



Quaternary Stratigraphy and Surficial Geology Peace River Final Report

**QUATERNARY STRATIGRAPHY AND SURFICIAL GEOLOGY
PEACE RIVER - FINAL REPORT**

Alberta Geological Survey Special Report SPE10
(Canada – Alberta MDA Project M93-04-035)

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PREFACE

This report is one of the final products from a project partly funded under the Canada-Alberta Partnership Agreement on Mineral Development (Project M93-04-035) through the Mineral Development Program by what was then called the Alberta Department of Energy (now Department of Resource Development). The project was designed to provide reconnaissance level information on the Quaternary geology (stratigraphic and surficial components) in the Peace River (NTS 84C west half) and Winagami regions (83N west half). The latter report by Balzer on the Winagami region is being released separately by Alberta Geological Survey (AGS).

There are a number of reasons for this project including:

1. The northern third of Alberta is unmapped with respect to surficial geology (with the exception of Wood Buffalo Park and McMurray Oil Sand region) and there is no information on the Quaternary stratigraphy.
2. Drift prospecting is one of the major exploration methods for mineral (gold, copper etc.) and kimberlite/lamproite/diamond exploration in many areas of Canada, including much of northern Alberta where the bedrock is hidden by moderate to great thicknesses of overburden. Essential to these activities in Alberta is knowledge of: i) the distribution and composition of the surficial sediments, ii) Quaternary stratigraphy, iii) Quaternary geological history with particular emphasis on the glacial flow directions and implications for dispersal of indicator minerals and elements, and iv) the thickness and composition of the unconsolidated Quaternary and late Tertiary sediments overlying bedrock.
3. Dialogue and work with both representatives from government and the Alberta Mineral Exploration Industry has shown that knowledge of the surficial geology and Quaternary stratigraphy is important. This knowledge will assist the Department of Energy to fulfill their mandate in assuring mineral resource development and use occur in an effective, orderly and environmentally responsible manner. It will help to maximize the effectiveness of drift prospecting and therefore the money invested by industry in this technique.
4. This information is required for petroleum, industrial, municipal, agricultural and forestry developments. The knowledge of the distribution of lacustrine clays, till and aggregate, for example, is important for construction such as highways, bridges, tailing ponds and buildings, and excavations for waste disposal sites and related facilities. Information on the Quaternary stratigraphy is essential to aquifer mapping as these aquifers provide water for petroleum and rural development.

EXECUTIVE SUMMARY

The surficial geology and glacial stratigraphy of the Peace River study area indicates the region was affected by at least two major ice advances. The surface morainal deposits, together with the flutes, and morainal ridges are evidence that the last glacial advance in the area consisted of an unobstructed southerly flowing Laurentide Ice Sheet. Deglaciation is marked in the uplands by deposition from stagnant ice and erosion by meltwater channels flowing predominantly down slope; and by the formation of glacial lakes within the plateaus surrounding the towns of Manning and Peace River. Two glacial lake elevations are defined at 610 metres in the vicinity of the Peace River townsite, and at 520 metres surrounding Manning. Slumping initiated along the major rivers after drainage of the glacial lakes. Up to six terrace levels were formed as downcutting continued to the present level. Two processes active at present include slumping of surficial and bedrock material as the rivers cut laterally and the accumulation of organic sediments in bogs, swamps and other areas of poor drainage.

Six stratigraphic units have been defined. Unit A consists of a preglacial sand and gravel unit of Cordilleran provenance. An earlier ice advance is represented by a limited exposure of Sub-unit B1 consisting of a fluvial, subangular to subrounded, boulder to cobble size gravel of Canadian Shield provenance. The gravel bed is overlain by Sub-unit B2, a glacial advance deposit, which can be greater than 100 metres thick, consisting predominantly of sand, with interbeds of gravel, clay, and diamict. Unit C is the only glacial till deposit of the area. This unit's compositional and textural characteristics are quite variable, both laterally and vertically, due to deposition that took place from basal, englacial, and supraglacial environments. Unit D consists of glaciolacustrine sediments which locally can exceed 30 metres in thickness. Recent deposits, consisting predominantly of alluvial, colluvial, and organic sediment make up Unit E.

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1.0 INTRODUCTION

1.1 OBJECTIVES

This project, partially funded under the Canada-Alberta Partnership Agreement on Mineral Development, (Project M93-04-035) was designed to provide reconnaissance level information on the Quaternary geology (stratigraphic and surficial components) in the Peace River region.

Specific objectives of the study are to provide reconnaissance level information on:

- a) the Quaternary stratigraphy, surficial geology, and history needed to encourage and focus ongoing long-term mineral exploration in Alberta; and
- b) the composition of surficial sediments, primarily till.

1.2 STUDY AREA

The study area (Figure 1.1) consists of the region covered by the western half of the 1:250,000 scale, Peace River map sheet (National Topographic System 84C W1/2), between 117° and 118° W. Longitude and 56° and 57° N. Latitude. Manning, Peace River, and Grimshaw are the largest towns in the region. Smaller communities and hamlets are located near highways. Several highways, together with secondary roads, waterways, and seismic trails provide access to most of the region. The local industry consists predominantly of agriculture, forestry, and oil and gas. The Daishowa pulp and paper mill is situated just 10 km north of the Peace River townsite.

1.2.1 Physiography and Drainage

The study area lies in the Interior Plains of Canada, within the Alberta Plateau and Peace River Lowland physiographic zones (Klassen, 1989). This region is characterized by rolling uplands, flat to undulating plateau areas and deeply entrenched river valleys. Elevation ranges between 326 m at the bottom of the Peace River valley and rises to a maximum of 838 m in the Clear Hills.

The topography map produced by Alberta Forest Lands and Wildlife reveals the study area included three plains at different elevations. The first lies at approximately 580 m southeast of the Peace River within the southern half of the area. The second at approximately 490 m, lies west of the Peace within the northern map half of the area and includes the town of Manning. A third plain, at approximately 640 m, exists adjacent to the Whitemud River, in the central portion of the area, and is presently an alluvial floodplain.

The highest elevations are in the Clear Hills (838 m) situated near the west central boundary of the map area (Tp p 88, R 25). A small hill (640 m) in the vicinity of the Deadwood Forestry Tower marks the eastern edge of a spur that extends from the flanks

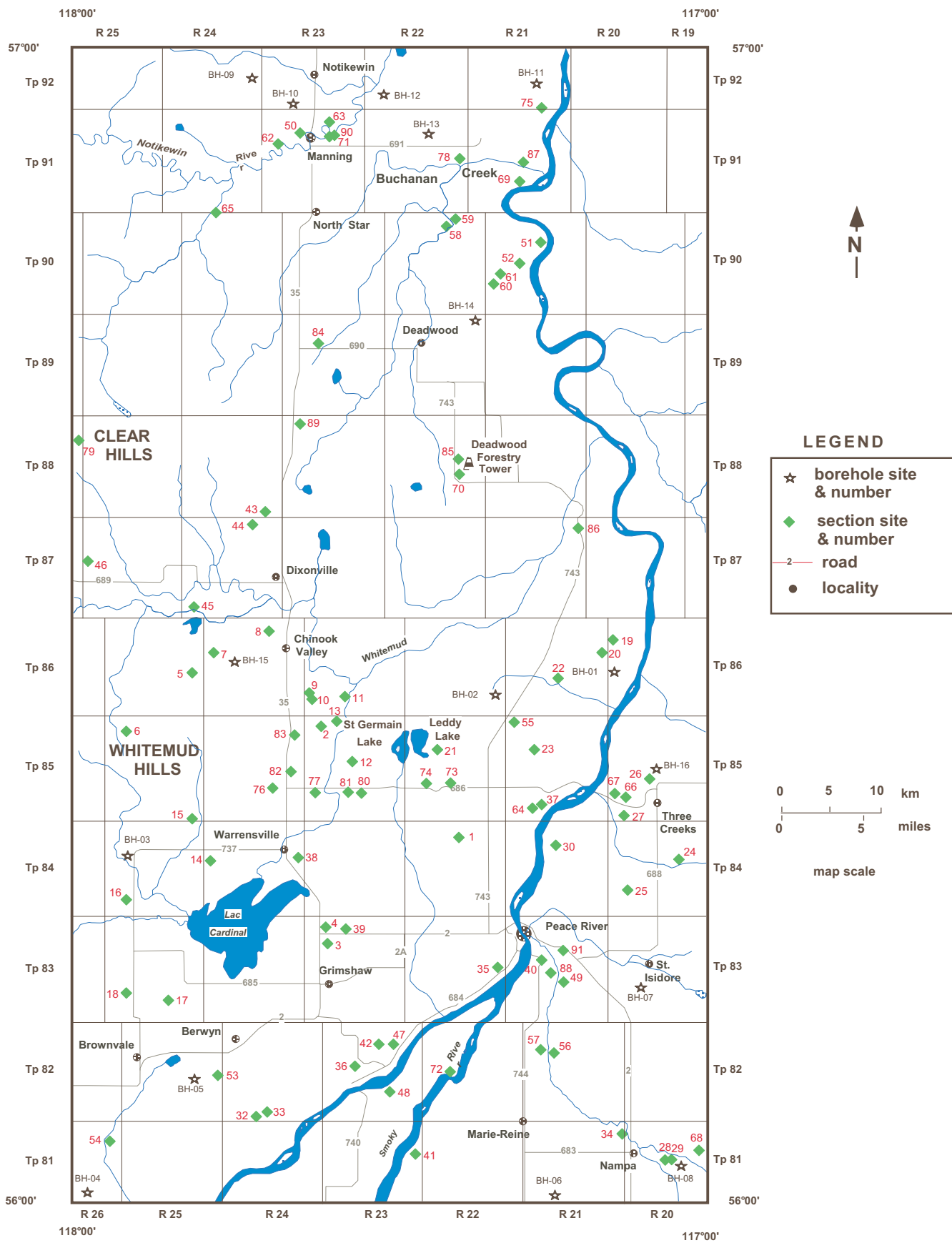


Figure 1.1. Location of geologic sections and boreholes, Peace River study area.

of the Clear Hills to form a prominent east-west trending ridge in the central portion of the map area. The Whitemud Hills (823 m), northwest of Lac Cardinal in the southern half of the area, forms the third upland. The plain adjacent to the Whitemud River, mentioned in the preceding paragraph, is situated between the Clear and Whitemud hills.

Four major rivers drain the study area, the Peace, Smoky, Whitemud and Notikewin. The largest river is the Peace with a valley depth of about 250 m. This river enters through the southwestern corner of the map area, flows northeasterly bisecting the Peace River townsite where it turns and follows in a meandering channel northward adjacent to the eastern margin of the map area. Up to six terrace levels have been mapped along the Peace River in the northern half of the map area. The Smoky River, the second largest, has a valley depth of 210 m near its confluence with the Peace. The Whitemud River carries the smallest volume and drains the central portion of the map area. It enters the west-central portion of the map area, within a floodplain and then begins to incise near Chinook Valley. From this point east to the Peace River, the valley's depth increases rapidly from 10 m at Chinook Valley to 110 m at its confluence with the Peace River, 45 km away. The meandering Notikewin River, with numerous oxbows, drains to the east into the Peace River and is situated along the northern edge of the region, flowing through the town of Manning. Its river banks, composed almost entirely of a dense, dark grey till, form vertical walls ranging from 10 to 35 m in height. The floodplain of this river valley, within the map area, is characterized by three terrace levels and point bars with well developed scroll bars. Throughout the map area, extensive slumping is observed along most of river, creek and stream banks. Paired and unpaired terraces are common.

The one major lake in the region, Lac Cardinal (100 km²), has a maximum depth of about 3 metres and is fed by perennial streams originating from the Whitemud Hills to the northwest. The lake drains to the northeast via Cardinal Creek and into the Whitemud River. Smaller lakes of note are St Germain and Leddy lakes, situated approximately 15 km northeast of Lac Cardinal. Many creeks and streams, often intermittent, cover the area. Ponding is variable, forming extensive swamps, bogs, sedge marshes and muskegs.

1.2.2 Bedrock Geology

The study area is underlain by the eastern limb of the Alberta Syncline which dips at a low angle towards the south (Rutherford, 1930). Cretaceous bedrock (Figure 1.2) includes the Fort St. John and Smoky Groups (Green, 1972; and Hamilton et al 1994). The formations within these Groups form continuous horizontal units dipping gently towards the northeast (Borneuf, 1980). Bedrock exposures are restricted primarily to river and stream banks, and occasionally along road cuts.

The Fort St. John Group includes the Shaftesbury and the Peace River formations. The lowermost unit in the area is the Lower Cretaceous Peace River Formation (Figure 1.2),

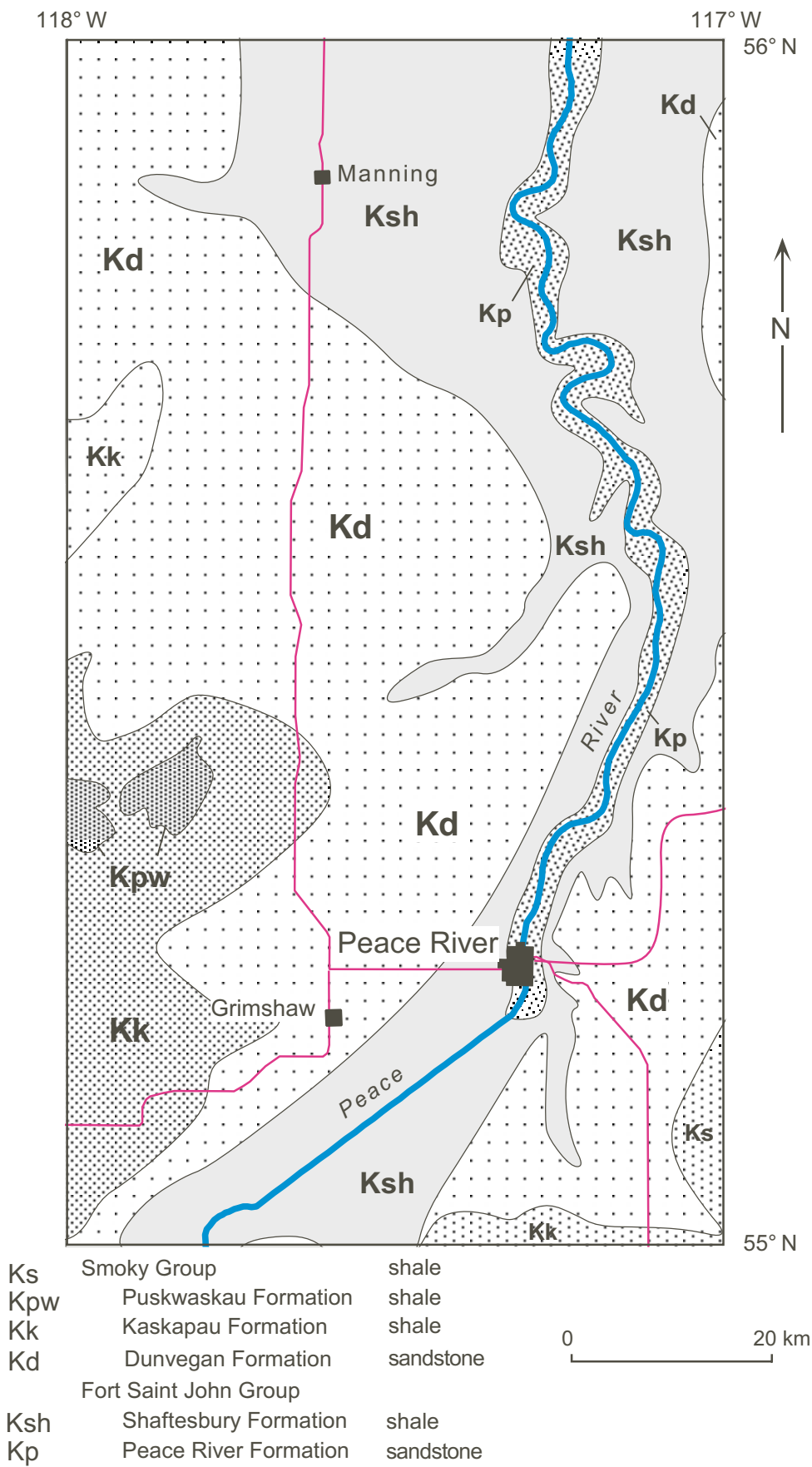


Figure 1.2 Bedrock geology map of the study area (from Green, 1970 and Hamilton and others, 1994).

which includes sandstones (Paddy and Cadotte members) underlain by shale (Harmon Member). The Paddy Member is a lithic, calcareous, continental greywacke with thin coal seams. Some marine fossils may occur. This unit is restricted to the southwestern portion of the Peace River sheet and is thickest (40 m) south of Clear Hills. The Cadotte Member is a marine, clean, coarse to fine grained, massively bedded sandstone. Alternating bands of thinly bedded sands and shales, and concretions 3 to 5 m in diameter are common. The Cadotte is 12 to 52 m thick. Notable fossils include *Gastrolites*, *Inoceramus cadottensis*, starfish and arenaceous foraminifera (Glass, 1990).

The Paddy Member and portions of the upper part of the Cadotte Member are exposed in vertical cliffs (up to 30 m in height) at the townsite of Peace River and downstream for about 10 kilometres. The lowermost unit, Harmon Member, consists of soft, fissile, non-calcareous, dark grey shale. Thin beds of bentonite and siltstone may occur. The Harmon Member varies from 10 to 34 m thick. The same fossils found in the Cadotte Member are present in the upper portions of the Harmon Member (Green, 1972). Exposure of the Harmon Member is restricted to river level of the Peace River within and north of Tp 90 and along Buchanan Creek at its confluence with the Peace River.

The overlying Shaftesbury Formation spans the boundary between Early and Late Cretaceous and contains fish-scale bearing, friable, dark marine shale, many nodules, and thin beds of concretionary ironstone (Green, 1972). Bentonite partings may occur. The lower portion of this unit contains thin silty and sandy intervals and abruptly overlies the Peace River Formation. The Shaftesbury is characterized by endemic ammonites, *Neogastrolites*, *Irenicoceras*, and *Beatonoceras*, *Posidonia nahwisi*, and *Holcolepis* (Glass, 1990). The fish-scale zone of the Shaftesbury Formation is a significant geophysical marker horizon. Several exposures of the Shaftesbury Formation have been noted along the Peace River, at its confluences with the Smoky and Whitemud rivers, and along Buchanan Creek (Figure 1.2). Roadside exposures include one south of Whitemud River along Highway 743 (Section #86).

The Dunvegan Formation of Late Cretaceous age, is a grey, fine-grained, feldspathic sandstone with thin beds of shale, shelly limestone and coal. Origin ranges from deltaic to marine. The Dunvegan is overlain conformably (transitionally) by the Kaskapau. Its lower contact is conformable with the Shaftesbury Formation. Fossils include shallow marine fauna, numerous conifers, cycads and ferns (Glass, 1990). This unit is exposed in river cuts along the Peace River, the northern part of the Smoky River (Figure 1.2), and along the Whitemud River east of Chinook Valley (Section #11). Smaller outcrops occur along Highway 743 near the Deadwood Forestry Tower (Section #85).

The Smoky Group, marine in origin and Late Cretaceous in age, contains the Kaskapau, Bad Heart and Puskwaskau formations (Figure 1.2). The lowermost formation, the Kaskapau, contains dark grey, fissile, carbonaceous shale with thin concretionary ironstone beds. The lower portion is interbedded with fine-grained, quartzose sandstone and thin beds of ferruginous oolitic mudstone. Its lower contact is transitional with the Dunvegan. Fossil assemblages in the formation include: *Inoceramus*, *Inoceramus*

(*Mytiloides labiatus*, *Dunveganoceras*, *Watinoceras*, *Scaphites s.l.* (Glass, 1990). This formation underlies the northern half of the region, and caps both the Whitemud Hills and the southeastern flank of the Clear Hills below 760 m elevation (Figure 1.2). Its thickness is approximately 160 m along the Smoky River. The Kaskapau is exposed in two small road cuts along Highway 35, a few kilometres north of Chinook Valley (Sections #82 & #83).

The Bad Heart Formation contains medium to coarse grained marine, quartzose and ferruginous oolitic sandstones and mudstones. Numerous marine fossils including: *Scaphites*, *Inoceramus stantoni* and *Pinna*, and bands of chert pebbles are present (Glass, 1990). The Bad Heart Formation is rarely exposed in the study area. Tokarsky (1967) noted that this formation is present in the Whitemud Hills at the elevation of about 760 m. The Bad Heart also shown as a thin line on that portion of the bedrock map south of the study area from south Watino through to Fahler. This unit is conformable with both the Puskwaskau and the underlying Kaskapau formations, pinching out towards the east. Thickness varies from 1.5 to 8 m.

The Puskwaskau Formation, a dark grey fossiliferous shale, is the youngest formation of the Smoky Group and of the bedrock units of the Peace River map sheet. The Puskwaskau Formation is composed of thinly bedded, dark marine shales with some speckled shale in the mid-portion. Tokarsky (1967) suggested that the Puskwaskau caps the Clear and Whitemud hills above 760 m elevation. No exposures were found in the map area. The Puskwaskau Formation is conformably overlain by the Wapiti Formation.

1.3 PREVIOUS WORK

1.3.1 Peace River Study Area

Some of the earliest work in the Peace River area was completed by Rutherford (1930). It was not until the late 1960's and into the 1970's that the area became extensively studied by the Alberta government, in particular, the Alberta Research Council and Alberta Energy. As a result, there are several reports (e.g. Jones, 1966; Tokarsky, 1967, 1971; Scheelar and Odynsky, 1968; Borneuf, 1981; and Ozoray, 1982) on the Peace River area from which information on drift material and surficial geology is available. Some surficial geology maps have been presented in reports (e.g. Jones, 1966; Scheelar and Odynsky, 1968; Tokarsky, 1967; Borneuf, 1981; and Fox *et al.*, 1987). These reports are generally of a regional scale and represent limited detail of surficial glacial deposits and geomorphology. Tokarsky (1967) described surficial sediments and glacial landforms for the area around Grimshaw-Lac Cardinal. There has been no work completed on the glacial stratigraphy of the Peace River area.

1.3.2 Regional Area

Much of the research in regards to the glacial history of northern Alberta has focussed on the Laurentide Ice Sheet and its interactions with Cordilleran ice during the last glaciation (Westgate *et al.*, 1972; Fenton, 1984; Fulton, 1989; Liverman *et al.*, 1989). Work west of

the area suggests that Cordilleran Ice did not extend into the study region (Liverman, 1989). The deglaciation history of northwestern and central Alberta has been documented (Taylor, 1960; St-Onge, 1972; Matthews, 1980). These provide a chronological sequence for the extensive glacial lakes that formed during initial stages of deglaciation as the result of meltwater dammed by the Laurentide Ice Sheet.

1.4 METHODOLOGY

Several techniques were employed to determine the surficial geology and glacial history of the region: a) preliminary research; b) field mapping, drilling and sampling; c) laboratory analyses; and d) computer data manipulation and synthesis.

1.4.1 Preliminary Research Techniques

This includes preliminary work such as the interpretation of Alberta Government black and white airphotos (scale 1:63,360) taken in 1984 and a review of all water-well logs presently on the database registry at the Alberta Environment Groundwater Branch. Airphoto interpretation, completed prior to conducting field work, identified surficial map units and geomorphic features based on morphology, tone of the airphotos and drainage patterns. These were refined and verified during the field seasons. Water-well logs were used to provide supplementary information in determining the lateral continuity of subsurface units, their stratigraphy, and bedrock topography.

1.4.2 Field Techniques

The study area was mapped, drilled and sampled during the 1993, 1994 and 1995 field seasons. A total of 91 stratigraphic sections and 16 cored boreholes are described in Appendices A and B. Field work was restricted to reasonably accessible areas due to time and manpower constraints. Access in the region was accomplished by truck, canoe and foot traverse.

Section samples were taken from the C-horizon and lower with a minimum sampling depth of 0.5 m and descriptions recorded in field notes. Borehole log descriptions were completed in the field using continuous five foot core lengths of approximately 7.5 cm diameter. These were recovered from a split tube sampler (CME core barrel) advanced inside the hollow stem auger as the borehole was drilled. The maximum core length was 45 m. The cores were boxed and shipped to an Alberta Geological Survey storage facility in Edmonton. The cores were later photographed and subsampled.

The majority of samples were from tills, gravels and waterlain diamicts. Samples representing local bedrock, glaciolacustrine, and glaciofluvial deposits were obtained for comparison. Larger samples, about 3 to 5 kg, were collected for lithological, granulometric and geochemical analyses. Multiple samples were taken from larger sections to try and obtain information on lateral and vertical variations of individual units.

1.4.3 Laboratory Techniques

Samples from stratigraphic sections and cores were analyzed by various methods to determine their geochemical, heavy mineral, granulometric, and lithologic characteristics. Granulometry and lithology analyses were conducted at the University of Alberta Quaternary Laboratory.

1.4.3.1 Geochemical Analysis

The <0.063 mm fraction of 165 surficial and core samples was recovered for geochemical analyses. These samples, representing till, waterlain diamict, glaciolacustrine, and bedrock units, were sent out for Atomic Absorption and Induced Neutron Activation analyses. Results are presented by Fenton and Pawlowicz in their northern Alberta MDA project report.

1.4.3.2 Heavy Mineral Analysis

Bulk, 26 kg, till samples from two cores (BH-01, BH-04) and five sections (94-LL-27, 94-LL-34, 94-LL-35, 94-LL-40, 94-LL-42) were taken for mineralogical studies. Heavy minerals in the sand-sized fraction were processed by the Saskatchewan Research Council (SRC) for diamond indicator mineral grains. Suitable grains were then hand picked for microprobe analysis. Results from this work are presented by Fenton and Pawlowicz in their northern Alberta MDA project report.

1.4.3.3 Granulometric Analysis

Samples of approximately 50 grams were prepared and analyzed using combined hydrometer and sieving techniques according to modified American Society for Testing and Materials methods (ASTM, 1967). The results were analyzed for several granulometric parameters (Folk, 1974) and for sand/silt/clay percentages. These were completed in order to determine areal and vertical dispersion patterns and to characterize the surficial units. Results of granulometric analyses are found in Appendix D.

1.4.3.4 Pebble Lithologic Analysis

Lithological identification of the pebble fractions (>#18 mesh, 1 mm, sieve) of the samples was completed by visual inspection of fresh surfaces (as required) with the aid of a hand lens. Pebbles were collected from both till and gravel units. Most of the surficial till units have less than 15% pebbles (~2cm or more) and hence a much larger area had to be sampled to collect the requisite 50 pebbles. Other pebble samples were collected from gravel units of preglacial, glacial and postglacial origins exposed in various gravel pits or section. The results of pebble lithologies are found in Appendix D.

1.4.4 Computer Data Manipulations

A base map was initially digitized with geographic information such as major water bodies (i.e. lakes, rivers, and creeks), roads, legal subdivision description grid, place localities, and railways. The map was converted to Canvas[®] (version 3.5) format where surficial geology information was added. Scaling to 1:100,000 was accomplished by fitting the map to the 1:100,000 scale Alberta Forestry map. All surficial geology information was input by hand.

2.0 SURFICIAL GEOLOGY

The surficial geology map (Figure 2.1) displays six mappable units based on composition, thickness, morphology and drainage characteristics: organic deposits (Unit 1); alluvium (Unit 2); colluvium (Unit 3); glaciolacustrine deposits (Sub-units 5a, 5b, 5c, 5d); morainal deposits (Sub-units 7a, 7b); and undifferentiated morainal deposits (7a/1, 7a/5, 7a/8). These map unit numbers are the same as those shown on the surficial geology map, prepared as the second part of this MDA project, for the west half of the Winagami map area (National Topographic System 83L W1/2) which adjoins the southern boundary of this study area.

Aeolian (Unit 4), glaciofluvial (Unit 6), and bedrock (Unit 8) units are not shown as separate map units because they are either too small to map or not present as a surficial unit. Map unit boundaries are transitional and should be viewed as approximate. Areas where more than one map unit is dominant or cannot be differentiated are indicated by a slash (eg. Unit 7a/1).

2.1 SURFICIAL MAP UNITS

2.1.1 Organic Deposits (Unit 1)

Organic deposits include marshes, swamps, fens and bogs of variable extent. They occupy shallow basins and poorly drained areas. These deposits are extensive, often covering several square kilometres, particularly near St. Germain and Leddy lakes, and the Clear and Whitemud hills. Organic deposits infill many of the relict meltwater channels in the Peace River area.

2.1.2 Alluvial Deposits (Unit 2)

Alluvial deposits contain moderately sorted sand, gravel, silt and clay. Reworked material from slump faces is also common. Most of this material is restricted to the present day river valleys, however remnant floodplains have been noted along the upper flanks of the valley walls. Material is deposited as channel fill, bars, floodplains and terraces. There are up to six terrace levels present along the Peace River generally restricted to the northern half of the region. The Notikewin River has three well defined terrace levels

present at elevations, in the Manning area, of 10, 20 and 30 metres above river level. Many terraces are major aggregate sources for the region. Multiple active gravel pits are present along the Peace River, particularly near the Peace River townsite and east of Manning.

Extensive floodplain deposits are found in the Notikewin and Whitemud rivers, in comparison to the Peace River where floodplains are significantly smaller in area. The floodplain of the Whitemud River, situated between the Whitemud and Clear hills, at about 640 m (2100 ft) in elevation, is the highest elevation floodplain in the area.

2.1.3 Colluvial Deposits (Unit 3)

Colluvium is comprised of a variety of slumped material, including till, clay, silt, sand, gravel, organic material and bedrock. These slumps form the gently undulating slopes of the major rivers. In areas of active slumping (Heart, Notikewin, Peace and Smoky rivers), valley sides are flanked by large scalloped hummocks and ridges. Some sections along these rivers contain sediment gravity flow structures, such as flow noses, convoluted laminae and slickensided detachment surfaces. Blocks of material may also contain either normal or reverse faulting.

Colluvium is actively deposited along the valley sides of all rivers and streams as a result of surface runoff and poor drainage. In many regions, particularly the Peace River townsite, slumping has required extensive preventive engineering of valley walls to prevent damage to residences, highways, railways and bridges.

2.1.4 Aeolian Deposits (Unit 4)

Aeolian deposits are composed primarily of moderately to well-sorted sand and silt. They form parabolic, irregular and linear dunes and ridges. These deposits are covered by forest vegetation and grasses. The areal extent of these features were not large enough to map as a discrete unit. Remnant parabolic dunes are present north of Dixonville, south of Deadwood and east of Leddy Lake.

2.1.5 Glaciolacustrine Deposits (Unit 5)

Deposits of glaciolacustrine origin are composed of laminated to massive units of silt and clay, with minor amounts of sand and diamict, and the occasional dropstone. Thickness varies from less than 2 m to over 30 m (near St. Isidore).

Low relief hummocks, ridges, flutes and slump scars typify the surface morphology. Relief is generally less than 2 m, but may reach 5 m. Glaciolacustrine deposits are divided into four sub-units (Figure 2.1) based primarily on morphology and drainage: subdued, flat to fluted (Sub-unit 5a); variable, flat to hummocky (Sub-unit 5b); hummocky (Sub-unit 5c); and hummocky and kettled (Sub-unit 5d).

Sub-unit 5a is a predominantly flat to low relief map unit of limited extent. Massive to laminated silts and clays dominate this area, however patches of organics are widespread. Drainage mimics the subtle fluting/ridged and groove patterns indicating general ice flow orientations.

Sub-unit 5b contains minor variations in morphology and drainage of which some are too localized to differentiate at this map scale. This unit varies from low-relief, flat areas to ridges, flutes, and grooves; and large (>3 m high) hummocks. Compositionally, the unit is dominated by silts and clays with minor fine sand and diamict. The unit is usually massive to laminated, but convoluted beds have been noted. Well to poorly-drained areas with local ponding and organics occur throughout the region. Grooves are widespread in the Marie-Reine and Nampa localities. Ridges and flutes are common at elevations between 580 to 640 metres south of Lac Cardinal between Berwyn and Grimshaw.

Sub-unit 5c is dominated by hummocks up to and occasionally exceeding 5 m high. Massive to laminated silts, clays and minor fine sand comprise the hummocks. Distribution of this unit appears confined to areas on the plateau adjacent to the Peace River with only minor patches elsewhere within the Peace River sheet. Organic sediments are widespread, partially infilling many of the depressions in this map unit.

Sub-unit 5d is dominated by hummocks and kettles. This unit forms a generally narrow unit bordering a morainal unit in the Manning area at approximately 487 m (1600 feet) elevation. Sub-unit 5c and 5d have somewhat similar morphology and composition. Sub-unit 5d however has extensive areas where ponds occupy the depressions, forming a kettle-like topography.

2.1.6 Glaciofluvial Deposits (Unit 6)

These deposits are not shown as separate map units because they are either too small to map or not present as a surficial unit. Glaciofluvial activity is evident by the presence of meltwater channels found notably in the Clear Hills and scattered elsewhere throughout the map area, generally associated with morainal deposits. Broad and shallow channels with poorly preserved sides are found east and west of Manning, near Chinook Valley, around Leddy and St. Germain lakes, and north of Brownvale. Other channels which are narrow with distinct steep walls are predominantly found in the Clear Hills. Most of the deposits appear to have been reworked by glaciolacustrine and/or morainal depositional processes.

2.1.7 Morainal Deposits (Unit 7)

Ablation, englacial and basal till (Unit 7) underlie most of the area. The thickness of Unit 7 ranges from less than 3 m to greater than 43 m. Morainal deposits can be subdivided into two units based on morphology, drainage and texture: mixed (Sub-unit 7a), and hummocky and kettled (Sub-unit 7b). All subunits may include small pockets of glaciofluvial, glaciolacustrine, aeolian, alluvial and organic deposits.

Sub-unit 7a (mixed unit) consists of ridges, hummocks, kettles and plains inseparable at this map scale. Relief for ridges and hummocks can exceed 5 m. Drainage is irregular. Compositionally, the unit contains brownish-grey to brown, ablation to englacial till, silty to clayey in texture, with a clast content of 15% or less. Fine sand lenses and laminae may be present. The clasts are sub-angular to sub-rounded, fresh to highly weathered and very friable. Lithologically, they are dominated by a mixture of local (e.g. coal fragments, shales, siltstones, and sandstones) and Canadian Shield/Paleozoic rock types (e.g. metamorphic, granites, carbonates, mafics, and volcanics) material. Cordilleran material (e.g. chert, quartzite, sodic granites, felsic volcanics, and sandstone) are also present where the till overlies the Grimshaw Gravels (Tokarsky, 1967).

Sub-unit 7b is a typical hummocky terrain associated with ice stagnation. Hummocks are irregular in shape and form "a basket of eggs" topography. Depressions commonly contain water during the spring and summer. Relief can exceed 10 m in height. Lower relief regions are used for crops, while the higher relief areas are restricted to grazing or forestry. This unit contains ablation and englacial till similar in composition, texture, colour and lithology to sub-unit 7a.

2.1.7.1 Undifferentiated Morainial Deposits (Units 7a/1, 7a/5, & 7a/8)

Unit 7a/1 consists of morainial deposits and organic deposits distributed over large areas and commonly found at higher elevations. The organic deposits are too small and abundant to map individually. They are found in the Clear and Whitemud hills, Deadwood Forestry Tower, and the St. Germain and Leddy lakes areas (Figure 2.1). Their morphology and composition are as described above for Units 7 and 1.

Unit 7a/5 is a mixed map unit incorporating elements of units 5 (glaciolacustrine) and 7 (moraine) which were associated with ice stagnation and periodic ponding of meltwater. The two units are combined into one unit since, individually, they are too small to map and are not easily distinguishable on airphotos. The low relief hummocks, ridges, and irregular forms are composed of a brown, oxidized, ablation till similar to sub-unit 7a. Interspersed with these are flat areas of interlaminated silts, clays and minor sand and diamict similar to sub-unit 5a. This unit is found south of Lac Cardinal and west of Deadwood.

Unit 7a/8 includes both morainial deposits and bedrock. A small area situated around the Deadwood Forestry Tower (Tp 88, R 22) is the only locality for unit 7a/8. Bedrock is exposed along portions of the surfaces of a few large flutes with morainial deposits on the lee side and the areas between the flutes.

2.1.8 Bedrock Deposits (Unit 8)

Bedrock is present at the surface near the Deadwood Forestry Tower. It is described above in Section 2.7.1, as it cannot be, for mapping purposes, differentiated from the till

unit in this area. Scouring by glacial erosion, as well as, rapid ice flow combined with little basal debris may have contributed to the bedrock being exposed.

2.2 GEOMORPHOLOGICAL FEATURES

2.2.1 Active-Ice Features

There are few good indicators of ice flow direction in the study area. Interpretation is based on flute/drumlinoid and groove orientations, arcuate morainal ridges, and areal distribution of the deposits. The areal distribution of these features suggest two major ice-flow orientations (Figure 2.1). The south to southwestward direction is stronger, and has more erosive flow movement that originated north to northeast of the Peace River map sheet. Low relief ridges, grooves and flutes south of Lac Cardinal and immediately south of Marie-Reine support this direction. Large flutes formed in the vicinity of the Deadwood Tower and other landforms crossing over upland areas suggest that this advance does not appear to have been affected by local topography.

Transverse ridges have been identified along the flanks of the uplands in the Peace River map sheet, particularly in the Clear and Whitemud hills. Their relationship to ice movement directions is associated with the stronger, more erosive southerly flow direction.

Other arcuate-shaped moraine ridges are found in the Clear Hills. They indicate a southeast flow direction probably associated with minor ice fluctuations that occurred during the initial stages of deglaciation. This direction may be a possible effect of ice streaming or diversion around local topographic features. The ice originated to the north and northwest of the Peace River map sheet.

2.2.2 Meltwater Features

Two types of meltwater channels are recognized. The broad, shallow and generally poorly defined channels are believed to have formed subglacially beneath what is interpreted to be stagnant and/or inactive ice. For these channels to form the meltwater must have been contained by some means; hence the interpretation that these were formed subglacially. The second type, are relatively long, sinuous, and steep-walled channels. These are interpreted to have formed at the base of ice walled channels. The narrow channels most likely formed later in the deglaciation when meltwater flow was confined between the walls of ice blocks. It is believed that at this stage large ice blocks were left behind at higher elevations as a result of the ice front of the Laurentide Ice Sheet rapidly melting back toward the north in part due to calving into the glacial lake occupying the broad Peace River lowland.

2.2.3 Post Glacial Features

Post-glacial features include remnants of possible beach deposits and of parabolic dunes. The beach deposits were first identified by Matthews (1980). These features, found south of Lac Cardinal, are not exposed in section and are very difficult to distinguish at ground level. Based on airphoto interpretation, they are straight to wavy, and appear to consist of sand because they are well-drained. These attributes therefore suggest beaches.

Sand dunes are poorly represented with only portions of their parabolic shapes preserved. Their composition is inferred by the light tone (i.e. well-drained) characteristic. Dunes are located east of Leddy Lake, near Dixonville, and west of the Deadwood Forestry Tower. The wind directions for these are south to southwest in Dixonville and Deadwood Forestry Tower area. In contrast, the dunes east of Leddy Lake suggest a north to northeast direction. Topography and position of the ice front would be some of the major factors dictating which wind direction would prevail. Hence, having directions with essentially 180° variance may not be uncommon in a glacial setting where large blocks of stagnant ice are present.

2.2.4 Recent Features

Slump scars and terraces form the Recent age landforms of the region. Slumping of the river valleys were initiated a short time after downcutting commenced. The instability of the till and glaciolacustrine sediment, and in places the shale bedrock, has resulted in continued slumping to present day.

Terraces superimposed on slumps, north of the Shaftesbury Ferry, indicate that terraces did not form until after slumping was initiated. Up to six terraces have been identified along the Peace River. These are poorly defined and generally restricted to the northern portion the region. Terraces are also present along the Notikewin River. Here there are three well defined levels at approximately 10, 20, and 30 metre levels. Scroll bars are easily identified on airphotos of the lowermost floodplain of the Notikewin River.

3.0 BEDROCK TOPOGRAPHY AND DRIFT THICKNESS

3.1 PREVIOUSLY IDENTIFIED BURIED CHANNELS

The surface of the bedrock is irregular. Many buried channels, likely Tertiary in age, occur throughout the area. The largest of these channels is located north of the Smoky River (Henderson, 1959) and along the Peace River (Shaftesbury Channel, Tokarsky, 1967). Smaller channels include the Manning (Marciniuk and Kerr, 1971), Berwyn and unnamed ones near Dixonville and Three Creeks (Tokarsky, 1967).

4.0 QUATERNARY STRATIGRAPHY

4.1 UNIT DESCRIPTIONS AND INTERPRETATIONS

Many of the units seen in stratigraphic sections have been previously described in the surficial and bedrock sections. A total of six major units, not including bedrock, have been recognized in the outcrops and boreholes. Many of the units are stratigraphically correlative (A to F, Figures 4.1, 4.2 and 4.3). The location of the geological sections and boreholes mentioned below are shown in Appendix A1 and B1 respectively and shown on Figure 1.1.

4.1.1 Bedrock

The lowermost unit in all cross-sections is bedrock. Due to the variability of the bedrock (see Bedrock Geology section in the Introduction), this unit was not designated a letter code. The bedrock type is dependent upon location of the section or borehole.

4.1.2 Unit A - Preglacial Deposit

The characteristics of unit A are based primarily on data from the gravel pits located in the Grimshaw area (i.e. Grimshaw Gravels, Tokarsky 1967) and the floodplain of the Peace River in the town of Peace River (Section #35 (Tp 83, R 22 Figure 1.1)) together with two exposures east of Manning (Sections #78 (Tp 91, R 22) and #69 (Tp 91, R 21)). Unit A is composed of preglacial, moderately sorted gravel (granule to boulder sized) and poor to moderately sorted fine to coarse sand. Locally, a distinctive orange oxidization stains some beds of the gravel. The clasts are sub- to well-rounded. Lithologies are dominantly Cordilleran in origin, consisting primarily of quartzites, sodic granites, felsic volcanics, ironstones, chert and sandstones. Large-scale, trough cross-bedding shows a weak paleocurrent direction towards the north to northeast in the Peace River area, and east (090 degrees) and north (360 degrees) orientations in the Manning area. Thickness is variable overlying shales of the Shaftesbury Formation in the Peace River Valley and Dunvegan sandstone/siltstone in the Grimshaw to Leddy Lake area. Its upper contact varies from conformable to abrupt. In the Peace River area, exposures of Unit A are 30 m (Grimshaw Gravels) to less than two metres thick (Section #69 (Tp 91, R 21)) and are overlain by either units B or C.

Unit A is found in paleochannels cut into the underlying bedrock, or in the case of the Grimshaw Gravels, as upper terrace deposits. This unit is thought to be the northern equivalent of the Saskatchewan Sands and Gravels (Tokarsky, 1967). The age of the sediments is questionable, due to a lack of dating control. Fossils found in a Peace River gravel pit are associated with a fossil assemblage that may be similar to that found at the Watino section. Sediments in the lower portion of the Watino section have been interpreted as Tertiary or Sangamon in age (Liverman *et al* 1989, Matthews 1980). Unit A is a major source of aggregate in the Peace River/Grimshaw and Manning areas.

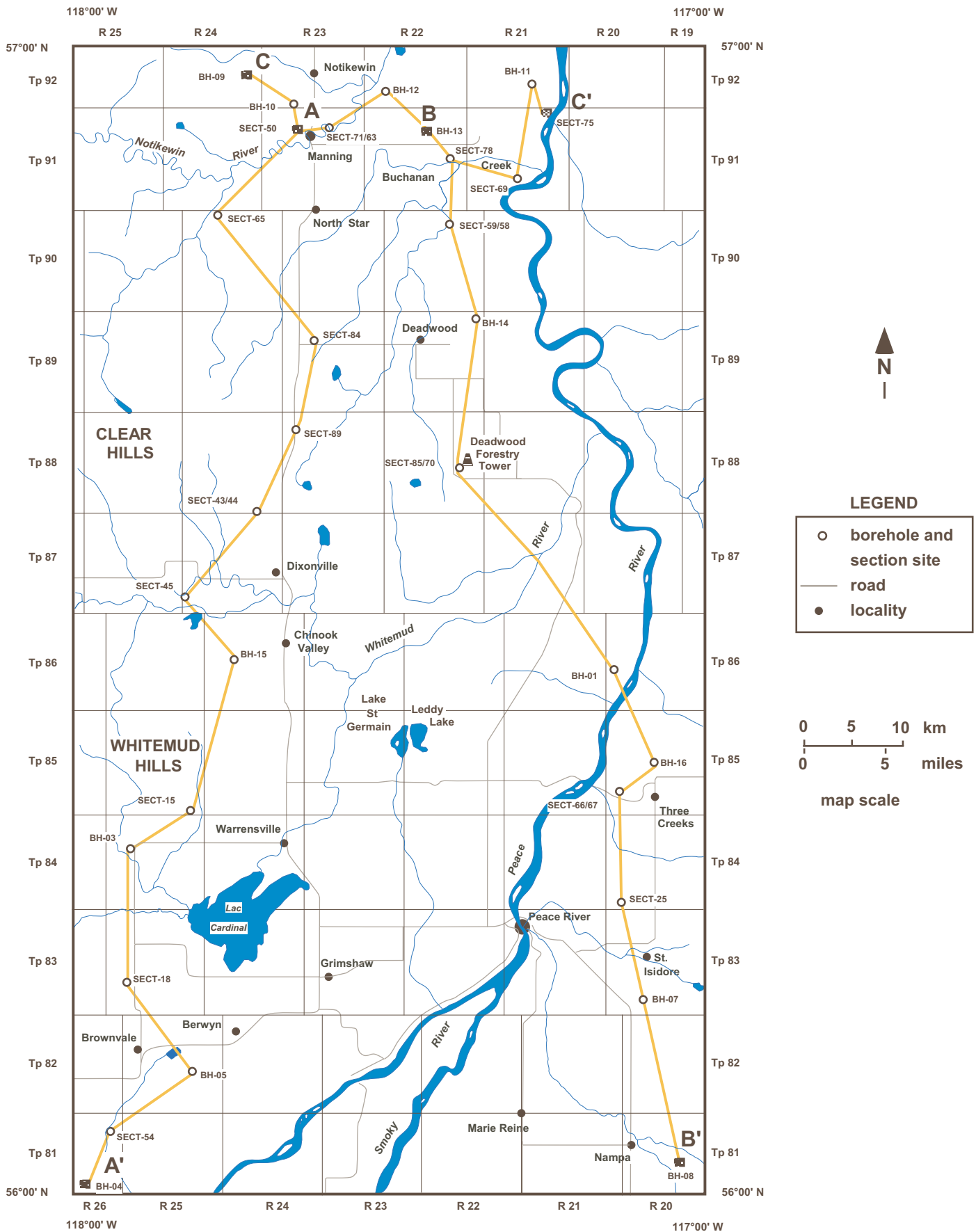


Figure 4.1. Location of geologic sections, Peace River study area.

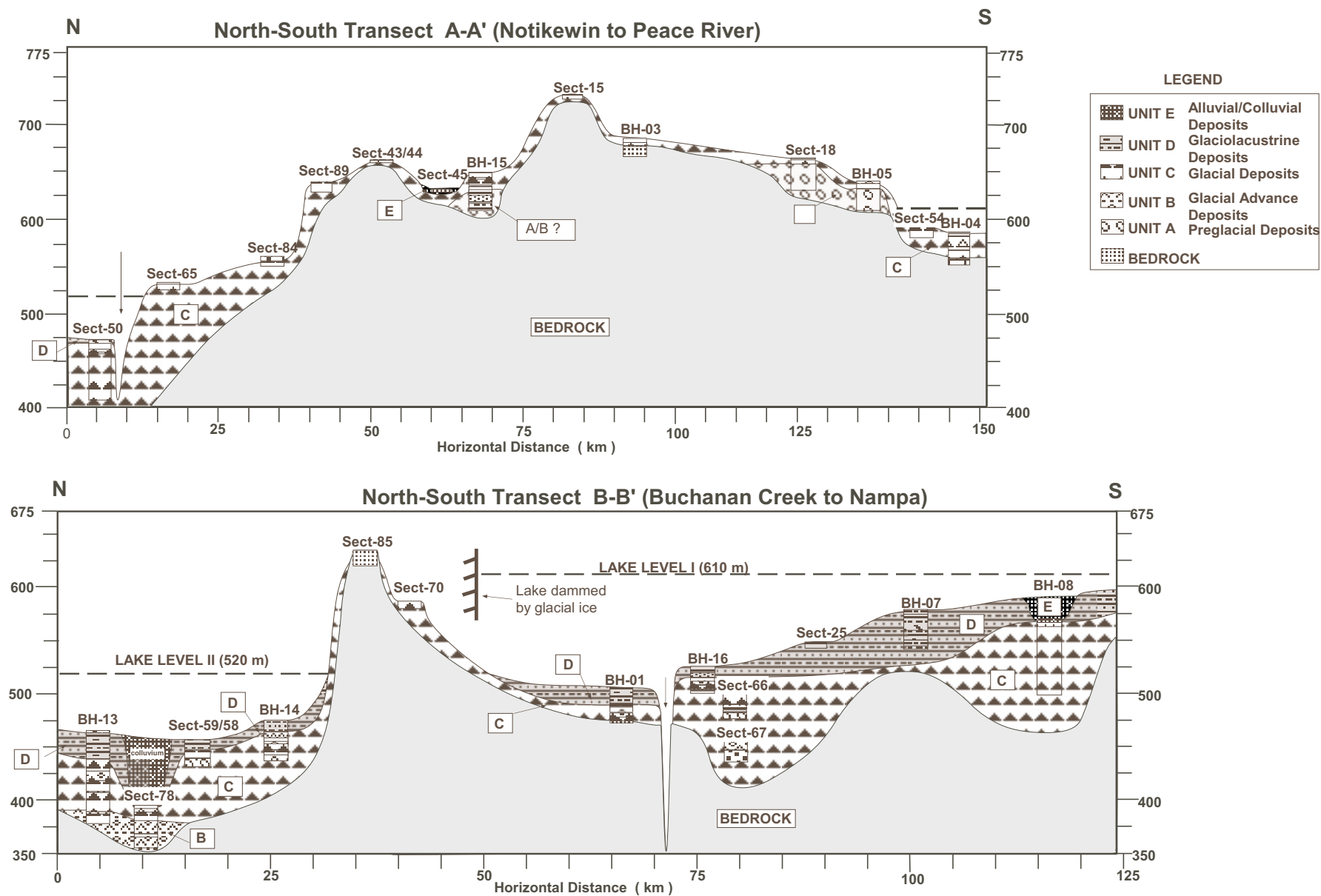


Figure 4.2 Peace River Cross-sections A-A' and B-B'.

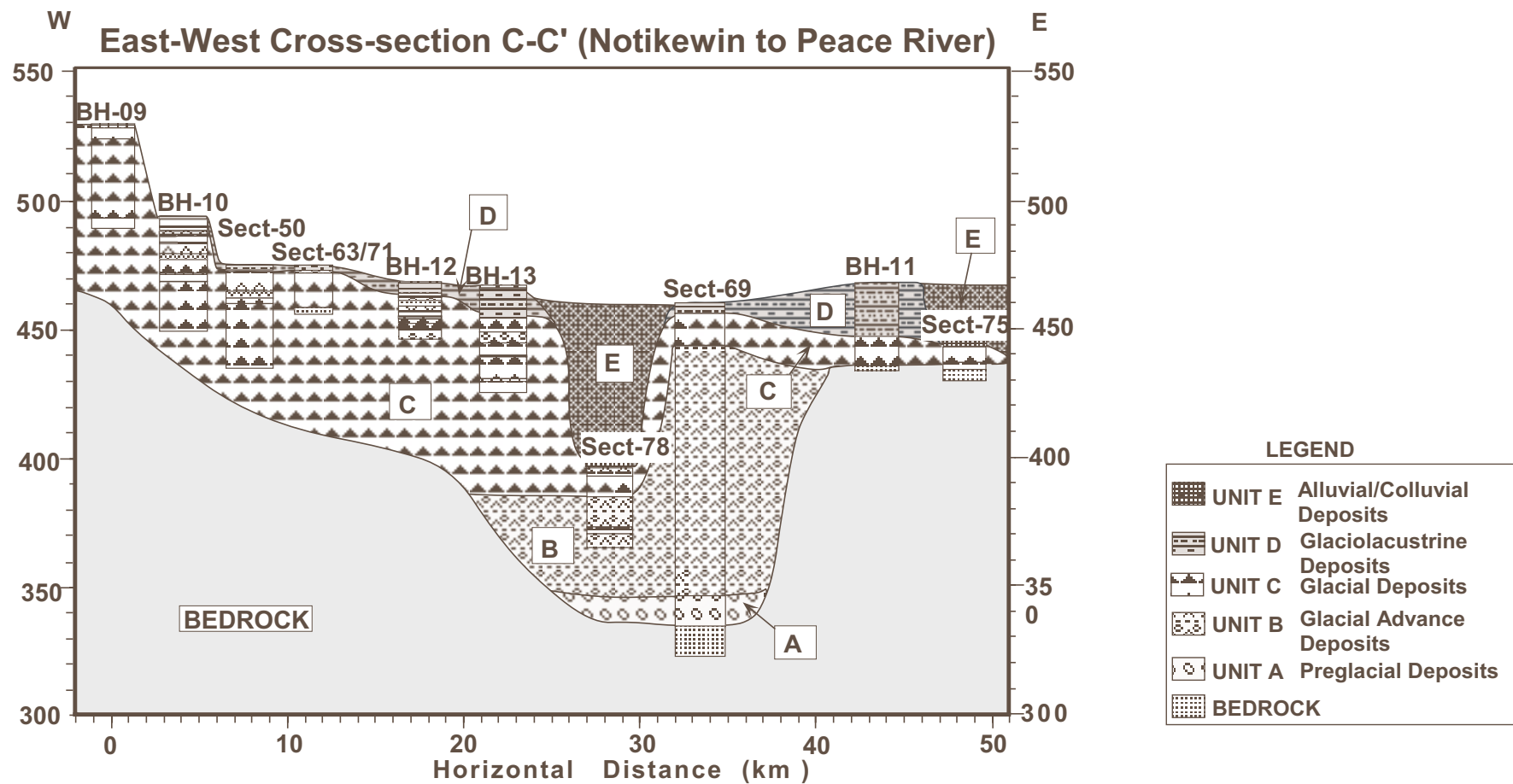


Figure 4.3 Peace River Cross-section C-C'.

4.1.3 Sub-unit B1 - Early Glacial Advance Deposit

The early advance deposit (Sub-unit B1) is represented by sands and gravels containing clasts of Canadian Shield provenance. The deposit is exposed in Sections #49 (Tp 83 R 21), #69 (Tp 91 R 21) and #91 (Tp 83 R 21). Thickness of this unit is not clearly defined as the underlying and overlying units are of similar texture and sedimentary origin. The deposit consists of gravel and sand interbeds with gravel beds becoming thinner and sand beds thicker up section (i.e. fining upwards sequence). Pebble lithologies present in this unit include rock types from the Precambrian Shield. A sand bed is believed to be in contact with the underlying sand and gravels of Unit A. Both the upper and lower contacts were either covered or not able to be identified in the exposures.

4.1.4 Sub-unit B2 - Late Advance Glacial Deposit

Sub-unit B2 contains a mixture of sediments including fine to coarse sand, gravel, diamict and massive to laminated silt and clay. Unit B2 is conformably overlain by unit C.

The deposit contains material of Canadian Shield origin, frequently containing thick tabular diamicton beds (2-4 m thick), and directly underlies a glacial till unit. Therefore, this unit is interpreted to have resulted from deposition of glaciofluvial material and debris flows generated near the ice front from advancing Laurentide Ice. The unit is well exposed in several exposures (Sections #36 (Tp 82 R 23), #42 (Tp 82 R 23), #47 (Tp 82 R 23), #69 (Tp 91 R 21) and #78 (Tp 91 R 22)) and present in a number of drilled boreholes (BH-01 (Tp 86 R 20), BH-07 (Tp 83 R 20), and BH-11 (Tp 92 R 21)). Generally composed of stratified to massive sand units that include planar, trough cross-bedding and rippled structures with lesser amounts of diamicton, gravel, silt and clay.

4.1.5 Unit C - Late Glacial Deposit

Unit C is a glacial sequence subdivided into sub-unit C-1, a lower, dark grey, massive, silty clay, till and sub-unit C-2 an upper, brown-grey to brown till. Sub-unit D-1 varies from englacial to basal/deformational depending upon location and depth. Clasts (pebbles and granules) comprise approximately 8-12% of the unit. The clasts are generally subangular to well rounded, and can be very fresh to very weathered in appearance. Dominant lithologies include local bedrock (eg. coal fragments, shales, siltstone, sandstones, and ironstone), material from the northeast, (Canadian Shield and Paleozoic outcrop regions: granites, volcanics, fine-grained mafics, pink-purple quartzites, carbonates, schists), and reworked underlying Cordilleran clasts (chert, quartzites, sodic granites, felsic volcanics and sandstones).

The lower unit is generally very compact and laterally extensive. Englacial portions of the unit may contain lenses or laminae of silt, clay and/or fine to coarse sand. Lenses range from 6 to 32 cm thick. In several boreholes (BH-01 (Tp 86 R 20), BH-04 (Tp 81 R 26), BH-12 (Tp 92 R 22), BH-13 (Tp 91 R 22), BH-14 (89 R 22), and BH-16 (Tp 85 R

20)), minor amounts of pea gravel are common in the lowermost portion of the till. The lower contact varies from abrupt/sharp to gradational and/or deformational with the underlying bedrock. The upper contact may be gradational or sharp with the upper till and Unit E (waterlain sediment), and is abrupt with alluvial sediments of Unit F. Unit thickness is highly variable, ranging from less than three metres near the Marie-Reine area to well over 40 m east of the Manning and Nampa areas.

The greyish-brown to brown, weathered upper till, designated as sub-unit C-2, consists predominantly of silty-clay, but locally includes more clay-, silt- or sand-rich facies. Sandier facies are common in the Deadwood Forestry Tower and Peace River townsite areas where the unit overlies the Dunvegan sandstone or Grimshaw Gravels. Till structure varies from massive to stratified (BH-03 (Tp 84 R 25), BH-04 (Tp 81 R 26), BH-10 (Tp 92 R 23), and BH-12 (Tp 92 R 22)). Thicker laminae and lenses of silt and occasionally sand are common. The till is predominantly ablation in origin, but thicker sequences contain englacial and glaciofluvial material.

Clasts comprise approximately 15% of the unit. Local lithologies, derived from soft young age bedrock, are friable and sub- to well-rounded although they have been transported relatively short distances by glacial ice. Conversely, Canadian Shield material, which in general is significantly more resistant, are angular to subrounded even though these clasts have traveled comparatively much longer distances than the local bedrock material. Areas underlain by the Grimshaw Gravels contain observable percentages of Cordilleran type lithologies (felsic volcanics, sodic granites, quartzites, and cherts). These clasts are generally well-rounded and are not significantly altered as a result of glacial transport other than some having striation marks.

Large vertical, oxidized fractures are common in sub-unit C-2 and occur at depths of up to 22 m (Section #50 (Tp 91 R 23)). The fractures are usually orange-brown to brown (Fe oxide) and black (Mn oxide) in colour and contain gypsum crystals up to 4 cm in length.

Sub-unit C-2 conformably overlies sub-unit C-1 in most regions. The lower contact is usually gradational or inter-laminated to interbedded (with 10 to 30 cm beds), but locally can be abrupt. The upper contact varies from gradational to abrupt, but appears to be conformable. This upper till varies in thickness from 1.5 m to about 16.5 m (BH-04). Alteration by groundwater, meteoric water and soil forming processes is visible in exposed sections. The upper till (sub-unit C-2) is interpreted as the upper ablation/englacial facies of the lower till and is attributed to the same ice depositional event as the lower till (sub-unit C-1).

4.1.6 Unit D Glaciolacustrine Deposit

Unit D contains waterlain sediments, and can be subdivided into two sub-units: D-1, diamict; and D-2, massive to laminated silts and clays. Sub-unit D-1 is a greyish-brown laminated to massive silty-clay diamict. Thickness is generally less than 50 cm and may be up to 1 m.

Abundant granule size calcareous concretions and local dropstones may comprise up to 4-5% of the unit. The lower and upper contacts are abrupt to gradational with units C and E. Subunit D-1 is variable in extent with minor thicknesses present in a number of exposures (Sections #47 (Tp 82 R 23), #50 (Tp 91 R 23), and #64 (Tp 85 R 21)) . This unit appears to have been deposited as ice-rafted debris or as debris flows from proximal Laurentide ice.

Sub-unit D-2 contains massive to laminated silts and clays. Laminae are 1 to 30 mm thick and may be convoluted. Dropstones (variable lithologies) and carbonate concretions comprise <1% of the unit. Thicker silt bands are commonly water-saturated. The lower contact is conformable, but abrupt with Unit D and gradational to abrupt with sub-unit D-1. The upper contact is conformable with the present soil horizons or is abrupt with the alluvial and aeolian sediments of Unit E. Sub-unit D-2 varies in thickness from 2 to 30 m (eg. BH-07 (Tp 83 R 20)). The thickest portions occur near St. Isidore, southeast of the Peace River. Sub-unit D-2 is interpreted as glaciolacustrine deposits due to its massive to rhythmically laminated structure, and to the presence of dropstones. These sediments were likely laid down in glacial dammed lakes during later stages of deglaciation.

4.1.7 Unit E Recent Deposits

Unit E contains sediments of post-glacial to Recent age (surficial units 1 to 4; organic, alluvial, colluvial and eolian deposits). Detailed descriptions of these units are contained in the surficial section previously mentioned. The lower contact of these units is variable, ranging from abrupt, yet conformable to erosional (e.g. alluvium). Alluvial sediments may overlie any unit, depending upon location. Unit E, with the exception of the organic deposits, is restricted to regions adjacent to present day rivers and creeks, forming the floodplain and channel deposits associated with the incision of the rivers and creeks.

4.2 CROSS-SECTION DESCRIPTIONS

Detailed correlations in the area are difficult. Many facies changes in the Quaternary sediments are widespread and not easily correlated between boreholes and sections. In addition, the underlying bedrock has been incised by numerous paleochannels and tributaries that are poorly documented in the current literature. The bedrock topography requires refinement based on alternative sources. Presented in this report are generalized summaries and cross-sections of the stratigraphy.

Three cross-sections have been constructed to depict the generalized glacial stratigraphy of the map area. Two north-south cross-sections are located on either side of the map area, and a third, east-west cross-section, is located in the Manning area (Figure 4.1). There is little control on the bedrock topography and consequently the surfaces shown in the cross-sections are for the most part conjectural. Bedrock depths can be confirmed where observed in sections and boreholes but, information from water well logs in some instances can be unreliable.

4.2.1 Cross-section A - A'

Cross-section A-A' (Figure 4.2) begins at an exposure along the Notikewin River in the town of Manning (Section #50), extends south across the upland areas of the Clear and Whitemud hills, and ends at a borehole site (BH-04) on the plateau just north of the Peace River, near the locality of Griffin. In this cross-section the lowland areas contain variable thicknesses of drift, generally more than 30m.

The Grimshaw Gravels, included in Unit A, are present at the south end of the cross-section, directly overlying bedrock of the Dunvegan Formation. These gravels extend from the western boundary of the map area to the northeast in the vicinity of Leddy Lake. They have been interpreted to be upper terrace deposits (Tokarsky 1967). An extensive study of the Grimshaw Gravel (CAESA 1994) has defined the extent and thickness.

Sub-unit B1 intersected in BH-15 consists of finely bedded, fine to medium sand, silt, and clay, with black horizons. These sediments have a strong sulphurous odour that may be attributed to reducing conditions associated with either a weathering product of the local shale bedrock which contains sulphur beds, or organic sediments. Shell and coal fragments are also present in these lower sediments.

It was originally thought that the organic material and shell fragments should be submitted for radiocarbon dating. However, since both the shells and coal are found in the local Cretaceous bedrock, and the fine coal fragments likely "contaminate" the organic material dating of these sediments does not appear warranted. Unfortunately, without a reference point, such as a date, it is difficult to determine where Unit B(?) fits into the stratigraphic sequence. These sediments are tentatively assigned to sub-unit B1 based on their similar appearance to sediments exposed in Sections #69 (Tp 91 R 21) and #91 (Tp 83 R 21).

Unit C occupies the entire cross-section and overlies either Unit A, Unit B, or bedrock. The thickness of Unit C is quite variable. It is relatively thick in the paleochannel (e.g. BH-04 (Tp 81 R 26)) at the south end of the cross-section, less than 4 m thick overlying Unit A and perhaps no more than 8 m in the uplands of the Whitemud and Clear hills. Thickness is unknown but generally greater than 30 m around Manning. The deep preglacial topography around the Manning area may have been one of the more favorable conditions which were conducive to producing and preserving the thick sequence of till accumulations.

Unit D, glaciolacustrine sediments, conformably overlie Unit C at elevations below approximately 610 m near the Peace River and 520 m in the Manning area. Thicknesses range from 4 to 8 m, which is thin in comparison to the southeastern corner of the map where cross-section B-B' is situated. As well, the sediments are more finely bedded to interlaminated and generally coarser than Unit D in cross-section B-B'.

Unit E is only present along this cross-section as floodplain sediments of the Whitemud River (Section #45 (Tp 87 R 24)).

4.2.2 Cross-section B - B'

Cross-section B-B' (Figure 4.3) extends north-south along the eastern side of the map area. It crosses the uplands near the Deadwood Forestry Tower, intersects the Peace River mid-way, and ends at a borehole near the village of Nampa (BH-08 (Tp 81 R 20)). Unit A is not exposed in this cross-section. The fluvial sands and gravels with minor diamicton beds are of Unit B (B2). They are interpreted as sediments deposited in front of the ice by meltwater as the Laurentide Ice advanced into the area from the north. This interpretation is supported by the presence of Canadian Shield type lithologies and diamicton beds within the fluvial sediments. Like cross-section A-A', Unit C extends through the entire cross-section. It overlies either bedrock or Unit B. Unit D can be more than 30 m thick (BH-0 (Tp 83 R 20)) and is thickest at both ends of the cross-section.

4.2.3 Cross-section C - C'

This cross-section begins just west of the hamlet of Notikewin and extends east to a gully section (Section #75 (Tp 92, R 21)) above the Peace River (Figure 4.3). In this short cross-section all stratigraphic units are well represented. The large paleochannel exposed in Section #69 (Tp 91 R 21), at the east end of the cross-section, contains a very thin sequence (<4 m) of Unit A sediments. These sediments are exposed in steep-sided gullies of loosely consolidated sands and gravels, making detailed observation and sampling of the sediments very difficult. Two determining factors for assigning these sediments to Unit A were that a) they overlie bedrock, and b) no Canadian Shield lithologies were observed in the cobble gravels. The assigned contact between Unit A and B (B1) in this exposure is arbitrary as it is situated beneath a covered portion of the slope. However, Unit B1 sediments are distinguishable on the basis of composition from Unit A sediments observed at the lower end of the exposure. Unit B1 directly underlies Unit B2. Unit B2 is composed predominantly of medium to coarse sand, with minor gravel, diamicton, and silt. Unit B2, observed in Section #78 (Tp 91 R 22), consists of a coarser sequence with thicker diamicton beds. At the west end of this cross-section Unit C is of unknown thickness (>30 m) and at the east end it is only 13 m thick where it directly overlies bedrock. Unit D covers the surface (Tp 92 R 24). It is thickest at BH-11 (Tp 92 R 21), where it is 20 m thick but, in general, they are comparably thinner than Unit C in the southeastern portion of the Peace River sheet. Unit E is composed of colluvial material.

5.0 QUATERNARY HISTORY

The Quaternary history of the region is complex and the surficial geomorphology is not easily related to the underlying bedrock. A lack of sediment control and dates between the end of the Cretaceous (65 Ma) and the latest datable material (ca. 50 ka) leaves a significant geochronological gap. However, based on the information available, generalized summaries of the glacial history are described below.

The paleotopography prior to glaciation is poorly understood. There was likely an older Peace River flowing from the Rocky Mountains, along with other smaller rivers from the Clear and Whitemud hills, converging and flowing northward similar to present day. However, there is clear evidence that they flowed different paths in the past as evidenced by the many buried channels in the area. The Shaftesbury Channel (Tokarsky, 1967) flowed along the north side of the present-day Peace River at the western edge of the map area but, beyond where it crosses the river just north of the Peace River townsite, its path is uncertain. The Manning Channel (Marciniuk and Kerr, 1971) has been identified from water well sites but it too has not been well mapped. Further study would be required to map the paleochannels of the area.

The presence of deeply buried paleochannels and areas of drift extending below 40m, where the depth to bedrock is unknown, suggest that the paleotopography contained broader and deeper valleys than are present today. This is particularly evident in the area surrounding Manning and east to the Peace River, and from the town of Peace River south to the Nampa area.

The region was likely covered by at least two major glacial advances. The stratigraphic position of Unit B1 (Sections #49 (Tp 83 R 21), #69 (Tp 91 R 21) and #91 (Tp 83 R 21)), below the ice advance complex recorded by the sediments of Units B2 and C, and the presence of Shield type rocks in the B1 fluvial sediments are the bases for concluding that more than one ice advance has affected the region. There is very little information of the earliest ice advance and nothing to suggest that there may actually be more than one early advance. There is also no evidence to suggest the age(s) of earlier ice advance(s).

The paleogeography during the last glacial advance is shown in Figures 5.1, to 5.4. At the late glacial maximum of the last ice advance, presumably of Late Wisconsinan age, the region was completely covered by ice (Figure 5.1). The east-west trending uplands comprising the Clear and Whitemud hills and the upland of the Deadwood Forestry Tower (Tp 88 R 22), were not a barrier to the advancing ice but, more than likely slowed down its advance. Large flutes, including those near the Deadwood Forestry Tower, Leddy Lake, and Whitemud Hills and grooves in the Nampa area, suggest an erosive advance generally from the north. The transverse ridges cored by thrust bedrock (Section #82 (Tp 85 R 24) and #83 T85 R 24)) provide more evidence of active ice. In the lowlands, flutes and grooves were formed oriented to the southwest in and around Grimshaw and southerly in the Marie-Reine area. In the uplands, arcuate-shaped morainal ridges were formed on the south slope of the Whitemud Hills.

During the initial waning of Laurentide glaciation, ice in the uplands was probably separated or acted independently to some extent from the ice in the lowlands surrounding the town of Peace River. As a result, minor fluctuations were produced, this marking the beginning of Glacial Lake Peace Stage I of deglaciation (Figure 5.2). Arcuate morainal ridges west of Brownvale (Figure 5.1), mark the only flow indicator to suggest ice movement from the northwest. These may have been formed by ice streaming or a minor surge. Ice in the lowlands melted rapidly and a glacial lake formed in the lowlands

surrounding Peace River and extended east of the study area. The lake was fed by meltwater from the west, north and east. The shoreline of this glacial lake reached a maximum elevation of approximately 610 m (2000 ft) and persisted long enough to deposit over 30 m of glaciolacustrine sediments in the St. Isidore area (BH-06) and form beach deposits south of Lac Cardinal.

Glacial melting progressed to a stage where the glacial lake drained through an outlet to the southeast (outside of the map area) and flooded north along the Peace River to inundate the Manning Lowland. Areas of glacial ice in the uplands became completely separated from the Laurentide Ice Sheet and melted, essentially, in place. This resulted in the formation of long, sinuous, steep-walled meltwater channels along and/or between ice blocks (Figure 5.3). As well, subglacial drainage from beneath these ice blocks may have formed the lineations along the slope of the Deadwood Forestry Tower and northern slopes of the Whitemud Hills.

Hummocky moraine units were being formed during this time as well. Downwasting and drainage continued to a point where the maximum lake level elevation of approximately 520 m (1700 ft) for Glacial Lake Peace Stage II was reached. The thickest glaciolacustrine sediments, situated alongside the Peace River (BH-11), are only about 20m thick. It is important to note that the thickness is both the function of the amount of sediment supplied to the lake and the duration of the lake. Therefore, if the sediment supply was about the same in both Stages I and II, the glacial lake confined to the Peace River area (Stage I) may have been longer lived. The two distinct lake levels also suggest that drainage occurred in pulses as new drainage ways were opened by ice melting or erosion.

Dunes (Figure 5.4) may have developed during the same time as Glacial Lake Peace Stage II or at some time later in a periglacial environment. It is difficult to relate their time of formation with the position of the ice front. When ice melted back far enough north to drain the glacial lake from the Manning area, deposition of glacial sediments was ended abruptly. Since this time, the Peace River and other rivers and streams began to cut down. Slumping took place and terraces were built at times of stable river levels. The exposed glaciolacustrine sediments likely remained poorly drained and water saturated for some time, thus precluding significant reworking by wind. Today, active slumping of glacial sediments and bedrock continues in most of the major rivers.

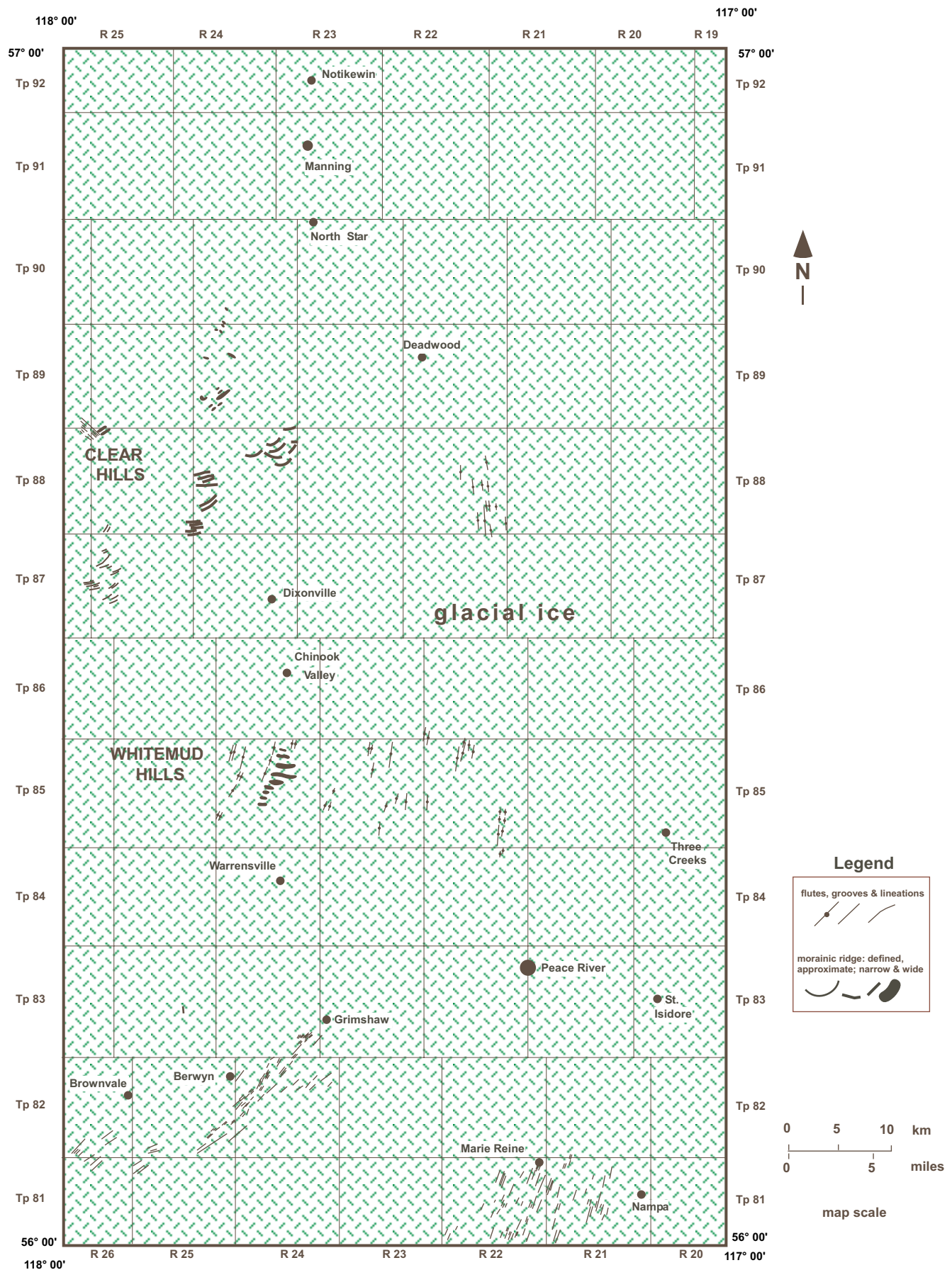


Figure 5.1. Paleogeography Stage I - late glacial maximum.

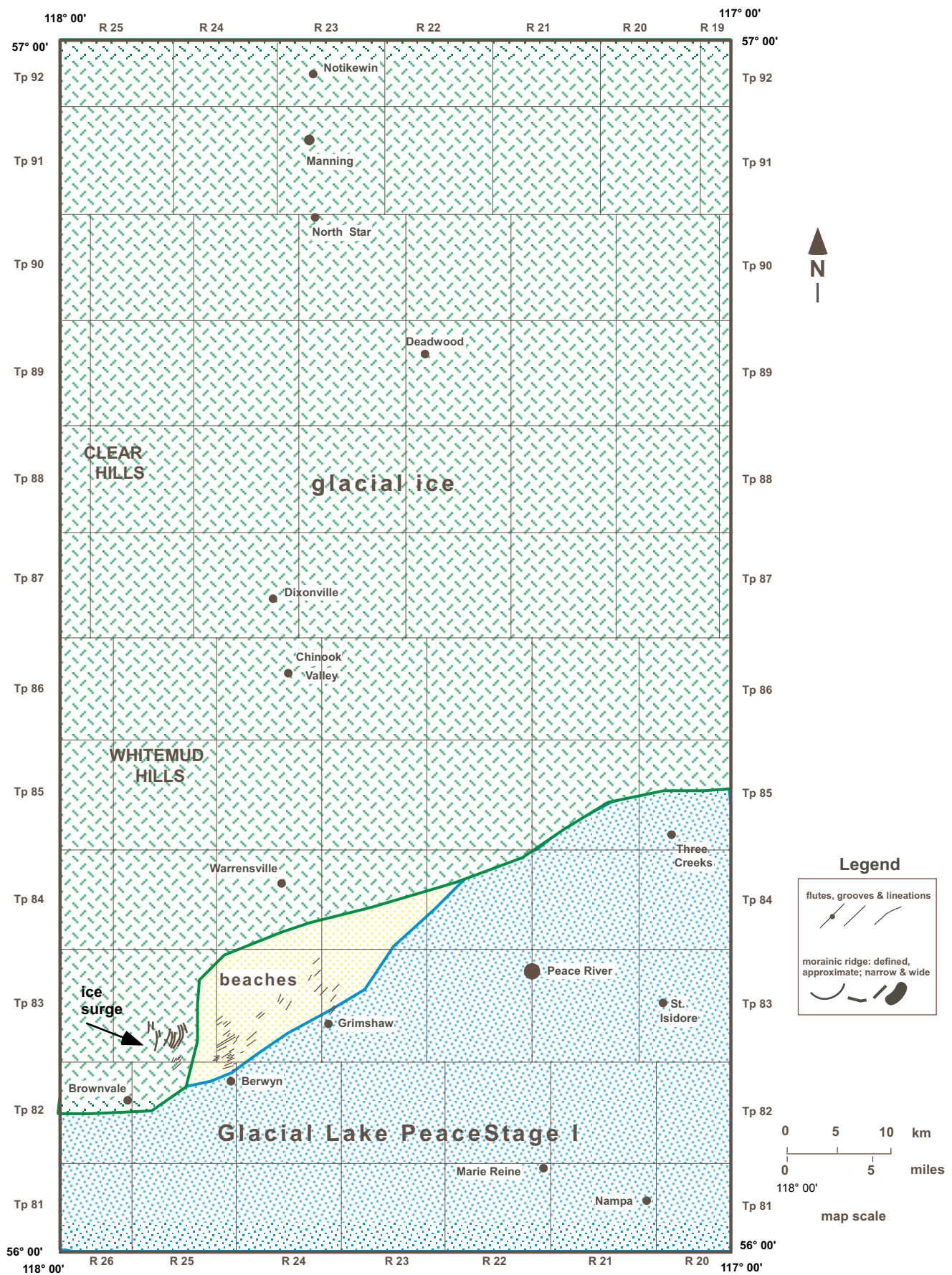


Figure 5.2. Paleogeography Stage II - position of ice and Stage I Glacial Lake Peace during early deglaciation.

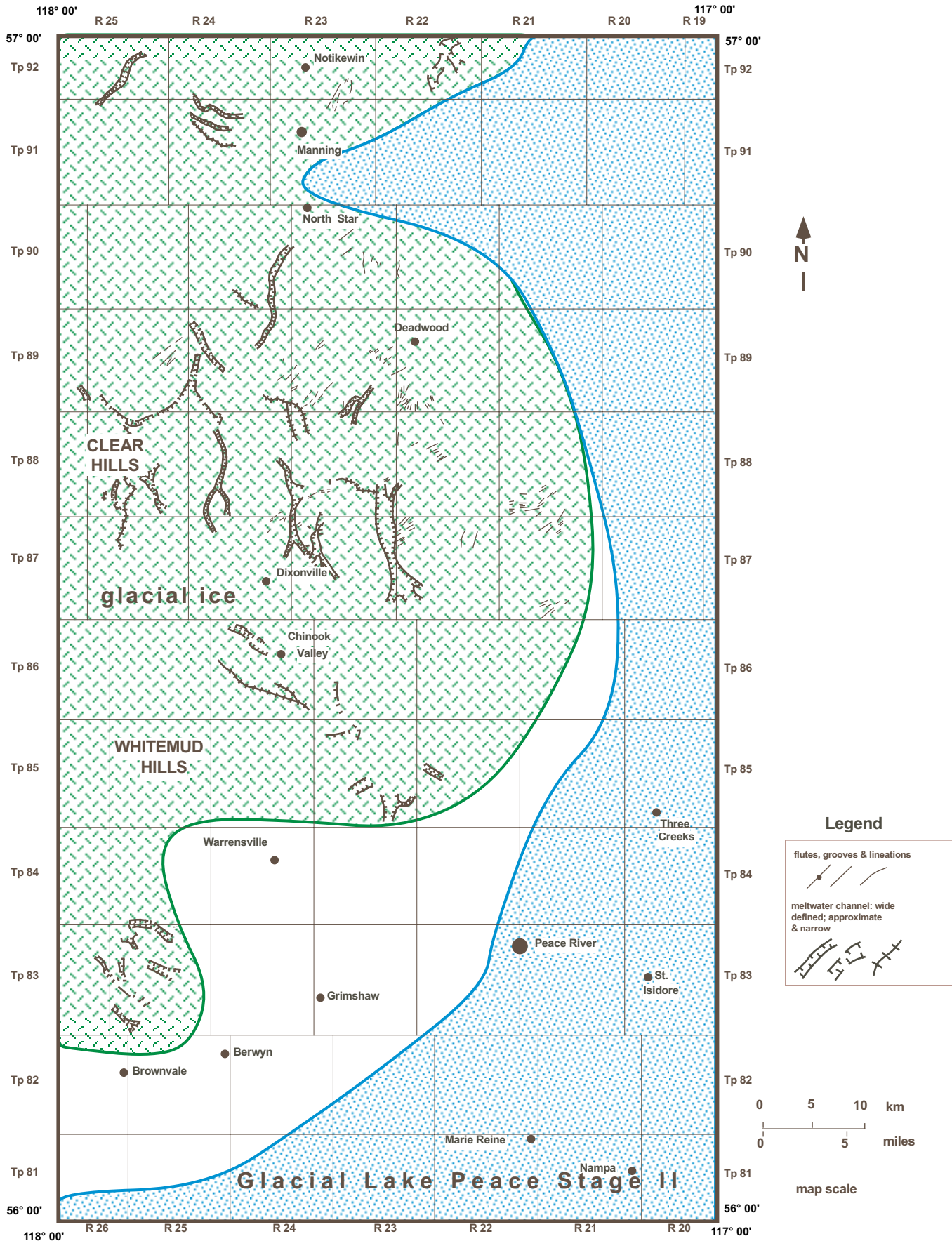


Figure 5.3. Paleogeography Stage III - position of ice and Stage II Glacial Lake Peace during late deglaciation.

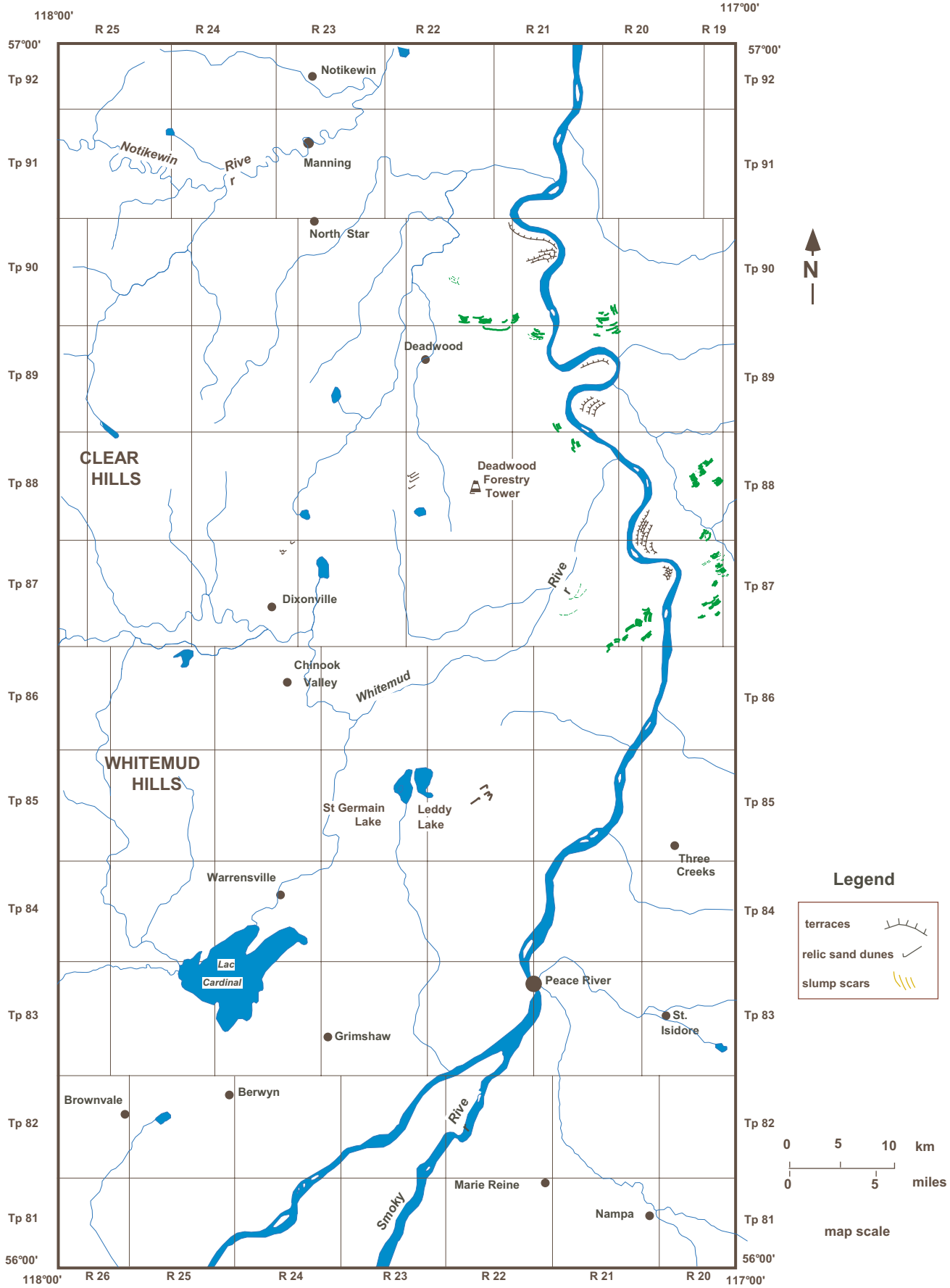


Figure 5.4. Paleogeography Stage IV - post glacial deposition.

6.0 CONCLUSIONS

The glacial stratigraphy and surficial geology (composed of glacial landforms, and primarily glaciolacustrine and morainal deposits) indicate the Peace River area was affected by at least two glacial advances.

The region was likely covered by an earlier glacial advance as evidenced by the position of Unit B1 (which consists of fluvial sediment with a Canadian Shield provenance) stratigraphically below the Late Glacial ice advance complex recorded by the sediments of Units B2 and C.

The late glacial advance into the region consisted of an unobstructed southerly ice flow and led to the formation of the morainal deposits, flutes, and moraine ridges present in the uplands of the Clear and Whitemud hills. The timing of the late glacial advance is assumed to have been in the Late Wisconsin based on the subglacial dates obtained at the Watino section.

Deglaciation was marked in the uplands by deposition from stagnant ice and erosion by meltwater channels which generally flowed down slope. Deglaciation in the lowlands was characterized by the formation of glacial lakes which initially submerged the southern portion of the Peace River valley. This was later followed by a northward melting ice margin extended northward to also flood the Manning region.

Six stratigraphic units have been defined. Unit A consists of a preglacial sand and gravel unit of Cordilleran provenance. An earlier ice advance is represented by Unit B1 consisting of a fluvial, subangular to subrounded, boulder to cobble size gravel of Canadian Shield provenance. The gravel bed is overlain by Unit B2 a glacial advance complex, which can be greater than 100 metres thick, consisting predominantly of sand, with interbeds of gravel, clay, and diamict.

Unit C is the only glacial till deposit of the area. The unit is widespread with the thickness depending on the topographic setting, and thicker deposits present in the lowlands and infilling paleochannels.

This unit can be divided into subunits C-1 and C-2. Sub-unit C-1, is a dark grey massive silty clay till, deposited at the base of the glacier by lodgement and basal melt out processes. This unit is enriched in local bedrock, with the greatest concentration at and near the basal contact and decreasing upwards. Sub-unit C-2 was deposited from englacial to supraglacial debris resulting in mixed lithologies (ie. both local and far traveled clasts) with more compositional and textural variability. There is no conclusive evidence which would suggest that sub-units C-1 and C-2 are separate ice advance events and thus it is assumed that they represent the same ice advance event.

Unit D is made up of glaciolacustrine sediments of thicknesses up to more than 30 metres. Recent deposits, consisting predominantly of alluvial, colluvial, and organic deposits make up Unit E.

The glacial stratigraphy, and thus history, in the lowland area of Manning is incomplete as a significant proportion of the sediment overlying the bedrock is not exposed and situated below auger coring depth. This is an extensive area of thick drift (>30m) where presumably the chances of preserving deposits from previous glaciation(s) are relatively high.

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APPENDIX A1
SECTION LOCATIONS

Appendix A1. Section Locations, Peace River Sheet (84C/W)

LEL SECTIONS		NTS	LSD (W of 5th)	UTM Zone 11V		Elevation	
#	Name	Sheet	LSD-SEC-TP-R	Northing	Easting	metres	feet
1	Weberville Sand Pit	84 C/6	09-34-84-22	6242500	476800	648	2125
2	Chinook Valley Section	84 C/5	03-32-85-23	6251500	462900	655	2150
3	Grimshaw Gravel Pit 1	84 C/4	13-29-83-23	6231800	462600	650	2135
4	Mullen Gravel Pit	84 C/4	04-32-83-23	6232400	462500	650	2135
5	Smithmill Site 1	84 C/5	01-23-86-25	6225800	449500	663	2175
6	Smithmill Site 2	84 C/5	12-29-85-25	6250800	443100	720	2360
7	Smithmill Site 3	84 C/5	14-19-86-24	6259700	451800	653	2140
8	Chinook Valley Site 1	84 C/5	01-34-86-24	6261200	457700	634	2080
9	Chinook Valley Site 2	84 C/5	12-07-86-23	6255500	461300	634	2080
10	Chinook Valley Site 3	84 C/5	06-07-86-23	6255400	461400	634	2080
11	Chinook Valley Site 4	84 C/5	70-09-86-23	6255400	465100	625	2050
12	Warrensville Site 1	84 C/5	01-21-86-23	6248200	465700	632	2075
13	Warrensville Site 2	84 C/5	13-33-85-23	6252800	464300	646	2120
14	Warrensville Site 3	84 C/5	16-19-84-24	6240000	452500	663	2175
15	Whitemud Hills Section	84 C/5	13-01-85-25	6245000	449400	732	2400
16	Figure Eight Lake Section	84 C/5	13-08-84-25	6237000	443000	678	2225
17	Brownvale Site 1	84 C/4	13-02-83-25	6225900	447500	663	2175
18	Brownvale Gravel Pit	84 C/4	09-08-83-25	6226900	444100	664	2180
19	Weberville Site 1	84 C/6	13-30-86-20	6260600	490100	511	1675
20	Weberville Site 2	84 C/6	13-24-86-21	6259400	488900	509	1670
21	Leddy Lake Gravel Pit	84 C/6	02-29-85-22	6249800	473700	663	2175
22	Weberville Site 3	84 C/6	04-15-86-21	6256200	485200	518	1700
23	Weberville Site 4	84 C/6	16-20-85-21	6249700	483400	549	1800
24	Wesley Creek Site 1	84 C/6	16-15-84-20	6238200	496500	572	1875
25	Wesley Creek Site 2	84 C/6	04-17-84-20	6236800	491800	549	1800
26	Three Creeks Site 1	84 C/6	09-16-85-20	6247400	494800	524	1720
27	Three Creeks Site 2	84 C/6	15-05-85-20	6244800	492700	526	1725
28	Nampa Site 1	84 C/2	13-24-81-20	6210700	500100	587	1925
29	Nampa Site 2	84 C/3	09-21-81-20	6210000	496660	572	1875
30	Wesley Gravel Pit	84 C/6	08-28-84-21	6240600	485100	503	1650
31A	Whitelaw Gravel Pit A	84 D/1	16-36-81-1*	6214400	436800	640	2100
31B	Whitelaw Gravel Pit B	84 D/1	16-36-81-1*	6214350	437200	640	2100
32	Berwyn Site 1	84 C/4	14-32-81-24	6214200	455000	564	1850
33	Berwyn Site 2	84 C/4	08-05-82-24	6214700	456000	564	1850
LEL SECTIONS		NTS	LSD (W of 5th)	UTM Zone 11V		Elevation	

#	Name	Sheet	LSD-SEC-TP-R	Northing	Easting	metres	feet
34	Nampa Section	84 C/3	12-30-81-20	6211800	491900	564	1850
35	Peace River Gravel Pit	84 C/3	16-13-83-22	6228100	479800	373	1225
36	Brick's Hill Section	84 C/4	14-20-82-23	6220500	464700	533	1750
37	"Pulpmill" Section	84 C/6	04-09-85-21	6245000	483800	503	1650
38	Warrensville Gravel Pit	84 C/5	14-24-84-24	6239900	459500	648	2125
39	Grimshaw Gravel Pit 2	84C/4	02-33-83-23	6232180	464900	653	2140
40	Judah Hill Section	84 C/3	08-20-83-21	6222900	483500	533	1750
41	Smoky River Section	84 C/3	16-25-81-23	6212400	472100	533	1750
42	McAllister Creek Section	84 C/4	01-33-82-23	6220500	464800	518	1700
43	Dixonville Site 1	84 C/12	14-36-87-24	6272300	457775	686	2250
44	Dixonville Site 2	84 C/12	16-34-87-24	6272200	455600	663	2175
45	Dixonville Site 3	84 C/12	09-06-87-24	6263600	450600	632	2075
46	Clear Hills Site 1	84 C/12	05-18-87-25	6266800	439300	678	2225
47	Saskatoon Berry Section	84 C/4	06-34-82-23	6222900	468200	533	1750
48	Shaftesbury Ferry Section	84 C/4	15-10-82-23	6217230	468500	381	1250
49	Heart River Site 3	84 C/3	05-10-83-21	6225900	485400	533	1750
50	Notikewin River Site 1	84 C/13	11-28-91-23	6308680	461020	472	1550
51	North Star Gravel Pit 1	84 C/14	05-27-90-21	6298860	483550	305	1000
52	North Star Gravel Pit 2	84 C/14	01-20-90-21	6299620	481770	450	1475
53	Berwyn Site 3	84 C/4	08-13-82-25	6217800	452800	617	2025
54	Griffin Creek Section	84 C/4	01-26-81-26	6211200	441300	594	1950
55	Weberville Site 5	84 C/6	14-31-85-21	6252800	481050	625	2050
56A	Heart River Site 1	84 C/3	04-29-82-21	6220400	483800	427	1400
56B	Heart River Site 1	84 C/3	03-29-82-21	6220500	484300	533	1750
57	Heart River Site 2	84 C/3	08-30-82-21	6221120	483400	533	1750
58	Rousseau Creek Site 1	84 C/14	12-27-90-22	6299320	474200	457	1500
59	Rousseau Creek Site 2	84 C/14	09-34-90-22	6300700	475100	457	1500
60	Deadwood Site 1	84 C/14	05-17-90-21	6295600	480320	472	1550
61	Deadwood Site 2	84 C/14	14-17-90-21	6296200	480900	465	1525
62	Notikewin River Site 2	84 C/13	02-30-91-23	6308000	458400	503	1650
63	Notikewin River Site 3	84 C/13	01-34-91-23	6309500	463500	472	1550
64	Slump Creek Section	84 C/6	02-08-85-21	6245000	483050	518	1700
65	Jim Creek Section	84 C/13	04-03-91-24	6301600	452300	533	1750
66	Pulpmill Road Site 1	84 C/6	16-07-85-20	6246200	491600	503	1650
LEL SECTIONS		NTS	LSD (W of 5th)	UTM Zone 11V		Elevation	
#	Name	Sheet	LSD-SEC-TP-R	Northing	Easting	metres	feet

67	Pulpmill Road Site 2	84 C/6	15-07-85-20	6246240	491200	457	1500
68	Heart River Site 4	84 C/3	12-22-81-20	6210100	496700	570	1870
69	Peace River Site 1	84 C/14	07-09-91-21	6303750	481100	457	1500
70	Deadwood Tower Site 1	84 C/11	05-14-88-22	6276000	475300	587	1925
71	Notikewin River Site 4	84 C/13	09-27-91-23	6309000	463450	457	1500
72	Smoky River Site 2	84 C/3	03-20-82-22	6218950	474800	518	1700
73	Highway 686 Site 1	84 C/6	02-15-85-22	6246700	476400	663	2175
74	Highway 686 Gravel Pit 2	84 C/6	01-17-85-22	6246550	473500	625	2050
75	Peace River Site 2	84 C/14	08-02-92-21	6311550	484700	442	1450
76	Jnct Hwy 35 & 686 Section	84 C/5	16-11-85-24	6246420	459000	671	2200
77	Highway 686 Site 2	84 C/5	13-08-85-23	6246420	462500	649	2130
78	Buchanan Creek Site 1	84 C/14	01-24-91-22	6306375	476700	396	1300
79	Clear Hills Site 2	84 C/12	01-25-88-26	6279175	439200	831	2725
80	Highway 686 Site 3	84 C/5	14-10-85-23	6246420	466200	654	2145
81	Highway 686 Site 4	84 C/5	15-09-85-23	6246420	465300	652	2140
82	Highway 35 Site 1	84 C/5	05-24-85-24	6248730	459200	693	2275
83	Highway 35 Site 2	84 C/5	03-36-85-24	6251500	459720	709	2325
84	Deadwood Site 3	84 C/12	02-28-89-23	6288520	463150	561	1840
85	Deadwood Tower Site 2	84 C/11	05-23-88-22	6277800	475300	632	2075
86	Whitemud River Site 1	84 C/11	06-01-88-21	6272700	487300	457	1500
87	Buchanan Creek Site 2	84 C/14	09-15-91-21	6305700	483050	381	1250
88	Heart River Site 5	84 C/3	02-16-83-21	6227120	484400	503	1650
89	Highway 35 Site 3	84 C/12	07-31-88-23	6280850	460100	640	2100
90	Notikewin River Site 5	84 C/13	12-26-91-23	6309000	464000	472	1550
91	Heart River Site 6	84 C/3	36-21-83-21	6230150	484800	458	1700

APPENDIX A2
SECTION LITHOLOGS

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		1		SECTION NAME:			Weberville Sand Pit				SURFACE ELEVATION:		648m{PRIVATE } (2125 ft)																		
LSD:		09		SEC:		34		TP:		84		R:		22		W of		5		NTS MAP:		84 C/6									
NORTHING:				6242500m				EASTING:				476800m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								discontinuous ground moraine, sandy, scattered rocks on surface							
EXPOSURE:																								sand burrow pit with east and north faces noted below							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-5m	>5m	medium sand	~5% fine and coarse sand; angular grains; near vertical face at top and covered by colluvium from ~1m below upper boundary; <1% granules; horizontally stratified, <1cm thick beds; vertical fracturing to obliquely dipping at 30-45°; some local oxidation @ upper contact where bentonite (?) is <u>not</u> present at contact
B	5 - 8.8m	3.8m	till	contacts; upper - irregular due to overlying unit being disturbed by excavation; lower - undulating, sharp; texture <15% with igneous, quartzite and ironstone clasts; clast sizes: >4mm- ~20%; pebbles- ~5%; cobbles- <5%; boulders- 0%; - shield clasts present; pebble cluster within 2cm of base; massive, mottling (grey & orange rust); near vertical face; weathered surface; very blocky (2cm sizes); weathered bentonite (?) band at lower contact is 2-3 cm (variable) thickness

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		2		SECTION NAME:			Chinook Valley Section				SURFACE ELEVATION:		655m (2150ft)														
LSD:		3		SEC:		32		TP:		85		R:		23		W of		5		NTS MAP:		84 C/6					
NORTHING:				6251500m				EASTING:				462900m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								slightly rolling topography with scattered clasts			
EXPOSURE:		road cut trench																									

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.8m	0.8m	medium sand	massive; some mottling in upper 63cm; blotchy oxidation; soil development down to ~63cm; 2.5Y4/4 (wet), 10YR5/5 in upper 63cm

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																	
SECTION #:		3		SECTION NAME:			Grimshaw Gravel Pit 1			SURFACE ELEVATION:		650m (2135ft)																															
LSD:		13		SEC:		29		TP:		83		R: 23		W of 5		NTS MAP:		84 C/4																									
NORTHING:				6231800				EASTING:				462600				UTM ZONE:				11V																							
SURFACE MORPHOLOGY:																						discontinuous ground moraine with rolling topography (1-2m relief)																					
EXPOSURE:																						west facing wall of gravel pit; pit is ~15-20m deep, 50m length																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-13m	>13m	sand and gravel	mostly clast supported gravel with few lenses of sand where mud swallows have nested; localized beds of oxidized gravels throughout; N facing slope has beds dipping to the E at ~30-35°, planar crossbeds with slightly concave near bottom
B	13-14m	<1m	sand and gravel	discontinuous bed; directly underlying till, gravel is oxidized & has a developed CCa horizon locally consisting of well rounded to subangular pebble to cobble, poorly sorted, massive to crudely bedded gravel; localized pockets of sand; pebble lithology includes red granites, sandstone, quartzites, felsic and mafic volcanics, and ironstone. NOTE - quartzite and sandstone pebble (~3cm) to large cobble (~30cm) are believed to be stone tools; i.e. evidence that man had occupied the area previous to the last glacial advance.
C	13 to 15m; ~ 50 to 30 cm below surface	1.5 to 2m	brown, weathered, massive, till (sandy)	vertical to steeply sloped; easily breaks away from cliff where not weathered on surface; 90% - most of unit is bulldozed away along the S & W edges of pit, access from N.; non calcareous; 2.5Y 6/4 light yellowish brown (weathered); 7.5 YR 6/6 reddish yellow (rusty weathered), 10YR 5/3, brown (weathered), 10YR 3/2, very dark greyish brown (fresh); sharp planar lower contact; upper contact is gradational, planar to undulating; granules & small pebbles 15% pebbles-30%, cobbles 1-2%

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1					
SECTION #:		4		SECTION NAME:			Mullen Gravel Pit			SURFACE ELEVATION:		648m (2135ft)			
LSD:	4	SEC:	32	TP:	83	R:	23	W of	5	NTS MAP:			84 C/4		
NORTHING:			6232400m			EASTING:			462500m			UTM ZONE:		11V	
SURFACE MORPHOLOGY:														discontinuous ground moraine with rolling topography	
EXPOSURE:														east and south facing walls of gravel pit; ~10 to 15m deep; ~100-150m length	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-6m	>6m	sand and gravel	<p>I - gravelly diamicton, highly oxidized.; 2.5Y6/6 to 2.5Y5/5; sandy silt with some clay in matrix; 45% clasts, chert, quartzite, quartz and others; sharp planar upper contact</p> <p>II - fine sand, filled with birds' nests; coarse to medium sand; lensoid with pebble interlaminae in sand units; mostly horizontally (thinly) bedded gravel with sand matrix, more oxidation and darker colour (ie. has more mafic rocks than III)</p> <p>III - Inclined gravel lag beds to shallow trough crossbeds; horizontally bedded and slightly dipping; gravel lag unit has shallow trough shaped, crossbeds to gently dipping and gravel lags;</p>

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																	
SECTION #:		5		SECTION NAME:			Smithmill Site 1			SURFACE ELEVATION:		663m (2175ft)																															
LSD:		1		SEC:		23		TP:		86		R: 25		W of 5		NTS MAP:		84 C/5																									
NORTHING:				6225800m				EASTING:				449500m				UTM ZONE:				11V																							
SURFACE MORPHOLOGY:																						flat to rolling topography; subangular sparsely scattered cobbles in farmer's field																					
EXPOSURE:																						road cut trench																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.35m	>0.35m	till	massive weathered, small blocky (~1cm) texture in upper 27 cm; 2.5Y3/2 (dry), 10YR3/2 (weathered); texture >4mm 2-3%; smaller clasts difficult to see; sandstone clast very weathered, disintegrated and gives sandy texture to matrix; very few clasts > 1 cm, subangular
B	0.35-1.11m	0.76m	silt	loosely to moderately consolidated, lots of roots; massive; some silt clumps; lower contact - undulated, gradational; Ah horizon in upper ~40cm

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		6		SECTION NAME:			Smithmill Site 2			SURFACE ELEVATION:		720m (2360ft)																											
LSD:		12		SEC:		29		TP:		85		R: 25		W of 5		NTS MAP:		84 C/5																					
NORTHING:				6250800m				EASTING:				443100m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				rolling topography in wooded area - difficult to discern (~ 11 km mark along road)																			
EXPOSURE:																				road cut trench																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.0m	>1.0m	clay	I (0 to 40 cm) mottled blue clay with blotches of silty clay of subunit II, generally blocky (~1cm), less blocky and wetter in lowermost 10 to 15 cm of exposure; 5Y6/4, 5Y4/1 II (40 to 64 cm) mottled silty clay, blocky (~1cm); no clast observed; 10YR3/1, 10YR4/4 III (64 to 86 cm) blocky (0.5cm) to massive brown silty clay, with trace (<1%) of clasts <1cm some rusty mottling; 10YR4/4 IV (86 cm to surface) Ah soil horizon (~14cm)

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1									
SECTION #:		7	SECTION NAME:				Smithmill Site 3				SURFACE ELEVATION:		653m (2140ft)						
LSD:		14	SEC:		19	TP:		86	R:		24	W of		5	NTS MAP:		84 C/5		
NORTHING:			6259700m			EASTING:			451800m			UTM ZONE:			11V				
SURFACE MORPHOLOGY:																		flat to rolling topography (near settlement of Smithmill along E-W gravel road)	
EXPOSURE:																		road cut trench	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0 -0.7m	>0.7m	waterlain till/ diamicton	Ah horizon developed down to approx. 30cm depth; B-horizon is blocky (2.5Y5/3) and 15 to 20 cm thick; in lower 50 cm it has a mottled dark brown clayey matrix (2.5Y4/4, 5Y3/2), with very small 2-3 mm clasts and one ironstone clast ~3cm

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		8		SECTION NAME:			Chinook Valley Site 1				SURFACE ELEVATION:		634m (2080ft)														
LSD:		1		SEC:		34		TP:		86		R:		24		W of		5		NTS MAP:		84 C/5					
NORTHING:				6261200m				EASTING:				457700m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								flat to rolling topography			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.58m	>1.58m	till	I (0-50 cm) wet till (2.5Y3/3, 2.5Y5/3) with medium to coarse sand lenses and stringers that contain gypsum crystals II (50-89 cm)-mottled (brown & dark brown) wetter till; only small clasts (<1cm) - ~20%, iron stained siltstone, igneous clasts; massive; 2.5Y3/2; almost varved-like sand interlaminated with clay; horizontal to slightly convex discontinuous bedding; gypsum also found in clay III (89-135 cm) weathered blocky; dry; very friable; <1% large clasts >2cm; 2.5Y5/3 IV (135-158 cm) soil horizon; 2.5Y5/3

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		9		SECTION NAME:			Chinook Valley Site 2				SURFACE ELEVATION:		634m (2080ft)														
LSD:		12		SEC:		7		TP:		86		R:		23		W of		5		NTS MAP:		84 C/5					
NORTHING:				6255500m				EASTING:				461300m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								hummocky terrain			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.7m	>0.7m	sand	fine, massive, mottled slightly with iron staining; more compact near contact of unit B and within 20 cm; clay stringers; 5Y5/3
B	0.7-2m	1.3m	till	~40% clast of which ~90% is locally derived clast lithology (mudstone) large sandstone cobble near/at base that is elongate, subangular, ~20cm; 2.5Y3/2

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		10		SECTION NAME:			Chinook Valley Site 3			SURFACE ELEVATION:		634m (2080ft)											
LSD:		6		SEC:		7		TP:		86		R: 23		W of 5		NTS MAP:		84 C/5					
NORTHING:				6255400m				EASTING:				461400m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						hummocky terrain	
EXPOSURE:																						road cut trench, ~50m and other side of road from Section #9	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.20m	>0.20m	massive sand	similar to Section #9, Unit A
B	0-1.0	>1.0m	till	contains some 1-3cm, clast that are subrounded-subangular; irregular-shaped to circular (collapsed) sand lenses (~10 to 20 cm) scattered throughout unit; one lense at/near upper surface has lag-like cluster of 1-3cm pebbles and bands of iron-stained sand stringers

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		11		SECTION NAME:			Chinook Valley Site 4				SURFACE ELEVATION:		625m (2050ft)														
LSD:		7		SEC:		9		TP:		86		R:		23		W of		5		NTS MAP:		84 C/5					
NORTHING:				6255400m				EASTING:				465100m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								hummocky to rolling, large cobbles scattered on surface			
EXPOSURE:																								cut bank along creek near its confluence with Whitemud River			

{PRIVATE }UNIT DESCRIPTION				
UNIT	DEPTH	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
Bed-rock	0-3m	>3m	sandstone/siltstone	Dunvegan Formation; contains ironstone concretions and ledges; horizontally bedded; some fine to coarse sand beds present
A	3-3.2m	~0.20m	till	massive; 2-3% clasts of variable local & distant lithology coarse clasts <1% occur near bottom and near top; weathered at top 30cm (~1 cm blocks); less weathered 30-60 cm (2-3cm blocks); lower portion blocky (4-5cm) compact; 2.5Y4/2, 5Y6/2
B	3.2m	0-0.1m	oxidized gravel	with sandy matrix; contains subrounded, granitic clast; thickness varies, no more than 109 cm; 10YR6/6
C	3.3-4.5m	1.2m	clayey silt	massive, moderately consolidated; very poorly exposed and not accessible

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		12		SECTION NAME:			Warrensville Site 1				SURFACE ELEVATION:		632m (2075ft)														
LSD:		1		SEC:		21		TP:		85		R:		23		W of		5		NTS MAP:		84 C/5					
NORTHING:				6248200m				EASTING:				465700m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								flat to rolling topography			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.5m	>1.5m	till	<p>I (0-31cm) massive & mottled >40cm thickness; moderately cohesive; ~5% clasts of igneous, chert, sandstone; small clasts 3-4 cm - subrounded to subangular; upper 10-11cm is silty matrix; massive lower portion has very clayey matrix; large sandstone boulder in ditch below section</p> <p>IIA (31-42cm) silty clay/sand mottled; appears slightly laminated and contorted; upper & lower contacts are sharp and planar; clay is grey coloured and sand is rust coloured; many small roots present; crudely horizontally bedded - iron staining; concretion around roots; silty clay & sand mottled with sand still iron stained</p> <p>IIB (42-60cm) massive fine to medium sand; 7.5YR 5/6, 2-5Y 6/1; rusted mottled pattern</p> <p>III (60-130cm) mottled brown & orange; 2.5Y 5/4 and 2.5Y 4/4; larger clasts (2-6 cm) within 8 cm of lower contact; moderately cohesive; upper contact gradational and convoluted; sharp, lower contact, nearly planar; quartzite and pink granites present; A & B soil horizons in upper 32 cm</p>

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1									
SECTION #:		13		SECTION NAME:			Warrensville Site 2				SURFACE ELEVATION:		646m (2120ft)						
LSD:	13	SEC:	33	TP:	85	R:	23	W of	5	NTS MAP:				84 C/5					
NORTHING:			6252800m			EASTING:			464300m			UTM ZONE:			11V				
SURFACE MORPHOLOGY:															flat to rolling topography with numerous large cobbles on surface				
EXPOSURE:		roadside excavation pit																	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.5m	1.5m	sand	5Y 4/2; massive, medium to fine; localized oxidation
B	1.5-2.0m	0.5m	till	may be part of slump of small cliff face, but ground has numerous large cobbles on the surface; there must be till on surface 10YR 3/2; 10YR 4/4; appears to be massive

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		14		SECTION NAME:			Warrensville Site 3			SURFACE ELEVATION:		663m (2175ft)											
LSD:		16		SEC:		19		TP:		84		R: 24		W of 5		NTS MAP:		84 C/5					
NORTHING:				6240000m				EASTING:				452500m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						hummock adjacent to discontinuous ground moraine	
EXPOSURE:		road cut trench																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.5m	~0.5m	sand	massive; fine compact; 5Y 4/3; also blotchy gypsum
B	0.5-1.5m	~1.0m	waterlain till/ diamicton	<p>I (50-100cm) near upper contact - mottled with gypsum; finely laminated silty clay and clay, wavy with fine discontinuous fine sand laminated that are iron stained (2.5Y 5/6); matrix - 5Y 5/3, 5Y 6/3; irregular upper contact</p> <p>II (100-120cm) silty clay, wavy interbeds of silty clay and clayey silt; wavy upper and lower contacts</p> <p>III (120-150cm) 2.5Y 5/3, 2.5Y 3/2; blocky with clasts; till-like texture containing horizontal to wavy interlaminae of fine sand (2.5Y 6/3) & conforms the bottom surface</p>

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		15		SECTION NAME:			Whitemud Hills Site 1				SURFACE ELEVATION:		732m (2400ft)														
LSD:		13		SEC:		1		TP:		85		R:		25		W of		5		NTS MAP:		84 C/5					
NORTHING:				6245000m				EASTING:				449400m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								hummocky (~2m) with localized kettles			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.5m	~0.5m	waterlain till/diamicton	massive silty clay less weathered with small clasts; 10YR3/1
B	0.5-1.0m	~0.5m	silty clay	massive; undulating upper and lower contacts; weathered; 10YR 5/3, 10YR 4/3; full of rootlets; contains lens of fine sand (2.5Y4/3)
C	1.0-1.4m	~0.4m	disturbed alluvium	2.5Y 5/4; clay silty - 2.5Y 8/4; fine sand - 2.5Y 6/2 and soil horizon; mostly finely laminated silt with lenses of clayey silt and fine sand

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		16		SECTION NAME:			Figure Eight Lake Section			SURFACE ELEVATION:		678m (2225ft)											
LSD:		13		SEC:		8		TP:		84		R: 25		W of 5		NTS MAP:		84 C/5					
NORTHING:				6237000m				EASTING:				443000m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						hummocky moraine	
EXPOSURE:																						road cut trench	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1m	>1m	waterlain till/ diamicton	stratified, not many clasts; a few larger(>2cm), <1%; all other (<1cm) clasts >4mm: ~15%; 10YR 3/2

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		17		SECTION NAME:			Brownvale Site 1				SURFACE ELEVATION:		663m (2175ft)														
LSD:		13		SEC:		2		TP:		83		R:		25		W of		5		NTS MAP:		84 C/54					
NORTHING:				6225900m				EASTING:				447500m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								ridged, <2m relief			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	9-0.2m	>0.2m	silt	contains very little clay (2.5Y 4/3); iron stain - 2.5Y 5/4; contains a clayey silt (2.5Y8/2) that has an intrusive-like form (~20cm neight) on the upper surface (i.e. a result of loading) ; gypsum stringers and lenses present
B	0.2-1.2m	~1.0m	silty clay	massive; slightly blocky but too wet to see weathering pattern; 10YR 5/4

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																	
SECTION #:		18		SECTION NAME:			Brownvale Gravel Pit			SURFACE ELEVATION:		664m (2180ft)																															
LSD:		9		SEC:		8		TP:		83		R: 25		W of 5		NTS MAP:		84 C/4																									
NORTHING:				6226900m				EASTING:				444100m				UTM ZONE:				11V																							
SURFACE MORPHOLOGY:																						rolling to hummocky topography in places																					
EXPOSURE:																						south and east facing walls of gravel pit ~25 to 30m deep, ~100-150m length																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-25m	>25m	sand and gravel	oxidized; clast supported; gravels @ upper contact
B	25-27m	~2m	till	massive ~5% clasts, contains high amount of oxidized pebbles (most likely from underlying unit); compact; difficult to view in steep sided gullies eroded by surface drainage

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		19		SECTION NAME:			Weberville Site 1				SURFACE ELEVATION:		511m (1675ft)														
LSD:		13		SEC:		30		TP:		86		R:		20		W of		5		NTS MAP:		84 C/6					
NORTHING:				6260600m				EASTING:				490100m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								flat to gently undulating topography			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.0m	>1.0m	interbedded silty clay and clayey silt	I (0-25cm) silty clay, same as II ; slight mottling, blocky, easily friable, slightly wet, 5Y3/2, 5Y4/3; contains ~9cm bed of interlaminated silty clay, greyish brown (10YR3/2) and clayey silt, brown (5Y3/2) II (25-35cm) clayey silt, interlaminated greyish brown (10YR 3/2) & brown (5Y 5/3) III (35-90cm) -silty clay, greyish brown (10YR 3/2), massive IV (90-100cm) soil horizon

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		20		SECTION NAME:			Weberville Site 2			SURFACE ELEVATION:		509m (1670ft)											
LSD:		13		SEC:		24		TP:		86		R: 21		W of 5		NTS MAP:		84 C/6					
NORTHING:				6259400m				EASTING:				488900m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						flat to gently undulating topography	
EXPOSURE:		road cut trench																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-2.0m	>2.0m	interbedded silty clay and clayey silt	clay, silt and silty clay interlaminated sequence of ~20 to 50cm thickness; contacts are planar to undulating; gypsum; 2.5Y 7/2; 2.5Y 6/1 I - finely laminated; olive brown clayey silt & light grey silty clay bands, slightly wavy; 5Y 6/3, 5Y 5/2 - weathered II - blocky, brown ,very grey mottled, clayey silt beds III - grey, silty clay; unit more recessive; 5Y 6/3; 2.5Y 4/4

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		21		SECTION NAME:			Leddy Lake Gravel Pit				SURFACE ELEVATION:		663m (2175ft)																		
LSD:		2		SEC:		29		TP:		85		R:		22		W of		5		NTS MAP:		84 C/6									
NORTHING:				6249800m				EASTING:				473700m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								flat to gently undulating topography with isolated ridges (possibly remnant parabolic dunes)							
EXPOSURE:																								shallow gravel pit excavation (2 to 3m depth)							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.2m	>0.2m	medium to fine sand	small trough crossbeds with stringers of silty clay (grey); silty lens is wavy to convolute - i.e. beds may have been disturbed by overriding causing load structures; oxidation localized; upper contact is sharp, planar
B	0.2-1.5m	~1.3m	till	massive; upper contact is sharp, wavylower contact-sharp, planar; very hard (like-concrete); contains large pebbles (subrounded); large 3-4cm blocky texture, calcite/gypsum along vertical rootlet and continues along at the base of the unit; ~3-4% clast (>4mm) of local ironstone & pink granites
C	1.5 -2m	0.5m	fine sand	massive with silt; lower contact-sharp, wavy; has distinct gravel in circular and planar convex pockets; sediments are more oxidized where gravel occurs.

{PRIVATE }SECTION DESCRIPTION										PAGE	1	OF	1			
SECTION #:		22		SECTION NAME:					Weberville Site 3		SURFACE ELEVATION:		518m (1700ft)			
LSD:	4	SEC:	15	TP:	86	R:	21	W of	5	NTS MAP:				84 C/6		
NORTHING:			6256200m			EASTING:			485200m			UTM ZONE:			11V	
SURFACE MORPHOLOGY:														flat to gently rolling topography		
EXPOSURE:		road cut trench														

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.34m	>1.34m	interlaminated silty clay and clayey silt	silty clay, olive brown, 2.5Y 5/3; clayey silt, brownish grey, 2.5Y 4/1; rusty mottles (olive, brown and grey); weathered; finely fissility (horizontal & vertical) in upper 30cm; banding is both inclined & horizontal; soil development down ~30 cm depth

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																
SECTION #:		23		SECTION NAME:				Weberville Site 4				SURFACE ELEVATION:		549m (1800ft)													
LSD:		16		SEC:		20		TP:		85		R:		21		W of		5		NTS MAP:		84 C/6					
NORTHING:				6249700m				EASTING:				483400m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								flat to gently rolling topography			
EXPOSURE:																								roadside gully eroded by surface drainage runoff			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.55m	>1.55m	interbedded/inter-laminated silty clay and clayey silt	<p>I (0-55cm) interbeds (1-2cm thickness) of silty clay (2.5Y3/1) and clayey silt (2.5Y5/4); grades up to thin interlaminae of silt and silty sand</p> <p>II (55-100cm) interlaminated silty clay (2.5Y4/2) and clayey silt (2.5Y3/2), wavy beds, with convoluted/distorted medium-fine sand lenses</p> <p>III (100-155cm) massive silty clay (2.5Y4/3) with a few interlaminae of clay (~5mm thickness) and fine sand (~1.5cm thickness)</p>

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		24		SECTION NAME:			Wesley Creek Site 1			SURFACE ELEVATION:		572m (1875ft)											
LSD:		16		SEC:		15		TP:		84		R: 20		W of 5		NTS MAP:		84 C/6					
NORTHING:				6238200m				EASTING:				496500m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						flat to rolling topography	
EXPOSURE:		road cut trench																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.86m	>1.86m	interbedded silty clay and clayey silt	<p>I (0-20cm) grey clay (10YR 4/2) with mottled interlaminae of silty clay (brown) 5 cm thick and 4cm apart; blocky texture; wet</p> <p>II (20-100cm); massive silty clay, grey, 2.5Y 3/1 to clayey silt, brown, 2.5Y 4/4; blotchy gypsum and less frequent (i.e. becomes concentrated in blotches); gypsum - 2.5Y 7/3</p> <p>III (100-120cm); interlaminated clayey silt, (2.5Y 4/1 (grey), and silty clay 2.5Y 4/3 (brown) with gypsum in both horizontal and vertical fractures</p> <p>IV (120-140cm) massive silty clay, 2.5 4/1 (grey) to clayey silt, 2.5Y 4/3 (brown) with fine sand laminae (~5mm thickness), present at 4cm intervals</p> <p>V (140-186cm) massive clayey silt, brown 10YR4/2; blocky texture</p>

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		25		SECTION NAME:			Wesley Creek Site 2			SURFACE ELEVATION:		549m (1800ft)											
LSD:		4		SEC:		17		TP:		84		R: 20		W of 5		NTS MAP:		84 C/6					
NORTHING:				6236800m				EASTING:				491800m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						hummocky terrain	
EXPOSURE:																						road side excavation	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.74m	>0.74m	medium to fine sand,	massive to stratified ripple, crossbed and planar beds; reacts with dilute HCl; oxidization of localize beds; CCa at upper contact
B	0.74-1.48m	0.74m	silt	2.5Y 4/4 (near lower contact), 2.5Y 6/4 mostly silt beds with interbeds of clayey diamict and 10YR4/4 (near surface); does not react with dilute HCl; large (8-10cm) cobble - white granite may occur within a distinct diamict bed; part of large hummock ~3-4m high with irregular surface; section occurs in a small creek; somewhat banded and very porous texture; soil horizon in upper 36 cm to surface

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		26		SECTION NAME:			Three Creeks Site 1			SURFACE ELEVATION:		524m (1720ft)											
LSD:		9		SEC:		16		TP:		85		R: 20		W of 5		NTS MAP:		84 C/6					
NORTHING:				6247400m				EASTING:				494800m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						flat to rolling topography	
EXPOSURE:																						road cut trench	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.8m	>1.8m	massive silty clay	gypsum (2.5Y 7/2) bands dipping @ ~25° to N; the silty clay is more fissile directly above and below; 5Y 3/1 (wet clayey silt); 2.5Y 3/2 (grey mottles); 2.5Y 5/4 (brown mottles); 2.5Y 4/2 (B horizon of weathered silty clay); grey & brown mottling, some gypsum (muddy colour)

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		27		SECTION NAME:			Three Creeks Site 2			SURFACE ELEVATION:		526m (1725ft)											
LSD:		15		SEC:		5		TP:		85		R: 20		W of 5		NTS MAP:		84 C/6					
NORTHING:				6244800m				EASTING:				492700m				UTM ZONE:				11V			
SURFACE MORPHOLOGY: hummock ~2m high in glaciolacustrine surficial map unit																							
EXPOSURE: road cut trench																							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.12m	>1.12m	massive clayey silt	mottled & blocky; 5Y 5/3; 5Y 4/2; begins to get wetter at 93cm depth; oxidized to 28cm depth (10YR 5/4)

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		28		SECTION NAME:			Nampa Site 1			SURFACE ELEVATION:		587m (1925ft)											
LSD:		13		SEC:		24		TP:		81		R: 20		W of 5		NTS MAP:		84 C/2					
NORTHING:				6210700m				EASTING:				500100m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						generally flat glaciolacustrine plain	
EXPOSURE:		drainage ditch trench																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.84m	>0.84m	clay, massive	5Y 4/1, 10YR 5/4 (at 40cm depth) 10YR 4/1, 10YR 4/3 at 84 cm depth; massive, wet, mottled grey & brown; compact, very fissile; black (5Y2.5/1) Ah horizon; Bt horizon is light grey with some iron staining (5Y4/1 and 10YR 5/4)

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		29		SECTION NAME:			Nampa Site 2				SURFACE ELEVATION:		572m (1875ft)														
LSD:		9		SEC:		21		TP:		81		R:		20		W of		5		NTS MAP:		84 C/3					
NORTHING:				6210000m				EASTING:				496660m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								flat to rolling glaciolacustrine plain			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.58m	>0.58m	massive silty clay	10YR 3/1 with fine granules, some large clasts (-5cm)
B	0.58-2.28m	1.7m	massive clay	slightly mottled 10YR 3/2; dropstones; one 2cm pebble, one Shield pebble noticed; lower contact - transitional
C	2.28-4.58m	2.3m	interbedded silty clay, clay, and clayey silt	with clay and fine sand interlaminae; some stones/granules; finely laminated clayey silt (olive brown) and clay (grey) laminae; at 3.5m interval vertical fractures infilled with dark grey overlying clay; gypsum stringers present; 2.5Y 5/3, 2.5Y 4/2; clay (2.5Y 3/1 and 2.5Y 3/2); 9cm thick interval of convoluted clayey silt bed with fine laminae and becomes thicker downwards; - rollups & convoluted - fine sand to silty clay, 2.5Y 5/4; 10YR 4/4 - iron stained blotches have fine sand to silt texture; and clayey silt, 2.5Y 4/3

{PRIVATE }SECTION DESCRIPTION										PAGE	1	OF	1						
SECTION #:		30		SECTION NAME:					Wesley Creek Gravel Pit		SURFACE ELEVATION:		503m (1650ft)						
LSD:	8	SEC:		28		TP:	84	R:	21	W of	5	NTS MAP:			84 C/6				
NORTHING:				6240600m				EASTING:				485100m				UTM ZONE:		11V	
SURFACE MORPHOLOGY:																flat to gently rolling			
EXPOSURE:		excavation pit, possible a gravel stockpile																	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-3m	~3m	sand & gravel stockpile ?	poorly sorted - highly calcareous; bedding distorted and may be stock pile gravel pit; location at edge of plateau doesn't fit in with surrounding glaciolacustrine plain.

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		31		SECTION NAME:			Whitelaw Gravel Pit				SURFACE ELEVATION:		640m (2100ft)														
LSD:		16		SEC:		36		TP:		81		R:		1		W of		6		NTS MAP:		84 D/1					
NORTHING:				621440m				EASTING:				436800m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								generally rolling discontinuous ground moraine			
EXPOSURE:																								large gravel pit extending over a km in length and width; several faces observed			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	>4m	sand and gravel	<p>I. fine-medium sand with interbeds of gravel; beds 10-20 cm thick; horizontally to slightly dipping; sand bed, lenses & laminated throughout unit; and is present in various bed forms</p> <p>II. ~50cm thick in places; locally forms angular unconformity with overlying unit III; horizontally bedded clasts supported (poorly sorted) medium pebble gravel; coarse to medium sand matrix - ~30%; minor medium sand lenses and interbeds; localized oxidized layer;</p> <p>III crudely dipping clast supported pebble (2-4 cm) gravel with some larger cobble (8-14cm)~1% minor medium-fine sand lenses 6-7cm thick, discontinuous due to post-depositions faulting; cobble lag of mostly surrounded to well rounded quartzites (6 - 12cm); large boulder at top of cliff is light pink granite, slightly metamorphosed; cobbles - also - red sandstone fine grain mafic rocks; cobble lag caps unit B; a large pebble lag (less defined) caps the sand block to the south of Unit B; cobble lag of mostly surrounded to well rounded quartzites (6-12cm); large boulder at top of cliff is light pink granite, slightly metamorphosed; cobbles - also - red sandstone, fine grain mafic rocks</p> <p>IV - a large pebble to cobble lag present at base of unit;</p>
B	N/A ; present within Unit A	2.5m length 1.5m height	large bedrock intraclast	<p>I -lower 90cm of bedrock, finely bedded silt and fine to medium sand with 1-2cm beds; normal slip faults infilled with calcite near base and edges; easily friable, breaks away from vertical face easily</p> <p>II - upper 58cm of bedrock block same as I but with slightly thicker beds (2-4cm) and has very compact, oxidized bands; coarser and more weathered than subunit I</p> <p>not certain when bedrock block was deposited (i.e. whether this is 1° or 2° (post depositional) or both; the bedrock block is generally bordered by an oxidation ring - indicating ground water, percolating through outer edges of the block; the river bank may have consolidated of bedrock & this entire block was eroded intact & fell into the braided gravel system (??)</p>
C	4-4.5m	0.5m	till	possibly large portion of till removed from surface - till-like; clayey matrix with clasts

{PRIVATE }SECTION DESCRIPTION										PAGE	1	OF	1				
SECTION #:		32		SECTION NAME:					Berwyn Site 1		SURFACE ELEVATION:		564m (1850ft)				
LSD:	14	SEC:	32	TP:	81	R:	24	W of	5	NTS MAP:				84 C/4			
NORTHING:			6214200m			EASTING:			455000m			UTM ZONE:			11V		
SURFACE MORPHOLOGY:														mostly flat glaciolacustrine plain with localized linear ridges of 2 to 3m relief			
EXPOSURE:		road cut trench															

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.0m	>1.0m	interbedded silty clay and clayey silt	I (0-29cm) massive silty clay with some clay (5Y4/2) II (29-56cm) massive clayey silt (5Y4/3) III (56-100cm) massive silty clay with minor clay (5Y4/2), clay may have been eluviated from this unit and collected below in clayey silt unit

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																
SECTION #:		33		SECTION NAME:				Berwyn Site 2				SURFACE ELEVATION:		564m (1850ft)													
LSD:		8		SEC:		5		TP:		82		R:		24		W of		5		NTS MAP:		84 C/4					
NORTHING:				6214700m				EASTING:				456000m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								flat to gently rolling glaciolacustrine plain			
EXPOSURE:																								part of slumped creek bank			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-2.0m	>2m	massive clay	minor gypsum, gradual increase in mottling and gypsum veining - down section; 2.5Y 5/4, brown mottle; 2.5Y 3/1 grey at top (wet) 2.5Y 4/1, grey mottle; 2.5Y 5/1, grey at top (weathered) gypsum bands thicker in lower ~20cm

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		34		SECTION NAME:			Nampa Section			SURFACE ELEVATION:		564m (1850ft)											
LSD:		12		SEC:		30		TP:		81		R: 20		W of 5		NTS MAP:		84 C/3					
NORTHING:				6211800m				EASTING:				491900m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						flat to gently rolling glaciolacustrine plain	
EXPOSURE:																						North facing river bank along Heart River, near hamlet of Nampa	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4.5m	>4.5m	massive till	I (0 to 3.5m) unoxidized dark grey till (5Y3/1, 3/2) II (3.5 to 4.5m) oxidized brown till, transitional colour change from I; lowermost 0 to 3m is covered by colluvium
B	4.5-7m	2.5m	interbedded silty clay and clayey silt	glaciolacustrine deposit I (4.5-5.1m) laminated silty clay and clayey silt; II (5.1-5.2m) massive grey clay - no dropstones; III (5.2-5.6m) massive grey clay, granules and dropstones present; 5Y4/1 IV (5.6-5.8m) massive grey clay, no dropstones; 5Y4/1 V (5.8-6.2m) mottled clay, with nodules of silt and fine sand 2.5Y3/3; 2.5Y3/2 VI (6.2-7.0m) laminated clay, silt, and clayey silt with large nodules or lens-like forms near top of unit; secondary movement may be due to recent slumping or loading, when overlying gravel lag deposited; mottled clay and silt; 2.5Y3/1, 2.5Y3/2
C	7-9.5m	2.5m	interbedded sand, silt and clayey silt	floodplain deposits I (7.0m and 8.1m) gravel lag with medium sand matrix; highly oxidized;(generally 2.5Y4/2), shells are present in upper portion II (7.0-7.7m) massive clayey silt grading up to massive silt; 5YR6/1 rust stains, 2.5Y3/2 III (7.7-8.2m) unit pinches out to E and W; medium to fine quartz-rich sand interbedded with clayey unit (one horizontal, another inclined) contains interbeds of gravel with granules, tiny pebbles & clay fragments - these beds are rich in shells and shell fragments IV (8.2-8.7m) interbedded fine-medium sand with silt laminae; massive to wavy silty clay laminae, unit thickens laterally to west; sand beds are slightly dipping, crossbedded to horizontal beds; varved units (silt and clay laminae) are slightly wavy to horizontal V (8.7-9.5m) massive silt with minor clay laminae, very weathered surface

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		35		SECTION NAME:			Peace River Gravel Pit			SURFACE ELEVATION:		373m (1225ft)																											
LSD:		16		SEC:		13		TP:		83		R: 22		W of 5		NTS MAP:		84 C/3																					
NORTHING:				6228100m				EASTING:				479800m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				alluvial plain adjacent to Peace River																			
EXPOSURE:																				observed east and south facing walls of active pit area																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-11m	>11m	gravel, minor sand	<p>I (0-7m) thinly bedded dipping (i.e. inclined), gravel, poorly sorted, medium sand supported matrix, minor sand lenses, subrounded to well rounded - no imbricated beds; grades to sand beds, slightly inclined to horizontal beds</p> <p>II (7-11m) mostly horizontally bedded to wavy, medium sand, poorly sorted gravel, ranges from cobble to pebble gravel beds, subrounded to well rounded shapes</p>

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		36		SECTION NAME:			Brick's Hill Section			SURFACE ELEVATION:		533m (1760ft)											
LSD:		14		SEC:		20		TP:		82		R: 23		W of 5		NTS MAP:		84 C/4					
NORTHING:				6220500m				EASTING:				464700m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																						flat to gently rolling glaciolacustrine plain	
EXPOSURE:																						slump scar exposure of plateau adjacent to Peace River	

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-19m	>19m	interbedded till, sand & gravel	till interstratified with gravel and sand lenses; matrix has small (6-10 cm in length) sand and gravel lenses of medium sand matrix; medium sand interbeds are mostly massive (1to1.5m thick); sand and gravel interbeds can contain sand and till-like lenses (generally \leq 1m); oxidized (ie. brown), silty and sandy matrix; first exposure was highly deformed, the till has been rolled up with sand caught in the center; center portion of unit shows inclined units of till, sand, till and sand, with mixing of till and sand in each dipping unit
B	19-21m	2m	sand & gravel	(alluvial lag deposit); fining upwards to silty clay; silt/fine sand
C	21-28m	7m	interbedded silty clay and clayey silt	possibly alluvial floodplain deposit; mostly silt with some clay beds; banded silt & clay; 2.5Y4/1 (weathered clay); 2.5Y6/3 (weathered silt); 5Y3/1 (wet clay); beds vary throughout in thickness and frequency; clay is more abundant; ellipsoid lens/nodules (i.e. clusters) of silt with clay - possibly roll-up structures

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																
SECTION #:		37		SECTION NAME:				Pulpmill Section				SURFACE ELEVATION:		503m (1650ft)													
LSD:		4		SEC:		9		TP:		85		R:		21		W of		5		NTS MAP:		84 C/6					
NORTHING:				6245000m				EASTING:				483800m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								flat to rolling glaciolacustrine plain			
EXPOSURE:																								slump scar of plateau adjacent to Peace River			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4.5m	>4.5m	interbedded silt, silty clay and clayey silt	<p>I (0-1.5m) massive silt 5Y 6/3</p> <p>II (1.5-2.5m) massive brown silty clay 2.5Y7/4; 2.5Y 5/2</p> <p>III (2.5-4.1m) silty clay, grey with stringers of varved clay & silt and silt lenses, gypsum common where silt stringers occur; banded silty clay beds varved with interlaminae of clay & clayey silt beds; silty clay bed is predominant unit; mottled grey-brown 2.5Y 5/1; 2.5Y 6/4; 2.5Y 6/6; dry 2.5Y 4/1; 2.5Y 4/4; wet</p> <p>IV (4.1-4.5m) clay to silty clay pinches out near centre of section; contains A and B Horizon - brown soil</p>

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																				
SECTION #:		38		SECTION NAME:				Warrensville Gravel Pit				SURFACE ELEVATION:		648m (2125ft)																	
LSD:		14		SEC:		24		TP:		84		R:		24		W of		5		NTS MAP:		84 C/5									
NORTHING:				6239900m				EASTING:				459500m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								discontinuous ground moraine, flat to rolling topography							
EXPOSURE:																								abandoned shallow gravel pit excavation (1-2m face observed)							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.7m	>0.7m	gravel	sharp, planar upper contact; horizontally to gently dipping gravels, coarse sand to clast supported, mostly subrounded to well rounded quartzite pebbles
B	0.7-1.5m	~0.8m	massive brown till	40% clasts of mostly rounded & subrounded medium pebbles; some cobbles, small pebbles and granules; clast lithology: sandstone, quartzite, quartz, granite; unit has nearly constant thickness; A & B soil horizon with gravel lens 10Y 4/4; 2.5Y 6/3) in upper 25 to 30 cm

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		39		SECTION NAME:			Grimshaw Gravel Pit #2 (just N of Hwy 2 in gully)		SURFACE ELEVATION:		653m (2140ft)																				
LSD:		2		SEC:		33		TP:		83		R:		23		W of		5		NTS MAP:		84 C/4									
NORTHING:				6232180m				EASTING:				464900m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								rolling topography, gullied in places, discontinuous ground moraine							
EXPOSURE:																								observed SW facing wall of excavation pit							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-10m	>10m	gravel, minor sand	similar to gravels (Unit A) of Sections #3 and #4 located ~5km west of this exposure; lower ~8m contains localized oxidized gravel beds and cross-trough bedding and sand lenses; upper 2m contains as many sand as gravel beds, crosstrough and horizontally bedded, <u>no</u> oxidized beds, contact between two subunits is sharp and planar

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		40		SECTION NAME:			Judah Hill Section				SURFACE ELEVATION:		533m (1750ft)														
LSD:		8		SEC:		20		TP:		83		R:		21		W of		5		NTS MAP:		84 C/3					
NORTHING:				6222900m				EASTING:				483500m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								flat to rolling glaciolacustrine plain			
EXPOSURE:																								slump scar of plateau adjacent to Heart River			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-3.5m	>3.5m	interbedded clay, clayey silt and silty clay	<p>I (0-2m) mottled grey & brown clay; almost blotchy colour patterns where there are larger blotches of grey & large blotches of brown; no colour appears to be predominant 2.5Y4/2; 2.5Y4/1; 2.5Y3/1, 2.5Y5/3</p> <p>II (2-2.5m) grey silty clay to clay with angular brown mud clasts - almost gives a breccia-like texture; grey silty clay is mottled as well but is predominantly grey 2.5Y4/3; 2.5Y4/1</p> <p>III (2.5-3.5m) varved clay, silty clay & silt (?); varying texture may be due to slumping and thus laminae may represent fissility rather than varving - difficult to determine since the lower contact is not well exposed; the weathered face shows features quite well - but a cleared fresh & wet face doesn't show varving as well; 2.5Y7/3 and 6/4 weathered clay; 2.5Y5/3 fresh clay; 2.5Y3/1(wet) 2.5Y6/1(dry);</p>

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																	
SECTION #:		41		SECTION NAME:			Smoky River Section			SURFACE ELEVATION:		533m (1750ft)																															
LSD:		16		SEC:		25		TP:		81		R: 23		W of 5		NTS MAP:		84 C/3																									
NORTHING:				6212400m				EASTING:				472100m				UTM ZONE:				11V																							
SURFACE MORPHOLOGY:																						gently rolling to flat glaciolacustrine plain																					
EXPOSURE:																						slump face of plateau, facing N, along Smoky River																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
bedrock	0-3m	>3m	grey medium sandstone	Dunvegan Formation; crude horizontal to slightly inclined bedding; grey medium sandstone
A	3-6m	3m	till	5Y 3/2 dark olive grey; non calcareous; ~8% clast; mostly medium & small pebbles, granules, weathered siltstone, sandstone, carbonate, granites, shale, ironstones;
B	6-8m	2m	silty clay & clayey silt	stratified silty clay & clayey silt, minor clay (black)

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		42		SECTION NAME:			McAllister Creek Section			SURFACE ELEVATION:		518m (1700ft)																											
LSD:		01		SEC:		33		TP:		82		R: 23		W of 5		NTS MAP:		84 C/4																					
NORTHING:				6220500m				EASTING:				464800m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				flat to gently rolling glaciolacustrine plain																			
EXPOSURE:																				several slump faces along perennial creek in gully																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-6m	>6m	dark grey till	massive - not certain if this is a different till that stratigraphically underlies the sand (unit B); it is difficult to determine the true relationship as there has been post depositional slumping, hence was this unit originally deposited on top of the sand and later mix into the sand unit as a result of slumping; not well exposed to see upper contact of unit; in places where it is exposed, the contact is irregular compact
B	6-16m	~10m	sand with interbeds of till and gravel	mostly) fine to coarse sand with discontinuous interbeds of till and minor gravel ; till subunits contain localized cobbles and large pebbles
C	16-18m	~3m	brown till	massive; forms a vertical weathered cliff with well developed columnar jointing typical of till sediments; unit appears massive & exposure is ~3m where it is thickest; the lateral continuity to the west of the section is lost in the colluvium in the cliff; the underlying sand (unit B) meets up with this unit but the nature of the contact is difficult to observe from this view point at the base of the exposure; a cobble to large pebble lag occurs at the base of this unit
D	18-21m	~3m	sand	crude horizontal bedding; appears to be (fine-medium) sand; it caps the entire exposure; it is thickest at the highest point of the exposure ~3m; mud swallows have their nests in this unit; could have been deposited as loess i.e. updraft winds picks up sand and drops at top of cliff and dependent upon length of exposure and if exposed to wind

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		43		SECTION NAME:			Dixonville Site 1				SURFACE ELEVATION:		686m (2250ft)																		
LSD:		14		SEC:		36		TP:		87		R:		245		W of		5		NTS MAP:		84 C/12									
NORTHING:				672300m				EASTING:				457775m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								hummocky ground 2-3 m relief to rolling							
EXPOSURE:																								road cut, facing N, dug out hole ~30cm x 70cm							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.7m	>0.7m	silty clay	massive with a few ironstone and sandstone dropstones 3-5 cm; slightly mottled; easily friable, wet; non-calcareous; 2.5Y 4/2 dark greyish brown

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		44		SECTION NAME:			Dixonville Site 2				SURFACE ELEVATION:		663m (2175ft)														
LSD:		16		SEC:		34		TP:		87		R:		24		W of		5		NTS MAP:		84 C/12					
NORTHING:				6272200m				EASTING:				455600m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								hummocky ground 2-3 m relief			
EXPOSURE:																								road cut, facing E ~30cmx2.5m			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.7m	>0.7m	waterlain till/diamicton	massive; slightly calcareous; 10YR 4/2 dark greyish brown; upper contact indistinct textural change, probably planar, gradational; lower contact not exposed; clast sizes: >4mm~5%; pebbles-<1%; cobbles-0%;boulders-0%; clast lithology: weathered tan calcareous siltstone, weathered orange sandstone calcareous, carbonate clasts, coal; slightly mottled - not well defined by concretions - more like patches of discolouration's
B	0-7-2m	~1.3m	silty clay	massive with some granules & dropstone <1%; non-calcareous; 2.5Y4/2 dark greyish brown; upper contact with soil horizon gradational; lower contact gradational, planar (?); small dropstones (granule to small pebble) there is lesser % of clasts >4mm in this unit than above - same lithology as below but in less amount; <ul style="list-style-type: none"> Note - the farmer's field has large pebbles scattered around, these are not found at depth. The "boulder pile" removed from the field consiststonets of subangular to subrounded clasts (average size ~10-15cm, some up to 20cm) of predominantly Shield provenance

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		45		SECTION NAME:			Dixonville Site 3			SURFACE ELEVATION:		632m (2075ft)											
LSD:		09		SEC:		06		TP:		87		R: 24		W of 5		NTS MAP:		84 C/12					
NORTHING:				623600m				EASTING:				450600m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																				generally flat floodplain			
EXPOSURE:																				road cut trench facing east			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.0m	>1.0m	interbedded fine sand & silt	floodplain deposit adjacent to Whitemud River; generally fining upwards sequence

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		46		SECTION NAME:			Clear Hills Site 1				SURFACE ELEVATION:		678m (2225ft)																		
LSD:		05		SEC:		18		TP:		87		R:		25		W of		5		NTS MAP:		84 C/12									
NORTHING:				6266800m				EASTING:				439300m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								rolling topography, 3 to 5m relief							
EXPOSURE:																								road cut trench facing west							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.0m	>1.0m	waterlain till/diamicton	massive; non-calcareous; 2.5Y 4/2; gradational change below soil horizon with granules % increasing with depth; clast sizes: >4mm 5-10%; pebbles-<1%; cobbles and boulders-0%; clast lithology carbonates, pink granites, weathered tan siltstone, orange sandstone, oxidized calcareous sandstone

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		47		SECTION NAME:			Saskatoon Berry Section			SURFACE ELEVATION:		533m (1750ft)																			
LSD:		06		SEC:		34		TP:		82		R:		23		W of		5		NTS MAP:		84 C/4									
NORTHING:				6222900m				EASTING:				468200m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								rolling to flat glaciolacustrine plain							
EXPOSURE:																								gully exposure, adjacent to McAllister Creek, near top of plateau, facing south							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-16m	~8m (exposed)	dark grey till	massive; forms near vertical cliff; very compact; calcareous; upper contact sharp, planar; lower contact not observed; clast sizes: >4mm-15%; pebbles-20%; cobbles 1% present; boulders-0%; no lenses or beds observed; section may have been slumped - i.e. unit not insitu
B	18-30m	~12m	interbedded(?) sand, silt, till and gravel	mostly, loosely cohesive; sand/silt calcareous, gravel calcareous, till calcareous; upper & lower contacts-sharp, planar; crude horizontal stratification; towards bottom of unit, beds are inclined dipping in towards the slope; very distorted in places
C	30-32m	~2m	dark grey till	forms near vertical cliff; upper compact; unit is 80% exposed; calcareous; upper and lower contacts sharp, irregular in place, planar to slightly wavy; clast sizes: >4mm-20%; pebbles-20%; cobbles-<1%; boulders-0%; clast lithology: quartzite, vein quartz, chert, sandstone, pink granite, gneiss; circular lenses of fine sand ~12cm diameter; flat-tabular lenses ~10cm long and 5cm wide; sand inclusions
D	32-35m	~3m	sand and gravel	sand supported pebble gravel - massive; forms near vertical cliff; loosely consolidated; unit is 75% exposed; upper and lower contacts - sharp, planar
E	35-40m	~5,m	brown till	silty clay brown massive with sand lenses and beds; forms vertical cliff; unit is 90% exposed; most of unit is inaccessible; >4mm 30-35%; pebbles-30%; cobbles-<1%; boulders-0%
F	40-50m	~10m	interbedded sand and silty clay till	slightly calcareous; only 1m exposed; very weathered face (cemented); unit is 2% exposed; (wet)2.5Y3/2 very dark greyish brown; (dry) 2.5Y3/2 greyish brown; sand lens (dry) 2.5Y 6/4 light yellowish brown; upper & lower contacts - sharp, planar;- not certain where to place boundary between unit E and F as unit E has sand interbeds; clast lithologies: carbonate, coal fragments, red granites, quartzites; pebble clasts ~5%; medium and large pebbles ~4%; discontinuous lenses/beds of till and sand, with variable thicknesses and lateral extent of each sediments vary from 2-3cm up to 50cm; where till is thickest there are small circular pockets (generally ~4-5cm diameter) of fine sand with minor clay; some of the fine-medium sand lenses are much less resistant to weathering
G	50-56m	~6m	silty clay	assume glaciolacustrine origin; very poorly exposed, assume this unit continues to surface

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		48		SECTION NAME:			Shaftesbury Ferry Section			SURFACE ELEVATION:		381m (1250ft)																											
LSD:		15		SEC:		10		TP:		82		R: 23		W of 5		NTS MAP:		84 C/4																					
NORTHING:				6217230m				EASTING:				468500m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				generally flat to rolling scroll bars, alluvial terrace																			
EXPOSURE:																				road cut exposed due to construction of road - no trenching required																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
<u>Bedrock</u>	0-10m	10m	shale	Shaftesbury Formation; black, very fissile, localized sulphur beds
A	10-15m	~5m	sand & gravel	alternating beds of clasts supported pea gravel to medium sand supported gravels; some gravel beds have a muddy matrix mix with sand; pebbles are well rounded to subrounded; mostly quartzite, few sandstone, chert, fine grain felsic; wood/coal found in sand supported pea gravel ~8m below terrace level; medium and fine sand beds, possibly finer grained silt and clay; large, wavy to ripple,cross-bedding
B	15-18m	~3m	silt, minor clay	massive in lower 2m to laminated/horizontally bedded in upper 1m with alternating silty clay and clayey silt (?); probably a mixture of loess and floodplain deposits

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		49		SECTION NAME:			Heart River Site 3			SURFACE ELEVATION:		533m (1750ft)											
LSD:		05		SEC:		10		TP:		83		R: 21		W of 5		NTS MAP:		84 C/3					
NORTHING:				6225900m				EASTING:				485400m				UTM ZONE:				11V			
SURFACE MORPHOLOGY: gently rolling surface morphology with isolated ridged - trending (NE/SW) hummocks 4-5m in height																							
EXPOSURE: slump along SE bank of Heart R confluence with Peace R; approx. height ~40m ht x 300m; 202° facing N; lower half (approx.) covered by colluvium																							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-20m	>20m	interbedded sand, silt, and silty clay	with minor silty clay laminae; noncalcareous - some oxidized laminae are calcareous; fine medium sand (wet) 10YR5/4 - yellowish brown, (dry) 10YR7/2 light grey; silt (wet) 2.5Y4/2 dark greyish brown (dry) 2.5Y6/4 light yellowish brown; oxidized silt 10YR3/4 dark yellowish brown; lower contact not exposed; upper contact sharp, undulating with clay bed - maybe a slump contact?; horizontally bedded; 2 to 10mm beds, silt beds have laminae of fine sand in them and oxidized band ~2mm is present in the silt beds as well; silt beds sometimes have ripple marks; more sand beds in the upper 3-4m where the gravel occurs; oxidization in sand & silt beds; a sand to muddy supported medium pebble gravel lens is present near top of exposure; massive - no apparent bedding in gravel lens
B	20-30m	~10m	till	I (lower 70cm) disturbed unit of till with gravel, sand and silt beds and lenses; poorly exposed II (upper 30cm) not defined with certainty - may be a gradational unit underlying lake sediments; or it is possible the unit is absent in places underlying subunit I, it is so chaotic it becomes difficult to discern or differentiate between the two
C	30-40m	~10m	silty clay	assume glaciolacustrine origin, not accessible and not described

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	3																					
SECTION #:		50		SECTION NAME:			Notikewin River Site 1			SURFACE ELEVATION:		472m (1550ft)																			
LSD:		11		SEC:		28		TP:		91		R:		23		W of		5		NTS MAP:		85 C/13									
NORTHING:				6308680m				EASTING:				461020m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								gently rolling to flat, very few stones - large pebbles scattered in farmers field							
EXPOSURE:		large river cut in N. bank of Notikewin River; NE-SW; facing SE; ~40m in height from top to river level, either end has been incised by river cut not long after depositional - now a terrace; ~10m vertical section is maximum exposure; runs along sides and at top, ~8m vertical section; with gully to top of bank in center. Colluviated material fills most of this scalloped shaped exposure. No major slumping, down slope of large blocks, is apparent																													

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-28m	>28m	dark grey massive till	moderately cohesive; 2% exposed; non-calcareous; wet 2.5 3/2 very dark greyish brown; lower contact not observed/exposed; upper contact planar (?) sharp; marked with high amount of fractures infilled with gypsum and oxidized band ~5cm across entire fracture; clast sizes: >4mm-6%; pebbles-5%; cobbles-1%; boulders-0%; clast lithology: shale - none in sample bag (too weathered to preserve with sulphur staining); coal - large pebble & small pebble; upper ~2m fractured and infilled with gypsum, also brown oxidized layer ~ 5cm across fracture depth - pattern shows up better on weathered surface
B	28-31m	~3m	brown and grey till	contains clay stringers at top and within unit; forms near vertical cliff; compact; 5% of unit exposed; non-calcareous; wet 2.5Y4/4 (olive brown) 2.5Y 3/2 (very dark greyish brown); dry 2.5 6/4 (light yellowish brown) 2.5Y 5/2 (greyish brown); lower contact - very difficult to see, exposure not good enough to be certain where it occurs; appears convoluted locally; upper contact - obvious in weathered face; not sure of lateral continuity of light brown unit; does this unit indicate an unconformity and thus Unit C, above is a separate till unit from this unit?? - lateral continuity of dark grey clay stringers is uncertain; clast sizes and lithologies: %>4mm - coal, shale (well rounded), granites (pink and red); carbonates, fine grain mafic rocks, orange weathered sandstone (calcareous), granite gneiss, vein quartz; 5% pebbles - ironstone, quartzites (few), pink and red granites, calcareous sandstone, gneiss; 2% cobbles - granite gneiss; no boulders; large plano-convex shape bounded by clay stringers; the texture of till inside and outside of this feature does not change; may have formed when unit was submerged (i.e. subaqueous) and clay represents boundary between a separate "mass" that formed in till unit as result of some displacement of water or loading (?); gypsum crystals fill entire fractures with iron oxide and Mn-oxide staining; random pattern & size of "mottled" dark grey colour in unit; appears to be "inclusion" of the grey till - may be from below (probably from above ??) it is ~ 60-70cm thick (i.e. across), and vertically orientated, outline is not well defined; infilled gypsum fractures-oriented horizontal, wavy, space 5-6cm apart; combined with large fractures that are near vertical and have some rusty, weathered gypsum crystals

{PRIVATE }UNIT DESCRIPTION				PAGE	2	OF	3
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION			
C	31-38m	~7m	massive brown till	forms vertical cliff with columnar jointing, upper ~1.5m of unit has thin columns spaced at 8-10cm where section forms nose (i.e. prominence between gullies on either side); where entire unit occurs as one vertical cliff there are large (1 to 1.2m) columns with smaller (10 to 20cm) columns within; columns become finer towards top (i.e. within 1.5 to 2m of upper part of unit has finest blocky pattern); easily breaks away from cliff face due to fractures; 60% of unit is exposed; wet - 2.5Y 3/2 (very dark greyish brown) till; dry - 2.5Y 5/4 (light olive brown) - Fe-oxide staining in fractures; upper contacts - sharp, wavy; lower contact - sharp, straight to undulating (noticeable from afar in weathered exposure and less distinct in exposed fresh face); small pebble lithology: coal (square-shape); pink granites (subangular); white carbonates (well rounded); (oxidized) very weathered carbonaceous sandstone (well rounded); quartzite (well rounded); shale (rounded); fine grained mafic (well rounded); chert medium-large pebbles-> granite/pegmatite(?) (abundant subangular to well rounded) ironstone (flat, tabular); vein quartz (well rounded); purple fine grained sandstone(?) (rounded); pebbles - gneiss; granite, white carbonate (well rounded, no more than 2cm); quartzite (well rounded, only a few observed); cobbles-granodiorite (with garnets), ironstones; medium grained sandstone (tabular); clast sizes: >4mm-10%; pebbles 2-3%; cobbles 1-2%; boulders-0%; very difficult to see features in weathered face due to small sloughing; fractures oxidized and infilled with gypsum; fractures form columnar (jointing) but also develops as cliff face itself fractures from sloughing and separates from face; - block shiny almost metallic lustre coat sides of fracture (Mn oxide) and Fe-oxide, i.e. rusty colour			
D	38-41.5m	~3.5m	silty clay	glaciolacustrine origin; thin bands (1-2cm) of grey silty clay, wavy, discontinuous, interbedded with olive diamicton, with ~5% granules and tiny pebbles, lensoid, thickness range ~60cm to 2cm; lateral continuity varies; unit thickest near centre of gully, pinches out on either side of gully as unit has been eroded by stream process in the past as base level lowered; terraces on either side of gully stand about 20m above river level; best exposed between gullies where it forms a vertical cliff; blocky (~1cm) non-cohesive, weathered; 30% of unit is exposed; non-calcareous; 10YR 3/2 silty clay (very dark greyish brown) 10YR5/3 diamicton (brown) 10YR4/2 non-oxidized diamicton (dark greyish brown); lower contact - sharp wavy where silty clay band occurs at base; clast sizes in diamicton beds; >4mm - 3-5% (well subrounded); pebbles- <1% of ironstone, fine-grained mafic, pink granite, weathered sandstone; one large cobble (8-10cm) subrounded - subangular granite gneiss, located at ~50cm above base of unit; random, wavy discontinuous thin beds of silty clay (grey) with thicker lensoid diamicton beds			

{PRIVATE }UNIT DESCRIPTION				PAGE	3	OF	3
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION			
E	N/A caps terrace replaces units B to D in most places	2-4m (variable)	interbedded sand and silt with gravel lag	<p>alluvial origin: the silt beds contain paleosols - these are highly calcareous (i.e. CCa horizon), the silt beds are grey in colour (i.e. reduction) with oxidized bands above and below; the upper most silt (palesol) i.e. youngest - has much less alteration - there are no reduced & oxidized layers, but there is a whitish powder accumulated here that is highly effervescent, i.e. calcite; the palesol marks the uppermost part of each fining upward sequence with planar beds at bottom and grades up into small scale cross-trough stratification; the reduced silt band (~3-5cm thick) is wavy to irregular - thinning out & less defined in places - probably due to the irregular movement of ground water infiltration through this horizon; each fining upward sequence is approx. 40 to 50cm; with 3 silt horizons present in this unit; the base of this unit is marked by a coarse to medium sand with minor small pebble to granule gravel; there is planar cross stratification present dipping ~30° to 45° to east; the gravel lag is a poorly exposed sand supported gravel; it appears to be massive since no stratification appears to be present. The lithologies have a mix of local (sandstone, siltstone, ironstone), Cordilleran (quartzite), Shield (igneous - red granite, gneiss, mafic fine grain and coarse grain); the terraces show an upper 4-5m (sometimes thinner) of fluvial deposits consisting usually of predominantly silt and clayey silt floodplain beds with a thin gravel lag (usually not more than 2m) bed rests on the massive dark grey till; units B & C are not observed (i.e. preserved) in the terrace cuts - they are only seen where the overlying glaciolacustrine are also preserved</p> <p>NOTE: whether units B & C represent different facies of till deposition or each represent a separate glacial advance is uncertain; the 3 till units are exposed at Section #50 - but are not exposed anywhere else along the Notikewin River (where the deposits are accessible) there are other exposures - but the steepness of the river cut prevented detailed descriptions at these sites (i.e. section #62); pictures along the Notikewin River on S side and E of the town of Manning appear to have lenses of sand and/or diamicton recurring in this the grey till (ie. unit A);</p>			

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																				
SECTION #:		51		SECTION NAME:				North Star Gravel Pit 1				SURFACE ELEVATION:		305m (1000ft)																	
LSD:		05		SEC:		27		TP:		90		R:		21		W of		5		NTS MAP:		84 C/14									
NORTHING:				6298860m				EASTING:				483550m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								surface morphology of the terrace is rolling with scroll bars of variable magnitude							
EXPOSURE:		E-W exposure facing S; small face in gravel pit with vertical exposure; ~4m (height) by ~30m (long); only ~10m length exposure of entire vertical exposure of 4m orientation 265° (to left of exposure)																													

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	4m	gravel	<p>I (0-2m)-poorly sorted, cobble, sand supported gravel, slightly imbricated; pebbly sand to matrix supported gravel; forms vertical face; poorly consolidated - easily breaks away from face; unit is ~15% exposed; calcareous sand matrix; upper contact planar, gradational; lower contact not exposed; clast sizes: matrix-sand-<5%; granules-20%; small pebbles-50%; pebbles-25%; cobbles 2-3%; horizontally bedded moderately defined (medium-fine) sand interbeds</p> <p>II (2-4m)-imbricated cobbles & large pebbles forms lag at 2.5m height; cobble sand supported, gravel; slightly cemented, forms vertical cliff; difficult to pry cobbles away because of packed sand matrix; unit is 100% exposed; calcareous sand matrix; upper contact - removed, lower contact planar, gradational; clast sizes: fine sand-5%; granules-20%; small pebbles-40%; pebbles-15%; cobbles (up to 12cm) -20%; poorly defined horizontal bedding, bed thickness ~20cm; small stringers - (~3m in length ~2cm thick) and clusters concentrated along horizontal plane</p>

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																				
SECTION #:		52		SECTION NAME:				North Star Gravel Pit 2				SURFACE ELEVATION:		450m (1475ft)																	
LSD:		01		SEC:		20		TP:		90		R:		21		W of		5		NTS MAP:		84 C/14									
NORTHING:				6299620m				EASTING:				481770m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								adjacent to a flat to rolling glaciolacustrine plain							
EXPOSURE:																								gravel pit excavation on edge of plateau above Peace River							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-5m	>5m	gravel	alluvial origin; very poor exposure; not certain of what's been bulldozed & what's in place; upper gravels very similar to Unit A - Sect #51 (cobble sand supported gravel) poorly sorted; only upper ~2m of cliff exposed

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		53		SECTION NAME:			Berwyn Site 3				SURFACE ELEVATION:		617m (2025ft)																		
LSD:		08		SEC:		13		TP:		82		R:		25		W of		5		NTS MAP:		84 C/4									
NORTHING:				6217800m				EASTING:				452800m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								flat to rolling mixed glaciolacustrine and ground moraine terrain							
EXPOSURE:				road cut trench																											

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.3m	>1.3m	brown till	massive silty small stones; moderately friable; forms vertical face near top where gully bank eroded away; upper 1m calcareous; less calcareous where till is moist below ~1m; 5Y 2.5/2 (black)-fresh/wet till matrix; lower contact not observed; clast sizes: >4mm-15-20%; pebbles-10%; cobbles and boulders-0%; clast lithology: coal, shale, sandstone (weathered orange) vein quartz; quartzite, siltstone (tan); white and black chert, white granite, quartzite; subrounded to well rounded shapes; at ~50cm depth dark grey clay and tan silt bands are discontinuous wavy, ~5-10mm thick; gypsum infills fractures are present in blotches throughout upper ~60cm of unit; gypsum continues in vertical to slightly inclined fractures spaced 20 to 30cm apart in upper 60cm and becoming more widely spaced & randomly oriented with depth

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																					
SECTION #:		54		SECTION NAME:			Griffin Creek Section				SURFACE ELEVATION:		594m (1950ft)																																		
LSD:		01		SEC:		26		TP:		81		R:		26		W of		5		NTS MAP:		84 C/4																									
NORTHING:				6211200m				EASTING:				441300m				UTM ZONE:				11V																											
SURFACE MORPHOLOGY:																								flat to rolling mixed glaciolacustrine and ground moraine terrain (~6m above bottom of creek)																							
EXPOSURE:																								slumped bank of creek; facing West, trend 010° ~7m exposed bank cut with upper ~1 to 2m vertical cliff and 10 to 12m in length on outside of creek bank;																							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-7m	7m	dark grey till	silty clay matrix ;massive; with many large pebbles; forms vertical cliff at top of creek cut; easily friable/breaks away from face; unit is 5% exposed; non-calcareous; 5Y3/2 dark olive grey - wet; no contacts observed; clast sizes: >4mm-20%; small pebbles 12-15%; medium-large pebbles-5%; cobbles 1-2%; boulders-0%; mostly well rounded clasts; a few subrounded to subangular; & still a few that are fractured clasts; gypsum - coarse sand-size crystals, infilling fractures that are near vertical to inclined, 30 cm apart; weathered face - blocky ~7x3cm large; suspect downslope mass movement

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		55		SECTION NAME:			Weberville Site 5				SURFACE ELEVATION:		625m (2050m)																		
LSD:		14		SEC:		31		TP:		85		R:		21		W of		5		NTS MAP:		84 C/6									
NORTHING:				6252800m				EASTING:				481050m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								rolling discontinuous ground moraine							
EXPOSURE:																								observed north facing wall excavation of ~3m deep; ~15 x 10m dimension; small gravel pit ~10 x 15m and 3m height							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-2m	>2m	gravel	massive, oxidized sand matrix supported gravel, poorly sorted; most of unit covered; non-calcareous; 10YR4/6 dark yellowish brown; lower contact not observed; clast sizes: ~40-60% clasts overall with small pebble-45%; medium-large pebbles-5%; cobbles~1%; boulders 0%; very poorly sorted, coarse-medium sand matrix, mostly subrounded to well rounded; one large, subangular pebble of sandstone; Fe oxide bed ~2mm thick; also Mn oxide - brownish black localized in almost circular lenses
B	2-2.5m	~0.5m	brown till	massive very silty with some sand, excavation forms vertical face, moderately cohesive and easily friable, unit is 90% covered; upper gradational and wavy contact, lower contact is sharp, planar; clast sizes: 4mm~10%; small pebbles-5%; large pebbles- 2-3%; cobbles and boulders-0%; pebble lithology: coal, carbonates, quartzite, siltstone (calcareous and tan coloured) oxidized ironstone, vein quartz, chert, granite, sandstone blocky (5x10mm), fractures - vertical discontinuous and horizontally wavy discontinuous
C	2.5-3.0m	~0.5m	silty clay	glaciolacustrine origin (?); massive; unit is 95% covered; non-calcareous; 5Y 4/3 olive; upper contact soil development blocky (3x9mm 'blocks') texture; fractures infilled with oxidized sand/gypsum

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		56		SECTION NAME:			Heart River Site 1				SURFACE ELEVATION:		533m (1750m)																		
LSD:		03		SEC:		29		TP:		82		R:		21		W of		5		NTS MAP:		84 C/3									
NORTHING:				6220500m				EASTING:				484300m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								mix of colluviated and alluvial sediment, chaotic distribution							
EXPOSURE:																								cut bank exposure along Heart River							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
bedrock	0-12m	>12m	shale	Shaftesbury formation

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																	
SECTION #:		57		SECTION NAME:			Heart River Site 2			SURFACE ELEVATION:		533m (1750ft)																															
LSD:		08		SEC:		30		TP:		82		R: 21		W of 5		NTS MAP:		84 C/3																									
NORTHING:				6221120m				EASTING:				483400m				UTM ZONE:				11V																							
SURFACE MORPHOLOGY:																						flat to gently rolling glaciolacustrine plain																					
EXPOSURE:																						facing E to SE; slump exposure near surface; ~upper 2 to 3m vertical exposure along top and sides of slump; approx. 10m along the slump face (including top and sides)																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
bedrock	0-2m	>2m	siltstone/ sandstone	Dunvegan formation; forms vertical cliff; upper contact sharp and slightly wavy; lower contact not observed; siltstone - cohesive and compact, appears massive; tan coloured; weathered face and highly fractured, inclined W to NW @ ~60°; sandstone very loosely consolidated - like sand; grey - medium sand; horizontally bedded with thin interbeds of ironstone and nodules;
A	2-7m	~5m	till	massive with mix of fine sand pockets/laminae; silt & clay laminae with silty clay matrix; forms vertical cliff along edges of slump face; very cohesive; 5% of unit is exposed; upper contact is sharp, planar - may be due to product of fracturing; lower contact is sharp, wavy; clast sizes: >4mm-10%; pebbles-5%; cobbles~1%; boulders<1%; pebble and cobble lithologies are: quartzite, sandstone, pink granite, granodiorite, ironstone of subangular-subrounded shapes; face is very weathered with lots of bee's/wasps nest in fractures; not able to get a fresh face to see good exposure; appears to have stratification; localized blotches show wavy laminae of silt, sand, and clay mixed in with till matrix; the face showed horizontally wavy laminae with concentric grey coloured till matrix between separations of laminae; sediments not likely deposited subsequently; face is constantly exposed to sun (heat) (probably frost ? in winter); highly fractured, very compact (concrete like)
B	7-8m	~1m	silty clay	forms vertical cliff below/underneath soil overhang; easily friable; 80% of unit is exposed; upper contact- A and B soil horizons; lower contact-sharp, planar; horizontal bedded (?) riddled with white specks of calcite and/or possibly gypsum; powdery appearance - (didn't take a close look); section was too dangerous to do extensive work; bees and wasps have nests everywhere in the till as it is fractures; temperature was extremely warm; slope was near vertical and difficult to access; a discontinuous clay bed occurs at contact with till & bedrock; large sandstone blocks, directly below this at lower contact with fine sand deposited in depressions

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																	
SECTION #:		58		SECTION NAME:			Rousseau Creek Site 1			SURFACE ELEVATION:		457m (1500ft)																															
LSD:		12		SEC:		27		TP:		90		R: 22		W of 5		NTS MAP:		84 C/14																									
NORTHING:				6299320m				EASTING:				474200m				UTM ZONE:				11V																							
SURFACE MORPHOLOGY:																						flat to rolling glaciolacustrine plain																					
EXPOSURE:																						cut bank section of Rousseau Creek, orientation 290° to left facing section																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-10m	10m	silty clay	10m of exposed lake sediments, silty clay with minor silt lenses; dark & light brown patches; exposure is steep & slump is too wet to walk across; appears to be silt and fine sand in lower ~5m; massive (i.e. no apparent bedding); light beige coloured in weathered face; forms almost vertical face; ~5m exposed; one medium, well rounded quartzite pebble found ~2.5m depth; weathered-calcareous; wet 10YR3/1 very dark grey, 10YR5/6 yellowish brown; dry 10YR5/1 grey, 10YR 6/4 light yellowish brown

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		59		SECTION NAME:			Rousseau Creek Site 2			SURFACE ELEVATION:		457m (1500ft)																											
LSD:		09		SEC:		34		TP:		90		R: 22		W of 5		NTS MAP:		84 C/14																					
NORTHING:				6300700m				EASTING:				475100m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				flat to rolling glaciolacustrine plain																			
EXPOSURE:																				creek cut; 290° to left facing section; 20-25m high 100-120m along creek; at least 60-70% covered by slump/colluvium																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-8m	>8m	sand and gravel	oxidized, sand supported, poorly sorted gravel; massive; only upper ~3m exposed; contact with upper unit forms vertical face; very loosely consolidated; sharp, planar (?) upper contact - (not observed in detail); pink granites, gneiss, quartzites, rusty sandstone, siltstone, large (cobble) pyritic concretion (perfect ~12mm sphere!), shale; coal; rocks of varying shape subangular - well rounded; both local and shield type rocks - also of varying size - large pebble to granule size
B	8-16m	~8m	till	massive, silty clay matrix; vertical face near upper contact with ~1-2m exposed; moderately consolidated; slightly calcareous; wet - 5Y3/2 dark olive grey; dry - 5Y5/2 olive grey; clast sizes: >4mm-5%; pebbles-10%; cobbles and boulders-0%; clast lithology: phosphatic shale; pink/red granites, gneiss, chert, quartzite, medium pebble and carbonate, weathered sandstone; purple sandstone; massive - very poor exposure
C	16-26m	~10m	silty clay	mostly massive glaciolacustrine sediments; upper 8m - sharp vertical face, lower 2m - forms a slope of colluvium with underlying till; unit is 80% exposed, but not easily accessible; not described in detail

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		60		SECTION NAME:			Deadwood Site 1				SURFACE ELEVATION:		472m (1550ft)																		
LSD:		05		SEC:		17		TP:		90		R:		21		W of		5		NTS MAP:		84 C/14									
NORTHING:				6295600m				EASTING:				480320m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								gentle hummocks ~1m relief on glaciolacustrine plain							
EXPOSURE:																								road cut trench on road leading to section #52							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-0.8m	>0.8m	sand	massive, medium to coarse, rounded - subangular quartz, K-feldspar, and chert

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		61		SECTION NAME:			Deadwood Site 2				SURFACE ELEVATION:		465m (1525ft)																		
LSD:		14		SEC:		17		TP:		90		R:		21		W of		5		NTS MAP:		84 C/14									
NORTHING:				6296200m				EASTING:				480900m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								gentle hummocks ~1m relief on glaciolacustrine plain							
EXPOSURE:																								~500m south, along same road as Section #60							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.5m	>1.5m	clayey silt	massive to stratified, with sand stringers and interbeds; roots have concentrated along sand bed; hummocks appear the same - but this section is situated on farmed land versus larch and pine vegetation seen in Section #61

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		62		SECTION NAME:			Notikewin River Site 2			SURFACE ELEVATION:		503m (1650ft)											
LSD:		02		SEC:		30		TP:		91		R: 23		W of 5		NTS MAP:		84 C/13					
NORTHING:				6308000m				EASTING:				458400m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																				gently rolling <1m hummocks			
EXPOSURE:																				river cut; ~6m of vertical cliff before slump with colluvial slope, then ~10m to river level around bend - the cliff is vertical down to river from top; i.e. ~16m vertical cliff			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-10m	>10m	olive till	massive; upper ~6m exposed; forms vertical cliff; very weathered and compact; unit is 20% exposed; non calcareous; wet 2.5Y 3/2 very dark greyish brown; dry 5Y 5/4 olive; clast sizes: >4mm-15%; pebbles-14%; cobbles~1%; boulders-<1%; compositions: red granites, weathered siltstone (tan), weathered sandstone (orange, oxidized); sandstone (pink): mafic medium grain; mudstones; vein quartz, quartzite, carbonates; black chert; many small pebbles and granules of granites are angular to subangular; small sand (medium grained) lens ~8x3cm; "mud ball" consists of 20-25% granules and small pebbles clasts, with silty clay matrix, others with sandier matrix; exposure is not very accessible; descriptions may not represent entire unit; numerous subvertical fractures infilled with gypsum

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		63		SECTION NAME:			Notikewin River Site 3			SURFACE ELEVATION:		472m (1550ft)															
LSD:		01		SEC:		34		TP:		91		R:		23		W of		5		NTS MAP:		84 C/13					
NORTHING:				6309500m				EASTING:				463500m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								rolling topography			
EXPOSURE:		Notikewin River cut bank just E of town of Manning - N. bank; small ~2m exposure at top of cliff on slump scar; steep vertical cliff below;																									

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-10m	>10m	dark grey till	silty massive texture; only observed upper ~50cm, ie. erosional contact with upper sand and gravel unit; easily friable; slightly calcareous; wet 2.5Y3/2 very dark greyish brown; clast sizes: >4mm-20%; pebbles-20%; cobbles->1%; boulders-0%; clast lithologies: shale, sandstone (pink, weathered orange oxidized) carbonates, pink & red granites
B	N/A erosional unit capping unit A	~2m	sand and gravel	represents capping unit found in three terrace levels (t ₁ , t ₂ , t ₃); coarse sand supported, very poorly sorted, mostly subrounded to subangular small and medium sized pebbles; generally has same lithology as underlying till; has lenses/interbeds of dark grey silty clay; gravel beds are not well exposed, but occur below the floodplain deposits in all terrace levels (ie t ₁ , t ₂ & t ₃); the gravel bed at t ₁ , site is only ~15cm thick; a pink granite boulder (21cm long), and 5-8cm cobbles also occur in this bed; oxidized sand is present at the lower erosional contact with till (i.e. channel lag of terrace)

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		64		SECTION NAME:			Slump Creek Section			SURFACE ELEVATION:		518m (1700ft)																											
LSD:		02		SEC:		08		TP:		85		R: 21		W of 5		NTS MAP:		84 C/6																					
NORTHING:				6245000m				EASTING:				483050m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				rolling to ridged (due to drainage) <1m relief																			
EXPOSURE:																				creek section depth of slump scallop ~50 to 60m along top																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
bedrock	0-7m	~7m	shale	Shaftesbury formation; horizontally bedded; forms vertical face not more than 2-3m vertical exposure at sample/description site (darker brown); easily friable; noncalcareous; wet - 5Y2.5/2 black 5Y 3/2 dark olive grey, 2.5Y 4/4 olive brown; dry - 5Y 6/2 light olive grey; upper contact is sharp, wavy with both sand and till; horizontal bedding - crudely defined by bands of grey & brown, the brown bands have iron stones formed in them; no complete beds of ironstone seen - only the odd ironstone nodule; brown beds vary from 1 to 6cm thick and occur 7-8 cm intervals; fractures infilled with black clay and granule size gypsum are present inclined @ ~60° to wavy with lens shape, gypsum also accumulates where fractures intersect; clay fractures infill with gypsum granules; fissile/blocky 1-2 cm; wet in fresh face; upper 2m of unit may have been distorted or altered by glacial overriding
A	7-8m	~0.60m	sand and till	distorted sand and till; calcareous - sand; slightly calcareous - till; wet - 5Y4/3 olive; dry - 2.5Y5/2 greyish brown; upper contact gradational as more sand lenses occur above main unit which is present in about equal proportions of till and sand; sharp; lower contact is wavy/irregular, till appears to be same texture as overlying Unit B; highly distorted unit with no well defined beds of either till or sand; there appears to be some loading by the till, i.e. sand appears to have been squeezed up and around the till; there may be some clay stringers; wet in fresh face
B	8-14m	~6m	olive brown till	massive; not well exposed - mostly covered in colluvium with isolated portions protruding out of section; breaks easily - moderately consolidated; <5% of unit is exposed; slightly calcareous; wet 2.5Y3/2 very dark greyish brown; dry 5Y5/3 olive; clast sizes: >4mm-20-30%; pebbles-25%; cobbles-0%; boulders-one seen in slope on section; large coal fragment ~3x4cm found at base of unit; quartzite, carbonate, vein quartz, ironstones, weathered sandstone (orange), red granite, chert, red mudstones; mostly well rounded to subrounded pebbles
C	14-18m	~4m	clay silt	this unit is very distorted; i.e. post depositional sediment flow/mixing/loading very difficult to discern separation & lateral distribution because of mixing of units; slump and colluvium covers most of this unit; contact between Units B and C is uncertain, this contact may not be a simple horizontal plane; silt to clayey silt appears to predominant texture, with minor diamict, fine to medium sand, and clay also present - no gravel units were observed

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		65		SECTION NAME:			Jim Creek Section			SURFACE ELEVATION:		533m (1750ft)																											
LSD:		04		SEC:		03		TP:		91		R: 24		W of 5		NTS MAP:		84 C/13																					
NORTHING:				6301600m				EASTING:				452300m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				gently undulating - swamp predominates																			
EXPOSURE:																				creek cut, ~2-3m bank exposed with ~1m of slump at base ~4-6m horizontal extent, facing south																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-3m	>3m	dark grey till	massive texture; exposed at creek bottom where water level has been higher (fresh exposure); unit is slumped over vertical face near creek level; i.e. eroded bank; hard, sticky & wet; slightly calcareous; wet 2.5Y3/2 very dark greyish brown; upper contact-erosional contact with recent fluvial sands; lower contact not observed; clast sizes: >4mm 10-15%; pebbles-5%; cobbles and boulders-0%; clast lithology: at exposed site many subangular granodiorites, red granites, carbonates and chert; stream bed is made up predominantly of Shield cobbles and some boulders, fewer ironstones and local lithology; stream banks appear to be till for some extent along creek - probably still the same till unit (>10m) seen near Manning along the Notikewin River; gypsum not observed; too wet, creek level too high for better access

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		66		SECTION NAME:			Pulpmill Road Site 1			SURFACE ELEVATION:		503m (1650ft)																											
LSD:		16		SEC:		07		TP:		85		R: 20		W of 5		NTS MAP:		84 C/6																					
NORTHING:				6246200m				EASTING:				491600m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				rolling with isolated hummock/ridges ~4m relief, ponding of water in depressions																			
EXPOSURE:		creek exposure - with extensive slumping/down slope displacement of sediments - especially till; 240° facing NNE; ~4.5m of vertical cut face with ~2m of slump with alluvium at base, and ~6m along creek																																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	4m	sand and gravel	crude inclined bedding 045° (dipping 20°); interbedded sand supported & clast sand supported beds have mostly granules; clast support beds vary from small to medium pebble; crude normal grading of individual beds; i.e. medium-pebble appears to form the channel lag deposit with smaller pebbles deposited over the lag; localized oxidization of fine-medium sand interbeds
B	4-5m	~1m	interlaminated clay and silty clay	with minor silt and clayey silt; this unit probably acted as the sliding base of the slump that has occurred in this gully; numerous slickenslide on upper & lower surfaces of numerous eye-shaped bodies; the surfaces are smooth & grooved; clay laminae are a highly fractured, and form fissile layers at the upper & lower contacts; the highly fractured layer is thicker at the upper contact with overlying till (~30-50cm)
C	5-20m	~15m	olive grey till	weathered, massive; this unit has probably moved down slope and is not insitu; i.e. colluvium has mixed within itself - there are no gravel lenses but there is a concentration (i.e. cluster) of large pebble to cobble size clasts ~40cm above base of unit; the lower ~40cm of this unit and unit B underlying seem to have undergone more mixing/sliding than the upper portion of Unit C (i.e. till); this mixed unit contains clay "stringers" and discontinuous sand interbeds within Unit B that have a blockier (~1cm blocks) texture than the overlying till; further down the gully ~20m lower, a mixed-up sand unit occurs- is this what overlies the gravel (Unit A)? and if so - how thick was this unit originally; an exposure upslope from this exposure (~50m above the previous exposure) consists of a dark grey massive silty clay till; cannot be certain how much downslope post depositional movement, if any has occurred; loosely consolidated (not sticky - too silty); slightly calcareous; wet 5Y3/2 dark olive grey; dry 10YR5/1 grey; no contacts observed; clast sizes: >4mm-10%; pebbles-10%; cobbles-<1%; boulders-0%; clast lithologies: local shale (with sulphur yellow weathered surface); carbonate, red granite, black medium grained clasts, brachiopod fossil; many subangular pebble clasts-granites (i.e. igneous rocks); some gypsum in fractures

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																	
SECTION #:		67		SECTION NAME:			Pulpmill Road Site 2			SURFACE ELEVATION:		457m (1500ft)																															
LSD:		15		SEC:		07		TP:		85		R: 20		W of 5		NTS MAP:		84 C/6																									
NORTHING:				6246240m				EASTING:				491200m				UTM ZONE:				11V																							
SURFACE MORPHOLOGY:																						rolling with isolated hummocks ~4m relief																					
EXPOSURE:																						plateau slump scar exposure, facing south																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-7m	>7m	sand	stratified medium sand with minor, granule gravel beds and laminae; upper contact - sharp, planar - wavy, sharp; post depositional down slope movement of Unit B has altered Unit A; wavy to ripple stratification, small scale stratification and planar bedding; localized oxidization, iron staining
B	7m	~10cm	clayey silt	varved clayey silt & silty clay, 2-6 mm thick, horizontally laminated
C	7-14m	~7m	olive grey till	very weathered face, very compact - like concrete; 2 large boulders ~2m and 1 above base of unit 20 to 40 cm in diameter; appear similar texture to till @ Section #66

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		68		SECTION NAME:			Heart River Site #4			SURFACE ELEVATION:		570m (1870ft)											
LSD:		12		SEC:		22		TP:		81		R: 20		W of 5		NTS MAP:		84 C/3					
NORTHING:				6210100m				EASTING:				496700m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																				section in floodplain			
EXPOSURE:		Heart River cut section, ~E-W facing N, ~9m to river with 3-4m exposed at the top & along the edges of the exposure; most of section covered by colluvium																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-7m	>7m	till	massive silty clay; forms vertical face just below slope surface; easily friable - even when wet (i.e. silty matrix); unit is 5% exposed; slightly calcareous; wet 2.5Y3/2 very dark greyish brown; dry 2.5Y5/2 greyish brown; upper contact wavy/irregular sharp, lower contact not observed; clast sizes: >4mm-10%; pebbles-9%; cobbles-1%; boulders-0%; clast lithology: carbonate, ironstone, sandstone, quartzite, red granite, granodiorites; gypsum infilling large vertical fractures

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	2																													
SECTION #:		69		SECTION NAME:			Peace River Site 1			SURFACE ELEVATION:		457m (1500ft)																											
LSD:		07		SEC:		09		TP:		91		R: 21		W of 5		NTS MAP:		84 C/14																					
NORTHING:				6303750m				EASTING:				481100m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				flat to rolling glaciolacustrine plain																			
EXPOSURE:																				cut bank exposure along Peace River, >140m thick, facing south																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
Bed-rock	0-12m	>12m	sandstone	Harmon Member of Peace River Formation; wavy & horizontal beds of fine-medium sand with iron staining; and thin dark purplish interbeds - some with gypsum veins; some sulphur stain as well; bedrock - crude horizontal beds of fine-medium sand, sulphur and iron staining throughout; modules/concretions vary from <1cm to >6m; upper 1 to 1.5m exposed; otherwise covered by colluvium
A	12-13.5m	1.5m	preglacial gravels	clast supported, poorly sorted, large pebble to pea gravel, well to subrounded clasts, quartz, quartzite, sandstone, chert, ironstone; wavy lower contact is contact difficult to determine sinc contact is with sand unit of Unit B (may be up to 8m thick)
B	13.5-38m	24.5m	gravel and sand interbeds	<p>II-gravel lag unit; very poorly sorted large cobble to small boulder (~30cm diameter) gravel with pea-sized to large pebble gravel matrix; boulders are subrounded to well rounded; clast lithology: red granites, purple quartzite, granite gneiss, mudstones (ironstones), diorite gneiss; less than 1% are quartzites; 30-40% are granite varieties <1% local sandstone; this gravel unit is approx. 1.5m thick; underlying the cover may be continuation of Unit B but there appears to be less obvious large boulders; clast supported matrix of pea to large pebble gravel mostly well rounded (minor subrounded);bands of oxidization (2-3cm thick) are present;</p> <p>I-interbedded sand and gravel- upper gravel bed-lithologies-> quartzites (20-30%), granites (2-3%); fine grained mafic (1-2%); quartz vein (1-2%) generally these beds thicken downwards; horizontal thin bedded sand (medium-fine) ~50cm thick exposed; gravel grades up to (fine to medium) with thin (3cm) to medium (10cm) beds of clast supported pebble (medium) to pea gravel; clast to sand supported, horizontally bedded, pea to large pebble gravel; minor lenses of sand; ~4m exposed at top of gully, horizontal to wavy beds, some fine sand beds that are more resiltstonetant to weathering; top of this unit is approx. half way on the section face; sand beds are horizontally bedded/laminated, interspersed with units of clayey silts to very fine sands that are rippled; plane rippled; some load structures present at contact between lower silt are upper medium-fine sand; sand bed thicknesses decrease downward to minor, thin (2-3cm) beds of sand in approx. (15 to 20cm thick);</p>

UNIT DESCRIPTION				PAGE 2 OF 2
C	38-128m	90m	sand with gravel, clay, and diamict interbeds	<p>sand-light beige (fine-medium) massive, somewhat compact, forming a bit of a vertical face at upper contact with Unit D; sands are medium to fine grained with interlaminae of very fine sand to silt that contain fragments (general <5mm, average 2-3mm) of fossilized wood(?);</p> <p>diamict-olive to light & darker grey; highly fractured in weathered face; forms small columns, 50-70cm in height near the gully's edge;</p> <p>clay-laminae & beds, discontinuous; found near upper contact of diamict bed (uncertain due to irregular/roughness of the weathered face),oxidized in lower 6-7cm (brown) contains a few stones (larger ones are 2-3cm) very weathered sandstone? (mostly); shale clasts (1cm) - found in oxidized and unoxidized clay; massive; highly fractured & crumples when clearing section;</p>
D	128-136m	8m	till	olive till; highly fractured closely spaced vertical fractures with wavy discontinuous horizontal fractures, most of exposure was inaccessible
E	136-140m	4m	silty clay to clayey silt	glaciolacustrine unit with wavy to near horizontal silty clay (ie dark grey) beds; appears to be fine-medium sand lens/bed within unit; above observations were made at a distance; most of face is inaccessible or not exposed

{PRIVATE }SECTION DESCRIPTION						PAGE 1 OF 1
SECTION #: 70		SECTION NAME: Deadwood Tower Site 1			SURFACE ELEVATION: 587m (1925ft)	
LSD: 05	SEC: 14	TP: 88	R: 22	W of 5	NTS MAP: 84 C/11	
NORTHING: 6276000m		EASTING: 475300m			UTM ZONE: 11V	
SURFACE MORPHOLOGY: localized topographic high that has been scoured forming large flutes (1km x 100m wide x 10m deep); oriented N-S						
EXPOSURE: Section is along roadside, ridge is ~5m high oriented 155° facing SW, exposure is sloped ~30-40° with some patchy grass and clover growing						

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-5m	>5m	greyish brown till	silty clay, blocky, massive; breaks apart easily; part of soil horizon; unit is mostly covered; calcareous; wet 5Y3/2 dark olive grey; dry 5Y4/3 olive; no contacts observed; clast sizes: >4mm 5-10%; pebbles-5%; cobbles-<1%; boulders-0%; clast lithology: red quartzite, carbonates, weathered red sandstone, tan siltstone, coal fragment, vein quartz; large sandstone boulder (~1.5m diameter) embedded in slope face

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		71		SECTION NAME:			Notikewin River Site 4		SURFACE ELEVATION:		457M (1500ft)																				
LSD:		09		SEC:		27		TP:		91		R:		23		W of		5		NTS MAP:		84 C/13									
NORTHING:				6309000m				EASTING:				463450m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								glaciolacustrine plain							
EXPOSURE:		till exposed in remnant of ~20m terrace ridge between field & river; river must have eroded away on either side; river cut facing ~W; ~14m (high) 25m (length); minor slump fans and colluvium drapes sporadically throughout section																													

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-6m	>6m	sand	fine to medium sand; silt with mud clasts (angular 3-4mm), silty clay interlaminated; till pockets/lenses (observed near upper contact with till); silt bed @ contact with upper till is sometimes faulted & in other places the horizontal bedding is intact, thickness ~10cm; fine sand & silt with medium sand stringers are present; stratification is expressed by medium sand (?) stringers within the unit which is greyish in colour - in contrast to this predominantly olive coloured unit; upper contact is irregular & sharp with fine sand to silt at contact showing minor faulting & micro-faulting within each block
B	6-12m	6m	massive grey till	silty grey till; fractured & weathered - easily breaks apart; unit is 80% exposed; wet-slightly calcareous; dry slightly more calcareous; wet 5Y3/2 dark olive grey; dry 5Y4/2 olive grey; upper contact erosional with terrace (fluvial); clast sizes: >4mm 5-10%; pebbles 5%; cobbles-1%; boulders-4%; clast lithology: pink granite, carbonates, quartzites, shale, coal fragments; upper ~1m of unit there are discontinuous beds/lenses of sand, these are dipping to the N ~20-30°; the weathering is greater at upper contact where the unit is blockier (2-3cm) - this may, on the other hand, indicate more clay and/or less clasts (pebbles) in till at this contact; there are "patches" of light olive; random shapes; almost blocky & tabular - up to 1 to 1.5m in dimension within 2m of the upper surface; these are not accessible & can only be observed at a distance from below; many vertical fractures (slightly wavy) may indicate slight post depositional movement
C	12-14m	2m	silt, sand, and gravel	floodplain deposit, unit not accessible and not described at this section; similar to terrace capping unit E described in Section #50

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		72		SECTION NAME:			Smoky River Site 2			SURFACE ELEVATION:		518m (1700ft)																											
LSD:		03		SEC:		20		TP:		82		R: 22		W of 5		NTS MAP:		84 C/3																					
NORTHING:				6218950m				EASTING:				474800m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				flat to gently rolling glaciolacustrine plain																			
EXPOSURE:																				slump area at top of plateau, facing S to SW, 1km SW of where Smoky River flows into Peace River																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	DEPTH INTERVAL	THICKNESS (M)	LITHOLOGY	UNIT DESCRIPTION
Bed-rock	0-20m	>20m	siltstone/sandstone	most likely Dunvegan Formation; lowermost part of exposure is a shale, most likely Shaftesbury Formation; contact between shale & this is covered; thickness unknown for both; ~2m from the upper contact was observed; upper ~1m of a massive siltstone, some alteration by water - i.e. oxidation of siltstone to a rusty colour is seen as a thin bed ~4cm thick at contact & below in lenses and discontinuous beds; lower ~1m is blocky, more compact fine sandstone;
A	20-26m	6m	medium to coarse sand	with interbeds of fine sand, silt, diamict, and clay; there are some large pebbles (~6cm length) and smaller ones are present in the sandy bed and granule-size gravel
B	26-28m	12m	interbedded silty clay and brown till	till thickness - 1 to 2m exposed, silty clay thicknesses - 30cm over an exposed distance of 2m; till appears blocky, weathered, large inclined gypsum filled fractures (~3cm thick); ~3% carbonate granules in matrix but till matrix is not calcareous >4mm~5%; no large pebbles seen
C	38-40	2m	silty clay	very fissile in places to blocky, very difficult to see sedimentary features as it falls apart into blocks & vertical face cannot be excavated easily (blocks & sand fills down from above)

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																																	
SECTION #:		73		SECTION NAME:			Highway 686 Site 1			SURFACE ELEVATION:		663m (2175ft)																															
LSD:		02		SEC:		15		TP:		85		R: 22		W of 5		NTS MAP:		84 C/6																									
NORTHING:				6246700m				EASTING:				476400m				UTM ZONE:				11V																							
SURFACE MORPHOLOGY:																						ridged to hummocky; relief ~8 to 10m high, length - unknown																					
EXPOSURE:																						road cut, E-W facing S; 10m height x 200m length																					

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	>4m	sand and gravel	very poorly exposed; not described
B	4-5m	~1m	medium sand	massive, oxidized at contact, localized in places & along fractures; slightly calcareous; upper contact: wavy, sharp; lower contact: not exposed; dry - 10YR6/3 pale brown; oxidized - 10YR5/8 yellowish brown
C	5-8m	~3m	till	silty clay, massive; easily breaks apart; mostly covered by vegetation over most of slope; slightly calcareous; dry 5Y 5/3 olive, 2.5Y 3/2 very dark greyish brown; lower contact-wavy sharp & inclined towards road; clast sizes: >4mm-5%; pebbles-4%; cobbles-<1%; boulders-0%; clast lithology: mostly quartzite, vein quartz, carbonates, siltstone, sandstone (weathered ironstone - large pebble size); gypsum - sparse but present

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		74		SECTION NAME:			Highway 686 Gravel Pit 2				SURFACE ELEVATION:		625m (2050ft)																		
LSD:		01		SEC:		17		TP:		85		R:		22		W of		5		NTS MAP:		84 C/6									
NORTHING:				6246550m				EASTING:				473500m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								flat to rolling discontinuous ground moraine							
EXPOSURE:																								~5km W of junction Hwy 686 & 743 on N side of Hwy							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-10m	>10m	sand and gravel	crude horizontal bedding of sand & gravel in both E-W & N-S faces; gravel is oxidized, cemented with both Mn- & Fe-oxide beds; some sand beds have gravelly (pea-size) interbeds; no Shield rocks seen in sections or in boulder pile; there is a thin till veneer - but most of this unit has been excavated and piled around boundary of gravel pit

{PRIVATE }SECTION DESCRIPTION										PAGE	1	OF	1				
SECTION #:		75		SECTION NAME:					Peace River site 2		SURFACE ELEVATION:		442m (1450ft)				
LSD:	08	SEC:	02	TP:	92	R:	21	W of	5	NTS MAP:				84 C/14			
NORTHING:			6311550m			EASTING:			484700m			UTM ZONE:			11V		
SURFACE MORPHOLOGY:														rolling topography, well away from valley top & not certain how far down the creek slope the exposure occurs			
EXPOSURE:														creek exposure, E-W facing S, ~6m vertical cliff, scalloped shaped, 2 scallops, ~20-25m in length at base			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
bedrock	0-2m	>2m	shale	Shaftesbury formation
A	2-2.6m	~0.6m	silty clay to clayey silt	glaciolacustrine to waterlain diamict; clayey silt (massive with varying numbers of fine sand interlaminae - some have more laminated than others) contain stringers of fine sand interlaminae (consist of finely stratified to interlaminated fine sand & clayey silt with sand more dominant, these are wavy discontinuous laminae 1-4mm thickness); granules, are predominantly shale clasts and also granite, carbonates;A ₂
B	2.6-3.6m	~1m	interbeds of waterlain diamict, clay and clayey silt	interbeds of waterlain diamict, clay and clayey silt are present in the lower half of the unit , 5Y3/2 dark olive grey, 2.5Y5/2 greyish brown (more calcareous than dark olive grey units);
C	2.6-7m	~4.5m	massive till	weathered olive till; thickness ->~3.5m; 5Y 4/3 olive; clast sizes: >4mm-15%; pebbles-14%; cobbles-1-2%; boulders-0%; clast lithology: of note are many carbonate clast of medium pebble size; weathered till - breaks into blocks even in fresh exposure - weathered face is very hard & difficult to get pick into sand pockets observed in small site but not apparent in weathered face; matrix is calcareous

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																				
SECTION #:		76		SECTION NAME:				Junction Hwy 35 & 686 Section				SURFACE ELEVATION:		671m (2200ft)																	
LSD:		16		SEC:		11		TP:		85		R:		24		W of		5		NTS MAP:		84 C/5									
NORTHING:				6246420m				EASTING:				459000m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								flat to rolling discontinuous ground moraine							
EXPOSURE:																								W side of road junction Hwy 35 & 686 road cut trench							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-2m	~2m	waterlain till/diamicton	discontinuous, overlies shale bedrock; lower contact with bedrock is difficult to distinguish; the shale breaks apart easily, is wet, oxidized (slightly mottled); there are no clasts & thus assumed to be bedrock

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		77		SECTION NAME:			Highway 686 Site 2				SURFACE ELEVATION:		649m (2130ft)														
LSD:		13		SEC:		08		TP:		85		R:		23		W of		5		NTS MAP:		84 C/5					
NORTHING:				6246420m				EASTING:				462500m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								hummock; ~4m high			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	>4m	till	massive, 10-15% clasts of Shield, local and Cordilleran clasts; only upper 2m observed

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																													
SECTION #:		78		SECTION NAME:			Buchanan Creek Site 1			SURFACE ELEVATION:		396m (1300ft)																											
LSD:		01		SEC:		24		TP:		91		R: 22		W of 5		NTS MAP:		84 C/14																					
NORTHING:				6306375m				EASTING:				476700m				UTM ZONE:				11V																			
SURFACE MORPHOLOGY:																				plain to rolling glaciolacustrine plain																			
EXPOSURE:																				base of creek with slump/colluvium covering large portion of slope down to creek																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-30m	>30m	sand	mostly medium to coarse, inclined to horizontal beds with interbeds of gravel, silty clay, and diamicton ranging in thickness from ~50 cm to more than 2m beds; most of exposure is inaccessible due to its steepness; unit package may represent subaqueous debris flow deposits of varying energies (note horizontal beds where facing into flow & inclined where facing perpendicular to flow)
B	30-35m	~5m	massive till	darker grey colour in lower ~4m where unit is thickest; upper ~5m is lighter olive brown colour; contact appears to be sharp, planar between these units of different colour (as observed from the base of the section across the creek); not certain if upper brown unit is colluvium that has slid down from above; most of unit is inaccessible (colluvium too slippery to climb) clast sizes: 20%>4mm; subrounded to subangular; clast lithology-red granites, vein quartz; calcareous

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		79		SECTION NAME:			Clear Hills Site 2				SURFACE ELEVATION:		831m (2725ft)														
LSD:		01		SEC:		25		TP:		88		R:		26		W of		5		NTS MAP:		84 C/12					
NORTHING:				6279175m				EASTING:				439200m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								hummock ~4m relief			
EXPOSURE:																								road cut trench, south facing			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	>4m	till	massive; <5% exposed; easily friable; very slightly calcareous; wet-2.5Y3/2 very dark greyish brown; dry-5Y5/3 olive brown; contacts not observed; clast sizes >4mm 5-10%; pebbles ~5%; clast lithology-carbonates, granites, weathered sandstone, quartzite

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		80		SECTION NAME:			Highway 686 Site 3				SURFACE ELEVATION:		654m (2145ft)														
LSD:		14		SEC:		10		TP:		85		R:		23		W of		5		NTS MAP:		84 C/5					
NORTHING:				6246420m				EASTING:				466200m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								rolling ground moraine			
EXPOSURE:																								road cut trench			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-1.5m	>1.5m	sand and gravel	poorly sorted sand supported; coarse sand to granular size supported gravel, predominantly well rounded quartzite pebble (medium-large) & small cobble (subrounded); large pebble - cobble concentrated @ contact with till; rusty colour - i.e. oxidized
B	1.5-3.5m	~2.0m	till	massive, silty clay, fresh - dark grey; slope exposed during recent road construction; easily friable; 5% of unit exposed; very slightly calcareous; 2.5Y3/2 very dark greyish brown; upper contact is sharp somewhat wavy - (gravel underlying) thin/discontinuous clay laminae (<5mm) at contact is oxidized; clast sizes: >4mm-5%; pebble & granules~5%; small sand lens above boulder (gneiss ~25cm in length) lens is ~10cm in length & 2-3cm high - consistinf of medium sand, no apparent stratification; oxidized ring on outer edge of lens

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1													
SECTION #:		81		SECTION NAME:			Highway 686 Site 4			SURFACE ELEVATION:		652m (2140ft)											
LSD:		15		SEC:		09		TP:		85		R: 23		W of 5		NTS MAP:		84 C/5					
NORTHING:				6246420m				EASTING:				465300m				UTM ZONE:				11V			
SURFACE MORPHOLOGY:																				rolling ground moraine			
EXPOSURE:				road cut trench																			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-2m	>2m	till	gravel not found at the surface; till exposed (~2m thick) in the ditch; pockets of gypsum - coarse sand size crystals of limestone present; detailed description not completed

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		82		SECTION NAME:			Highway 35 Site 1				SURFACE ELEVATION:		693m (2275ft)																		
LSD:		05		SEC:		24		TP:		85		R:		24		W of		5		NTS MAP:		84 C/5									
NORTHING:				6248730m				EASTING:				459200m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								flank of transverse morainal ridge							
EXPOSURE:																								road cut; N-S facing West; ~5m exposure; ~20m wide							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	>4m	displaced bedrock	2.5Y3/2 very dark greyish brown - clay with sulphur lens/laminae, contains the odd granule - (pink feldspar); mixture of grey medium-fine sand & grey clay with mud clasts - very disturbed
B	4-5m	0-2m variable	till (?)	silty clay with till-like texture, section too poorly exposed to obtain clear description of unit; till (?) - 10YR5/4 yellowish brown; grey sand - 5Y6/2 olive grey;

{PRIVATE }SECTION DESCRIPTION										PAGE	1	OF	1														
SECTION #:		83		SECTION NAME:					Highway 35 Site 2		SURFACE ELEVATION:		709m (2325ft)														
LSD:		03		SEC:		36		TP:		85		R:		24		W of		5		NTS MAP:		84 C/5					
NORTHING:				6251500m				EASTING:				459720m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								ridged to rolling ground moraine			
EXPOSURE:																								east side of Hwy 35; ~3km south of Section #82			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	>4m	displaced bedrock	similar to Section #82, not described in detail; bedrock unit more clearly defined here than in Section #82
B	4-5m	0-2m variable	till (?)	similar to Section #82; not described in detail

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																
SECTION #:		84		SECTION NAME:				Deadwood Tower Site 3				SURFACE ELEVATION:		561m (1840ft)													
LSD:		02		SEC:		28		TP:		89		R:		23		W of		5		NTS MAP:		84 C/12					
NORTHING:				6288520m				EASTING:				463150m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								rolling till plain			
EXPOSURE:																								stream cut/gully			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-2.5m	~2.5m	till/waterlain diamict	silty clay, wet till; not many rocks (pebble size) in till, ~1% granules - 5Y3/2 dark olive grey

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																				
SECTION #:		85		SECTION NAME:				Deadwood Tower Site 2				SURFACE ELEVATION:		632m (2075ft)																	
LSD:		05		SEC:		23		TP:		88		R:		22		W of		5		NTS MAP:		84 C/11									
NORTHING:				6277800m				EASTING:				475300m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								lateral edge of flute near Deadwood Forestry Tower							
EXPOSURE:				road cut trench																											

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
bedrock	0-7m	>7m	shale/siltstone	Dunvegan formation; no surface till observed at this site

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																
SECTION #:		86		SECTION NAME:				Whitemud River Site 1				SURFACE ELEVATION:		457m (1500ft)													
LSD:		06		SEC:		01		TP:		88		R:		21		W of		5		NTS MAP:		84 C/11					
NORTHING:				6272700m				EASTING:				487300m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								rolling till plain			
EXPOSURE:																								road cut (no trenching required)			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
bedrock	0-6m	>6m	shale	Shaftesbury formation; surface sediments not exposed, all of road cut is shale bedrock

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																																								
SECTION #:		87		SECTION NAME:				Buchanan Creek Site 2				SURFACE ELEVATION:		381m (1250ft)																																					
LSD:		09		SEC:		15		TP:		91		R:		21		W of		5		NTS MAP:				84 C/14																											
NORTHING:				6305700m				EASTING:				483050m				UTM ZONE:				11V																															
SURFACE MORPHOLOGY:																										alluvial terrace along Buchanan Creek																									
EXPOSURE:																										creek bank																									

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
bedrock	0-5m	>5m	shale	Shaftesbury formation with ironstone ledges
A	5-10m	~5m	gravel	cobble to medium pebble gravel, well rounded to subrounded clasts, some medium sand supported beds but predominantly clasts supported gravel; horizontal bedding; alternating beds of cobble clasts supported (~30-50cm thick) & medium pebble sand supported gravel (~20-50cm thick); sand is calcareous

{PRIVATE }SECTION DESCRIPTION								PAGE	1	OF	1																				
SECTION #:		88		SECTION NAME:				Heart River Site 5				SURFACE ELEVATION:		503m (1650ft)																	
LSD:		02		SEC:		16		TP:		83		R:		21		W of		5		NTS MAP:		84 C/3									
NORTHING:				6227120m				EASTING:				484400m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								flat to rolling glaciolacustrine plain							
EXPOSURE:																								slump scar >15 below face (not if exposure is insitu)							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-4m	>4m	sand and "varves" of silty clay and clayey silt interbeds	stratified medium sand, capped by varved beds of ~5-6cm; ripple laminae at base of thicker (2cm) silt beds & finer sand (5mm) & clay beds (2-3mm); this is overlain by wavy (i.e.-less amplitude) beds of sand, silt & clay of equal proportions (i.e. each ~2-5cm thick) beds; underlying the varved sediments are horizontal & planar crossbeds; fine sand/silt beds are slightly oxidized
B	4-6m	~2m	"disturbed" silty clay and clay silt interbeds	very tightly folded & sheared what appears to have been varved sediments of thinly bedded silty clay & clayey silt; shear/slickenside lineation also observed

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																					
SECTION #:		89		SECTION NAME:			Highway 35 Site 3				SURFACE ELEVATION:		640m (2100ft)																		
LSD:		07		SEC:		31		TP:		88		R:		23		W of		5		NTS MAP:		84 C/12									
NORTHING:				6280850m				EASTING:				460100m				UTM ZONE:				11V											
SURFACE MORPHOLOGY:																								rolling ground moraine dissected by meltwater channels							
EXPOSURE:																								sidewall of small meltwater gully on E side of Hwy 35, ~7.5km south of Deadwood							

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-5m	~5m	till/waterlain diamict	massive, very poorly exposed; >1m of colluvium to dig through to get to what was believed to be the surficial material; brown silty clay matrix, few (<2%) small to large pebbles and no granules observed

{PRIVATE }SECTION DESCRIPTION							PAGE	1	OF	1																	
SECTION #:		90		SECTION NAME:			Notikewin River Site 5				SURFACE ELEVATION:		472m (1550ft)														
LSD:		12		SEC:		26		TP:		91		R:		23		W of		5		NTS MAP:		84 C/13					
NORTHING:				6309000m				EASTING:				464000m				UTM ZONE:				11V							
SURFACE MORPHOLOGY:																								alluvial terrace			
EXPOSURE:																								near vertical cliff throughout - actively slumping river section along Notikewin River			

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-10m	>10m	till	dark grey massive till (not described)
B	10-12m	~2m	sand, gravel and silt	alluvial terrace deposits (not described)

{PRIVATE }SECTION DESCRIPTION						PAGE 1 OF 1
SECTION #: 91		SECTION NAME: Heart River Site 6			SURFACE ELEVATION:	
LSD: 16	SEC: 21	TP: 83	R: 21	W of 4	NTS MAP:	
NORTHING:		EASTING:			UTM ZONE:	
SURFACE MORPHOLOGY: flat to rolling glaciolacustrine plain						
EXPOSURE: gully/creek cut adjacent to (W side) to Hwy 2, leading down the hill into town of Peace River						

{PRIVATE }UNIT DESCRIPTION				
UNIT	INTERVAL	THICKNESS	LITHOLOGY	UNIT DESCRIPTION
A	0-20m	>20m	sand	stratified, very fine to coarse sand; only ~10% or less is exposed, thickness of unit is a very crude estimate because of the sporadic nature of the exposures along gully; variable bed thicknesses ranging from several centimetres to thin (<5mm) beds; load structures in coarse sand beds; observed a poorly sorted cluster of large pebble to granule, coarse to medium sand to clast supported, with notable mafic (greenish-coloured) volcanic (?) and red granites (i.e. Shield origin), of subangular to subrounded shapes; shale unit believed to directly underlie this unit is only exposed on the other side and near the base of the gully

APPENDIX B
BOREHOLE LOCATIONS

Appendix B1. Borehole Locations, Peace River Sheet (84C/W)

LEL BOREHOLES		NTS Sheet	LSD (W OF 5TH)	UTM Zone 11V		Elevation		Total Depth		Bottomed in
#	Name		LSD-SEC-TP-R	Northing	Easting	(ft)	(m)	(ft)	(m)	
BH-01	Weberville Site 1	84 C/6	04-18-86-20	6256140	490180	1660	506	104	31.70	grey till
BH-02	Weberville Site 2	84 C/6	13-01-86-22	6254420	478780	2100	640	27.5	8.38	siltstone
BH-03	Figure Eight Lake	84 C/5	12-21-84-25	6239320	444530	2250	686	52.5	16.00	shale
BH-04	Peace River	84 C/4	04-14-81-26	6207780	439800	1925	587	107	32.61	siltstone
BH-05	Brownvale	84 C/4	13-11-82-25	6217540	449450	2100	640	62.5	19.05	gravel
BH-06	Nampa Site 1	84 C/3	02-17-81-21	6207100	470600	1940	591	22.5	6.86	shale
BH-07	St Isidore	84 C/3	01-08-83-20	6225310	493200	1900	579	100	30.48	silty clay
BH-08	Nampa Site 2	84 C/3	12-22-81-20	6210050	496750	1875	572	133	40.54	grey till
BH-09	Notikewin	84 C/13	03-13-92-24	6314500	456220	1740	530	135	41.15	grey till
BH-10	Manning Airport	84 C/13	12-04-92-23	6312000	460500	1611	491	138	42.06	grey till
BH-11	Buchanan Creek	84 C/14	12-15-92-21	6315100	481850	1525	465	112	34.14	siltstone
BH-12	Manning Site 1	84 C/13	12-08-92-22	6313430	469000	1525	465	68	20.73	grey till
BH-13	Manning Site 2	84 C/14	13-35-91-22	6311100	473580	1525	465	138	42.06	grey till
BH-14	Deadwood	84 C/14	13-36-89-22	6291620	477100	1560	475	118	35.97	sand
BH-15	Smithmill	84 C/5	13-21-86-24	6259500	454400	2130	650	123	37.49	sand
BH-16	Three Creeks	84 C/6	16-16-85-20	6247800	494730	1725	525	76	23.17	gravel

APPENDIX B2
BOREHOLE LITHOLOGS

PROJECT: MDA N Alta	DATA NO: LEL-BH-01	LOGGED BY: L Leslie	DATE: 18 Aug 93	page 1 of 4
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1660' NTS MAP: 84C/6	
BOREHOLE NAME: Weberville site 1		LSD: 4 SEC: 18 TP: 86 R: 20 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 490180 m	NORTHING: 6256140 m	BOTTOMED IN: dark grey till	
DESCRIPTION OF LOCATION: Glaciolacustrine plain about 20 km NE of Weberville				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	2.5	76	72	0.72	fill	
			5	0.76	soil	organic layer, roots,etc
2.5	7.5	137	20	0.96	soil	very oxidized soil with Ae horizon at base
			87	1.83	silt clay	grey with orange mottles & light grey; crudely banded & inclined fracture patterns
			29	2.12	silt clay	grey with orange mottles & light grey; moderate effervescence
			17	2.29	no core	
7.5	12.5	152	152	3.81	silty clay	massive mottled orange brown(i.e. iron stained), light grey; mottling pattern is small, circular blotches (75cm); moderate effervescence; changes to more oxidized with fractures inclined @ 30° & infilled with calcite; bands of slightly oxidized (i.e. few blotches/mottles) to highly oxidized zones; 10-20 cm thick
12.5	17.5	152	39	4.20	silty clay	bands of slightly oxidized & highly oxidized zones; iron stains; moderate-high effervescence
			83	5.03	silty clay	large blotches orange brown light grey borders; fractures are highly effervescence (i.e. infilled with calcite) 10 cm from base of interval
			27	5.30	silt with clay laminae	horizontal laminae brown silt & dark brown clay laminae; moderate-high effervescence
17.5	22.5	152	10	5.43	silt with clay laminae	same as above
			40	5.83	silty clay	massive grey mottled orange brown
			29	6.12	silty clay	massive no mottles
			60	6.72	silty clay	massive grey silty clay with inclined fractures filled with calcite; some mottles of calcite occur in matrix
			12	6.84	silt with clay laminae	horizontal laminae brown silt & dark brown clay
			2	6.86	silty clay	massive grey
22.5	27.5	152	15	7.01	silt	massive with minor amounts of clay (grey); high effervescence
			9	7.10	silty clay	massive with minor amounts of clay; moderate-high effervescence

PROJECT: MDA N Alta	DATA NO: LEL-BH-01	LOGGED BY: L Leslie	DATE: 18 Aug 93	page 2 of 4
LOCATION: Weberville site 1	SURFACE EL: 1660'	LSD: 4 SEC: 18 TP: 86 R: 20 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			23	7.33	silt	massive with minor amounts clay laminae
			45	7.78	clay with silt laminae	massive with minor inclined silt laminae; silt lighter grey & grainy
			60	8.38	?	
27.5	32.5	152	146	9.80	silty clay	massive silty clay with bands of carbonate (clayey silt) - light grey; occurs as bands or spotty wisps & grainy texture
			10	9.90	silt with clay laminae	light grey & grey horizontal laminae
32.5	37.5	123	17	10.07	silt with clay laminae	same as above
			12	10.19	silty clay	massive grey
			94	11.13	silt with clay laminae	thin horizontal beds; clay beds are 2-3mm thick with thicker silt beds
			30	11.43	no core	
37.5	42.5	152	10	11.53	silt with clay laminae	
			26	11.79	clay with silt laminae	
			36	12.14	clay	massive
			25	12.39	silt with clay laminae	
			55	12.95	clay with silt laminae	zone of silt & clay interlaminated ~8cm thick & isolated beds of silt; predominantly massive silty clay
42.5	47.5	152	82	13.77	clay	grey massive; moderate effervescence
			71	14.48	clay with granules	find the occasional pebble (~1cm) & small stones at 38cm from top of unit; moderate effervescence
47.5	52.5	152	57	15.05	silty clay	few stone (<1cm) found throughout; moderate effervescence
			95	16.00	till	massive; matrix silty; dark grey; contact with upper unit is sharp; matrix gets quite stony @ contact; moderate effervescence
52.5	57.5	81	81	16.81	till	massive, grey; stone 3-4cm size more frequent; holding up coring; moderate effervescence
			73	17.53	no core	
57.5	59	47	47	18.00	till	massive grey; matrix-no change; large stone-pushed through; moderate effervescence
59	64	152	152	19.52	till	massive grey; stones & granules; large carbonate clast 2/3rds down

PROJECT: MDA N Alta	DATA NO: LEL-BH-01	LOGGED BY: L Leslie	DATE: 18 Aug 93	page 3 of 4
LOCATION: Weberville site 1	SURFACE EL: 1660'	LSD: 4 SEC: 18 TP: 86 R: 20 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
64	69	152	94	20.44	till	massive grey;stones & granules; granite,shale,quartz,large purple & white banded sandstone (Athabasca sandstone ?)-oxidized on one side @ base
			10	20.54	silt/silty clay	horizontal interbeds;olive brown & dark grey
			4	20.58	till	massive grey;stone & granules ~10%
			13	20.75	fine sand	horizontal bedded;dark bands;moderate-high effervescence
			24	21.03	till	sand lens ~3cm from top;massive grey; stones & granules
69	73	~60	42	21.45	till	rock encountered;slow drilling;
			18	21.66	coarse-medium sand	gradational till to sand;sample is disturbed so this may still be till
			2	21.68	fine sand	massive grey
			57	22.25	no core	
73	77.5	82	9	22.34	till	massive grey
			5	22.39	medium sand	grey with dark bands
			46	22.85	till	massive grey; disturbed
			7	22.92	sand & till	lens-not true bed; disturbed
			10	23.02	till	massive grey; large quartzite pebble; granite gneiss; pink blotchy quartz
			60	23.62	no core	
77.5	82.5	56	56	24.18	till	massive grey;one sand lens near top; predominantly stones & granules; scattered clasts; one flat iron shape of finegrained mafic rock; till is compact;hole still dry
			97	25.15	no core	
82.5	87.5	60	31	25.46	fine sand	thin horizontal bedded;rock in sand bed ~2cm may have been pushed in by drilling or is insitu?; moderate effervescence
			26	25.71	till	massive grey with sand lens in middle; large clast(~4cm) @ base;moderate effervescence
			5	25.76	sand	massive grey
			91	26.67	no core	
87.5	92.5	64	23	27.00	medium sand	massive grey;disturbed due to drilling; peices of till mixed in with sand; gravel bed of sand & pebbles(2-3cm);subangular to subrounded
			18	27.18	till	massive grey
			4	27.22	sand & gravel	massive grey;pebbles(2-3cm) ~5%;sand predominant medium grey, some fine & coarse grey
			8	27.30	till	massive grey;stones & granules

PROJECT: MDA N Alta	DATA NO: LEL-BH-01	LOGGED BY: L Leslie	DATE: 18 Aug 93	page 4 of 4
LOCATION: Weberville site 1	SURFACE EL: 1660'	LSD: 4 SEC: 18 TP: 86 R: 20 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPT H (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			7	27.37	fine sand	grey finely laminae (?)
			8	27.45	till	massive grey;stones & granules; ROCK!!!
			74	28.19	no core	ENDED DRILLING FOR THE DAY
92.5	97.5	46	46	28.65	till?	massive grey;significant amount sand matrix; very compact; gravelly bed btwn 25-29cm interval with red sandstone,carbonates, orange-brown crystal(quartz?); very angular clast 3-5cm; pink granite pebbles; moderate effervescence; highly fractured ls clast(~6cm) @ base
			106	29.72	no core	
97.5	102.5	72	72	30.44	till	massive grey;large granite cobble(~9cm) @ top- this was likely the rock holding up drilling; water was poured down the hole and core is more intact now;2-3% stones of 3-5cm;stonier,pebbles & granules ~10%; pink & red granite, quartzite,chert(?);moderate effervescence
			80	31.24	no core	
102.5	104	104	~64	-	slough	only drilled 1.5' but core is longer! speculate that core slipped out from previous run;PYRITIC CONCRETION (5cm)
			40	31.70	till	massive grey;sample is very dry & compact-difficult to drill thru;stones 3-5cm ~4-5%; lots of granites; moderate-high effervescence
						ENDED HOLE;TOO DIFFICULT TO DRILL

PROJECT: MDA N Alta	DATA NO: LEL-BH-02	LOGGED BY: L Leslie	DATE: 17 Aug 93	page 1 of 2
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION.: 2100' NTS MAP: 84C/6	
BOREHOLE NAME: Weberville site 2		LSD: 13 SEC: 01 TP: 86 R: 22 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 478780 m	NORTHING: 6254420 m	BOTTOMED IN: bedrock	
DESCRIPTION OF LOCATION: Gently rolling till plain with isolated flute ridges				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	2.5	52	49	0.49	gravel	road surface
			13	0.52	topsoil	black/silty organics
			24	0.76	no core	
2.5	7.5	71	22	0.98	topsoil	organics
			21	1.19	clayey silt	B horizon; fine mottles light grey & orange; slightly effervescence
			6	1.25	Cca	orange brown oxidized horizontal; highly effervescence; sandy horizon
			19	1.44	silty clay	till-like texture; some granules & small pebbles (granite ~1cm); massive grey/brown
			85	2.29	no core	
7.5	10	76	38	2.67	silty clay till	massive grey/brown, stones up to 3cm; some granite, sandstone, coal fragments, chert, quartzite (<1cm); somewhat mottled with grey & orange brown (due to sandstone clast) black flakes with oxidized clasts
			2	2.69	fine sand	olive brown; wavy contacts
			30	2.99	clay	grey brown with silt and fine sand (oxidized) subhorizontal (due to drilling?) laminae @ 10cm interval; coal specs; oxidized & unoxidized bands; oxidized silty bands filled with gypsum crystals; very slight to no effervescence
			6	3.05	medium sand	sharp, planar upper contact; light grey with some orange oxidized wisps grades into olive sand; massive; ironstone clast in lower band
10	15	44	23	3.28	medium sand	massive grey; quartz, quartzite, chert, red sandstone grains
			21	3.49	sand & gravel	massive, grades from medium sand above; 25% of 3-5cm clasts, subrounded to well rounded; larger 5-6cm clasts occur at base; caution-the fining upwards may be due to drilling; lg (~7.5cm) quartzite caught in shoe
			108	4.57	no core	
15	22.5	152	76	5.33	no core	drilled through gravel
			41	5.74	siltstone/shale	
			62	6.36	siltstone/shale	with more fine sand interbeds
			50	6.86	siltstone/shale	

PROJECT: MDA N Alta	DATA NO: LEL-BH-02	LOGGED BY: L Leslie	DATE: 17 Aug 93	page 2 of 2
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LOCATION: Weberville site 2	SURFACE EL: 2100'	LSD: 13 SEC: 01 TP: 86 R: 22 MER: W of 5
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DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
22.5	27.5	152	67	7.53	siltstone/shale	
			88	8.38	siltstone/shale	with more fine sand interbeds

PROJECT: MDA N Alta	DATA NO: LEL-BH-03	LOGGED BY: L Leslie	DATE: 1 Sept 93	page 1 of 3
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION.: 2250' NTS MAP: 84C/5	
BOREHOLE NAME: Figure Eight Lake		LSD: 12 SEC: 21 TP: 84 R: 25 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 444530 m	NORTHING: 6239320 m	BOTTOMED IN: bedrock	
DESCRIPTION OF LOCATION: Hummocky (4-5m) terrain at road leading into Figure Eight Lake Municipal Park				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	2.5	76	9	0.09	gravel	road fill
			42	0.51	clay/silt	road fill
			25	0.76	stratified brown till	upper 11cm is a gradational change from laminae clay & silt and then into brown stratified till; silt laminae are oxidized; few granules & pebbles; one clast sandstone(?) 2cm; oxidized & very weathered siltstone; red granite
2.5	7.5	152	152	2.29	massive brown till	"quasi-till", granules & tiny pebbles; very few stones >1cm; lithology-siltstone(tan), sandstone(red), coal, red granite; near vertical fractures infilled with Mn oxide with ironstone clast; probably precipitated within unit as a product of the ironstone clasts found @ 84 & 104cm interval within unit; gypsum infilling fractures in lower 62cm; no carbonate granules
7.5	12.5	152	14	2.43	massive brown till	slight mottling of light brown; coal & quartz clasts
			68	3.11	mottled brown till	mottling is in crude bands (~5cm thick) and "veiny"; mostly light brown with a little brown; gypsum crystals in blotches & clusters; lithology-weathered orange siltstone, sandstone, red granite, quartz, shale, coal
			50	3.61	mottled brown till	less mottling; fracture infilling of gypsum & oxidized orange silt, inclined @ 45°
			20	3.81	brown laminated till	light brown silt laminae are horizontal & occur 1 to 5cm apart; gypsum along horizontal silt laminae
12.5	17.5	121	43	4.24	massive brown till	granules mostly with few small pebbles; gypsum blotches
			79	5.03	laminated brown till	large gypsum vein @ 30cm from top; laminae is fine (1-1.5cm) in upper 15cm & occur 2-5cm apart in lower portion; mostly granules of coal, orange weathered siltstone, tan sandstone; quartz; quartzite
			33	5.33	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-03	LOGGED BY: L Leslie	DATE: 1 Sept 93	page 2 of 3
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LOCATION: Figure Eight Lake	SURFACE EL: 2250'	LSD: 12 SEC: 21 TP: 84 R: 25 MER: W of 5
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DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
17.5	22.5	152	152	6.86	massive brown/grey till	first sign of carbonate clasts; >1cm clasts, interval of mainly granules & tiny pebbles and stony(3-5cm)matrix; lithology-quartz, granite,carbonates,NO COAL, weathered siltstone
22.5	27.5	152	152	8.38	massive brown/grey till	lithology-no change + lots of tiny granules of shale;few clasts >1cm; chert, large quartzite pebble in middle of interval & in shoe; lower 4cm goes into a brown massive till
27.5	32.5	103	4	8.42	brown till	abundant oxidized siltstone & some shale granules
			6	8.48	grey till	a break in core @ top of this unit; gradational into lower laminae brown till(i.e. grey mottles at the lower contact)
			93	9.41	laminated brown till	granules of shale,orange siltstone, tan sandstone,~20-25%; one carbonate clast,weathered siltstone clast near center of unit;this oxidized unit with abundant local clast may signify a different till since above this is an unoxidized till(brown/grey)
			49	9.91	no core	
32.5	37.5	152	16	10.07	grey till	mottles of light grey brown; granules of weathered orange siltstone,tan sandstone, shale- in total~10%or <; one quartz clast ~1.5cm
			12	10.19	light grey brown till	granules & tiny pebbles ~15-20%; weathered orange siltstone,tan sandstone,shale;granite
			46	10.65	laminated clayey silt	elongated 8cm quartzite cobble;oxidized fine sand lens above cobble; few shale,siltstone clast within this unit; fine
			33	10.98	laminated silty clay	dark & light grey bands ~1-2cm thick; still finding granules of shale & weathered siltstone; weathered orange bands near base; medium sand laminae in lower 4-5cm of unit
			11	11.09	oxidized silty clay	orange with grey bands; still granules of weathered orange siltstone, tan sandstone, shale
			34	11.43	laminated dark grey silty clay	finely laminae & mottled light grey; deformed "shale";small slickenslides & broken shale clasts
37.5	42.5	148	42	11.85	deform shale	appearance of many broken shale clasts
			5	11.90	deform siltstone	predominant silt beds; core is broken up into very small pieces; dry

PROJECT: MDA N Alta	DATA NO: LEL-BH-03	LOGGED BY: L Leslie	DATE: 1 Sept 93	page 3 of 3
LOCATION: Figure Eight Lake	SURFACE EL: 2250'	LSD: 12 SEC: 21 TP: 84 R: 25 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			93	12.83	siltstone/shale	finely laminae;oxidized bands @60 & 90cm; core intact
			12	12.95	no core	
42.5	47.5	109	94	13.89	siltstone/shale	predominant siltstone laminae;slightly wavy beds
			15	14.04	shale/siltstone	wavy beds of shale(dark grey) with some siltstone(light grey)
			43	14.47	no core	
47.5	52.5	156	156	16.00	siltstone/shale	

PROJECT: MDA N Alta	DATA NO: LEL-BH-04	LOGGED BY: L Leslie	DATE: 30 Aug 93	page 1 of 3
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION.: 1925' NTS MAP: 84C/4	
BOREHOLE NAME: Peace River		LSD: 4 SEC: 14 TP: 81 R: 26 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 439800 m	NORTHING: 6207780 m	BOTTOMED IN: bedrock	
DESCRIPTION OF LOCATION: Glaciolacustrine plain about 12 km SW of Brownvale				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	2.5	68	43	.43	road fill	silty clay slightly mottled
			8	.51	Ah	
			17	.68	silty clay	mottled;horizontal laminae;olive brown, orangey brown & light to dark grey
			8	.76	no core	
2.5	7.5	101	14	.90	silty clay	mottled;horizontal laminae;olive brown, orangey brown & light to dark grey
			58	1.48	silty clay	massive,dark grey;crumbles easily;some brown silt pockets are highly effervescence;powdered gypsum in lower 15cm
			28	1.76	clay	massive, small mottles of brown silt and lenses of gypsum;one dropstone (5mm) non-effervescence
			53	2.29	no core	
7.5	12.5	136	~10	2.39	clay	massive,small mottles of brown silt and lenses of gypsum;some crumpled;sharp lower contact;clasts are predominant very weathered composed of siltstone & sandstone;one bright orange,highly oxidized
			34	2.73	stratified till/ fine sand	sample is very crumpled;appears to be intervals of fine sand and silt with a brown stratified till interval @ middle (~10cmm thick) with granules & tiny pebbles of siltstone,sandstone,and pink granites
			91	3.64	stratified brown till	finely laminae silt bands (light brown);fine sand(?) highly oxidized orange;brown & grey bands;clasts lithology-siltstone, sandstone, carbonates (all moderate to high effervescence) and quartz;granules 2-3%
			17	3.81	no core	
12.5	17.5	107	~50	4.31	stratified brown till	sample crumpled-may represent interbedded silt units or may be result of drilling; clasts are more frequent and larger(4-5 cm);lithology siltstone, carbonates,quartzite-quartz(?) and oxidized sandstone & siltstone;small gypsum lenses/bands

PROJECT: MDA N Alta	DATA NO: LEL-BH-04	LOGGED BY: L Leslie	DATE: 30 Aug 93	page 2 of 3
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LOCATION: Peace River	SURFACE EL: 1925'	LSD: 4 SEC: 14 TP: 81 R: 26 MER: W of 5
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DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			57	4.88	stratified brown till	finely laminae-like 91cm interval above; shale clast(~3cm) 10 cm from base; smaller shale clasts throughout; lithology same with addition of shale clasts
			45	5.33	no core	
17.5	22.5	107	43	5.76	stratified brown till	crumpled core-shoe changed to attempt to get better recovery
			64	6.40	stratified brown till	tiny pebbles(<5mm)~15% of shale, siltstone, carbonates, sandstone (orangey), quartz; matrix slightly effervescence (takes ~30 sec to react); pebbles >1cm very rare
			46	6.86	no core	
22.5	27.5	121	35	7.21	stratified brown till	crumpled core-same as above(?); 4-5cm clasts, siltstone(orangey), three vein quartz clasts
			86	8.07	stratified brown till	stratified bands have same appearance-orangey oxidized bands more effervescence; a few tiny pebble size pink granites
			31	8.38	no core	
27.5	32.5	~46	~46	8.84	stratified brown till	(?) crumpled core; quartzites well rounded; carbonates
			107	9.91	no core	
32.5	35	0	76	10.67	no core	
35	37.5	0	76	11.43	no core	
						penetrometer hit rock and sampled a 3cm till; spear sent down to shatter rock
37.5	42.5	51	51	11.94	stratified brown till	core is crumpled; large quartzite(6-8cm) square shaped/subrounded; frequent gypsum veining
			101	12.95	no core	
42.5	47.5	0	152	14.48	no core	spear sent down again to shatter rock
47.5	52.5	0	152	16.00	no core	
52.5	57.5	0	152	17.53	no core	pushed through with plug
57.5	62.5	152	152	19.05	stratified brown till	texture no change; lithology-no change; stone ~1cm sizes more abundant; gypsum veining occurs every 10-20cm; higher effervescence on lighter bands(5-7cm thick); well rounded (3cm) of quartzite & granite

PROJECT: MDA N Alta	DATA NO: LEL-BH-04	LOGGED BY: L Leslie	DATE: 30 Aug 93	page 3 of 3
LOCATION: Peace River	SURFACE EL: 1925'	LSD: 4 SEC: 14 TP: 81 R: 26 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			28	20.57	no core	
67.5	72.5	74	~20	20.77	massive dark grey till	core is chewed up;difficult to discern;texture similar to stratified brown till but with less granules and tiny pebbles
			54	21.31	stratified brown till	contact difficult to see since slight colour changes can't be seen in bright sunlight;gypsum veining;core is mangled for 7cm interval-why(?); coal fragments @ base
			79	22.10	no core	
72.5	77.5	~22	~22	22.32	massive dark grey till	mangled core; large quartzite (6-7cm); subangular-subrounded
			130	23.62	no core	
77.5	82.5	0	152	25.15	no core	plug in to push through
82.5	87.5	~20	~20	25.35	till	small mangled sample
			132	26.67	no core	
87.5	92.5	~40	~40	27.07	grey till	mangled sliver;large quartzite cobble
			112	28.19	no core	
92.5	97.5	0	152	29.72	no core	
97.5	102.5	109	7	29.79	brown fine sand	massive appears to be slough
			92	30.71	siltstone	massive(?);core is mangled & slightly wet;bottom~15cm is dry rock fragments-here there is fine laminae of light grey & grey
			53	31.24	no core	
102.5	107.5	~20	~20	31.44	siltstone	mangled core
			132	32.76	no core	stopped drilling-too difficult

PROJECT: MDA N Alta	DATA NO: LEL-BH-05	LOGGED BY: L Leslie	DATE: 31 Aug 93	page 1 of 2
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 2100' NTS MAP: 84C/4	
BOREHOLE NAME: Brownvale		LSD: 13 SEC: 11 TP: 82 R: 25 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 449450 m	NORTHING: 6217540 m	BOTTOMED IN: gravel	
DESCRIPTION OF LOCATION: Hummocky to rolling undifferentiated till and glaciolacustrine plains				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	2.5	59	38	0.38	roadfill	
			21	0.59	soil?	
2.5	6.5	42	20	0.79	silty clay	very dry,easily friable; may be brown till
			22	1.01	brown till	
						HIT ROCK-MOVED 1' OVER & CONTINUED
0	7.5			2.28	no core	
7.5	12.5	142	43	2.71	brown till?	mangled core,difficult to discern; powdered gypsum veining
			41	3.12	stratified light brown till	'waterlain' till;mostly silty bands with small darker brown horizontal laminae containing pebbles & granules; 3cm quartzite clast
			58	3.71	stratified brown till	finely laminated;fine sand bands;clast lithology <1cm-carbonate,rusty siltstone & sandstone, shale, quartz, quartzite; no effervescence
			10	3.81	no core	
12.5	17.5	84	41	4.22	stratified brown till?	mangled core;appears mottled;lithology-siltstone rusty sandstone,quartzite;gradational lower contact
			43	4.65	stratified light brown till	fine dark laminae;pebbles & granules throughout;light brown is siltier;lithology-no change;no clast larger than 1cm
			68	5.33	no core	
17.5	22.5	63	8	5.41	dark brown till	massive;lithology-red granites,siltstone,orangey sandstone/siltstone
			27	5.68	stratified brown till	gradational upper contact over ~6cm; fine dark brown laminae;one red siltstone clast (5mm)-largest clast noticed
			13	5.81	light brown till	massive;~5%clast <1cm;quartz,quartzite
			15	5.96	brown till	massive;1-2cm stones-well-subrounded-carbonate,quartz, quartzite, (7cm) subangular, weathered diorite(coarse,dark grains)
			89	6.85	no core	
22.5	26	106	95	7.80	stratified light brown till	orangey band of silt;powdered gypsum; ~5%clast <1cm in upper 66cm with lower part up to 10% with larger clasts;quartz & quartzite predominant, with a few black chert

PROJECT: MDA N Alta	DATA NO: LEL-BH-05	LOGGED BY: L Leslie	DATE: 31 Aug 93	page 2 of 2
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LOCATION:Brownvale	SURFACE EL: 2100'	LSD: 13 SEC: 11 TP: 82 R: 25 MER: W of 5
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DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			12	7.94	dirty gravel	medium-coarse matrix;moderate effervescence;sub ang to well rounded;matrix supported;3-4cm clast with average size ~1.5cm;quartz,quartzite,chert;no granites seen
26	42.5	0	501	12.95	no core	pushed through
42.5	47.5	20	20	13.15	dirty gravel	sub to well rounded;medium-coarse sand matrix;no shield clasts
			132	14.47	no core	
47.5	57.5	0	305	17.52	no core	pushed through
57.5	62.5	16	16	17.68	medium sand	clean subangular grains of orange quartzite, black chert,muscovite flakes, white quartz, pink feldspar(?)
			136	19.05	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-06	LOGGED BY: L Leslie	DATE: 18 Aug 93	page 1 of 1
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1940' NTS MAP: 84C/3	
BOREHOLE NAME: Nampa site 1		LSD:02 SEC: 17 TP: 81 R: 21 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 470600	NORTHING: 6207100	BOTTOMED IN: bedrock	
DESCRIPTION OF LOCATION: Grooved glaciolacustrine plain				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	2.5	61	44	0.44	fill	
			7	0.51	silty clay	gypsum in blotches & beds 5-10cm apart
			15	0.76	no core	
2.5	7.5	135	74	1.50	silty clay	brown-grey mottles with orange-brown; gypsum in blotched & infilling fractures-horizontal, inclined,& vertical; no effervescence
			9	1.59	clayey silt	finely laminated;some black blotches; no effervescence
			10	1.69	clayey silt-till	transitional,very few stones
			24	1.93	silty clay/till	laminated silty clay & till;one oxidized sand bed mid-way;one quartz pebble;grainy texture
			8	2.01	Bedrock	Kaskapau Formation;finely laminated siltstone & shale
			27	2.28	no core	
7.5	12.5	152	152	3.81	Bedrock	with sulfur beds
12.5	17.5	152	152	5.33	Bedrock	mostly shale,with sulfur beds
17.5	22.5	152	152	6.86	Bedrock	mostly shale,no sulfur beds

PROJECT: MDA N Alta	DATA NO: LEL-BH-07	LOGGED BY: L Leslie	DATE: 16 Aug 93	page 1 of 3
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1900' NTS MAP: 84C/3	
BOREHOLE NAME: St Isidore		LSD: 01 SEC: 08 TP: 83 R: 20 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 493200 m	NORTHING: 6225310 m	BOTTOMED IN: silty clay	
DESCRIPTION OF LOCATION: Flat glaciolacustrine plain				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	2.5	.76	10	0.10	fill	
			50	0.60	silty clay	gleying @ base;gypsum lenses
			16	0.76	silty clay	grey-slightly mottled
2.5	7.5	132	45	1.21	silty clay	massive
			48	1.69	clayey silt	
			16	1.85	silty clay	
			23	2.08	clayey silt	
			20	2.28	no core	
7.5	12.5	152	37	2.66	silty clay	massive;grey-brown;minor gypsum lenses
			36	3.02	clayey silt-silt	massive;grey-brown
			8	3.10	clay	slightly mottled;grey & brown mottles
			33	3.43	clayey silt	some clayey bands
			10	3.53	silty clay	
			29	3.82	clayey silt	
12.5	17.5	152	33	4.15	silty clay	massive;grey & brown mottles
			71	4.86	silty clay	minor granules & pebble present;shale & siltstone clasts
			51	5.33	clayey silt	slightly more granules present
17.5	22.5	152	34	5.67	silty clay	grey-brown;minor mottling;<1% granules; one sandstone dropstone (~2cm);minor gypsum
			118	6.85	silty clay	grey-brown mottling;<1% granules
22.5	27.5	152	93	7.78	silty clay	gypsum lensing,some inclined >45°; minor mottling-grey-brown;very few granules
			19	7.79	silty clay	grey-brown;very few granules & pebbles
			41	8.38	silty clay	gypsum,inclined @ ~30°, @ 18 & 29cm, ~2cm thick,banding grey & brown 3-10cm apart
27.5	32.5	152	18	8.56	silty clay/clayey silt	small lens of brown pebble gravel
			21	8.77	clayey silt	oxidized brown;very minor granules
			48	9.25	silty clay	large mottles;small pebble gravel as above with large clast 3-5cm from contact
			65	9.91	clayey silt/silty clay	banded-oxidized/non-oxidized
32.5	37.5	23	23	10.14	clayey silt/silt/clay	mostly dark grey;hit rock

PROJECT: MDA N Alta	DATA NO: LEL-BH-07	LOGGED BY: L Leslie	DATE: 16 Aug 93	page 2 of 3
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LOCATION: St Isidore	SURFACE EL: 1900'	LSD: 01 SEC: 08 TP: 83 R: 20 MER: W of 5
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DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			129	11.43	no core	
37.5	42.5	152	26	11.69	slough	
			76	12.45	silty clay	dark grey;minor granules & pebbles
			37	12.82	coarse sand	with minor gravel in upper 20cm ~2-3% pebbles;lower 20 cm is medium sand with no gravel
			13	12.95	silty clay/clayey silt	slight effervescence;massive;grey
42.5	47.5	152	152	14.48	silty clay/clayey silt	massive,gray;clast up to 5cm more frequent;texture slightly siltier than above
47.5	52.5	112	112	15.60	silty clay	slivered;massive;few 3-5cm pebbles; slight effervescence;rock caught
			40	16.00	no core	
52.5	62.5	0	305	19.05	no core	pushed through
62.5	65	42	18	19.23	slough	
			6	19.26	silty clay/clayey silt	grey;massive;granules ~10%;slight effervescence
			20	19.46	clay	massive;grey;moderate effervescence
			32	19.78	no core	
65	67.5	62	62	20.43	clay	massive;grey;moderate effervescence
			14	20.57	no core	
67.5	72.5	152	152	22.09	clay	massive;grey;small subhorizontal,wavy,laminae, slicken-slides with whitish flakes that have very high effervescence (i.e.calcite);structures may be due to drilling
72.5	77.5	152	60	22.69	clay	inverted cross-trough features @ ~5cm intervals-may be due to drilling
			92	23.62	clay	no structures
77.5	82.5	152	125	24.87	clay	grey;massive;moderate effervescence;light circular bands @ <1cm intervals & further apart near base
			27	25.14	clay	light bands are <1-1cm or more,planar & show clast-like shale fragments <1cm
82.5	87.5	63	63	25.77	clay	grey;massive;no structures
			89	26.66	no core	
87.5	92	137	123	27.89	clay	top 3'of core lost from last run;fracture interval ~20-30cm apart, inclined @ ~45°;circular pattern found @3' from top

PROJECT: MDA N Alta	DATA NO: LEL-BH-07	LOGGED BY: L Leslie	DATE: 16 Aug 93	page 3 of 3
LOCATION: St Isidore	SURFACE EL: 1900'	LSD: 01 SEC: 08 TP: 83 R: 20 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			14	28.04	clay	black/light (silt) & dark grey,wavy interlaminated; small-scale water release/deformation fine-medium sand laminae ~3cm from base
92	97	102	18	28.22	clay/silt	massive, grey; disturbed
			30	28.52	clay/silt/sand	disturbed; red sandstone (~2cm) & 2-3mm pebble ~5cm from base
			20	28.72	clay/silt/sand	horizontally interbedded; organic horizon; abrupt upper contact with medium sand bed
			16	28.88	medium sand	massive; grey
			14	29.02	silt	with clay laminae; horizontally laminated; organic beds
			4	29.08	clay	with silt laminae
			48	29.56	no core	
97	98.5	46	46	30.02	medium sand	massive; pink translucent, quartz grains are sub to well rounded; pink to red opaques, pale green, white & black (chert) grains
98.5	100	46	8	30.10	silt	with some clay; massive; grey; some organic wisps; moderate effervescence
			3	30.13	silt	with some pebbles & fine sand; gravel-like bed with some pebbles (3mm-1cm); moderate effervescence
			35	30.48	silt	with some clay; grey; massive; some black organic wisps; moderate effervescence

PROJECT: MDA N Alta	DATA NO: LEL-BH-08	LOGGED BY: L Leslie	DATE: 10 Aug 94	page 1 of 2
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1875' NTS MAP: 84C/3	
BOREHOLE NAME: Nampa site 2		LSD: 12 SEC: 22 TP: 81 R: 20 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 496750 m	NORTHING: 6210050 m	BOTTOMED IN: dark grey till	
DESCRIPTION OF LOCATION: On floodplain of the Heart River 3 km west of Nampa				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	3	91	55	0.55	fill	
			36	0.91	medium sand	massive with some bands of organics
3	8	70	39	1.30	medium sand	similar to above
			15	1.45	fine sand	some silt, more compact & cohesive; slightly effervescence
			16	1.61	medium sand	loose
			82	2.44	no core	
8	13	52	8	2.52	sand	
			15	2.67	very fine sand	oxidized, wavy bands
			21	2.88	fine/medium sand	interbedded; medium sand oxidized
			8	2.96	sand & gravel	coarse to medium sand supported gravel; clasts ~1cm - subrounded to subangular; granite & quartzites present
			100	3.96	no core	
13	18	152	132	5.28	till	greyish-brown, granules of carbonate, sandstone siltstone, pink granite, shale; non-effervescence; 1-2% clasts >4mm; gypsum crystals in lower 15cm
			20	5.49	till	greyish-brown, more granules (2-3%); same lithologies & gypsum crystals present
18	23	152	152	7.01	till	similar to above but with more gypsum crystals & present in bands; bands of oxidized & dark grey ~1-2cm thick; few stones/small pebbles; ~5% clasts >4mm; very slightly effervescence
23	28	100	100	8.01	till	greyish-brown; rock stuck in shoe subangular, red granite (~4mm dia); gypsum is patchy; lithology-siltstone(tan); sandstone(rusty); both weathered, shale, carbonate, granites;
			52	8.53	no core	
28	33	152	152	10.06	grey till	matrix appears to be siltier; there are more granules (~5%); 5% clasts >4mm; slightly effervescence; oxidized bands at 50 & 80cm depth

PROJECT: MDA N Alta	DATA NO: LEL-BH-08	LOGGED BY: L Leslie	DATE: 10 Aug 94	page 2 of 2
LOCATION: Nampa site 2	SURFACE EL: 1875'	LSD: 12 SEC: 22 TP: 81 R: 20 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPT H (m)	LITHOLOG Y	CORE DESCRIPTION
from	to					
33	38	152	152	11.58	dark grey till	massive;no oxidized;5Y3/1-very dark grey; 6-8% clasts >4mm; lithology-vein quartz, siltstone sandstone, shale, carbonate, granites, fine grained mafics; slightly effervescence
38	43	152	152	13.11	dark grey till	same as above but with coal clats ~3cm diameter; slightly effervescence, same lithogies
43	48	152	152	14.63	dark grey till	same but with no coal clasts
48	53	152	152	16.15	dark grey till	slightly more effervescence, otherwise no changes
53	58	152	152	17.68	dark grey till	moderate to highly effervescence in 30cm at base
58	63	128	128	18.96	dark grey till	rock in the way, core is 'swirled'
			24	19.20	no core	
63	68	0	152	20.73	no core	pushed through
68	73	152	152	22.25	dark grey till	~8% granules;a few pebbles every 10cm, some close together,silty clay matrix
73	78	152	152	23.77	dark grey till	~10%granules & small pebbles;no pebbles
78	83	152	152	25.30	dark grey till	finegrainedmafic(~4cm);moderate effervescence; ~10% granules
83	88	152	152	26.82	dark grey till	@82 & 120cm-bands oxidized,brownish fine sand;6cm pocket of sand & gravel
88	93	152	152	28.35	dark grey till	massive;lithology-shale, siltstone, sandstone, quartzite, carbonate, granites;easy drilling
93	98	152	152	29.87	dark grey till	massive;wet core 40-112cm interval;~15% granules>4mm,slightly more than above
98	103	152	152	31.39	dark grey till	massive;moderate effervescence;dry core;~2% pebbles;~15% granules
103	108	20	20	31.59	dark grey till	broken pieces of core
			132	32.92	no core	
108	118	0	304	35.96	no core	
118	123	152	152	37.49	dark grey till	massive;moderate effervescence; ~15%granules; moist
123	128	152	152	39.01	dark grey till	no change
128	133	152	152	40.54	dark grey till	no change

PROJECT: MDA N Alta	DATA NO: LEL-BH-09	LOGGED BY: L Leslie	DATE: 11 Aug 94	page 1 of 2
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1740' NTS MAP: 84C/13	
BOREHOLE NAME: Notikewin		LSD: 03 SEC: 13 TP: 92 R: 24 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 456220 m	NORTHING: 6314500 m	BOTTOMED IN: dark grey till	
DESCRIPTION OF LOCATION: Hummocky to rolling till plain				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	3	91	26	0.26	soil	A & B horizons
			65	0.91	brown-grey till	massive;CCa in upper 20cm;lithology-siltstones (tan & weathered), sandstone (rusty), carbonate, granite; ~1% clasts >4mm; predominant granules & small pebbles;slight effervescence.
3	8	130	88	1.79	banded brown & grey till	5Y3/2(dark olive grey) & 5Y3/1(very dark grey); banded/stratified; clay-rich bands darker with slight effervescence near base (~1 cm thick);~2% clasts >4mm; lithology-shale, coal, siltstone, & sandstone; predominantly granules & small pebbles.
			42	2.21	brown-grey till	5Y3/2(dark olive grey);slight effervescence; similar to above but with no banding;many granule-size shale clasts & weathered siltstone & sandstone,carbonate,one highly weathered granite schist, vein quartz(few)
			22	2.43	no core	
8	13	152	152	3.96	brown-grey till	scattered gypsum crystals; coal,carbonate, granites; ~5% clasts >4mm of which ~15% are pebbles(ie. not all grans)
13	18	152	61	4.57	brown-grey till	same as above
			91	5.48	dark brown-grey till	may be more clay in matrix; more gypsum present than above; first green sandstone, angular,~15cm (Badheart Formation ?)
18	23	152	36	5.84	dark grey till	5Y2.5/1-black;massive;core chewed up
			32	6.16	dark brown/dark grey till	frequent light & dark bands ~1-2 cm thick throughout; lithology-no change
			84	7.01	dark grey till	5Y3/1-very dark grey;very compact; some gypsum;~5% clasts >4mm;~15-20% granules & tiny pebbles;lithology-no change
23	28	105	105	8.01	dark grey till	moderately effervescence; no change
			47	8.53	no core	
28	33	142	142	9.95	dark grey till	no change
			10	10.05	no core	
33	38	152	152	11.58	dark grey till	massive;no change
38	43	152	152	13.10	dark grey till	no change;~5% shale granules

PROJECT: MDA N Alta	DATA NO: LEL-BH-09	LOGGED BY: L Leslie	DATE: 11 Aug 94	page 2 of 2
LOCATION: Notikewin	SURFACE EL: 1740'	LSD: 03 SEC: 13 TP: 92 R: 24 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOG Y	CORE DESCRIPTION
from	to					
43	48	152	152	14.63	dark grey till	top 40-50cm core has thinner diameter & broken up;lithology & %-same;still very compact & slightly moist;hole dry
48	53	152	152	16.15	dark grey till	
53	58	152	152	17.68	dark grey till	
58	63	152	152	19.20	dark grey till	
63	68	152	152	20.73	dark grey till	core looks like shale bedrock on surface-but probably sheen is due to high clay content in matrix
68	73	152	152	22.25	dark grey till	
73	78	152	152	23.77	dark grey till	
78	83	152	152	25.30	dark grey till	large mudstone pebble-local bedrock
83	88	152	152	26.82	dark grey till	light grey siltstone clasts smudged with drilling & is twisted within the core;high clay content;very compact
88	93	152	152	28.35	dark grey till	
93	98	152	152	29.87	dark grey till	
98	118	0	610	35.97	dark grey till	pushed through with plug
118	123	152	124	37.21	dark grey till	appears to be less pebbles;granules & tiny pebbles-no change;moderate effervescence
			28	37.49	banded silty clay	banded grey & tan coloured;carbonate dropstone (subrounded ~3cm) near base; tan bands are fine sand to silty sand
123	128	152	152	39.01	dark grey till	much the same as above 132cm interval
128	133	152	152	40.54	dark grey till	red granite(subrounded ~4cm)near top;wisps of fine-medium grey sand at 41 & 52 cm from top of this interval
133	135	58	58	41.12	dark grey till	same; dry hole
			94	42.06	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-10	LOGGED BY: L Leslie	DATE: 12 Aug 94	page 1 of 2
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1611' NTS MAP: 84C/13	
BOREHOLE NAME: Manning Airport		LSD: 12 SEC: 04 TP: 92 R: 23 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 460500 m	NORTHING: 6312000 m	BOTTOMED IN: dark grey till	
DESCRIPTION OF LOCATION: At turn in road just north of airport gate				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	3	74	13	0.13	fill	
			20	0.33	clay/silty clay	dry pack road fill
			30	0.63	stratified silty clay/ clayey silt	mostly silty clay with thin interbeds of clayey silt and fine sand- 3-4 cm thick
			28	0.91	no core	
3	8	54	39	1.30	silty clay	massive with few granules,high effervescence
			15	1.45	brown till	massive, high effervescence in upper 12cm
			98	2.44	no core	
8	13	130	125	3.69	brown till	massive;very slight effervescence;-5% clasts >4mm;-10%-granules;lithology-coal, siltstone (tan) sandstone(rusty), carbonate, red granites, shale;rusty mottles
			5	3.74	silty clay	massive-vaguely laminated appearance
			22	3.96	no core	
13	18	152	129	5.25	silty clay	laminated(poorly defined);<1% granules A few scattered gypsum crystals
			23	5.49	brown till	~10%-granules;lithology-coal, siltstone(tan) sandstone (rusty),carbonate,red granites, shale
18	23	152	36	5.85	brown till	massive:gypsum
			38	6.23	stratified brown till	light & dark beds (~2cm thick) with thin gypsum stringers; very slightly effervescence, laminae within stratified layers
			78	7.01	brown till	massive:gypsum interspaced at 4cm couplets & 12 cm apart;very slightly effervescence
23	28	140	98	7.99	stratified brown till	~5mm thick laminae;alternating rusty & dark brown;powdered siltstone(tan);high effervescence
			38	8.37	brown till	has rusty beds ~4mm thick,15cm below upper contact
			16	8.53	no core	
28	33	152	152	10.06	stratified brown till	rusty beds containing gypsum; very slightly effervescence; ~5% clasts >4mm;-15%-granules
33	38	85	85	10.91	stratified brown till	mangled core; hit ironstone (~8cm); slightly effervescence
			67	11.58	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-10	LOGGED BY: L Leslie	DATE: 12 Aug 94	page 2 of 2
LOCATION: Manning Airport	SURFACE EL: 1611'	LSD: 12 SEC: 04 TP: 92 R: 23 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
38	43	152	152	13.11	stratified brown till	only slightly chewed up in upper 30cm;lower 58cm is less stratified; weathered pinkish (10R5/8-red)sandstone (~4mm); weathered tan siltstone (2.5Y7/4-pale yellow); matrix-5Y3/2-dark olive grey;moderate effervescence
43	48	152	140	14.51	stratified brown till	mangled in upper 30cm with gypsum in oxidized beds
			12	14.63	brown-grey till	transitional change to this massive unit;readily effervescence
48	53	152	152	16.15	banded brown/grey till	38cm-grey/17cm-brown/32cm-grey/24cm-brown/19cm-grey/10cm-brown/20cm-grey; both very effervescent
53	58	152	72	16.87	banded brown/grey till	29cm-grey/16cm-brown/15cm-grey/14cm-brown
			80	17.68	dark grey till	massive;same as grey till bands above
58	63	152	152	19.20	dark grey till	oxidized fractures infilled with gypsum;very effervescent;water @59'
63	68	152	152	20.73	dark grey till	wet core on surface;some difficulty drilling through ironstone clasts;very effervescent
68	73	152	152	22.25	dark grey till	oxidized brown till mixed in with grey till in lower 11cm of core
73	78	152	50	22.75	brown-grey till	patches of brown and grey due to oxidation in fractures;gypsum-not seen;
			102	23.77	dark grey till	
78	83	152	152	25.30	dark grey till	
83	88	152	152	26.82	dark grey till	
88	93	152	152	28.35	dark grey till	
93	98	152	152	29.87	dark grey till	
98	118	0	609	35.96	dark grey till	pushed through
118	123	48	48	36.44	dark grey till	three medium pebbles held up drilling
			105	37.49	no core	pushed through rock
123	128	0	152	39.01	dark grey till	
128	133	152	152	40.54	dark grey till	
133	138	152	152	42.06	dark grey till	still moderate effervescence;lithology-coal, shale, siltstone, sandstone red granite, carbonate

PROJECT: MDA N Alta	DATA NO: LEL-BH-11	LOGGED BY: L Leslie	DATE: 13 Aug 94	page 1 of 3
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1525' NTS MAP: 84C/14	
BOREHOLE NAME: Buchanan Creek		LSD: 12 SEC: 15 TP: 92 R: 21 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 481850 m	NORTHING: 6315100 m	BOTTOMED IN: Bedrock	

DESCRIPTION OF LOCATION: Gently rolling glaciolacustrine plain with isolated hillocks

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	3	70	15	0.15	fill	
			18	0.33	fine sand	beige
			37	0.71	silty clay	with fine sand interbeds
			20	0.91	no core	
3	8	123	15	1.06	fine sand	massive;crumpled up
			5	1.11	silty clay	with fine sand interbeds
			9	1.20	silty clay	massive; dark brown
			67	1.87	clayey silt	massive; light brown
			12	1.99	silty clay	massive; dark brown
			13	2.12	clayey silt	massive; light brown
			32	2.44	no core	
8	13	152	52	2.96	clayey silt	massive; light brown
			100	3.96	silty clay	dark brown; somewhat mottled with light brown;fractures infilled with gypsum space 25-30 cm apart;no dropstones; very slightly effervescent
13	18	152	132	5.28	silty clay	scattered siltstone, sandstone (weathered,rusty),and carbonate granules-all effervescent;fractures contain calcite
			20	5.48	fine sand	wet;massive;readily effervescent;2.5Y4/2-dark greyish brown
18	23	105	105	6.53	very fine sand	massive, wet-liquifiable;lower 13 cm is drier & more compact; moderate effervescence
			47	7.01	no core	
23	28	96	96	7.97	very fine sand	massive, wet-liquifiable;lower part is drier & more compact; moderate effervescence
			56	8.53	no core	
28	33	152	152	10.06	clayey silt/silty clay	light grey & very slight effervescence;fine sand(light grey) laminae @6-8cm intervals in the lower 24 cm;core was mangled slightly
33	38	152	132	11.38	silty clay	more clay than above interval;5Y3/1-very dark grey;fine sand laminae still present
			20	11.58	fine sand	5Y4/1-dark grey;mostly fine sand thin beds (<4mm) with some interlaminated of silty clay
38	43	152	13	11.71	fine sand	with a few silty clay interlaminated
			7	11.78	silty clay	with a few fine sand interlaminated

PROJECT: MDA N Alta

DATA NO: LEL-BH-11

LOGGED BY: L Leslie

DATE: 13 Aug 94

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LOCATION: Buchanan Creek

SURFACE EL: 1525'

LSD: 12 SEC: 15 TP: 92 R: 21 MER: W of 5

DRILLED DEPTH (ft)	RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
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from	to					
			26	12.04	fine sand/silty clay	near equal proportions; thin beds to laminae
			31	12.35	fine sand	with a few silty clay interlaminated
			23	12.58	silty clay	with a few fine sand interlaminated
			6	12.64	fine sand	with a few silty clay interlaminated
			47	13.11	silty clay	more frequent fine sand interlaminated
43	48	152	60	13.71	silty clay	
			28	13.99	fine sand	
			38	14.37	silty clay	
			10	14.47	fine sand	
			6	14.53	silty clay	
			10	14.63	fine sand	
48	53	152	46	15.09	silty clay	a few thin beds of fine sand (4-6cm thick) & 7-12 cm apart
			106	16.15	silty clay	no fine sand interlaminated as seen above
53	58	152	152	17.68	silty clay	fine sand bed (6cm thick) & 10cm above base of interval
58	63	152	152	19.20	silty clay	grey; no fine sand interlaminated; massive; no granules seen since 13'-18' interval
63	68	152	145	20.65	silty clay	no granules; very slight effervescence
			7	20.73	dark grey till	sharp, planar, upper contact; ~5% granules & tiny pebbles; moderate effervescence; lithology-shale, siltstone, sandstone, carbonate, red granite
68	73	152	152	22.25	dark grey till	~2% clasts >4mm; ~6-8% granules; ~2%-small pebbles; moderate effervescence; same lithology; 5Y3/1-very dark grey
73	78	152	152	23.77	dark grey till	
78	83	125	125	25.02	dark grey till	subrounded (~6cm) limestone pebble caught in core ~40cm from top; moderate effervescence
			27	25.29	no core	
83	88	139	139	26.69	dark grey till	
			13	26.82	no core	
88	93	90	90	27.72	dark grey till	slight effervescence
			62	28.35	no core	
93	98	152	152	29.87	dark grey till	slight effervescence
98	108	0	305	32.92	no core	pushed through
108	113	131	43	33.35	dark grey till	pyritized, petrified wood fragment ~2cm length
			9	33.44	medium sand	massive; moderate effervescence

PROJECT: MDA N Alta	DATA NO: LEL-BH-11	LOGGED BY: L Leslie	DATE: 13 Aug 94	page 3 of 3
LOCATION: Buchanan Creek	SURFACE EL: 1525'	LSD: 12 SEC: 15 TP: 92 R: 21 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOG Y	CORE DESCRIPTION
from	to					
			18	33.62	dark grey till	massive; <~1% granules & tiny pebbles

			5	33.67	fine sand	wet;compact;sharp uppe and lower contacts
			59	34.26	grey sandstone	fine & medium sand;2.5Y6/2-light brownish grey & 2.5Y4/2-dark greyish brown;horizontal bedded/laminae fine medium sand & 9cm-massive grey medium sand at base
			19	34.44	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-12	LOGGED BY: L Leslie	DATE: 14 Aug 94	page 1 of 3
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1525' NTS MAP: 84C/13	
BOREHOLE NAME: Manning site 1		LSD: 12 SEC: 08 TP: 92 R: 22 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 469000 m	NORTHING: 6313430 m	BOTTOMED IN: wet sand	
DESCRIPTION OF LOCATION: Gently rolling to flat glaciolacustrine plain				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	3	91	22	0.22	fill	
			12	0.34	silt/fine sand	moderate effervescence; CCa @ 22cm depth
			19	0.53	silty clay	slight to no effervescence
			20	0.73	clayey silt	with fine sand; high effervescence
			11	0.91	silty clay	
3	8	128	12	1.03	clayey silt	dessicated & broken up
			45	1.48	silty clay	slightly dessicated & broken up
			10	1.58	clayey silt	
			46	2.04	silty clay	predominant dark brown;banded ~5-15mm thick;high effervescence in upper 2-3cm,then has only slight effervescence;very few gypsum crystals
			12	2.16	silty clay	predominant light brown;banding not well defined
			24	2.44	no core	
8	13	152	152	3.96	silty clay	banded;horizontal fractures infilled with gypsum,spacing >30cm;also a few clusters of gypsum
13	18	152	105	5.01	silty clay	8cm thick interval of till ~50cm from top; slivers for 40cm below this contact-most likely a large pebble in the way;granules of coal, shale, sandstone (iron staining),& red siltstone
			47	5.48	stratified brown till	crudely stratified-light & dark brown;~15% granules & ~1% clasts>4mm;lithology-shale, coal,red siltstone, orangey sandstone, carbonate, red granite;slight effervescence; gypsum crystals scattered throughout
18	23	133	133	6.81	stratified brown till	11cm-silty clay till/18cm-sand dominant with some silty clay till interlaminated/30cm-silty clay till/6cm-sand dominant with some silty clay till interlaminated/lower 33cm-silty clay till with a few sand interlaminated near base; sand slightly more effervescence than silty clay till
			19	7.01	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-12	LOGGED BY: L Leslie	DATE: 14 Aug 94	page 2 of 3
LOCATION: Manning site 1	SURFACE EL: 1525'	LSD: 12 SEC: 08 TP: 92 R: 22 MER: W5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
23	28	135	135	8.36	medium-fine sand	slightly wet sand, broken at top and more compact in lower 48cm; gravel (very poorly sorted, sand supported matrix) in lower 10cm of core; sand is massive in upper 2/3rds; appears crudely stratified (light & dark bands) & contains a 'till' interbed
			17	8.53	no core	
28	33	152	22	8.75	medium-fine sand	as above
			73	9.48	stratified brown till	crudely stratified; horizontal fractures infilled with gypsum; medium-coarse sand interlaminated; slight effervescence; lithology-shale, sandstone, siltstone, coal, carbonate, red granite one medium sandstone pebble caught in core
			25	9.73	medium sand	with silty clay till interlaminated, 2-3cm apart; planar sharp upper and lower contacts
			32	10.06	stratified brown till	crudely stratified as above
33	38	146	100	11.06	stratified brown till	crudely stratified; sand laminae ~5cm from top; gypsum crystals (~1cm length) infilling horizontal fractures; grey till band (2cm thick) ~53cm from top; moderate effervescence; ~15% granules & ~5% clasts >4mm;
			32	11.38	grey till	massive; ~15% granules & ~5% clasts >4mm;
			20	11.58	grey till	with brown till bands ~1cm thick & ~2-3cm apart; texture of both are same
38	43	100	84	12.42	grey till	sand (10 & 3cm thick) ~50 & 4cm consecutively from base
			26	12.68	sand	with silty clay till interlaminated
			42	13.10	no core	
43	48	152	81	13.91	brown/grey till	inclined bands (~60°); brown till bands contain gypsum crystals; grey till has slight effervescence; brown till has moderate effervescence
			71	14.63	grey till	thin bands of brown (~2cm thick); grey-brown colour in lower 12-15cm
48	53	152	96	15.59	brown-grey till	crudely stratified, not distinctly a 'grey' or 'brown' till; a few horizontal fractures infilled with gypsum; sand (~1cm thick) at base; slight effervescence

PROJECT: MDA N Alta	DATA NO: LEL-BH-12	LOGGED BY: L Leslie	DATE: 14 Aug 94	page 3 of 3
LOCATION: Manning site 1	SURFACE EL: 1525'	LSD: 12 SEC: 08 TP: 92 R: 22 MER: W5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			56	16.15	grey till	massive;slight effervescence;~15% granules & ~1% clasts>4mm
53	58	141	26	16.41	grey till	massive;slight effervescence
			18	16.59	sand	wet;moderate effervescence
			97	17.56	grey till	masive with a few slightly oxidized sand interbeds
			11	17.68	no core	
58	63	152	152	19.20	grey till	sand & gravel pocket ~36cm from top
63	68	152	152	20.73	grey till	sampler caught in auger-abandonned hole

PROJECT: MDA N Alta	DATA NO: LEL-BH-13	LOGGED BY: L Leslie	DATE: 15 Aug 94	page 1 of 2
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1525' NTS MAP: 84C/14	
BOREHOLE NAME: Manning site 2		LSD: 13 SEC: 35 TP: 91 R: 22 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 473580 m	NORTHING: 6311100 m	BOTTOMED IN: dark grey till	
DESCRIPTION OF LOCATION: Rolling to hummocky glaciolacustrine plain				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	3	91	28	0.28	fill	
			63	0.91	silty clay	dark grey massive to crudely stratified
3	8	152	152	2.44	silty clay	some light brown mottling; moderate effervescence
8	13	152	127	3.70	silty clay	
			26	3.96	very fine sand	high effervescence
13	18	152	152	5.49	silty clay	generally massive with some light brown mottling and silt interlaminated (5Y3/1-very dark grey); moderate effervescence
18	23	152	152	7.01	silty clay	generally massive, very little mottling & no silt interlaminated; some dark grey banding
23	28	152	152	8.53	silty clay	silt pockets in upper 15cm; scattered granules & tiny pebbles; till 'pockets' slight effervescence
28	33	152	152	10.06	silty clay	generally massive; silt pockets (high effervescence) 30cm from top; 2 pinkish bands ~2cm thick & ~2cm apart @ 30cm from base; slight effervescence
33	38	152	152	11.58	silty clay	massive; no granules nor 'till' pockets
38	43	152	138	12.96	silty clay	silt laminae @ 27cm from top & from 40-45cm depth interval; massive
			16	13.11	dark grey till	sharp, planar upper contact; very slight effervescence; ~15% granules & ~1% clasts >4mm; predominant lithology-shale & coal
43	53	152	152	14.63	dark grey till	~15% granules & ~5% clasts >4mm; lithology-shale, carbonate, vein quartz, red granite; slight effervescence
53	58	152	152	16.15	dark grey till	
58	63	152	152	19.20	dark grey till	massive; granule & small pebble gravel seam ~30cm from base
63	68	86	-	19.20	rock	subangular, grey limestone
			10	19.30	sand & gravel	
			58	19.88	dark grey till	massive; same as above
			18	20.06	sand & gravel	
			67	20.73	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-13	LOGGED BY: L Leslie	DATE: 15 Aug 94	page 2 of 2
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LOCATION: Manning site 2	SURFACE EL: 1525'	LSD: 13 SEC: 35 TP: 91 R: 22 MER: W of 5
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DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
68	73	138	13	20.86	sand & gravel	very poorly sorted granule-coarse sand supported matrix, medium pebble gravel
			121	22.07	dark grey till	massive with sand interbed (~2cm thick), 4cm from base
			18	22.25	sand & gravel	most not recovered
73	78	152	152	23.77	dark grey till	massive, same as above
78	83	152	152	25.30	dark grey till	
83	88	152	47	25.77	dark grey till	
			4	25.81	fine sand	beige, slightly wet
			29	26.10	dark grey till	
			6	26.16	sandy gravel	medium-coarse sand gravel; very compact with clayey silt matrix
			10	26.26	dark grey till	
			10	26.36	sandy gravel	medium-coarse sand gravel; very compact with clayey silt matrix
			46	26.82	no core	
88	93	152	66	27.48	dark grey till	
			18	27.66	sand & gravel	has some clay & silt in matrix, almost as though most of fines were washed out
			68	28.35	dark grey till	
93	98	152	152	29.87	dark grey till	
98	118	0	610	35.97	no core	pushed through
118	123	152	51	36.48	dark grey till	high effervescence otherwise no change
			74	37.22	silty clay	with fine sand-interlaminated & grey till interbeds-3-4cm thick & 10-15cm apart; high effervescence; fine sand has very high effervescence
			28	37.49	silty clay	with a few fine sand interlaminated; high effervescence
123	128	152	54 ?	39.01	dark grey till	
128	133	152	152	40.54	dark grey till	~15% granules & ~5% clasts >4mm; lithology-shale, sandstone, siltstone, carbonate, vein quartz, red granite; slight effervescence
133	138	140	140	41.94	dark grey till	
			12	42.06	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-14	LOGGED BY: L Leslie	DATE: 16 Aug 94	page 1 of 3
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1560' NTS MAP: 84C/14	
BOREHOLE NAME: Deadwood		LSD: 13 SEC: 36 TP: 89 R: 22 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 477100 m	NORTHING: 6291620 m	BOTTOMED IN: sand & till	
DESCRIPTION OF LOCATION: Flat to hummocky glaciolacustrine plain				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	3	62	20	0.20	fill	mostly clay pack
			11	0.31	sand & gravel	
			32	0.63	sand	light & dark bands with clay & rocks-fill?
			28	0.91	no core	
3	8	89	9	1.00	fine-medium sand	mottled;crumpled up;massive
			20	1.20	silty clay	grey & rust mottling
			4	1.24	clayey silt	grey & rust mottling (fine pattern); moderate effervescence
			53	1.77	silty clay	with grey fine-medium sand interlaminated 20-30cm apart
			3	1.80	fine sand	grey & rust mottling; moderate effervescence
			64	2.44	no core	
8	13	152	7	2.51	fine sand	wet;brownish with some grey colour; moderate effervescence
			120	3.71	silty clay	grey & rust mottling; fine sand interlaminated; slight effervescence & high effervescence at lower contact
			10	3.81	fine sand	moderate-high effervescence
			15	3.96	silty clay	
13	18	152	49	4.45	silty clay	
			78	5.23	fine sand	wet;brown (5Y4/3-olive);liquifiable
			23	5.49	silty clay	
18	23	87	4	5.53	silty clay	grey-brown;massive;no mottling
			16	5.69	fine sand	with clayey silt & silty clay interlaminated; greyish brown (5Y4/2-olive grey)
			13	5.82	silty clay	grey;massive;no mottling;no granules; (5Y3/2-very dark grey)
			11	5.93	fine-medium sand	grey-brown with grey interlaminated
			36	6.29	silty clay	grey-brown
			11	6.40	fine sand	with clayey silt & silty clay interlaminated;cohesive & drier
			61	7.01	no core	
23	28	152	71	7.72	fine sand	massive with some silt;grey; slight effervescence

PROJECT: MDA N Alta	DATA NO: LEL-BH-14	LOGGED BY: L Leslie	DATE: 16 Aug 94	page 2 of 3
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LOCATION: Deadwood	SURFACE EL: 1560'	LSD: 13 SEC: 36 TP: 89 R: 22 MER: W of 5
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DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOG Y	CORE DESCRIPTION
from	to					
			85	8.53	silty clay/clayey silt	predominant silty clay; clayey silt (light grey) has significant fine sand content; interlaminated are ~2cm thick & 10-15cm apart; slight effervescence; clayey silt laminae are slightly more effervescence
28	33	152	21	8.74	fine sand	
			131	10.06	silty clay/clayey silt	clayey silt bed/laminae as follows: 1-4cm; 29-41cm; 51-57cm; 64.5-67cm; 69.7cm; 71.5-89.5cm; 92-101cm; 129-129.5cm; 123.5-124cm; fine sand bed from 57-62cm
33	38	152	152	11.58	silty clay	slightly mottled grey & light grey; pinkish smudge in lower 35cm; 'till' pocket (7cm in length) 10cm from base; very few granules-one shale & dark grey carbonate (1.5 cm & 53cm from top); very little effervescence
38	43	152	52	12.10	grey till	~5% granules & ~1% clasts >4mm; lithology-shale, siltstone sandstone, carbonate, red granite
			100	13.10	silty clay	massive
43	48	152	44	13.54	silty clay	with 'till' pockets
			57	14.11	grey till	with some silty clay pockets
			7	14.18	coarse sand	~2% granules; pinkish colour
			44	14.63	grey till	~10% granules & ~2% clasts >4mm; lithology-green & pink sandstone, carbonate
48	53	152	45	15.08	grey till	
			35	15.43	silty clay	with clayey silt & fine sand interlaminated @ 4-6cm, 12-17cm, & 27-28cm
			72	16.15	grey till	red granite ~3cm, subangular; ~10-15% granules & ~2% clasts >4mm
53	58	152	152	17.68	grey till	~10% granules & ~3-5% clasts >4mm; moderate effervescence; lithology-shale, carbonate, red granite
58	63	152	152	19.20	grey till	~2cm shale clasts; ~1cm, very hard coal fragment
63	68	119	63	19.83	grey till	well rounded fine grained mafic pebble (3cm) @ base
			23	20.06	till/medium sand	sand @ 3-4cm & 14-14.5cm
			32	20.38	medium sand	clean, some granules & tiny pebbles; horizontally bedded; silt interlaminated spaced ~2cm apart
			34	20.73	no core	

PROJECT: MDA N Alta	DATA NO: LEL-BH-14	LOGGED BY: L Leslie	DATE: 16 Aug 94	page 3 of 3
LOCATION: Deadwood	SURFACE EL: 1560'	LSD: 13 SEC: 36 TP: 89 R: 22 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPT H (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
68	73	64	34	21.07	medium sand	fairly clean,pink grains (K-spar) ~5%;shale grains,quartz grains ~10%; moderate effervescence
			24	21.31	grey till	with some sand interlaminated;moderate effervescence
			6	21.37	fine-medium sand	very wet;most of core lost-mark on sampler tube suggest unit is ~105cm
			88	22.25	no core	
73	78	152	152	23.77	grey till	~10% granules & ~1% clasts>4mm;moderate effervescence;sand(~5mm thick)15cm from base
78	83	152	152	25.30	grey till	moderate effervescence;mid-portion slivered
83	88	152	152	26.82	grey till	~15% granules & ~3% clasts>4mm;moderate effervescence
88	93	152	97	27.79	grey till	fine grey sand laminae ~8cm above base
			26	28.05	grey till	with grey sand;basal contact inclined & sharp
			30	28.35	grey till	massive;granule-size coal fragments
93	98	152	152	29.87	grey till	~10% granules & ~3% clasts>4mm; moderate effervescence;lithology-carbonate, coal, sandstone, siltstone,granite small medium sand lens(mostly quartz & K-feldspar grains)~3cm long & ~5mm wide, situated almost vertical ~14cm from top of core
98	103	110	110	30.97	grey till	compact,drier than above;rock caught-metamorphosed granodiorite with garnets & yellow staining-fine groundmass
			42	31.39	no core	
103	108	152	152	32.92	grey till	slight more effervescence in lower 20cm;two sand lenses (2-3mm thick) at base; high effervescence;matrix feels silt(grittier) ~15% granules;grey fine sand ~15cm from base
108	113	53	25	33.17	grey sand	lower 10cm has dark calcareous interlaminated;upper half appears to have >50%quartz & feld-has little to no effervescence
			28	33.45	grey till	moderate effervescence
			99	34.44	no core	pushed through;sampler stuck 8'above bottom of hole
113	118	0	152	35.97	sand(?)	assumed sand plugging up hole

PROJECT: MDA N Alta	DATA NO: LEL-BH-15	LOGGED BY: L Leslie	DATE: 17 Aug 94	page 1 of 3
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 2130' NTS MAP: 84C/5	
BOREHOLE NAME: Smithmill		LSD: 13 SEC: 21 TP: 86 R: 24 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 454400 m	NORTHING: 6259500 m	BOTTOMED IN: fluvial sand	
DESCRIPTION OF LOCATION: Gently rolling till plain				

DRILLED DEPTH (ft)		RECOVER Y (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOG Y	CORE DESCRIPTION
from	to					
0	3	.91	53	0.53	fill	
			38	0.91	brown till	mottled with iron staining;no effervescence; ~1% clasts >4mm;~6-8% granules
3	8	152	152	2.44	brown till	very slight effervescence;sand pocket 68cm below top is 45cm thick (appears like bor-ing);~3mm circular, medium sand-moderate effervescence banding dark & light brown ~2cm apart; coal
8	13	152	152	3.96	brown till	mottling;no banding;very slight effervescence; ~2-3% clasts >4mm;~10% granules;lithology-coal, tan siltstone, quartzite, red granite, rusty sandstone
13	18	127	127	5.23	brown till	rock obstructing;upper 64cm slivered; lower 20cm banded,dark & light,5-10mm thick very slight effervescence
			25	5.49	no core	
18	23	152	152	7.01	brown & grey till	oxidized fractures inclined ~60° & ~8cm thick; brown-5Y3/2-dark olive grey; grey-5Y3/1-very dark grey;spacing ~16-20 cm;thinner (~2-4cm thick)oxidized bands in lower half;both very slight effervescence; ironstones only seen in brown bands
23	28	152	152	8.53	grey till	slightly more effervescence;~3% clasts >4mm; ~15% granules;lithology-coal,tan siltstone, quartzite, red granite,rusty sandstone, shale, carbonate; oxidized fractures inclined ~60° & ~3-5mm thick
28	33	152	152	10.06	grey till	no iron band; massive; slight-moderate effervescence;texture-no change
33	38	152	152	11.58	grey till	no change; upper 25cm slivered-red granite (~5cm)
38	43	121	121	12.79	grey till	
			31	13.11	no core	
43	48	152	152	14.63	grey till	
48	53	152	13	14.76	grey till	
			31	15.07	silty clay	massive;some till 'pockets'near base; gradational change from till to silty clay; slight effervescence

PROJECT: MDA N Alta	DATA NO: LEL-BH-15	LOGGED BY: L Leslie	DATE: 17 Aug 94	page 2 of 3
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LOCATION: Smithmill	SURFACE EL: 2130'	LSD: 13 SEC: 21 TP: 86 R: 24 MER: W of 5
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DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			108	16.15	grey till	moderate effervescence to slight effervescence in lower 15cm
53	58	152	152	17.68	grey till	moderate-slight effervescence;rusty sandstone, very weathered, ~1cm diameter,~10cm from top
58	63	152	60	18.28	grey till	gradational basal contact over ~5cm, i.e. silty clay & till intermixed
			92	19.20	silty clay	crude stratification with very fine sand interlaminated;no to slight effervescence
63	68	152	152	20.73	silty clay	
68	73	152	152	22.25	silty clay	very fine sand beds(light grey)more fequent & thicker-high effervescence;lower half is massive
73	78	152	152	23.77	silty clay	fine sand interbeds-@6cm (~1cm thick,high effervescence) & 61cm(~5cm thick, slight effervescence)
78	83	152	72	24.49	silty clay	massive;no sand beds
			48	24.97	fine sand	wet;black, sulfur odour from beds(5mm thick) ~5cm from base; slight effervescence
			32	25.30	stratified fine sand	black & greyish laminae,horizontal, slightly wavy,high sulfur odour; slight effervescence
83	88	121	121	26.51	stratified fine sand	
			31	26.82	no core	
88	93	117	21	27.03	medium sand	massive?,reds, blacks,, beiges, quartz
			96	27.99	stratified fine sand	
			35	28.35	no core	
93	98	152	89	29.23	medium sand	small shell fragments(1-2mm);massive
			10	29.33	silty clay	with fine sand & silt laminae(~2cm thick beds near base);organic band (~2cm thick) near center
			53	29.87	stratified fine sand	with silt & silty clay(in upper 12cm);much the same as above;
98	103	78	78	30.65	stratified fine sand	some shell fragments;ironstone granules form a discontinuous bed;a few other granules
			74	31.39	no core	
103	108	152	152	32.92	silty clay	with fine sand interbeds & interlaminated-some more effervescence than others;dark grey specks & beds of organics;a few granules-coal, pink feldspar, ironstone
108	113	144	27	33.19	grey till	well rounded,quartzite pebble (~4cm);loosely consolidated

PROJECT: MDA N Alta	DATA NO: LEL-BH-15	LOGGED BY: L Leslie	DATE: 17 Aug 94	page 3 of 3
LOCATION: Smithmill	SURFACE EL: 2130'	LSD: 13 SEC: 21 TP: 86 R: 24 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
			117	34.36	fluvial sediments	interbedded medium sand (~2cm), fine sand (~3cm), silt, silty clay; interlaminated of broken ironstone (~20cm apart)
			8	34.44	no core	
113	118	97	97	35.41	fluvial sediments	sequence continues from above; beds are thinner; medium sand (~1.5cm); fine sand (<5mm); silt & silty clay (~5mm)
			56	35.97	no core	
118	123	67	67	36.64	fluvial sediments	mostly medium sand, minor ironstone concretion beds
			85	37.49	no core	ended hole-sand getting caught between sample tube & inside of auger, organic beds (~4-5cm apart); two silt & silty clay beds ~50cm apart

PROJECT: MDA N Alta	DATA NO: LEL-BH-16	LOGGED BY: L Leslie	DATE: 18 Aug 94	page 1 of 2
DRILLER: Ken Pearson Canadian Geological	TYPE DRILL: Hollow stem auger with 5' split sampler	DRILL METHOD: Core	SURFACE ELEVATION: 1725' NTS MAP: 84C/6	
BOREHOLE NAME: Three Creeks		LSD: 16 SEC: 16 TP: 85 R: 20 MER: W of 5		
U.T.M. ZONE: 11V/MN	EASTING: 494730 m	NORTHING: 6247800 m	BOTTOMED IN: gravel	
DESCRIPTION OF LOCATION: Rolling to hummocky glaciolacustrine plain				

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	CORE DESCRIPTION
from	to					
0	3	0	0	.91	no core	pushed through gravel pad
3	8	98	28	1.19	gravel	still part of pad
			70	1.89	silty clay	with clayey silt @ 16-18cm, 21-22cm, & 40-41cm; clayey silt beds moderate-high effervescence; calcite nodules ~6cm from base
			55	2.44	no core	
8	13	122	122	3.66	silty clay	2.5Y3/1 very dark grey; slight effervescence; gypsum medium-grained crystals scattered in lower half; two clayey silt beds in upper 20 cm-high effervescence;
			30	3.96	no core	
13	18	106	105	5.01	silty clay	coarse grain gypsum forming bands (~3cm thick & 20 cm apart) near lower half; smudged coal fragments; one silt laminae ~58cm from base
			48	5.49	no core	
18	23	156	118	6.67	silty clay	with clayey silt interbeds (high effervescence) @ 72-89cm & 96-102cm; gypsum (medium-coarse) crystals throughout; few dark bands, some granules-very weathered rusty pebbles & quartz
			34	7.01	clayey silt	with silty clay interbeds; one clayey silt bed-3-5cm thick-high effervescence
23	28	107	107	8.08	fine sand	with silt & few silty clay & clayey silt interbeds in upper ~15cm; below are horizontally, finely laminated-bedded (range between ~5cm to <5mm thick); dark organic laminae present near base; all high effervescence
			45	8.53	no core	
28	33	69	69	9.22	fine-medium sand	thin horizontal laminae with dark organic & oxidized laminae throughout
			83	10.06	no core	
33	36	91	44	10.50	fine-medium sand	appears massive

PROJECT: MDA N Alta	DATA NO: LEL-BH-16	LOGGED BY: L Leslie	DATE: 18 Aug 94	page 2 of 2
LOCATION: Three Creeks	SURFACE EL: 1725'	LSD: 16 SEC: 16 TP: 85 R: 20 MER: W of 5		

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOG Y	CORE DESCRIPTION
from	to					
			47	10.97	grey till	upper ~10cm more of a silty clay with gradual change to till over next 23 cm; lower 26 cm is true till with ~1% clasts >4mm; ~15% granules, lithology-granite, vein quartz, siltstone, sandstone & shale
36	43	0	213	13.11	no core	pushed through with plug
43	48	117	117	14.28	grey till	5Y2.5/1-black; upper 53cm is slivered; fractured (10cm) red granite gneiss; moderate effervescence
			35	14.63	no core	
48	53	70	13	14.76	slough	clayey till?
			13	14.89	gravelly sand	granules & tiny pebble coarse fraction with medium sand matrix; moderate effervescence
			44	15.33	coarse sand	pinkish(K-feldspar) & white, translucent (quartz); moderate effervescence; black bands ~1cm & ~2-3cm apart near base of core
			82	16.15	no core	
53	58	152	83	16.98	grey till	moderate effervescence
			8	17.06	sand	dirty, medium-fine sand; moderate effervescence
			51	17.57	grey till	slightly less stony with larger sizes; moderate effervescence
			10	17.68	silty clay	massive; high clay content; no effervescence
58	63	152	22	17.90	silty clay	with gravel interbeds @13-14cm & 19-21cm; dark & light grey bands
			25	18.15	very fine sand	black bands ~2cm thick present
			105	19.20	grey till	gradational from silty clay to transitional (~20-25 cm thick) to true till
63	68	152	152	20.73	grey till	no change; moderate effervescence; very poorly defined clayey horizons
68	73	152	141	22.11	grey till	no clayey horizons
			15	22.25	very fine sand/clayey silt	lower 6cm has organic bands & very fine sand beds are 5-10mm thick, high effervescence with massive upper 9cm;
73	76	104	27	22.52	silty clay	wet & very disaggregated; not certain of sand or silt content, or if stratified
			62	23.14	grey till	clayey bed ~3cm thick in center
			15	23.29	sandy gravel	moderate effervescence; very poorly sorted with rounded to angular clasts; mostly coarse to medium sand matrix with range of clasts from granule to medium pebble
			48	23.77	no core	
76	83	0	0	25.30	no core	pushed through to 78; no recovery from last run

APPENDIX C
PEBBLE LITHOLOGIES

Appendix C. Pebble Lithologies

Pebble Lithological Analysis for Gravel Units

	LEL-04		LEL-05		LEL-06		LEL-11		LEL-12		LEL-13		LEL-22		LEL-24		LEL-27		LEL-30		LEL-31		LEL-32		LEL-34	
	Section #69		Section #69		Section #69		Section #51		Section #51		Section #3		Section #47		Section # 91		Section #18		Section #31		Section #35		Section #55		Section #42	
	UNIT D		UNIT B		UNIT E		UNIT A		UNIT B		UNIT A		UNIT C		UNIT A		UNIT A		UNIT A		UNIT A		UNIT A		UNIT B	
Rock type	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%
felsic volcanic	nil	nil	nil	nil	nil	nil	6	7	9	14	6	5	nil	nil	5	9	13	11	nil	nil	nil	nil	nil	nil	nil	nil
f.g. mafic	7	6	18	17	8	10	14	16	8	13	22	18	nil	nil	6	11	18	15	6	6	9	9	8	10	7	12
metamorphic	1	1	nil	nil	7	8	1	1	nil	nil	nil	nil	1	1	nil	nil	nil	nil	1	1	nil	nil	nil	nil	nil	nil
granite	15	14	6	5	8	10	12	14	3	5	10	8	4	6	10	19	nil	nil	17	18	5	5	3	4	14	24
quartzite	8	7	10	9	7	8	8	9	4	6	15	12	13	19	nil	nil	22	18	14	15	11	11	12	16	3	5
vein quartz	nil	nil	nil	nil	nil	nil	1	1	nil	nil	nil	nil	nil	nil	nil	nil	6	5	nil	nil	nil	nil	nil	nil	nil	nil
chert	nil	nil	nil	nil	nil	nil	1	1	nil	nil	4	3	3	4	nil	nil	nil	nil	14	15	11	11	9	12	2	3
carbonate	3	2	nil	nil	3	4	nil	nil	nil	nil	nil	nil	11	16	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	9	15
sandstone	69	66	70	66	39	48	44	50	29	47	63	51	31	45	26	50	62	51	41	44	62	63	44	58	18	30
mudstone	2	1	nil	nil	nil	nil	1	1	nil	nil	3	2	5	7	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	2	3
shale	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
ironstone	nil	nil	1	1	7	8	nil	nil	9	14	nil	nil	nil	nil	5	10	nil	nil	nil	nil	nil	nil	nil	nil	4	7
conglomerate	nil	nil	nil	nil	1	1	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
coal	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
	total=105		total=105		total=80		total=88		total=62		total=123		total=68		total=52		total=121		total=93		total=98		total=76		total=59	

Pebble Lithological Analysis for Till Units

	LEL-01		LEL-02		LEL-08		LEL-14		LEL-17		LEL-18		LEL-20		LEL-21		LEL-29		LEL-35	
	Section #68		Section #73		Section #69		Section #70		Section #50		Section #79		Section #47		Section #47		Section # 18		Section #42	
	UNIT A		UNIT A		UNIT G		UNIT A		UNIT C		UNIT A		UNIT A		UNIT B		UNIT B		UNIT A	
Rock type	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%	amount	%
felsic volcanic	nil	nil	nil	nil	nil	nil	5	4	nil	nil	nil	nil	nil	nil	nil	nil	3	3	2	3
f.g. mafic	15	11	5	10	8	9	24	19	24	27	3	4	4	5	6	9	9	10	3	4
metamorphic	1	nil	nil	nil	4	5	3	2	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
granite	17	12	2	4	18	21	27	21	14	16	20	30	5	6	5	8	5	5	12	15
quartzite	7	1	9	18	nil	nil	4	3	nil	nil	nil	nil	1	1	12	19	22	24	8	10
vein quartz	2	nil	nil	nil	1	1	1	1	nil	nil	1	1	nil	nil	nil	nil	nil	nil	nil	nil
chert	3	nil	4	8	3	3	nil	nil	nil	nil	2	3	nil	nil	nil	nil	3	3	4	5
carbonate	37	26	2	4	22	32	22	17	21	23	11	16	13	17	2	3	4	4	11	14
sandstone	33	23	27	53	15	25	31	25	26	29	16	24	34	44	27	43	42	46	34	43
mudstone	7	1	2	4	10	12	3	2	1	1	nil	nil	11	14	11	17	nil	nil	2	3
shale	4	nil	nil	nil	1	1	6	5	nil	nil	3	4	nil	nil	nil	nil	nil	nil	1	1
ironstone	14	1	nil	nil	4	5	nil	nil	nil	nil	11	16	nil	nil	nil	nil	2	2	2	3
conglomerate	nil	nil	nil	nil	nil	nil	nil	nil	4	4	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
coal	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	9	12	nil	nil	1	1	nil	nil
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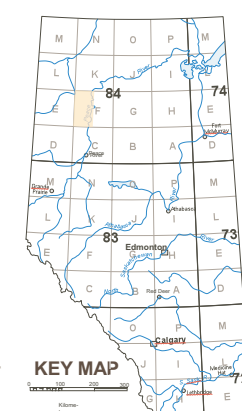
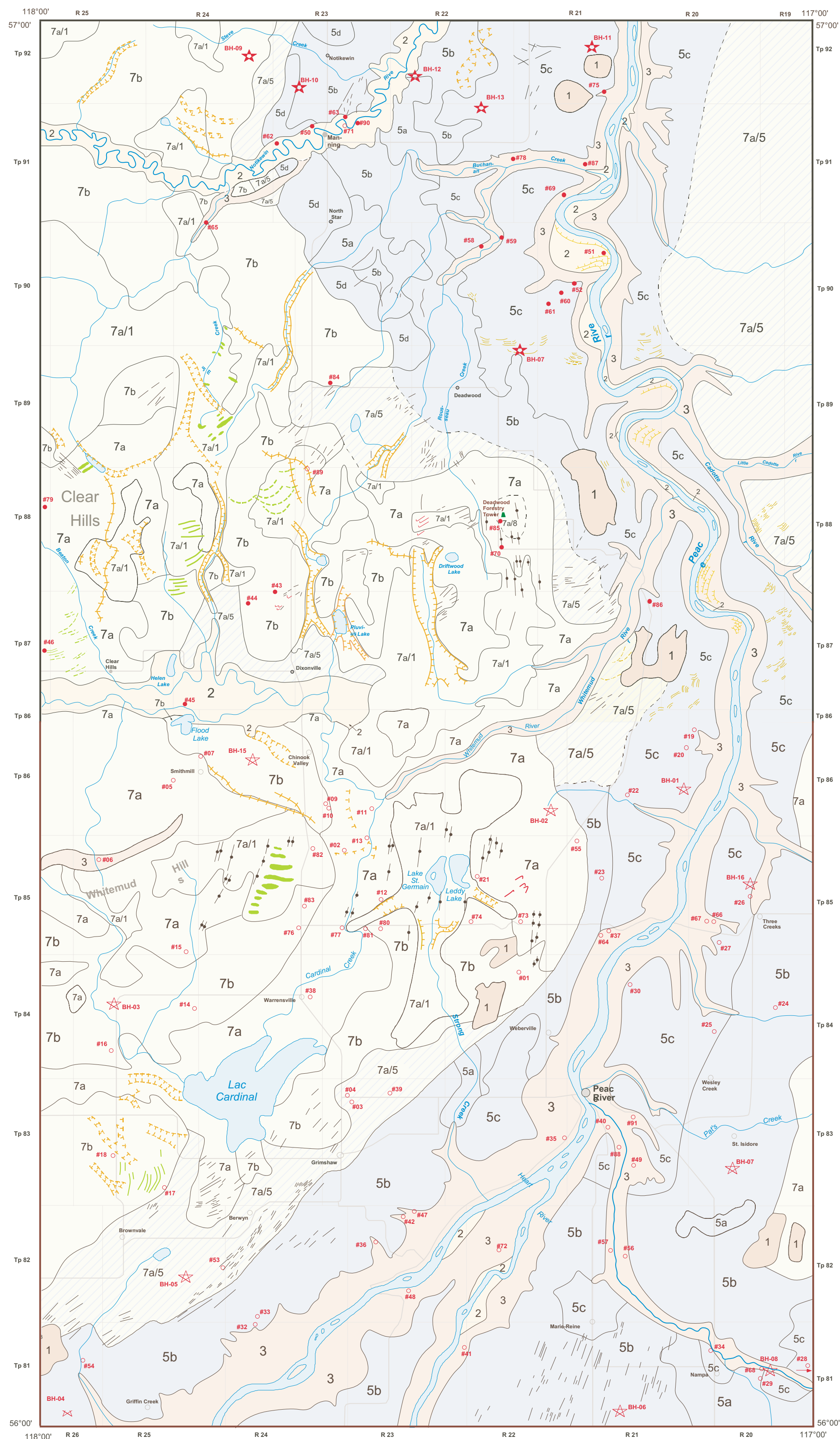
APPENDIX D

DATA FROM HYDROMETER GRAIN SIZE ANALYSES



Appendix D. Data from hydrometer grain size analyses

Sample Number	Sample Location	Sample Depth (metres)	medium to coarse sand (%)	fine sand (%)	silt (%)	clay (%)
LEL-01	Section #68	2.0	13.0	14.0	31.0	42.0
LEL-02	Section #73	3.0	14.0	17.0	41.0	28.0
LEL-08	Section #69	12.0	13.0	14.0	34.0	39.0
LEL-14	Section #70	2.0	10.0	17.0	30.0	43.0
LEL-17	Section #50	7.5	9.0	14.0	35.0	42.0
LEL-18	Section #79	3.0	6.0	10.0	38.0	46.0
LEL-20	Section #47 Unit A	40.0	12.0	17.0	29.0	42.0
LEL-21	Section #47 Unit B	25.0	10.0	15.0	34.0	41.0
LEL-29	Section #54	4.0	16.0	16.0	38.0	30.0
LEL-35	Section #42	17.0	16.0	16.0	31.0	37.0
LEL-301	Borehole 08	40.0	10.0	13.0	31.0	46.0
LEL-302	Borehole 08	6.5	13.0	12.0	30.0	45.0
LEL-303	Borehole 09	41.0	8.0	8.0	36.0	48.0
LEL-304	Borehole 09	4.0	11.0	13.0	31.0	45.0
LEL-307	Borehole 16	21.0	9.0	12.0	40.0	39.0
LEL-309	Borehole 16	10.0	3.0	40.0	40.0	17.0
LEL-310	Borehole 10	41.5	14.0	16.0	29.0	41.0
LEL-315	Borehole 10	9.0	15.0	14.0	31.0	40.0
LEL-319	Borehole 11	33.5	8.0	18.0	37.0	37.0
LEL-320	Borehole 14	31.5	15.0	17.0	32.0	36.0

SURFICIAL GEOLOGY OF PEACE RIVER AREA ALBERTA (NTS 84CW)



MAP SYMBOLS

roads.....	
map units: defined; approximate.....	
towns.....	
section sites.....	
borehole sites.....	
flutes, grooves & lineations.....	
meltwater channel: wide defined; approximate & narrow.....	
morainic ridge: defined, approximate; narrow & wide.....	
terraces.....	
relic sand dunes.....	
slump scars.....	

MAP LEGEND

RECENT DEPOSITS

- 1 ORGANIC**
composed of organic muck, peat and marls; present in shallow basins and poorly drained areas; and of variable extent, distributed throughout the map area
- 2 ALLUVIAL**
composed of stratified deposits of clay, silt, sand, and gravel; present as channel fill, bars, floodplains, and terraces along the Notikewim, Whitemud, and Peace Rivers
- 3 COLLUVIAL**
composed of a variety of material including, clay, silt, sand, gravel, till, and bedrock; forming the slopes of the major creeks and rivers in the map area

GLACIAL DEPOSITS

- 5** **GLACIOLACUSTRINE**
 composed of laminated to massive deposits of clay, silt, and minor sand with the occasional dropstones; distributed along the broad plains adjacent to the Notikewin and Peace Rivers

 - a) subdued; flat to fluted and grooved; generally less than 2 metre relief
 - b) variable; flat to hummocky; generally 2 to 4 metre relief
 - c) hummocky; generally 3 to 4 metre relief and occasionally up to 5 metres
 - d) hummocky and kettled; generally 3 to 4 metre relief and occasionally up to 5 metres

7 **MORAINIC**
 composed of massive to stratified, silty clay till; distributed throughout the map area

 - a) mixed; contains ridges, hummocks, kettles, and plains; generally less than 3 metre relief and occasionally up to 5 metres
 - b) hummocky and kettled; irregularly shaped features; generally less than 5 metre relief and occasionally up to 8 metres

BEDROCK

- 8** composed predominantly shale, siltstone, and sandstone of Cretaceous age; dependent upon location within the map area

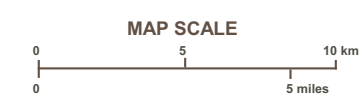


Figure 2.1. Surficial geology map Peace River area (NTS 84C west half).