

North Saanich Parks Forest Soil Properties

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Image: Gulf View Park soil profile

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Introduction

North Saanich is within the Coastal Douglas-fir (CDF) biogeoclimatic zone of British Columbia (BC). The CDF zone is the smallest and most at-risk zone in BC, having undergone intense development pressure with many natural ecosystems converted to human use. The zone is experiencing ecosystem fragmentation and degradation from deforestation, and changes due to fire suppression, ditching, draining, and dredging. Most forests that are found today in the CDF have regenerated after logging (Nuszdorfer et al., 1991, p. 82). The presence of alien species that outcompete less aggressive native species, in addition to climate change stresses may result in severely compromised ecosystems. As a result, it is important to study the soils of this area among the other natural resource components that comprise this zone.

The Friends of North Saanich parks (FNSP) wished to obtain information on the soil properties of eight North Saanich Parks in which they have been working because no specific descriptions had been produced to date. Examining soil properties within each park should provide a better understanding of the health of the vegetation and aid in effectively managing the ecosystems within the park. Coarse textured soils, for example, lose moisture quickly and could be a source of concern in an area with increased summer drought periods. Moreover, knowing what soils are present can assist to determine what vegetation is most appropriate on the site for restoration purposes.

Methods

A soil pit was dug in each of the 8 parks in which the Friends of North Saanich Parks currently works, as visible in Figure 1. The location of the pits were chosen to be representative of each park; that is, they were homogenous areas, typical of the slope, aspect, vegetation and topography of the park. Green Park was divided into two soil descriptions due to a large variation in vegetation and terrain from the higher elevation section of the park (“Green Park Upper”) and the low elevation section of the park (“Green Park Lower”).

To conduct field assessments, soil forms were used from Describing Ecosystems in the Field (Province of British Columbia, 1980). This field guide describes the detailed steps necessary to collect and classify soil properties. Further training to fill out soil forms was acquired through a Pacific Regional Society of Soil Science 3-day soil identification course completed in May, 2022. Moreover, several experienced professionals, Hally Hofmeyr, Bob Maxwell, and Sharon Hope, completed site visits in collaboration with myself. They assisted in determining properties such as soil associations and textures. To further determine soil associations, the British Columbia Soil Information Finder Tool was utilized to find past surveys that were completed as part of studies with wider scopes on the South Island. These studies provided a baseline of what associations might fit the park soils best before reading through the association descriptions (Province of British Columbia, 2018). GPS locations of the soil pits were taken using the “GPS Coordinates” phone app at an approximate 10 m accuracy. The locations were then mapped using the QGIS mapping software together with previous maps made during a 2021 Friends of North Saanich Parks project by Katrina Adams.

Results

Figure 1 below shows the location of all nine soil pits that were dug and examined. The soil pits are named after the North Saanich Park they are within. The results of this examination are described park by park with tabulated field data, pictures, and descriptions. Further data can be found in the Appendix.



Figure 1 Map of all soil pit locations

Denham Till

Denham Till is classified as a Gleyed Dystric Brunisol (GL.DYB) due to the distinct and prominent mottling occurring in the B and C horizons (Agriculture and Agri-Food Canada, 1998, p. 59). The B horizon has the suffix “g” due to the gleying (the gray colour and the mottling) yet it is modified with “j” as the colour does not have a low chroma. The mottling in the lower horizons is a common attribute of an imperfectly draining Fairbridge soil association along with the silty clay loam texture and lack of stones (BC Ministry of Environment, 1989, p. 99). The soil pit location has the coordinates of 48.68035170, -123.46799020 and can be seen on a map in Figure 2 below.

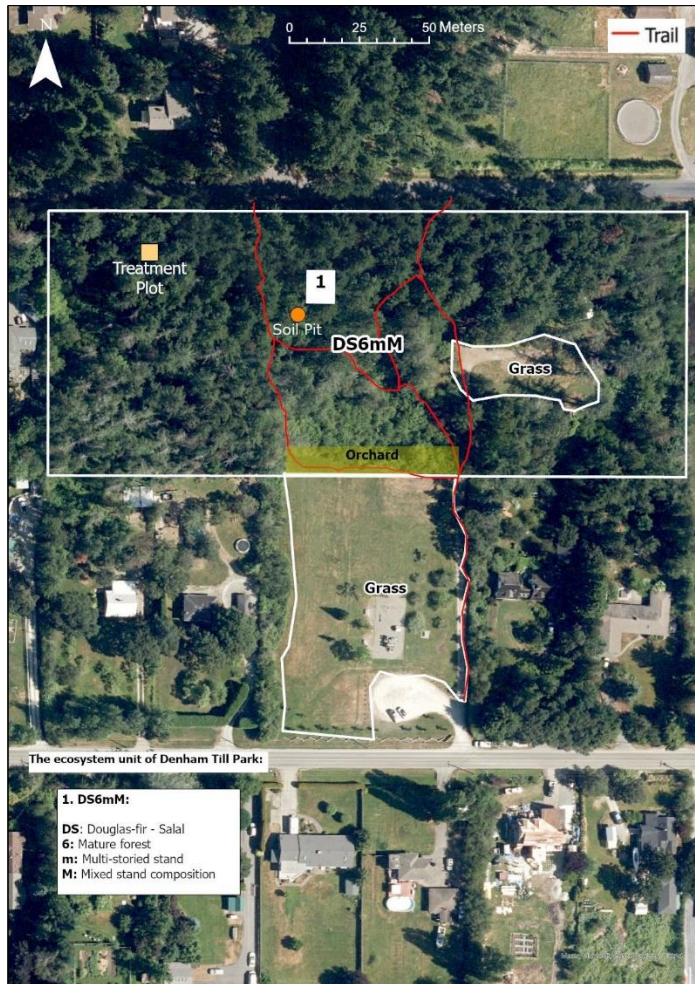


Figure 2 Map of Denham Till soil pit location. Original map courtesy of Adams, 2021.

Table 1 Denham Till Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
LF	-2 to 0	Type: Mull F is < 1 cm, no H				
Ah	0 to 15	Silty clay loam; sticky, plastic; weak to moderate medium subangular blocky	20% subangular (5% gravel, 15% cobble)	10 YR 4/3 crushed moist	Few fine, few coarse	Plentiful tubular pores
Bgj	15 to 40	Silty clay loam; sticky, plastic; weak to moderate coarse subangular blocky	15% subangular gravel	10 YR 5/4 exped moist	Few fine, plentiful coarse	Distinct mottling, plentiful tubular pores
Cg	40 to 60+	Silty clay loam; sticky, plastic; weak to moderate coarse angular blocky	5% subangular gravel	10 YR 5/3 exped moist	None	Poor drainage, prominent mottling, few tubular pores
Other notes: This location has an elevation of 42 m ASL, a slope of 2%, and an aspect of 200° SW. The rooting depth is 40 cm. This soil is classified as a Gleyed Dystric Brunisol (GL.DYB) in the Fairbridge soil association.						



Figure 3 Surrounding area

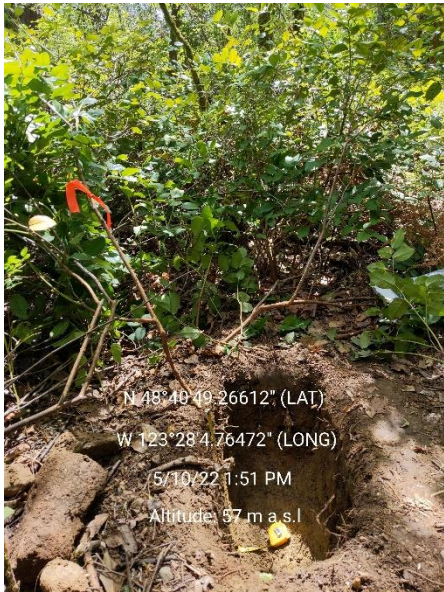


Figure 4 Outer view of the Denham Till soil pit



Figure 5 Denham Till soil profile in the shade



Figure 6 Denham Till soil profile in the sun



Figure 7 Tubular pores



Figure 8 Prominent mottling in the C layer



Figure 9 Nearby fallen tree

Green Park Lower

Green Park Lower is classified as a Melanic Brunisol (MB) due in it having a thick, dark-coloured Ah horizon and a Bm horizon well above the 5 cm thick requirement (Agriculture and Agri-Food Canada, 1998, p. 55). The anthropogenic phase designation has been applied here because there is evidence of burning and human disturbance in the B horizon, with discolouration visible in Figure 13. The lowest horizon of the Green Park Lower pit is called BC rather than a C or parent material because there are roots as far as 60 cm. Since it is a fluvial site with high coarse fragment content, it is in the Dashwood soil association (BC Ministry of Environment, 1989, p. 90). The soil pit location has the coordinates of 48.68190270, -123.41884940 and can be seen on a map in Figure 10 below.

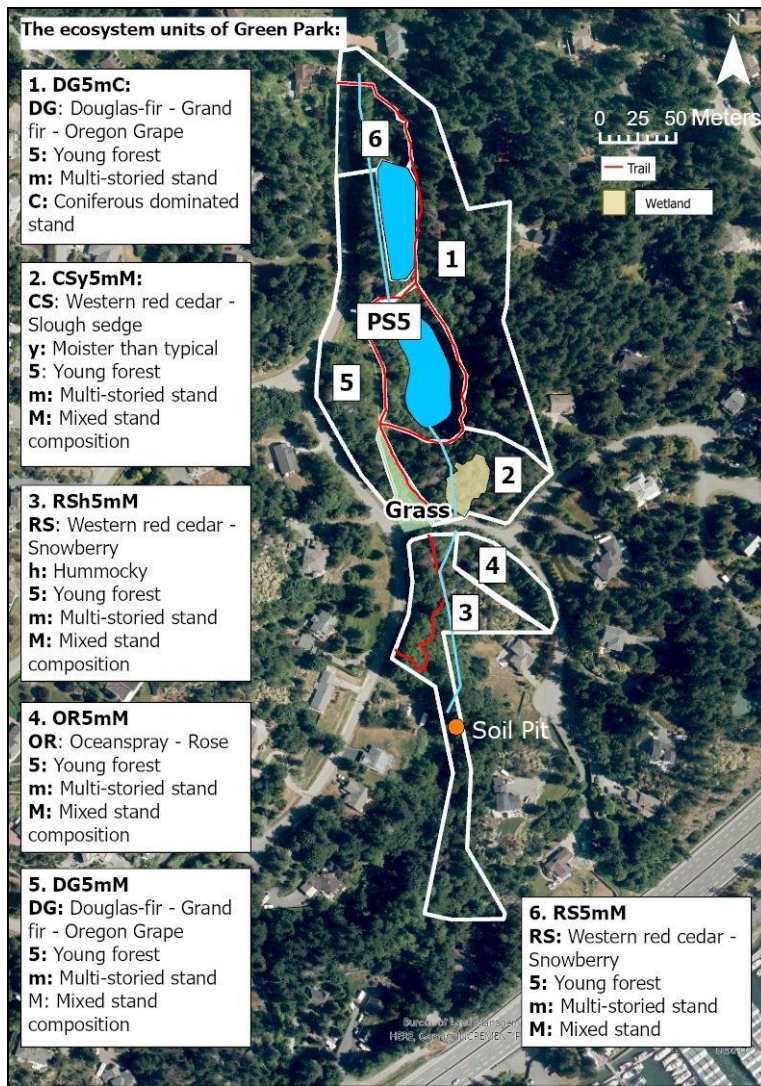


Figure 10 Map of Green Park Lower soil pit location. Original map courtesy of Adams, 2021.

Table 2 Green Park Lower Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
LF	-3 to 0	Type: Mull F is < 0.2 cm, no H				
Ah	0 to 24	Loamy sand; nonsticky, nonplastic; weak very fine subangular blocky	15% subangular gravel	2.5 Y 2/0 crushed moist	Abundant fine, few coarse	Secondary structure is single grained
Bm	24 to 45	Loamy sand; nonsticky, nonplastic; weak very fine subangular blocky	20% (10% subangular gravel, 10% angular cobble)	7.5 YR 3/4 crushed moist	Plentiful medium, few fine	Secondary structure is single grained. Charcoaled, fire-impacted layer
BC	45 to 75+	Loamy sand; nonsticky, nonplastic; weak very fine subangular blocky	50% subangular (30% gravel, 20% stone)	10 YR 3/3 crushed moist	Few fine	Secondary structure is single grained
Other notes: This location has an elevation of 30 m ASL, a slope of 10%, and an aspect of 145° SE. The rooting depth is 60 cm. It is a fluvial site. This soil is classified as a Melanic Brunisol (MB) anthropogenic phase in the Dashwood_soil association.						



Figure 11 Surrounding area

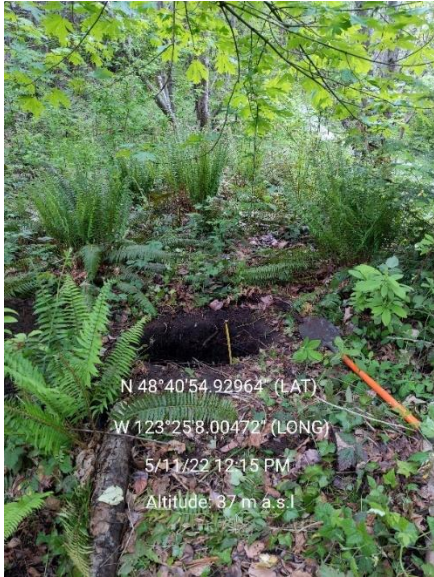


Figure 12 Outer view of the Green Park Lower soil pit



Figure 13 Green Park Lower soil profile



Figure 14 Prevalent sandstone (left) and charcoal (right)

Green Park Upper

Green Park Upper is classified as an Orthic Dystric Brunisol (O.DB) in the Mexicana soil association. Dystric Brunisols have thinner Ah horizons than Melanic and Sombric Brunisols (Agriculture and Agri-Food Canada, 1998, p. 55). Mexicana soils have underlying sedimentary bedrock (BC Ministry of Environment, 1989, p. 135). In Green Park, sedimentary bedrock is visible in the outcrop shown in Figure 19 and from the sandstone fragments found throughout. Green Park Upper has a high coarse fragment content but without the fluvial influence of Green Park Lower. It also has a loam to silty loam texture rather than the lower site's loamy sand texture leading to the differences in soil association. The lowest horizon in Green Park Upper is called Bm2 rather than a C/parent material horizon because there are roots throughout the horizon. The soil pit location has the coordinates of 48.68348430, -123.41841860 and can be seen on a map in Figure 15 below.

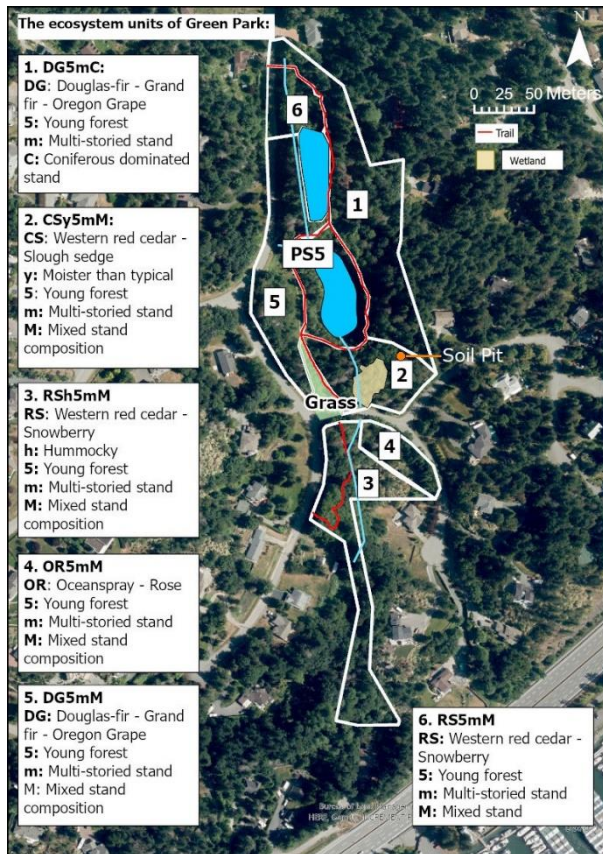


Figure 15 Map of Green Park Upper soil pit location. Original map courtesy of Adams, 2021.

Table 3 Green Park Upper Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
LF	-1.5 to 0	Type: Mull F is > 0.2 cm, no H				
Ah	0 to 10	Loam; slightly sticky, plastic; weak to moderate coarse subangular blocky	20% subangular (5% gravel, 10% cobble, 5% stone)	10 YR 3/3 crushed moist	Plentiful coarse, plentiful fine	Fractured sandstone (pervious)
Bm1	10 to 40	Loam; slightly sticky, slightly plastic; weak to moderate medium subangular blocky	25% subangular (15% gravel, 10% cobble)	10 YR 4/4 crushed moist	Plentiful coarse, plentiful medium	Fractured sandstone (pervious)
Bm2	40 to 70+	Silty loam; slightly sticky, slightly plastic; weak medium subangular blocky	5% subangular gravel	10 YR 4/6 crushed moist	Few coarse, few medium	Slight cementing 65 cm down with iron deposits. Secondary structure is single grained.
Other notes: This location has an elevation of 52 m ASL, a slope of 10%, and an aspect of 290° SW. The rooting depth is at least 70 cm. This soil is classified as an Orthic Dystric Brunisol (O.DB) in the Mexicana soil association.						



Figure 16 Surrounding area



Figure 17 Outer view of the Green Park Upper soil pit



Figure 18 Green Park Upper soil profile



Figure 19 Nearby bedrock outcrop



Figure 20 Slight cementation with iron deposits

Gulf View

Gulf View is classified as an Orthic Sombric Brunisol (O.SB) due to its dark-coloured and thick Ah horizon (Agriculture and Agri-Food Canada, 1998, p. 57). It is in the Beddis soil association with the permeable, sandy loam textured upper horizons (BC Ministry of Environment, 1989, p. 60). There are plentiful pores in both the Ah and Bm layers which are visible in Figure 25. The soil pit location has the coordinates of 48.61787910, -123.41582660 and can be seen on a map in Figure 21 below.

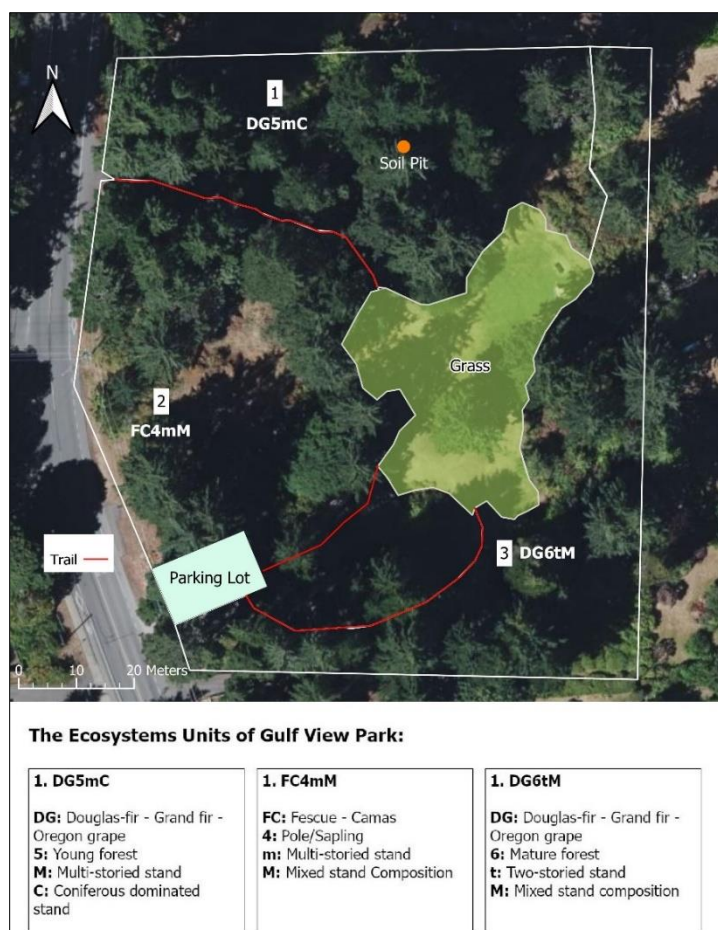


Figure 21 Map of Gulf View soil pit location. Original map courtesy of Adams, 2021.

Table 4 Gulf View Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
LF	-1.5 to 0	Type: Mull F is 0.5 cm, no H				
Ah	0 to 22	Sandy loam; slightly sticky, slightly plastic; weak to moderate coarse subangular blocky	10% subangular (5% gravel, 5% cobble)	7.5 YR 3/2 crushed moist	Few fine, few medium	Plentiful tubular pores
Bm	22 to 56	Sandy loam; slightly sticky, nonplastic; weak to moderate coarse angular blocky	20% subangular (15% gravel, 5% cobble)	10 YR 4/3 crushed moist	Few coarse, few medium	Plentiful vesicular pores
C	56 to 75+	Sandy clay loam; slightly sticky, slightly plastic; moderate coarse angular blocky	15% subangular gravel	10 YR 5/6 crushed moist	None	No mottling
Other notes: This location has an elevation of 70 m ASL, a slope of 10%, and an aspect of 30° NE. The rooting depth is 56 cm. This soil is classified as an Orthic Sombric Brunisol (O.SB) in the Beddis soil association.						



Figure 22 Surrounding area



Figure 23 Outer view of the Gulf View soil pit



Figure 24 Gulf View soil profile



Figure 25 Tubular pore (left), vesicular pore (right)

Lillian Hoffar

Lillian Hoffar is classified as a Gleyed Melanic Brunisol (GL.MB) in the Cowichan soil association. The gleying is caused by poor soil drainage. This is evident in the mottling in the C horizon. The Cowichan association aligns with this poor drainage and the silty loam to silty clay loam textures (BC Ministry of Environment, 1989, p. 84). The soil pit location has the coordinates of 48.66946970, -123.41538320 and can be seen on a map in Figure 26 below.



Figure 26 Map of Lillian Hoffar soil pit location. Original map courtesy of Adams, 2021.

Table 5 Lillian Hoffar Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
LF	-3 to 0	Type: Mull F < 0.5 cm, no H				
Ah	0 to 16	Silty loam; nonsticky, slightly plastic; weak to moderate coarse subangular blocky	15% subangular (5% gravel, 10% cobble)	5 YR 3/2 crushed moist	Few very fine, few fine	None
Bm1	16 to 40	Silty clay loam; slightly sticky, nonplastic; weak coarse subangular blocky	10% subangular (5% gravel, 5% cobble)	10 YR 3/3 crushed moist	Few coarse, few fine	No mottling
Bm2	40 to 50	Silty clay loam; sticky, slightly plastic; weak to moderate medium subangular blocky	5% subangular gravel	10 YR 3/2 crushed moist	Few medium	No mottling
Cg	50 to 60+	Silty clay; sticky, plastic; moderate very coarse subangular blocky	2% subangular gravel	2.5 Y 6/2 inped dry	None	Prominent mottling, poor drainage

Other notes: This location has an elevation of 5.4 m ASL, a slope of 7%, and an aspect of 300° NW. The rooting depth is 50 cm. This soil is classified as a Gleyed Melanic Brunisol (GL.MB) in the Cowichan soil association.



Figure 27 Surrounding area

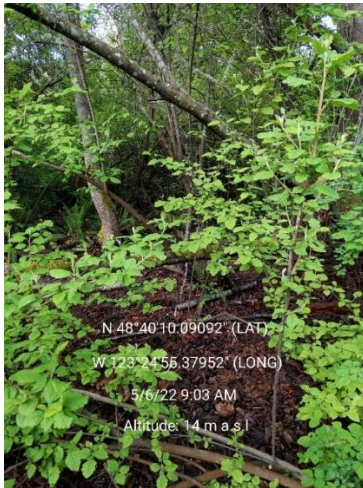


Figure 28 Outer view of the Lillian Hoffar soil pit before digging commenced



Figure 29 Lillian Hoffar soil profile

Nymph Point

Nymph Point is classified as an Orthic Dystric Brunisol (O.DYB) in the eroded phase due to the soil pit location being in the high-tide zone and therefore receiving wave action. It is a Saanichton soil association as it has few gravel coarse fragments as well as tough marine clay textures that cause slow permeability (Day, Farstad, Laird, 1959, p. 63). The lowest horizon in Nymph Point is called BCg rather than a C/parent material horizon due to there being plentiful roots throughout the horizon. The soil pit location has the coordinates of 48.67505570, -123.41716370 and can be seen on a map in Figure 30 below.



Figure 30 Map of Nymph Point soil pit location. Original map courtesy of Adams, 2021.

Table 6 Nymph Point Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
LF	-3 to 0	Type: Mull F is 0.2 – 0.5 cm, no H				
Ah	0 to 11	Silty clay loam; sticky, slightly plastic; moderate coarse subangular blocky	5% subangular gravel	5 YR 3/1 crushed moist	Few fine	Few tubular pores
Bg	11 to 50	Silty clay; sticky, slightly plastic; moderate very coarse subangular blocky	2% subangular gravel	10 YR 5/4 crushed moist	Few fine, few medium	Prominent mottling, few tubular pores
BCg	50 to 86+	Silty clay; sticky, plastic; moderate coarse subangular blocky	1% subangular gravel	10 YR 6/4 exped dry	Plentiful coarse, few fines	Faint mottling
<p>Other notes: This location has an elevation of 3 m ASL, a slope of 3%, and an aspect of 130° SE. The rooting depth is at least 86 cm. This soil is classified as an Orthic Dystric Brunisol (O.DYB) eroded phase in the Saanichton soil association.</p>						



Figure 31 Nymph Point soil profile after digging (left), and dried out but with measuring tape (right)

Prentice Pond

Prentice Pond is classified as an Orthic Distric Brunisol (O.DB) in the Qualicum soil association. This classification is based on its loam to sandy loam texture from sediments deposited by fluvial and/or fluvioglacial action. The classification is also based on it being well drained with a high gravel coarse fragment content (BC Ministry of Environment, 1989, p. 147). The soil pit location has the coordinates of 48.67922700, -123.40784700 and can be seen on a map in Figure 32 below.

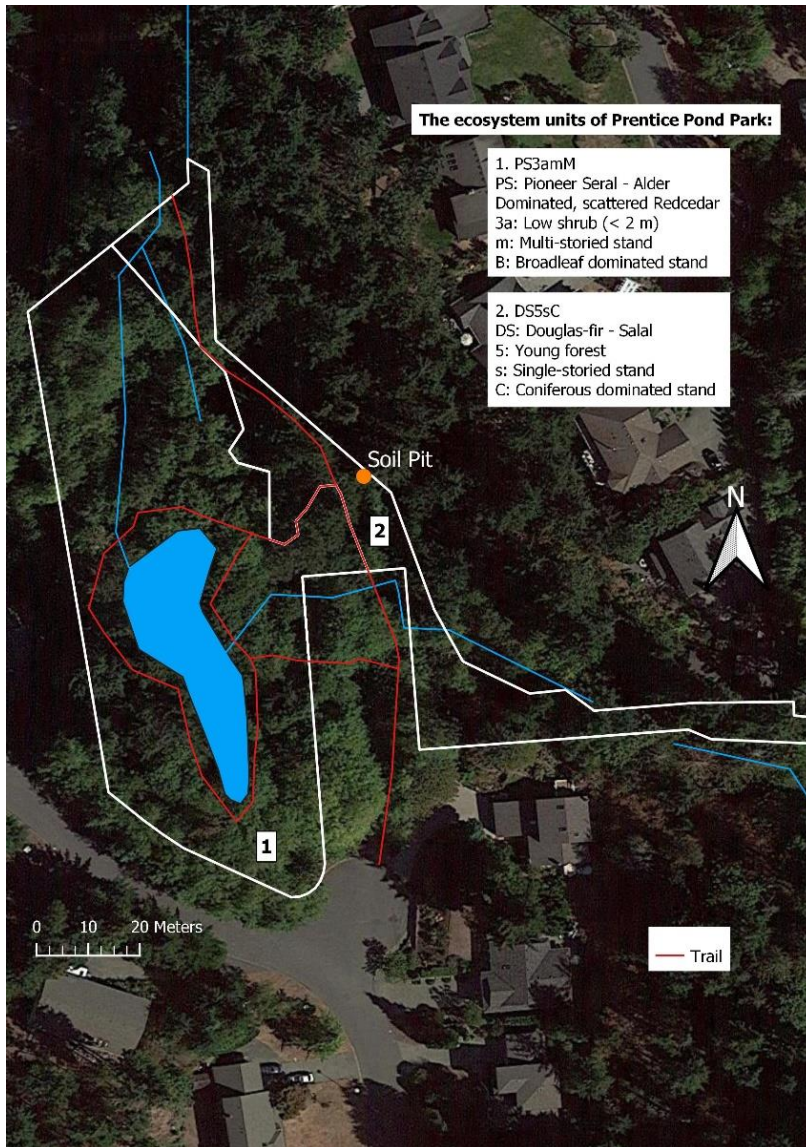


Figure 32 Map of Prentice Pond soil pit location

Table 7 Prentice Pond Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
L	-4 to 0	Type: Mull No F, no H, L is mostly moss				
Ah	0 to 11	Loam; slightly sticky, slightly plastic; weak to moderate coarse subangular blocky	12% (10% angular gravel, 2% subangular cobble)	7.5 YR 3/2 crushed moist	Few fine, few coarse	Colluvium coarse fragments
Bm1	11 to 32	Sandy loam; slightly sticky, nonplastic; weak coarse subangular blocky	17% subangular (15% gravel, 2% cobble)	10 YR 4/4 crushed moist	Few fine, few medium	Secondary structure is single grained
Bm2	32 to 65	Sandy loam; slightly sticky, nonplastic; weak to moderate coarse subangular blocky	17% subangular (15% gravel, 2% cobble)	7.5 YR 4/4 crushed moist	Plentiful coarse, plentiful medium	Secondary structure is single grained. Charcoaled wood 35 cm down.
C	65 to 80+	Sandy loam; slightly sticky, slightly plastic; weak to moderate coarse subangular blocky	16% (15% subangular gravel, 1% angular cobble)	10 YR 3/3 crushed moist	None	None
Other notes: This location has an elevation of 32 m ASL, a slope of 15%, and an aspect of 275° W. The rooting depth is 65 cm. This soil is classified as an Orthic Distric Brunisol (O.DB) in the Qualicum soil association.						



Figure 33 Outer view of the Prentice Pond soil pit



Figure 34 Prentice Pond soil profile



Figure 35 Nearby fallen tree

Quarry

Quarry is classified as an Orthic Sombric Brunisol (O.SB) in the Beddis soil association with sandy loam to loamy sand texture that is well drained (BC Ministry of Environment, 1989, p. 60). The soil pit location has the coordinates of 48.61263440, -123.41603740 and can be seen on a map in Figure 36 below.

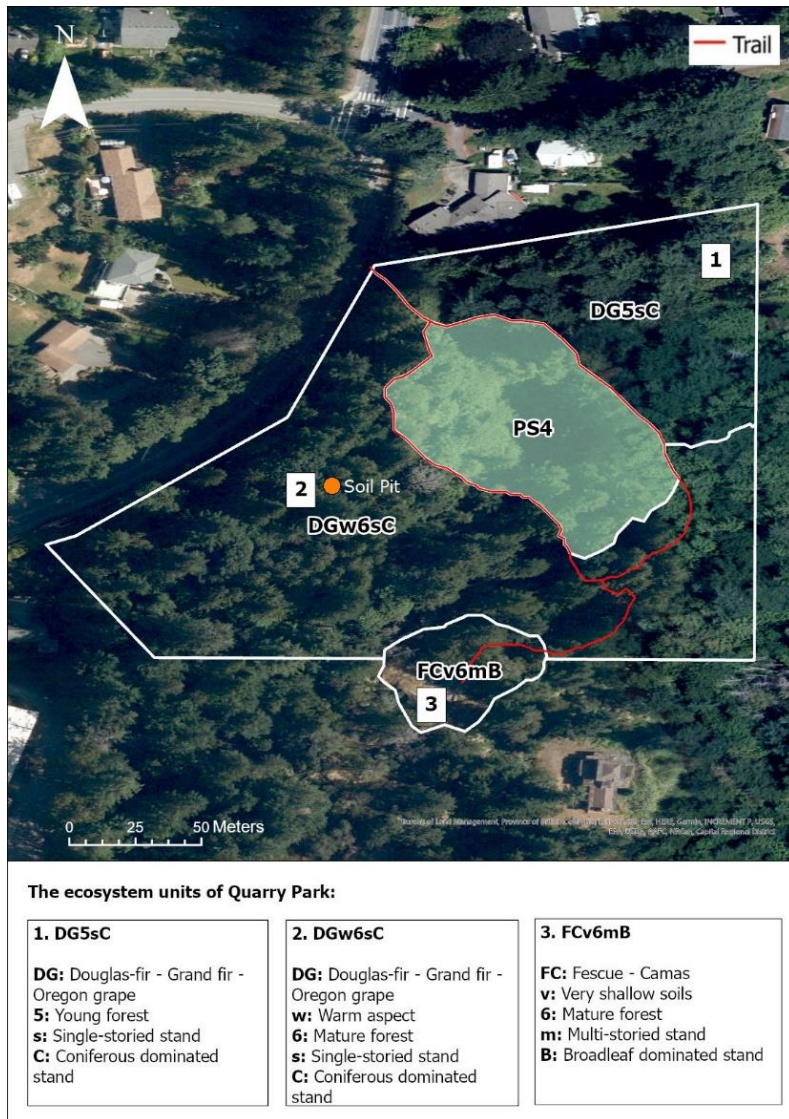


Figure 36 Map of Quarry soil pit location. Original map courtesy of Adams, 2021.

Table 8 Quarry Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
LFH	-1.5 to 0	Type: Mull F is > 0.2 cm, virtually no H				
Ah	0 to 15	Sandy loam; nonsticky, nonplastic; weak to moderate medium subangular blocky	10% subangular gravel	5 YR 2.5/1 crushed dry	Plentiful very fine, few fine	None
Bm	15 to 70	Sandy loam; slightly sticky, nonplastic; weak to moderate medium subangular blocky	15% (10% subangular gravel, 5% rounded cobble)	10 YR 3/6 crushed moist	Few coarse, plentiful fine	None
C	70 to 80+	Loamy sand; nonsticky, nonplastic; weak very fine subangular blocky	15% subangular gravel	10 YR 5/8 crushed moist	None	Secondary structure is single grained
Other notes: This location has an elevation of 96.8 m ASL, a slope of 25%, and an aspect of 290° NW. The rooting depth is 70 cm. This soil is classified as an Orthic Sombric Brunisol (O.SB) in the Beddis soil association.						



Figure 37 Surrounding area



Figure 38 Outer view of the Quarry soil pit



Figure 39 Quarry soil profile

Small Quarry

A second small pit was dug in the park and the location was referred to as “Small Quarry”. It was located above bedrock and was chosen to demonstrate the soil development 95 years after the quarry ceased activity. This soil is classified as an Orthic Sombric Brunisol (O.SB) with an Ah layer that is 12 cm thick (a few centimetres less than the main Quarry soil pit) and a B layer that is 20 cm thick. The soil pit location has the coordinates of 48.61282380, -123.41572130 and can be seen on a map in Figure 40 below.

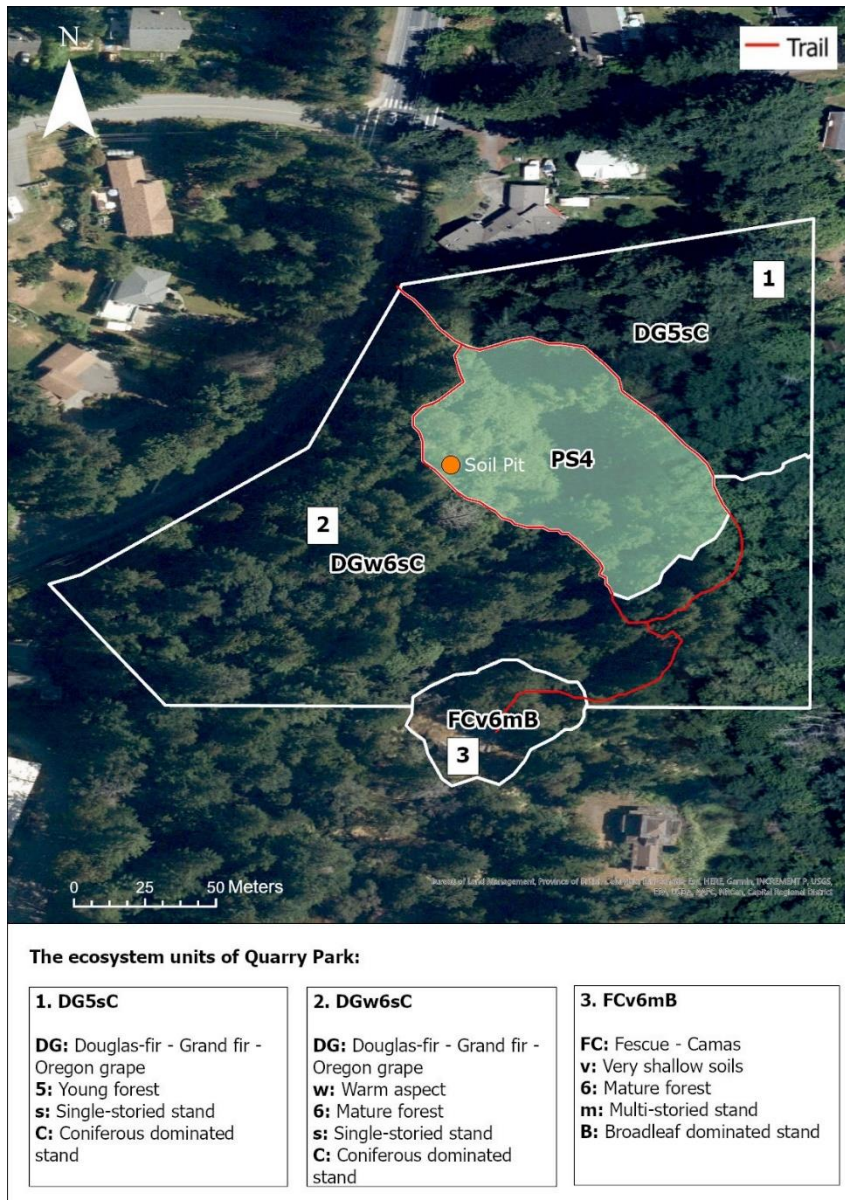


Figure 40 Map of Small Quarry soil pit location. Original map courtesy of Adams, 2021.

Table 9 Small Quarry Soil Summary

Horizon	Depth (cm)	Texture & structure	Coarse fragments	Colour	Roots	Additional Comments
LF	-2 to 0	Type: Mull F is 0.2 cm, no H				
Ah	0 to 12	Loam; weak to moderate medium subangular blocky	10% subangular gravel	10 YR 3/3 crushed moist	Few fine	None
B	12 to 32	Silty loam; moderate fine subangular blocky	25% subangular (20% gravel, 5% cobble)	2.5 Y 5/4 crushed moist	Few coarse, few fine	None
R	32+	/	/	/	/	Bedrock

Other notes: This location has an elevation of 102 m ASL, a slope of 17%, and an aspect of 310° NW. The rooting depth is 32 cm. This soil is classified as an Orthic Sombric Brunisol (O.SB).



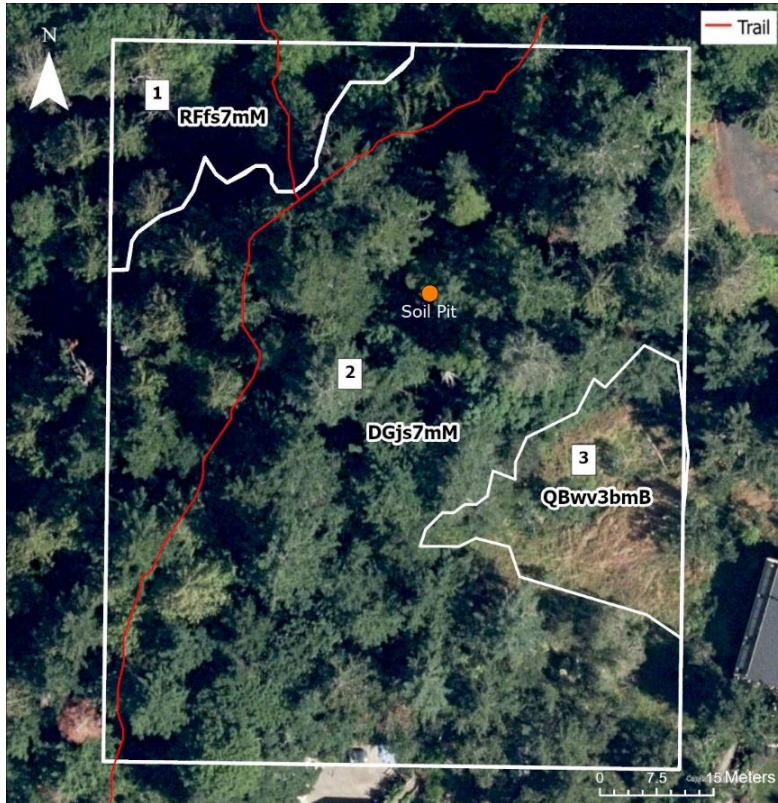
Figure 41 Small Quarry soil profile



Figure 42 Fallen tree next to profile

R.O. Bull

R.O. Bull is classified as an Orthic Sombric Brunisol (O.SB) in the Beddis soil association with loam to loamy sand texture that is well drained (BC Ministry of Environment, 1989, p. 60). The lowest horizon in R.O. Bull is called Bm2 rather than a C/parent material horizon due to there being roots throughout the horizon. The soil pit location has the coordinates of 48.67677050, -123.47960150 and can be seen on a map in Figure 43 below.



The Ecosystems Units of RO Bull Park:

1. RFfs7mM	2. DGjs7mM	3. QBwv3bmB
RF: Western red cedar - Grand fir - Foamflower f: Fine textured soil s: Shallow soil 7: Old forest m: Multi-storied stand M: Mixed stand modifier	DG: Douglas-fir - Grand fir - Oregon grape j: Gentle Slope s: Shallow soil 7: Old forest m: Multi-storied stand M: Mixed stand modifier	QB: Garry Oak - Brome/Mixed grasses w: Warm Aspect v: Very shallow Soil 3b: Tall shrub (2-10 m) m: Multi-storied stand M: Mixed stand composition

Figure 43 Map of R.O. Bull soil pit location. Original map courtesy of Adams, 2021.

Table 10 R.O. Bull Soil Summary

Horizon	Depth (cm)	Texture, consistency & structure	Coarse fragments	Colour	Roots	Additional Comments
LFH	-2 to 0	Type: Moder F is 0.75 cm, H is 0.2 cm				
Ah	0 to 15	Loam; slightly sticky, plastic; weak to moderate coarse subangular blocky	12% subangular (7% gravel, 5% cobble)	10 YR 3/2 crushed moist	Few fine, few medium	Bit of charcoal in this layer
Bm1	15 to 45	Loamy sand; nonsticky, nonplastic; weak fine subangular blocky	20% subangular (15% gravel, 5% cobble)	7.5 YR 5/6 crushed dry	Plentiful fine, plentiful medium	Secondary structure is single grained
Bm2	40 to 70+	Loamy sand; nonsticky, nonplastic; weak very fine subangular blocky	10% subangular gravel	10 YR 6/6 crushed dry	Few coarse, few fine	Secondary structure is single grained
Other notes: This location has an elevation of 25 m ASL, a slope of 15%, and an aspect of 300° NW. The rooting depth is at least 70 cm. This soil is classified as an Orthic Sombric Brunisol (O.SB) in the Beddis soil association with slightly higher coarse fragments.						



Figure 44 Surrounding area

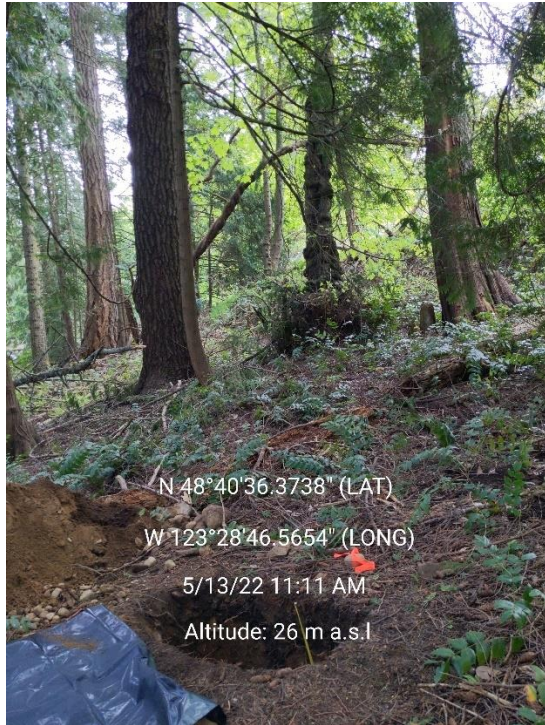


Figure 45 Outer view of the R.O. Bull soil pit



Figure 46 R.O. Bull soil profile

Discussion

The parks with poor soil drainage including Denham Till, Lillian Hoffar, and Nymph Point all had clay in their soil textures compared to the other parks with textures of sand, silt, and loam. This clay is likely glaciomarine in origin as they are all close to the ocean. “Soils in the CDF are generally derived from morainal, colluvial, and marine deposits” (Nuszdorfer et al., 1991, p. 84). Although Denham Till and Nymph Point soil pits had plentiful coarse roots, the root distribution was lacking in abundance in these three poorly draining parks as well as in Gulf View Park. The importance of this is that “[r]oots in a soil indicate relationships of soil properties to the habits and adaptations of plants. Their absence may be equally significant and is recorded because the lack of plant roots may reflect unfavourable conditions in the soil” (BC Ministry of Environment, 1980).

Gulf View, Quarry, and R.O. Bull were all classified as Orthic Sombric Brunisol (O.SB) in the Beddis soil association, however Gulf View had the least root abundance. This could be due to Gulf View Park being ecologically less mature and drier than Quarry Park with a herbaceous cover only recently returning after invasive removal (Hope, 2021). R.O. Bull is the only park assessed which has an LFH layer defined as a moder with a more prominent F layer. This could be a result of R.O. Bull Park being an old growth site, it being the first park that the Friends of North Saanich restored to a 97% invasive-free status, as well as it being relatively less disturbed than the other parks (Adams, 2021).

Green Park Lower had sand in its texture whereas the Upper site had silt. Another difference between the two sites is the lowest horizon, the BC layer, in Green Park Lower, has the highest coarse fragments out of any park at 50% subangular (30% gravel, 20% stone) whereas the lowest horizon in Green Park Upper, Bm2, has 5% subangular gravel. This is probably from a difference in deposition, likely fluvial versus morainal.

The parks with well-draining soils may experience greater stress in increasing drought conditions. Establishing a solid root structure in Gulf View Park may be necessary to increase the availability of nutrients and resilience to change.

Recommendations

Due to the rain shadow effect from the Olympic Mountains and increased summer temperatures on the Saanich Peninsula over time, the Saanich Peninsula has been known for decades as suffering from summer drought. As of August 2022, Vancouver Island is at a drought level of 3 out of 5. “At Level 3, conditions are becoming severely dry. Potentially serious ecosystem or socio-economic impacts are possible in some circumstances” (Province of British Columbia, 2022, p. 16). However, there are virtually no studies of the stands within the CDF that include the North Saanich municipality, that might link the Brunisolic soil properties described in this paper with the impact of summer drought on forest stands and the subsequent potential decline in stand productivity within the eight parks described here. It is generally accepted from academic studies that Redcedar common to the northern section of the Saanich Peninsula is unlikely to thrive under the current pattern of global climate change. In future, FNSP should have a small study completed this fall examining the decline of soil moisture within the soil profiles of the parks over four summer months. However, this study will be too small to be definitive and it is very limited in scope. Since the impact of drought is important, we will also have a specific study under Dr. Kevin Brown within three parks that will examine the potential reduction in Douglas fir needle nutrients under summer drought conditions.

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Appendices

Denham Till Soil Data

1 Horizon	2 Horizon Depth (cm)		3 Horizon Thickness (cm)		4 Horizon Boundary		5 Coarse Fragment Descript						6 Soil Texture <2 mm	
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm		
								%	Type	%	Type	%		Type
LFH	-2	0	/	/	/	/	/	/	/	/	/	/	/	/
A	0	15	8	15	G	S	18	3	S	15	S	/	/	SiCL
Bgj	15	40	10	25	D	W	10	10	S	/	/	/	/	SiCL
Cg	40	60+	20+	30+	/	/	5	5	S	/	/	/	/	SiCL

Horizon	7 Structure								8 MST	9 Consist.				
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.	
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.						
LFH	/	/	/	/	/	/	/	/	/	/	/	/	/	
A	WM	M	SBK	/	M	F	SBK	/	M	/	/	3	3	
Bgj	WM	C	SBK	/	WM	M	SBK	/	M	/	/	3	3	
Cg	WM	C	ABK	/	WM	M	SBK	/	W	/	/	3	3	

Horizon	11										12								
	Colour 1					Colour 2					AB	SI	CO	Mottles					Bound Dist.
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma				X F C M	F M C	F D P	Aspect	Hue	
		Number	Letter(s)				Number	Letter(s)			Number	Letter(s)	Number					Letter(s)	
A	7	10	YR	4	3	/	/	/	/	/	/	/	/	/	/	/	/	/	
Bgj	3	10	YR	5	4	/	/	/	/	/	C	M	D	3	7.5	YR	5	6	D
Cg	3	10	YR	5	3	/	/	/	/	/	M	M	P	4	5	YR	5	6	S

Horizon	13								16						
	Roots 1				Roots 2				Pores						
	Ab	Size	Dr	Dist	Ab	Size	Dr	Dist	Ab.	Size	Ori	Dist	Cont	Mor	Type
	X F P A	V F M C	V H O R	IN EX MX	X F P A	V F M C	V H O R	IN EX MX	F P A	V F M C	V H O R	IN EX MX	CO DC	S D C	V I T
A	F	F	R	IN	F	C	R	MX	P	M	H	IN	DC	S	T
Bgj	F	F	R	IN	P	C	R	MX	P	M	H	IN	DC	S	T
Cg	/	/	/	/	/	/	/	/	F	M	H	IN	DC	S	T

Green Park Lower Soil Data

1	2		3		4		5						6		
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript						Soil Texture <2 mm		
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm			
								%	Type	%	Type	%		Type	
LFH	-3	0	/	/	/	/	/	/	/	/	/	/	/	/	/
A	0	24	22	28	G	S	15	15	S	/	/	/	/	LS	
Bm	24	45	18	21	G	S	20	10	S	10	A	/	/	LS	
BC	45	75+	/	/	/	/	50	30	S	/	/	20	S	LS	

Horizon	7								8	9			
	Structure								MST	Consist.			
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.					
LFH	/	/	/	/	/	/	/	/	M	/	/	/	/
A	W	VF	SBK	/	/	/	SGR	/	M	/	/	1	1
Bm	W	VF	SBK	/	/	/	SGR	/	M	/	/	1	1
BC	W	VF	SBK	/	/	/	SGR	/	M	/	/	1	1

Horizon	11										12						13										
	Colour 1					Colour 2					Mottles						Roots 1			Roots 2							
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma	A B	S I	C O	Colour			Bound Dist.	A b	Si ze	D r	D is t	A b	Si ze	D r	D is t		
		Number	Letter(s)				Number	Letter(s)						Number	Letter(s)	Value										Chroma	S C D
A	7	2	Y	2	0	/	/	/	/	/	/	/	/	/	/	/	A	F	R		I	N	F	C	R	M	X
Bm	7	7	Y	3	4	/	/	/	/	/	/	/	/	/	/	/	P	M	R		I	N	F	F	R	I	N
BC	7	1	Y	3	3	/	/	/	/	/	/	/	/	/	/	/	F	F	R		I	N	/	/	/	/	/

Green Park Upper Soil Data

1	2		3		4		5						6	
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript						Soil Texture <2 mm	
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm		
								%	Type	%	Type	%		Type
LFH	-1.5	0	/	/	/	/	/	/	/	/	/	/	/	/
Ah	0	10	5	15	G	W	20	5	S	10	S	5	S	L
Bm1	10	40	20	35	D	W	25	15	S	10	S	/	/	L
Bm2	40	70+	/	/	/	/	5	5	S	/	/	/	/	SiL

Horizon	7								8	9			
	Structure								MST	Consist.			
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.					
LFH	/	/	/	/	/	/	/	/	M	/	/	/	/
Ah	WM	C	SBK	/	WM	VF	SBK	/	M	/	/	2	3
Bm1	WM	M	SBK	/	WM	VF	SBK	/	M	/	/	2	2
Bm2	W	M	SBK	/	/	/	SGR	/	M	/	/	2	2

Horizon	11										12						13								
	Colour 1					Colour 2					Mottles						Roots 1			Roots 2					
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma	X F C M	F M C	F D P	Colour			Bound Dist.	A b	Si ze	D r	D is t	A b	Si ze	D r	D is t
		Number	Letter(s)				Number	Letter(s)						Number	Letter(s)	Value									
Ah	7	10	YR	3	3	/	/	/	/	/	/	/	/	/	/	/	P	C	R	M X	P	F	R	I N	
Bm 1	7	10	YR	4	4	/	/	/	/	/	/	/	/	/	/	/	P	C	R	M X	P	M	R	M X	
Bm 2	7	10	YR	4	6	/	/	/	/	/	/	/	/	/	/	/	F	C	R	M X	F	M	R	M X	

Gulf View Soil Data

1	2		3		4		5						6	
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript						Soil Texture <2 mm	
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm		
								%	Type	%	Type	%		Type
LFH	-1.5	0	/	/	/	/	/	/	/	/	/	/	/	/
Ah	0	22	20	28	G	S	10	5	S	5	S	/	/	SL
Bm	22	56	10	41	D	I	12	10	S	2	S	/	/	SL
C	56	75+	0+	35+	/	/	5	5	S	/	/	/	/	SCL

Horizon	7								8	9			
	Structure								MST	Consist.			
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.					
LFH	/	/	/	/	/	/	/	/	M	/	/	/	/
Ah	WM	C	SBK	/	WM	F	SBK	/	M	/	/	2	2
Bm	WM	C	ABK	/	WM	F	ABK	/	M	/	/	2	1
C	M	C	ABK	/	M	M	ABK	/	M	/	/	2	2

Horizon	11										12								
	Colour 1					Colour 2					Mottles								
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma	X F C M	F M C	F D P	Aspect	Hue		Value	Chroma	Bound Dist.
		Number	Letter(s)				Number	Letter(s)							Number	Letter(s)			
Ah	7	7.5	YR	3	2	/	/	/	/	/	/	/	/	/	/	/	/	/	
Bm	7	10	YR	4	3	/	/	/	/	/	/	/	/	/	/	/	/	/	
C	7	10	YR	5	6	/	/	/	/	/	/	/	/	/	/	/	/	/	

Horizon	13								16						
	Roots 1				Roots 2				Pores						
	Ab	Size	Dr	Dist	Ab	Size	Dr	Dist	Ab.	Size	Ori	Dist	Cont	Mor	Type
	X F P A	V F M C	V H O R	I N E X M X	X F P A	V F M C	V H O R	I N E X M X	F P A	V F M C	V H O R	I N E X M X	C O D C	S D C	V I T
Ah	F	F	R	IN	F	M	R	IN	P	M	H	IN	DC	S	T
Bm	F	C	R	MX	F	M	R	IN	P	M	/	IN	/	S	V
C	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/

Lillian Hoffar Soil Data

1	2		3		4		5						6		
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript						Soil Texture <2 mm		
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm			
								%	Type	%	Type	%		Type	
LFH	-3	0	/	/	/	/	/	/	/	/	/	/	/	/	/
Ah	0	16	11	16	D	W	15	5	S	10	S	/	/	/	SiL
Bm1	16	40	20	25	G	W	10	5	S	5	S	/	/	/	SiCL
Bm2	40	50	8	10	N	S	5	5	S	/	/	/	/	/	SiCL
Cg	50	60+	/	/	/	/	2	2	S	/	/	/	/	/	SiC

Horizon	7								8	9			
	Structure								MST	Consist.			
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.					
LFH	/	/	/	/	/	/	/	/	M	/	/	/	/
Ah	WM	C	SBK	/	WM	F	SBK	/	M	/	/	1	2
Bm1	W	C	SBK	/	W	F	SBK	/	M	/	/	2	1
Bm2	WM	M	SBK	/	W	VF	SBK	/	M	/	/	3	2
Cg	M	VC	SBK	/	M	C	SBK	/	W	/	/	3	3

Horizon	11										12						13								
	Colour 1					Colour 2					Mottles						Roots 1				Roots 2				
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma	A B	S I	C O	Colour			Bound Dist.	A b	Si ze	D r	D is t	A b	Si ze	D r	D is t
		Number	Letter(s)				Number	Letter(s)			X F C M	F M C	F D P	Aspect	Number	Letter(s)		Value	Chroma	S C D	X F P A	V F M C	V H O R	I N E X M X	X F P A
Ah	7	5	Y R	3	2	/	/	/	/	/	/	/	/	/	/	/	F	V	R	I N	F	F	R	I N	
Bm1	7	10	Y R	3	3	/	/	/	/	/	/	/	/	/	/	/	F	C	R	M X	F	F	R	I N	
Bm2	7	10	Y R	3	2	/	/	/	/	/	/	/	/	/	/	/	F	M	R	I N	/	/	/	/	
Cg	6	25	Y	6	2	/	/	/	/	C	M	P	9	75	Y R	5	6	C	/	/	/	/	/	/	/

Nymph Point Soil Data

1	2		3		4		5						6	
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript						Soil Texture <2 mm	
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm		
								%	Type	%	Type	%		Type
LFH	-3	0	/	/	/	/	/	/	/	/	/	/	/	/
Ah	0	11	8	11	N	S	5	5	S	/	/	/	/	SiCL
Bg	11	50	30	43	D	W	2	2	S	/	/	/	/	SiC
BCg	50	86+	/	/	/	/	1	1	S	/	/	/	/	SiC

Horizon	7								8	9			
	Structure								MST	Consist.			
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.					
LFH	/	/	/	/	/	/	/	/	M	/	/	/	/
Ah	M	C	SBK	/	S	M	SBK	/	M	/	/	3	2
Bg	M	VC	SBK	/	S	C	SBK	/	D	/	/	3	2
BCg	M	C	SBK	/	S	M	SBK	/	D	/	/	3	3

Horizon	13								16						
	Roots 1				Roots 2				Pores						
	Ab	Size	Dr	Dist	Ab	Size	Dr	Dist	Ab.	Size	Ori	Dist	Cont	Mor	Type
	X F P A	V F M C	V H O R	IN EX MX	X F P A	V F M C	V H O R	IN EX MX	F P A	V F M C	V H O R	IN EX MX	CO DC	S D C	V I T
Ah	F	F	R	IN	/	/	/	/	F	M	H	IN	DC	S	T
Bg	F	F	R	IN	F	M	R	MX	F	M	H	IN	DC	S	T
BCg	P	C	H	MX	F	F	R	IN	/	/	/	/	/	/	/

Prentice Pond Soil Data

1	2		3		4		5						6	
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript						Soil Texture <2 mm	
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm		
								%	Type	%	Type	%		Type
LFH	-4	0	/	/	/	/	/	/	/	/	/	/	/	/
Ah	0	11	8	11	N	S	12	10	A	2	S	/	/	L
Bm1	11	32	16	23	N	S	17	15	S	2	S	/	/	SL
Bm2	32	65	30	35	N	S	17	15	S	2	S	/	/	SL
C	65	80+	/	/	/	/	16	15	S	1	A	/	/	SL

Horizon	7								8	9			
	Structure								MST	Consist.			
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.					
LFH	/	/	/	/	/	/	/	/	M	/	/	/	/
Ah	WM	C	SBK	/	WM	M	SBK	/	M	/	/	2	2
Bm1	W	C	SBK	/	/	/	SGR	/	M	/	/	2	1
Bm2	WM	C	SBK	/	/	/	SGR	/	M	/	/	2	1
C	WM	C	SBK	/	W	M	SBK	/	M	/	/	2	2

Horizon	11										12						13								
	Colour 1					Colour 2					Mottles						Roots 1			Roots 2					
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma	X F C M	F M C	F D P	Colour			Bound Dist.	A b	Si ze	D r	D is t	A b	Si ze	D r	D is t
		Number	Letter(s)				Number	Letter(s)						Number	Letter(s)	Value									
Ah	7	Y	3	2	/	/	/	/	/	/	/	/	/	/	/	F	F	R	/	I N E X M X	F	C	R	M X	
Bm1	7	Y	4	4	/	/	/	/	/	/	/	/	/	/	/	F	F	R	/	I N E X M X	F	M	R	M X	
Bm2	7	Y	4	4	/	/	/	/	/	/	/	/	/	/	/	P	C	R	/	M X	P	M	R	M X	
C	7	Y	3	3	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	

Quarry Soil Data

1	2		3		4		5								6	
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript								Soil Texture <2 mm	
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm				
								%	Type	%	Type	%	Type			
LFH	-1.5	0	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Ah	0	15	10	20	G	W	10	10	S	/	/	/	/	/	/	SL
Bm	15	70	40	55	G	S	15	10	S	5	R	/	/	/	/	SL
C	70	80+	7	10+	/	/	15	15	S	/	/	/	/	/	/	LS

1	7								8	9			
Horizon	Structure								MST	Consist.			
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.					
LFH	/	/	/	/	/	/	/	/	M	/	/	/	/
Ah	WM	M	SBK	/	WM	F	SBK	/	M	/	/	1	1
Bm	WM	M	SBK	/	WM	M	SBK	/	M	/	/	2	1
C	W	VF	SBK	/	/	/	SGR	/	M	/	/	1	1

Horizon	11										12						13								
	Colour 1					Colour 2					Mottles						Roots 1		Roots 2						
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma	X F C M	F M C	F D P	Colour			Bound Dist.	A b	Si ze	D r	D is t	A b	Si ze	D r	D is t
		Number	Letter(s)				Number	Letter(s)						Number	Letter(s)	Number									
	Number	Letter(s)	Value	Chroma	Number	Letter(s)	Value	Chroma	X F C M	F M C	F D P	Aspect	Number	Letter(s)	Value	Chroma	SCD	X F P A	V F M C	V H O R	I N E X M X	X F P A	V F M C	V H O R	I N E X M X
Ah	8	5	Y R	2 .5	1	/	/	/	/	/	/	/	/	/	/	/	P	V	R	I N	F	F	R	I N	
Bm	7	10	Y R	3	6	/	/	/	/	/	/	/	/	/	/	/	F	C	H	M X	P	F	R	I N	
C	7	10	Y R	5	8	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	

Small Quarry Soil Data

1	2		3		4		5						6	7											
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript						Soil Texture <2 mm	Structure											
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm		Primary				Secondary							
								%	Type	%	Type	%		Type	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.			
LFH	-2	0	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Ah	0	12	9	11	N	S	10	10	S	/	/	/	/	L	WM	M	SBK	/	/	/	/	/	/	/	/
B	12	32	17	20	N	S	25	20	S	5	S	/	/	SiL	M	F	SBK	/	/	/	/	/	/	/	/
R	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/

Horizon	11										12						13								
	Colour 1					Colour 2					Mottles						Roots 1			Roots 2					
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma	X F C M	F M C	F D P	Colour			Bound Dist.	A b	Si ze	D r	D is t	A b	Si ze	D r	D is t
		Number	Letter(s)				Number	Letter(s)						Number	Letter(s)	Value									
Ah	7	10	YR	3	3	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
B	7	25	Y	5	4	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/

R.O. Bull Soil Data

1	2		3		4		5						6	
Horizon	Horizon Depth (cm)		Horizon Thickness (cm)		Horizon Boundary		Coarse Fragment Descript						Soil Texture <2 mm	
	Upper	Lower	Min	Max	Dist	Form	% by vol	Gravel <7.5 cm		Cobbles 7.5 - 25 cm		Stones >25 cm		
								%	Type	%	Type	%		Type
LFH	-2	0	/	/	/	/	/	/	/	/	/	/	/	/
Ah	0	15	10	18	G	I	12	7	S	5	S	/	/	L
Bm1	15	45	15	30	G	W	20	15	S	5	S	/	/	LS
Bm2	45	70+	20	25+	/	/	10	10	S	/	/	/	/	LS

Horizon	7								8	9			
	Structure								MST	Consist.			
	Primary				Secondary				D M W	Dry	Moist	Wet	Plast.
	Grade	Class	Kind	Kind Mod.	Grade	Class	Kind	Kind Mod.					
LFH	/	/	/	/	/	/	/	/	M	/	/	/	/
Ah	WM	C	SBK	/	W	VF	SBK	/	M	/	/	2	3
Bm1	W	F	SBK	/	/	/	SGR	/	M	/	/	1	1
Bm2	W	VF	SBK	/	/	/	SGR	/	M	/	/	1	1

Horizon	11										12						13								
	Colour 1					Colour 2					Mottles						Roots 1			Roots 2					
	Aspect	Hue		Value	Chroma	Aspect	Hue		Value	Chroma	A B	S I	C O	Colour			Bound Dist.	A b	Si ze	D r	D is t	A b	Si ze	D r	D is t
		Number	Letter(s)				Number	Letter(s)						Number	Letter(s)	Value									
Ah	7	10	YR	3	2	/	/	/	/	/	/	/	/	/	/	/	F	F	R	I N	F	M	R	M X	
Bm 1	8	75	YR	5	6	/	/	/	/	/	/	/	/	/	/	/	P	F	R	I N	P	M	R	M X	
Bm 2	8	10	YR	6	6	/	/	/	/	/	/	/	/	/	/	/	F	C	R	M X	F	F	R	I N	