots to 90 cm
	80 – 105	SAND – trace silt, medium grained sand, grey, moist, hard below 105 cm

**Area D Test Pit Logs
R. Shellinck
District Lot 208
Excavated April 8, 2009**

TEST PIT No.	DEPTH (cm)	DESCRIPTION
TP-35	0 – 10	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	10 – 20	SAND – trace gravel, trace silt, medium grained, loose, red, dry
	20 – 130	SAND – coarse grained sand, variegated green/ grey, roots to 95 cm
TP-36	0 – 30	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	30 – 100	SAND – trace gravel, trace silt, medium grained, loose, red, dry
	100 – 160	SAND – coarse grained sand, variegated green / grey, roots to 110 cm
TP-37	0 – 10	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	10 – 120	SAND – trace gravel, trace silt, medium grained, loose, red, dry
	120 – 140	SAND – coarse grained sand, variegated green / grey, roots to 120 cm, cemented pockets below 130 cm
TP-38	0 – 10	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets
	10 – 75	SAND – trace gravel, trace silt, medium grained, loose, red, dry
	75 – 130	SAND – coarse grained sand, variegated green/grey, roots to 110 cm
TP-39	0 – 30	SAND – trace gravel, trace silt, medium grained, loose, red, dry,
	30 – 135	SAND – coarse grained sand, variegated green / grey, roots to 130 cm, occasional cobbles

**Area E Test Pit Logs
R. Shellinck
District Lot 208
Excavated April 8, 2009**

TEST PIT No.	DEPTH (cm)	DESCRIPTION
TP-30	0 – 10	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets, cobbles
	10 – 130	SAND – some gravel, trace silt, medium grained, loose, dry, light brown to red, cemented pockets and mottling at 130 cm
TP-31	0 – 25	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets, cobbles
	25 – 130	SAND – some gravel, fine to medium grained, loose, red to tan, dry, roots to 130 cm,
	130 – 150	SAND – coarse grained, grey, mottled at 140
TP-32	0 – 15	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets, cobbles
	15 – 40	SAND – trace gravel, trace silt, fine to medium grained, loose, brown, dry
	40 – 130	SAND and GRAVEL – trace silt, variegated green/grey, roots to 130 cm, cemented pockets at 110 cm .
TP-33	0 – 10	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets, cobbles
	10 – 20	SAND – some gravel, trace silt, medium grained, loose, red, dry, some organics
	20 – 125	SAND and GRAVEL – coarse grained sand, variegated green/grey, mottled below 110
TP-34	0 – 10	FOREST DEBRIS – organics, sandy, loose, brown, numerous rootlets, cobbles
	10– 45	SAND – trace gravel, trace silt, medium grained, loose, red, dry
	45 – 130	SAND – some gravel, coarse grained sand, variegated green/grey, roots to 130 cm