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REPORT ON

TERRAIN AND SOIL BASELINE FOR THE MUSKEG RIVER MINE PROJECT

Submitted to:

Shell Canada Limited
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P.O. Box 100, Station 'M'
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December 1997 **972-2237**

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January 21, 1998

Proj. No. 972-2237

Dr. Doug Mead
Senior Environmental Scientist
Safety and Environmental Resources
Shell Canada Limited.
400 - 4th Avenue SW
P.O. Box 100, Station M
Calgary, AB T2P 2H5

RE: Final report - Terrain and Soil Baseline

Dear Doug

Attached is the final report for the 1997 terrain and soil baseline report for the Muskeg River Mine Project. This report summarizes the outcome of work completed in 1997 on evaluation of terrain and soil in the local study area for the Muskeg River Mine Project. It includes: a) a discussion on the environmental setting for the Muskeg River Mine Project local study area (LSA); b) the results of soil surveys of the LSA; c) the results of a terrain analysis of the LSA; d) a brief overview of reclamation considerations; and e) discussion in the methodologies employed for the baseline study.

The terrain and soil baseline report provided information valuable to the completion of the terrestrial and reclamation planning component of the Muskeg River Mine Project EIA and operating approval applications.

Should you have any questions about this report, please contact me at 299-5640.

Yours very truly,

GOLDER ASSOCIATES LTD.

John R. Gulley, M.Sc., P. Biol.
Oil Sands Project Director

attachment

cc. Judy Smith (Shell)
Ian Mackenzie (EIA Project Manager)

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1. INTRODUCTION

1.1 OBJECTIVES

Shell Canada Limited (Shell) is proposing to develop the Muskeg River Mine Project on the west side of Lease 13, about 75 km north of Fort McMurray. The Terms Of Reference issued by Alberta Environmental Protection (AEP) for the Muskeg River Mine Project requires that a baseline terrain soil and report be prepared to inventory the pre-construction terrestrial resources within the proposed development area. This report was prepared with reference to previous studies conducted within the immediate locale, specifically the baseline study for Syncrude Canada Limited's (Syncrude) Aurora Mine (Landcare 1996), Suncor's Steepbank Mine (Leskiw et al. 1996) and, on a broader scale, the AOSERP soils inventory (Turchenek and Lindsay 1982).

As part of the terrestrial baseline program, Golder Associates Ltd. (Golder) and Can-Ag Enterprises Ltd. (Can-Ag) were retained to complete a field sampling program.

1.2 STUDY AREA

The Local Study Area (LSA) for the Muskeg River Mine Project is located on the western side of Shell's oil sands Lease 13. It is bounded on the west by the Athabasca River, to the north by the boundary of Lease 13 and on the south and east by a buffer that extends 500 m beyond the perimeter of the development footprint (Figure 1).

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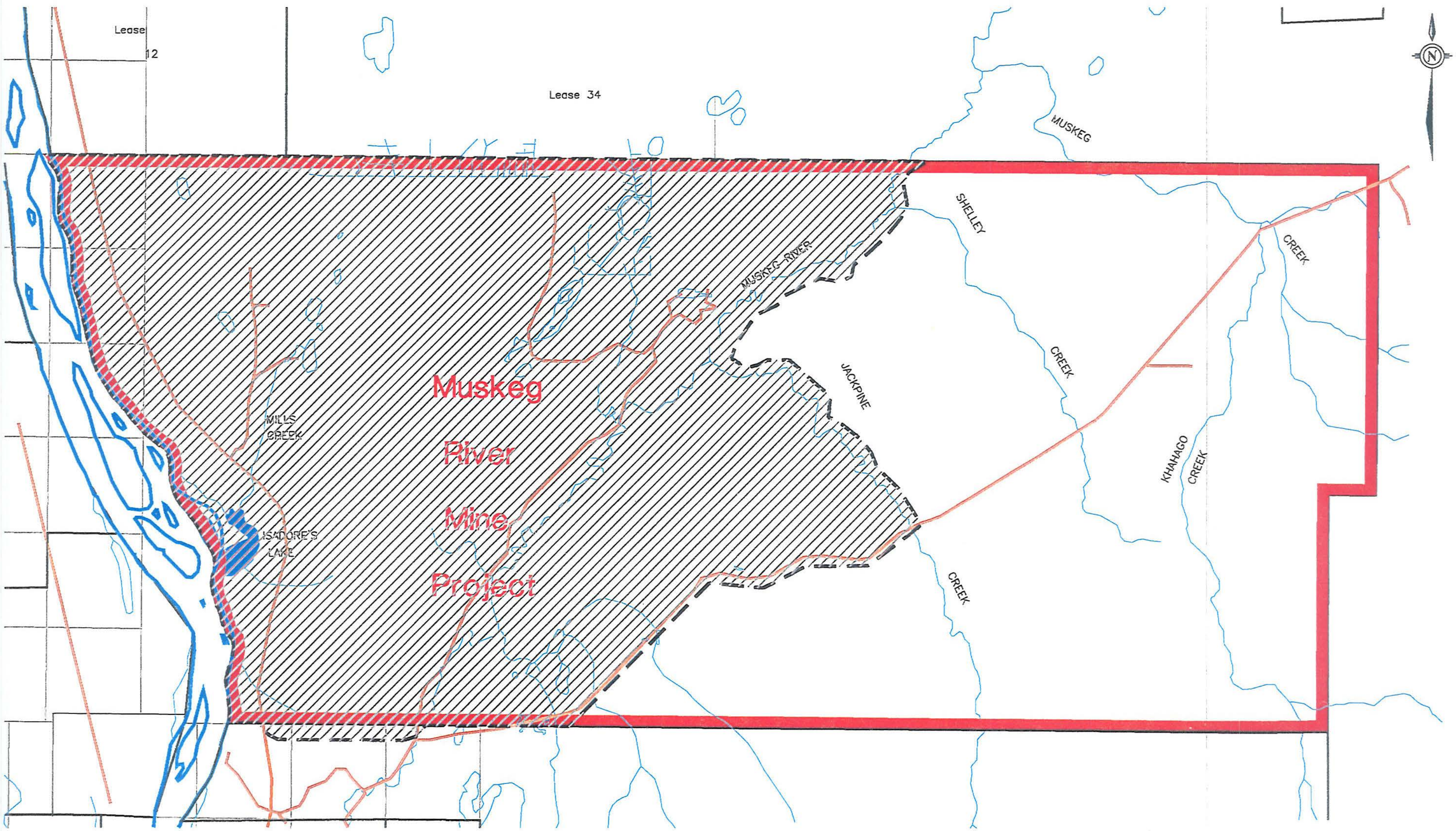


REFERENCE

DIGITAL DATA SETS 74D, 74E, 74I
84A AND 84H FROM RESOURCE DATA DIVISION
ALBERTA ENVIRONMENTAL PROTECTION, 1997.

0 1 2 3 4 5km

SCALE 1:100,000

Golder Associates

SHELL CANADA LIMITED

TERRESTRIAL LOCAL STUDY AREA FOR MUSKEG RIVER MINE PROJECT

27 NOV 97	FIGURE 1	DRAWN BY:

2. METHODS

2.1 SOIL MAPPING

2.1.1 Review of Existing Information and Soil Names

A review of existing soil survey information for the LSA and surrounding region was undertaken in both the pre-planning and interpretation stages. Pertinent sources include the work of Crown and Twardy for the Fort McMurray Region (1970), Leskiw et al. (1996) for Suncor's Steepbank Mine, Turchenek and Lindsay (1982) in the AOSERP study area, and Landcare (1996) for Syncrude's Aurora Mine.

Soils were initially classified to the subgroup level according to criteria established by the Agriculture Canada Expert Committee on Soil Survey (1987). Reference to the above background sources revealed that nomenclature was inconsistent, particularly between the two recent and the two older studies. Therefore, a cross-referencing approach, similar to that of Landcare (1996), was used so the soil names and map units would conform to those for Soil Correlation Area (SCA) 20 in the Alberta Soil Names File (RRTAC 1993). Where a soil had no equivalent in SCA 20, the name from its originating SCA was retained, (e.g., the Muskeg series is found in SCA 18).

2.1.2 Field Inspection Methodology

Location of the field inspection sites was based on a number of considerations:

- Alberta Environmental Protection requirements of 40 soil inspection sites/mi. sq. ($15/km^2$) for all areas falling within the first 10 year footprint plus those areas planned for the construction of facilities and infrastructure (access roads, muskeg storage areas, overburden dumps and tailings settling pond). A reduced density of 13 soil inspection sites/square mile ($5/km^2$) is required for areas outside the development footprint but within the LSA (Sansom, pers. comm. 1997).

- The desire to sample in as many map polygons as possible within the preliminary Alberta Vegetation Inventory (AVI) pre-stratification of the LSA carried out in July 1997.

- Access via existing cutlines throughout the LSA.

- The availability of data from a number of sites surveyed by Landcare (1996) for Syncrude's Aurora mine. One hundred and forty sites from the latter fell within the LSA and an additional 638 inspections were done specifically for the Muskeg River Mine Project.

Field sampling was conducted August 15 - 25, 1997. Inspection sites were located at regular intervals along transects that correspond to cutlines and access routes from previous developments in the area (e.g., Alsands, OSLO). A significant unstructured survey component was included to allow characterization of differences in landscape features, and to coincide with vegetation and forestry plots. Land surface and soil profile characteristics were recorded using the criteria outlined in the CanSIS manual (Agriculture Canada 1983). Topsoil moisture conditions varied from dry on knolls to moist or saturated in depressional areas. Bogs and fens were generally saturated and frost was encountered at depths below a metre in a few instances. The soil was examined to a depth of 1 metre (or depth of organics plus 20 cm into the underlying mineral material) at the majority of the sites, except where stoniness, contact with residual oil sands or frost precluded augering. Information from soil inspections was extrapolated to map units using the principles of geomorphology and surficial geology in concert with the vegetation patterns and interpretation of the aerial photographs to delineate individual soil map units. It must be stressed that soil types naturally grade into one another so that the boundaries must be viewed as generalized.

2.2 TERRAIN ANALYSIS

The terrain or landform analysis component of this study is based on integrating data from a number of sources:

- the soil map units;
- the AVI map units;
- the composition of the surficial deposits; and
- a digital elevation model of the LSA with a two metre contour interval.

Due to the high degree of interdependence among these components, the terrain unit names were derived principally from the characteristics of the surficial materials.

Due to the relative lack of relief in the LSA the more customary approach of using elevation changes, elevation ranges/classes, or breaks in slope to define landscape units was foregone in favour of a technique based primarily on surficial material properties. Soil inspections were carried out to coincide to a large degree with the AVI polygons. Once the soils had been described and given their appropriate subgroup classification and series names, the polygon boundaries were adjusted to conform with those of the underlying soils. Vegetation-soil correlations tend to be quite high but were by no means 100% (i.e., a particular vegetation type may be found primarily on one soil type in the LSA but that does not necessarily mean every unit of that soil type will support only that vegetation type). Factors such as aspect, slope position and composition of the subsurface materials also affect the microenvironment and hence what vegetation is found at a particular location.

The initial terrain units were derived by combining soil units with similar genetic properties. All the soil units with glaciofluvial parent materials were merged to produce larger map units having comparable morphological and mechanical characteristics. The highly fragmented nature of the landscape in the LSA resulted in the generation of an exceedingly complex terrain map. While a few large contiguous terrain units may be discerned, much of the area is a heterogeneous mix of small pockets of various materials.

2.3 SAMPLING AND LABORATORY ANALYSES

Soils from the Project LSA were collected for chemical and physical analyses, by Enviro-Test Labs, Edmonton. Efforts were made to sample from representative profiles of as many of the soil series in the LSA as possible. Samples to the 1 metre depth were taken at 42 inspection sites, but where a series was not sampled comparable data from either Leskiw et al. (1996) or Landcare (1996) were used.

Analyses were restricted to critical requirements of each typical profile using standard soil investigation techniques as outlined by McKeague (1978). The results are presented after each soil series description. The routine chemical characteristics included: electrical conductivity (EC), saturation percentage (% SAT), soluble cations, sodium absorption ratio (SAR), and soil reaction (pH) of both the saturated paste and in $CaCl_2$ suspension. Organic matter content (% OM), exchangeable cations (calcium, magnesium, sodium and potassium) and soil fertility in terms of plant available nutrients (nitrogen, phosphorus, potassium and sulfur) were also assessed.

Physical analyses consisted of water retention characteristics and particle size analysis (texture). The difference between field capacity (1/3 bar) and wilting point (15 bar) equals the available water holding capacity on a percent weight basis. Particle size (texture) is an evaluation of the mineral fraction of the soil in % sand, % silt and % clay.

3. ENVIRONMENTAL SETTING

3.1 NATURAL REGION AND CLIMATE

The LSA is located in the Central Mixedwood subregion of the Boreal Forest Natural Region of Alberta (AEP 1994). This subregion is the largest in spatial extent in the province and characterized by a cool, moist (i.e., boreal) climate regime conducive to the growth of mixed aspen-spruce forests with a significant component of bogs and fens in poorly drained areas. Strong (1992) classifies this as the Mid-Boreal Mixed wood Ecoregion of the Boreal Ecoprovince. Pettapiece (1989) notes the climate as having moderate to severe temperature limitations to plant growth while both Dzikowski and Heywood (1990) and Strong (1992) provide extensive long-term statistical summaries on parametres such as growing-degree days and length of the frost-free season.

3.2 PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The LSA is characterized as having a subdued relief with near-level topography. A maximum elevation of 300 masl (metres above sea level) occurs approximately mid-way between the Athabasca and Muskeg Rivers with the land falling away to the east, 280 masl along the west bank of the Muskeg, and west, 280 masl at the top of the escarpment on the east bank of the Athabasca. Between the Muskeg River and Jackpine Creek the land rises gradually from 280 to 310 masl. From north to south the elevation drops from 300 to 260 masl. Overall, the slopes in the LSA are less than 0.5%.

Pettapiece (1986) places the majority of the LSA within the Northern Plains physiographic region; however, the extreme southeast corner of township 95, range 10, west of the fourth meridian and all of the eastern section of Lease 13 fall into the McMurray Lowland physiographic region. The Athabasca River valley is classed separately as part of the Northern Alberta Lowlands. Table 1 provides a more detailed evaluation of the surface characteristics of the LSA.

Table 1 Physiographic Setting of the Muskeg River Mine Project LSA

Region	Section	District	Surface Expression	Surficial Materials	Elevation, masl
Northern Plains	Great Slave Plain	Embarras Plain	Level - Undulating	Glaciofluvial, Eolian[(a)]	200 - 350
Northern Alberta Lowlands	Wabasca Lowland	Athabasca Valley	Steep	Undifferentiated	275 - 600
Northern Alberta Lowlands	McMurray Lowland	Kearl Lake Plain	Undulating	Glaciolacustrine	300 - 450

(after Pettapiece 1986)

[(a)] Eolian - Windblown deposits are extremely small and widely scattered throughout the LSA. They do not form sizable contiguous units, but exist primarily as veneers overlying other deposits.

Bayrock (1971) mapped the surficial geology of the LSA as primarily glaciofluvial outwash sands, medium to coarse in texture containing pebbles and gravel lenses. The outwash sands vary in depth from less than 1 to more than 6 m. Relief is classified as level to gently undulating. Two relatively small inclusions of different material are noted as occurring within the LSA but outside the development footprint. Both are found along the east bank of the Athabasca River valley. The first is a small deposit of meltwater channel sediments described as 3 to 6 m of medium to coarse grained sands, overlying 1 to 3 m of lag gravels containing many large boulders. The second is a pocket of recent alluvial stream sediments, mainly sands, which coincides with bedrock outcrops of the Waterways formation.

3.3 BEDROCK GEOLOGY

The bedrock geology is principally the oil impregnated sandstone and siltstone of the McMurray formation. These are Cretaceous deltaic deposits with some inter-bedding of Clearwater formation shales (Green 1972, Ozoray et al. 1980, RCA 1970). As noted in section 3.2, a small area of the Waterways shale and limestone complex is exposed along the eastern bank of the Athabasca River. More detailed discussions of various aspects of the geology of the LSA may be found in Carrigy and Kramers (1973).

4. SOIL SURVEY OF THE LOCAL STUDY AREA

The soil map units detailed in this report are based on the diagnostic properties of the principal soil series after which they have been named. It is important to realize that while a soil unit may be mapped as Bitumount, for example, this is not meant to imply that all the soils within the boundaries of that unit will conform to the description of a typical Bitumount profile. Rather, the predominant soil series found within a specified polygon falls within the range of natural variability that has been interpreted as belonging to the Bitumount series. The unit name reflects the dominant soil type but is not exclusive of others.

Landcare (1996) devised a descriptive system that produced 150 different soil unit types within the LSA, some of which had as many as 5 different soil series within a single map polygon. In this report, the soils mapping is based on: the scale required in the Terms of Reference (AEP 1997); the mapping parametres set out for the Northern Forested Region of Alberta (Alberta Soil Advisory Committee 1987) for baseline reporting; and the stripping and salvaging capabilities of the equipment likely to be used in the project development operations.

4.1 DESCRIPTION OF SOIL SERIES AND SOIL MAP UNITS

A summary description of each of the soil map units is provided in the following section, including: the aerial extent of each map unit, the soil subgroup type, the soil parent material, soil texture, topography, slope position, soil drainage class, predominant vegetation type and noteworthy comments. These are followed by chemical and physical analysis for specific series profiles as noted. The soil map units are identified for the LSA in Figure 2 (Muskeg River Mine Project Soil Classification).

4.1.1 Bitumount Series (BMT Soil Unit)

Extent (area/percent of LSA)	1915 ha / 17.5%
Soil Subgroup	peaty Orthic Gleysol (ptBMT), Orthic Humic Gleysol (BMT)
Parent Material	glaciofluvial
Texture (surface/subsurface)	peat/sandy clay loam (sandy loam to clay loam)
Topography (class/% slope)	1-2/0-2%
Slope Position	lower, level, depressional
Drainage Class	poorly to imperfectly drained
Predominant Vegetation Type	typical upland → few transition: aspen-white spruce → tamarack-black spruce
Comments	Analytical data are for plot 299, ptBMT.

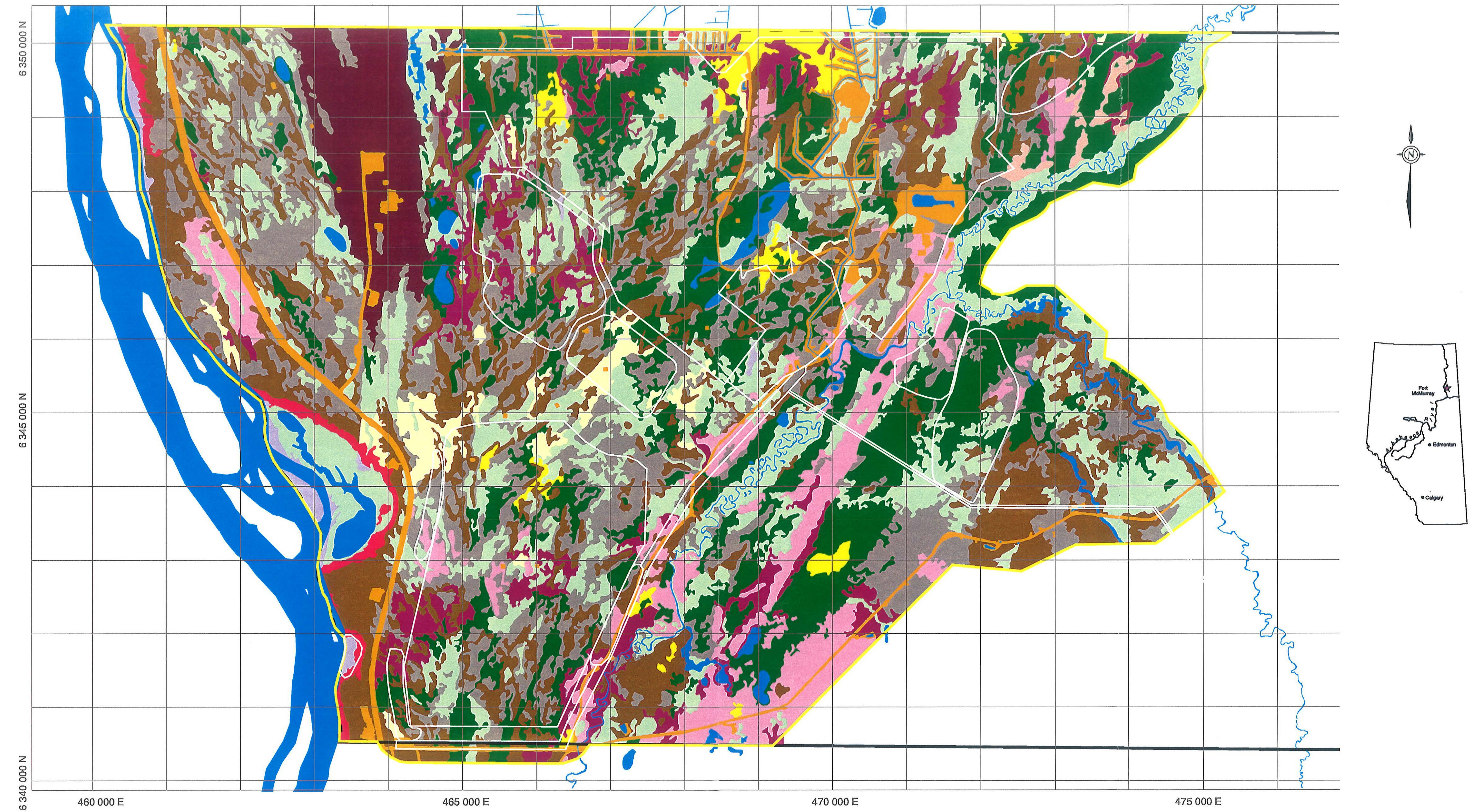
PLOT #299						
Horizon	**Depth**	**Colour**	**Mottles**	**Texture**	**Structure**	**Consistence**
LFH	16-0					
Ae	0-3	10 YR 5/2		L	MA	FRIABLE
Bg	3-19	10 YR 6/4	10 YR 5/6	LS	MA	FRIABLE
BCg	19-35	10 YR 6/3	10 YR 5/8	LS	MA	FRIABLE
Cg	35-100	10 YR 6/3		SL	MA	FRIABLE
R	100+			Oil Sands		

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LFH	16-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bg	3-19	13.8	6.4	64.8	17	18.2	SL	n/a
BCg	19-35	10	5.2	74.8	10	15.2	SL	n/a
Cg	35-100	12.3	6.2	69.8	11	19.2	SL	23

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
LFH	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	13	300
Bm	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
BCg	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	0.22	3	32.5	8.8	1.3	0.12	n/a	n/a	n/a

Horizon	Avail-S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
LFH	56	n/a	n/a	n/a	n/a	n/a	5.9	54
Bm	n/a	0.096	10	2.4	0.066	11	6	n/a
BCg	n/a	0.035	6.5	1.7	0.077	7.8	6	n/a
Cg	n/a	0.026	6.9	1.2	0.087	8.3	7.6	n/a

n/a = not analyzed or not applicable



LEGEND

Local Terrestrial Study Area
Lease 13
Open water

SOIL UNITS

Bitumount (BMT,ptBMT)
Dover (DOV,DOV.XR)
Fort (FRT,FRT.XR,glFRT)
Mildred (MIL,MIL.XR,glMIL)
McLelland (MLD)
McLelland (MLD.XC,MLD.XG, MLD.XR,MLD.XS,MLD.XT)
McMurray (MMY,glMMY)
Muskeg (MUS)
Muskeg (MUS.XC,MUS.XR, MUS.XS,MUS.XT)
Steepbank (STP,ptSTP)
Rough Broken (RB)
Ruth Lake (RUT)
Cultural Features and Disturbed Lands (AIH,AIM)

SOURCE: The Forestry Corp., CanAg Enterprises Ltd., Golder Associates Ltd.

Based on August 1997 Survey

1 0 1 2
Kilometers

MAP PROJECTION: Universal Transverse Mercator Zone 12 DATUM: NAD 83

Golder Associates

SHELL CANADA LIMITED

MUSKEG RIVER MINE PROJECT
SOIL CLASSIFICATION

19 Jan. 1998 | Figure 2 | PRODUCED BY: J.S./R.P. REVIEWED BY:

/data8/oilsands/972-2237/9700/9701/final/arcview/soil50fin.apr

4.1.2 Dover Soil Series (DOV Soil Unit)

Extent (area/percent of LSA)	42 ha/0.4%
Soil Subgroup	Orthic Gray Luvisol (DOV)
Parent Material	glaciolacustrine
Texture (surface/subsurface)	loam/silt-clay loam
Topography (class/% slope)	1-2/0.5-2.0%
Slope Position	lower
Drainage Class	well drained
Predominant Vegetation Type	typical upland: aspen, balsam poplar
Comments	Mineral soil of A horizon rated as good salvage potential. Analytical data are for plot 719.

PLOT#719					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
LFH	6-0				
Ae	0-6	10 YR 5/2	SiL	PL	FRIABLE
Btnj	6-35	10 YR 5/3	C	COL/SBK	FIRM
BC	35-72	10 YR 5/3	C	SBK	FIRM
Caa	72-110+	10 YR 5/3	C	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LF	6-0	n/a	n/a	36.3	30.3	33.4	n/a	n/a
Ae	0-35	n/a	n/a	29.3	19.3	51.4	CL	n/a
Btnj	35-72	n/a	n/a	19.3	19.3	61.4	HC	n/a

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
LF	n/a	n/a	n/a	n/a	n/a	n/a	2.0	110	1100
Ae	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Btnj	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
BC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

n/a = not analyzed or not applicable

4.1.3 Fort Series (FRT Soil Unit)

Extent (area/percent of LSA)	652 ha / 6.0%
Soil Classification	Orthic Gray Luvisol (FRT), Gleyed Gray Luvisol (glFRT)
Parent Material	medium to coarse glaciofluvial
Texture (surface/subsurface)	sandy loam/sandy clay loam
Topography (class/% slope)	3/2-5%
Slope Position	mid to lower, level
Drainage Class	well (FRT), poorly (glFRT)
Predominant Vegetation Type	aspen to treed/shrubby fen (tamarack, black spruce)
Comments	Mineral soil of A horizon rated as good salvage material. Analytical data from plot 263.

PLOT#263					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
LFH	3-0	n/a	n/a	n/a	n/a
Ae	0-11	10 YR 5/3	SL	SG	LOOSE
Bt	11-27	10 YR 4/3	CL	SBK	FIRM
BC	27-34	10 YR 5/3	SL	SG	LOOSE
C	34-57	10 YR 4/6	SL	SG	LOOSE
ROCK	57+				

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LFH	3-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ae	0-11	7.5	3.1	74.6	13	12.4	SL	n/a
Bt	11-27	21.8	14.1	34.6	14	51.4	SLL	n/a
C	34-57	6.6	4.1	80.6	5	14.4	SL	21

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
LFH	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	40	390
Ae	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C	0.18	2.6	24.1	3.4	1.6	0.13	n/a	n/a	n/a

Horizon	Avail-S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
LFH	29	n/a	n/a	n/a	n/a	n/a	5.4	13
Ae	n/a	0.043	1.3	0.25	0.056	3.4	4.6	n/a
Bt	n/a	0.052	8.5	1.4	0.18	15	4.6	n/a
C	n/a	0.061	4.3	0.38	0.077	6.1	6	n/a

n/a = not analyzed or not applicable

4.1.4 McLelland Series (MLD Soil Unit)

The McLelland soil series was divided into two subgroups: typic mesisols (MLD 1) which have a depth of greater than 120 cm of organic material above the mineral contact and terric mesisols (MLD 2) where the mineral contact occurs between 40 and 120 cm below the surface. In the site inspection list the profiles for MLD 1 are listed as MLD, the profiles incorporated into MLD 2 are listed as MLD. XC, MLD.XG, MLD. XR, MLD.XS and MLD.XT.

It must also be noted that while the McLelland series has been described as either typic or terric mesisols there are occurrences of two other organic subgroups in the deposits. Fibric material, which is less decomposed than mesic and humic material, which is in a more advanced stage of decomposition, was encountered within many of the McLelland profiles. These horizons are designated as Of and Oh respectively. Fibrisols and humisols were also found as distinct profiles at some inspection sites but proved to be too small in spatial extent to be practically mapped; therefore, while the series are mapped as mesisols they are not exclusively mesisolic in composition. Permafrost was also detected in a number of profiles but was not extensive enough to warrant classification as a cryosolic soil series.

Extent (area/percent of LSA)	MLD 1 : 2,115 ha/19.5% MLD 2 : 2,0529 ha/18.8%
Soil Subgroup	MLD 1 : Typic Mesisol (TM), MLD 2 : Terric Mesisol (TM)
Parent Material	organic (MLD 1), organic/mineral (MLD 2)
Texture (surface/subsurface)	peat (MLD 1), peat/mineral (MLD 2)
Topography (class/% slope)	1/0-0.5%
Slope Position	level, depressional
Drainage Class	poor - very poor
Predominant Vegetation Type	treed/shrubby fen
Comments	Fen peat, salvage for use in building reclamation soil. Analytical data for plot 96 (TYM) and plot 345 (TM).

PLOT#96					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
Om	0-190	n/a	n/a	n/a	n/a
Oh	190-210	n/a	n/a	n/a	n/a
Cg	210+	10 YR 4/1	SCL	STR	V. FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Om	0-190	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Oh	190-210	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	210+	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
Om	n/a	n/a	n/a	n/a	n/a	n/a	14	2.8	n/a
Oh	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	0.51	6.6	74.7	15.9	5.9	0.18	n/a	n/a	n/a

Horizon	Avail-S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
Om	240	n/a	n/a	n/a	n/a	n/a	5.8	68
Oh	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	n/a	n/a	n/a	n/a	n/a	n/a	6.6	n/a

PLOT#345					
Horizon	Depth	Colour	Texture	Structure	Consistence
Om	0-190	n/a	n/a	n/a	n/a
Oh	190-210	n/a	n/a	n/a	n/a
Cg	210+	10 YR 4/1	SCL	STR	V. FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Of	0 - 10	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Om	10 - 60	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Oh	60 - 70	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	70+	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail - N µg/g	Avail - P µg/g
Of	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	26
Om	n/a	n/a	n/a	n/a	n/a	n/a	4.0	7.4
Oh	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	0.22	6.7	30.8	8.0	0.5	0.28	n/a	n/a

Horizon	Avail - S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
Of	36	n/a	n/a	n/a	n/a	n/a	6.5	84
Om	33	n/a	n/a	n/a	n/a	n/a	6.1	80
Oh	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	n/a	n/a	n/a	n/a	n/a	n/a	7.1	n/a

n/a = not analyzed or not applicable

4.1.5 McMurray Series (MMY Soil Unit)

Extent (area/percent of LSA)	88 ha/0.8 %
Soil Subgroup	Cumulic Regosol (MMY), Gleyed Cumulic Regosol (glMMY)
Parent Material	fluvial, minor fluvial over morainal
Texture (surface/subsurface)	loam-silt loam/sandy loam-sand
Topography (class/% slope)	4/6-9% (MMY), 0/0-0.5 (glMMY)
Slope Position	mid - lower (MMY), depressional (glMMY)
Drainage Class	moderately well (MMY), imperfectly-poorly (glMMY)
Predominant Vegetation Type	dogwood, shrubby fen
Comments	Restricted to Athabasca River floodplain. Analytical data from plot 415 in Leskiw et al. (1996).

PLOT#415					
Horizon	Depth	Colour	Texture	Structure	Consistence
Oh	0-35	n/a	n/a	n/a	n/a
Bg	35-60	10 YR 5/2	SL	SG	V. FRIABLE
Cg	60-100+	10 YR 5/1	SL	SG	V. FRIABLE

Horizon	Depth cm	Moisture	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
F	6-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C1	0-50	n/a	n/a	27	48	25	SL	61
C2	50-100+	n/a	n/a	32	42	23	L	63

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail - N µg/g	Avail - P µg/g
C1	0.59	n/a	n/a	n/a	n/a	0.2	n/a	n/a
C2	0.69	n/a	n/a	n/a	n/a	0.3	n/a	n/a

Horizon	Avail - S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
C1	0.59	n/a	n/a	n/a	n/a	n/a	7.7	6.44
C2	0.69	n/a	n/a	n/a	n/a	n/a	7.5	n/a

n/a = not analyzed or not applicable

4.1.6 Mildred Series (MIL Soil Unit)

Extent (area/percent of LSA)	1,895 ha/17.3%
Soil Subgroup	Orthic Eutric Brunisols, Eluviated Eutric Brunisols
Parent Material	glaciofluvial
Texture (surface/subsurface)	sandy loam/loamy sand - sand
Topography (class/% slope)	1-3/0 - 5 %
Slope Position	lower to crest
Drainage Class	well to rapid
Predominant Vegetation Type	jack pine - white spruce to treed/shrubby fen
Comments	Sandy textures, salvage B horizon to mix with peat for reclamation soils. MIL.XR have stony or residual materials within 1 metre of surface, poor salvage materials.

PLOT#317					
Horizon	Depth	Colour	Texture	Structure	Consistence
LFH	3-0	n/a	n/a	n/a	n/a
Bm	0-25	10 YR 4/6	LS	GR	FRIABLE
BC	25-30	10 YR 5/6	SL	SG	FRIABLE
Cca	30-45	10 YR 5/6	SL	SG	FRIABLE
ROCKS	45+	n/a	n/a	n/a	n/a

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LFH	3-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bm	0-25	8.5	5.2	73.8	14	12.2	SL	n/a
Cca	30-45	28.7	16.4	60.8	22	17.2	SL	54

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
LFH	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	43	730
Bm	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cca	0.45	3.6	93.8	6.8	4.4	0.097	n/a	n/a	n/a

Horizon	Avail - S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
LFH	140	n/a	n/a	n/a	n/a	n/a	6.3	28
Bm	n/a	0.11	8.6	0.41	0.066	6.9	6.4	n/a
Cca	n/a	0.035	40	0.4	0.051	11	8.1	n/a

n/a = not analyzed or not applicable

PLOT#321					
Horizon	Depth	Colour	Texture	Structure	Consistence
LFH	4-0	n/a	n/a	n/a	n/a
Ae	0-7	7.5 YR 4/4	SiL	W.PL	FRIABLE
Bm	7-30	5 YR 4/4	SiL	W.SBK	FRIABLE
ROCKS	30-50	n/a	n/a	n/a	n/a
C	50-80+	n/a	S	Oil Sands	HARD

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LFH	4-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ae	0-7	1.7	6.5	55.8	31	13.2	SL	n/a
Bm	7-30	12.4	6.8	54.8	29	16.2	SL	n/a
IIC	30-50	8.7	5	69.8	12	18.2	SL	38

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
LFH	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	37	510
Ae	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bm	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
IIC	0.42	5.9	56.8	20.2	1.1	0.17	n/a	n/a	n/a

Horizon	Avail - S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
LFH	54	n/a	n/a	n/a	n/a	n/a	5	60
Ae	n/a	0.026	7.3	2.3	0.066	10	5.4	n/a
Bm	n/a	0.052	8.6	2.6	0.041	9.4	6.3	n/a
IIC	n/a	0.17	21	2	0.01	4.5	8.3	n/a

n/a = not analyzed or not applicable

4.1.7 Muskeg Series (MUS Soil Unit)

The Muskeg soil series was divided into two subgroups : typic mesisols (MUS 1) which have a depth of greater than 120 cm of organic material above the mineral contact and terric mesisols (MUS 2) where the mineral contact occurs between 40 and 120 cm below the surface. In the site inspection list the profiles for MUS 1 are listed as MUS, while the profiles incorporated into MUS 2 are listed as MUS. XC, MUS. XR and MUS.XS.

It must also be noted that while the Muskeg series has been described as either typic or terric mesisols there are occurrences of two other organic subgroups in the deposits. Fibric material, which is less decomposed than mesic, and humic material, which is in a more advanced stage of decomposition, was encountered in some of the Muskeg profiles. These horizons are designated as Of and Oh respectively. Fibrisols and humisols were also found as distinct profiles at some inspection sites but proved to be too small in spatial extent to be practically mapped; therefore, while the series are mapped as mesisols they are not exclusively mesisolic in composition. Permafrost was also detected in a few profiles but was not extensive enough to be classified separately as a cryosolic soil series.

Extent (area/ percent of LSA)	MUS 1: 157 ha/1.4% MUS 2: 183 ha/1.7%
Soil Subgroup	MUS 1: Typic mesisol (TYM) MUS 2: Terric Mesisol (TM)
Parent Material	organic
Texture (surface/subsurface)	peat (MUS 1), peat/mineral (MUS 2)
Topography (class/% slope)	1/0-0.5%
Slope Position	level - depressional
Drainage Class	poor to very poor
Predominant Vegetation Type	shrubby bog
Comments	Bog peat, salvage for use in building reclamation soil. Analytical data from plot 215 (TYM) and plot 477 (TM).

PLOT#215					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
Of	0-50	n/a	n/a	n/a	n/a
Om	50-200+	n/a	n/a	n/a	n/a

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Of	0-50	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Om	50-200	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
Of	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	10	65
Om	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	3.4	34

Horizon	Avail - S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
Of	n/a	n/a	n/a	n/a	n/a	n/a	4.7	93
Om	n/a	n/a	n/a	n/a	n/a	n/a	5.2	88

n/a = not analyzed or not available

PLOT#477					
Horizon	Depth	Colour	Texture	Structure	Consistence
Of	0-30	n/a	n/a	n/a	n/a
Om	30-90	n/a	n/a	n/a	n/a
Cg	90-120+	10 YR 6/1	S	SG	LOOSE

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Of	0-30	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Om	30-90	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
Of	n/a	n/a	n/a	n/a	n/a	n/a	15	31	310
Om	n/a	n/a	n/a	n/a	n/a	n/a	3.0	8.8	56

Horizon	Avail - S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
Of	43	n/a	n/a	n/a	n/a	n/a	3.4	98
Om	33	n/a	n/a	n/a	n/a	n/a	4.1	92

n/a = not analyzed or not applicable

4.1.8 Rough Broken (RB Unit)

Extent (area/percent of LSA)	98 ha/0.9 %
Soil Subgroup	not applicable
Parent Material	variable, undifferentiated
Texture (surface/subsurface)	variable
Topography (class/% slope)	6-8/+16 %
Slope Position	crest - lower
Drainage Class	variable
Predominant Vegetation type	variable if present
Comments	Extremely heterogeneous in all aspects due to steep, unstable slopes. No analytical data.

4.1.9 Ruth Lake Series (RUT Soil Unit)

Extent (area/percent of LSA)	445 ha 4.1 %
Soil Subgroup	Orthic Eluviated Brunisols, Eluviated Eutric Brunisols
Parent Material	glaciofluvial
Texture (surface/subsurface)	sandy loam/sands, gravels
Topography (class/% slope)	3-5/2 - 15 %
Slope Position	mid, upper, crest
Drainage Class	well to rapid
Predominant Vegetation Type	aspen
Comments	Major deposit around Susan Lake gravel pit. Very stony. Analytical data from plot 219.

PLOT#219					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
LFH	10-0	n/a	n/a	n/a	n/a
Bm	0-30	10 YR 4/6	SL	SG	LOOSE
BC	30-40	10 YR 3/6	SL	SG	LOOSE
ROCKS	40+	n/a	n/a	n/a	n/a

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	%Clay	Texture	Sat %
LFH	10-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bm	0-30	n/a	n/a	76.6	16	7.4	SL	n/a

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
LFH	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	58	370
Bm	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Horizon	Avail - S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
LFH	28	0.21	22	3.0	0.96	43	4.8	23
Bm	n/a	0.026	22	0.23	0.056	4.5	5.0	n/a

n/a = not analyzed or not applicable

4.1.10 Steepbank Series (STP Soil Unit)

Extent (area/percent of LSA)	610 ha/5.6 %
Soil Subgroup	Orthic Gleysol (STP), peaty Orthic Gleysol (ptSTP), Orthic Luvic Gleysol (STP)
Parent Material	glaciofluvial
Texture (surface/subsurface)	clay-clay loam/loam-sandy loam
Topography (class/% slope)	2-3/0.5-5 % (STP), 1/0-0.5% (ptSTP)
Slope Position	lower (STP), depressional (ptSTP)
Drainage Class	moderately well-imperfectly (STP), poor (ptSTP)
Predominant Vegetation Type	extremely variable: transitional from upland (aspen-white spruce) to fen/swamp (tamarack, black spruce)
Comments	Analytical data from plot 301.

PLOT#301					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
LFH	6-0	n/a	n/a	n/a	n/a
Ae	0-4	10 YR 5/2	CL	MA	FRIABLE
Bg	4-20	10 YR 5/4	C	MA	FRIABLE
Ccag1	20-45	10 YR 4/4	C	MA	FIRM
Ccag2	45-120+	10 YR 5/3	C	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LFH	6-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bg	4-20	29.2	19.7	23.8	15	61.2	HC	n/a
Ccag1	20-45	38	24.7	15.5	10	74.5	HC	63
Ccag2	45-120	40	26.6	11.7	14	74.3	HC	67

Horizon	EC mS/cm	Na mg/L	Ca mg/L	Mg mg/L	K mg/L	SAR	Avail-N µg/g	Avail-P µg/g	Avail-K µg/g
LFH	n/a	n/a	n/a	n/a	n/a	n/a	<0.2	12	400
Bg	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ccag1	0.47	6.2	67.9	14.8	0.7	0.18	n/a	n/a	n/a
Ccag2	0.34	6.1	44.1	14	1.2	0.22	n/a	n/a	n/a

Horizon	Avail - S µg/g	Na meq/ 100g	Ca meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
LFH	90	n/a	n/a	n/a	n/a	n/a	4.9	28
Bg	n/a	0.096	17	3.7	0.19	12	6.5	n/a
Ccag1	n/a	0.15	39	6.8	0.23	29	7.8	n/a
Ccag2	n/a	0.2	45	4.8	0.18	21	8.1	n/a

n/a = not analyzed or not applicable

4.1.11 Non-Soil Units

Some areas within the LSA are open water while others have been disturbed by previous development activities (e.g., Alsands, OSLO, gravel pits). Part of the area is also made up of infrastructure such as roads and cutlines. These features account for a relatively small portion of the LSA and are described in Table 2, the abbreviations are AVI vegetation cover codes.

Table 2 Extent of Non-Soil Units in the Muskeg River Mine Project LSA

Feature	Area, ha	% of LSA[b]
Open Water (NWL) and Stream Channels (SC)	185	1.7
Disturbed Land [a]	540	4.9
Total, Non-Soil Units	725	6.6

[a] Cultural Features (AIH), Disturbed Lands (AIM).
[b] LSA area = 10,945 ha.

4.1.12 Summary

The surface area of the Project LSA is comprised of naturally occurring soils, open water, areas disturbed by previous developments and permanent infrastructure (primarily roadways). These features total 10,954 hectares in extent and are distributed as shown in Table 3 and Figure 2.

Table 3 Distribution of Land Surface Cover in the Muskeg River Mine Project LSA

Feature	Area (ha)	% of LSA
Soil Cover	10,229	93.4
Open Water and stream channels	185	1.7
Disturbed Lands	540	4.9
Total Area	10,954	100.0

[a] Cultural Features (AIH), Disturbed Lands (AIM)

5. RECLAMATION CONSIDERATIONS

The environmental interpretations of the soil survey information focus on two principal areas: land capability for forestry, and extents and volumes of salvageable soil materials for use in reclamation to attain equivalent capability of pre-disturbance soil conditions.

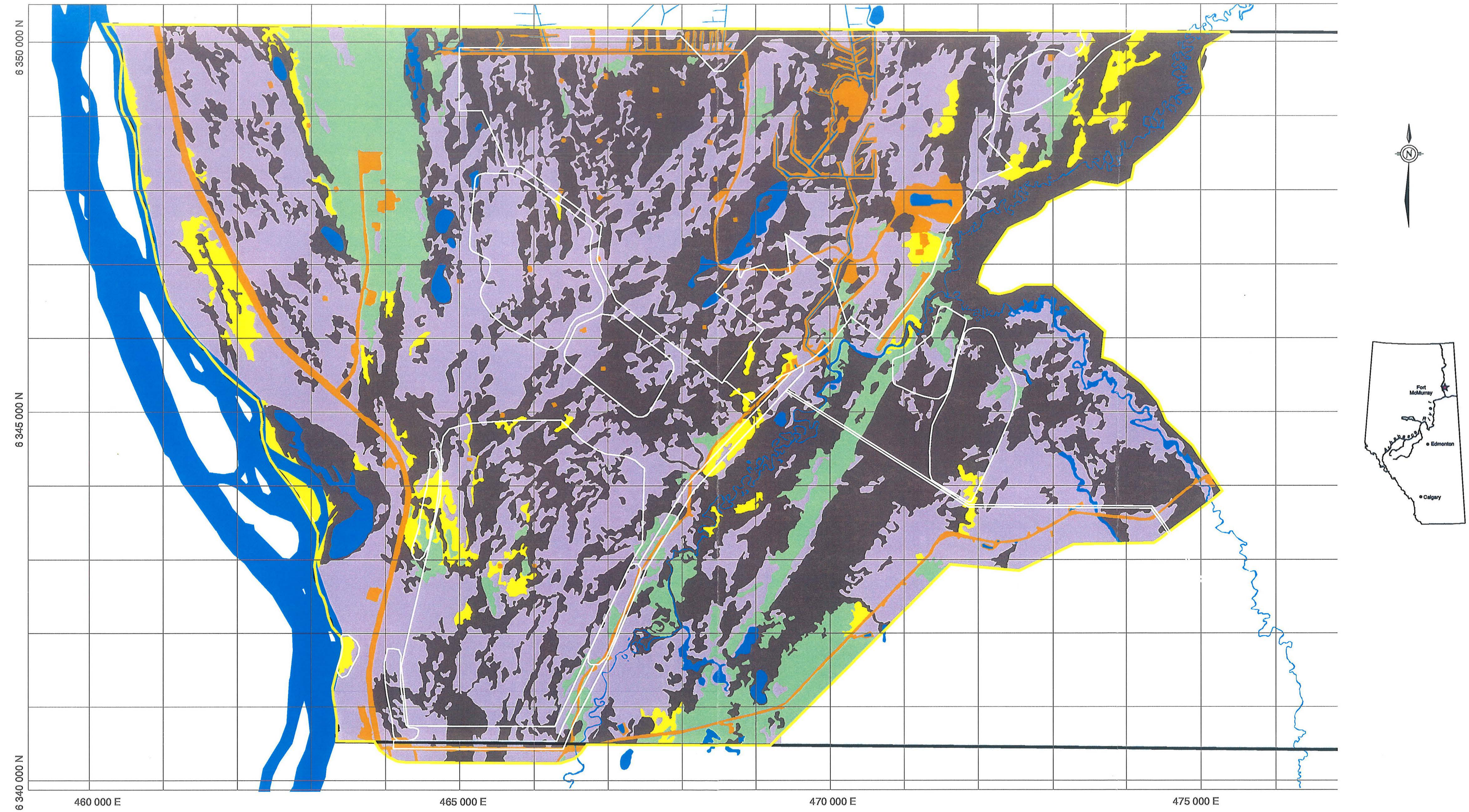
5.1 CAPABILITY FOR FORESTRY

The Land Capability Classification For Forest Ecosystems In The Oil Sands Region (Leskiw 1997) was devised to evaluate the potential of pre- and post-disturbance soils (i.e., naturally occurring and "reconstructed" respectively, for forest production). The rating system has five classes:

- Class 1: High Capability
- Class 2: Moderate Capability
- Class 3: Low Capability
- Class 4: Currently Non-productive
- Class 5: Permanently Non-productive

These classes are approximately equivalent to the Canada Land Inventory Forestry Capability Classes 3 to 7, respectively (CLI 1974). Forest capability ratings for the pre-disturbance soils of the LSA are listed in Table 4. Total areas of soil in each capability class are summarized in Table 5. The spatial distribution of these classes is shown in Figure 3: Muskeg River Mine Project Land Capability for Forest Ecosystems.

Since large portions of the study area contain organic soils supporting non-productive forest, the goal of reclamation might be to restore some of these former organic lands to commercially productive forest. The capability evaluation can be used to plan soil reconstruction for a targeted quality and end land use.



LEGEND

Local Terrestrial Study Area

Lease 13

Open water

CAPABILITY CLASSES

High (1)

Moderate (2)

Low (3)

Currently Non-Productive (4)

Permanently Non-Productive (5)

Cultural Features and Disturbed Lands

SOURCE: The Forestry Corp., CanAg Enterprises Ltd., Golder Associates Ltd., Leskiw, 1996

Based on August 1997 Survey

1 0 1 2

Kilometers

MAP PROJECTION: Universal Transverse Mercator Zone 12   DATUM: NAD 83

Golder Associates

SHELL CANADA LIMITED

MUSKEG RIVER MINE PROJECT
LAND CAPABILITY CLASSIFICATION
FOR FOREST ECOSYSTEM

19 Jan. 1998	Figure 3	PRODUCED BY: J.S./R.P. REVIEWED BY:

/data8/oilsands/972-2237/9700/9701/final/arcview/landcap50fin.apr

Table 4 Forest Capability Ratings for Pre-Development Soil Series in the Muskeg River Mine Project LSA

Soil Series	Area (ha)	Area % of LSA	Capability Class[a]
Bitumount	1915	17.5	4 (2)
Dover	42	0.4	2
Fort	652	6.0	3 (2)
McLelland	4193	38.3	5
McMurray	88	0.8	2
Mildred	1895	17.3	3 (4)
Muskeg	338	3.1	5
Rough Broken	99	0.9	4
Ruth Lake	445	4.1	3
Steepbank	610	5.6	4 (2)

[a] =X(Y) dominant class (significant component of subdominant class)

Table 5 Summary of Pre-Development Areas in Each Capability Class

Capability Class	Area (ha)	Area (%)
Class 1	0	0.0
Class 2	418	3.8
Class 3	997	9.1
Class 4	4,299	39.3
Class 5	4,515	41.2
Disturbed Lands	540	4.9
Open Water and Stream Channels	185	1.7
Total	10,954	100.0

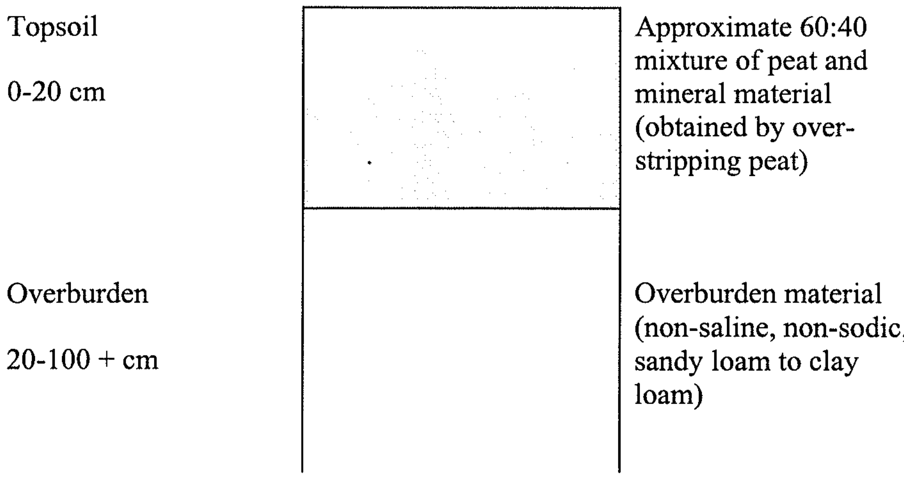
5.1.1 Potential Reclamation Scenarios

Capability ratings for soils in the post-reclamation landscape depend on a number of factors but those of greatest importance are the depth and composition of the topsoil mix. These are also amenable to manipulation in order to tailor the landscape to a desired end land use. Reclamation soils are not soils which have evolved naturally but rather are mixtures of the organic and mineral components salvaged during the construction phase of the project. By over stripping the peat to include a predetermined amount of the underlying mineral material, soil salvage materials are obtained for reclamation. The depth of soil and percent peat to percent mineral ratio in the reconstructed soil can be altered to produce a desired capability class or to compensate for characteristics of the substrate that may have undesirable impacts on vegetation regeneration (typically these are either chemical properties or drainage related).

Two examples are given to show possible outcomes of applying the same reclamation soil mix over different base materials.

Forest Scenario 1

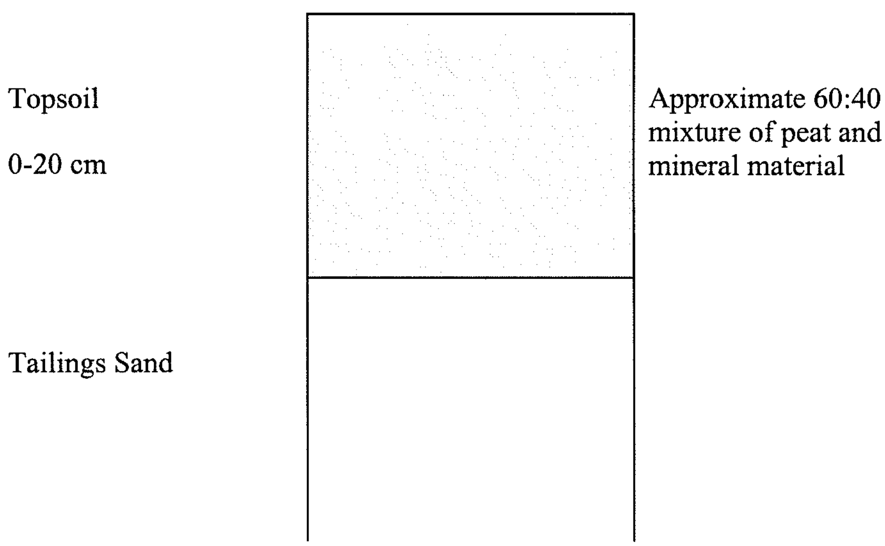
A potential reclamation scenario for a moderately productive forest soil is illustrated below:



This soil profile, with a loam or finer subsoil texture, would be a Class 2 forest soil on a level well-drained plain or upper slope position. On a sandy loam subsoil the capability would be Class 3. On lower slopes receiving lateral seepage, or level areas with a water table at 1 to 3 m, these soils would be one class better. If water tables become shallower than 1 m, then the rating will be lowered to Class 3 or 4 depending on the degree of wetness.

Forest Scenario 2

Low capability forest land (Class 3) can be created by placing 20 cm of mixed peat and mineral material over tailings sand, as illustrated below.



Normally this soil would be Class 3; however, with added moisture through seepage or a water table at 1 to 3 m, it could become Class 2, or if excessively wet, it could be Class 4 or 5. Adding greater depth of peat-mineral mix (to 50 cm) would increase the soil index only slightly (less than one class).

5.2 RECLAMATION MATERIALS

The soil quality is rated based on the Soil Quality Criteria Relative to Disturbance and Reclamation (Alberta Soil Advisory Committee 1987).

5.2.1 Organic Soil Materials

The mesisolic soils of the McLelland and Muskeg series, with their fibric and humic inclusions, make excellent materials for incorporation into the reconstructed soils used to cover the post-development landscape. Organic matter has a high negative surface charge which allows it to adsorb, store and release nutrient cations for plant use. Similarly it has the ability to absorb significant volumes of water and is useful in improving the moisture retention characteristics of coarser textured mineral materials such as sands. A third benefit is the low bulk density which helps alleviate potential compaction problems associated with finer textured mineral components with high clay content. This permits better water infiltration and root penetration. As decomposition of organic matter occurs, polysaccharides are released into the soil which act as organic "glues" and improve soil structure, particularly valuable in soils with high sand content Brady (1990). Organic matter may also provide a store of propagation materials/seed stock for native species, the presence of which could enhance revegetation success depending upon the end land use requirements.

5.2.2 Mineral Soil Materials

The mineral soils of the LSA are those which have evolved on fluvial, glaciofluvial and lacustrine parent materials. Laboratory analyses indicate no problematic chemical properties with any of these soils as salinity and sodicity values are low in most instances. The major constraints in salvaging these materials for use in reclamation are coarse textures and the nature of the underlying substrate.

Soil series with an XG suffix have gravel within 120 cm of the surface, making them poor salvage material. Similarly, soils with an XR suffix have residual material within 120 cm of the surface - this may include a high amount of stones, unconsolidated bedrock or in some cases oil sands - which are best avoided as reclamation materials.

If mineral soils are to be salvaged for reclamation purposes it is suggested that "a mixture of the organic and A horizons of the soil solum and perhaps a portion of the B horizon to a depth of about 30 cm depending on site specific conditions" might be appropriate for use as topsoil (Alberta Soil Advisory Committee 1987). Generally in the oil sands environment, with types of equipment used, it is impractical to strip soil of such shallow depths.

5.2.3 Soil Quality Criteria for Reclamation

Soil quality is rated based on the Soil Quality Criteria Relative to Disturbance and Reclamation (Alberta Soil Advisory Committee 1987). The authors of the Criteria observe that the values for some soil properties are appropriate for tree growth. Therefore, if other vegetation species are preferred in the reclamation planning, reference to the other sections of the Criteria should be made.

Table 6 Criteria for evaluating the suitability of surface material (upper lift) for revegetation in the Northern Forest

Rating/Property	Good (G)	Fair (F)	Poor (P)	Unsuitable (U)
Reaction (pH)[a]	5.0 to 6.5	4.0 to 5.0 6.5 to 7.5	3.5 to 4.0 7.5 to 9.0	<3.5 and >9.0
Salinity (EC)[b] (dS/m)	<2	2 to 4	4 to 8	>8
Sodicity (SAR)[b]	<4	4 to 8	8 to 12	>12[c]
Saturation (%)[b]	30 to 60	20 to 30 60 to 80	15 to 20 80 to 120	<15 to >120
Stoniness/ Rockiness[d] (% Area)	<30/<20	30-50/20-40	50-80/40-70	>80/>70
Texture	FSL, VFSL, L, SiL, SL	CL, SCL, SiCL	LS, SiC, C, HC, S	- -
Moist Consistency	very friable, friable	firm	loose, very firm	extremely firm
$CaCO_3$ Equivalent (%)	<2	2 to 20	20 to 70	>70

from Alberta Soil Advisory Committee 1987

(a) pH values presented are most appropriate for trees, primarily conifers. Where reclamation objective is for other end land uses, such as erosion control, and where other plant species may be more important.

(b) Limits may vary depending on plant species to be used.

(c) Materials characterized by an SAR of 12 to 20 may be rated as poor if texture is sandy loam or coarser and saturation % is less than 100.

(d) <25 cm diameter stones/rocks intercepting surface.

Table 7 Criteria for evaluating the suitability of the subsurface material (lower lift) for revegetation in the Northern Forest Region

Rating/Property	Good (G)	Fair (F)	Poor (P)	Unsuitable (U)
Reaction (pH)[a]	5.0 to 7.0	4.0 to 5.0 7.0 to 8.0	3.5 to 4.5 8.0 to 9.0	<3.5 and >9.0
Salinity (EC)[b] (dS/m)	<3	3 to 5	5 to 8	>8
Sodicity (SAR)[c]	<4	4 to 8	8 to 12	>12[d]
Saturation (%)	30 to 60	20 to 30 60 to 80	15 to 20 80 to 100	<15 to >100
Coarse Fragments (%/Vol)	<30[e] <15[f]	30-50[e] 15 to 30[f]	50-70[e] 30 to 50[f]	>70[e] >50[f]
Texture	FSL, VFSL, L, SiL, SL	CL, SiC, SiCL	S, LS, S, C, HC	bedrock
Moist Consistency	very friable, friable firm	very firm	loose, extremely firm	hard rock
$CaCO_3$ Equivalent (%)	<5	5 to 20	20 to 70	>70

from Alberta Soil Advisory Committee 1987

(a) pH values presented are most appropriate for trees, primarily conifers.
(b) Higher value takes into consideration that in the lower lift the pH values of the soils are generally higher.
(c) Limit may vary depending on plant species to be used.
(d) Materials characterized by an SAR of 12 to 20 may be rated as poor if texture is sandy loam or coarser and saturation % is less than 100.
(e) Matrix texture (modal) finer than sandy loam.
(f) Matrix texture (modal) sandy loam and coarser.

5.2.4 Suitability and Mass Balances of Soils in the Muskeg River Mine Project LSA for Salvage and Reclamation Uses

The soils in the Project LSA fall into two broad categories, those derived from organic materials and those that have developed on mineral parent materials. Both have potential value for placement as reclamation materials in the closure landscape.

5.2.4.1 Organic Soils

The soils of the McLelland and Muskeg series make excellent materials for incorporation in the reclamation soil mix (see Sections 5.1.1 and 5.2.1 of this report). Table 8 presents an inventory of the total amount of organic material estimated to be present in the development footprint of the Project (but excludes the tailings settling pond and all overburden disposal areas).

Table 8 Approximate Volumes of Salvageable Organic Materials in the Footprint of the Muskeg River Mine Project

Soil Series	Area (ha)	Average Depth (m)	Volume [(a)] $1000\ m^3$
McLelland 1	1,065	1.8	19,170
McLelland 2	735	0.7	5,145
Muskeg 1	115	1.8	2,070
Muskeg 2	60	0.7	420
TOTAL	1,975	n/a	26,805

[(a)] figures do not include potential shrink or swell of material.

5.2.4.2 Mineral Soils

A very small percentage of the mineral soil cover in the LSA is suitable for use as reclamation material. It includes the A horizons of the Dover and Fort series. These are relatively shallow horizons, for Dover an average of 0.25 m and for Fort an average of 0.10 m, which, given the scale of equipment used in oil sands development, are impractical to salvage. If mineral materials in addition to what is obtained by over-stripping of the organic deposits is required it is suggested that salvaging of the Dover and Fort soils to a depth of 1.0 m is a possibility.

The coarse textured Mildred soils lack an A horizon, but the upper 1 m is suitable for combining with organic material to form the reclamation soil mix. As with the Dover and Fort series discussed above, this should be considered if additional mineral material above and beyond that obtained during stripping of the peat is required. Table 9 presents data on the approximate amounts of suitable mineral materials in the proposed development footprint (but excluding the tailings settling pond and overburden disposal areas).

Table 9 Approximate Volumes of Mineral Soils Suitable for Salvage in the Development Footprint of the Muskeg River Mine Project

Soil Series	Area (ha)	Average Depth (m)	Volume [(a)] $1000\ m^3$
Dover	1	1.0	10
Fort	143	1.0	1,430
TOTAL	144		1,440
Mildred[(b)]	715	1.0	7,150

[(a)] Figures do not include potential shrink or swell of material

[(b)] Values for Mildred soils are presented. However, these soils are typically of less value for reclamation soils than Dover and Fort soils

6. TERRAIN ANALYSIS OF THE LOCAL STUDY AREA

6.1 GENERATION OF THE TERRAIN UNITS

The Terrain Units were developed by combining soil map units derived from similar genetic materials. The process of polygon amalgamation as described in Section 2.2 and outlined in Table 10 is provided below while the linkages between soil units and terrain units is shown graphically in Figure 4. Upon completion of the terrain classification map it was compared to the wetland classification map (Golder 1997), and some minor discrepancies were noted. Upon review and consultation among the component leaders it was determined that some of the bog and shallow bog units should be reclassified as fen or shallow fen units. As a result, there is not a direct 100% correlation between the soil units and terrain units for these two categories as outlined in Table 10.

Table 10 Correlation of Soil Units to Terrain Units

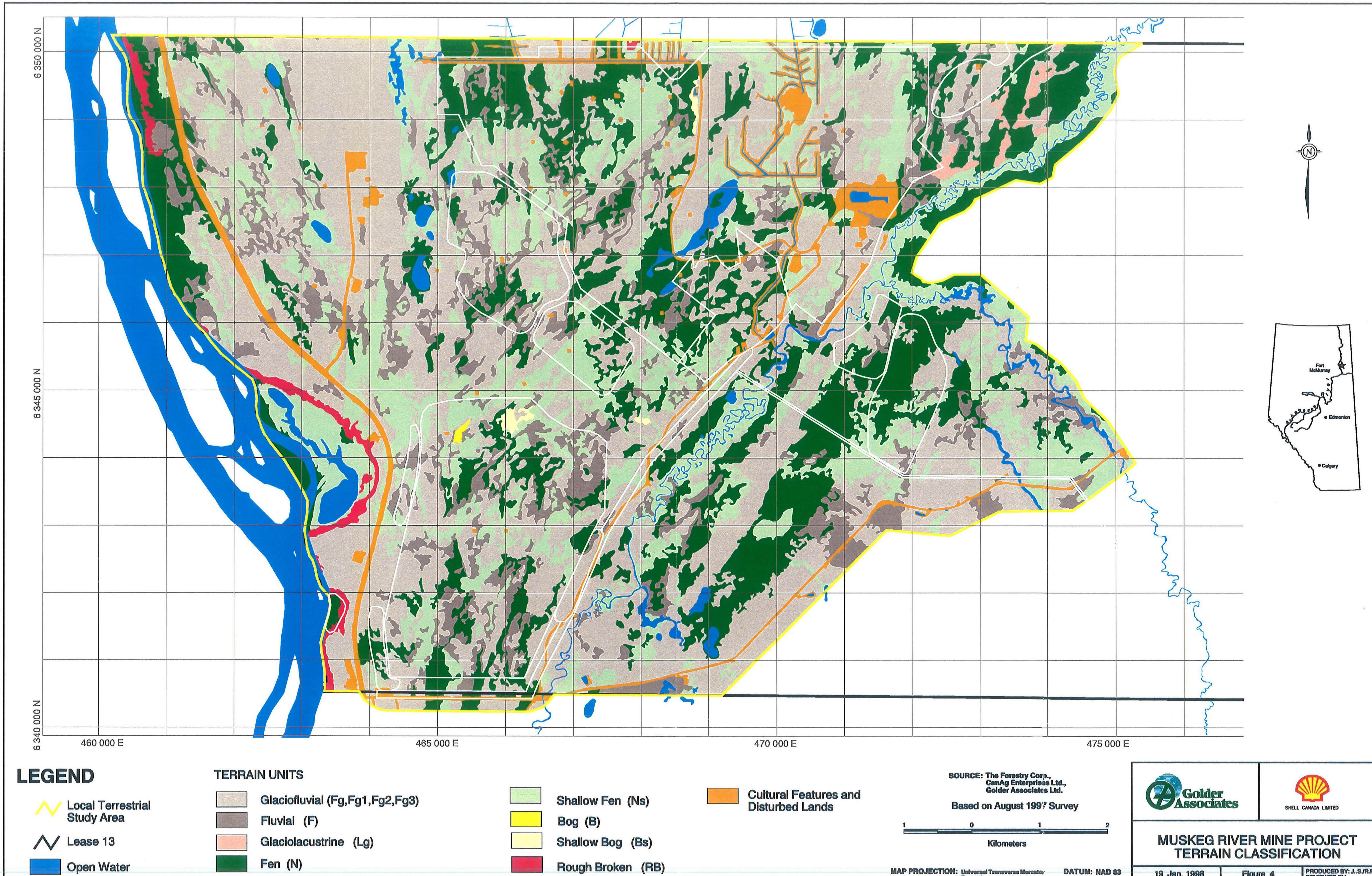
Soil Unit	Terrain Unit[a]	Soil Unit	Terrain Unit[a]
BMT	Fg	MLD.XR	Ns
ptBMT	Fg1	MLD.XS	Ns
DOV	Lg	MMY	F
DOV.XR	Lg	glMMY	F
FRT	Fg2	MUS	B
FRT.XR	Fg2	MUS.XC	Bs
glFRT	Fg2	MUS.XR	Bs
MIL	Fg1	MUS.XS	Bs
MIL.XR	Fg1	STP	Fg2
glMIL	Fg1	ptSTP	Fg2
MLD	N	RUT	Fg3
MLD.XC	Ns	RB	RB
MLD.XG	Ns		

(a) Fg1 = mainly S, LS with some SL
Fg2 = mainly L or finer, some SL
Fg3 = SL over gravels, some finer layers

6.2 DESCRIPTION OF TERRAIN CLASSIFICATION UNITS

6.2.1 Bogs (B Units)

Bogs are wet, poorly-drained peatlands occupying level or depressional areas in the landscape. Accumulations of poor to moderately decomposed organic material, mainly Sphagnum mosses, these deposits tend to be acidic in nature due to the stagnant water regime and are generally nutrient-poor



6 350 000 N
6 345 000 N
6 340 000 N
460 000 E
465 000 E
470 000 E
475 000 E
N
Fort McMurray
Edmonton
Calgary
/data8/oilsands/972-2237/9700/9701/final/arcview/microterr50fin.apr
LEGEND
Local Terrestrial Study Area
Lease 13
Open Water
TERRAIN UNITS
Glaciofluvial (Fg,Fg1,Fg2,Fg3)
Fluvial (F)
Glaciolacustrine (Lg)
Fen (N)
Shallow Fen (Ns)
Bog (B)
Shallow Bog (Bs)
Rough Broken (RB)
Cultural Features and Disturbed Lands
SOURCE: The Forestry Corp., CanAg Enterprises Ltd., Golder Associates Ltd.
Based on August 1997 Survey
1 0 1 2
Kilometers
MAP PROJECTION: Universal Transverse Mercator Zone 12
DATUM: NAD 83
Golder Associates
SHELL CANADA LIMITED
MUSKEG RIVER MINE PROJECT
TERRAIN CLASSIFICATION
19 Jan. 1998
Figure 4
PRODUCED BY: J.S./R.P.
REVIEWED BY:

(Beckingham and Archibald 1996). The depth of organics over the underlying mineral contact varies considerably from less than 50 cm to over 2 m.

Two categories of bogs were mapped in the LSA: bogs (B Units) where the depth of organics above mineral contact was greater than 120 cm and shallow bogs (Bs Units) where mineral substrate was encountered between 40 and 120 cm of the surface. Landcare (1996) noted the possible presence of permafrost in some of the bog units, which was verified at some of the inspection sites.

6.2.2 Fens (N Units)

Fens are a form of peatland characterized by a water table at or near the surface for part of the year. As opposed to the stagnant conditions of the bog units, fens have varying degrees of surface or subsurface lateral flow which produces a relatively nutrient-rich, oxygenated environment (Beckingham and Archibald 1996). Fens develop on accumulations of poor to moderately decomposed organics – primarily mosses and sedges.

Two categories of fens were mapped in the LSA: fens (N Units), where the organic depth over mineral was greater than 120 cm and shallow fens (Ns Units), where mineral contact was made between 40 and 120 cm of the surface. Fens are one of the dominant terrain features of the LSA. Halsey et al. (1995) identified the presence of paleopermafrost features within some fen areas in the southeastern portion of the LSA. Permafrost was encountered at some inspection sites during the field work.

6.2.3 Fluvial (F Units)

Fluvial deposits are of relatively recent origin, medium to coarse textured and restricted to the present floodplain of the Athabasca River.

6.2.4 Glaciofluvial (Fg Units)

Quaternary glaciofluvial deposits are the principal unit comprising 50.5% of the LSA. The composition varies, but is generally coarse textured, ranging from sandy loams through sands to gravels and in some instances boulders may be found. Smith and Fisher (1993) and Smith (per. comm. 1996) indicate that this area may have been a major spillway for the release of water from glacial Lake Agassiz which would explain the coarseness of the materials. While the relief is mostly low-lying with gentle slopes, some locally higher areas exist that are very well drained. Conversely, there are expanses of level terrain where drainage is poor, due to the underlying materials, and organic deposits have accumulated. Small, isolated areas of eolian (windblown) sands and silts in the form of thin surface veneers or minor dunes are found in scattered locations in association with the glaciofluvial deposits.

6.2.5 Glaciolacustrine (Lg Units)

This unit combines features that in other studies (e.g., Landcare 1996) may be subdivided into recent lacustrine and glaciolacustrine units. These deposits are fine textured, mainly silts and clays, and form a mantle less than 2 m in thickness over glacial till. Surface expression tends to be gently undulating which, combined with the fine textures, may impede drainage to the point where organic deposits have accumulated. Lg units are limited to a very small area in the northeastern section of the LSA.

6.2.6 Rough Broken (RB Units)

A small percentage of the LSA along the escarpment of the Athabasca River is mapped as a Rough Broken unit. While this is a distinct unit, its composition is non-uniform due to changes in slope angle, slope position and parent materials which are described as undifferentiated. This unit is characterized by significant variability.

6.2.7 Other Features

There are other features which make up part of the LSA In addition to the 6 terrain units previously described. They are noted as: cultural features, disturbed lands and water.

The extent of terrain units in the LSA is outlined in Table 11.

Table 11 Extent of Terrain Units in the Muskeg River Mine Project LSA

Terrain Unit	Area (ha)	% of LSA
Bog (B)	4	0.04
Shallow Bog (Bs)	16	0.2
Bogs, total	20	0.24
Fen (N)	2155	19.6
Shallow Fen (Ns)	2300	21.0
Fens, total	4455	40.6
Fluvial (F)	88	0.8
Glaciofluvial (Fg)	5526	50.5
Glaciolacustrine (Lg)	42	0.4
Rough Broken (RB)	98	0.9
Total Area of Terrain Units	10,229	93.2
Disturbed Lands (AIH, AIM[a])	540	4.9
Water (NWL[a])	185	1.7
Total Area, Other Features	725	6.6
Total Area in LSA	10,954	100.0

[a] AIH, AIM and NWL these are spatial features that occur within the Muskeg River Mine Project area but are not terrain units; the abbreviations used are AVI codes.

6.2.8 Summary

Medium to coarse textured glaciofluvial deposits are the dominant surficial materials occupying approximately 50% of the Muskeg River Mine Project LSA. While there are some fairly uniform expanses of these deposits, a significant amount is found intermingled with organic materials creating a very complex landscape over much of the central section of the LSA.

Organic deposits, primarily fens with a small bog component, account for about 41% of the surface deposits. These are characterized by peat thicknesses ranging from 0.5 to greater than 2 metres. The soils are poorly drained with water tables near the surface (<1 m) for much of the growing season. Most of the soils are Mesisols and while minor amounts of Humisols and Fibrisols do occur, they are not large enough to warrant classifying as separate map units

Small pockets of coarse textured fluvial materials of recent origin are found along the floodplain of the Athabasca River. These make up less than 1% of the LSA.

Lacustrine parent materials make up less than 0.5% of the area and are confined to the very northeast corner of the LSA. These are clay to clay loam, non-stony materials on nearly level topography.

The final unit is referred to as Rough Broken. It includes mainly colluvial parent materials, is found along the steep escarpment of the Athabasca River and accounts for about 1% of the surface material.

Cultural features, disturbed areas and water comprise the remainder of the LSA.

7. CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details please contact the undersigned.

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APPENDIX I

KEY TO SOIL MAPPING UNITS AND INSPECTION SITES

KEY TO SOIL MAPPING UNITS AND INSPECTION SITES

SOIL SERIES / MAP UNIT: (Map Unit is named after dominant series)

Bitumount	-	BMT
Dover	-	DOV
Fort	-	FRT
McLelland-Typic	-	MLD 1
McLelland-Terric	-	MLD 2
McMurray	-	MMY
Mildred	-	MIL
Muskeg Typic	-	MUS 1
Muskeg Terric	-	MUS 2
Ruth Lake	-	RUT
Rough Broken	-	RB
Steepbank	-	STP

Soil Phases: (Prefix or suffix may be applied as series modifier)

gl - gleyed (prefix)
pt - peaty (prefix)
XC - clay contact between 40 - 120 cm below surface (suffix)
XG - gravel contact between 40 - 120 cm below surface (suffix)
XR - residual material contact between 40 - 120 cm below surface (suffix)
XS - sand contact between 40 - 120 cm below surface (suffix)
XT - till contact between 40 - 120 cm below surface (suffix)

Examples : ptBMT = peaty Bitumount
MLD.XS = McLelland with sand contact between 40 and 120 cm below surface

SOIL SUBGROUP CLASSIFICATION:

Brunisols

GLEB	-	Gleyed Eutric Brunisol
GLEEB	-	Gleyed Eluviated Eutric Brunisol
EEB	-	Eluviated Eutric Brunisol
ODB	-	Orthic Dystric Brunisol
OEB	-	Orthic Eutric Brunisol

Gleysols

OG	-	Orthic Gleysol
OLG	-	Orthic Luvic Gleysol
RG	-	Rego Gleysol

Luvisols

BRGL	-	Brunisolic Gray Luvisol
GLGL	-	Gleyed Gray Luvisol
OGL	-	Orthic Gray Luvisol

Organics

TH	-	Terric Humisol
TM	-	Terric Mesisol
TYF	-	Typic Fibrisol
TYH	-	Typic Humisol
TYM	-	Typic Mesisol

Regosols

OR	-	Orthic Regosol

PARENT MATERIALS:

F	-	fluvial
Fg	-	glaciofluvial
Lg	-	glaciolacustrine
M	-	morainal/till
O	-	organic

SLOPE POSITION:

C	-	crest
U	-	upper slope
M	-	middle slope
L	-	lower slope
D	-	depression
Lv	-	level

SLOPE CLASS:

1	-	0 - 0.5%	level
2	-	0.5 - 2%	nearly level
3	-	2 - 5%	very gentle slopes
4	-	6 - 9%	gentle slopes
5	-	10 - 15%	moderate slopes
6	-	16 - 30%	strong slopes
7	-	31 - 45%	very strong slopes
8	-	46-70%	extreme slopes

SURFACE LANDFORM

1	dissected
2	hummocky
3	inclined
4	knob and kettle
5	level
6	rolling
7	ridged
8	steep
9	terraced
10	undulating
11	duned
12	fen
13	bog
14	marsh
15	swamp

DRAINAGE CLASSES:

R	-	rapidly
W	-	well
MW	-	moderately well
I	-	imperfectly
P	-	poorly
VP	-	very poorly

EDATOPE (COMPOSITE OF MOISTURE AND NUTRIENT REGIMES)

Moisture Regime

2	xeric
3	subxeric
4	submesic
5	mesic
6	subhygric
7	hygric
8	subhydric
9	hydric

Nutrient Regime

P	poor
M	medium
R	rich

Example: Edatope 5 m=mesic, medium

Capability Rating For Forestry

1	high
2	moderate
3	low
4	currently non-productive
5	permanently non-productive

APPENDIX II

KEY TO TERRAIN MAPPING UNITS

KEY TO TERRAIN MAPPING UNITS

Code	Terrain Unit
B	bog
Bs	shallow bog
F	fluvial (recent)
Fg	glaciofluvial
Lg	glaciolacustrine and lacustrine
N	fen
Ns	shallow fen
RB	rough broken areas

APPENDIX III

INSPECTION SITE LIST

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
1	FRT	OGL	Fg	3	10	Crest	W	3	5M
2	STP	OLG	F	2	5	Level	I	2	6M
3	FRT	OGL	Fg	2	10	Level	MW	3	5M
4	FRT	OGL	Fg	2	10	Level	MW	3	5M
5	FRT	OGL	Fg	3	5	Crest	W	3	5M
6	MLD-xc	TH	O/Fg	1	5	Dep	VP	5	8M
7	FRT	EEB	F	2	10	Upper	MW	4	5M
8	FRT	EEB	F	6	10	Level	W	2	6M
9	BMT	OG	F	2	5	Level	MW	5	7bM
10	MLD	TYH	O	1	5	Dep	VP	5	8R
11	DOV	OGL	Lg	3	10	Mid	MW	2	5M
12	ptSTP	ptOG	F	2	5	Level	P	2	7aM
13	MLD-xc	TH	O/Fg	1	5	Level	VP	5	8M
14	MLD	TYH	O	1	5	Level	VP	5	8M
15	DOV	OGL	Lg	3	10	Upper	MW	2	5M
16	MLD	TYH	O	1	10	Dep	VP	5	8M
17	DOV-xr	OGL	Lg	2	10	Crest	MW	2	5M
18	FRT	OGL	Fg	3	5	Level	W	3	5M
19	FRT	OGL	Fg	3	5	Upper	W	2	5M
20	FRT	OGL	Fg	1	5	Upper	W	3	5M
21	FRT	OGL	Fg	5	10	Mid	W	2	5M
22	MIL	EEB	Fg	1	5	Level	W	3	5M
23	MIL-xr	EEB	Fg	4	10	Upper	W	3	5M
24	FRT	OGL	Fg	3	5	Level	W	3	5M
25	FRT	OGL	Fg	4	10	Upper	W	3	5M
26	BMT	OLG	F	1	5	Dep	P	4	7bM
27	MIL	EEB	Fg	1	5	Crest	W	3	5M
28	MLD	TYH	O	1	5	Dep	P	5	8M
29	STP	OLG	F	4	10	Mid	P	2	7aP
30	glFRT	GLGL	Fg	3	10	Crest	I	1	6M
31	glFRT	GLEEB	Fg	3	10	Mid	I	2	6M
32	MIL	EEB	Fg	5	10	Upper	W	3	5M
33	MLD	TYH	O	1	5	Dep	P	5	8M
34	MIL	EEB	Fg	3	10	Upper	W	2	5M
36	MIL	OEB	Fg	1	5	Crest	W	3	4M
37	MIL-xr	OEB	Fg	1	10	Crest	R	4	5M
38	MIL-xr	EEB	Fg	1	5	Upper	W	3	5P
39	ptSTP	ptOG	O/Lg	2	10	Dep	P	4	7bP
40	ptSTP	ptOG	O/Lg	3	10	Level	P	2	7aM
41	ptSTP	ptOG	O/Lg	2	5	Level	P	2	7aM
42	MLD-xc	TH	O	1	5	Dep	P	5	8M
43	ptSTP	ptOG	O/Lg	1	5	Level	P	2	7aM
44	ptSTP	ptOG	O/Lg	1	10	Level	I	2	7aM
45	MIL-xr	EEB	Fg	3	10	Crest	W	4	5M
46	MIL-xr	EEB	Fg	1	10	Crest	W	3	5P
47	ptBMT	ptOG	Fg	3	10	Dep	P	4	7bM
48	MLD-xs	TH	O	1	10	Level	P	5	8M
49	MLD	TYH	O	2	5	Level	VP	5	8M
50	MLD-xs	TH	O	3	5	Level	VP	5	8M
51	MUS	TYH	O	3	10	Mid	VP	5	8M

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
52	BMT	OG	F	2	10	Mid	P	4	7bP
53	STP	OG	F	1	5	Level	W	4	7bP
54	MLD	TYH	F	1	5	Level	VP	5	8M
55	MLD	TYH	O	1	5	Level	VP	5	8M
56	MLD	TYH	O	1	5	Level	VP	5	8M
57	MLD	TYH	O	1	5	Level	VP	5	8M
58	MLD	TYH	O	1	5	Level	VP	5	8M
59	MLD	TYH	O	1	5	Level	VP	5	8M
60	MIL-xr	OR	F	1	5	Level	W	4	5P
61	MLD	TYH	O	1	5	Level	MW	5	8P
62	ptSTP	ptOG	F	3	10	Mid	W	4	6P
63	MIL-xr	OEB	Fg	3	10	Crest	P	2	4M
64	MLD-xc	TH	O	0	10	Level	VP	5	8M
65	MIL-xr	EEB	Fg	3	10	Upper	W	3	5P
66	ptSTP	ptOG	F	1	10	Level	VP	4	7bP
67	MIL-xr	EEB	O	4	10	Crest	MW	3	5M
68	MIL	OEB	Fg	3	10	Mid	W	3	5P
69	MLD-xs	TH	O	0	10	Level	VP	5	8M
70	MIL-xr	OEB	Fg	1	5	Level	W	2	5P
71	MLD-xs	TH	O	1	5	Level	W	5	8M
72	MIL-xr	EEB	Fg	3	10	Crest	W	4	4M
73	ptBMT	ptOG	O/Fg	1	10	Level	P	4	7bM
74	MIL	OEB	Fg	5	10	Crest	W	4	4M
75	MIL	EEB	Fg	3	10	Mid	W	3	5M
76	MIL	EEB	Fg	2	5	Crest	W	4	4M
77	MIL	OEB	Fg	3	10	Upper	W	3	5M
78	MIL	EEB	Fg	2	5	Crest	W	2	5M
79	BMT	OEB	Fg	4	10	Mid	P	4	7bM
80	MLD	TYM	O	1	10	Level	P	5	8M
81	MIL-xr	OEB	Fg	2	4	Level	I	1	6M
82	FRT-xr	OEB	Fg	2	5	Level	MW	2	5M
83	MLD-xs	TH	O	1	5	Level	P	5	7aM
84	MLD	TYM	O	1	5	Level	P	5	8M
85	MIL-xr	OEB	Fg	1	5	Level	I	1	6R
86	MIL-xr	OEB	Fg	1	5	Level	W	2	5M
87	MLD	TYH	O	1	5	Level	P	5	8M
88	MIL-xr	OEB	Fg	3	5	Crest	MW	3	5M
89	MLD	TYM	O	1	5	Level	P	5	8M
90	MLD	TYM	O	1	5	Level	P	5	8M
91	MLD	TYM	O	1	5	Level	P	5	8M
92	MLD	TYM	O	1	5	Level	P	5	8M
93	FRT	OGL	Fg	1	5	Level	MW	2	5M
94	MLD	TYM	O	1	5	Level	P	5	8M
95	MLD-xr	TH	Fg	1	5	Level	P	4	9M
96	MLD	TYM	O	1	5	Level	P	5	6M
97	MLD	TYM	O	1	5	Level	P	5	8M
98	MLD	TYM	O	1	5	Level	P	5	8M
99	FRT	OGL	Fg	4	3	Mid	MW	2	5M
100	MIL-xr	OEB	Fg	4	3	Level	MW	3	5M
101	MLD	TYM	O	1	5	Level	VP	5	8M

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
102	MLD	TYM	O/Fg	1	5	Level	VP	5	8M
103	MIL	EEB	Fg	4	4	Level	W	3	4M
104	MIL-xr	OEB	Fg	1	5	Level	W	3	4M
105	MIL	OEB	Fg	3	10	Upper	W	3	4M
106	MLD-xc	TH	O	1	10	Dep	VP	5	8M
107	MIL-xr	EEB	Fg	4	10	Mid	MW	3	5M
108	MIL	OEB	Fg	3	5	Level	W	3	5M
109	MIL	EEB	Fg	2	5	Level	W	4	5M
110	MIL-xr	OEB	Fg	4	10	Crest	W	3	4M
111	MIL-xr	OEB	Fg	3	10	Level	W	3	4M
112	MIL-xr	OEB	Fg	3	5	Crest	W	4	4M
113	MUS-xs	TH	O/Fg	1	5	Dep	P	5	8M
114	MIL-xr	EEB	Fg	3	10	Crest	W	3	4M
115	MUS	TYM	O	1	5	Dep	P	5	8M
116	ptBMT	ptOG	Fg	3	10	Mid	P	4	7bP
117	MLD	TYM	O	1	5	Dep	VP	5	8M
118	MIL-xr	EEB	Fg	4	10	Crest	W	3	4M
119	MUS	TYM	O	1	5	Dep	P	5	8P
120	ptBMT	ptOG	Fg	1	5	Level	P	2	7aM
121	MLD	TYM	O	1	5	Level	P	5	8M
122	MLD	TYM	O	1	5	Level	P	5	8M
123	MLD	TYM	O	1	5	Level	P	5	8M
124	MLD-xc	TM	O	1	5	Level	P	5	8M
125	MLD	TYM	O	1	5	Level	P	5	8M
126	MIL-xr	OEB	Fg	4	10	Crest	MW	3	5M
127	MIL-xr	EEB	Fg	4	10	Mid	MW	3	5M
128	MIL-xr	OEB	Fg	3	10	Mid	MW	2	5M
129	MIL-xr	EEB	Fg	4	10	Mid	MW	3	5M
130	MIL	EEB	Fg	1	5	Level	MW	3	5M
131	MIL	EEB	Fg	5	10	Crest	MW	3	5M
132	MIL-xr	EEB	Fg	1	5	Level	MW	3	5M
133	MLD	TYM	O	1	4	Level	VP	5	8M
134	MIL-xr	OEB	Fg	1	10	Level	W	4	4M
135	MLD	TYM	O	1	10	Level	VP	5	8M
136	MIL	EEB	Fg	4	10	Crest	W	3	4M
138	MUS-xs	TH	Fg	2	5	Level	P	5	8P
139	MLD	TYM	O	1	5	Level	VP	5	8M
140	BMT	OG	Fg	3	10	Level	P	2	7aP
140	MIL-xr	OEB	Fg	3	10	Level	P	2	7aP
142	MIL	EEB	Fg	3	10	Crest	W	4	4P
143	ptBMT	ptOG	Fg	1	10	Level	P	2	7aP
144	MLD-xc	TM	O/Fg	1	5	Level	VP	5	8M
145	MLD-xs	TM	O/Fg	1	5	Level	VP	5	8M
146	MLD	TYM	O	1	5	Level	VP	5	8P
147	BMT	OG	Fg	1	10	Level	P	3	7aP
148	MUS	TYF	O	1	5	Level	P	5	8P
149	MUS	TYM	O	1	5	Level	P	5	8P
150	MLD	TYM	O	1	5	Level	VP	5	8M
151	ptBMT	ptOG	Fg	3	10	Level	P	4	8M
152	MIL-xr	OEB	Fg	3	10	Upper	W	3	5M

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
153	MUS-xc	TM	O	1	5	Level	P	5	8P
154	MIL	EEB	Fg	4	10	Crest	W	3	5M
155	MLD	TYM	O	1	5	Level	VP	5	8M
156	MLD	TYM	O	1	5	Level	VP	5	8M
157	BMT	OG	Fg	3	10	Crest	P	2	7aP
158	MLD	TYM	O	1	5	Level	VP	5	8M
159	MIL	OEB	Fg	4	10	Crest	MW	3	4P
160	MUS-xs	TH	O/Fg	3	10	Level	P	5	8P
161	MLD	TYM	O	1	5	Level	P	5	8M
162	MIL	EEB	Fg	4	10	Crest	W	3	4M
163	MLD	TYM	O	1	5	Level	VP	5	8M
164	MLD	TYM	O	1	5	Level	VP	5	8M
165	MLD	TYM	O	1	5	Level	VP	5	8M
166	BMT	OG	Fg	1	5	Level	VP	2	7aM
167	MLD	TYM	O	1	5	Level	VP	5	8M
168	MLD	TYM	O	1	5	Level	VP	5	8M
169	MLD	TYM	O	1	5	Level	VP	5	8M
170	MIL-xr	OEB	Fg	4	7	Crest	P	3	4M
171	MLD	TYM	O	1	5	Level	VP	5	5M
172	MLD	TYM	O	1	5	Level	VP	5	8M
173	MIL	EEB	Fg	3	10	Crest	MW	3	6M
174	MLD	TYM	O	1	5	Level	P	5	8M
175	MIL-xr	EEB	Fg	4	10	Crest	MW	3	5M
176	MIL-xr	EEB	Fg	4	10	Crest	W	3	4M
177	MLD	TYM	O	1	5	Level	VP	5	8M
178	MLD	TYM	O	1	5	Level	VP	5	8M
179	MIL-xr	OEB	FG	3	10	Upper	MW	3	5M
180	MLD	TYM	O	1	5	Level	VP	5	8M
181	ptBMT	ptOG	O/Fg	1	5	Level	P	4	7bM
182	MIL-xr	EEB	Fg	4	10	Upper	MW	3	5M
183	MIL-xr	OR	Fg	2	10	Upper	MW	3	5P
184	MUS	TYM	O	1	5	Level	VP	5	8P
185	MIL-xr	EEB	Fg	3	10	Crest	MW	3	5M
186	MLD	TYM	O	1	5	Level	VP	5	8M
187	MIL-xr	EEB	Fg	4	10	Upper	W	3	5M
188	MIL-xr	EEB	Fg	3	10	Mid	MW	3	5M
189	MIL-xr	EEB	Fg	3	10	Mid	MW	4	5M
190	MIL-xr	EEB	Fg	3	10	Mid	W	4	5M
191	MIL-xr	EEB	Fg	3	10	Mid	W	3	5M
192	MIL-xr	EEB	Fg	2	10	Mid	W	3	4M
193	MIL	EEB	Fg	3	10	Level	W	2	6M
194	MLD	TYM	O	2	10	Level	VP	5	8M
195	MIL-xr	EEB	Fg	4	10	Upper	W	3	5M
196	RUT	EEB	Fg	3	10	Level	MW	3	5M
197	MLD	TYM	O	1	5	Level	VF	5	8M
198	MLD	TYM	O	1	5	Level	VP	5	8M
199	MLD	TYM	Fg	1	5	Level	VP	5	8M
200	FRT	OGL	Fg	3	6	Upper	MW	2	5M
201	MLD	TYH	O	1	6	Dep	VP	5	5M
202	MIL-xr	OEB	F	1	6	Crest	W	3	5M

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
203	BMT	RG	Fg	3	6	Level	I	4	7bM
204	STP	LUG	Fg	3	6	Upper	P	2	7aM
205	MLD	TYM	O	1	5	Level	VP	5	8M
206	MIL	EEB	Fg	4	10	Upper	W	3	5M
207	MIL-xr	EEB	Fg	5	5	Crest	W	3	5M
208	MLD	TYM	Fg	1	5	Level	VP	5	8M
209	MIL-xr	OEB	Fg	3	4	Crest	W	3	5M
210	STP	RG	Fg	2	5	Level	P	2	7aM
211	FRT	OGL	Fg	4	6	Upper	MW	2	5M
212	FRT	OGL	Fg	4	6	Upper	MW	2	5M
213	MIL-xr	OEB	Fg	5	6	Upper	W	3	5M
214	FRT	OGL	Fg	3	6	Level	MW	2	5M
215	MUS	TYM	O	1	5	Level	VP	5	8P
216	MLD-xs	TM	Fg	3	10	Mid	P	5	8M
217	MIL-xr	OR	Fg	3	10	Level	MW	3	5M
218	RUT	OGL	Fg	3	10	Level	I	1	6M
219	RUT	OEB	Fg	3	10	Mid	W	2	5M
220	MLD-xs	TM	O/Fg	1	5	Level	VP	5	8M
221	RUT	OEB	Fg	3	10	Upper	W	2	5M
222	BMT	glOEB	Fg	1	10	Level	I	1	6M
223	glRUT	GLGL	Fg	3	10	Level	I	2	6R
224	RUT	OEB	Fg	2	10	Mid	W	3	5M
225	MLD	TYM	O	1	5	Level	VP	5	8M
226	RUT	OEB	Fg	4	10	Crest	W	3	5M
227	MUS	TYM	O/Fg	1	5	Level	P	5	8P
228	MLD	TYM	O/Fg	1	5	Level	VP	5	8M
229	RUT	EEB	Fg	4	10	Mid	W	3	5M
230	RUT	OGL	Fg	4	10	Mid	MW	2	5M
231	MIL	OEB	Fg	4	11	Crest	R	4	4P
232	RUT	BRGL	Fg	3	10	Mid	W	2	5M
233	BMT	OLG	Fg	1	5	Level	P	4	7bM
234	RUT	OEB	Fg	5	10	Crest	W	3	5M
235	RUT	EEB	Fg	3	10	Upper	W	3	4M
236	MIL	OEB	Fg	4	6	Crest	W	4	5M
237	MIL	EEB	Fg	2	11	Upper	W	3	5M
238	MIL-xr	OEB	Fg	4	11	Upper	W	3	5M
239	MLD-xc	TM	O	1	5	Level	P	5	8M
240	MIL-xr	OEB	Fg	3	10	Crest	W	3	5M
241	MIL-xr	EEB	Fg	4	10	Upper	W	3	6M
242	BMT-xr	OG	Fg	2	6	Dep	P	2	7aM
243	FRT-xr	OGL	Fg	2	10	Crest	W	2	5M
244	MLD-xs	TM	O/Fg	1	5	Dep	VP	5	8M
245	MIL-xr	OEB	Fg	2	6	Level	W	3	5M
246	ptBMT	ptOG	Fg	1	5	Dep	VP	4	7bM
247	MIL	OEB	Fg	3	5	Upper	W	4	5M
248	STP	RG	Fg	1	5	Level	P	4	7bM
249	MIL-xr	OEB	Fg	4	6	Crest	W	3	5M
250	STP	OG	Fg	1	6	Level	P	4	7bM
251	MIL-xr	OEB	Fg	3	10	Upper	W	3	5M
252	MIL-xr	OEB	Fg	2	6	Level	W	4	5M

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
253	MLD	TYH	O	1	5	Level	VP	5	8M
254	MIL	OEB	Fg	4	10	Upper	W	4	5M
255	MUS	TYM	O	1	5	Dep	VP	5	8P
256	FRT	OGL	Fg	3	6	Level	W	3	5M
257	MLD-xc	TM	O	1	5	Dep	VP	5	8M
258	FRT	OGL	Fg	3	10	Level	W	2	5M
259	STP	RG	Fg	1	5	Level	VP	4	7bM
260	ptSTP	ptRG	O/Fg	1	5	Dep	VP	4	7bM
261	FRT	OGL	Fg	3	10	Mid	W	3	5M
262	ptBMT	ptRG	Fg	1	5	Dep	VP	4	7bM
263	FRT	OGL	Fg	2	6	Mid	W	2	5M
264	MUS-xs	TM	O	1	5	Dep	P	5	7aR
265	MIL-xr	OEB	Fg	3	6	Level	W	2	5M
266	MIL-xr	EEB	Fg	4	10	Crest	W	3	5M
267	MIL	EEB	Fg	2	6	Mid	W	4	5M
268	FRT-xr	BR.GL	Fg	2	6	Level	W	3	5M
269	MIL-xr	OEB	Fg	2	6	Level	W	3	5M
270	MLD-xc	TH	O/Fg	1	5	Dep	P	5	8M
271	MLD	TYH	O	1	5	Dep	VP	5	8M
272	MIL-xr	OEB	Fg	3	11	Crest	W	3	5M
273	MLD-xs	TM	O	1	5	Level	VP	5	8M
274	FRT	OGL	Fg	3	5	Crest	W	3	5M
275	MIL	OEB	Fg	2	11	Mid	W	3	5M
276	FRT	OGL	F/Res	3	10	Upper	W	2	5M
277	MIL-xr	OGL	Fg	5	11	Level	W	3	5M
278	MLD-xc	TM	Fg	1	5	Dep	VP	5	7aR
279	FRT	BRGL	Fg	4	10	Upper	W	3	5M
280	ptBMT	ptOG	Fg	1	5	Dep	WP	4	7bM
281	FRT	OGL	Fg	3	11	Level	W	2	5M
282	MIL	OEB	Fg	4	11	Mid	W	3	5M
283	MLD-xs	TH	Fg	1	5	Dep	P	5	7aR
284	ptBMT	ptOG	Fg	1	6	Dep	P	4	7bM
285	MLD-xs	TH	O	1	5	Dep	VP	5	7aR
287	MIL	OGL	Fg	3	10	Upper	W	2	5M
288	MLD-xs	TM	O/Fg	1	5	Dep	VP	5	7aR
289	FRT	OGL	Fg	2	6	Upper	W	3	5M
290	FRT	OGL	Fg	3	6	Mid	P	2	7bM
291	BMT	OG	Fg	1	5	Dep	P	2	6M
292	FRT	EEB	Fg	2	6	Mid	W	3	5M
293	MIL	EEB	Fg	3	10	Level	W	3	5M
294	FRT	OGL	Fg	5	10	Crest	W	2	5M
295	MLD-xr	TH	O/Res	2	10	Mid	P	2	6R
296	FRT	BRGL	Fg	1	5	Dep	W	2	5M
297	FRT	BRGL	Fg	3	10	Mid	W	3	5M
298	MIL-xr	EEB	Fg	3	10	Crest	W	4	5M
299	ptBMT	ptOG	Fg	2	10	Mid	I	4	5R
300	MIL-xr	OEB	Fg	3	10	Level	W	2	5R
301	STP	OLG	Fg	2	6	Crest	I	1	6M
302	MLD-xs	TM	O/Fg	1	5	Dep	P	5	8M
303	MIL	EEB	Fg	2	6	Upper	MW	3	5M

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
304	MLD	TYH	O	1	5	Level	P	5	7aR
305	MLD	TYM	O	1	5	Level	VP	5	8M
306	MLD-xs	TM	O	1	5	Level	VP	5	8M
307	MIL-xr	OEB	Fg	2	6	Crest	W	2	5M
308	MLD	TYM	O	0	5	Level	VP	5	8M
309	MIL-xr	OR	Res	2	6	Crest	W	3	5M
310	MIL-xr	OEB	F/Res	2	6	Crest	W	3	5M
311	MLD	TYM	O	1	5	Level	VP	5	8M
312	MIL	EEB	Fg	3	6	Crest	W	3	5M
313	MUS-xs	TM	O	1	5	Level	VP	5	8P
314	glMMY	RG	F	2	5	Dep	P	3	7aP
315	MIL-xr	OR	Fg/Res	4	9	Mid	W	2	5M
316	MIL-xr	EEB	Fg/Res	4	8	Upper	W	3	5M
317	MIL-xr	OEB	Fg/Res	3	9	Mid	W	3	4M
318	MIL	OEB	Fg	3	3	Mid	W	3	5M
319	MIL	OEB	Fg	6	3	Mid	W	3	5M
320	MIL	OR	Fg	2	5	Level	W	3	5M
321	MIL-xr	EEB	Fg/Res	3	10	Upper	W	3	4M
322	MIL-xr	OR	Fg/Res	3	9	Upper	W	4	5M
323	MMY	OR	F	4	9	Mid	W	3	5M
340	MIL-xr	EEB	M	4	10	Crest	MW	3	5M
341	MLD	TYM	O	1	4	Level	F	5	8M
342	MIL-xr	OEB	Fg/Res	4	10	Crest	MW	3	5M
343	BMT	OG	Fg	2	10	Level	I	1	6P
344	MIL-xr	EEB	Fg	3	10	Crest	MW	3	5M
345	MLD-xs	TM	O	1	5	Level	F	5	8M
346	MLD-xs	TM	O	1	5	Level	P	5	8P
347	ptBMT	ptOG	Fg	1	5	Level	P	2	7aP
348	MIL	EEB	Fg	3	10	Crest	W	4	4M
349	MLD-xs	TM	O	1	5	Level	P	5	8M
350	MIL	EEB	Fg	4	10	Crest	MW	4	4M
351	MLD-xg	TH	O	1	5	Level	P	4	7bM
352	MLD-xc	TM	O	1	5	Level	P	5	8M
353	MLD	TYM	O	1	5	Level	P	5	8M
354	MLD	TYM	O	1	5	Level	VP	5	8M
355	MLD	TYM	O	1	5	Level	VP	5	8M
356	MLD	TYM	O	1	5	Level	P	5	8M
357	MLD	TYM	O	0	5	Level	P	5	8M
358	MLD	TYM	O	1	5	Level	VP	5	8M
359	MIL-xr	OEB	Fg	2	5	Crest	MW	3	5M
360	MLD	TYH	O/Fg	1	5	Level	VP	5	8M
361	MLD	TYM	O	1	5	Level	PV	5	8M
362	MLD	TYM	O	1	10	Level	VP	5	8M
363	MLD	TYM	O	2	10	Level	P	5	8M
364	MIL-xr	OEB	Fg	2	10	Mid	MW	2	5M
365	FRT	EEB	Fg	3	10	Upper	MW	2	5M
366	MLD	TYM	O	1	5	Level	VP	5	8M
367	MLD	TYM	O	1	5	Level	VP	5	8M
368	MLD	TYM	O	1	5	Level	VP	5	8M
369	MLD	TYM	O	1	5	Level	VP	5	8M

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
370	MIL	EEB	Fg	2	5	Upper	MW	4	8M
371	MLD	TYM	O	1	5	Level	VP	5	8M
372	MLD	TYM	O/Lg	1	5	Level	VP	5	8M
373	MLD	TYM	O/Lg	1	5	Level	VP	5	8M
374	MLD	TYM	O	1	5	Level	VP	5	8M
375	MLD	TYM	O	1	5	Level	VP	5	5R
376	FRT	OGL	Fg	3	10	Crest	W	2	5M
377	MIL	EEB	Fg	2	5	Level	MW	3	5M
378	MIL	EEB	Fg	2	5	Level	MW	3	5P
379	MLD	TYM	O	1	5	Level	VP	5	8M
380	MLD	TYM	O	1	5	Level	VP	5	8M
381	MLD	TYM	O	1	5	Level	VP	5	8M
382	MLD	TYM	O	1	5	Level	P	5	8M
383	STP	OG	Fg	1	5	Level	P	4	7bM
384	MIL	EEB	Fg	5	10	Crest	W	4	4M
385	ptBMT	ptOG	Fg	2	10	Level	P	4	7bM
386	MLD	TYH	O	1	5	Level	P	5	8M
387	MIL-xr	EEB	Fg/Res	3	10	Crest	W	3	4M
388	BMT	GLEB	Fg	3	6	Mid	I	2	6M
389	MIL	EEB	Fg	4	6	Mid	MW	3	5M
390	MIL	OEB	Fg	4	6	Upper	W	3	5M
391	MIL-xr	EEB	Fg/Res	5	6	Upper	MW	3	5M
392	MUS-xs	TM	Fg	3	6	Mid	P	5	8P
393	MIL-xr	EEB	Fg/Res	2	6	Level	W	3	5M
394	BMT	RG	Fg	2	6	Level	P	4	7bM
395	MIL	EEB	Fg	4	6	Mid	MW	3	5M
396	MIL-xr	EEB	Fg/Res	3	6	Upper	W	3	5M
400	MIL-xr	OEB	Fg/Res	3	10	Upper	R	3	4M
401	glMIL	GLEB	Fg	3	10	Upper	R	2	6M
402	MIL-xr	EEB	Fg/Res	3	10	Upper	R	3	4M
403	MLD-xs	TH	O/Fg	2	5	Dep	VP	5	8M
404	MIL	EEB	Fg	3	10	Mid	W	4	4M
405	MUS-xs	TM	O/Fg	1	5	Level	P	5	8M
406	MIL-xr	EEB	Fg/Res	3	10	Upper	R	4	4M
407	MUS-xs	TH	O/Fg	2	5	Dep	P	5	8M
408	MIL-xr	EEB	Fg	3	10	Mid	W	4	5M
409	glMIL-xr	GLEB	Fg/Res	3	10	Mid	I	3	6M
410	MLD-xs	TM	O/Fg	2	5	Dep	VP	5	8M
411	MIL-xr	EEB	Fg	3	10	Upper	W	2	4M
412	MUS-xc	TM	O/Fg	2	5	Dep	PV	5	8M
413	MUS	TYM	O	1	5	Dep	WP	5	8M
414	MLD-xs	TM	O/Fg	2	5	Level	VP	5	8P
415	ptBMT	ptOG	Fg	2	10	Level	P	2	7aM
416	MIL-xr	ODB	Fg/Res	3	10	Level	W	3	4M
417	MIL-xr	EDB	Fg/Res	4	10	Mid	R	3	4M
418	MIL-xr	EEB	Fg/Res	4	10	Upper	W	4	4M
419	MLD-xs	TH	O/Fg	2	5	Dep	VP	5	8M
420	MLD	TYM	O	1	5	Dep	VP	5	8M
421	MLD	TYM	O	1	5	Dep	VP	5	8M
422	MLD	TYM	O	1	5	Dep	VP	5	8M

Plot	Series	Subgroup	Parent Material	Slope Class	Surface Landform	Slope Position	Drainage	Forest Capability Class	Edatope Level
423	MLD	TYM	O	1	5	Dep	VP	5	8M
424	MLD	TYM	O	1	5	Dep	VP	5	8M
425	MIL-xr	EEB	Fg/Res	5	10	Crest	W	3	4M
426	BMT	OG	Fg	2	10	Level	P	3	7aM
427	BMT	OG	Fg	2	5	Level	I	2	7aM
428	MIL	OG	Fg	2	5	Level	I	3	7aM
429	glMIL	GLEB	Fg	3	10	Mid	MW	3	6M
430	MLD-xs	TM	O/Fg	1	5	Level	VP	5	8M
431	BMT	OG	Fg	3	10	Mid	P	4	7aM
432	MLD-xc	TM	O/Fg	1	5	Level	VP	5	8M
433	ptBMT	ptOG	Fg	1	5	Level	P	2	7aM
434	MLD-xc	TH	O/Fg	1	5	Level	VP	5	8M
435	MLD-xs	TH	O	1	5	Level	VP	5	8M
436	MLD	TYM	O	1	5	Level	VP	5	8M
437	BMT	OLG	Fg	1	10	Mid	P	3	7aP
438	FRT	OGL	Fg	2	10	Mid	W	3	5M
439	MLD	TYM	O	1	5	Level	VP	5	8M
440	MIL-xr	OGL	Fg	3	10	Mid	P	3	4M
441	MIL	OGL	Fg	4	10	Mid	W	4	4M
442	BMT	ptOG	Fg	2	10	Level	P	3	7aM
443	MIL-xr	EEB	Fg	3	10	Upper	W	4	3M
444	FRT	OGL	Fg	3	5	Crest	W	3	5M
445	MLD-xs	TM	O/Fg	2	10	Dep	VP	5	8M
446	MIL-xr	EEB	Fg/Res	3	10	Mid	W	3	4M
447	MUS-xc	TM	O/Fg	2	10	Level	P	5	8P
448	FRT-xr	OGL	Fg/Res	3	10	Crest	MW	2	5M
449	MLD	TYM	O	1	10	Level	VP	5	8M
450	MLD	TYM	O	1	3	Level	VP	5	8M
451	BMT	GLGL	Fg	2	5	Level	L	2	6M
452	MUS-xs	TM	Fg	2	10	Level	VP	5	8R
453	MLD-xr	TH	O/Res	1	5	Dep	VP	5	8M
454	MLD	TYM	O	1	5	Dep	VP	5	8M
455	MLD-xs	TH	O/Fg	1	5	Level	VP	5	8M
456	MIL	EEB	Fg	3	10	Upper	R	4	3P
457	MLD	TYM	O	1	5	Level	VP	5	8M
458	MLD	TYM	O	1	10	Level	V	5	8M
459	BMT	GLEEB	Fg	3	10	Mid	I	4	6P
460	BMT-xr	OG	Fg/Res	2	10	Level	P	2	6M
461	MUS	TYM	O	2	10	Level	VP	5	8P
462	MIL-xr	EEB	F/Res	4	10	Upper	W	4	4M
463	BMT	OLG	F	2	10	Level	P	3	7aM
464	MLD	TYM	O	2	5	Level	VP	5	8M
465	MLD	TYM	O	1	5	Level	VP	5	8M
466	MLD-xs	TM	O/Fg	1	5	Level	VP	5	8M
467	MIL	EEB	Fg	4	10	Mid	R	4	3P
468	MLD	TYM	O	1	5	Level	VP	5	8M
469	MLD	TYM	O	1	5	Level	VP	5	8M
470	glFRT-xr	GLGL	Fg	3	10	Level	L	1	6M
471	MIL-xr	EEB	Fg/Res	4	10	Upper	R	5	4P
472	ptBMT	ptOG	O/Fg	2	5	Level	P	5	7bM

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474	ptSTP	ptOG	O/Fg	2	5	Level	P	2	7aM
475	MLD-xs	TM	O/Fg	2	5	Level	VP	5	8M
476	glFRT	GLGL	Fg	3	10	Upper	L	1	6M
477	MUS-xs	TM	O	1	5	Level	VP	5	8P
478	MLD-xs	TH	O/Fg	2	5	Level	VP	5	8M
479	FRT	OGL	Fg	2	10	Mid	MW	2	5M
480	MLD-xs	TM	O	1	5	Level	VP	5	8M
481	STP	OLG	Fg	3	10	Level	P	2	7aP
482	MLD-xs	TM	O/Fg	2	5	Level	VP	5	8M
483	ptSTP	ptOG	O/Fg	1	5	Level	P	4	7bM
484	STP	OG	Fg	3	10	Mid	P	2	7aM
485	MLD-xs	TH	O/Fg	1	5	Level	VP	5	8M
486	MLD	TYM	O	1	10	Level	VP	5	8M
487	MLD	TYM	O	1	5	Level	VP	5	8M
488	MIL-xr	EEB	Fg/Res	3	10	Upper	W	3	5M
489	MLD	TYM	O	1	5	Level	VP	5	8M
490	MLD	TYM	O	1	10	Level	VP	5	8M
491	ptSTP	ptOG	Fg	1	5	Level	P	2	7aP
492	MLD-xs	TM	O	1	10	Level	VP	5	8M
493	BMT	OLG	Fg	3	10	Level	P	4	7aM
494	MIL-xr	EEB	Fg/Res	3	10	Upper	W	4	5M
495	ptSTP	ptOG	Fg	3	10	Level	P	2	5M
496	MIL-xr	EEB	Fg/Res	4	10	Upper	W	3	5M
497	ptSTP	ptOG	Fg	3	10	Level	P	4	7bM
498	MIL-xr	EEB	Fg/Res	3	10	Upper	W	3	5M
499	MLD-xs	TH	O/Fg	1	5	Level	VP	5	8M
500	DOV	OGL	Lg	3	5	Mid	MW	2	5M
501	MIL-xr	EEB	Fg/Res	3	6	Level	W	2	5M
502	MIL	GLEEB	Fg	2	5	Level	I	3	6M
510	FRT	EEB	Fg	2	5	Level	W	3	5M
512	MLD-xs	TM	O	2	5	Level	P	5	7aM
513	MIL	EEB	Fg	3	10	Mid	W	4	5M
519	FRT	OGL	F/Lg	3	10	Upper	W	2	5M
520	FRT	BRGL	F/Lg	3	10	Mid	W	3	5M
522	FRT	OGL	Fg	5	3	Mid	W	3	4P
523	FRT	OGL	Fg	2	10	Level	W	3	5M
524	FRT	OGL	F/Lg	1	5	Level	W	2	5M
525	MIL	OR	Fg	1	5	Level	R	4	4P
526	glFRT	GLGL	Fg	1	5	Level	MW	1	4M
527	FRT	EEB	Fg	1	5	Level	W	3	4M
528	MUS-xr	TM	O/Res	2	5	Level	W	5	5M
529	MLD-xs	TM	O	1	5	Level	VP	5	8M
530	BMT	GLEEB	Fg	1	5	Level	P	4	7aM
532	MIL	EEB	Fg	2	10	Mid	W	3	4M
539	MIL	EEB	Fg	4	3	Mid	W	3	5M
541	MUS	TYF	O	1	5	Level	VP	4	7bM
542	FRT-xr	OGL	Fg/Res	3	3	Upper	W	2	5M
543	MUS-xc	TM	O	1	5	Dep	I	5	6M
575	FRT	EEB	Fg	2	5	Level	W	3	5M
576	BMT	OLG	Fg	1	5	Level	P	4	7bP

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577	MUS-xs	TM	O	1	5	Level	VP	5	8P
578	MUS-xc	TM	O	1	5	Level	VP	5	8P
579	MLD-xs	TM	O	1	5	Level	VP	5	8M
580	STP	OLG	Fg	2	5	Level	P	4	7bM
581	BMT	OLG	Fg	2	5	Level	P	4	7bP
582	MLD-xr	TM	O/Res	2	5	Level	P	5	7aM
583	MIL	EEB	Fg	2	5	Level	W	3	4M
584	MLD-xr	TM	O/Res	1	5	Level	P	5	7aM
585	MIL	EEB	Fg	2	5	Level	W	3	4M
586	MUS	TYM	O	1	5	Level	P	5	7aM
600	MLD	TYM	O	3	10	Dep	VP	5	8M
601	MIL-xr	OEB	Fg/Res	4	10	Upper	W	2	5M
602	MUS-xs	TH	O	2	10	Level	VP	5	8M
603	MIL-xr	OEB	Fg/Res	4	10	Crest	W	3	5M
604	FRT	BRGL	Fg	4	10	Upper	W	2	5M
605	ptSTP	ptOG	O/Fg	1	10	Level	P	4	7bM
606	MLD-xs	TH	O/Fg	1	10	Dep	VP	5	8M
607	MIL-xr	EEB	Fg/Res	3	10	Upper	W	3	5M
608	MLD	TYM	O	1	5	Level	VP	5	8M
609	ptBMT	ptOG	Fg	2	5	Level	P	4	7bM
610	MIL-xr	EEB	Fg/Res	3	10	Crest	W	2	4M
611	ptSTP	ptOG	Fg	2	10	Level	P	4	7aM
612	MIL-xr	EEB	Fg/Res	2	10	Mid	W	4	5M
614	MIL-xr	EEB	Fg/Res	3	10	Crest	W	4	4M
615	ptSTP	ptOG	M	2	5	Level	P	4	7bM
616	MIL-xr	EEB	M	4	10	Upper	W	3	5M
618	MUS	TYM	O	2	5	Level	VP	5	8M
619	MUS	TYM	O	1	5	Level	VP	5	8P
620	MLD-xs	TH	O/Fg	1	5	Level	VP	5	8M
621	MLD-xs	TH	O/Fg	1	5	Level	VP	5	8M
622	MLD	TYM	O	1	5	Level	VP	5	8M
623	MLD-xc	TH	O/Fg	1	5	Level	VP	5	8M
624	MLD	TYH	O	1	5	Level	VP	5	8M
625	MLD-xc	TH	O/Lg	1	5	Level	VP	5	8M
626	MLD-xr	TH	O/Res	1	5	Level	VP	5	5M
627	ptSTP	ptOG	Fg	1	5	Level	P	4	7bM
628	MLD-xr	TM	O/Res	1	5	Level	VP	5	8M
629	MLD	TYH	O	1	5	Level	VP	5	8M
630	ptSTP	ptOG	Fg	1	5	Level	P	4	7bM
631	MLD	TYH	O	1	5	Level	F	5	8M
632	ptSTP	ptOG	Fg	1	5	Level	P	4	7bM
633	MLD	TYM	O	1	5	Level	VP	5	8M
634	FRT	OGL	Fg	2	10	Level	MW	3	5M
635	MUS-xr	TH	O/Res	1	5	Level	VP	5	8M
640	MLD	TYM	O	1	10	Level	VP	5	8M
641	MIL-xr	EEB	Fg/Res	5	10	Crest	W	3	4M
642	MLD	TYH	O	1	5	Level	VP	5	8M
643	STP	HULG	Fg	2	10	Mid	P	3	7aM
644	MIL-xr	EEB	Fg/Res	2	10	Upper	MW	3	4M
645	MLD-xc	TM	Fg	3	10	Level	VP	5	8M

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646	MLD	TYH	O	1	10	Level	VP	5	8M
647	MIL-xr	EEB	Fg/Res	1	10	Crest	W	3	4M
648	ptSTP	ptOG	Fg	1	10	Level	VP	2	7aM
655	RUT	EEB	Fg	5	10	Crest	W	3	4M
656	MIL	EEB	Fg	2	10	Upper	W	3	4M
669	RUT	OMB	Fg	3	10	Crest	R	3	4M
672	ptBMT	ptOG	Fg	2	10	Level	I	2	7aM
673	RUT	OMB	Fg	1	10	Level	R	3	4M
674	RUT	EMB	Fg	2	10	Level	W	4	4M
675	BMT	OHG	Fg	4	10	Level	P	2	7aM
676	MLD-xg	TM	O	1	5	Level	VP	5	8M
677	MLD-xs	TM	O	1	5	Level	VP	5	8M
678	MIL-xr	EEB	Fg/Res	5	10	Crest	W	4	3M
679	MIL-xr	EEB	Fg/Res	4	10	Upper	W	3	4M
680	MLD	TYM	O	1	5	Level	VP	5	8M
681	MIL-xr	EEB	Fg/Res	3	10	Upper	R	3	4M
682	MIL-xr	EEB	Fg/Res	4	10	Upper	W	4	4M
683	BMT	OHG	Fg	2	5	Level	P	4	7bM
684	MLD	TYM	O	1	5	Level	VP	5	8M
685	MIL-xr	EEB	Fg/Res	2	10	Crest	W	4	3M
686	MUS-xs	TH	O/Fg	1	10	Level	P	5	7aM
687	MLD-xs	TH	O	1	5	Level	VP	5	8M
688	MLD-xs	TM	O	1	5	Level	P	3	7aR
689	MIL-xr	EEB	Fg/Res	3	10	Upper	W	3	4M
690	MUS-xs	TH	O	1	10	Level	VP	5	8M
691	MIL	OEB	Fg	3	10	Crest	W	3	5M
693	MUS-xc	TH	O/Fg	1	10	Level	F	5	8M
694	MUS-xs	TH	O/Fg	2	5	Level	VP	5	8M
695	MIL-xr	EEB	Fg/Res	3	10	Upper	W	3	4M
696	MLD	TYM	O	1	5	Level	VP	5	8M
697	MIL-xr	EEB	Fg/Res	3	10	Upper	W	3	4M
698	MLD	TYM	O	1	5	Level	VP	5	8M
699	MLD	TYM	O	1	5	Level	VP	5	8M
700	MLD	TYM	O	1	5	Level	VP	5	8M
701	MLD	TYM	O	1	5	Level	VP	5	8M
702	ptBMT	ptOG	Fg	5	10	Level	P	3	7aM
703	MIL-xr	OEB	Fg/Res	4	10	Crest	R	3	5M
704	MUS-xs	TM	O/Fg	1	10	Level	VP	5	8M
705	BMT	OG	Fg	2	10	Level	P	2	7aM
706	MIL	EEB	Fg	2	10	Level	P	3	5M
707	ptSTP	ptHG	Fg	3	10	Mid	P	4	7bM
708	MLD-xs	TH	O/Fg	1	3	Level	VP	5	8M
709	MLD-xc	TM	O/Lg	2	10	Level	P	5	8M
710	MLD	TYH	O	1	5	Level	VP	5	8M
711	BMT	ptOG	Fg	3	10	Level	P	5	8M
712	MIL-xr	EEB	Fg/Res	3	10	Upper	MW	3	4M
713	MUS	TYF	O	2	10	Level	VP	5	8M
714	MIL-xr	OGL	Fg/Res	4	10	Upper	W	3	5M
715	STP	OG	Fg	2	10	Mid	MW	3	5M
716	FRT	OGL	Fg	3	10	Crest	W	3	5M

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717	MLD	TYM	O	3	10	Dep	VP	5	8M
718	FRT-xr	OGL	Fg/Res	5	10	Crest	W	3	4M
719	DOV	OGL	Lg	2	10	Crest	MW	1	6M
720	MLD	TYM	O	1	10	Level	VP	5	8M
721	DOV-xr	OGL	Lg/Res	4	10	Upper	W	2	5M
722	MLD	TYM	O	1	5	Level	VP	5	8M
723	DOV	OGL	Lg	3	10	Upper	W	2	5M
724	MLD-xc	TM	O/Fg	1	5	Level	VP	5	8M
725	DOV	OGL	Lg	2	10	Level	MW	2	5M
726	MLD	TYM	O	1	5	Level	VP	5	8M
727	MLD	TYM	O	1	5	Level	VP	5	8M
728	ptSTP	ptRG	Fg	2	10	Level	I	2	7aM
729	MIL-xr	OGL	Fg/Res	2	10	Upper	MW	3	5M
730	MUS	TYM	O	1	10	Level	VP	5	8M
731	MIL-xr	EEB	Fg/Res	4	10	Crest	W	4	4M
732	MUS	TYM	O	1	5	Level	VP	5	8M
733	MIL-xr	EEB	Fg/Res	3	10	Upper	MW	4	4M
734	MLD	TYM	O	1	5	Level	VP	5	8M
735	MLD	TYM	O	1	5	Level	VP	5	8M
736	MIL-xr	EEB	Fg/Res	5	10	Upper	W	4	5M
737	MLD	TYM	O	1	5	Level	VP	5	8M
738	MUS	TYM	O	1	5	Level	VP	5	8M
739	MUS-xs	TM	O/Fg	1	5	Level	VP	5	8M
740	MLD-xs	TH	O/Fg	1	5	Level	VP	5	8M