QUATERNARY STRATIGRAPHY AND SURFICIAL GEOLOGY PEACE RIVER-WINAGAMI REGION YEAR ONE REPORT FOR THE END FISCAL YEAR 1993-94

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Prepared by
S.A. Balzer[1], L.E. Leslie[1] and M.M. Fenton[2]

Alberta Geological Survey Department
Alberta Research Council
P.O. Box 8330
Edmonton, Alberta
T6H 5X2

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(1) Geology Department, University of Alberta, (2) Alberta Geological Survey

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SUMMARY

A reconnaissance survey of the southern half of the Peace River map area (84C/w 1/2) revealed the presence of predominantly two types of surficial glacial deposit they are: morainal and glaciolacustrine. Surficial morainal deposits that are thicker than 4 m are present in generally low lying areas and some are believed to overly deeply buried preglacial valleys. Indicator minerals were picked from thick (>10 m) till units intersected in two separate drill holes (BH-01 and -04). Surficial glaciolacustrine deposits, generally confined to the area south and east of the Peace River, range from 4 to 10 m thick and can be as much as 30 m thick locally. Synthesis of the Quaternary stratigraphy and glacial history is ongoing. Stratigraphic and geomorphic evidence collected to date, suggests that a single glacial advance has affected the area. A second field season in 1994 is planned .

The Quaternary geology and stratigraphy of the Winagami region (NTS 83 N/w1/2) is consistent with at least one major ice advance. Distribution of the surface units and ice directional land forms indicate a strong southwest ice movement direction. Most of the surficial deposits are associated with ice stagnation and deglaciation. Ice-contact stagnation, glaciolacustrine and aeolian deposits are areally extensive and can exceed 20 m in thickness. Stratigraphic correlation of the upper Quaternary units between boreholes and large sections increases in complexity towards the north of the map area. The lowermost glacial unit in all cores is a dark grey massive till. Preliminary lithologic identification of the clasts in this till indicate a Canadian Shield origin. The thickness of Quaternary deposits varies, ranging from a few metres near Reno to well over 30 m in the southeast of the map area. Bedrock topography is irregular due to the presence of several large paleochannels.

1. INTRODUCTION

This project is one of two designed to provide information on: a) the Quaternary geology and stratigraphy, and b) the mineralogy and geochemistry of portions of northern Alberta.

The investigation of both map areas is being done as part of a Ph.D. thesis at the University of Alberta. Principal researcher for the Winagami area is S. Balzer and for the Peace River area is L. Leslie. This report presents the results of the first year of investigation and consists of two free standing chapters one for the Peace River sheet and the second for the Winagami sheet.

1.1 OBJECTIVE

Overall: To provide the reconnaissance level information on the Quaternary Geology (stratigraphy and surficial geology) needed to both encourage and focus ongoing, long-term mineral exploration in Alberta.

Specifically:

1) To initiate and complete the reconnaissance scale study (1:250,000 scale) of the Quaternary geology in portions of two map sheets (Peace River , NTS 84 C West half and Winagami 83N West Half; Figure 1.1).

2) To provide information on the distribution and composition of the surficial sediments and Quaternary stratigraphy, and on the Quaternary geological history of the map areas with particular emphasis on the glacial flow directions and implications for dispersal of indicator minerals and elements. Also information on the thickness and composition of the unconsolidated Quaternary and late Tertiary sediments overlying bedrock (ie the drift thickness and bedrock topography).

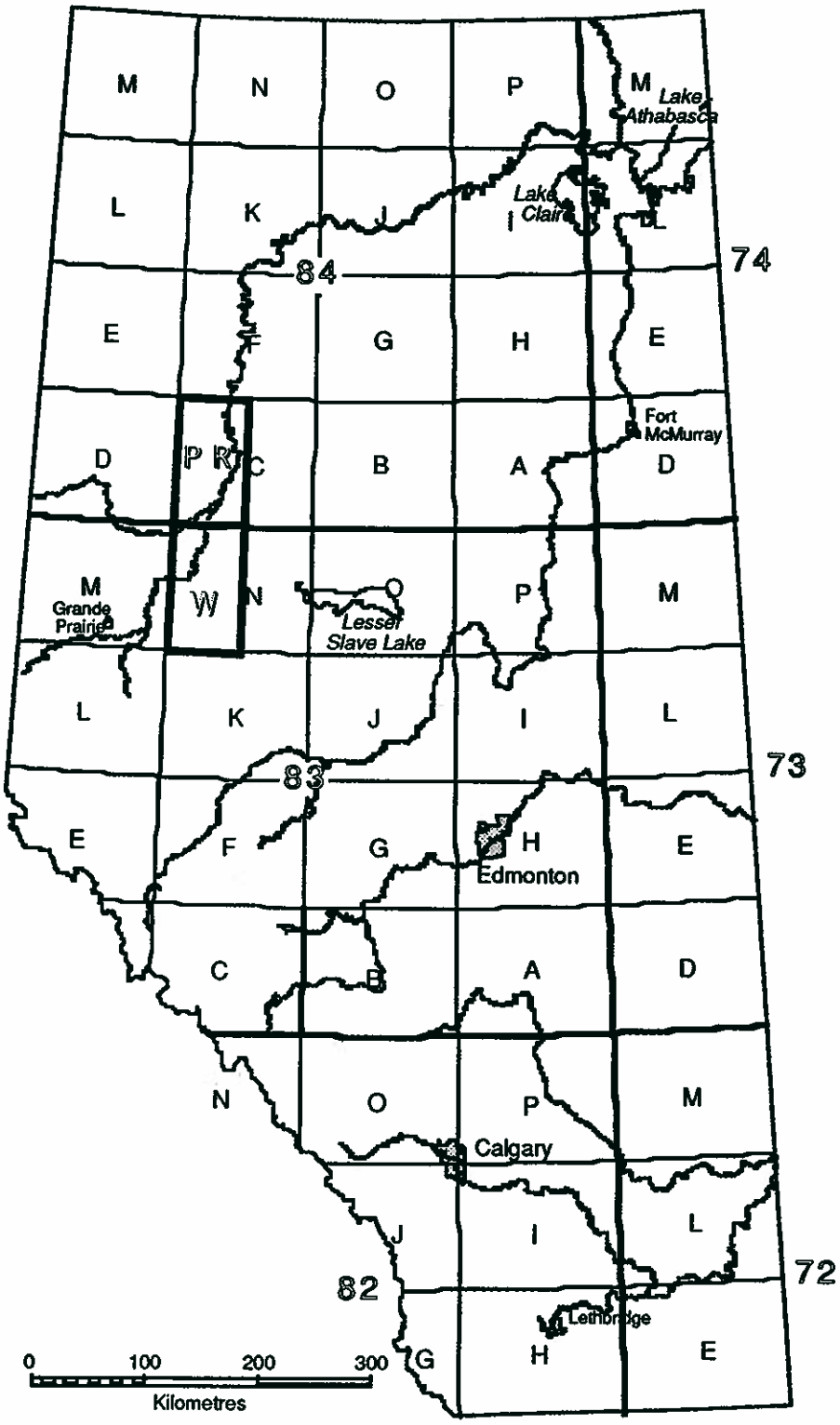


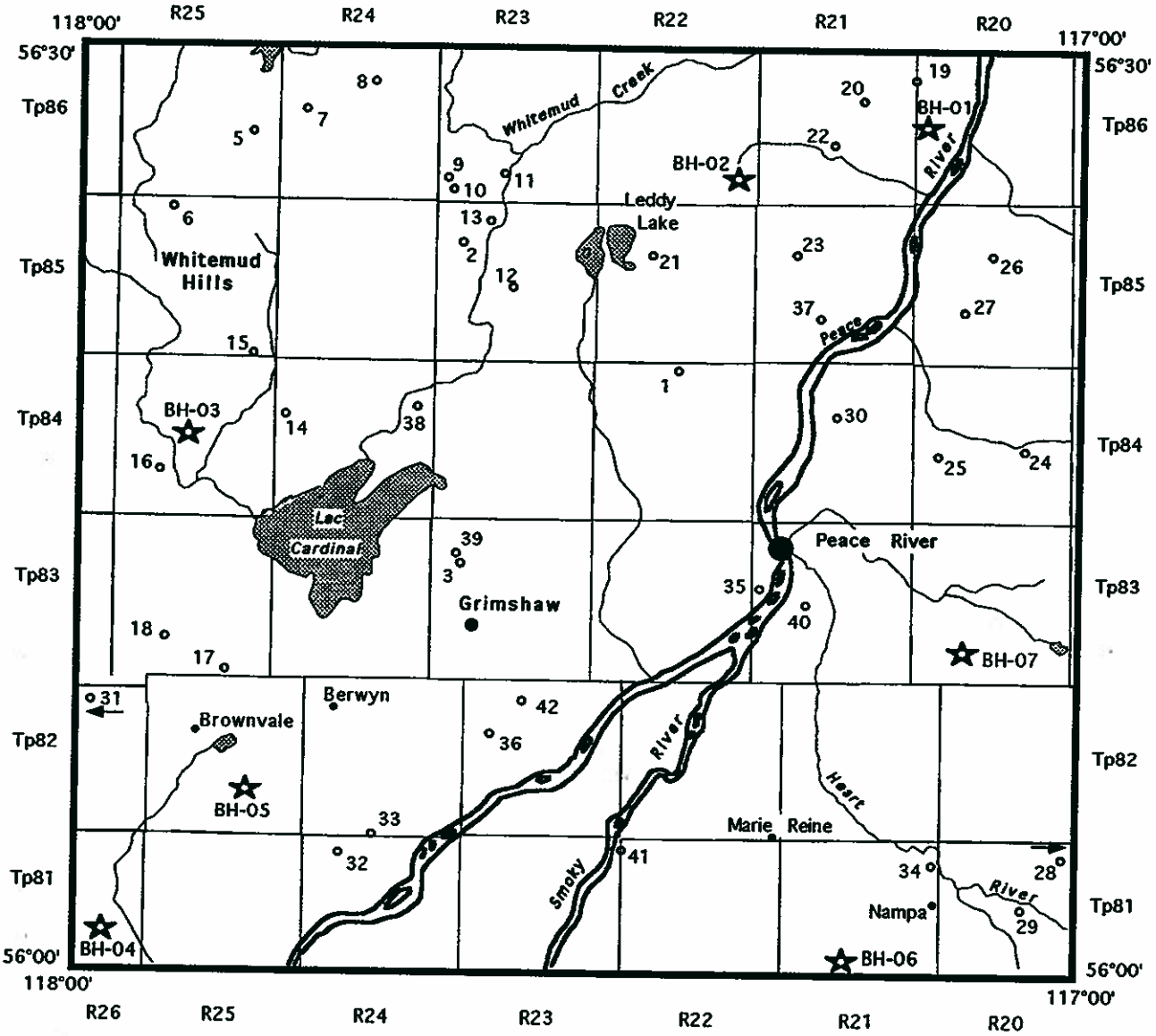
Figure 1.1. Location map; P R = Peace River map area and W= Winagami map area.

1.2 SELECTION OF MAP AREAS

The study areas are 83N W1/2 Winagami; 84C W1/2 Peace River. These were chosen from portions of National Topographic System maps 83M Grand Prairie; 83N Winnagami; 84C Peace River; 84K, Mount Watt; and 84J Vermilion Chutes. The choice was based on the authors knowledge combined with dialogue with members of the Alberta Mineral Exploration Industry working in northern Alberta during the Calgary Mining Forum and the Canadian Institute of Mining and Metallurgy meeting Calgary May 1993 and the Geological Association of Canada meeting Edmonton, May 1993.

The reasons for choosing these areas are:

1) They lie within areas of active exploration for kimberlites, lamporites, and related diamonds. Also, requests have been received, from exploration companies for information on the surficial geology, Quaternary Stratigraphy and glacial history of these map areas.
2) These map sheets have the best developed road system in northern Alberta thus helping reduce field costs (road travel is considerably less expensive than utilizing helicopters).
3) The project leaders experience in preparing the drift thickness map of Alberta for the Geological Atlas of Western Canada (Fenton et al., 1994) has shown that the drift is relatively thin in many portions of these study areas making them a good target for drift prospecting.



PEACE RIVER 1993 MAP AREA SECTION LOCATIONS

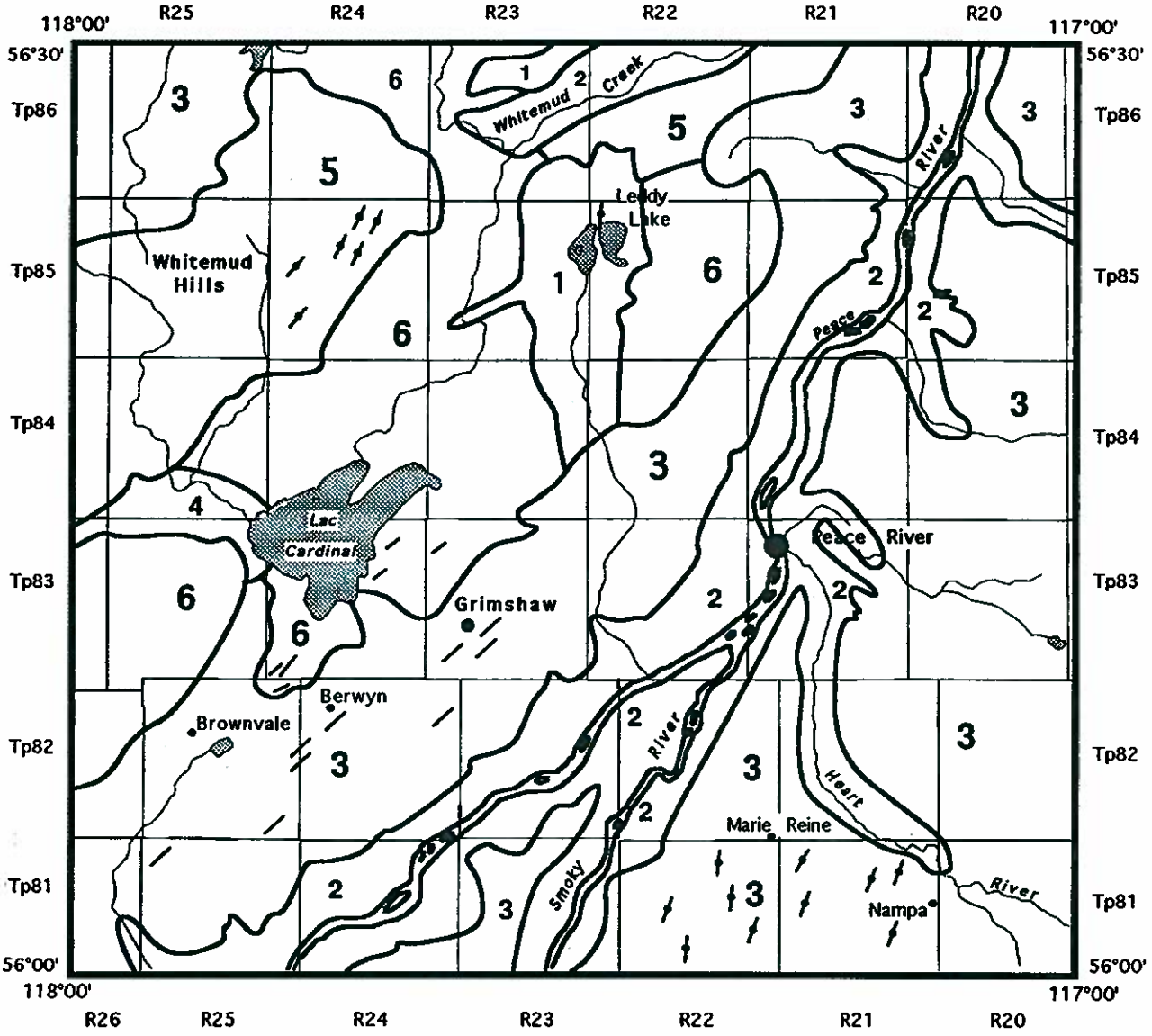
(84 C/SW Quarter)

Scale 0 3 6 miles

MAP SYMBOLS

- Section site
- Borehole site
- Town, village
- Indicates a section site approximately 1 mile from the map boundary

Figure 2.1 Sample and borehole locations within the Peace River 1993 map area.



PRELIMINARY SURFICIAL GEOLOGY OF PEACE RIVER 1993 MAP AREA

(84 C/SW Quarter)

Scale 0 3 6 miles

LEGEND

MAP UNITS

1 Organic Deposits
2 Colluvial Deposits
3 Glaciolacustrine Deposits
4 Glaciofluvial Deposits
5 Morainal Deposits
6 Undifferentiated Morainal Deposits

MAP SYMBOLS

Glacial flow indicator
Remnant beach deposit
Town, village
Map boundary

Figure 2.2 A preliminary surficial geology map of the Peace River 1993 map area.

2. PEACE RIVER AREA (84C w1/2) L.E. LESLIE

2.1 INTRODUCTION

This research project, funded under the Canada-Alberta Partnership Agreement on Mineral Development, was undertaken to determine the regional surficial geology, Quaternary stratigraphy and glacial history of the Peace River map area (NTS 84C/W). The first year of this two-year project has been completed, hence the material presented here may be modified as the research progresses.

Four weeks were spent during the summer of 1993 conducting a reconnaissance survey of surficial sediments and land forms within the southern half of the project area. This work included collecting samples primarily of till and gravel, and describing exposures in gravel pits, along roadsides, and along cut-banks of creeks and rivers in the area. Locations of forty-two stratigraphic sections and seven drill holes are shown in Figure 2.1 and their brief descriptions are given in Appendix A. Log data sheets are included in Appendix B of three of holes which intersected thick till deposits (BH-01, -03, and -04).

During the fall/winter of 1993-1994, laboratory and office studies included: (1) preparing samples for heavy mineral, geochemical, and granulometric analyses and (2) digitizing field notes and drill core logs. A preliminary surficial geology map of the southern half of the project area has been compiled and data collection from water well and geophysical logs is continuing.

2.2 PRELIMINARY SURFICIAL GEOLOGY MAP

The preliminary surficial geology map in Figure 2.2 is based on airphoto analysis and ground checking of areas accessible by road. This simplified version, prepared specifically for this report, identifies six major map units.

The non-glacial map units which are shown on the surficial map, include organic and colluvial deposits. The most extensive organic deposits (map unit 1) (map unit 3 in Balzer map this report)) are situated in the north-central part of the map area. They include areas of swamp or bog where the surface morphology is generally flat. The colluvial deposits (map unit 2) (map unit 1 in Balzer map this

report) are present along the valley walls of the rivers and creeks and are predominantly the result of rotational slumping. Slumping is currently active in some areas along the Peace River. Alluvial sediments, generally consisting of fan and flood plain deposits, are not shown on the map (Figure 2.2). Three glacial map units are recognized in the map area: glaciolacustrine, glaciofluvial, and morainal deposits. Glaciolacustrine deposits (map unit 3) (map units 7 and 8 in Balzer map this report) are situated in the southeastern portion and the northwestern corner of the map area. These sediments were deposited in and adjacent to ice-contact lakes. The sediment generally consists of stratified sand, silt, and clay with scattered drop stones in some of the silt and clay units. Beach deposits of gravel and sand, which exist in the area south of Lac Cardinal, are also included in map unit 3. The local morphological expression of the map unit 3 lake sediments can be flat, rolling, ridged, hummocky, or any combination of these. Coarser sediments generally form the hummocks and ridges.

Map unit 4 (map unit 5 in Balzer map this report)consists of glaciofluvial deposits based on airphoto interpretation and the presence of meltwater channel features. However, no exposed sections were observed in this map unit to verify the nature of the deposits.

Morainal deposits (map units 5 and 6) (map units 6 and 9 in Balzer map this report) are situated in the northwestern part of the map area. Map unit 5 represents till that consists of both non-stratified and stratified deposits which generally are thicker than 2 m. More work is required to be able to distinguish between the non-stratified sediments that were deposited directly by glacier ice, and the stratified sediments, or flow tills, that were deposited indirectly by glacier ice. Within map unit 5, there may also be some areas where till is less than 2 m thick, particularly in the Whitemud Hills. Undifferentiated till deposits (map unit 6) represent discontinuous till sediments that overly glaciofluvial sand and gravel deposits. The till is massive, brown in colour and generally less than 2 m thick. More work is needed to determine the origin of the underlying glaciofluvial sediments since some deposits may, in fact, be non-glacial. The local morphological expression of morainal deposits (map units 5 and 6) include rolling, hummocky, kettled and combinations of these.

2.3 PRELIMINARY QUATERNARY STRATIGRAPHY

The synthesis of the Quaternary stratigraphy will include preparation of bedrock topography and 'drift' thickness maps. For this report, 'drift' will refer to all sediments that overly bedrock and, therefore, may include both glacial and non-glacial deposits.

The presence of buried channels is a major factor that contributes to the complexity of the stratigraphy in the project area. As well, the lack of good exposures along the Peace River valley and in some other areas dissected by rivers also hinders stratigraphic development. One source of subsurface data is from water well logs. Unfortunately, these data can be ambiguous because of the inconsistencies of the terminology used by different drillers. As well, the bedrock contact is not always easily distinguishable from the 'drift' sediments. However, water well data will be useful where it can be confirmed with stratigraphic information from nearby sections and boreholes.

Seven drill holes were completed to assist in developing a preliminary stratigraphy. Eight till units have been recognized in three drill holes (BH-01, -03, -04 in Appendix B) which intersect a thick till sequence. The till units are: (1) massive brown till; (2) mottled brown till; (3) stratified brown till; (4) interbedded massive and stratified brown tills; (5) massive dark grey till; (6) interbedded massive brown and massive dark grey tills; (7) massive dark grey till with sand interbeds; and (8) sand with massive dark grey till interbeds (Figure 2.3).

Generally, the massive brown till and stratified brown till units contain predominantly smaller clasts, usually granules and tiny pebbles (<1 cm), compared with the massive dark grey till unit which has 2 to 3% more clasts greater than 1 cm and a greater proportion of coarse pebbles (5 to 6 cm). Local pebble lithologies include siltstone, sandstone, shale, and coal fragments. Further traveled pebble lithologies include vein quartz, quartzite, pink granites, mafic volcanics, and carbonates. These preliminary pebble lithology observations cannot be used as a viable method to distinguish the different till units. A comprehensive lithological analysis that will include the coarse sand to

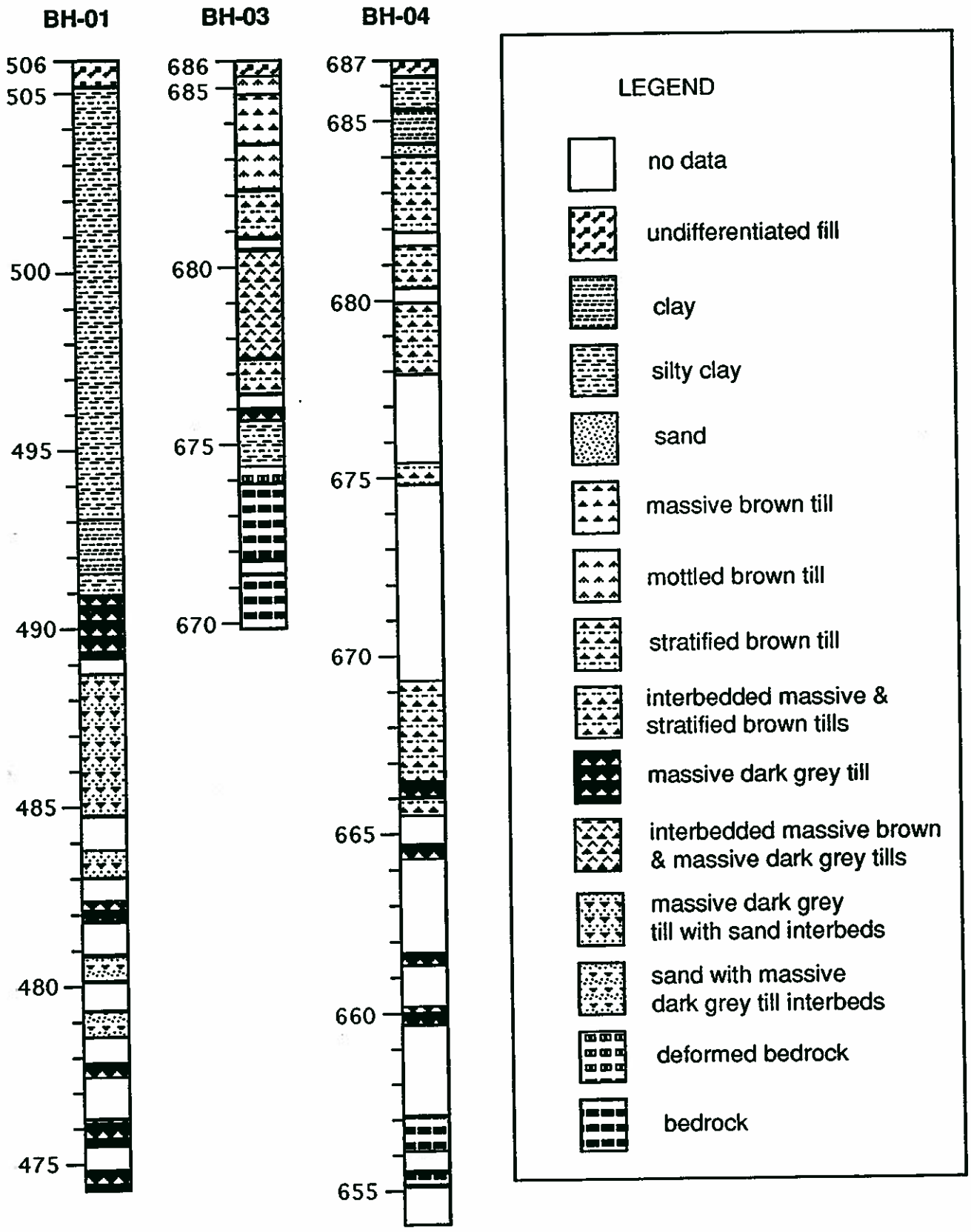


Figure 2.3 Stratigraphic columns from three 1993 boreholes. (Elevation in metres are shown on left side of columns)

coarse pebble clasts is expected to yield some distinguishable differences amongst the various till units.

The presence of a till unit consisting of interbedded massive brown and massive grey tills is noteworthy. It is commonly assumed that the brown colour of till is indicative of oxidation in comparison to the dark grey colour which is not oxidized. It is possible that ground water has preferentially oxidized the brown coloured tills and was unable to infiltrate and, therefore, oxidize the grey coloured tills. Variability of physical characteristics, such as colour, grain size and sorting, may have been the result of minor fluctuations of the ice front that allowed deposition both from the base of the glacier and via a different basal process (i.e., melt-out versus lodgment). The different colours may therefore be due to different depositional processes rather than post-depositional oxidation of the tills. The brown and grey tills probably do not represents separate ice advances.

A detailed granulometric analysis of clasts greater than 1 mm to include their percentages, size-fractions, and lithologies are planned. It is hoped that distinguishing characteristics can be developed from these analyses to determine if there are multiple tills or a single till. Till types must be identified in order to be able to use these units to correlate and identify ice flow directions.

To determine the potential for diamonds, bulk sub-samples of approximately 30 kilograms each were collected from two drill holes. The two samples that were selected include the dark grey massive till unit from 16.1 to 31.7 m in hole BH-01 and the stratified brown till unit from 5.3 to 19.1 m in hole BH-04. These were sent to the Saskatchewan Research Council for heavy mineral separation. Preliminary results picked one pyrope garnet from hole BH-01 and one chrome diopside from hole BH-04.

2.4 DISCUSSION

The surficial geology of the Peace River area gives evidence for two main depositional environments. Much of the area adjacent to and southeast of the Peace River appears to have been dominated by a glacial lake, most likely formed as the result of eastern flowing drainage dammed by glacier ice to the east. The subsequent drainage of the glacial lake occurred at some time during

deglaciation of the area. The accumulation of lake sediments and beach deposits are evidence for this glacial lake.

Adjacent to the glacial lake environment are areas predominantly influenced by glacial ice. The presence of morainal deposits and hummocky topography are evidence for glacial ice activity. Glacial grooves located south of Marie Reine, in the vicinity of Leddy Lake, and in the Whitemud Hills indicate one ice flow direction trending approximately northeast-southwest to north-south (Figure 2.2). At present, there is no geomorphological evidence for more than one ice flow direction.

To date, there has not been enough work completed on the stratigraphy and nature of the glacial deposits to rule out the possibility of more than one glacial advance. With limited supporting data, the variable till units can be explained by different depositional settings and post depositional events. There are several aspects of the project that have yet to be completed, hence some of the conclusions may subsequently require revision in whole or in part.

2.5 CONCLUSIONS

The work so far represents a small portion of the work to be completed. The field season in 1994 is expected to be extended to three entire months with the help of a field assistant. This will allow time to reach less accessible areas and complete work on the entire project area. As well, it is anticipated that the 1994 drilling program will be extended to include the northern half of the project.

3. WINAGAMI AREA (83N w1/2) S. A. BALZER

3.1 INTRODUCTION

The study area is in the western half of the 1:250,000 scale Winagami map area (National Topographic System 83N/w1/2). This project, funded under the Canada-Alberta Partnership Agreement on Mineral Development, has three objectives: 1) to map the regional surficial and Quaternary geology; 2) perform a reconnaissance of the area's Quaternary stratigraphy; and, 3) determine the history and direction(s) of glacial ice movement and their affect on geochemical and lithological dispersal patterns.

The purpose of this report is to provide a preliminary compilation and interpretation of the surficial geology and stratigraphy of the northern half of the study area.

3.2 METHODOLOGY

3.2.1 Field

The northwestern corner of the Winagami sheet was mapped and sampled during the 1993 field season; a total of 72 stratigraphic sections and seven cored boreholes were described (Table 3.1). Field work was restricted to reasonably accessible areas due to time and manpower constraints. Access in the region was accomplished by truck and foot traverse.

The location of the 72 stratigraphic sections which were described are shown on Figure 3.1. Sampling was restricted to the C-horizon and lower. Minimum sampling depth was 0.75 m from the surface. Seven hollow-stem auger cores (Figure 3.1) were drilled by Canadian Geological Drilling Limited. Maximum core depth was 45 metres, with a core diameter of 7.5 cm. A total of 135 samples were collected; 73 from the stratigraphic sections and 62 from two borehole cores.

Table 3.1 Section and Borehole Locations

SITE #	DATE	NTS	LSD	UTM N	UTM E	Elevation (ft.)
93-Section Sites						
93-SB-01	6/26/93	83 N/11	77-23-34-16	6175075	470675	1825
93-SB-02	6/26/93	83 N/12	77-23-32-10	6174450	466800	1850
93-SB-03	6/26/93	83 N/11	78-22-07-08	6177400	475550	1850
93-SB-04	6/26/93	83 N/14	78-23-34-16	6184875	470750	1825
93-SB-05	6/26/93	83 N/14	79-23-26-08	6192150	470450	1800
93-SB-06	6/28/93	83 N/14	77-22-35-13	6178350	480575	1875
93-SB-07	6/28/93	83 N/11	77-21-09-15	6168600	488025	1925
93-SB-08	6/28/93	83 N/11	77-21-16-03	6168650	487525	1925
93-SB-09	6/28/93	83 N/11	76-21-31-16	6165375	484950	1925
93-SB-10	6/28/93	83 N/11	76-22-12-14	6158825	482475	1825
93-SB-11A	7/6/93	83 N/11	76-22-27-12	6162975	478800	1850
93-SB-11B	8/5/93	83 N/11	76-22-27-12	6162970	478800	1850
93-SB-11C	8/5/93	83 N/11	76-22-27-12	6162960	478800	1845
93-SB-11D	8/5/93	83 N/11	76-22-27-12	6162950	478800	1840
93-SB-12	6/28/93	83 N/13	78-26-32-15	6185150	437800	1800
93-SB-13	6/28/93	83 N/13	78-26-35-13	6185100	441800	1850
93-SB-14	6/28/93	83 N/13	78-26-32-15	6180850	438250	1866
93-SB-15	6/28/93	83 N/13	78-26-15-01	6178725	441325	1850
93-SB-16	7/6/93	83 N/16	77-26-14-01	6169000	442950	1900
93-SB-17	7/6/93	83 N/12	77-26-25-04	6172225	443375	1875
93-SB-18	7/6/93	83 N/12	77-25-29-04	6172150	446400	1850
93-SB-19	7/7/93	83 N/12	77-24-31-14	6175225	455225	1850
93-SB-20	7/7/93	83 N/12	78-25-02-04	6175375	451250	1875
93-SB-21	7/7/93	83 N/13	78-25-17-16	6180000	447975	1850
93-SB-22	7/7/93	83 N/13	78-24-30-02	6181800	455650	1850
93-SB-23	7/7/93	83 N/13	78-24-33-13	6184550	457850	1850
93-SB-24	7/7/93	83 N/13	79-25-01-01	6185075	452175	1850
93-SB-25	7/7/93	83 N/13	80-25-18-08	6198625	444250	1300
93-SB-26	7/7/93	83 N/13	80-25-18-01	6198375	444375	1450
93-SB-27	7/7/93	83 N/13	80-25-05-05	6195450	444450	1850
93-SB-28	7/8/93	83 N/13	79-25-29-02	6191650	445400	1800
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93-SB-30	7/8/93	83 N/13	80-25-12-15	6197950	451950	1850
93-SB-31	7/8/93	83 N/13	80-24-19-08	6200250	454225	1850
93-SB-32	7/8/93	83 N/13	80-24-28-01	6201250	457400	1875
93-SB-33	7/12/93	83 N/13	79-24-15-01	6188325	458700	1850
93-SB-34	7/12/93	83 N/13	79-24-01-09	6185825	462225	1825
93-SB-35	7/12/93	83 N/13	79-24-13-16	6189525	462250	1850
93-SB-36	7/12/93	83 N/13	80-23-20-15	6201050	465175	1875
93-SB-37	7/12/93	83 N/13	79-23-22-10	6190800	468425	1525
93-SB-38	7/12/93	83 N/13	79-23-28-02	6191450	466625	1800
93-SB-39	7/13/93	83 N/5	75-26-03-05	6146800	439500	2100
93-SB-40	7/13/93	83 N/5	75-26-08-15	6149575	437300	2025
93-SB-41	7/13/93	83 N/12	75-26-23-08	6151600	442775	2025
93-SB-42	7/13/93	83 N/5	75-25-18-04	6149850	444475	2075
93-SB-43	7/13/93	83 N/5	74-25-34-14	6146175	451775	2150
93-SB-44	7/14/93	83 N/5	74-25-35-15	6146075	454025	2150
93-SB-45	7/14/93	83 N/12	75-23-29-12	6153400	465700	1875

Table 3.1 Section and Borehole Locations

SITE #	DATE	NTS	LSD	UTM N	UTM E	Elevation (ft.)
93-SB-46	7/18/93	83 N/11	77-20-16-09	6169700	498275	2012
93-SB-47	7/18/93	83 N/11	76-20-30-04	6162150	493575	2037
93-SB-48	7/18/93	83 N/11	76-21-01-08	6156400	493375	1962
93-SB-49	7/18/93	83 N/11	76-20-04-01	6155675	498075	3012
93-SB-50	7/18/93	83 N/11	75-20-29-01	6152425	496350	2000
93-SB-51	7/18/93	83 N/11	75-20-19-13	6152300	493700	1925
93-SB-52	7/19/93	83 N/11	75-21-27-12	6153225	488550	1850
93-SB-53	7/19/93	83 N/11	75-22-36-08	6154550	483300	1700
93-SB-54	7/19/93	83 N/11	77-22-05-02	6165450	476550	1837
93-SB-55	7/20/93	83 N/14	78-20-20-18	6180725	493550	2000
93-SB-56	7/20/93	83 N/14	80-20-04-03	6194550	495650	2030
93-SB-57	7/20/93	83 N/14	79-21-27-04	6191400	486925	1975
93-SB-58	7/20/93	83 N/14	79-21-02-01	6184825	489650	1975
93-SB-59	7/20/93	83 N/14	80-23-13-01	6197900	471800	1875
93-SB-60	7/24/93	83 N/11	75-23-15-16	6150725	470475	1887
93-SB-61	7/24/93	83 N/11	75-23-23-13	6152350	470600	1875
93-SB-62	7/24/93	83 N/11	75-22-23-14	6152350	481100	1800
93-SB-63	7/24/93	83 N/11	75-22-27-01	6152475	480350	1850
93-SB-64	7/24/93	83 N/11	75-22-27-13	6153750	478725	1850
93-SB-65A	7/24/93	83 N/11	76-23-01-02	6155650	473150	1850
93-SB-65B	8/4/93	83 N/11	76-23-01-02	6155730	473150	1835
93-SB-65C	8/4/93	83 N/11	76-23-01-03	6155700	473020	1750
93-SB-65D	8/4/93	83 N/11	75-23-36-14	6155600	472960	1700
93-SB-65E1	8/4/93	83 N/11	76-23-01-03	6165000	472850	1675
93-SB-65E2	8/4/93	83 N/11	76-23-01-03	6156000	472850	1650
93-SB-66	7/24/93	83 N/11	77-23-27-04	6172375	469100	1850
93-SB-67A	7/25/93	83 N/12	77-24-34-11	6174500	460075	1250
93-SB-67B	7/25/93	83 N/12	77-24-34-11	6174500	460075	1275
93-SB-67C	7/25/93	83 N/12	77-24-34-11	6174500	460075	1285
93-SB-67D	7/25/93	83 N/12	77-24-34-11	6174500	460075	1290
93-SB-67E	7/26/93	83 N/12	77-24-34-11	6174500	460075	1250
93-SB-67F	7/26/93	83 N/12	77-24-34-11	6174500	460075	1300
93-SB-67G	7/26/93	83 N/12	77-24-34-11	6174500	460075	1300
93-SB-67H	7/26/93	83 N/12	77-24-34-11	6174500	460075	1335
93-SB-68	7/27/93	83 N/12	77-24-34-10	6174475	460075	1450
93-SB-69A	7/27/93	83 N/12	77-24-21-06	6170900	458275	1387
93-SB-69B	7/27/93	83 N/12	77-24-21-07	6171050	458575	1375
93-SB-70	7/27/93	83 N/12	77-24-34-16	6175125	460650	1300
93-SB-71	8/5/93	83 N/11	76-22-20-13	6161775	475600	1400
93-SB-72	8/5/93	83 N/11	76-22-19-16	6161950	475475	1425
93-Drill Sites						
93-SAB-03	19-20/08/93	83N/14	80-20-28-03	6201025	495560	1975
93-SAB-04	8/19/93	83N/14	80-23-35-16	6204200	470600	1850
93-SAB-06	24-25/08/93	83N/11	76-22-27-12	6255700	473275	1850
93-SAB-07	25-26/08/93	83N/11	75-23-36-15	6163025	478775	1800
93-SAB-10	26-27/08/93	83N/11	77-23-12-13	6168600	472350	1825
93-SAB-013	8/28/93	83N/13	80-25-05-04	6295025	444500	1825
93-SAB-14	8/29/93	83N/13	79-23-21-13	6291400	465650	1850

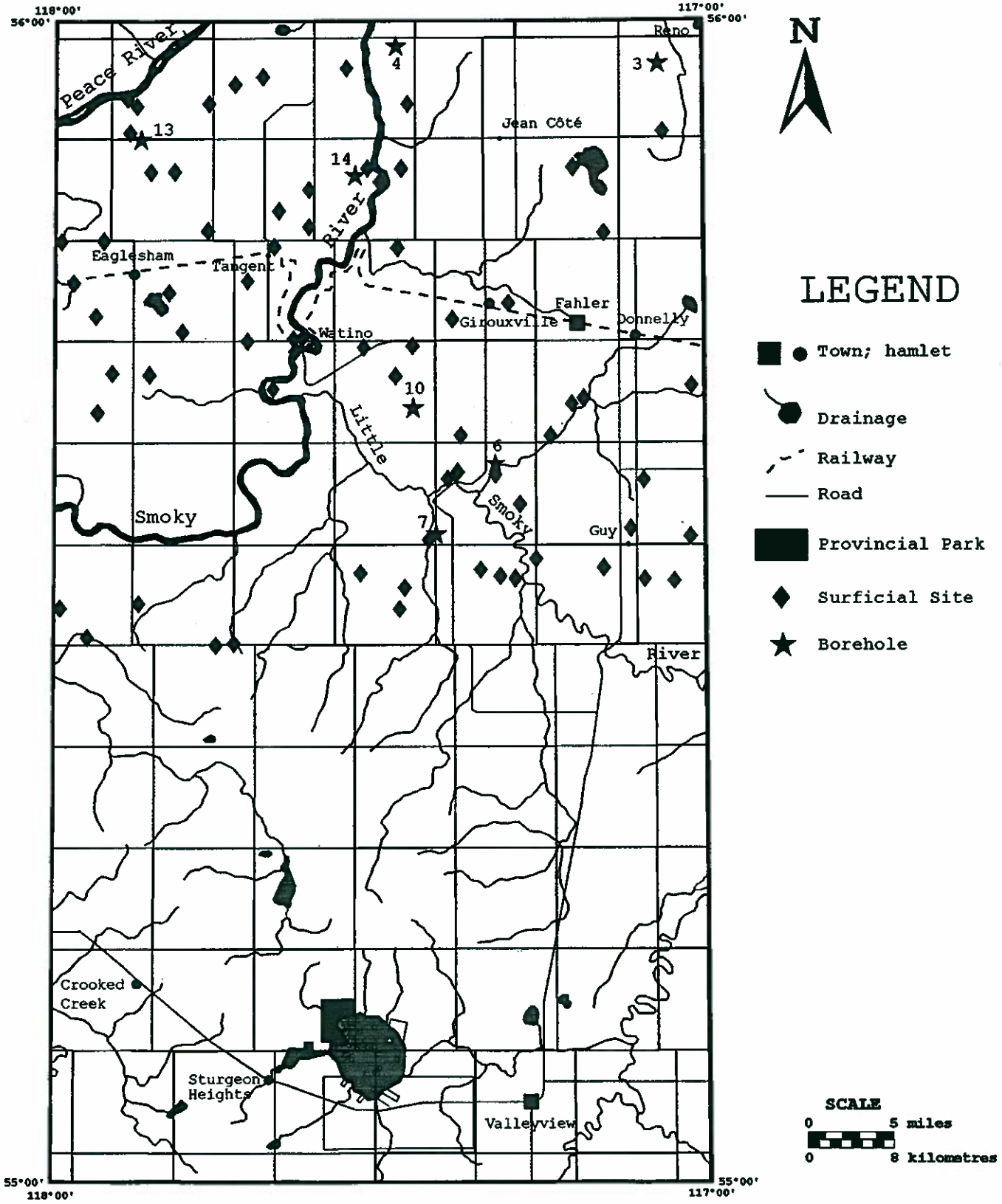

Figure 3.1 Location of sections and boreholes

Sampling of the sections was restricted primarily to tills, gravels and possible waterlain diamicts (Table 3.2). Some samples that represent glaciolacustrine, glaciofluvial and aeolian deposits were obtained for comparison. Samples of about 3 to 5 kg were taken for lithological, granulometric and geochemical analyses. Multiple samples were taken at larger sections to obtain information on lateral and vertical variations within individual units.

The auger cores were described in detail in the field. Two of the deeper cores (93-SAB-06, 93-SAB-13) were sampled for laboratory analyses. Each unit was represented by a minimum of one sample. Thick till units were sampled at 1.5 m intervals (Table 3.2).

3.2.2 Laboratory

Samples from the stratigraphic sections and the cores are being analyzed by various methods to determine their granulometric, lithologic and geochemical characteristics.

The <0.063 mm fraction of 88 surficial and core samples was recovered for geochemical analyses. These samples, which represent till, waterlain diamict and glaciolacustrine units, were sent out for Atomic Absorption and Induced Neutron Activation analyses. Results are currently pending.

Three 26 kg till samples were separated from two cores for mineralogical studies. Heavy minerals in the sand size fraction were processed by the Saskatchewan Research Council (SRC) for diamond indicator mineral grains. Suitable grains were then hand picked for microprobe analysis.

Granulometric and lithologic analyses are underway at the University of Alberta. Granulometric parameters of the samples will be determined through combined hydrometer and sieving techniques according to American Society for Testing and Materials (ASTM) methods. Lithological identification of the coarse sand to pebble fractions of the samples will be determined visually using binocular microscopy.

SAMPLE #	UTM N	UTM E	SAMPLE DESCRIPTION
Section Samples			
93-SB-05a	6192150	470450	Mottled silty clay till, fractured, gypsum crystals, oxidized
93-SB-05b	6192150	470450	Mottled silty clay till, some oxidization, gypsum crystals, fractured
93-SB-05c	6192150	470450	Mottled silty clay till, some oxidization, gypsum crystals, fractured
93-SB-06a	6178350	480575	Clayey till, compact, with some silt stringers
93-SB-06b	6178350	480575	Clayey diamict, few granules, some silt stringers
93-SB-06c	6178350	480575	Gravel lag interbedded with clayey diamict
93-SB-07a	6168600	488025	Massive clay
93-SB-07b	6168600	488025	Clayey diamict, few granules, massive
93-SB-08a	6168650	487525	Clayey till, massive, granule content increases down-section
93-SB-08b	6168650	487525	Clayey till, massive, granule content increases down-section
93-SB-09a	6165375	484950	Sand and gravel, oxidized
93-SB-09b	6165375	484950	Clayey till, massive
93-SB-10a	6158825	482475	Mottled silty clay till, fractured, gypsum crystals, oxidized
93-SB-10b	6158825	482475	Mottled silty clay till, fractured, gypsum crystals, oxidized, fine sand lenses
93-SB-11b	6162970	478800	Clayey diamict, few granules, laminated, white specks
93-SB-11c	6162970	478800	Clayey diamict, few granules, laminated, white specks
93-SB-11d	6162970	478800	Mottled clay silty till, large gypsum crystals, massive with some stratification
93-SB-11e	6162970	478800	Mottled clay silty till, large gypsum crystals, massive with some stratification
93-SB-11f	6162970	478800	Rip-up lens of fine sandy silt
93-SB-26a	6198375	444375	Mottled, silty-clay till, white veining, fractured, slightly stratified
93-SB-26b	6198375	444375	Sandy, silty till, some stratification
93-SB-26c	6198375	444375	Reworked diamict (possible debris flow), stratified, flow nose present
93-SB-32	6201250	457400	Mottled, clay-silty till, massive and compact
93-SB-38a	6191450	466625	Laminated clayey-silt till, compact, weathered clasts
93-SB-38b	6191450	466625	Laminated silty-clay till, compact, weathered clasts
93-SB-38c	6191450	466625	Sandy-silt till, very compact, weathered clasts

Table 3.2 Sample Descriptions

SAMPLE #	UTM N	UTM E	SAMPLE DESCRIPTION
93-SB-39a	6146800	439500	Laminated silty-clay diamict, a few granules
93-SB-39b	6146800	439500	Laminated clayey-silt till, compact, gypsum crystals in lenses
93-SB-39c	6146800	439500	Mottled clayey-silt till, some lamination, weathered clasts, lenses of fine sand
93-SB-39d	6146800	439500	Mottled clayey-silt till, weathered clasts, some lenses of fine sand
93-SB-40a	6149575	437300	Laminated silt and clay, and clayey-silt till, abundant white specks and lenses
93-SB-40b	6149575	437300	Mottled clayey-silt till, white veining, convoluted, compact
93-SB-40c	6149575	437300	Stratified clayey-silt till and fine sand, very convoluted
93-SB-40o	6149575	437300	Coal fragments
93-SB-41a	6151600	442775	Silty-clay till, compact
93-SB-41b	6151600	442775	Mottled, silty-clay till, medium sand laminae, stringers of gypsum crystals
93-SB-42a	6149850	444475	Compact silty-clay till, large lens of fine sand
93-SB-42b	6149850	444475	Mottled, clayey-silt till, gypsum crystals in pockets
93-SB-43a	6146175	451775	Silty-clay diamict, resembles disturbed alluvium, weathered
93-SB-43b	6146175	451775	Mottled, clayey-silt till, oxidized silty-fine sand laminae
93-SB-44a	6146075	454025	Clayey-silt till, highly convoluted, compact
93-SB-44b	6146075	454025	Silty-clay till, highly convoluted, rip-up lenses, very compact
93-SB-44g	6146075	454025	Poorly sorted, oxidized gravel
93-SB-44o	6146075	454025	Organic lens
93-SB-46	6169700	498275	Silty-clay diamict, possibly a till, compact
93-SB-47a	6162150	493575	Mottled, silty-clay till, weathered clasts, compact
93-SB-47b	6162150	493575	Mottled, clayey-silt till, pockets of fine sand, gypsum veining
93-SB-48	6156400	493375	Mottled, clayey-silt till
93-SB-50a	6152425	496350	Compact silty-clay till, abundant gypsum veining
93-SB-50b	6152425	496350	Compact clayey-silt till, abundant gypsum veining, fine sand
93-SB-51	6152300	493700	Compact, silty-clay till, some gypsum veining
93-SB-52a	6153225	488550	Mottled, silty-clay till, lots of gypsum veining
93-SB-52b	6153225	488550	Massive, clay till, some fractures
93-SB-52c	6153225	488550	Massive, clay till, some fractures
93-SB-53a	6154550	483300	Laminated silty-clay till and silty-clay, granule rich
93-SB-53b	6154550	483300	Mottled, silty-clay till, white specks, compact

Table 3.2 Sample Descriptions

SAMPLE #	UTM N	UTM E	SAMPLE DESCRIPTION
93-SB-53c	6154550	483300	Massive, clayey-silt till, compact, some white veining
93-SB-55a	6180725	493550	Slightly mottled silty-clay till, compact
93-SB-55b	6180725	493550	Slightly mottled silty-clay till, white specks and lenses
93-SB-56	6194550	495650	Very compact, silty-clay till, rust spots
93-SB-62	6152350	481100	Massive silty-clay diamict, few granules
93-SB-65a	6155730	473150	Mottled, silty-clay till, very compact, lenses of fine sand, rust spots
93-SB-65b	6155600	472960	Mottled silty-clay till, very compact, massive
93-SB-65c	6155600	472960	Mottled silty-clay till, very compact, massive
93-SB-67a	6174500	460075	Cross-stratified gravel and coarse sand
93-SB-67b	6174500	460075	Cross-stratified gravel and coarse sand
93-SB-67c	6174500	460075	Wood fragment
93-SB-67d	6174500	460075	Organics, coal and fine sand
93-SB-67e	6174500	460075	Oxidized gravel and coarse to medium sand
93-SB-68a	6174475	460075	Coal
93-SB-68b	6174475	460075	Cross-stratified gravel and fine to coarse sand
93-SB-72a	6161950	475475	Mottled, silty till, oxidized, some sand
93-SB-72b	6161950	475475	Massive clay-silty till, very compact
Drill Core Samples			
93-SAB-06			
7 - 7.5	6255700	473275	Laminated silt and clay, white veining
11 - 11.5	6255700	473275	Finely laminated silty-clay, calcareous laminae
13.5 - 14	6255700	473275	Thinly laminated silty-clay diamict, some granules
19 - 20	6255700	473275	Thinly laminated, clayey-silt diamict, rare granules, weakly calcareous
23.5 - 24.5	6255700	473275	Laminated, clayey-silt diamict, rare granules, weakly calcareous, gypsum crystals
28 - 29	6255700	473275	Laminated clayey-silt till, fractured, abundant clasts
32.5 - 33.5	6255700	473275	Massive, silty-clay till, oxidized fractures, very compact
37 - 38	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
41.5 - 42.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
46 - 47	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
50.1 - 51.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles

Table 3.2 Sample Descriptions

SAMPLE #	UTM N	UTM E	SAMPLE DESCRIPTION
55 - 56	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
62.5 - 63.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
67 - 68	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
71.5 - 72.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
76 - 77	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
80.5 - 81.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
85 - 86	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
89.5 - 90.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
94 - 94	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
98.5 - 99.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
103 - 104	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
107.5 - 108.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
123.5 - 124.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
128 - 129	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
132.5 - 133.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
137 - 138	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
141.5 - 142.5	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
146 - 147	6255700	473275	Massive, silty-clay till, abundant granules and small pebbles
93-SAB-13			
5 - 5.5	6295025	444500	Stratified silt and sandy-silt, calcareous, oxidized fractures with gypsum crystals
8 - 8.5	6295025	444500	Laminated sandy-silt, and clay, calcareous, water-saturated
12 - 12.5	6295025	444500	Finely stratified silt and fine sand, calcareous
16.5 - 17	6295025	444500	Thinly laminated silt and clay, convoluted, gypsum rosettes
17.5 - 18	6295025	444500	Massive silty clay, occasional lens of fine sand
22.5 - 23	6295025	444500	Laminated fine sandy-silt and silt/clay, moderately calcareous
27.5 - 28	6295025	444500	Massive silty clay, occasional lens of fine sand
32.5 - 33	6295025	444500	Contorted laminae of silt and clay, calcareous, water saturated
34.5 - 35	6295025	444500	Massive silty clay, occasional lens of fine sand
41.5 -42	6295025	444500	Contorted laminae of silt and clay, calcareous, water saturated
45 - 45.5	6295025	444500	Massive silty clay, occasional lens of fine sand
49 - 50	6295025	444500	Massive clayey-silt diamict, possibly till
52.5 - 53	6295025	444500	Massive silty clay, occasional lens of fine sand

Table 3.2 Sample Descriptions

SAMPLE #	UTM N	UTM E	SAMPLE DESCRIPTION
57.5 - 58	6295025	444500	Silt, some laminae of silty-clay, calcareous, water saturated
62.5 - 63.5	6295025	444500	Massive silty clay, occasional lens of fine sand
67.5 - 68	6295025	444500	Laminated silt and silty-clay, occasionally convoluted
70 - 71	6295025	444500	Vaguely stratified silty-clay till, lenses of calcareous silt
72.5 - 73.5	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
76.5 - 77.5	6295025	444500	Vaguely stratified silty-clay till, lenses of calcareous silt
80 - 81	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
84.5 - 85.5	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
89 - 90	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
93.5 - 94.5	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
98 - 99	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
102.5 - 103.5	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
107 - 108	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
111.5 - 112.5	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
116 - 117	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
120.5 - 121.5	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
125 - 126	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
129.5 - 130.5	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles
134 - 135	6295025	444500	Massive, silty-clay till, abundant granules and small pebbles

Table 3.2 Sample Descriptions

3.3 PRELIMINARY SURFICIAL GEOLOGY

The surficial geology of the western half of the Winagami map area consists of nine mappable units based on composition, thickness, morphology and drainage characteristics (Figure 3.2). Composition and thickness determines the unit number. Associated letters represent subgroups based on variations in morphology and drainage. The units are: colluvium (1); alluvium (2); organics (3); aeolian (4a, 4b); glaciofluvial (5); ice-contact stagnation (6a, 6b, 6c, 6d); glaciolacustrine veneer (7a, 7b, 7c, 7d, 7e), and blanket (8a, 8b, 8c, 8d, 8e, 8f); and, morainal deposits (9). Unit boundaries are usually transitional and should be viewed as approximate.

Quaternary unit designations differ between the Winagami and adjacent Peace River map areas. This is due to either local variation within regional map units or lack of correlation due to the presence or absence of local units. Equivalent units are listed under the following descriptions.

3.3.1 Colluvial Deposits (Unit 1)

Colluvium (Leslie, unit 2) occurs along all rivers and streams as slumps (Figure 3.2). Comprised of silt, sand, gravel and rubble, these slumps form the gently undulating slopes of the major rivers. In areas of active slumping, large scalloped hummocks and ridges flank the Peace and Smoky rivers. Sections along these rivers commonly exhibit sediment gravity flow structures, such as flow noses, convoluted laminae and slickensides along detachment surfaces.

3.3.2 Alluvial Deposits (Unit 2)

Alluvial deposits occur along the current river systems as channel fill, bars and flood plains (Figure 3.2). The deposits are comprised of moderately sorted sand, gravel, silt and sometimes clay. Reworked material from slump faces are common. Up to four generations of terraces (paired and unpaired) appear along the Smoky River near Watino.

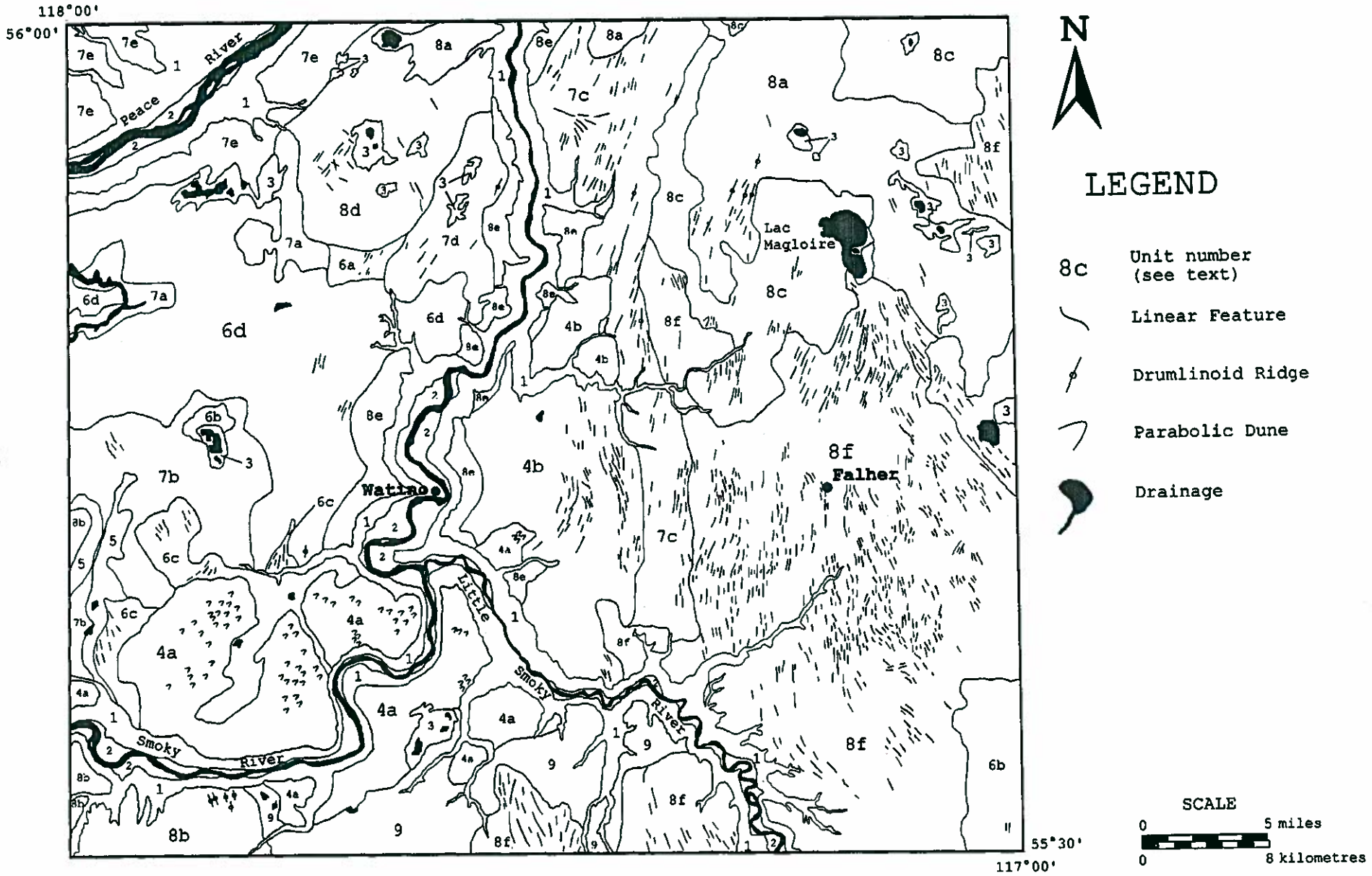

Figure 3.2 Preliminary surficial geology, NW corner, Winagami map area (83N), Alberta

3.3.3 Organic Deposits (Unit 3)

Organic deposits (Leslie, unit 1), swamps, fens and peat bogs of variable extent, occur in shallow basins and poorly drained areas (Figure 3.2). The largest peat bog covers approximately 8 km^2.

Local and regional groundwater discharge in the area enhances alkalinization producing abundant hardpan south of the Peace River. High water tables in the northern half of the area produce marshy conditions and ponding.

3.3.4 Aeolian Deposits (Unit 4)

Post-glacial aeolian deposits are widespread around Watino (Figure 3.2). Composed primarily of moderately to well-sorted sand and silt, they form parabolic, irregular and linear dunes, hummocks and ridges.

The thickness of unit 4 is variable, ranging from a veneer (<2m) in the east to a thick blanket (>2m) in the west.

Forested, large scale (>10m) parabolic and irregular dunes form areally extensive dune fields south of the Smoky River (4a). The sands become interbedded with and overlie finer silts and clays towards the east. This transitional zone contains large, linear ice-contact stagnation ridges trending north-south (4b). Many of the ridges are greater than 3 m in height and 1 km in length. Sections through the ridges reveal ice-contact micro-faulting resulting from collapse after ice melting.

3.3.5 Glaciofluvial Deposits (Unit 5)

Moderately sorted glaciofluvial deposits (Leslie, unit 4) are composed of sand, silt and minor amounts of clay. Their thickness is variable. For mapping purposes, this unit is restricted to deposits formed at the margin of, within or under ice. Most of these deposits are found in meltwater channels (Figure 3.2). Reworking by glaciofluvial processes is common throughout the area, particularly in the ice-contact stagnation regions.

3.3.6 Ice-Contact Stagnation Deposits (Unit 6)

These deposits (Leslie, unit 5) are composed primarily of sand and silt, with minor amounts of clay and till, which have been deposited at the margin of, within or under glacial ice. Most of the deposits appear to have been reworked by glaciofluvial processes. Cobbles and boulders on the surface are frequent (6b).

Streamlined ridges, hummocks and kames of variable relief and morphology typify these regions (6a). Unit thickness is variable, but usually exceeds 2 m. Modification by aeolian processes occurs along the boundary areas of the dune fields west of Watino (6c, 6d).

Drainage in areas underlain by Unit 6 varies from moderate to poor, with polygonal and kettled drainage patterns common. Swamps are commonly associated with these deposits, particularly in topographic depressions (6d). In areas where this unit is thin, underlying drainage patterns are discernible. Polygonal drainage patterns on till are well defined at the surface.

3.3.7 Glaciolacustrine Deposits (Units 7, 8)

Deposits of glaciolacustrine origin (Leslie, unit 3) overlie most of the northern half of the area (Figure 3.2). Their thickness varies from a veneer (unit 7) to a thick blanket with veneer patches (unit 8). These units are composed of laminated to massive deposits of silts, clays and minor amounts of sand, with occasional dropstones. Laminated units may be convoluted. Slumping along the Peace and the Smoky rivers (7e, 8e) commonly occurs in this unit.

Low relief hummocks, ridges, flutes (7a, 7b, 7d, 8a, 8b, 8d, 8f) and slump scars typify the surface morphology of units 7 and 8. Relief is generally less than 1 m (7c), but may reach 2 m (8a, 8b).

Drainage in those areas underlain by units 7 and 8, is variable, and is dependent upon the thickness of this unit, the grain size of the underlying sediments and the orientation of the flutes. Well to poorly-drained areas with local ponding (7d, 8c) occur throughout the region.

3.3.8 Morainal Deposits (Unit 9)

Ablation and basal till (Leslie, unit 5) underlie most of the area. Exposure near the surface is local and restricted primarily to the south of the Little Smoky and Smoky rivers (Figure 3.2). The thickness of Unit 9 is undetermined in most of the area, but ranges from less than 7 m to greater than 30 m.

Unit 9 includes small pockets of glaciolacustrine, aeolian and organic deposits. Hummocks up to 2 m high occur near the flanks of the rivers. Cobbles and boulders may be present on the surface.

Drainage in areas underlain by Unit 9 is moderate to poor, with abundant local ponding.

3.3.9 Ice Directional Indicators

There are few good indicators of ice flow direction in the study area. Interpretation is based on flute/drumlinoid orientation and areal distribution of the deposits. The areal distribution of flutes and drumlinoid ridges, particularly in the eastern half of the study area, indicate two ice-flow directions (Figure 3.2). The dominant direction is southward, with some variation to the east and west. The subordinate trend is southeastward. These features may be caused by local ice streaming or earlier ice flow.

Perhaps the best indicator of ice flow direction is the lateral distribution of aeolian, ice-contact and stagnation deposits. Aeolian deposits, such as dunes and loess, are usually found near ice fronts. Ice-contact and stagnation features are found proximal to and comprise the retreating ice front. The position of the aeolian deposits to the southwest of the ice-contact and stagnation deposits, indicates there was an ice front located in the northeast.

3.4 PRELIMINARY QUATERNARY STRATIGRAPHY

Detailed stratigraphy in the northern half of the study area is still being developed. A generalized summary of the stratigraphy is presented in Figure 3.3.

Southeast of the Smoky River, the stratigraphy appears to be relatively straightforward (Figure 3.3a). The uppermost unit contains glaciolacustrine silts and clays with the occasional dropstone and fine sand lens. This unit is finely-laminated, brown to grey in colour with extensive oxidization along silt bands. Large fractures, infilled with gypsum crystals, usually occur within the upper 7.5 m, but may be found to depths of 15 m. Clay content increases down-core, with laminae becoming thicker and more massive in appearance.

Towards the west, the glaciolacustrine deposits are overlain by ice-contact stagnation and aeolian deposits. The thickness of these silt and sand deposits is unknown at present due to a lack of appropriate sections. Along the Smoky River near Watino, thick sections of alluvial and glaciofluvial deposits are exposed. These exposures are difficult to reconcile with the surrounding surficial deposits.

The laminated silts and clays grade eastward into a finely laminated diamict (Figure 3.3a) containing clasts of granule-size (2 to 4 mm) or smaller, and abundant white, calcareous specks and lenses. This unit appears to form a transition between the lake deposits above and the till below. It is suggested that it may be a subaqueously deposited diamict.

Two visually distinctive tills underlie the glaciolacustrine deposits and subaqueous diamict: (a) an upper, laminated, brown and grey, highly oxidized

and silty till; and, (b) a lower, massive, dark grey, compact silty-clay till (Figure 3.3a). The upper till is local in areal extent, and has undergone post-depositional alteration by groundwater. In places, it grades into or becomes interlaminated with the lower grey till.

The dark grey till is regionally extensive and occurs in all seven boreholes (Figure 3.3). Till thickness is variable, ranging from less than 2 m in the north to greater than 30 m south of Fahler. Clasts in the till appear to be dominantly of Canadian Shield origin, although this has not yet been verified by detailed lithological analysis. Vertical variations within the till are not visually apparent, but should be discernible once all lithological, granulometric and geochemical data become available.

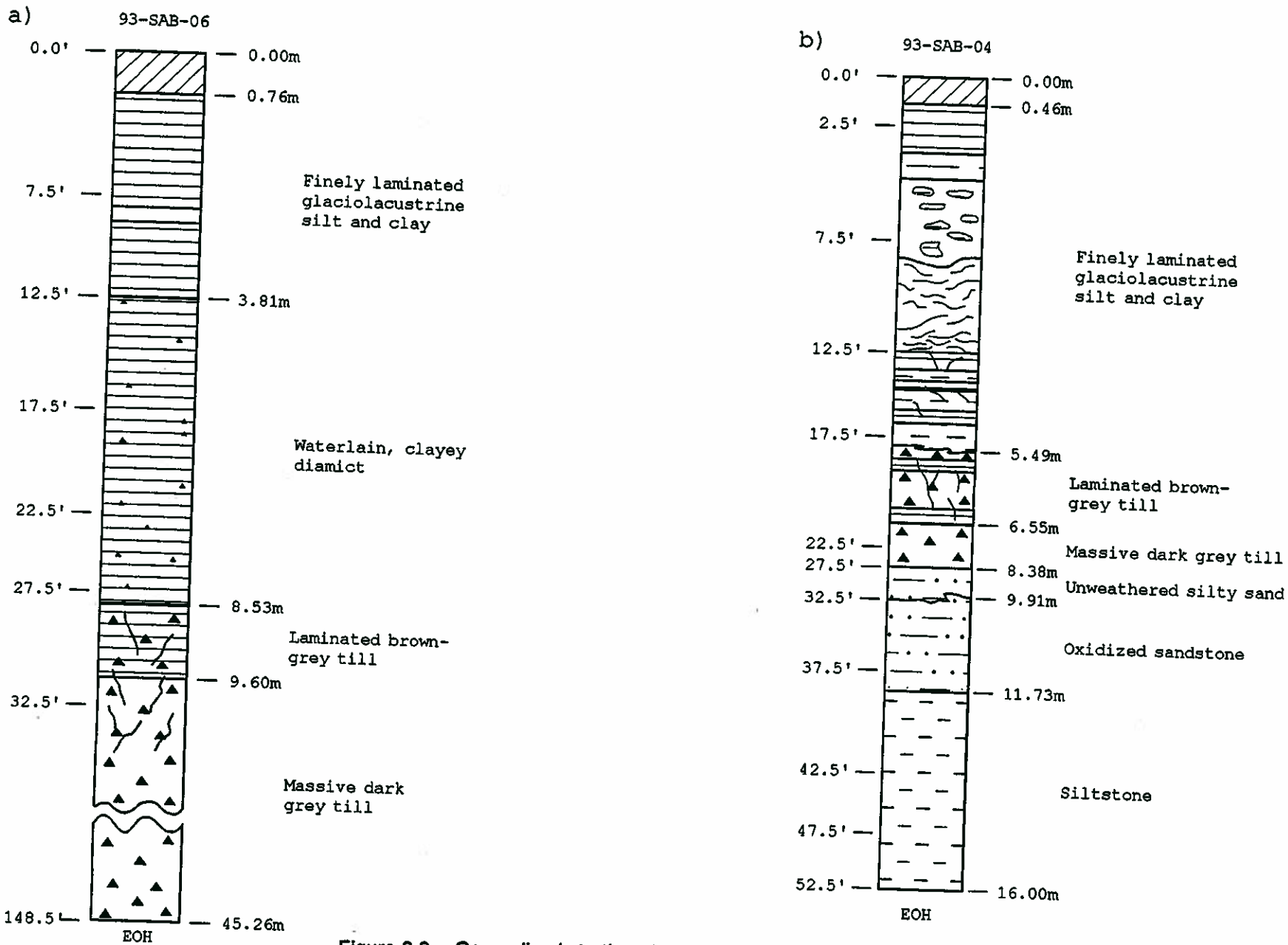

Figure 3.3 Generalized stratigraphy of selected boreholes

Stratigraphy of the upper units becomes more complex northwards. Drift thickness is highly variable and bedrock has been intersected within 10 m of the surface at borehole 93-SAB-04 (Figure 3.3b). The dark grey till east of the Smoky River appears at the base of the sections and cores. Overlying and occasionally interbedded with the till are a multitude of possible units: a laminated grey-brown till; massive to finely laminated to convoluted glaciolacustrine silts and clays (Figure 3.3b); and, possible alluvial or glaciofluvial flood plain silts, clays and fine sands.

3.5 DISCUSSION

Preliminary review of the Quaternary geology and stratigraphy of the Winagami area has indicated that this region has experienced at least one major glacial advance. The preservation of the flutes and drumlinoid ridges, and lack of cross-cutting relationships indicates a single ice advance.

Most of the surficial deposits are associated with ice stagnation and retreat. The large scale ice-contact stagnation ridges mark one of the ice positions during such a retreat. Modification of this region by glaciofluvial processes is evidenced by the hummocky appearance of the ridges and their environments.

Glaciolacustrine deposits cover much of the area, particularly in the east. The extent and thickness of these deposits indicates that significant amounts of water were ponded during deglaciation. The appearance of what appears to be waterlain diamict indicates that the lake was proximal to the ice-front. The timing of lake drainage is uncertain.

The dune field in the southwest part of the map area extends towards Grande Prairie. The areal extent of the field and the height of the dunes indicates that the region was fed by deflation of silt and sand at the ice front. The prevailing westerly winds enhanced parabolic dune formation/migration and impeded reforestation of the region following deglaciation.

Detailed stratigraphy in the region is not available at the present time. The upper units increase in complexity northwards and become difficult to correlate over short distances. Southwards, the sections show glaciolacustrine silts and clays

overlying till. This sequence is typical of ice proximal deposits. The presence of an uniform grey till over the entire region indicates that maximum ice advance was south or southwest of the study area. Analysis of lateral and vertical variations in matrix and clast components of the till will provide better information on the provenance of the material.

3.6 CONCLUSIONS

The currently available data allow several preliminary conclusions to be made about the geology of the Winagami study area. Overall, the lateral and vertical geology of the region is consistent with at least one major ice advance. The distribution of surficial units and the orientation of the flutes and drumlinoid ridges indicate a strong southwest ice-flow direction.

Most of the surficial deposits are associated with ice stagnation and deglaciation. These include lake deposits in the north and east, extensive aeolian sand and silt deposits, meltwater channels and ablation till. It is, therefore, suggested that the ice front lay in the northeast.

Stratigraphic correlation between drill cores and sections becomes increasingly difficult northwards due to the complex relationships between the uppermost units. However, the regional extent of the lower, dark grey till indicates that ice advanced beyond the boundaries of the study area.

4. REFERENCES

Fenton, M.M., Schreiner, B.T., Nielsen, E., and Pawlowicz, J.G., 1994. Quaternary geology of the western plains. In Geological Atlas of the Western Canadian sedimentary basin, Mossop G.D. and Shetsen I (comps.), Calgary, Canadian Society of Petroleum Geologists and Alberta Geological Survey - Alberta Research Council, p 413-420.

APPENDIX A
SECTION AND BOREHOLE LOCATIONS

APPENDIX A1. 1993 Section locations and descriptions

SITE	NAMES	NTS	LSD LSD-SEC-TP-R	UTM N	UTM E	Elevation (Feet)	SITE DESCRIPTION
1	Weberville Sand Pit	84 C/6	9-34-84-22	6242500	476800	2125	1m till overlying medium crossbedded sand
2	Chinook Valley	84 C/5	3-32-85-23	6251500	462900	2150	80cm massive medium sand
3	Grimshaw Gravel Pit	84 C/4	13-29-83-23	6231800	462600	2135	1.4m till overlying oxidized crossbedded gravel
4	Mullen Gravel PitA	84 C/4	4-32-83-23	6232400	462500	2135	observed only
5	Smithmill Stop1	84 C/5	1-23-86-25	6225800	449500	2175	1m massive till
6	Smithmill Stop2	84 C/5	12-29-85-25	6250800	443100	2360	1m massive 'blue' clay
7	Smithmill Stop3	84 C/5	14-19-86-24	6259700	451800	2140	1m till(?) with small pebbles & granules
8	Chinook Valley Stop1	84 C/5	1-34-86-24	6261200	457700	2080	1.5m massive till with gypsum
9	Chinook Valley Stop2	84 C/5	12-7-86-23	6255500	461300	2080	hummock:1m till overlying sand
10	Chinook Valley Stop3	84 C/5	6-7-86-23	6255400	461400	2080	hummock:1m till overlying sand
11	Chinook Valley Stop4	84 C/5	7-9-86-23	6255400	465100	2050	2m massive brown till overlying bedrock
12	Warrensville Stop1	84 C/5	1-21-86-23	6248200	465700	2075	1.3m massive till with sand & silt interbeds
13	Warrensville Stop2	84 C/5	13-33-85-23	6252800	464300	2120	50cm till(?) overlying sand
14	Warrensville Stop3	84 C/5	16-19-84-24	6240000	452500	2175	40cm stratified till overlying silty clay & sand
15	Whitemud Hills	84 C/5	13-1-85-25	6245000	449400	2400	till(?) pebbles & granules overlain by silt & silty clay
16	Figure 8 Lake	84 C/5	13-8-84-25	6237000	443000	2225	>1m massive till
17	Brownvale Stop1	84 C/4	13-2-83-25	6225900	447500	2175	1m clay silt altered by gypsum
18	Brownvale Gravel Pit	84 C/4	9-8-83-25	6226900	444100	2180	1m till overlying oxidized gravel
19	Weberville Stop1	84 C/6	13-30-86-20	6260600	490100	1675	silty clay overlying clay silt
20	Weberville Stop2	84 C/6	13-24-86-21	6259400	488900	1670	2m interlaminated silty clay & clayey silt
21	Leddy Lake Gravel Pit	84 C/6	2-29-85-22	6249800	473700	2175	gravel/1.3m massive brown till/med-fine sand
22	Weberville Stop3	84 C/6	4-15-86-21	6256200	485200	1700	1.4m clayey silt & silty clay interbeds
23	Weberville Stop4	84 C/6	16-20-85-21	6249700	483400	1800	1.5m clayey silt, silty sand & silty clay interbeds
24	Wesley Creek Stop1	84 C/6	16-15-84-20	6238200	496500	1875	2m clayey silt & silty clay interbeds

APPENDIX A1(continued). 1993 Section locations and descriptions

25	Wesley Creek Stop2	84 C/6	4-17-84-20	6236800	491800	1800	hummock:1.5m stratified sand overlain by 2m silt
26	Three Creeks Stop1	84 C/6	9-16-85-20	6247400	494800	1720	2m silty clay & clayey silt interbeds
27	Three Creeks Stop2	84 C/6	15-5-85-20	6244800	492700	1725	1m silty clay & clayey silt interbeds
28	Nampa Stop1	84 C/2	13-24-81-20	6210700	500100	1925	80cm massive clay
29	Nampa Stop2	84 C/3	9-21-81-20	6210000	496660	1875	3.5m silty clay & clayey silt interbeds overlying till(?) with granules & pebbles
30	Wesley Creek Gravel Pit	84 C/6	8-28-84-21	6240600	485100	1650	3m outwash(?) sandy gravel
31A	Whitelaw Gravel Pit A	84 D/1	16-36-81-1*	6214400	436800	2100	1m discontinuous till overlying cross-bedded gravel
31B	Whitelaw Gravel Pit B	84 D/1	16-36-81-1*	6214350	437200	2100	1.4m till overlying sand and gravel
32	Berwyn Stop1	84 C/4	14-32-81-24	6214200	455000	1850	1m silt & clayey silt interbeds
33	Berwyn Stop2	84 C/4	8-5-82-24	6214700	456000	1850	2m clay to silty clay
34	Nampa Section	84 C/3	12-30-81-20	6211800	491900	1850	floodplain silty clay & clayey silt overlying >1.5m till
35	Peace River Gravel Pit	84 C/3	16-13-83-22	6228100	479800	1225	>10m stratified gravel, localized oxidized beds
36	"Creek" Section	84 C/4	14-20-82-23	6220500	464700	1750	4m silty clay & clayey silt/till(?)/sand
37	"Pulpmill" Section	84 C/6	4-9-85-21	6245000	483800	1650	>3m silty clay, clayey silt,& sand interbeds
38	Warrensville Gravel Pit	84 C/5	14-24-84-24	6239900	459500	2125	50cm till overlying gravel
39	Mullen Gravel PitB	84 C/4	4-32-83-23	6231800	462500	2135	stratified gravel overlying oxidized clayey gravel
40	Judah Hill	84 C/3	8-20-83-21	6222900	483500	1750	>2m massive clay
41	Smoky River Section	84 C/3	16-25-81-23	6212400	472100	1750	composite section of silty clay overlying till
42	McAllister Creek Section	84 C/4	1-33-82-23	6220500	464800	1700	composite section with till overlying sand & gravel

* Denotes LSD W of 6th Meridian; all others are W of 5th Meridian
All locations are in UTM Zone 11V

APPENDIX A2. 1993 Borehole locations and sub-samples

#	NAME	NTS	LSD	UTM N	UTM E	Elevation (feet)	Total Depth (feet)	(metres)	Sub sample # and depth(m)
BH-01	Weberville	84 C/6	4-18-86-20	6256140	490180	1660	104	31.70	120 (15.3); 121 (16.2); 122 (17.7); 123 (18.7); 124 (19.7); 125 (21.0); 126 (22.4); 127 (22.9); 128 (24.3); 129 (25.6); 130 (27.4); 131 (28.6); 132 (30.5); 133 (31.7) Heavy mineral sample PR-003(16.1-31.7)
BH-02	Weberville	84 C/6	13-1-86-22	6254420	478780	2100	27.5	8.38	no sub-samples
BH-03	Figure 8 Lake	84 C/5	12-21-84-25	6239320	444530	2250	52.5	16.00	140 (1.5); 141 (2.1); 142 (3.1); 143 (4.1); 144 (5.2); 145 (6.1); 146 (7.1); 147 (8.1); 148 (9.2); 149 (10.1); 150 (11.6); 151 (13.6)
BH-04	Peace River	84 C/4	4-14-81-26	6207780	439800	1925	107	32.61	100 (3.7); 101 (4.3); 102 (4.9); 103 (6.2); 104 (7.5); 105 (8.5); 106 (11.5); 107 (17.6); 108 (18.7); 109 (19.9); 110 (21.5); 111 (28.2); 112 (30.1); 113 (31.5) Heavy mineral sample PR-010 (5.3-19.1)
BH-05	Brownvale	84 C/4	13-11-82-25	6217540	449450	2100	62.5	19.05	no sub-samples
BH-06	Nampa	84 C/3	2-17-81-21	6207100	470600	1940	22.5	6.86	no sub-samples
BH-07	St Isidore	84 C/3	1-8-83-20	6225310	493200	1900	100	30.48	no sub-samples

APPENDIX B
LOG DATA FROM THREE 1993 AUGER BOREHOLES

LIST OF ABBREVIATIONS

amts	amounts
bn	brown
C	clay
carb	carbonate rock
Cdn Geologic	Canadian Geological Drilling
crse	coarse grained
CSi	clayey silt
deform	deformed
dk	dark
efferv	effervescence
f.g.	fine grained
lam	laminated
litho	lithology
lt	light
mass	massive
MDA N Alta	Mineral Development Agreement Northern Alberta
med	medium grained
mod	moderate
Muni	Municipal
oxid	oxidized
qtz	quartz
qtzite	quartzite
sh	shale
SiC	silty clay
sis	siltstone
ss	sandstone
strat	stratified
/	denotes an interbedded units

APPENDIX B1. Borehole log data for 93-BH-01

PROJECT: MDA N Alta	DATA NO:93-BH-01	LOGGED BY:L Leslie	DATE:17-18/08/93
DRILLER: Cdn Geol Ken Pearson	TYPE DRILL: Hollow auger/split sampler	DRILL METHOD: Core	SURFACE ELEVAITON: 1660'
LOCATION: Weberville	LSD 4 SEC 18 TP 86 R 20 MER W of 5		
UTM ZONE: 11V/MN	UTM EASTING 490180m	UTM NORTHING 6256140m	
COMMENTS ON LOCATION Glaciolacustrine plain ca 20 km NE of Weberville, W bank of Peace R.			

DRILLED INTERVAL (ft)		CORE RECOVERY (cm)	UNIT INTERVAL (cm)	TOTAL DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
0	2.5	87	59	0.59	topsoil	land clearing
			18	0.77	topsoil	road fill
			5	0.82	soil	organic layer, roots,etc
2.5	7.5	137	20	0.96	soil	very oxidized soil with Ae horizon
			87	1.83	Si C	grey mottled orange & lt grey; crudely banded & inclined;
			29	2.12	Si C	grey mottled, orange & lt grey; mod efferv
			17	2.29	no core	
7.5	12.5	156	156	3.81	SiC	massive mottled orange brown, lt grey; mottling pattern is small, circular blotches (75cm); mod efferv; changes to more oxid & fractures filled with calcite inclined @ 30°; bands of slightly oxid (ie. few blotches/mottles) to highly oxid zones; 10-20 cm thick
12.5	17.5	156	39	4.20	SiC	bands of slightly oxid & highly oxid zones; iron stains; mod-high efferv
			93	5.13	SiC	large blotches orange brown lt grey borders; fractures are highly efferv (ie. filled with calcite) 10 cm from base of interval
			27	5.40	Si with C laminae	horizontally laminated brown Si & dk brown clay; mod-high efferv
17.5	22.5	156	10	5.43	same	same as above
			40	5.83	SiC	massive grey mottled orange brown
			29	6.12	SiC	massive no mottles
			60	6.72	SiC	massive grey SiC with inclined fractures filled with calcite; some mottles of calcite occur in matrix
			12	6.84	Si with C laminae	horizontally laminated brown Si & dk brown C
			2	6.86	SiC	massive grey
22.5	27.5	156	15	7.01	Si	massive with minor amts of C (grey); high efferv
			9	7.10	SiC	massive with minor amts of C; mod-high efferv

PROJECT: MDA N Alta	DATA NO:93-BH-01	LOGGED BY:L Leslie	DATE:17-18/08/93
LOCATION: Weberville	SURFACE EL: 1660'	LSD 4 SEC 18 TP 86 R 20 MER W of 5	
COMMENTS ON LOCATION Glaciolacustrine plain ca 20 km NE of Weberville, W bank of Peace R.			

DRILLED INTERVAL (ft)		CORE RECOVERY (cm)	UNIT INTERVAL (cm)	TOTAL DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
			23	7.33	Si	masssive with minor amts C lam
			45	7.78	C with Si laminae	massive with minor inclined silt lam; silt lighter grey & grainy
27.5	32.5	156	146	9.80	SiC	massive SiC with bands of carbonate (CSi) - light grey; occurs as bands or spotty wisps & grainy texture
			10	9.90	Si with C laminae	lt grey & grey horizontally laminated
32.5	37.5	123	17	10.07	same	same as above
			12	10.19	SiC	massive grey
			94	11.13	Si w C lam	thin horizontal beds;clay beds are 2-3mm thick with thicker silt beds
			30	11.43	no core	
37.5	42.5	156	10	11.53	Si with C laminae	same as above
			26	11.79	C with Si laminae	same as above
			35	12.14	C	massive
			25	12.39	Si with C lam	lt grey & grey horizontally laminated
			53	12.92	C with Si lam	zone of silt & clay interlam ~8cm thick & isolated beds of silt; predominantly massive SiC
42.5	47.5	156	82	13.77	C	grey massive; mod efferv
			71	14.48	C with granules	find the occasional pebble (~1cm) & small stones at 38cm from top of unit; mod efferv
47.5	52.5	156	57	15.05	SiC	few stone (<1cm) found thruout;mod efferv
			100	16.00	till	massive;matrix silty;dark grey;contact with upper unit is sharp;matrix gets quite stony @ contact;mod efferv
52.5	57.5	81	81	16.81	till	massive,grey;stone 3-4cm size more frequent;holding up coring;mod efferv
			75	17.52	no core	
57.5	59	49	49	18.01	till	massive grey;matrix no change-stony; large stone pushed thru; mod efferv
59	64	156	156	19.51	till	massive grey;stones & granules; large carbonate (ie. carb) clast 2/3rds down

APPENDIX B1. (continued)

PROJECT: MDA N Alta	DATA NO:93-BH-01	LOGGED BY:L Leslie	DATE:17-18/08/93
LOCATION: Weberville	SURFACE EL: 1660'	LSD 4 SEC 18 TP 86 R 20 MER W of 5	
COMMENTS ON LOCATION Glaciolacustrine plain ca 20 km NE of Weberville, W bank of Peace R.			

DRILLED INTERVAL (ft)		CORE RECOVERY (cm)	UNIT INTERVAL (cm)	TOTAL DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
64	73	156	94	20.44	till	massive grey;stones & granules;granite, sh,qtz,large purple & white banded ss (Athabasca ss ?)-oxid on one side @ base
			10	20.54	Si/SiC	horizontal interbeds;olive brown & dk grey
			4	20.58	till	massive grey;stone & granules ~10%
			13	20.75	fine sand	horizontally bedded;dark bands;mod-high efferv
			24	20.99	till	sand lens ~3cm from top;massive grey; stones & granules
69	73	~60	42	21.03	till	rock encountered;slow drilling;disturbed
			18	21.21	crse-med sand	gradational till to sand;sample is disturbed so this may still be till
			2	21.24	fine sand	massive grey
			101	22.25	no core	
73	77.5	82	9	22.34	till	massive grey
			5	22.39	med sand	grey with dark bands
			46	22.85	till	massive grey; disturbed
			7	22.92	sand & till	sand lens (ie. not true bed); disturbed
			10	23.02	till	massive grey; large qtzite pebble; granite gneiss; pink vein qtz
			60	23.62	nil	no recovery
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 f.g.mafic rock; till is compact;hole still dry
			97	25.15	no core	
82.5	87.5	60	31	25.46	fine sand	thin horizontally bedded;rock in sand bed ~2cm may have been pushed in by drilling or is insitu?; mod efferv
			26	25.71	till	massive grey with sand lens in middle; large clast(~4cm) @ base;mod efferv
			5	25.76	sand	massive grey
			91	26.67	no core	

PROJECT: MDA N Alta	DATA NO:93-BH-01	LOGGED BY:L Leslie	DATE:17-18/08/93
LOCATION: Weberville	SURFACE EL: 1660'	LSD 4 SEC 18 TP 86 R 20 MER W of 5	
COMMENTS ON LOCATION Glaciolacustrine plain ca 20 km NE of Weberville, W bank of Peace R.			

DRILLED INTERVAL (ft)		CORE RECOVERY (cm)	UNIT INTERVAL (cm)	TOTAL DEPTH (cm)	LITHOLOGY	COMMENTS
from	to					
92.5	97.5	64	23	27.00	med 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 predom med grain, some fine & crse grain
			8	27.30	till	massive grey;stones & granules
			7	27.37	fine sand	grey; finely laminated (?)
			8	27.45	till	massive grey;stones & granules; ROCK!!!
			74	28.19	nil	no recorvery;ENDED DRILLING FOR THE DAY
			108	29.72	nil	no recovery
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, qtzite,chert(?);mod efferv
			80	31.24	no core	
102.5	104	104	~64	~31.30	sluff	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 now ~4-5%; lots of granites; mod-high efferv
						ENDED HOLE;TOO DIFFICULT TO DRILL

APPENDIX B2. Borehole log data for 93-BH-03

PROJECT: MDA N Alta	DATA NO:93-BH-03	LOGGED BY:L Leslie	DATE:01/09/93
DRILLER: Cdn Geol	TYPE DRILL:Hol auger	SURFACE ELEV. 2250'	FROM 1:50,000 map
LOCATION: Figure Eight Lake	LSD 12 SEC 21 TP 84 R 25 MER W5		
U.T.M. ZONE 11V/MN	EASTING 444530m	NORTHING 6254420m	
COMMENTS ON LOCATION: Hummocky (4-5m) moraine,at road leading into Figure 8 L Muni Park.			

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
0	2.5	76	9	9	gravel	road fill
			42	51	C/Si	road fill
			25	76	bn strat till	upper 11cm is a gradational change from lam clay & silt and then into bn strat till; silt lam are oxid; few granules & pebbles; one clast ss(?)2cm; oxid & very weathered sis; red granite
2.5	7.5	156	156	2.28	bn mass till	with granules & tiny pebbles;very few stones >1cm;lithology-sis(tan), ss(red), coal,red granite;near vertical fractures infilled with Mn oxide(black) with ironstone clast found @ 84 &104cm interval within unit;gypsum infilling fractures in lower 62cm; no carbonate (ie.carb) granules
7.5	12.5	156	14	2.42	bn mass till	slight mottling of lt brown; coal & qtz clasts
			70	3.12	bn mottled till	mottling is in crude bands (~5cm thick) and "veiny";mostly lt brown with a little brown;gypsum crystals in blotches & clusters; litho-weathered orange sis, ss, red granite, qtz,sh,coal
			55	3.67	bn mottled till	less mottling;fracture infilling of gypsum & oxidized orange silt, inclined @ 45°
			21	3.88	bn lam till	lt brown silt lam are horizontal & occur 1-5cm apart;gypsum along horiz silt lam
12.5	17.5	121	43	4.24	bn mass till	granules mostly with few small pebbles; gypsum blotches
			79	5.03	bn lam till	large gypsum vein @ 30cm from top; lam is fine (1-1.5cm)in upper 15cm & occur 2-5cm apart in lower portion; mostly granules of coal,orange weathered sis,tan ss;qtz;qtzite
			33	5.33	no core	
17.5	22.5	156	156	6.86	bn/grey mass till	first sign of carb clasts; >1cm clasts, interval of mainly granules & tiny pebbles and stony(3-5cm)matrix; litho-qtz,granite,carbs,NO COAL,weathered sis

PROJECT: MDA N Alta	DATA NO:93-BH-03	LOGGED BY:L Leslie	DATE: 01/09/93
LOCATION:Figure 8 Lake	SURFACE EL: 2250'	LSD 12 SEC 21 TP 84 R 25 MER W5	
COMMENTS ON LOCATION:Mh map unit; to entrance of Figure 8 Lake Municipal Park			

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
22.5	27.5	156	156	8.38	bn/grey mass till	litho-no change + lots of tiny granules of sh;few clasts >1cm; chert,lg qtzite pebble in middle of interval & in shoe; lower 4cm goes into a bn mass till
27.5	32.5	103	4	8.42	bn till	abundant oxidized sis & some sh granules
			6	8.48	grey till	a break in core @ top of this unit; gradational into lower lam bn till(ie grey mottles at the lower contact)
			93	9.41	bn lam till	granules of sh,orange sis, tan ss,~20-25%; one carb clast,weathered sis clast near center of unit;this oxidized unit with abundant local clast may signify a different till since above this is an unoxidized till(bn/grey)
			49	9.90	no core	
32.5	37.5	156	16	10.05	grey till	with mottles of lt grey bn; granules of weathered orange sis,tan ss,sh-in total~10%or <; one qtz clast ~1.5cm
			12	10.17	lt grey bn till	granules & tiny pebbles ~15-20%; weathered orange sis,tan ss,sh;granite
			46	10.63	lam CSi	elongated 8cm qtzite cobble;oxidized fine sand lens above cobble; few sh,sis clast within this unit
			32	10.95	lam SiC	dk & lt grey bands ~1-2cm thick; still finding granules of sh & weathered sis; weathered orange bands near base; medium sand lam in lower 4-5cm of unit
			9	11.04	oxidized SiC	orange with grey bands; still granules of weathered orange sis, tan ss,sh
			34	11.38	dk grey lam SiC	finely lam & mottled lt grey; deformed "sh";sm slickenslides & broken sh clasts
37.5	42.5	148	42	11.85	deform sh	appearance of many broken sh clasts
			5	11.90	deform sis	predominantly silt beds; core is broken up into very small peices; dry
			93	12.83	lam sis/sh	finely lam;oxidized bands @60 & 90cm;doesn't appear to be deformed,core intact
			12	12.95	no core	
42.5	47.5	109	94	13.89	lam sis/sh	predom sis lam;slightly wavy beds
			15	14.04	lam sh/sis	wavy beds of sh(dk grey) with some sis(lt grey)

APPENDIX B2. (comtinued)

PROJECT: MDA N Alta	DATA NO:93-BH-03	LOGGED BY:L Leslie	DATE: 01/09/93
LOCATION:Figure 8 Lake	SURFACE EL: 2250'	LSD 12 SEC 21 TP 84 R 25 MER W5	
COMMENTS ON LOCATION:Mh map unit; to entrance of Figure 8 Lake Municipal Park			

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
			43	14.47	no core	
47.5	52.5	156	156	16.00	lam sis/sh	

PROJECT:MDA N Alta	DATA NO:93-BH-04	LOGGED BY:L Leslie	DATE:30/08/93
DRILLER:Cdn Geol Ken Pearson	TYPE DRILL: Hollow auger/split sampler	SURFACE ELEV.1925'	FROM: 1:50,000 map
LOCATION: Peace R	LSD 4 SEC 14 TP 81 R 26 MER W5		
U.T.M. ZONE: 11V/MN	EASTING 439800m	NORTHING 6207780m	
COMMENTS ON LOCATION: On glaciolacustrine plain ~12km SW of Brownvale			

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
0	2.5	68	43	.43	road fill	Silty clay slightly mottled
			8	.51	topsoil	
			17	.68	SiC	mottled;horizontal lam;olive brown (bn), orangey bn & lt & dk grey
			8	.76	no core	
2.5	7.5	101	14	.90	SiC	mottled; horizontal lam; olive bn, orangey bn & lt & dk grey
			58	1.48	SiC	massive,dark grey;crumbles easily;some bn silt pockets are highly efferv;powdered gypsum in lower 15cm
			28	1.76	C	massive, small mottles of bn silt and lenses of gypsum;one dropstone (5mm) non-efferv
			53	2.29	no core	
7.5	12.5	136	~10	2.39	C	massive,small mottles of bn silt and lenses of gypsum;some crumpled;sharp lower contact;clasts are predom very weathered composed of sis & ss;one bright orange,highly oxidized
			34	2.73	inter-bedded strat till & fine sand	sample is very crumpled;appeara to be intervals of fine sand and silt with bn stratified till;till interval @ middle is ~10cmm thick with granules & tiny pebbles of sis,ss,and pink granites
			91	3.64	strat bn till	finely lam silt bands (lt bn);fine sand(?) highly oxidized orange;bn & grey bands;clasts litho-sis,ss,carbs (all mod to high efferv) and qtz;granules 2-3%
			17	3.81	no core	
12.5	17.5	107	~50	4.31	strat bn till	sample crumpled-may represent interbedded silt units or may be result of drilling; clasts are more frequent and larger(4-5 cm);litho sis,carbs, qtzite-qtz(?) and oxidized ss & sis; small gypsum lenses/bands

PROJECT:MDA N Alta	DATA NO:93-BH-04	LOGGED BY:L Leslie	DATE:30/08/93
LOCATION:Peace River	SURFACE EL:1925'	LSD 4 SEC 14 TP 81 R 26 MER W5	
COMMENTS ON LOCATION: On glaciolacustrine plain ~12 km SW of Brownvale			

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
			57	4.88	strat bn till	finely lam (like 91cm interval above);sh clast(~3cm) 10 cm from base;smaller sh clasts throughout;litho same with addition of sh clasts
			45	5.33	no core	
17.5	22.5	107	43	5.76	strat bn till	crumpled core-shoe changed to attempt to get better recovery
			64	6.40	strat bn till	tiny pebbles(<5mm)--15% of sh,sis,carbonates (carb), ss(orangey), qtz;matrix slightly efferv (takes ~30 sec to react);pebbles >1cm very rare
			46	6.86	no core	
22.5	27.5	121	35	7.21	strat bn till	crumpled core-same as above(?); 4-5cm clasts, sis(orangey),vein qtz X 3
			86	8.07	strat bn till	strat bands have same appearance-orangey oxidized bands more efferv;a few tiny pebble-sized pink granites
			31	8.38	no core	
27.5	32.5	~46	~46	8.84	strat bn till (?)	crumpled core; qtzites well rounded; carbs
			107	9.91	no core	
32.5	35	nil	nil	10.67	no core	
35	37.5	nil	nil	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	strat bn till	core is crumpled;large qtzite(6-8cm) square shaped/subrounded;gypsum veining frequent
			101	12.95	no core	
42.5	47.5	nil	nil	14.48	no core	spear sent down again to shatter rock
47.5	52.5	nil	nil	16.00	no core	
52.5	57.5	nil	nil	17.53	no core	pushed through with plug
57.5	62.5	154	154	19.05	strat bn till	texture no change;litho-no change; stone ~1cm sizes more abundant; gypsum veining occurs every 10-20cm; efferv higher on lighter bands of 5-7cm thick;well rounded clasts(3cm) of qztite & granite

PROJECT:MDA N Alta	DATA NO:93-BH-04	LOGGED BY:L Leslie	DATE:30/08/93
LOCATION:Peace River	SURFACE EL:1925'	LSD 4 SEC 14 TP 81 R 26 MER W5	
COMMENTS ON LOCATION: On glaciolacustrine plain ~12 km SW of Brownvale			

DRILLED DEPTH (ft)		RECOVERY (cm)	UNIT INTERVAL (cm)	DEPTH (m)	LITHOLOGY	COMMENTS
from	to					
62.5	67.5	124	124	20.29	strat bn till	upper~40cm is mangled; core wet in lower 20cm of core (some water was put down hole);dark grey massive till band(~15cm) occurs 50cm from base;drilled through large sis nodule(oxidized);large gypsum veins(2-3 cm) in lower 20cm & inclined;well rounded clasts(2-5cm)~2%;still seeing granules & tiny pebbles of sh,sis,ss qtz,qtzites, granites, & carbs
			28	20.57	no core	
67.5	72.5	74	~20	20.77	dk grey mass till	core is chewed up;difficult to discern;texture similar to strat bn till but with less granules and tiny pebbles
			54	21.31	strat bn 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 fragment @ base of interval
			79	22.10	no core	
72.5	77.5	~22	~22	22.32	dk grey mass till	mangled core; large qztite clast(6-7cm); subangular-subrounded
			130	23.62	no core	
77.5	82.5	nil	nil	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 qtzite cobble
			112	28.19	no core	
92.5	97.5	nil	nil	29.72	no core	
97.5	102.5	109	7	29.79	fine sand	brown,massive appears to be sluff
			92	30.71	sis bedrock	massive(?);core is mangled & slightly wet;bottom~15cm is dry rock fragment-here there is fine lam of lt gray & gray
			53	31.24	no core	
102.5	107.5	~20	~20	31.44	sis bedrock	mangled core
			132	32.74	no core	stopped drilling-too difficult