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REPORT ON

SOIL AND TERRAIN BASELINE

FOR

PROJECT MILLENNIUM

Submitted to:

Suncor Energy Inc., Oil Sands
Fort McMurray, Alberta

April 1998

972-2205

EXECUTIVE SUMMARY

Golder Associates Ltd. was retained by Suncor Energy Inc. to conduct a soil and terrain baseline assessment in support of the proposed Project Millennium development. The objectives of the baseline were: to sample and map the soil resources; to provide a baseline soil inventory; map and provide an inventory of the baseline terrain units; determine, map and provide an inventory of the land capability for forest ecosystems; and, assess the volumes and suitabilities of soils for reclamation purposes in the Local Study Area.

Field work was carried out in September of 1997 using a 1:20,000 scale photomosaic for reference. Soils were described in terms of: profile characteristics, surficial materials, position in the landscape (i.e. slope and aspect), drainage and soil chemistry. Soil sampling was carried out to the 1.0 metre depth at most sites, or to the depth of peat plus 20 cm into the underlying mineral materials for most organic deposits. Sample site location was dictated in part by access and so was primarily at 100 m intervals along haul roads, cutlines, around well pads, cutblocks and other cleared areas. A free survey component, which permitted departure where desireable from the regular sampling interval, was included to assure characterization of as much of the diversity of the LSA as practical. Inspections coincided as frequently as possible with previously surveyed vegetation inspection sites to provide a direct site level linkage.

Mapping was finalized by assigning soil series designations to each Alberta Vegetation Inventory (AVI) polygon for which profile data was available, statistically evaluating the relationships and using these data, in concert with aerial photo interpretation, to determine the highest probable soil series-AVI relationships for the rest of the polygons. Terrain units were generated by combining all soil series with the same parent materials, eg. - all series with glaciofluvial parent materials were amalgamated to produce glaciofluvial terrain units. Land capabilities for forest ecosystem ratings for each soil series were computed using the system devised by Leskiw (1998b). All three of these parameters were mapped for baseline (i.e. pre-development) conditions in the Local Study Area. Both the organic and mineral soil resources were rated with respect to their efficacy for reclamation purposes following defined soil quality criteria, their suitabilities for surface or subsurface applications noted and the volumes of available materials calculated.

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April 27, 1998

Proj. No. 972-2205

Mr. Martin Holysh
Senior Environmental Specialist
Sustainable Development
Suncor Energy Inc., Oil Sands
P.O. Box 4001
Fort McMurray, AB
T3H 3E3

RE: Final Report on Soil and Terrain Baseline for Project Millennium

Dear Martin:

Attached are five copies of the Soil and Terrain Baseline for Project Millennium. This report summarizes the following soil and terrain baseline objectives:

- to sample and map the soil resources in LSA;
- provide baseline soil inventory;
- map and provide inventory of baseline terrain units;
- determine, map and provide inventory of the land capability for forest ecosystems; and
- assess the suitability and volumes of soils for reclamation purposes in the LSA.

If you have any additional questions about the report, please contact either Dr. William (Bill) White at 216-8950 or me at 299-5640.

Yours very truly,

GOLDER ASSOCIATES LTD.

Shawn McKeown

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

attachments (5)

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1. INTRODUCTION

1.1 OBJECTIVES

Suncor Energy Inc., Oil Sands (Suncor) is proposing to develop Project Millennium (the Project) on parts of Leases 19 and 25 north of Fort McMurray. The Project Millennium Terms Of Reference, issued on March 4, 1998 by Alberta Environmental Protection (AEP 1998), requires that a baseline soils and terrain 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 Suncor's Steepbank Mine (Leskiw et al. 1996), Shell Canada Limited's (Shell) Muskeg River Mine Project (Golder 1997), Syncrude Canada Limited's (Syncrude) Aurora Mines (Landcare 1996) and on a broader scale, the AOSERP soils inventory (Turchenek and Lindsay 1982).

As part of the Project Millennium 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 AREAS

The Local Study Area (LSA) for Project Millennium is located in all or parts of townships 91 and 92, ranges 8 and 9, west of the fourth meridian. It is bounded on the west by the Athabasca River, to the north and east by the Steepbank River and on the south and east by a buffer that extends a minimum of 500 m beyond the perimeter of the development footprint (Figure 1). This LSA covers an area of 16,181 ha.

The Regional Study Area (RSA) for Project Millennium encompasses an area of 2,428,645 ha. A synopsis of the soil and terrain components in the RSA may be found in Section 7 of this report.

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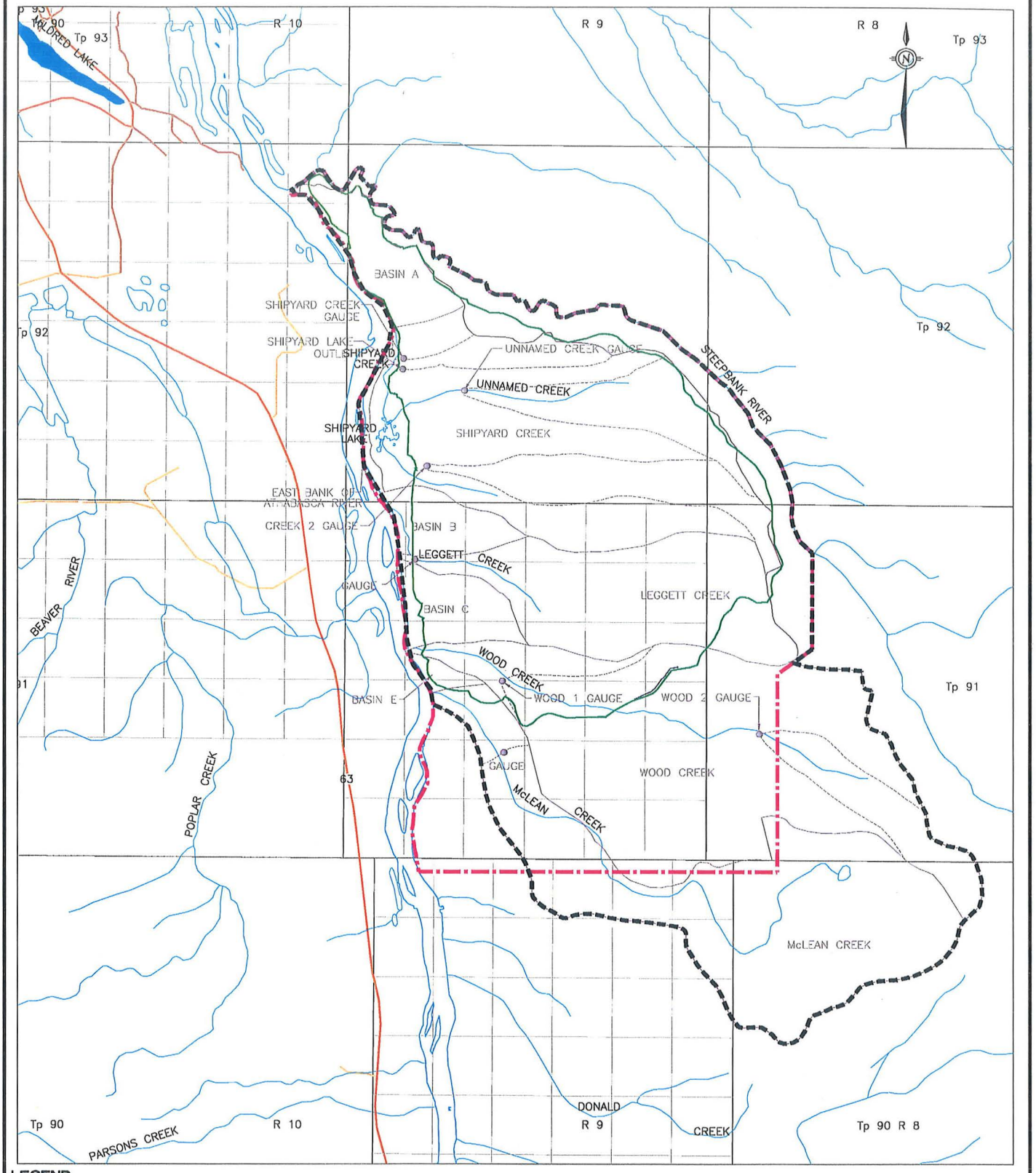


LEGEND

- EAST BANK MINING AREA
- LOCAL DRAINAGE BASIN
- LOCAL DRAINAGE SUB BASIN
- LOCAL BASIN GAUGE
- LOCAL STUDY AREA FOR TERRESTRIAL
- LOCAL STUDY AREA FOR AQUATICS

REFERENCE

DIGITAL DATA SETS 74D AND 74E RESOURCE DATA DIVISION, ALBERTA ENVIRONMENTAL PROTECTION, 1997.
MINE PLAN SUPPLIED BY SUNCOR ENERGY, MAR 1998.
DATUM IS IN NAD83 UTM

0 1 2 3 4 5km

SCALE 1:150,000

SUNCOR ENERGY

Project Millennium
Taking Suncor into the 21st Century

LOCAL STUDY AREA FOR PROJECT MILLENNIUM WETLANDS/TERRESTRIAL BASELINE

06 Apr. 1998	Figure 1	DRAWN BY: CG/TM

2. METHODS

2.1 SOILS 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 Leskiw et al. (1996) for Suncor's Steepbank Mine, Crown and Twardy for the Fort McMurray Region (1970), Turchenek and Lindsay (1982) in the AOSERP study area, Landcare (1996) for Syncrude's Aurora Mine and Golder (1997n) for Shell's Muskeg River Mine Project.

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 three recent and two older studies. Therefore, a cross-referencing approach, similar to that of Landcare (1996) and Golder (1997), 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.
- Existing access routes within the LSA.
- The availability of data from 734 sites surveyed by Leskiw et al. (1996) for Suncor's Steepbank Mine.

Field sampling was conducted September 14 - 25, 1997 with 870 inspection sites being visited. Due to extremely wet conditions, access was by four wheel drive all-terrain vehicles (ATVs), a tracked Argo and helicopter. Inspection sites were located at regular intervals along transects that correspond to cutlines, winter haul roads and other access routes within the development area. A significant independent 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 the uplands to saturated or standing water in most level and depressional areas. Bogs and fens were generally saturated and frost was encountered at depths below 1 m in some locations. The soil was examined to a depth of 1 m (or depth of organics plus 20 cm into the underlying mineral material) at the majority of the sites, except where stoniness, contact with residual materials 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 was based on integrating data from a number of sources:

- the soil map units;
- the Alberta Vegetation Inventory (AVI) map units;
- the Alberta Wetlands Inventory (AWI) map units;
- the composition of the surficial deposits; and
- a digital elevation model of the LSA with a 2 m contour interval.

Due to the relative lack of relief over most of 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 series in the LSA but this does not necessarily mean

every unit of that series will support only that vegetation type). Factors such as aspect, slope position and composition of the subsurface materials also affect the micro-environment and hence the vegetation found at a particular location.

Terrain units were derived by combining soil units with similar genetic properties. For example, all the soil units with glaciofluvial parent materials were merged to produce larger map units having comparable morphological and mechanical characteristics. The terrain unit names, therefore, reflect the characteristics of the surficial materials

2.3 SAMPLING AND LABORATORY ANALYSES

Soils from the Project LSA were collected for chemical and physical analyses, by Enviro-Test Labs, Saskatoon. Efforts were made to sample as many of the soil series in the LSA as possible. Samples were taken to the 1 m depth at 26 inspection sites, but where a series was not sampled, comparable data from Leskiw et al. (1996) were used. Additional samples, from various horizons of assorted profiles, were collected and analyzed to assist in compiling a database for assessing soil properties used in the reclamation criteria ratings.

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 Mixedwood Ecoregion of the Boreal Ecoprovince. Pettapiece (1989) notes the climate as having moderate to severe temperature limitations to plant growth. Dzikowski and Heywood (1990) and Strong (1992) provide extensive, long-term statistical summaries on parameters such as growing-degree days and length of the frost-free season.

3.2 PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The LSA is characterized as having subdued relief and nearly level topography (Strong 1992). Elevations rise gradually, west to east, from approximately 320 masl (metres above sea level) along the Athabasca River escarpment to roughly 400 masl along the Steepbank River escarpment. A few minor uplands occur on the east side of the LSA rising to nearly 440 masl. From the northwest, the elevation rises gently from 320 masl at the confluence of the Athabasca and Steepbank river valleys to 380 masl in the extreme southeast. Overall, the slopes in the LSA are less than 0.5%.

Pettapiece (1986) places the western half of the LSA, townships 91 and 92, range 9, west of the fourth meridian, in the Northern Alberta Lowlands physiographic region. The eastern half of the LSA, townships 91 and 92, range 8, west of the fourth meridian, falls within the Saskatchewan Plains physiographic region. Table 1 provides a more detailed evaluation of the surface characteristics of the LSA.

Table 1 Physiographic Setting of the Project Millennium LSA

Region	Section	District	Surface Expression	Surficial Materials	Elevation, masl
Saskatchewan Plains	Methy Portage Plains	Steepbank Plain	Undulating	Glaciolacustrine, Morainal/Till	425 - 500
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)

Bayrock and Reimchen (1973) mapped the surficial geology of the LSA as primarily thin ground moraine composed of loamy Kinosis till in the north and thick, bedded glaciolacustrine sands and silts to the south. The valley slopes of the Athabasca and Steepbank rivers are classed as erosional or slumping (i.e. colluvium), with alluvial deposits along the floodplains. Small, isolated inclusions of glaciofluvial outwash sands and gravels are found in old channel bottoms and are often associated with medium to fine textured aeolian sands that occur in sheets and dunes. In the extreme south of the LSA are located small areas of: thick, bedded glaciolacustrine clays and silts; thin glaciolacustrine clays and silts with numerous pebbles; and thick, coarse textured glaciofluvial kame/kame moraine deposits consisting of mixed sands and gravel to pure gravel. In general the topography is level to undulating except along the river and stream channels.

3.3 BEDROCK GEOLOGY

The bedrock geology in townships 91 and 92, range 9, west of the fourth meridian is principally marine origin, Lower Cretaceous silty shale, siltstone and fine sandstone of the Clearwater Formation. McMurray Formation sandstone, siltstone and silty shales, of deltaic origin, are exposed along the Athabasca River valley and limited amounts of Waterways Formation (marine shales and argillaceous limestone) may be found in the Athabasca floodplain. In townships 91 and 92, range 8, west of the fourth meridian, the Grand Rapids formation, consisting of fine-grained, deltaic-marine sandstone, siltstone and shale dominate the bedrock geology (Green 1972, Ozoray 1974, RCA 1970). 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

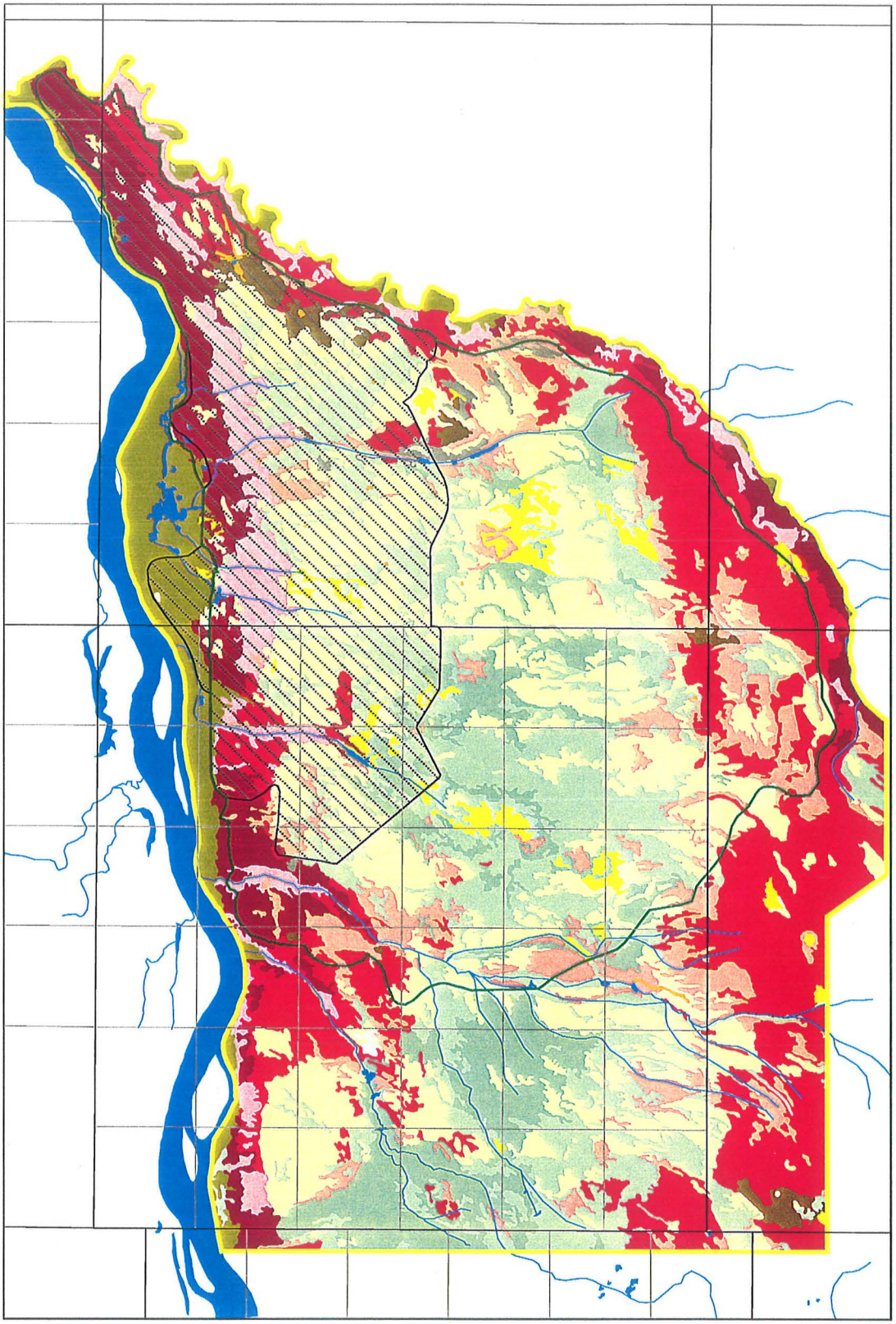
The soil map units detailed in this report are based on the diagnostic properties of the principal soil series after which they have been named. It is important to realize that while a soil unit may be mapped as Kinosis, for example, this is not meant to imply that all the soils within the boundaries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

In this report, the soils mapping is based on: a) the scale required in the Terms Of Reference (AEP 1998); b) the mapping parameters set out for the Northern Forested Region of Alberta (Alberta Soil Advisory Committee 1987) for baseline reporting; and c) the stripping and salvaging capabilities of the equipment likely to be used for project 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 analyses for specific series profiles as noted. The soil map units are identified for the LSA in Figure 2 (Project Millennium LSA Soil Classification).

Note: Leskiw (pers. comm 1998a) stated that the soils identified in the Steepbank Mine baseline soil survey (Leskiw et al. 1996) were reclassified to conform with the series names used for the Aurora Mine (Landcare 1996) and Muskeg River Mine Project (Golder 1997n). For this reason inconsistencies in nomenclature will arise if the contents of this baseline report are compared with those in the comparable parts of the Steepbank Mine documentation for the same geographic locations.



LEGEND

- Terrestrial Local Study Area
- East Bank Mining Area
- Steepbank Mine
- Open Water

Soil Classification

- Bitumount (BMT, ptBmt)
- Kinosis (KNS, glKNS)
- Mildred (MIL, glMIL)
- McLelland (MLD)
- McLelland (shMLD)
- McMurray (MMY, glMMY)
- Muskeg (MUS)
- Muskeg (shMUS)
- Steepbank (STP, ptSTP)
- Rough Broken (RB2)
- Rough Broken (RB3)
- Cultural Features and Disturbed Land

West of Fourth Meridian

N

1000 0 1000 2000 3000

Metres
Scale 1:100,000

SOURCES: Suncor
Golder
CAN-AG
The Forestry Corp

Map Projection: UTM 12
Datum: NAD 83

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Taking Suncor into the 21st Century

LOCAL STUDY AREA SOIL CLASSIFICATION

27 Apr. 1998	Figure 2	PRODUCED BY: JS REVIEWED BY:

data14/suncor/local/9700/9740/arcview/lsa_soil.apr

4.1.1 Bitumount Series (BMT Soil Unit)

Extent (area/percent of LSA)	65.4 ha/0.4%
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 → fen transition: aspen-white spruce → tamarack-black spruce
Comments	* Analytical data from plot 299 in Golder (1997).

PLOT #299 *						
Horizon	**Depth**	**Colour**	**Mottles**	**Texture**	**Structure**	**Consistence**
LFH	16-0	n/a	n/a	n/a	n/a	n/a
Ae	0-3	10 YR 5/2	n/a	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
Bg	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
Bg	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

4.1.2 Kinosis Series (KNS Soil Unit)

Extent (area/percent of LSA)	3086.3 ha/18.4 %
Soil Classification	Orthic Gray Luvisol (KNS), Gleyed Gray Luvisol (glKNS)
Parent Material	medium glacial till/morainal
Texture (surface/subsurface)	sandy loam/sandy clay loam-clay loam
Topography (class/% slope)	1-4/0-9%
Slope Position	mid to lower, level
Drainage Class	moderately well - well (KNS) imperfect (glKNS)
Predominant Vegetation Type	upland (aspen, white spruce)
Comments	Analytical data for plot 1561 (KNS) and plot 1757 (glKNS).

PLOT#1561					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
LFH	8-0	n/a	n/a	n/a	n/a
Ae	0-9	10 YR 6/1	SL	PL	FRIABLE
Bm	9-32	10 YR 6/4	SL	SBK	FIRM
BC	32-60	10 YR 5/4	SCL	MA	FIRM
Ck	60-80	10 YR 4/4	SCL	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LFH	8-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ae	0-9	15.0	4.5	48	39	13	L	n/a
Bm	9-32	12.2	6.0	59	24	17	SL	n/a
BC	32-60	n/a	n/a	49	18	33	SCL	n/a
Ck	60-80	n/a	n/a	54	17	29	SCL	33

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	<0.4	88	590
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
BC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ck	0.29	6.4	27.8	9.0	2.4	0.27	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	42	n/a	n/a	n/a	n/a	n/a	4.9	53
Ae	n/a	0.026	1.6	0.082	0.072	4.3	4.5	n/a
Bm	n/a	0.63	1.7	0.016	0.082	5.0	4.6	n/a
BC	n/a	n/a	n/a	n/a	n/a	n/a	4.3	n/a
Ck	n/a	n/a	n/a	n/a	n/a	n/a	5.0	n/a

n/a = not analyzed or not applicable

PLOT#1757					
Horizon	Depth	Colour	Texture	Structure	Consistence
LFH	8-0	n/a	n/a	n/a	n/a
Aegj	0-15	10 YR 6/2	fSL	PL	FRIABLE
Btgj	15-45	10 YR 5/3	SCL	SBK	FRIABLE
BCg	45-120	10 YR 5/3	CL	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LFH	8-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Aegj	0-15	14.8	6.5	59	30	11	SL	n/a
Btgj	15-45	n/a	n/a	65	15	20	SL	n/a
BCg	45-120	n/a	n/a	52	16	32	SCL	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	<0.4	80	550
Aegj	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Btgj	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

Horizon	Avail-S µg/g	Na meq/100g	Ca meq/100g	Mg meq/100g	K meq/100g	CEC meq/100g	pH	% OM
LFH	41	n/a	n/a	n/a	n/a	n/a	4.3	46
Ae	n/a	0.043	0.90	0.082	0.11	6.9	3.8	n/a
Bm	n/a	n/a	n/a	n/a	n/a	n/a	4.5	n/a
BC	n/a	n/a	n/a	n/a	n/a	n/a	6.6	n/a
Ck	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 McLelland Series (MLD Soil Unit)

The McLelland soil series was divided into two subgroups: typic mesisols (MLD) which have a depth of greater than 120 cm of organic material above the mineral contact and terric mesisols (shMLD) where the mineral contact occurs between 40 and 120 cm below the surface

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 within the deposits. Fibric material (which is less decomposed than mesic) and humic material (in a more advanced stage of decomposition) was encountered in a number 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.

Extent (area/percent of LSA)	MLD : 1530.8 ha/9.1% shMLD : 3037.5 ha/18.1%
Soil Subgroup	MLD : Typic Mesisol (TYM), shMLD : Terric Mesisol (TM)
Parent Material	organic (MLD), organic/mineral (shMLD)
Texture (surface/subsurface)	peat (MLD), peat/mineral (shMLD)
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 1832 (MLD) and plot 1908 (shMLD).

PLOT#1832					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
Of	0-26	n/a	n/a	n/a	n/a
Om	26-157	n/a	n/a	n/a	n/a
Cg1	157-167	10 YR 4/1	C-CL	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Of	0-26	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Om	26-157	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	157-167	n/a	n/a	50	24	26	SCL	34

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	6.0	49	770
Om	n/a	n/a	n/a	n/a	n/a	n/a	<0.4	6.8	100
Cg	0.61	25.8	74.8	16.4	5.1	0.70	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
Of	110	n/a	n/a	n/a	n/a	n/a	6.5	88
Om	52	n/a	n/a	n/a	n/a	n/a	5.9	54
Cg	n/a	n/a	n/a	n/a	n/a	n/a	7.7	n/a

PLOT#1908					
Horizon	Depth	Colour	Texture	Structure	Consistence
Of	0-20	n/a	n/a	n/a	n/a
Om	20-46	n/a	n/a	n/a	n/a
Cg	46-103	10 YR 5/1	L	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Of	0-20	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Om	20-46	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	46-103	n/a	n/a	49	24	27	SCL	39

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	<0.4	39
Om	n/a	n/a	n/a	n/a	n/a	n/a	<0.4	7.6
Cg	0.56	15.9	59.3	33.1	3.5	0.41	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	110	n/a	n/a	n/a	n/a	n/a	5.8	82
Om	23	n/a	n/a	n/a	n/a	n/a	5.5	82
Cg	n/a	n/a	n/a	n/a	n/a	n/a	7.1	n/a

n/a = not analyzed or not applicable

4.1.4 McMurray Series (MMY Soil Unit)

Extent (area/percent of LSA)	783 ha/4.7 %
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 and Steepbank river floodplains. Analytical data from plot 415 in Leskiw et al. (1996).

PLOT#415					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
F	6-0	1O YR 2/1	n/a	n/a	n/a
C1	0-50	10YR 4/3	SiL	MA	FRIABLE
C2	50-100	10YR 4/3	Sl	MA	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

4.1.5 Mildred Series (MIL Soil Unit)

Extent (area/percent of LSA)	187.5 ha/1.1%
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. Analytical data from plot 1783 (MIL).

PLOT#1783					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
Ahe	0-2	10 YR 4/1	S	SG	LOOSE
Ae	2-6	10 YR 6/3	S	SG	LOOSE
Bm	6-58	10 YR 5/8	S	SG	LOOSE
BC	58-100	10 YR 7/2	S	SG	LOOSE

Horizon	**Depth cm**	**Moisture 1/3 Bar**	**Moisture 15 Bar**	**% Sand**	**% Silt**	**% Clay**	**Texture**	**Sat %**
Ahe	0-2	5.6	4.5	n/a	n/a	n/a	n/a	n/a
Ae	2-6	3.3	1.6	95	5	0	S	n/a
Bm	6-58	3.6	2.1	91	4	5	S	n/a
BC	58-100	1.7	1.1	97	0	3	S	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**
Ahe	n/a	n/a	n/a	n/a	n/a	n/a	<0.4	13	59
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
BC	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**
Ahe	1.6	0.13	1.2	0.082	0.13	5.8	4.6	2.9
Ae	n/a	0.078	0.4	0.15	0.051	1.5	4.8	n/a
Bm	n/a	0.035	0.25	0.049	0.046	1.7	5.0	n/a
BC	n/a	n/a	n/a	n/a	n/a	n/a	5.3	n/a

n/a = not analyzed or not applicable

4.1.6 Muskeg Series (MUS Soil Unit)

The Muskeg soil series was divided into two subgroups : typic mesisols (MUS) which have a depth of greater than 120 cm of organic material above the mineral contact and terric mesisols (shMUS) where the mineral contact occurs between 40 and 120 cm below the surface.

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 (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 encountered at six inspection sites. These profiles were classified as cryoslic soils; however, they were highly scattered and not extensive enough to be classified separately as a cryosolic soil series or mapped as a contiguous unit.

Extent (area/ percent of LSA)	MUS : 316.4 ha/1.9% shMUS : 3671.1 ha/21.8%
Soil Subgroup	MUS : Typic mesisol (TYM) shMUS : Terric Mesisol (TM)
Parent Material	organic
Texture (surface/subsurface)	peat (MUS), peat/mineral (shMUS)
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 1726 (MUS) and plot 2160 (shMUS).

PLOT#1726					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
Of	0-30	n/a	n/a	n/a	n/a
Om	30-120	n/a	n/a	n/a	n/a
Cg	120-160	10 YR 4/1	SCL	MA	FRIABLE

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	30-120	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	120-160	n/a	n/a	54	15	31	SCL	41

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	<0.4	72	1000
Om	n/a	n/a	n/a	n/a	n/a	n/a	<0.4	5.2	76
Cg	0.41	6.70	56.3	17.1	3.10	0.20	n/a	n/a	n/a

Horizon	Avail - S µg/g	Na meq/ 100g	a meq/ 100g	Mg meq/ 100g	K meq/ 100g	CEC meq/ 100g	pH	% OM
Of	62	n/a	n/a	n/a	n/a	n/a	4.4	93
Om	36	n/a	n/a	n/a	n/a	n/a	5.3	85
Cg	n/a	n/a	n/a	n/a	n/a	n/a	7.4	n/a

n/a = not analyzed or not available

PLOT#2160					
Horizon	Depth	Colour	Texture	Structure	Consistence
Of	0-20	n/a	n/a	n/a	n/a
Om	20-54	n/a	n/a	n/a	n/a
Cg	54-100	10 YR 5/4	CL	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Of	0-20	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Om	20-54	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cg	54-100	n/a	n/a	53	24	23	SCL	32

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	<0.4	23	430
Om	n/a	n/a	n/a	n/a	n/a	n/a	<0.4	8.4	100
Cg	0.29	6.4	48.2	8.90	1.20	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
Of	26	n/a	n/a	n/a	n/a	n/a	6.0	79
Om	22	n/a	n/a	n/a	n/a	n/a	6.5	57
Cg	n/a	n/a	n/a	n/a	n/a	n/a	7.1	n/a

4.1.7 Steepbank Series (STP Soil Unit)

Extent (area/percent of LSA)	1461.8 ha/8.7 %
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 1916 (STP) and 1659 (ptSTP).

PLOT#1916					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
LFH	5-0	n/a	n/a	n/a	n/a
Ae	0-12	10 YR 7/1	SiL	PL	FRIABLE
Btj	12-32	10 YR 6/3	L	SBK	FRIABLE
BC	32-60	10 YR 7/2	CL	BK	FIRM
C	60-110	10 YR 5/2	CL	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
LFH	5-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ae	0-12	n/a	n/a	52	34	14	L	n/a
Btj	12-32	n/a	n/a	40	34	26	L	n/a
BC	32-60	n/a	n/a	36	17	47	C	n/a
C	60-110	n/a	n/a	46	19	35	CL	40

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	<0.4	47	910
Ae	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Btj	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
C	0.43	11.8	63.1	15.3	1.00	0.35	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	57	n/a	n/a	n/a	n/a	n/a	4.3	61
Ae	n/a	0.15	3.3	0.48	0.061	5.0	6.0	n/a
Btj	n/a	n/a	n/a	n/a	n/a	n/a	5.4	n/a
BC	n/a	n/a	n/a	n/a	n/a	n/a	6.8	n/a
C	n/a	n/a	n/a	n/a	n/a	n/a	7.6	n/a

n/a = not analyzed or not applicable

PLOT#1659					
Horizon	Depth	Colour	Texture	Structure	Consistence
Om	17-0	n/a	n/a	n/a	n/a
Ae	0-10	10 YR 6/3	fSL	PL	VERY FRIABLE
Btg	10-40	10 YR 7/2	CL	SBK	FRIABLE
Bcg	40-60	7.5 YR 6/4	CL	MA	FIRM
Cg	60-110	10 YR 5/2	CL	MA	FIRM

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Om	17-0	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ae	0-10	n/a	n/a	78	17	5	LS	n/a
Btg	10-40	n/a	n/a	55	21	24	SCL	n/a
Bcg	40-60	n/a	n/a	44	14	42	C	n/a
Cg	60-110	n/a	n/a	46	16	38	CL	42

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	<0.4	32	460
Ae	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Btg	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	0.23	5.10	29.0	9.10	0.800	0.21	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	45	n/a	n/a	n/a	n/a	n/a	4.2	82
Ae	n/a	0.017	0.97	0.21	0.026	2.5	4.6	n/a
Btj	n/a	n/a	n/a	n/a	n/a	n/a	4.8	n/a
BC	n/a	n/a	n/a	n/a	n/a	n/a	5.0	n/a
C	n/a	n/a	n/a	n/a	n/a	n/a	6.3	n/a

n/a = not analyzed or not applicable

4.1.8 Rough Broken 2 (RB 2 Unit)

Extent (area/percent of LSA)	1158 ha/6.9 %
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. Analytical data from plot 721 in Leskiw et al. (1996).

PLOT#721					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
LFH	2-0	n/a	n/a	n/a	n/a
Ae	0-12	n/a	LS	n/a	n/a
Bm	12-40	n/a	fSL	n/a	n/a
C	40-70	n/a	fSL	n/a	n/a

Horizon	Depth cm	Moisture 1/3 Bar	Moisture 15 Bar	% Sand	% Silt	% Clay	Texture	Sat %
Ae	0-12	n/a	n/a	79	15	6	LS	n/a
Bm	12-40	n/a	n/a	77	14	9	SL	n/a
C	40-70	n/a	n/a	75	16	9	SL	35

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
Ae	n/a	n/a	n/a	n/a	56	n/a	0.3	4	56
Bm	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
C	0.21	n/a	n/a	n/a	n/a	0.2	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
Ae	5.4	<0.1	0.1	0.2	0.1	4.4	4.8	23
Bm	n/a	<0.1	<0.1	<0.1	<0.1	3.4	n/a	n/a
C	n/a	n/a	n/a	n/a	n/a	n/a	5.0	n/a

n/a = not analyzed or not applicable

4.1.9 Rough Broken 3 (RB3 Unit)

Extent (area/percent of LSA)	740 ha/ 4.4%
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	Analytical data from plot 727 in Leskiw et al. (1996).

PLOT#727					
Horizon	**Depth**	**Colour**	**Texture**	**Structure**	**Consistence**
LFH	17-0	n/a	n/a	n/a	n/a
Ae	0-10	10 YR 4/4	CL	GR	FRIABLE
Bt	10-40	10 YR 4/4	SCL	SBK	FIRM
BCg	40-100	n/a	CL	MA	FIRM

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 Non-Soil Units

Some areas within the LSA are open water while others have been disturbed by previous development activities. Part of the area is also made up of infrastructure such as haul roads, cutlines and drilling pads. These features account for a relatively small portion of the LSA and are described in Table 2.

Table 2 Extent of Non-Soil Units in the Project Millennium LSA

Feature	Area, ha	% of LSA[a]
Water	120	1
Disturbed Lands	22	<1
Total, Non-Soil Units	142	1

[a] LSA area = 16,181 ha

4.1.11 Summary

The surface area of the Project LSA is comprised of naturally occurring soils, open water and areas disturbed by previous developments (primarily winter haul roads and small drill pads). These features total 16,181 ha in extent and are distributed as shown in Table 3 and Figure 2.

Table 3 Distribution of Soil Series in the Project Millennium LSA

	Approved Steepbank		Project Millennium		Buffer Areas		Total LSA	
Soil Series	ha	%LSA	ha	%LSA	ha	%LSA	ha	%LSA
Bitumount	0	0	33	<1	3	<1	36	<1
ptBitumount	15	<1	14	<1	0	0	29	<1
Kinosis	324	2	704	4	1,596	10	2,623	16
glKinosis	17	<1	112	1	334	2	463	3
McMurray	98	1	5	<1	422	3	525	3
glMcMurray	58	<1	5	<1	194	1	258	2
Mildred	97	1	34	<1	54	<1	186	1
glMildred	0	0	2	<1	0	0	2	<1
McLelland	107	1	583	4	840	5	1,530	9
shMcLelland	810	5	1,299	8	928	6	3,037	19
Muskeg	64	<1	223	1	30	<1	316	2
shMuskeg	1,030	6	1,572	10	1,069	7	3,672	23
Steepbank	87	1	370	2	253	2	710	4
ptSteepbank	40	<1	443	3	269	2	752	5
Rough Broken 2	563	3	210	1	385	2	1,158	7
Rough Broken 3	443	3	66	<1	232	1	740	5
Sub-total	3,754	23	5,676	35	6,610	41	16,040	99
Disturbed Lands	14	<1	1	<1	7	<1	22	<1
Water	8	<1	7	<1	105	1	120	1
Sub-total	22	<1	8	<1	112	1	142	1
Total	**3,776**	**23**	**5,684**	**35**	**6,721**	**42**	**16,181**	**100**

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 with respect to pre-disturbance soil conditions.

5.1 CAPABILITY FOR FORESTRY

The Land Capability Classification For Forest Ecosystems In The Oil Sands Region, revised edition (Leskiw 1998b) was devised to evaluate the potential of pre- and post-disturbance soils (i.e., naturally occurring and "reconstructed" respectively, for forest production). The purpose of this classification system was to aid in the evaluation of land capabilities and planning of soil-handling procedures. The rating system has five classes which are approximately equivalent to the Canada Land Inventory Forestry Capability Classes 3 to 7, respectively (CLI 1974). Defined capability classes and their characteristics are outlined in Table 4.

Table 4 Land Capability Classification for Forest Ecosystems in the Oil Sands Region, Revised (Leskiw 1998b)

Capability Class	Index Points	Forest Capability - Productivity and Limitations
1	81 - 100	**High Capability** - Land having no significant limitations to sustained forest production, or only minor limitations that will be overcome with normal management practices.
2	61 - 80	**Moderate Capability** - Land having limitations which, taken together, are moderately limiting for sustained forest production. The limitations will reduce productivity or benefits, or increase inputs to the extent that the overall cost-benefit will remain attractive but appreciably inferior to that expected on Class 1 land.
3	41 - 60	**Low Capability** - Land having limitations which, taken together, are severe for sustained forest production. The limitations will reduce productivity or benefits, or increase inputs to the extent that the overall advantage to be gained from the use will be low.
4	21 - 40	**Conditionally Productive** - Land having severe limitations; some of which may be surmountable through management, but which cannot be corrected with existing knowledge.
5	0 - 20	**Non-Productive** - Land having limitations which appear so severe as to preclude any possibility of successful forest production.

This classification system was developed for and applies directly to oil sands region forest ecosystems, it does not apply directly to other ecosystem types such as grasslands or wetlands. For example, lands rated in capability Class 4 (Conditionally Productive) and Class 5 (Non-Productive) for forest production may, in fact, be highly productive wetlands areas. It may be noted that all the fen and bog soils in the Project Millennium LSA are rated as Class 5 for forest ecosystems.

Forest capability ratings for the pre-disturbance soils of the LSA are listed in Table 5. Total areas of soil in each capability class are summarized in Table 6. The spatial distribution of these classes is shown in Figure 3: Project Millennium LSA 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.

5.1.1 Reclamation Approach

Soil capability is a significant controlling factor for many associated terrestrial ecosystem characteristics, such as, vegetation and wildlife. The principal objective of reclamation is to provide the closure landscape with soils of "equivalent capability", or better, with respect to their naturally occurring pre-development counterparts. Realization of this goal markedly enhances the potential for successfully re-establishing the desired vegetation communities and wildlife habitats.

5.1.1.1 Soil Reconstruction Techniques and Potential Reclamation Scenarios

Ultimately, the overall success of a reclamation plan relies for the greater part upon the quality of the reconstructed soils and the substrate-landform complexes which they overlie. Typically, soils are reconstructed via a "one-lift" or "two-lift" replacement technique (Figures 4 and 5). In the "one-lift" approach peat deposits are over-stripped to incorporate 25 - 50%, by volume, of the underlying mineral material - usually 1 m of peat plus 0.4 m of mineral. This peat-mineral amendment (or cover soil mix) is placed on the prepared substrate and spread to a depth of 15 to 50 cm. "Two-lift" operations involve placing a 50 cm thick cap, either sandy or clayey subsoil, over the substrate followed by placement of 15 to 25 cm of cover soil mix on the surface. A range of variations to these basic themes exists and is dependent upon the composition of the mineral component of the amendment - coarse textured sands enhance drainage but add little in the way of nutrient holding capacity to the mix; fine textured clays impede drainage but have a very high nutrient storage potential; medium textured loams offer the best combination of drainage and nutrient retention.

Table 5 Land Capability for Forest Ecosystem Ratings and Their Extent for Soil Series in the Project Millennium LSA

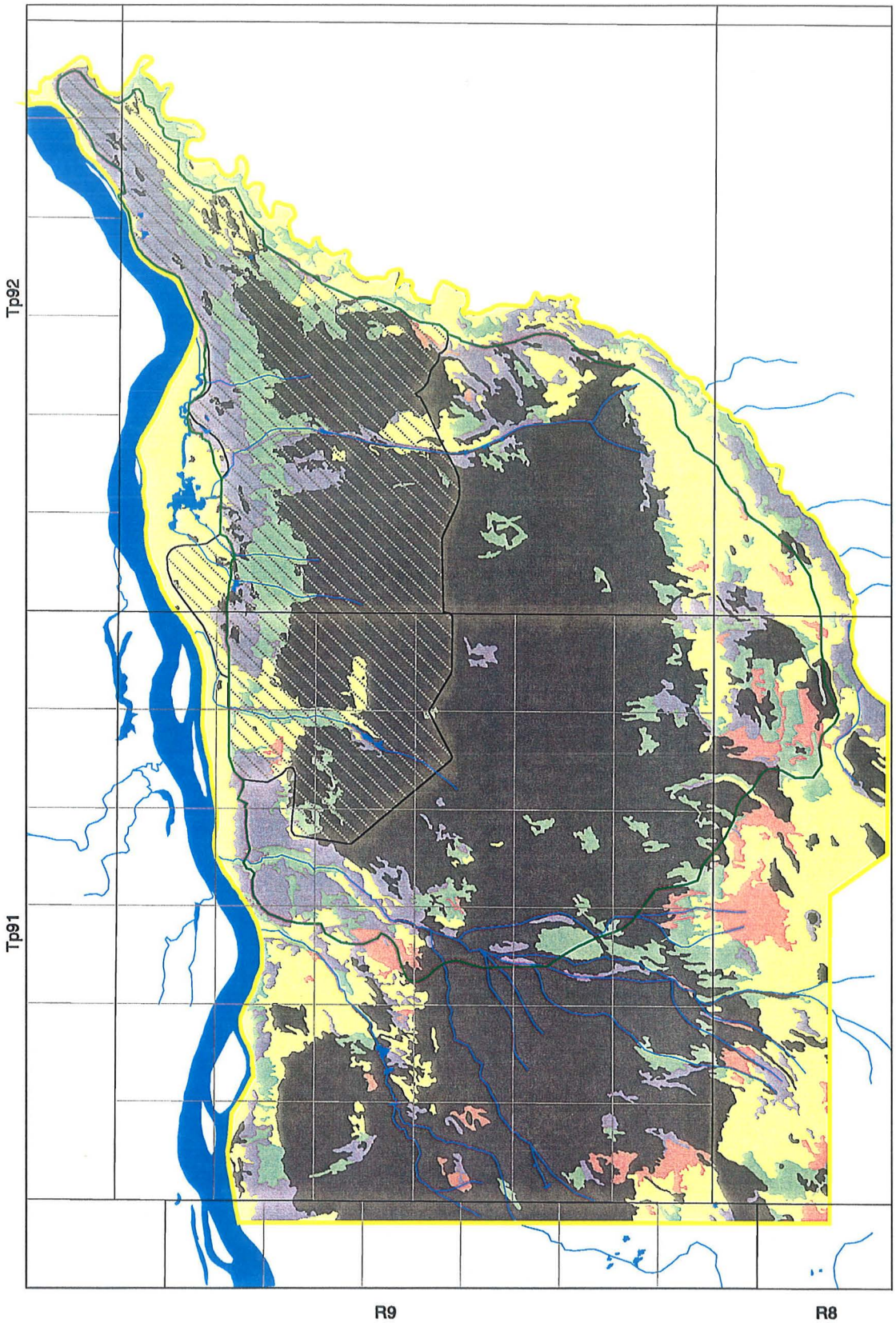
Soil Series[a]	Approved Steepbank		Project Millennium		Buffer Areas		Total LSA		Capability Class
	ha	%LSA	ha	%LSA	ha	%LSA	ha	%LSA	(X)Y[b]
Bitumount	15	<1	47	<1	3	<1	65	<1	4(2)
Kinosis	341	2	816	5	1930	12	3,086	19	2(1)
McMurray	156	1	10	<1	617	4	784	5	2
Mildred	97	1	36	<1	54	<1	188	1	3(1)
McLelland	917	6	1,882	12	1,768	11	4,567	28	5
Muskeg	1,096	7	1,795	11	1,099	7	3,988	25	5
Steepbank	127	1	813	5	522	3	1,462	9	4(3)
Rough Broken 2	563	3	210	1	385	2	1,158	7	4
Rough Broken 3	443	3	66	<1	232	1	740	5	3
Disturbed Lands	14	<1	1	<1	7	<1	22	<1	5[c]
Water	8	<1	7	<1	105	1	120	1	5[d]
Total	**3,776**	**23**	**5,683**	**35**	**6,722**	**42**	**16,181**	**100**	**n/a***

NOTES: [a] All soil series variants were grouped together, e.g. Bitumount includes both Bitumount and the peaty Bitumount variant.
[b] X(Y) = dominant class (significant component of subdominant class).
[c] All disturbed lands were assumed to be non-productive for forestry.
[d] All water was assumed to be non-productive for forestry.

Table 6 Summary of Pre-Development Areas in Each Land Capability for Forest Ecosystems Class

Capability Class	Approved Steepbank		Project Millennium		Buffer Areas		Total LSA	
	ha	%LSA	ha	%LSA	ha	%LSA	ha	%LSA
Class 1	17	<1	114	1	334	2	465	3
Class 2	496	3	728	4	2,212	14	3,437	21
Class 3	580	4	543	3	552	3	1,675	10
Class 4	650	4	613	4	644	4	1,907	12
Class 5[a]	2,033	13	3,685	23	2,978	18	8,698	54
Total	**3,776**	**23**	**5,683**	**35**	**6,721**	**42**	**16,181**	**100**

[a] All disturbed lands and water were assumed to be non-productive for forestry.


LEGEND
Terrestrial Local Study Area
East Bank Mining Area
Steepbank Mine
Open Water
Capability Classes
High (1)
Moderate (2)
Low (3)
Conditionally Non-Productive (4)
Non-Productive (5)
Tp92
Tp91
R9
R8
Fort McMurray
Edmonton
Calgary
West of Fourth Meridian
N
1000 0 1000 2000 3000
Metres
Scale 1:100,000
SOURCES: Suncor
Golder
CAN-AG
Klohn-Crippen
The Forestry Corp
Map Projection: UTM 12
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LOCAL STUDY AREA
LAND CAPABILITY
FOR FOREST ECOSYSTEMS
(PRE-DEVELOPMENT)
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Figure 3
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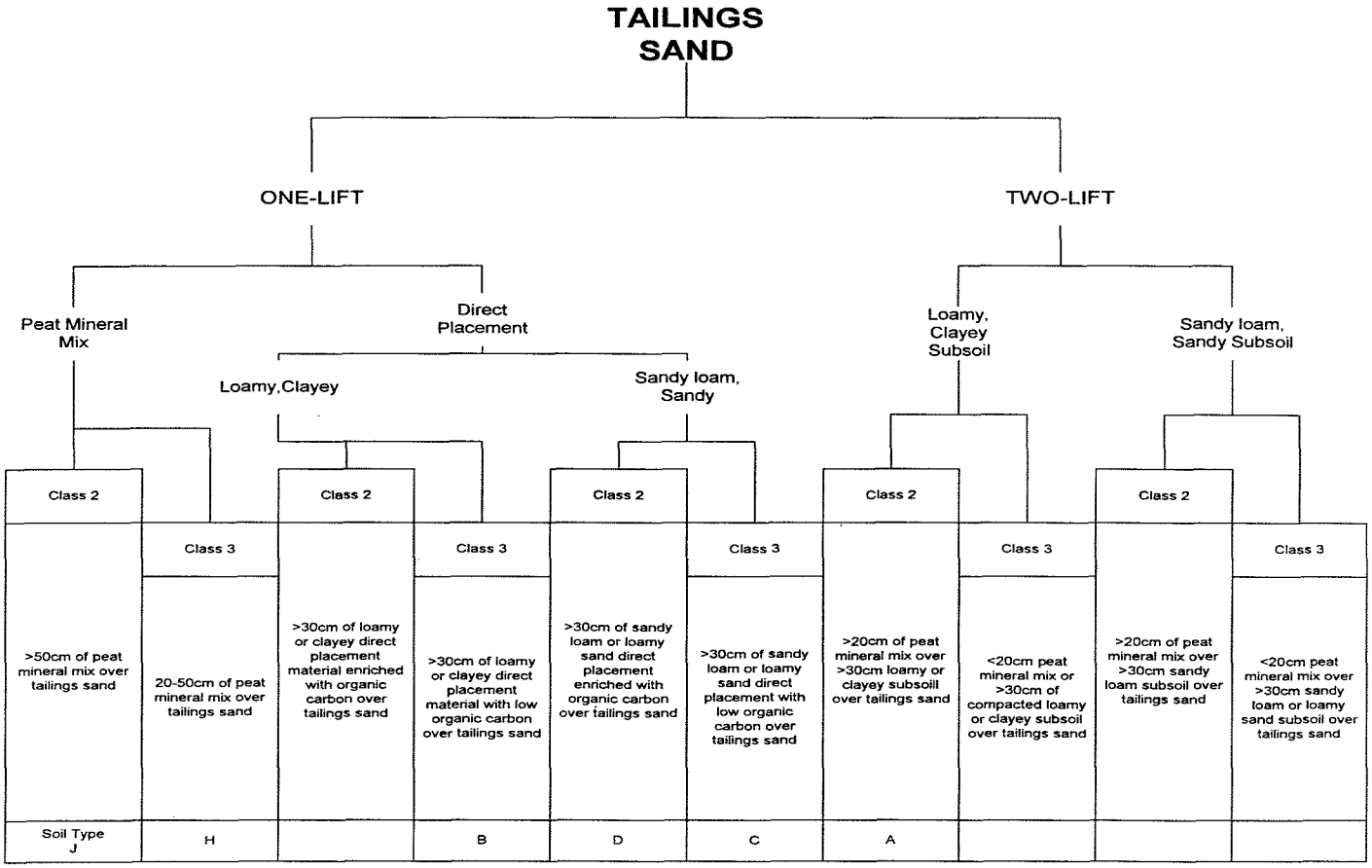
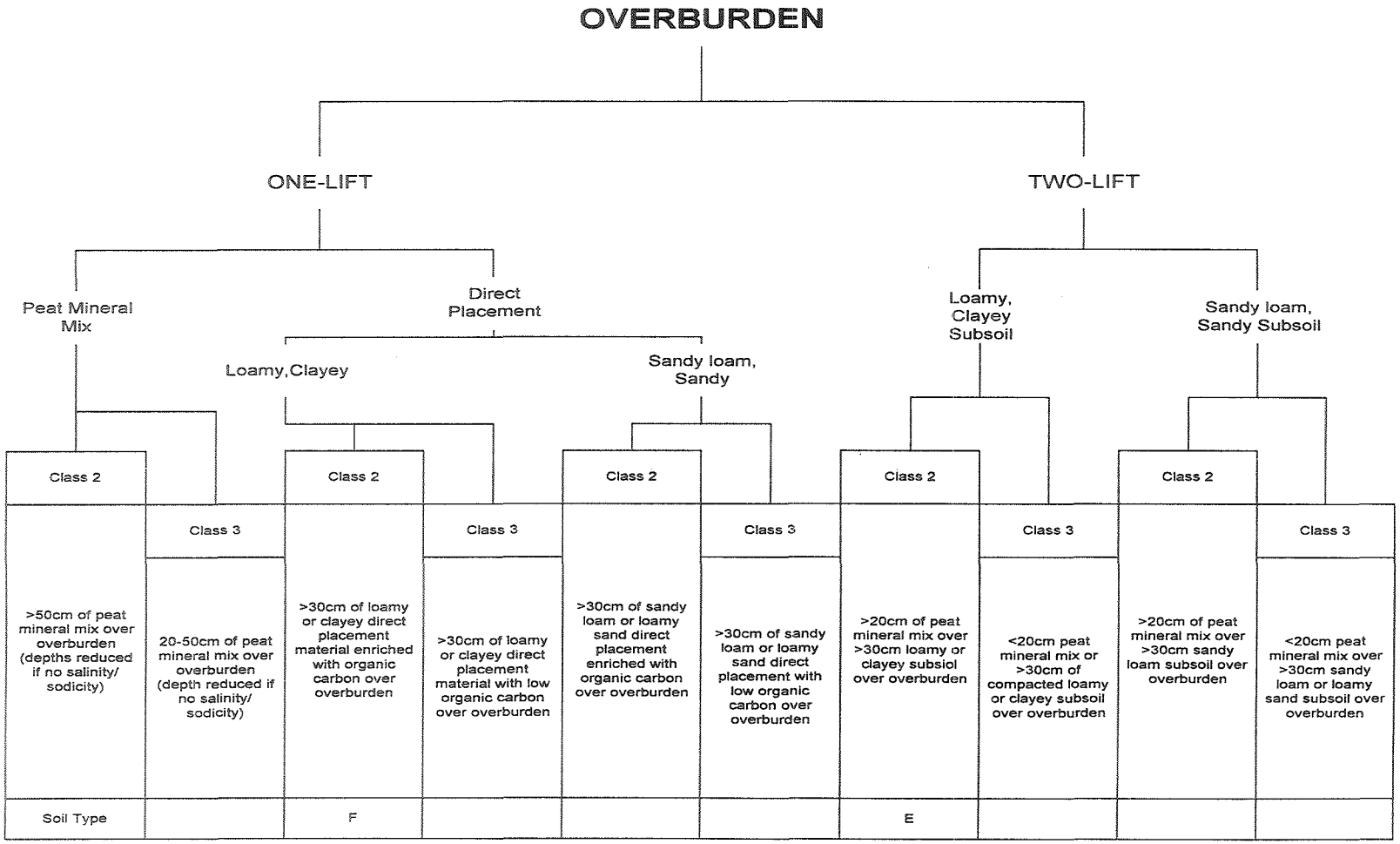
Figure 4 Soil Reconstruction on Tailings Sand



From: Oil Sands Vegetation Reclamation Committee 1998

Figure 5 Soil Reconstruction on Overburden



From: Oil Sands Vegetation Reclamation Committee 1998

properties. The qualities of the mineral fraction available at a particular location allow a certain amount of leeway in "designing" the reconstructed soil to best suit end land use requirements.

The second aspect, substrate-landform complexes, plays an equally critical role in determining the likelihood of achieving a successful outcome of the reclamation plan. A reconfigured landscape may be engineered to accomodate a variety of substrates, overburden or tailings sands for example, with varying physical properties which in turn will affect the required cover soil composition to produce a desired capability rating. Potential configurations are shown in Figures 4 and 5 and discussed at length in the draft report of The Oil Sands Vegetation Reclamation Committee (1998). It is also possible to engineer a prescribed mixture of slopes and aspects into the reclaimed landscape which, in turn, may provide a greater range of conditions within a given capability 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 for reclamation. 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, lacustrine and morainal 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.

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). However, with the types of equipment used in the oil sands environment, 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. The criteria for evaluating surface and subsurface materials are set out in Tables 7 and 8, respectively.

Table 7 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

Source: 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 improtant.

(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 8 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

Source: 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 Project Millennium 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 9 presents an inventory of the total amount of organic material estimated to be present in the Project Millennium LSA while Table 10 indicates the volumes present only under the mine pit areas within the development footprint, i.e. excludes all designated overburden and muskeg storage locations plus the tailings pond.

Table 9 Approximate Volumes of Salvageable Organic Materials in the Project Millennium LSA

Soil Series	Area (ha)	Average Depth (m)	Volume [(a)] m^3
McLelland	1,531	1.51	23,115,000
shMcLelland	3,037	0.80	24,300,000
Muskeg	316	1.55	4,904,000
shMuskeg	3,672	0.65	23,863,000
Total	**8,556**	**1.13**	**76,181,800**

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

Table 10 Approximate Volumes of Salvageable Organic Materials in the Development Footprint of Project Millennium

Soil Series	Area (ha)	Average Depth (m)	Volume [(a)] m^3
McLelland	625	1.51	9,437,500
shMcLelland	1,620	0.80	12,960,000
Muskeg	270	1.55	1,755,000
shMuskeg	1,925	0.65	12,512,500
Total	**4,440**	**1.13**	**36,665,000**

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

5.2.4.2 Mineral Soils

None of the mineral soils in the LSA are recommended for direct placement as reclamation material due primarily to textural limitations. It is suggested that the present practice of over-stripping the organic deposits to incorporate some of the underlying mineral subsoils is the most practical approach.

The suitabilities listed in Table 11 were produced by reviewing analytical data from project Millennium field inspection sites. These data are for mineral soils only and generally included A, B and C horizons to a depth of 1 m. The site-specific values were compared to the Criteria for Evaluating the Suitability of Surface Material (Upper Lift) for Revegetation in the Northern Forest (Alberta Soil Advisory Committee 1987) and suitability ratings duly assigned to each soil series in the LSA. As data were only available for the upper 1 m of the profiles, no evaluation was made for the subsurface soils (Lower Lift) below this depth except for the mineral materials underlying the 2 organic series, McLelland and Muskeg. The latter exception was required as this is the material likely to be included in the peat salvage over-stripping operation and, therefore, form a component of the reclamation soil mixture.

Table 11 Suitability of Mineral Soils in the Project Millennium LSA for Reclamation Placement as the Upper Lift

Series	pH	Ece (C only) [a]	SAR	SAT% (C only)	Texture	Consistence
BMT	ND [b]	ND/G	ND/G	ND/G	ND/G-P	ND/G-F
KNS	G (Low)	G	G	G	G-F	F
MIL	G	G	G	G	G-(	G-F
MMY	ND/F (high)	G	ND/G	ND/G	ND/G	ND/G
MLD (C only)	F-G	G	G	G	G-F	F
MUS (C only)	F-G	G	G	G	G	F
STP	G (low)	G	G	G	G-F	F
RB (C only)	ND/G	ND/G	ND/G	ND/G	ND/G-F	ND/F

(a) C only = analytical data available only for C horizons.
(b) ND = no data from Millennium field inspection sites, information from Leskiw et al 1996. Leskiw (1998) pers. comm March 18, 1998 - no EC, SAR, SAT% problems on any soil to 1.2 m depth.

Based on the measured (i.e., analytical) and observed (in the field) soil properties in the project Millennium LSA and data from Leskiw et al 1996, the observations in Table 12 with respect to the efficacy of mineral soil use for reclamation may be made.

Table 12 Overall Suitability Ratings and Recommended Placement of Upper Lift Mineral Materials for Reclamation Purposes

Series	Suitability [a]	Limitations	Placement
BMT	Fair	texture	upper subsoil
KNS	Good	none	upper subsoil
MIL	Fair	texture	topsoil [b]
MMY	Fair - Good	texture	upper subsoil
MLD [c]	Fair	pH, texture	topsoil [b]
MUS [c]	Good	pH, texture	topsoil [b]
STP	Good	texture	upper subsoil
RB	Fair	texture	upper subsoil

(a) composite rating based on interpretations of Millennium data and similar material from Leskiw et al 1996.
(b) only if mixed 50:50 or 40:60 with organic material/peat.
(c) pertains only to the underlying mineral horizons if mixed 50:50 or 40:60 with organic material/peat.

The medium to coarse textured mineral soils of the Kinosis and Steepbank series have very shallow A and B horizons, on average 15 cm and 20 cm respectively. The upper 0.5 m of the profile for both series is suitable for placement as upper subsoil, i.e., as a cap beneath the reclamation topsoil mix. Table 13 presents data on the approximate amounts of these materials available within the project development footprint (as per Table 10, these data exclude the areas under the overburden and muskeg storage areas and the tailings pond).

Table 13 Approximate Volumes of Mineral Soils Suitable for Salvage in the Development Footprint of Project Millennium

Soil Series	Area (ha)	Average Depth (m)	Volume [(a)] m^3
Kinosis	759	0.5	3,795,000
Steepbank	357	0.5	1,785,000
TOTAL	1,116	n/a	5,580,000

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

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 is set out in detail in Table 12; however, a brief explanation of one facet must be included at this point. The wetlands classification map (Golder 1998m) was used for reference when mapping LSA soils; however, due to systemic differences between the soil and wetlands classification systems there are discrepancies between some of the bogs and fens. As a result, there is not a direct 100% correlation between the organic soil and terrain units and their wetlands counterparts, either with respect to location or areas. The extent and distribution of the terrain units is shown in Figure 6.

Table 14 Correlation of Soil Units to Terrain Units

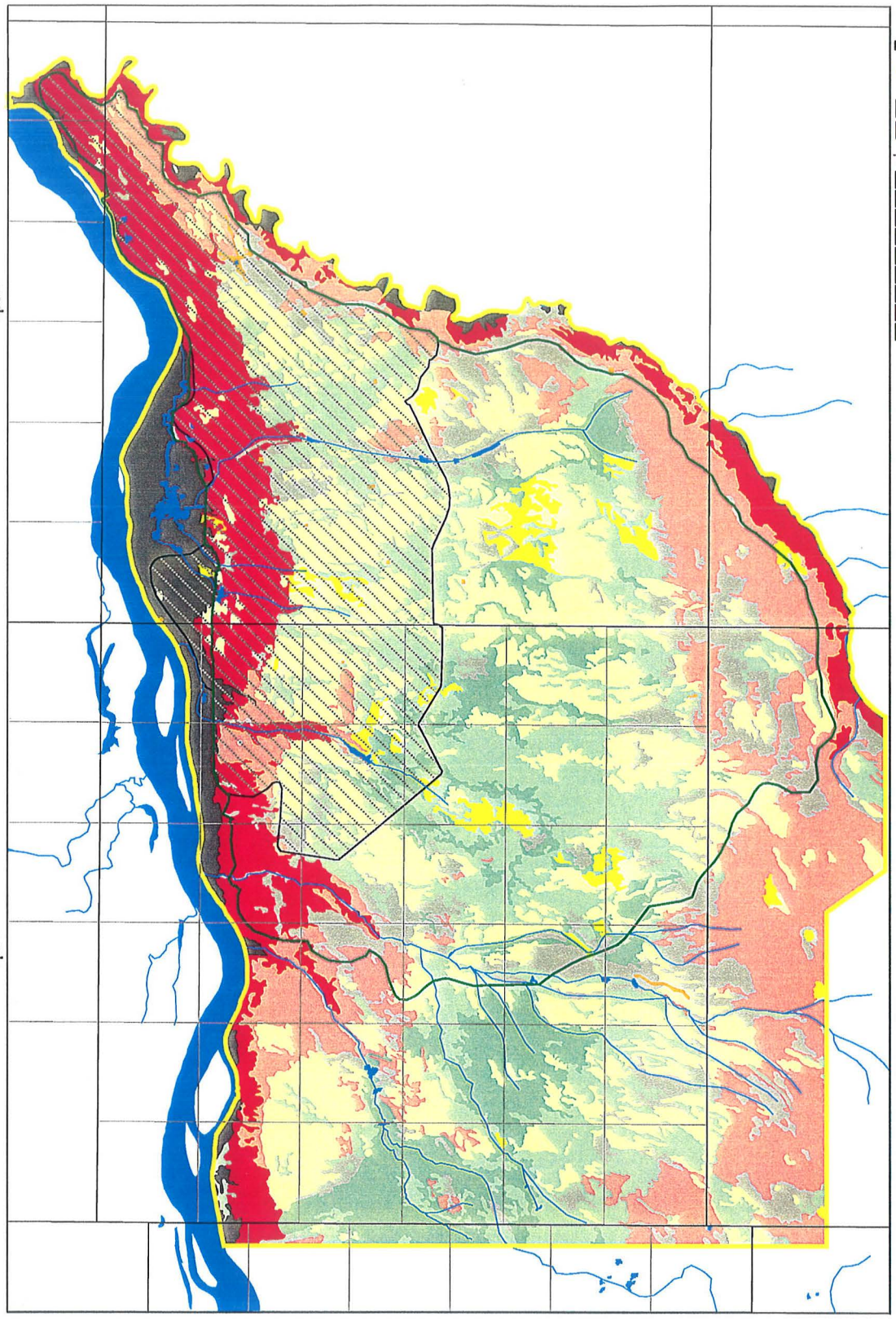
Soil Unit - Name/Map Units		Terrain Unit - Name/Map Units	
Bitumount	BMT	Glaciofluvial	Fg
peaty Bitumount	ptBMT	Glaciofluvial	Fg1
Kinosis	KNS	Morainal/Till	Mor/T
gleyed Kinosis	glKNS	Morainal/Till	Mor/T
Mildred	MIL	Glaciofluvial	Fg1
gleyed Mildred	glMIL	Glaciofluvial	Fg1
McLelland	MLD	Fen	N
terric McLelland	shMLD	Shallow Fen	Ns
McMurray	MMY	Fluvial	F
gleyed McMurray	glMMY	Fluvial	F
Muskeg	MUS	Bog	B
terric Muskeg	shMUS	Shallow Bog	Bs
Steepbank	STP	Glaciofluvial	Fg2
peaty Steepbank	ptSTP	Glaciofluvial	Fg2
Rough Broken 2,3	RB2, RB3	Rough Broken	RB

(a) Fg1 = mainly Sands, Loamy Sands with some Sandy Loams.
Fg2 = mainly Loams or finer, some Sandy Loams.

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



West of Fourth Meridian

N

1000 0 1000 2000 3000

Metres
Scale 1:100,000

SOURCES: Suncor
Golder
CAN-AG
The Forestry Corp

Map Projection: UTM 12
Datum: NAD 83

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LOCAL STUDY AREA TERRAIN CLASSIFICATION

27 Apr. 1998	Figure 6	PRODUCED BY: JS REVIEWED BY:

/data14/suncor/local/9700/97402/arcview/terrain.apr

(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. Permafrost was encountered at some of the inspection sites during field work.

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 organic material, made up primarily of 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. Halsey et al. (1995) identified the presence of paleopermafrost features within some fen areas in the southeastern portion of the LSA but none were encountered 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 floodplains of the Athabasca and Steepbank Rivers.

6.2.4 Glaciofluvial (Fg Units)

The composition varies from fine to coarse, clay loams through sandy loams to sands and, as a result, drainage conditions are also quite varied. These units are not extensive in any particular location in the LSA.

6.2.5 Morainal/Till (Mor/T Units)

Kinosis till is found primarily along the eastern side of the LSA, it exhibits some evidense of fluvial sorting and varies from fine to medium in texture, i.e. clay loam through sandy loam. Surface expression ranges from undulating ground moraine to hummocky moraine.

6.2.6 Rough Broken (RB 2 & 3 Units)

These units are found mainly around the periphery of the LSA along the escarpments of the Athabasca and Steepbank River valleys. The two units are similar yet distinct, in having non-uniform (undifferentiated) parent materials, slope angles and positions in the landscape. RB2 is found in lower to upper slope locations, whereas RB3 occurs on upper slopes and the proximal areas of the plateau with a shallower gradient. RB3 is rated as class 4, versus class 5 for RB2. Both units are notable for a high degree of internal variability.

6.2.7 Other Features

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

The extent of terrain units in the LSA is detailed in Table 13.

6.2.8 Summary

Organic deposits, split almost equally between bogs and fens, account for approximately 53% of the surficial deposits in the LSA. They are characterized by peat thicknesses ranging from 0.5 to greater than 2 m - the majority of the units are of the shallow variety. 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

Coarse textured fluvial materials of recent origin are found along the floodplains of the Athabasca and Steepbank rivers. These make up less than 5% of the LSA.

Glaciofluvial deposits, which comprise slightly less than 11% of the area, are widely scattered throughout the LSA although they tend to occur with greater frequency near the various watercourses.

Morainal/till units composed of fine to medium textured Kinosis till occupy 19% of the LSA, mainly on the east and south sides.

The final unit is referred to as Rough Broken. It includes mainly colluvial parent materials, is found along the escarpments of the Athabasca and Steepbank rivers and accounts for nearly 12% of the surface material.

Disturbed areas and water comprise the remaining 1% of the LSA.

Table 15 Extent of Terrain Units in the Project Millennium LSA

Terrain Unit	Approved Steepbank		Project Millennium		Buffer Areas		Total LSA	
	ha	%LSA	ha	%LSA	ha	%LSA	ha	%LSA
Bog (B)	64	<1	223	1	30	<1	316	2
Shallow Bog (Bs)	1,030	6	1,571	10	1,069	7	3,672	23
Fen (N)	107	1	583	4	841	5	1,531	9
Shallow Fen (Ns)	810	5	1,299	8	927	6	3,036	19
Fluvial (F)	157	1	10	<1	617	4	784	5
Glaciofluvial	239	2	896	5	579	3	1,715	10
Morainal/Till (Mor/T)	341	2	816	5	1,930	12	3,086	19
Rough Broken 2 &3 (RB2&3)	1,006	6	275	2	617	4	1,898	12
Sub-total	3,754	23	5,675	35	6,610	41	16,040	99
Disturbed Lands	14	<1	1	<1	7	<1	22	<1
Water	8	<1	7	<1	105	1	120	1
Sub-total	22	<1	8	<1	112	1	142	1
Total	**3,776**	**23**	**5,683**	**35**	**6,721**	**42**	**16,181**	**100**

7. REGIONAL STUDY AREA

7.1 INTRODUCTION

To place Project Millennium in a spatial context, a synopsis of the Regional Study Area (RSA) within which it falls is appropriate. The potential impacts that developments will have on the soil and terrain resources of the RSA are outlined in detail in the Project Millennium Environmental Impact Assessment (EIA).

7.2 REGIONAL STUDY AREA BOUNDARIES

The spatial boundaries for the RSA are defined as all or parts of: townships 85-102, ranges 2-16, west of the 4th meridian as shown in Figure 7. The total area so encompassed is approximately 2,428,645 ha in extent.

7.3 SOIL AND TERRAIN UNITS OF THE RSA

Analysis of soil and terrain units at the RSA level was conducted in the following manner:

- partially prepared digital files of the soil maps accompanying Turchenek and Lindsay (1982) were acquired and additional information to encompass the northeastern portion of the RSA was incorporated; and
- once the soil mapping was complete, terrain units were derived by combining all soil types having similar genetic characteristics into common groups (e.g., all soil series with eolian parent materials became eolian terrain units) - a comparable process to that used in the LSA terrain classification. Some variations were required, however, to accommodate the wider range of genetic materials found in the RSA.

Table 16 details the extent of each soil series found in the RSA for the baseline conditions. Figure 7 shows the RSA Soil classification.

Table 17 provides the matrix for correlating RSA soil series and terrain units.

Table 16 Soils of the Project Millennium RSA, Baseline and Impact Conditions

Soil Series/Map Unit	RSA Baseline Area, ha	RSA Baseline, % RSA	Project Millennium LSA Area, ha	Project Millennium LSA, % RSA
Algar	47,879	2	0	0
Bitumount	11,110	<1	65	<0.1
Buckton	32,571	1	0	0
Dover	83,279	3	0	0
Eaglesham (McLelland)[a]	148,060	6	4,567	0.18
Firebag	128,251	5	0	0
Horse River	26,076	1	0	0
Heart	87,154	4	0	0
Joslyn	86,797	4	0	0
Kearl	1,167	<1	0	0
Kinosis	72,705	3	3,086	0.13
Kenzie (Muskeg)[b]	804,394	33	3,988	0.16
Legend	105,507	4	0	0
Livock	47,198	2	0	0
Mildred	205,269	8	188	<0.1
Mikkwa	112,834	5	0	0
McMurray	71,246	3	783	<0.1
Namur	55,302	2	0	0
Rough Broken	66,577	3	1,898	0.08
Ruth Lake	22,417	1	0	0
Rock	19,329	1	0	0
Steepbank	40,871	2	1,462	0.06
Surmont	18,088	1	0	0
Total, Soil Units	**2,299,727**	**95**	***16,039***	***0.66***
AIM[c]	48,955	2	22	<0.1
NWL[d]	72,764	3	120	<0.1
IR[e]	7,199	<1	0	0
Total, Non-Soil Units	***128,918***	***5***	***142***	***<0.1***
Total	**2,428,645**	**100**	**16,181**	**0.67**

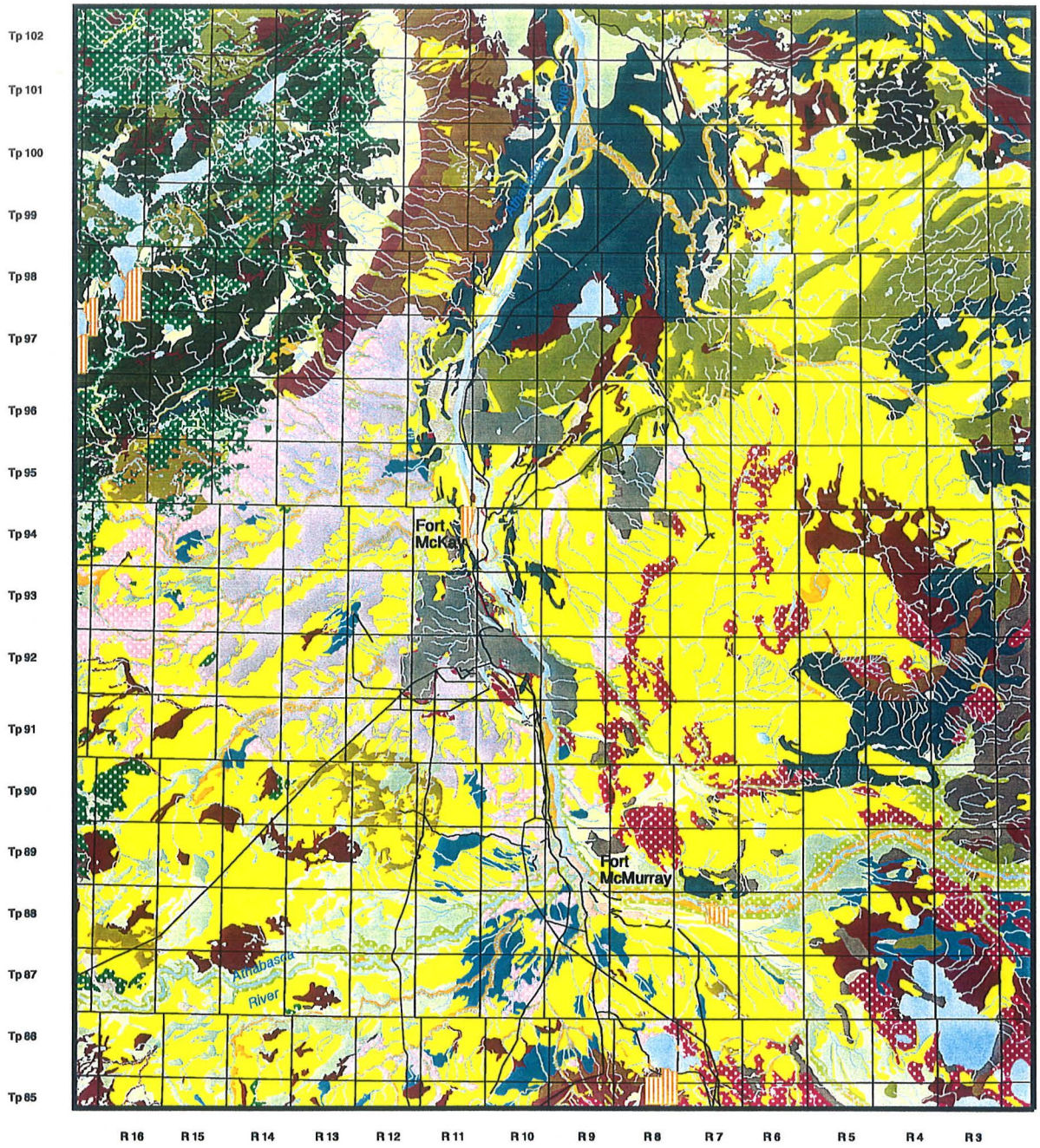
[a] Eaglesham (McLelland) - this soil series was named McLelland in the LSA to conform with the Alberta Soil Names File.

[b] Kenzie (Muskeg) - this soil series was named Muskeg in the LSA to conform with the Alberta Soil Names File.

[c] AIM - disturbed lands.

[d] NWL - open water, rivers, streams and lakes.

[e] IR - Indian Reserves, no soil survey data available for these areas



West of Fourth Meridian

SOURCES: Suncor, Syncrude, Petro-Canada, Golder, Alberta Research Council AOSERP (Report 122)

Scale 1:1,000,000

10 0 10 20 30 40

Kilometres

Map Projection: UTM 12
Datum: NAD 83

LEGEND

- Regional Study Area
- Linear Disturbances
- Open Water
- Existing Open Pit Mines
- Other Disturbances
- Municipalities
- Indian Reserves

SOIL CLASSIFICATION

- Algar
- Buckton
- Bitumont
- Dover
- Eaglesham
- Firebag
- Horse River
- Heart
- Joslyn
- Kearl
- Kinosis
- Kenzie
- Legend
- Livock (Fort)
- Mildred
- Mikkwa
- McMurray
- Namur
- Rock
- Rough Broken
- Ruth Lake
- Surmont
- Steepbank

N

SUNCOR ENERGY

Project Millennium

REGIONAL STUDY AREA SOIL CLASSIFICATION IMPACT ASSESSMENT BASELINE

27 Apr. 1998	Figure 7	PRODUCED BY: K.K.Q. REVIEWED BY:

/data14/suncor/regional/9700/9740/arcview/soil2.apr

Table 17 Correlation of the Project Millennium RSA Soil Series and Terrain Units

Terrain Unit	Soil Series[a]	Area, ha	Area, % of RSA
Bog (B)	Kenzie 1	807,781	33
Shallow Bog (Bs)	Kenzie 2; Mikkwa 1 and 2	112,576	5
Eolian (E)	Heart 4, 5 and 6	87,154	4
Fen (N)	Eaglesham 1	148,060	6
Fluvial (F)	Chipewyan 1; Mamawi 1 and 2; McMurray 1 and 2; Namur 1 and 2	126,087	5
Glacio-fluvial (Fg)	Bitumount 1; Firebag 1, 2 and 3; Mildred 1 and 2; Ruth Lake 1	355,287	15
Glacio-fluvial & Glacio-lacustrine, medium, over Morainal/Till (LFg)	Livock 1	59,752	2
Glacio-lacustrine over Morainal/Till (Lg1/M)	Algar 1, Dover 1, Joslyn 1, Steepbank 1	257,585	11
Glacio-lacustrine (Lg2)	Kearl 1	1,167	<1
Morainal/Till, fine (M1)	Buckton 1, Horse River 1, Legend 1, Surmont 1	184,588	8
Morainal/Till, coarse (M2)	Kinosis 1	73,757	3
Rough Broken (RB)	Rough Broken	66,603	3
Rock	Rock	19,329	1
Sub-Total, Terrain Units		***2,299,727***	***96***
Disturbed Lands	Disturbed Lands	48,955	2
Water	Water	72,764	3
IR[b]	Indian Reserves	7199	<1
Sub-Total, Non-Terrain		***128,918***	***5***
TOTAL		**2,428,645**	**100**

(a) Soil Series - names are as used in Turchenek and Lindsay (1982).
(b) Indian Reserves, no terrain classification done for these areas.

Table 18 provides a comparison of the terrain units and their extent in the Project Millennium RSA and LSA.

Table 18 Terrain Units of the Project Millennium RSA, Baseline Conditions

Terrain Unit	RSA Baseline Area, ha	RSA Baseline, % RSA	Project Millennium Area, ha	Project Millennium, % RSA
Bog (B)	807,781	33	316	<0.1
Shallow Bog (Bs)	112,576	5	3,671	<0.15
Eolian (E)	87,154	4	0	0
Fen (N)	148,606	6	4,567	0.2
Fluvial (F)	126,087	5	784	<0.1
Glacio-fluvial (Fg)	355,287	15	1,715	0.1
Glacio-fluvial & Glacio-lacustrine, medium, over Morainal/Till (LFg)	59,752	2	0	0
Glacio-lacustrine over Morainal/Till (Lg1/M)	257,585	11	0	0
Glacio-lacustrine (Lg2)	1,167	<1	0	0
Morainal/Till, fine (M1)	184,588	8	3,086	0.1
Morainal/Till, coarse (M2)	73,757	3	0	0
Rough Broken (RB)	66,603	3	1,898	0.1
Rock	19,329	1	0	0
Sub-Total, Terrain Units	***2,299,727***	***96***	***16,039***	***0.66***
Disturbed Lands	48,955	2	22	<0.1
Water	72,764	3	120	<0.1
IR[(a)]	7,199	<1	0	0
Sub-Total, Non-terrain	***128,918***	***5***	***142***	***<0.1***
TOTAL	**2,428,645**	**100**	**16,181**	**0.67**

[(a)] IR - Indian Reserves, no terrain classification done for these areas.

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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
Kinosis	-	KNS
McLelland-Typic	-	MLD
McLelland-Terric	-	shMLD
McMurray	-	MMY
Mildred	-	MIL
Muskeg-Typic	-	MUS
Muskeg-Terric	-	shMUS
Rough Broken 2	-	RB2
Rough Broken 3	-	RB3
Steepbank	-	STP

Soil Phases: (prefix applied as series modifier)

gl - gleyed (prefix)
pt - peaty (prefix)
sh - shallow (prefix)

examples: glMMY = gleyed McMurray
ptSTP = peaty Steepbank
shMLD = shallow McLelland

SOIL SUBGROUP CLASSIFICATION:

Brunisols

GLEB	-	Gleyed Eutric Brunisol
GLEEB	-	Gleyed Eluviated Eutric Brunisol
EEB	-	Eluviated Eutric Brunisol

Cryosols

MEOC	-	Mesic Organic
TMEOC	-	Terric Mesic Organic
TFIOC	-	Terric Fibric Organic

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
TF	-	Terric Fibrisol
TYF	-	Typic Fibrisol
TYH	-	Typic Humisol
TYM	-	Typic Mesisol

Regosols

OR	-	Orthic Regosol

PARENT MATERIALS:

F	-	fluvial
Fg	-	glaciofluvial
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 5m = mesic, medium

Land Capability for Forest Ecosystems

1	high
2	moderate
3	low
4	conditionally productive
5	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
Mor/T	morainal/glacial till
N	fen
Ns	shallow fen
RB	rough broken

APPENDIX III

INSPECTION SITE LIST

Plot	Series	Subgroup	PM	Slope Class	Landform	Slope Position	Drainage	Forest Capability Class	Edatope
1003	ptSTP	ptRG	M	1	5	Level	P	3	7a-M
1004	MIL	OEB	F/M	1	5	Level	W	3	5-M
1005	STP	OG	M	1	5	Level	P	4	7a-M
1006	STP	RG	M	1	5	Level	P	4	7b-M
1007	ptSTP	ptRG	M	1	5	Level	P	4	7b-P
1008	ptSTP	ptRG	M	1	5	Level	P	3	7b-P
1009	STP	RG	M	1	5	Level	P	3	7b-P
1010	shMUS	TM	O/M	1	5	Level	VP	3	8-P
1011	shMUS	TM	O/M	1	5	Level	P	4	8-P
1012	STP	RG	F	1	5	Level	P	2	7b-P
1013	MIL	EEB	F	1	5	Level	MW	2	5-M
1014	KNS	OGL	F	1	5	Level	W	2	5-M
1015	MIL	EEB	F	1	5	Level	W	3	4-M
1016	MIL	EEB	F	1	5	Level	W	3	4-M
1017	ptSTP	ptRG	L/F	2	5	Level	P	4	7a-M
1018	KNS	OGL	F/M	1	5	Level	MW	1	5-M
1019	glKNS	GLGL	M	1	5	Level	I	1	6-M
1020	KNS	OGL	M	2	5	Level	MW	1	5-M
1021	ptSTP	ptOG	M	1	5	Level	P	1	7b-M
1022	KNS	OGL	M	2	5	Level	MW	1	5-M
1023	ptSTP	ptOG	M	1	5	Level	P	1	7b-M
1024	STP	OG	M	3	5	L	P	1	7a-M
1025	KNS	OGL	M	2	5	Level	I	2	5-M
1026	STP	OLG	M	1	15	D	VP	4	7b-P
1027	ptSTP	ptRG	M	1	15	D	VP	5	7b-P
1028	ptSTP	ptOG	F	1	5	Level	VP	5	7b-P
1029	ptSTP	ptOR	M	1	5	Level	P	2	7b-M
1030	shMUS	TM	O/M	1	5	Level	P	2	8-P
1031	ptSTP	ptOLG	F	1	5	Level	VP	5	7b-M
1032	ptSTP	TM	O/F	1	5	Level	P	5	8-P
1033	shMUS	TM	O/M	1	13	D	VP	2	8-P
1034	shMUS	TM	O/M	1	5	D	P	5	8-P
1035	shMUS	TM	O/M	1	13	Level	VP	5	8-P
1036	shMUS	TM	O/M	1	5	Level	P	5	8-P
1037	STP	OLG	M	1	5	Level	P	5	7a-M
1038	glKNS	GLGL	M	2	5	Level	I	2	6-M
1039	STP	OLG	M	1	5	Level	VP	2	7b-M
1040	STP	OLG	M	2	5	Level	P	4	7b-M
1041	ptSTP	ptOLG	M	1	5	Level	P	4	7b-P
1042	STP	OLG	M	2	5	Level	P	5	7b-P
1043	shMUS	TM	O/M	1	13	Level	P	2	8-P
1044	STP	OLG	F/M	1	5	Level	P	5	7b-M
1045	shMUS	TM	O/M	1	5	Level	P	5	8-M
1046	ptSTP	ptOLG	F/M	1	5	Level	P	2	7a-P
1047	shMUS	TM	O/M	1	13	Level	P	5	8-P
1048	shMUS	TM	O/M	1	5	Level	VP	5	8-P
1049	shMUS	TM	O/M	1	5	Level	VP	5	8-P
1050	shMUS	TM	O	1	5	Level	VP	5	8-P
1051	MLD	TYF	O	1	13	Level	VP	5	8-M

1052	MUS	TYM	O/M	1	5	Level	VP	5 8-P
1053	MUS	TYF	O	1	5	Level	VP	5 8-P
1054	MUS	TYF	O/M	1	6	Level	P	5 8-P
1055	KNS	OGL	M	2	5		MW	2 5-M
1056	shMUS	TM	O/M	1	13	Level	P	5 8-P
1057	shMUS	TM	O/M	1	13	Level	VP	5 8-P
1058	STP	OLG	M	1	5	Level	P	4 7b-P
1059	shMLD	TM	O/M	1	12		VP	5 8-M
1060	STP	OLG	M	1	5	Level	P	5 7b-P
1061	KNS	OGL	M	1	5	Level	MW	5 5-M
1062	MUS	TYF	O/M	1	13	Level	P	5 8-P
1063	shMUS	TF	O/M	1	13	Level	P	5 8-P
1064	MUS	TYM	O/M	1	13		VP	5 8-P
1065	shMUS	TF	O/M	1	5	Level	P	5 8-P
1066	MUS	TYM	O/M	1	13	Level	VP	5 8-P
1067	shMUS	TM	O	1	5	Level	P	5 8-P
1068	shMUS	TM	O/M	1	13	Level	P	5 8-P
1069	shMUS	TM	O/M	1	5	Level	P	5 8-P
1070	MUS	TYF	O/M	1	13	Level	P	5 8-P
1071	shMUS	TM	O/M	1	5	Level	VP	5 8-P
1072	shMUS	TF	O/M	1	13	Level	VP	5 8-P
1073	shMLD	TF	O/M	1	5	Level	VP	1 8-M
1074	shMUS	TF	O/M	1	13	Level	VP	5 8-P
1075	shMUS	TM	O/M	1	5	Level	VP	1 8-P
1076	MLD	TYF	O/M	1	13	Level	VP	5 8-M
1077	shMUS	TM	O/M	1	5	Level	VP	5 8-P
1078	MLD	TYM	O/M	1	13	Level	VP	5 8-M
1079	shMUS	TF	O/M	1	13	Level	VP	5 8-P
1080	MLD	TYF	O/M	1	13	Level	VP	5 8-M
1081	shMUS	TM	O/M	1	5	Level	VP	5 8-P
1082	MLD	TYF	O/M	1	13	Level	VP	5 8-M
1083	shMLD	TF	O/M	1	13	Level	VP	5 8-M
1084	shMLD	TM	O/M	1	5	Level	VP	5 8-M
1085	shMLD	TF	O/M	1	13	Level	VP	5 8-M
1086	shMLD	TH	O/M	1	5	Level	VP	5 8-M
1087	shMUS	TF	O/M	1	13	Level	VP	5 8-P
1088	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1089	MLD	TYF	O/M	1	13	Level	VP	5 8-M
1090	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1091	MLD	TYF	O	1	13	Level	VP	5 8-M
1092	MLD	TYM	O	1	13	Level	VP	5 8-M
1093	MLD	TYF	O	1	13	Level	VP	5 8-M
1094	MLD	TYM	O	1	13	Level	VP	5 8-M
1095	MLD	TYM	O	1	12	Level	VP	5 8-M
1096	MLD	TYM	O	1	12	Level	VP	5 8-M
1097	MLD	TYM	O	1	12	Level	VP	5 8-M
1098	KNS	OGL	M	1	5	C	W	2 5-M
1099	KNS	OGL	M	3	3	M	MW	3 5-M
1100	MLD	TYM	O	1	12	Level	VP	5 8-M
1101	MLD	TYM	O/M	1	13	Level	VP	5 8-M
1102	MLD	TYM	O	1	12	Level	VP	5 8-M
1103	MLD	TYF	O	1	13	Level	VP	5 8-M

1105	MLD	TYM	O	1	12	Level	VP	5 8-M
1105	MLD	TYF	O	1	12	Level	VP	5 8-M
1106	MLD	TYM	O	1	12	Level	VP	5 8-M
1107	MLD	TYF	O	1	12	Level	VP	5 8-M
1108	MLD	TYM	O	1	12	Level	VP	5 8-M
1109	MLD	TYF	O	1	12	Level	VP	5 8-M
1110	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1111	MLD	TYF	O	1	12	Level	VP	5 8-M
1112	MLD	TYM	O	1	12	Level	VP	5 8-M
1113	MLD	TYF	O/M	1	12	Level	VP	5 8-M
1114	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1115	MLD	TYF	O	1	12	Level	VP	5 8-M
1116	MLD	TYM	O	1	12	Level	VP	5 8-M
1117	MLD	TYM	O	1	12	Level	VP	5 8-M
1118	MLD	TYM	O	1	12	Level	VP	5 8-M
1119	MLD	TYF	O	1	12	Level	VP	5 8-M
1120	MLD	TYM	O	1	12	Level	VP	5 8-M
1121	MLD	TYF	O	1	12	Level	VP	5 8-M
1122	MLD	TYM	O	1	13	Level	VP	5 8-M
1123	MLD	TYF	O	1	12	Level	VP	5 8-M
1124	MLD	TYM	O	1	12	Level	VP	5 8-M
1125	MLD	TYF	O	1	12	Level	VP	5 8-M
1126	MLD	TYM	O	1	12	Level	VP	5 8-M
1127	MLD	TYF	O	1	12	Level	VP	5 8-M
1128	MLD	TYM	O	1	12	Level	VP	5 8-M
1129	MLD	TYM	O	1	12	Level	VP	5 8-M
1130	MLD	TYM	O	1	12		VP	5 8-M
1131	MLD	TYM	O	1	12	Level	VP	5 8-M
1132	MLD	TYF	O	1	12	Level	VP	5 8-M
1133	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1134	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1135	MLD	TYF	O	1	12	Level	VP	5 8-M
1136	shMUS	TM	O/M	1	5	Level	VP	5 8-P
1137	shMLD	TM	O/M	1	13	Level	VP	5 8-M
1138	shMLD	TM	O/M	1	13	Level	VP	5 8-M
1139	shMUS	TM	O/M	1	13	Level	VP	5 8-P
1140	shMUS	TM	O/M	1	13	Level	VP	5 8-P
1141	shMUS	TF	O/M	1	5	Level	VP	5 8-P
1142	shMUS	TM	O/M	1	13	Level	VP	5 8-P
1143	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1144	shMUS	TM	O/M	1	5	Level	VP	5 8-P
1145	ptSTP	ptOLG	M	1	12	Level	P	5 7b-M
1146	KNS	OGL	F/M	1	5	Level	W	5 5-M
1147	shMUS	TF	O/M	1	13	Level	VP	5 8-P
1148	STP	OLG	M	1	5	Level	P	5 7b-M
1149	ptSTP	ptOG	O/M	2	5	Level	P	5 7b-M
1150	shMLD	TM	O/M	2	5	Level	VP	5 8-M
1151	shMUS	TM	O/M	2	13	Level	VP	5 8-P
1152	shMUS	TM	O/F	2	5	Level	P	5 8-P
1153	shMUS	TM	O/F	2	5	Level	P	5 8-P
1154	shMUS	TM	O/F	1	13	Level	VP	5 8-P
1155	STP	OLG	M	1	14	Level	VP	4 7b-M

1156	shMLD	TH	O/M	1	14	Level	VP	4	8-M
1157	BMT	OLG	O/F	1	5	Level	W	4	7b-P
1158	shMLD	TM	O/M	2	5	Level	VP	5	8-M
1159	KNS	OGL	F/M	1	5	Level	W	5	5-M
1160	shMUS	TM	O/M	2	5	Level	VP	5	8-P
1161	STP	OLG	M	3		Level	P	5	7a-M
1162	shMLD	TM	O/M	1	13	Level	VP	5	8-M
1163	KNS	OGL	F/M	1	5	Level	W	5	5-M
1164	ptSTP	ptOLG	O/F/M	1	5	Level	P	5	7b-P
1165	KNS	OGL	M	1	5	Level	MW	5	5-M
1166	ptSTP	ptOLG	O/F/M	2	13	Level	VP	4	7b-M
1167	MIL	EEB	M	1	5	Level	W	4	5-M
1168	STP	OLG	M	1	5	Level	P	4	7b-M
1169	KNS	OGL	F	4	5	M	MW	4	5-M
1170	ptSTP	ptOG	M	1	5	Level	P	4	7b-M
1171	STP	OLG	M	2	5	Level	P	4	7a-M
1172	KNS	OGL	F/M	4	9	M	MW	4	5-M
1173	STP	OLG	F	1	5	Level	P	4	7b-P
1174	KNS	OGL	M	5	8	L	W	4	5-M
1175	STP	OG	F	3	5	Level	P	4	7b-M
1176	ptSTP	ptOG	F	1	5	Level	P	2	7a-M
1177	STP	OLG	F	2	5	Level	P	4	7b-M
1178	STP	OLG	F	3	3	U	VP	4	7b-M
1179	STP	OLG	F/M	2	5	Level	MW	4	7a-P
1180	STP	OG	M	3	3	M	I	2	7b-P
1181	ptSTP	ptOG	M	1	5	Level	P	4	7b-P
1182	MIL	OEB	F/M	2	3	L	MW	2	5-M
1183	STP	OLG	M	1	5	Level	P	4	7b-M
1184	KNS	OGL	M	2	9	M	W	2	5-M
1185	ptSTP	ptOG	M	2	5	Level	P	4	7b-M
1186	KNS	OGL	M	3	7	C	MW	2	4-M
1187	ptSTP	ptOG	M	1	5	Level	P	4	7b-M
1188	KNS	OGL	M	3	9	M	W	3	5-M
1189	STP	OG	F	1	5	Level	P	2	7a-P
1190	KNS	OGL	M	3	3	M	W	2	5-M
1191	shMLD	TM	O/M	1	5	Level	VP	2	8-M
1192	KNS	OGL	M	2	3	U	MW	2	5-M
1193	shMUS	TM	O/M	1	13	Level	VP	2	8-P
1194	shMLD	TM	O/M	1	5	Level	VP	5	8-M
1195	shMLD	TM	O/M	1	13	Level	P	5	8-M
1196	shMUS	TM	O/F	1	5	Level	P	5	8-P
1197	shMUS	TM	O/M	1	13	Level	P	5	8-M
1198	shMLD	TF	O/M	1	5	Level	VP	5	8-M
1199	shMUS	TM	O/M	1	13	Level	VP	5	8-P
1200	shMLD	TF	O/M	1	13	Level	P	5	8-M
1201	shMLD	TM	O/M	1	12	Level	VP	5	8-M
1202	shMLD	TF	O/M	1	12	Level	VP	5	8-M
1203	ptSTP	ptOLG	F/M	3	3	M	I	2	7a-M
1204	shMLD	TF	O/M	1	13	Level	P	5	8-M
1205	ptSTP	ptOLG	F/M	3	3	U	VP	3	7b-M
1206	ptSTP	ptOG	O/M	1	13	Level	VP	5	7b-M
1207	MIL	OEB	F	3	3	U	W	3	4-M

1208	KNS	OGL	M	1	5	Level	W	3 5-M
1209	MIL	OEB	F/M	3	3	M	W	3 4-M
1210	MIL	EEB	F/M	1	5	Level	W	3 5-M
1211	MIL	OEB	F	1	5	Level	W	3 4-M
1212	ptBMT	ptOG	O/F	1	5	Level	P	3 7b-M
1213	MIL	EEB	F	1	5	C	W	3 4-M
1214	BMT	OLG	F/M	1	5	Level	P	2 7b-P
1215	KNS	OGL	M	1	5	Level	W	4 5-M
1216	KNS	OGL	M	1	5	Level	MW	4 5-M
1217	RBZ	OGL	C	6	8	M	W	3 4-P
1218	MIL	EEB	F/M	1	5	Level	MW	3 5-M
1219	KNS	OGL	M	1	5	Level	W	3 5-M
1220	KNS	OGL	M	2	5	Level	MW	3 5-M
1221	KNS	OGL	M	1	5	Level	W	3 5-M
1222	STP	OLG	M	1	5	Level	P	2 7a-M
1223	KNS	OGL	M	1	5			3 5-M
1224	ptSTP	ptOG	M	1	5	Level	P	3 7b-M
1225	KNS	OGL	M	1	5	Level	W	3 5-M
1226	ptSTP	ptOG	O/M	1	5	Level	P	3 7b-M
1227	STP	OG	C/M	3	3	U	P	3 7a-M
1228	shMUS	TF	M	1	5	Level	P	3 8-P
1229	KNS	OGL	M	2	3	U	W	3 5-M
1230	ptSTP	ptOG	O/M	1	5	Level	P	3 7b-M
1231	ptSTP	ptOG	O/M	1	5	Level	P	2 7a-M
1232	shMUS	TM	O/M	1	5	Level	VP	3 8-P
1233	ptSTP	ptOLG	O/M	2	5	Level	P	3 7b-M
1234	ptSTP	ptOG	O/M	1	5	Level	VP	3 7b-M
1235	KNS	OGL	O/M	3	3	M	MW	3 5-M
1236	shMUS	TM	O/M	1	5	Level	VP	3 8-P
1237	ptSTP	ptOG	O/M	1	5	Level	P	3 7a-M
1238	shMLD	TM	O/M	1	5	Level	VP	3 8-M
1239	shMUS	TM	O/M	1	5	Level	VP	3 8-P
1240	shMLD	TM	O/M	1	13	Level	VP	5 8-M
1241	KNS	OGL	M	3	3	M	MW	2 5-M
1242	shMUS	TM	O/F	1	13	Level	VP	3 8-P
1243	BMT	OLG	F/M	1	5	Level	P	3 7b-P
1244	BMT	OLG	F/M	1	5	Level	P	3 7b-P
1245	ptSTP	ptOG	O/F/M	1	5	Level	VP	3 7b-M
1246	KNS	OGL	M	2	3	M	MW	3 5-M
1247	MIL	EEB	F/M	3	3	U	W	3 5-M
1248	STP	OLG	F/M	3	3	M	P	3 7b-M
1249	KNS	OGL	C/M	3	3	L	W	3 5-M
1250	KNS	OGL	F/M	3	3	M	MW	3 5-M
1251	ptSTP	ptOG	O/M	1	5	Level	VP	3 7b-M
1252	KNS	OGL	F/M	1	5	C	W	3 5-M
1253	MIL	EEB	F	1	5	Level	W	3 5-M
1254	MIL	EEB	F	2		M	W	3 5-M
1255	KNS	OGL	F/M	2		Level	W	3 5-M
1256	ptSTP	ptOG	O/M	1	5	Level	P	5 7b-P
1257	shMLD	TM	O/M	1	5	Level	VP	5 8-M
1258	shMUS	TF	O/M	1	13	Level	VP	5 8-P
1259	shMUS	TM	O/M	1	13	Level	VP	5 8-P

1260	ptSTP	ptOG	O/M	1		Level	VP	5	7b-M
1261	shMUS	TM	O/M	1	13	Level	VP	5	8-P
1262	ptSTP	ptOG	O/M	1	13	Level	P	5	7b-M
1263	shMUS	TM	O/M	1	13	Level	VP	5	8-P
1500	STP	ptRG	T	1	5	Level	VP	4	8-M
1501	shMUS	TM	O/T	1	5		VP	5	8-P
1502	shMLD	TM	O/T	1	5	Level	VP	5	8-M
1503	shMLD	TM	O/T	1	5	Level	VP	5	8-M
1504	shMUS	TM	O/T	1	5	Level	VP	5	8-P
1505	shMLD	TM	O/F	1	5	Level	VP	5	8-M
1506	shMLD	TM	O/F	1	5	Level	VP	5	8-M
1507	shMLD	TM	O/F	1	5	Level	VP	5	8-M
1508	shMLD	TM	O/T	1	5	L	VP	5	8-M
1509	shMLD	TM	O/L	1	5	Level	VP	5	8-M
1510	shMLD	TM	O/L	1	5	Level	VP	5	8-M
1511	shMLD	TM	O/L	1	5	Level	VP	5	8-M
1512	shMLD	TM	O/F	1	5	Level	VP	5	8-M
1513	shMUS	TM	O/F	1	5	Level	VP	5	8-P
1514	shMLD	TM	O/F	1	5	Level	VP	5	8-P
1515	shMLD	TM	O/F	1	5	Level	VP	5	8-M
1516	KNS	OGL	T	3	10	M	MW	2	5-M
1517	KNS	OGL	T	3	10	M	MW	2	5-M
1518	KNS	OGL	T	3	10	M	MW	5	5-M
1519	MIL	EEB	F	3	10	M	MW	3	5-M
1520	glMIL	GLEEB	F	2	10	M	I	3	6-M
1521	STP	OLG	F	2	10	M	P	5	6-M
1522	shMLD	TM	O/F	1	5	Level	P	5	8-M
1523	shMLD	TM	O/T	1	5	Level	VP	5	8-M
1524	shMUS	TM	O/F	1	5	Level	VP	5	8-P
1525	MLD	TYM	O	1	5	Level	VP	5	8-M
1526	STP	RG	F	1	5	Level	P	5	7a-M
1527	shMUS	TM	O/F	1	5	Level	VP	5	8-P
1528	shMUS	TM	O/F	1	5	Level	VP	5	8-P
1529	shMUS	TM	O/F	1	5	Level	VP	5	8-P
1530	shMLD	TM	O/F	1	5	Level	VP	5	8-M
1531	shMUS	TM	O/F	1	5	Level	VP	5	8-P
1538	STP	OLG	T	3		M	I	4	7a-M
1539	glKNS	GLEB	T	2		M	I	1	6-M
1540	STP	ptRG	T	1		Level	P	4	7a-M
1541	KNS	OGL	F	1		Level	MW	4	5-M
1542	STP	OLG	T	1		Level	P	2	7a-M
1543	KNS	OGL	T	1		M	MW	4	5-M
1544	shMUS	TM	O/T	1		Level	VP	4	8-M
1545	STP	OLG	T	1		Level	VP	2	7b-M
1546	STP	OLG	T	2		M	P	4	7b-M
1547	STP	ptOG	T	1		Level	P	4	7b-M
1548	shMUS	TM	O/T	1		Level	VP	5	8-M
1549	shMUS	TM	O/T	1		Level	VP	4	8-M
1550	STP	OGL	T	2		M		4	7a-M
1551	STP	OLG	T	2		M	MW	4	7a-M
1552	KNS	OGL	T	2		M	MW	2	5-M
1553	KNS	OGL	T	3		M	MW	2	5-M

1555	STP	OLG	F	3	10	M	VP	4	7b-M
1556	MIL	EEB	F	3	10	M	MW	3	5-M
1557	BMT	OLG	F	2	10	L	I	4	7b-M
1558	shMLD	TM	O/T	1	5	Level	VP	5	8-M
1559	KNS	OGL	T	2		M	MW	2	5-M
1559	KNS	OGL	T	3	10	M	W	2	5-M
1560	KNS	OGL	T	2	10	M	W	2	4-M
1561	KNS	EEB	T	2	10	M	MW	2	5-M
1562	KNS	OGL	T	1	10	L	I	2	5-M
1563	glKNS	GLGL	T	2	10	L	I	2	6-M
1564	shMUS	TM	F	1	10	L	P	2	8-P
1565	STP	OLG	F	4	10	M	I	4	7a-M
1566	ptSTP	ptRG	F	1		D	VP	3	8-M
1567	KNS	EEB	T	6	10	U	W	4	5-M
1568	shMLD	TM	O/F	1		D	VP	5	8-M
1569	STP	OLG	F	3	10	M	I	4	7b-M
1570	MIL	EEB	F	3	10	U	W	3	5-M
1571	STP	OLG	T/F	3	10	M	P	4	7b-M
1572	shMUS	TH	F	3	10	L	I	4	8-P
1573	STP	OLG	F	3	10		P	4	7b-M
1574	KNS	OGL	T	4	10	U	MW	2	5-M
1575	STP	ptRG	F	2	10	D	VP	4	8-M
1576	STP	OLG	F	3	10	M	I	4	7b-M
1577	STP	RG	F	3	10	D	VP	4	7b-M
1578	KNS	OGL	T	3	10	M	W	2	4-M
1579	KNS	OGL	T	2	10	M	W	2	5-M
1580	KNS	OGL	T	2	10	M	W	2	5-M
1581	MIL	EEB	F	3	10	M	R	2	4-M
1582	KNS	OGL	T	1	10	L	I	2	5-M
1583	STP	OG	T	1	10	L	P	2	7b-M
1584	STP	OGL	T	1	5	D	P	4	7b-M
1585	ptSTP	ptRG	M	1		D	VP	4	8-M
1586	KNS	OGL	T	4	10	M	W	2	5-M
1587	KNS	BRGL	T	4	10	M	W	2	5-M
1588	KNS	OGL	T	2	10	M	W	2	5-M
1589	MIL	EEB	F	2	10	M	R	2	4-M
1590	MIL	EEB	F	2	10	M	R	2	5-M
1591	KNS	OGL	T	2	10	M	R	2	4-M
1592	KNS	OGL	T	2	10	M	W	2	5-M
1593	KNS	OGL	T	3	10	M	W	2	5-M
1594	KNS	OGL	M	1	10	M	W	2	5-M
1595	KNS	OGL	M	1	10	Level	W	2	5-M
1596	KNS	OGL	M	1	5	Level	W	2	5-M
1597	MIL	EEB	F	2	10	M	W	2	5-M
1598	KNS	OGL	M	3	10	M	W	3	5-M
1599	KNS	BRGL	M	4	10	M	W	2	5-M
1600	KNS	OGL	M	2	10	M	W	2	5-M
1601	KNS	OGL	M	3	10	M	W	2	5-M
1602	KNS	OGL	M	3	10	M	I	2	5-M
1603	KNS	OGL	M	2	5	Level	W	2	5-M
1604	shMLD	TM	O/F	3	10	D	P	4	8-M
1605	shMUS	TM	O/L	1	5	Level	P	2	8-P

1606	shMLD	TH	O/M	1	5	Level	VP	5	8-M
1607	MUS	TYM	O	1	5	Level	VP	5	8-M
1608	shMLD	TM	O/F	1	5	Level	VP	5	8-M
1609	MUS	TYM	O	1	5	Level	VP	5	8-M
1610	KNS	OGL	M	3	10	U	W	3	5-P
1611	KNS	OGL	M	3	10	L	MW	2	5-M
1612	KNS	BRGL	M	3	10	L	MW	2	5-M
1613	KNS	OGL	M	3	10	M	MW	2	5-M
1614	KNS	BRGL	M	3	10	M	VP	2	5-M
1615	KNS	OGL	M	3	10	M	VP	2	5-M
1616	KNS	OGL	M	3	10	M	MW	2	5-M
1617	KNS	OGL	M	3	10	M	MW	2	5-M
1618	KNS	OGL	M	3	10	M	MW	2	5-M
1619	KNS	OGL	M	3	10	M	MW	2	5-M
1620	KNS	OGL	M	3	10	M	MW	2	5-M
1621	ptSTP	ptOG	M	2	13	Level	VP	3	8-P
1622	STP	ptOLG	M	2	13	Level	P	4	8-P
1623	shMLD	TM	O/M	2	12	Level	VP	5	8-M
1624	shMUS	TM	O/M	2	13	Level	VP	5	8-P
1625	shMUS	TM	O/M	2	13	Level	P	5	8-P
1626	shMUS	TM	O/M	2	13	Level	VP	5	8-P
1627	MUS	TYM	O	2	13	Level	VP	5	8-P
1628	glKNS	GLGL	M	2	5	L	I	2	6-M
1629	glKNS	GLGL	M	2	5	M	I	2	6-M
1630	STP	OLG	M	2	5	M	I	4	7a-M
1631	shMUS	TM	O/M	2	13	Level	P	5	8-P
1632	shMUS	TM	O/M	2	13	Level	P	5	8-P
1633	shMUS	TM	O/F	2	13	Level	P	5	8-P
1634	ptSTP	ptOG	M	2	13	Level	P	3	7b-P
1635	ptSTP	ptOLG	M	2	10	Level	MW	3	7a-M
1636	glKNS	GLGL	M	2	5	Level	I	1	6-M
1637	glKNS	GLGL	M	2	5	Level	MW	1	6-M
1638	glKNS	GLGL	M	2	5	Level	I	1	6-M
1639	KNS	EEB	M	2	10	Level	MW	1	5-M
1640	KNS	BRGL	M	5	10	M	W	2	5-M
1641	MIL	EEB	F	6		M	W	3	5-M
1642	shMLD	TM	O/F	2	12	D	VP	5	8-M
1643	ptSTP	ptOG	M	2	5	Level	P	3	7a-M
1644	STP	OLG	M	2	5	Level	P	3	7a-M
1645	STP	OLG	M	2	5	Level	I	3	7a-M
1646	STP	OLG	M	2	5	Level	P	3	7b-M
1647	STP	OLG	M	2		Level	VP	3	7b-M
1648	ptSTP	ptOLG	O/M	2	13	Level	VP	3	8-M
1649	ptSTP	ptOG	O/M	2	13	Level	P	3	8-P
1650	STP	OLG	M	2	10	Level	I	3	6-M
1651	KNS	OGL	M	2	10	Level	MW	2	5-M
1652	shMUS	TM	O/M	2	13	Level	P	5	8-P
1653	ptSTP	ptOLG	M	3	5	L	P	3	7b-P
1654	ptSTP	ptOLG	M	3	10	M	P	3	7b-P
1655	shMLD	TM	O/M	2	12	D	VP	5	8-M
1656	STP	OLG	M	2	13	M	P	3	7b-P
1657	STP	OLG	M	2	13	L	P	3	7b-P

1658	ptSTP	ptOLG	M	2	5	Level	P	3 7b-P
1659	ptSTP	ptOLG	M	2	13	Level	P	3 7b-P
1660	ptSTP	ptOG	M	2	13	Level	P	3 8-P
1661	shMLD	TM	O	2	12	D	VP	5 8-M
1662	STP	OLG	F	2	10	U	MW	4 7a-P
1663	MIL	EEB	F/M	2	10		MW	4 5-M
1664	STP	ptOG	O/M	2	13	Level	P	5 7b-P
1665	MLD	TYM	O	2	12	Level	VP	5 8-M
1666	MLD	TYM	O	2	12	Level	VP	5 8-M
1667	MLD	TYM	O/M	2	12	D	VP	5 8-M
1668	ptSTP	ptOLG	M	2	13	U	P	5 7b-P
1669	shMUS	TM	O/M	2	13	Level	P	5 8-P
1670	shMUS	TM	O/M	2	13	Level	P	5 8-P
1671	shMUS	TM	O/M	2	13	Level	P	5 8-P
1672	shMLD	TM	O/M	2	12	Level	VP	5 8-M
1673	shMUS	TM	O/M	2	13	Level	P	5 8-P
1674	shMUS	TM	O/M	2	13	Level	P	5 8-P
1675	shMUS	TM	O/M	2	13	Level	P	5 8-P
1676	shMUS	TM	O/M	2	13	Level	P	5 8-P
1677	shMLD	TM	O/M	2	12	Level	VP	5 8-M
1678	shMLD	TM	O/M	2	12	Level	VP	5 8-M
1679	shMUS	TM	O/M	2	13	Level	P	5 8-P
1680	shMLD	TM	O/M	2	12	Level	VP	5 8-M
1681	shMUS	TM	O/M	2	13	Level	P	5 8-P
1682	glKNS	GLGL	M	2	5	U	I	1 6-M
1683	ptSTP	ptRG	O/M	2	13	Level	P	3 7b-P
1684	MLD	TYM	O/M	2	12	Level	VP	5 8-M
1685	ptSTP	ptOLG	O/M	2	5	Level	P	3 7b-P
1686	shMLD	TM	O/M	2	12	Level	VP	5 8-M
1687	STP	OLG	M	2	5	Level	I	3 7a-M
1688	ptSTP	ptOLG	M	2	5	Level	I	3 7a-M
1689	shMUS	TM	O/M	2	13	Level	P	4 8-P
1690	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1691	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1692	ptSTP	ptOLG	O/M	2	13	Level	P	5 7b-P
1693	shMUS	TM	O/M	1	13	Level	VP	5 8-P
1696	shMUS	TM	O/M	2	13	Level	P	5 8-P
1697	shMUS	TM	O/M	2	13	Level	P	5 8-P
1698	MUS	TYM	O	2	13	Level	P	5 8-P
1699	MLD	TYM	O/M	2	12	Level	VP	5 8-M
1700	shMLD	TM	O/M	2		Level	VP	5 8-M
1701	MLD	TYM	O/M	2	12	Level	VP	5 8-M
1702	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1703	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1704	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1705	MLD	TYM	O	1	12	Level	VP	5 8-M
1706	MLD	TYM	O	1	12	Level	VP	5 8-M
1707	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1708	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1709	MLD	TYM	O/M	2	12	Level	VP	5 8-M
1710	MLD	TYM	O/M	2	12	Level	VP	5 8-M
1711	shMLD	TM	O/F	2	12	Level	VP	5 8-M

1712	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1713	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1714	shMUS	TM	O/M	2	13		P	5 8-P
1715	shMUS	TM	O/M	1	13	Level	P	5 8-P
1716	shMUS	TM	O	1	13	Level	P	5 8-P
1717	shMUS	TM	O/M	1	13	Level	P	5 8-P
1718	shMUS	TM	O/M	1	13	Level	P	5 8-P
1719	shMUS	TM	O/M	1	13	Level	P	5 8-P
1720	ptSTP	ptOLG	O/M	1	13	Level	P	3 8-P
1721	shMUS	TM	O/M	1	13	Level	P	5 8-P
1722	KNS	EEB	M	5	10	U	MW	4 5-M
1723	glKNS	GLGL	F/M	3	3	L	I	1 6-M
1724	KNS	BRGL	O/M	2	12	Level	P	2
1725	MLD	TYM	O/M	2	12	Level	P	5
1726	MUS	MEOC	O/M	1	13	Level	VP	5 8-P
1727	shMUS	TM	O/M	1	13	Level	VP	5 8-P
1728	shMUS	TM	O/M	1	13	Level	VP	5 8-P
1729	shMUS	TM	O/M	1	13	Level	VP	5 8-P
1730	shMUS	TM	O/M	1	13	Level	P	5 8-P
1731	shMUS	TM	O/M	1	13	Level	P	5 8-P
1732	shMUS	TM	O/M	1	13	Level	P	5
1733	shMUS	TM	O/M	1	13	Level	P	5 8-P
1734	shMUS	TM	O/M	1	13	Level	P	5 8-P
1735	shMUS	TM	O/M	1	13	Level	P	5 8-P
1736	shMUS	TM	O/M	2	13	Level	P	5 8-P
1737	shMUS	TM	O/M	1	13	Level	P	5 8-P
1738	shMUS	TM	O/M	1	13	Level	P	5 8-P
1739	shMUS	TM	O/M	1	13	Level	P	5 8-P
1740	STP	OLG	M	2	10	U	I	5 7a-P
1741	MLD	TYM	O/M	1	12	Level	VP	5 8-M
1742	KNS	OGL	M	7	3	M	MW	4 5-M
1743	KNS	OGL	M	3	10	U	W	2 5-M
1744	shMLD	TM	O/GF	2	12	L	P	5 7b-M
1745	KNS	OGL	M	2	10	U	W	2 5-M
1746	MLD	TYM	O	2	12	D	VP	5 8-R
1747	MUS	TYM	O	2	13	Level	P	5 8-P
1748	MUS	TYM	O/M	2	13	Level	P	5 8-P
1749	MLD	TYM	O	2	12	D	VP	5 8-M
1750	MUS	TYM	O	1	13	Level	P	5 8-P
1751	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1752	MLD	TYM	O/M	2	12	D	VP	5 8-M
1753	ptSTP	ptOLG	M	1	13	Level	P	3 8-P
1754	ptSTP	ptOLG	M	2	13	Level	P	3 7b-P
1755	KNS	OGL	M	2	10	Level	MW	4 5-M
1756	KNS	OGL	M	2	5	Level	MW	2 5-M
1757	glKNS	GLGL	M	2	5	Level	I	4 6-M
1758	MIL	EEB	F/M	2	10	Level	MW	2 5-M
1759	shMLD	TM	O/M	2	12	Level	VP	5 8-M
1760	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1761	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1762	ptSTP	ptOLG	M	2	13	L	P	5 7b-P
1763	shMUS	TM	O/M	2	13	Level	P	5 7b-P

1764	MLD	TYM	O	1	12	D	VP	5	8-M
1765	shMLD	TM	O/M	2	12	Level	VP	5	8-M
1766	shMUS	TM	O/M	2	13	Level	P	5	8-P
1767	shMUS	TM	O/M	2	13	Level	P	5	8-P
1768	shMUS	TM	O/M	2	13	Level	P	5	8-P
1769	shMUS	TM	O/M	1	13	Level	P	5	8-P
1770	shMUS	TM	O/M	1	13	Level	P	5	8-P
1771	shMUS	TM	O/M	1	13	Level	P	5	8-P
1772	shMUS	TM	O/M	1	13	Level	P	5	8-P
1773	shMUS	TM	O/M	1	13	Level	P	5	8-P
1774	shMUS	TM	O/M	2	13	Level	P	5	8-P
1775	MLD	TYM	O	2	12	Level	VP	5	8-M
1776	shMUS	TM	O/M	2	13	Level	P	5	8-P
1777	shMUS	TM	O/M	1	13	Level	P	5	8-P
1778	shMUS	TM	O/M	2	13	Level	P	5	8-P
1779	shMUS	TM	O/M	1	13	Level	P	5	8-P
1780	shMUS	TM	O/M	2	13	Level	P	5	8-P
1781	glKNS	GLGL	M	2	5	U	I	1	8-P
1782	shMUS	TM	O/M	2	13	Level	P	5	8-P
1783	MIL	EEB	F	2	10	M	R	3	2-P
1799	shMLD	TM	O	1	12	Level	VP	5	8-M
1800	shMLD	TM	O/L	1	12	Level	VP	5	8-M
1801	shMUS	TM	O/L	1	13	Level	P	5	8-P
1802	shMUS	TM	O/L	1	13	Level	P	5	8-P
1803	shMLD	TM	O	1	12	Level	VP	5	8-M
1804	shMUS	TM	O/L	1	13	Level	VP	5	8-P
1805	STP	OLG	F	1	10	M	P	4	7a-M
1806	shMUS	TM	F	3	10	M	P	3	8-P
1807	shMUS	TM	O/L	1	13	Level	VP	5	8-P
1808	MLD	TYM	GF	1	12	Level	VP	5	8-M
1809	shMUS	TM	O	1	13	Level	VP	5	8-P
1810	ptSTP	ptRG	L	1	5	Level	P	3	7a-M
1811	MLD	TYM	O/F	1	12	Level	VP	5	8-M
1812	shMLD	TM	O/L	1	12	Level	VP	5	7a-M
1813	MUS	TYM	O	1	13	Level	P	5	8-P
1814	shMUS	TM	O/T	1	13	Level	VP	5	8-M
1815	MLD	TYM	O/F	1	12	Level	VP	5	8-M
1816	MLD	TYM	O	1	12	Level	VP	5	8-M
1817	MUS	TYM	O/L	1	13	Level	VP	5	8-M
1818	MLD	TYM	O	1	12	Level	VP	5	8-M
1819	MLD	TYM	O	1	12	Level	VP	5	8-M
1820	shMLD	TM	O/L	1	12	Level	VP	5	8-M
1821	shMUS	TM	O/L	1	13	Level	VP	5	8-P
1822	MLD	TYM	O	1	12	Level	VP	5	8-M
1823	MUS	TYM	O	1	13	Level	VP	5	8-P
1824	MUS	TYM	O	2	13	Level	VP	5	8-P
1825	ptSTP	ptRG	O/M	2	5	Level	VP	5	7a-M
1826	ptSTP	ptOG	M	1	13	Level	VP	3	8-P
1827	MLD	TYM	O/T	1	12	Level	VP	5	8-M
1828	ptSTP	ptRG	M	1	5	Level	P	5	7b-M
1829	shMLD	TM	O/L	1	12	Level	VP	5	8-M
1830	MLD	TYM	O	1	12	Level	VP	5	8-P

1831	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1832	MLD	TYM	O/L	1	12	Level	VP	5 8-M
1833	MLD	TYM	O/L	1	12	Level	VP	5 8-M
1834	MLD	TYM	O	1	12	Level	VP	5 7a-M
1835	MLD	TYM	O	1	12	Level	VP	5 8-M
1836	shMUS	TM	O/L	1	13	Level	VP	5 8-P
1837	MLD	TYM	O/L	1	12	Level	VP	5 8-M
1838	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1839	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1840	MLD	TYM	O	1	12	Level	VP	5 8-M
1841	MUS	TYM	O/L	1	13	Level	VP	5 8-P
1842	ptSTP	ptRG	O/L	1	13	Level	VP	5 7b-P
1843	MUS	TYM	O/L	1	13	Level	VP	5 8-P
1844	shMUS	TM	O/L	1	5	Level	VP	5 8-P
1845	shMLD	TM	O/L	1	12	Level	P	5 8-M
1846	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1847	shMUS	TM	O/L	1	13	Level	P	5 8-P
1848	shMUS	TM	O/L	1	13	Level	P	5 8-P
1849	shMLD	TM	O	1	12	Level	VP	5 8-M
1850	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1851	shMUS	TM	O/L	1	13	Level	P	5 8-P
1852	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1853	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1854	shMLD	TM	O	1	12	Level	VP	5 8-M
1855	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1856	MLD	TYM	O/L	1	12	Level	VP	5 8-M
1857	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1858	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1859	shMUS	TM	O/L	1	13	Level	VP	5 8-P
1860	ptSTP	ptOG	O/M	1	5	Level	P	5 7b-P
1861	shMLD	TM	O/M	1	12	Level	VP	5 8-M
1862	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1863	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1864	MLD	TYM	O/L	1	12	Level	VP	5 8-M
1865	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1866	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1867	MLD	TYM	O/L	1	12	Level	VP	5 8-M
1870	shMLD	TM	O	1	12	Level	VP	5 8-M
1871	shMLD	TM	O	1	12	Level	VP	5 8-M
1872	MLD	TYM	O/L	1	12	Level	VP	5 8-M
1873	ptSTP	ptOG	L	1	5	Level	P	3 7b-P
1874	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1875	MLD	TYM	O	1	12	Level	VP	5 8-M
1876	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1877	shMLD	TM	O/L	1	12	Level	VP	5 8-M
1878	MLD	TYM	O	1	12	Level	VP	5 8-M
1879	MUS	MEOC	O	1	13		P	5 8-P
1880	KNS	OGL	M	2	10	U	W	5 5-M
1881	MLD	TYM	O	1	12	Level	VP	5 8-M
1882	MLD	TYM	O/L	1	12	Level	VP	5 8-M
1883	MLD	TYM	O	1	12	Level	VP	5 8-M
1884	shMLD	TM	O/L	1	12	Level	VP	5 8-M

1885	MLD	TYM	O	1	12	Level	VP	5	8-M
1886	MLD	TYM	O/L	1	12	Level	VP	5	8-M
1887	shMUS	TM	O/L	1	13	Level	VP	5	8-P
1888	MLD	TYM	O/L	1	12	Level	VP	5	8-M
1889	shMUS	TM	O/M	1	13	Level	VP	5	8-P
1890	shMUS	TM	O/L	1	12	Level	P	5	8-P
1891	shMLD	TM	O/L	1	12	Level	VP	5	8-M
1892	MLD	TYM	O/L	1	12	Level	VP	5	8-M
1893	shMUS	TM	O	1	13	Level	P	5	8-P
1894	MLD	TYM	O/L	1	12	Level	VP	5	8-M
1895	shMLD	TM	O	1	12	Level	VP	5	8-P
1896	MLD	TYM	O/L	1	12	Level	VP	5	8-M
1897	shMUS	TMEOC	O	1	13	Level	P	5	8-P
1898	MLD	TYM	O/L	1	12	Level	VP	5	8-M
1899	shMUS	TMEOC	O/L	1	5	Level	P	5	8-P
1900	shMLD	TM	O	1	12	Level	VP	5	8-M
1901	shMLD	TM	O/F	1	12	Level	VP	5	8-M
1902	MUS	MEOC	O	1	13	Level	P	5	8-P
1903	shMLD	TM	O	1	12	Level	VP	5	8-P
1904	MUS	TYM	O/L	1	13	Level	P	5	8-P
1905	MUS	TYM	O	1	13	Level	P	5	7a-M
1906	shMLD	TM	O/L	1	12	Level	VP	5	8-M
1907	shMUS	TM	O	1	13	Level	P	5	8-P
1908	shMLD	TM	O/L	1	12	Level	VP	5	8-M
1909	shMUS	TM	O	1	13	Level	P	5	8-P
1910	shMUS	TM	O/F	1	13	Level	P	5	8-P
1911	MLD	TYM	O/L	1	12	Level	VP	5	8-M
1912	shMUS	TM	O/F	1	13	Level	VP	5	8-P
1913	shMUS	TM	O/L	1	13	Level	VP	5	8-P
1914	shMUS	TM	O/L	1	13	Level	VP	5	8-P
1915	shMUS	TM	O/L	1	13	Level	P	3	8-P
1916	STP	OLG	L	1	5	Level	P	4	7b-M
1917	ptSTP	ptRG	T	1	5	Level	P	5	7b-M
1918	glKNS	GLGL	M	1	5	Level	I	4	7a-M
1919	shMLD	TM	O/L	1	12	Level	VP	5	8-M
1920	ptSTP	ptRG	F	1	5	Level	P	5	7b-P
1921	ptSTP	ptRG	O/L	1	5	Level	P	5	7b-P
1922	shMUS	TM	O/F	1	13	Level	P	5	8-P
1923	shMUS	TM	O/L	1	13	Level	P	5	8-P
1924	shMUS	TM	O/M	1	5	Level	P	5	8-P
1925	ptSTP	ptRG	F	1	5	Level	P	5	7b-P
1926	shMUS	TMEOC	O/L	1	13	Level	P	5	8-P
1927	shMLD	TM	O/L	1	12	Level	VP	5	8-M
1928	shMLD	TM	O/L	1	12	Level	P	5	8-M
1929	shMUS	TM	O/L	1	13	Level	P	5	8-P
1930	shMUS	TM	O/F	1	13	Level	P	5	8-P
1931	ptSTP	ptRG	O/L	1	13	Level	P	3	7b-P
1932	shMUS	TM	O	1	13	Level	P	5	8-P
2000	MIL	EEB	F	2	5	U	W	3	4-P
2001	shMUS	TM	O	2	13	D	P	5	8-M
2003	shMUS	TM	O/F	2	13	D	P	5	8-P
2004	shMUS	TM	O/F	2	13	Level	VP	5	8-P

2005	ptBMT	ptOG	F	2	5	D	P	2 7b-P
2006	BMT	RG	F	2	5	D	P	4 7b-P
2007	shMLD	TM	O/F	2	5	M	P	5 8-M
2008	ptSTP	ptRG	F	3	5	M	P	3 7b-P
2009	shMLD	TM	O/F	2	12	D	P	5 8-M
2010	shMUS	TM	O/F	3	13	U	P	5 8-P
2011	shMUS	TH	O	2	13	Level	P	5 8-P
2012	ptSTP	ptRG	F	2	5	D	P	3 7b-P
2013	ptSTP	ptRG	O	2	5	L	P	3 7b-P
2014	shMUS	TM	O/L	2	13	L	P	5 8-P
2015	ptBMT	ptRG	F	2	5	D	VP	2 8-P
2017	ptSTP	ptOG	L	2	5	D	P	5 7b-P
2018	shMLD	TM	O/L	2	12	D	VP	5 8-P
2019	shMLD	TM	O/F	2	12	D	VP	4 8-P
2020	STP	GLGL	F	3	5	L	I	2 7a-P
2021	glKNS	GLGL	F	2	5	Level	I	2 7a-M
2022	shMLD	TH	O/FL	2	13	Level	P	5 8-M
2023	shMUS	TM	O/F	2	13	L	P	5 8-P
2024	shMUS	TH	O/F	2	13	Level	VP	5 8-P
2025	shMLD	TM	O/F	2	12	Level	P	5 8-M
2026	MLD	TYM	O/L	2	12	Level	VP	5 8-M
2027	ptBMT	ptRG	O/L	2	5	Level	VP	2 8-M
2028	shMLD	TF	O/F	2	12	Level	VP	2 8-M
2029	shMUS	TM	O/F	2	13	Level	VP	5 8-P
2030	shMUS	TM	O/L	2	13	Level	P	5 8-P
2031	ptBMT	ptRG	F	2	13	Level	P	4 8-P
2032	STP	OG	FL	2	13	Level	P	4 7b-P
2033	STP	OG	FL	3	5	Level	P	4 7a-P
2034	shMUS	TH	O/L	2	13	Level	P	5 8-P
2035	STP	ptOG	F/L	2	5	Level	P	5 7b-P
2036	STP	GLGL	FL	2	5	Level	I	3 7b-P
2037	STP	ptRG	O/L	2	5	Level	I	3 7b-P
2038	MLD	TYM	O/LT	1	12	Level	VP	3 8-M
2039	shMLD	TH	O/L	2	12	Level	P	5 8-P
2040	ptSTP	ptRG	LT	2	5	Level	P	3 7b-P
2041	shMUS	TM	O/L	2	13	Level	P	5 8-P
2042	shMUS	TM	O/L	1	13	Level	P	5 8-P
2043	shMLD	TM	O/F	2	12	Level	VP	5 8-M
2044	shMLD	TM	O/FL	2	12	Level	VP	5 8-M
2045	shMLD	TF	O/L	2	12	Level	VP	5 8-M
2046	shMLD	TM	O/F	2	12	Level	VP	5 8-M
2047	shMLD	TM	O	2	12	Level	VP	5 8-M
2048	MLD	TYM	O/L	2	12	Level	VP	5 8-M
2049	MLD	TYF	O/L	2	12	Level	VP	5 8-M
2050	shMLD	TM	O	2	12	Level	VP	5 8-M
2051	MUS	TYM	O	2	13	Level	P	5 8-P
2052	shMLD	TF	O/L	2	12	Level	VP	5 8-M
2053	shMUS	TF	O/L	2	13	Level	P	5 8-P
2054	MUS	TYM	O/I	2	13	Level	P	5 8-P
2055	MLD	TYF	O	2	12	Level	VP	5 8-M
2056	MLD	TYF	O/L	2	12	Level	VP	5 8-M
2057	ptSTP	ptOLG	F/M	3	10	U	I	3 7b-P

2058	DOV	OGL	L	3	10	U	MW	2 5-M
2059	KNS	OGL	F	3	10	C	W	2 5-M
2060	KNS	OGL	M	3	10	U	MW	4 5-M
2061	KNS	OGL	L/M	3	10	M	MW	4 5-M
2062	ptSTP	ptOG	M	2	10	Level	P	5 7a-P
2063	shMUS	TM	O/L	2	13	Level	P	5 8-P
2064	shMUS	TM	O/L	2	13	Level	P	5 8-P
2065	MLD	TYF	O/L	2	12	Level	VP	5 8-M
2065	MLD	TYF	O	2	13	Level	VP	5 8-P
2066	shMLD	TM	O/L	2	12	Level	VP	5 8-M
2068	MLD	TYF	O/F	2	12	Level	VP	5 8-M
2069	shMUS	TF	O/L	2	13	L	P	5 8-P
2070	shMUS	TM	O/L	2	13	Level	P	5 8-P
2071	shMUS	TM	O	2	13	Level	P	5 8-P
2072	shMUS	TF	O/L	2	13	Level	P	5 8-P
2073	shMUS	TM	O	2	13	Level	P	5 8-P
2074	shMUS	TM	O/L	2	13	Level	P	5 8-P
2075	ptSTP	ptRG	LT	2	13	Level	P	5 8-P
2077	STP	OLG	M	2	13	Level	P	5 7b-M
2078	ptBMT	ptRG	F	2	13	Level	P	3 7b-M
2079	shMLD	TM	O/L	2	12	Level	VP	5 8-M
2080	shMUS	TM	M	2	13	Level	P	5 8-P
2081	shMUS	TF	O/M	2	13	Level	P	5 8-P
2082	shMUS	TF	O/M	2	13	Level	VP	5 8-P
2083	shMUS	TF	O/F	2	13	Level	P	5 8-P
2084	shMUS	TF	O/F	2	13	Level	P	5 8-P
2085	shMUS	TF	O/M	2	13	Level	P	5 8-P
2086	shMUS	TM	O/M	2	13	Level	P	5 8-P
2087	shMLD	TF	O/M	2	12	Level	VP	5 8-M
2088	shMUS	TF	O	2	13	Level	P	5 8-P
2089	MLD	TYF	O/F	2	12	Level	VP	5 8-M
2090	shMUS	TF	O/F	2	13	Level	P	5 8-P
2091	MUS	TYF	O/L	2	13	Level	P	5 8-P
2092	shMUS	TM	F	2	13	Level	P	5 8-P
2093	ptSTP	ptRG	O/M	2	12	Level	P	5 7b-P
2094	shMUS	TF	O/M	2	13	Level	P	5 8-P
2095	shMUS	TF	O/M	2	13	Level	P	5 8-P
2096	shMUS	TF	O/M	2	13	Level	P	5 8-P
2097	shMLD	TF	O/M	2	13	Level	VP	5 8-M
2098	shMLD	TF	O/M	2	12	Level	VP	5 8-P
2099	MLD	TYF	O	2	12	Level	VP	5 8-M
2100	ptSTP	ptOG	M	2	13	Level	P	5 7b-P
2101	shMUS	TM	O/M	2	13	Level	P	5 8-P
2102	shMUS	TM	O/M	2	13	Level	VP	5 8-P
2103	ptSTP	ptOG	M	2	13	Level	VP	5 7b-P
2104	shMUS	TH	O/M	2	13	Level	VP	5 8-P
2105	shMLD	TH	O/M	2	12	Level	VP	5 8-M
2107	ptSTP	ptOG	M	1	10	Level	VP	3 7b-P
2108	ptSTP	ptOG	M	2	5	Level	P	3 7b-P
2109	shMLD	TM	O/M	2	12	Level	P	5 8-M
2110	shMUS	TM	O/M	2	13	Level	VP	3 8-P
2111	ptSTP	ptOG	L/M	2	5	Level	P	3 7b-P

2112	shMUS	TM	O/M	1	13	Level	VP	5 8-P
2113	shMUS	TM	O/M	1	13	Level	VP	5 8-P
2114	shMLD	TM	O/M	1	12	Level	VP	5 8-M
2115	MLD	TYM	O/M	1	12	Level	VP	5 8-M
2116	shMLD	TH	O/M	1	12	Level	VP	5 8-M
2117	shMUS	TM	O/M	1	12	Level	VP	5 8-M
2118	shMUS	TM	O/M	1	13	Level	VP	5 8-P
2119	shMUS	TM	O/M	1	13		VP	5 8-P
2120	shMLD	TM	O/M	1	12	Level	VP	5 8-M
2121	shMUS	TM	O/M	1	13		VP	5 8-P
2122	MLD	TYM	O/M	1	12	Level	VP	5 8-M
2123	shMLD	TM	O/L	1	12		P	5 8-M
2124	shMUS	TM	O/M	2	13	Level	P	5 8-P
2125	MLD	TYM	O/M	2	12	Level	VP	5 8-M
2126	shMUS	TM	O/M	12	13	Level	P	5 8-P
2127	shMUS	TM	O/M	2	13	Level	P	5 8-P
2128	ptSTP	ptOLG	M	1	13	Level	P	5 7b-P
2129	ptSTP	ptOLG	M	2	13	Level	P	3 7b-P
2130	shMLD	TM	O/M	1	12	Level	VP	5 8-M
2131	shMLD	TM	O/M	1	12	Level	VP	5 8-M
2132	MLD	TYM	O/M	1	12	Level	VP	5 8-M
2133	MLD	TYM	O	1	12	Level	VP	5 8-M
2134	shMUS	TM	O/M	1	13	Level	P	5 8-P
2135	shMUS	TM	O/M	2	13	Level	VP	5 8-P
2136	shMUS	TM	O/M	2	13	Level	P	5 8-P
2137	shMLD	TH	O/M	1	12	Level	VP	5 8-M
2138	shMLD	TF	O/M	2	12	Level	VP	5 8-M
2139	shMUS	TF	O/M	2	13	Level	VP	5 8-M
2140	shMUS	TM	O/M	2	13	Level	P	5 8-P
2141	shMUS	TM	O/M	2	13	Level	P	5 8-P
2142	shMLD	TM	O/M	2	12	Level	P	5 8-P
2143	ptSTP	ptRG	O/M	20	13	Level	P	5 8-P
2144	shMLD	TM	O/L	2	12	Level	VP	5 8-M
2145	shMLD	TF	O	2	12	Level	VP	5 8-M
2146	MLD	TYF	O/M	2	12	Level	VP	5 8-M
2147	shMUS	TF	O/F	2	13	Level	P	5 8-P
2148	shMLD	TF	O/M	2	12	Level	VP	5 8-M
2149	shMUS	TM	O/M	2	13	Level	P	5 8-P
2150	MLD	TYF	O/M	2	12	Level	VP	5 8-M
2151	shMUS	TF	O	2	13	Level	P	5 8-P
2152	MLD	TYF	O/M	2	12	Level	VP	5 8-M
2153	shMUS	TM	O/M	2	13	Level	P	5 8-P
2154	shMUS	TM	O	2	13	Level	P	5 8-P
2155	MUS	TYM	O/M	2	13	Level	VP	5 8-P
2156	shMLD	TF	O/F	2	12	Level	VP	5 8-M
2157	shMUS	TM	O/M	2	13	Level	VP	5 8-P
2158	ptSTP	ptRG	M	2	13	Level	P	5 7b-P
2159	shMLD	TM	O/L	2	12	Level	VP	5 8-M
2160	shMUS	TM	O/M	2	13	Level	P	5 8-P
2161	MLD	TYF	O	2	12	Level	VP	5 8-M
2162	shMLD	TM	O/M	2	12	Level	VP	5 8-M
2163	shMLD	TM	O	2	12	Level	VP	5 8-M

2164	ptSTP	ptRG	O/M	2	13	Level	P	5	8-P
2165	shMUS	TFIOC	O	2	13	Level	P	5	8-P
2166	shMLD	TM	O	2	12	Level	VP	5	8-M
2167	shMLD	TM	O/M	2	12	Level	P	5	8-M
2168	shMLD	TM	O/L	2	13	Level	P	5	8-M