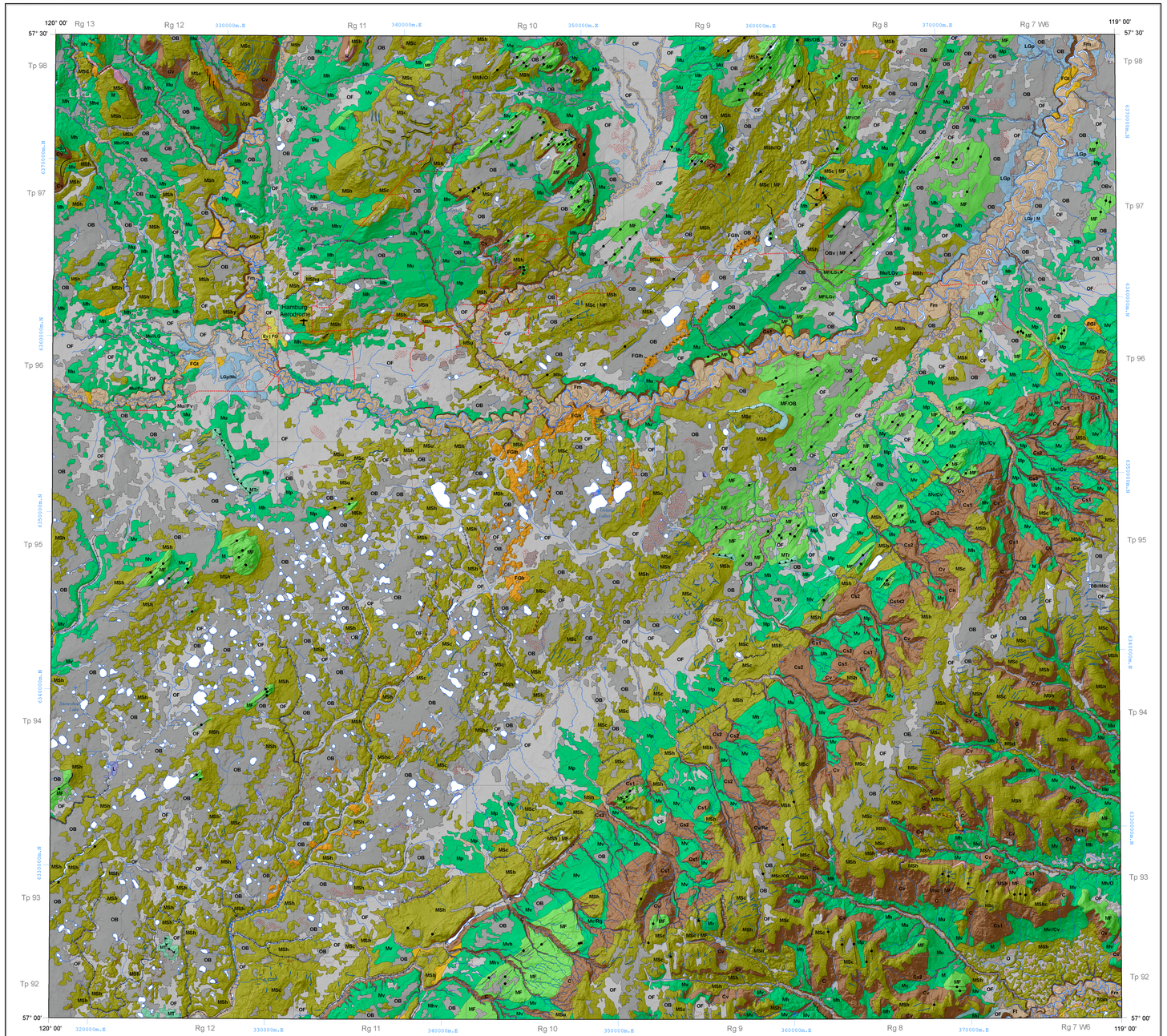
NTS 84E/SW
SURFICIAL GEOLOGY



This is a common map legend for the surficial geology of northern Alberta. Coloured legend blocks indicate map units that appear on this map. Not all map symbols shown in the legend necessarily appear on this map.

UNIT	UNIT NAME	DESCRIPTION AND GENESIS
QUATERNARY		
HOLOCENE		
A		**ANTHROPOGENIC MATERIALS:** Artificially made ground or geological materials that have been disturbed by human activity, such that their physical properties (e.g. structure, cohesion, compaction) have been drastically altered.
O		**ORGANIC DEPOSITS:** Undifferentiated peat (woody to fibrous muck) occurring in wetlands; commonly underlain by fine-grained, poorly drained glaciolacustrine deposits; includes marshes, swamps, bogs and fens.
	OB	**Bog peat:** Occurs in a peatland with a fluctuating water table and commonly a raised surface; peatland surface is dominated by sphagnum mosses, heath shrubs and short, stunted trees.
	OF	**Fen peat:** Occurs in peatland which receives water from slowly flowing streams and groundwater, with the water table lying at the land surface; peatland surface is dominated by sedges, with grasses and reeds near local pools, and is sparsely treed.
C		**COLLUVIAL DEPOSITS:** Materials that have reached their present position as a result of direct, gravity-induced movement; commonly occurs as slope and slump deposits confined to valley slopes and floors; includes pre-existing bedrock, till, glaciolacustrine, glaciofluvial and eolian sediments, generally poorly sorted.
F		**FLUVIAL DEPOSITS:** Sediments transported and deposited by streams and rivers; synonymous with alluvium. Includes well-sorted stratified sand, gravel, silt, clay and organic sediments occurring in channel and overbank deposits (e.g., postglacial floodplains, terraces, fans and deltas).
L		**LACUSTRINE DEPOSITS:** Sediments deposited in and adjacent to recent and modern lakes; includes offshore sand, silt and clay, minor organic deposits; may also include minor littoral (nearshore) beaches and bars composed of sand, silt and minor gravel.
E		**EOLIAN DEPOSITS:** Wind deposited sediments; comprise well-sorted, medium- to fine-grained sand and minor silt; generally massive to locally cross-bedded or ripple-laminated; includes both active and vegetated dunes and sand sheets.
PLEISTOCENE		
LG		**GLACIOLACUSTRINE DEPOSITS:** Primarily fine-grained, distal sediments deposited in or along the margins of glacial lakes, including sediments released by the melting of floating ice. Includes laminated (rhythmically bedded) to massive fine sand, silt and clay, and may contain ice-rafted debris.
LGL		**Littoral and nearshore sediments:** Massive to stratified, well-sorted silty sand, pebbly sand and minor gravel; occurs in beaches, bars, spits and deltaic foresets deposited during regression and lowering of glacial lakes.
FG		**GLACIOFLUVIAL DEPOSITS:** Sediments deposited by glacial meltwater streams as subaerial or subaqueous outwash. Includes sand and gravel, often stratified, minor silt, and may show evidence of ice melting (slumped structures). Features include meltwater channels, kettle holes, terraces and minor ice-contact sediments.
FGI		**Ice-contact sediments:** Sediments deposited by meltwater streams flowing either in direct contact with the ice margin (kame terraces) or within and/or under glacial ice (eskers, crevasse ridges). Includes massive to stratified, poor to moderately sorted, coarse-grained sediments (predominately pebble gravel and coarse-grained sand, locally till) and may show evidence of ice melting (slumped structures).
M		**MORAINE:** Diamicton (till) deposited directly by glacial ice and consisting of a mixture of clay, silt, sand and minor pebbles, cobbles and boulders. Locally, this unit may contain blocks of bedrock, pre-existing stratified sediment and till, or lenses of glaciolacustrine and/or glaciofluvial sediment.
MS		**Stagnant ice moraine:** Material resulting from the collapse and slumping of englacial and supraglacial sediment in response to the melting of buried stagnant ice at the ice margin; sediment is mainly diamicton, but locally includes stratified sediments of glaciolacustrine or glaciofluvial origin. Characterized by low to high-relief hummocky topography
MT		**Ice-thrust moraine:** Terrain formed from the glaciotectonic displacement of materials as blocks or rafts in a more or less intact state. Materials may include syngenetic till, as well as masses of pre-existing sediments and/or bedrock. Characterized by high to moderate relief and features include hill-hole pairs and glaciotectonic moraines.
MF		**Fluted moraine:** Glacially streamlined terrain; varies from alternating furrows and ridges to nearly equidimensional smoothed hills; all landforms parallel the local ice flow direction; includes flutes, drumlins and drumlinoids.
FP		**PREGLACIAL FLUVIAL DEPOSITS:** Sediments transported and deposited by streams and rivers prior to glaciation. This includes sand and gravel deposited in paleovalleys (i.e., preglacial floodplains, terraces, fans and deltas).
PRE-QUATERNARY		
RT		**UNCONSOLIDATED FLUVIAL GRAVELS:** Predominantly well-sorted, quartzite and chert gravel and cobbles; Cordilleran source, Paleogene to Neogene.
R		**BEDROCK**

SYMBOL LEGEND

- Permafrost; relict and/or active
- Landslide and active layer failure scar (large)
- Beach or strandline
- Wave-cut bench
- Meltwater channel (minor)
- Meltwater channel (minor, paleoflow direction known)
- Meltwater channel (lateral)
- Crevasse filling
- Ice thrust ridge
- Esker (paleoflow direction unknown)
- Esker (paleoflow direction known)
- Drumlinoid or streamlined landform
- Buried drumlinoid or streamlined landform
- Minor moraine ridge
- Major moraine ridge

BASEMAP LEGEND

- Primary road, gravel
- Unimproved road
- Truck trail
- River
- Lake
- UTM, Zone 11 Grid (430000m.E)
- Contour, intervals 50 metres
- Aerodrome

UNIT NOTATION

Example: sandy GLACIOLACUSTRINE plain

s LG p
- s: Textural modifier
- LG: Genetic unit
- p: Geomorphic modifier

Textural Modifier

Textural characteristics may be applied to the terrain classification as a prefix based on field observations or by inference from distinctive genesis and/or morphology. When two modifiers are given, the second letter is the dominant texture, with the first letter indicating the secondary texture; i.e., sc for sandy clay.

p = pebble
g = gravel
s = sand
$ = silt
c = clay
a = sand-silt-clay

GENETIC & GEOMORPHOLOGICAL MODIFIERS

c	**crevasse fill**	ice-contact ridges formed by the slumping of sediment into crevasses on the ice surface or the squeezing of till into fractures at the ice base
d	**doughnut rings and ridges**	circular hummocks with a central depression, plateau mounds and brain-like pattern ridges; low to moderate relief
e	**eroded**	planar surface eroded by glacial meltwater, often capped by a boulder lag and/or thin deposit of sand and gravel
g	**gullied**	slopes dissected by modern ravines created by intermittent runoff
h	**hummock**	assemblage of approximately equidimensional hills and hollows; moderate to high relief (commonly greater than 2 m)
m	**meander**	sinuous curves, loops and oxbows produced as meltwater and modern streams shift their channels over time
p	**plain**	deposit greater than 2 m thick; commonly masks geomorphic pattern of underlying deposits; flat to gently rolling topography (commonly less than 2 m relief)
r	**ridged**	one or more parallel or subparallel, convex, linear morphological elements with a length-to-width ratio greater than 2; low to high relief
s1	**slide**	movement of material down slope inferred to have occurred along zones of weakness; includes rotational and translational slides
s2	**flow**	movement of material down slope inferred to have occurred by internal deformation, similar to the flow of a viscous fluid; includes debris, earth and mud flows
t	**terrace**	a bench of either erosional or depositional origin that flanks the sides of floodplains, valleys and lakes; includes fluvial and glaciofluvial terraces, shoreline terraces and antiplanation terraces
u	**undulating**	low-relief rolling terrain; swell and swale topography
v	**veneer**	thin mantle of unconsolidated sediment that is too thin to mask the minor irregularities of the surface of the underlying material; it ranges in thickness from 10 cm to 1 metre and may be discontinuous
y	**dissected**	channelled or dissected by glacial meltwater and/or Holocene fluvial activity

Complex

Where two or more classes of terrain are interspersed in a mosaic or repeating pattern on a scale too small to warrant meaningful differentiation, the proportion of each component in the combination is given in a two or three-position designation set off by slashes denoting arbitrary percentage limits. Examples are:

'Mp/LGv'	indicates the area is underlain by approximately 60% morainal plain and up to 40% glaciolacustrine veneer
'Mv/LGv/FGp'	indicates at least 60% of the area is underlain by morainal veneer, with up to 40% glaciolacustrine veneer and less than 15% glaciofluvial plain
'LGp/!M'	indicates more than 60% of the area is underlain by a glaciolacustrine plain, with less than 15% moraine

Stratigraphic Sequence

Where materials of different origins or textures are known to be superimposed or can be confidently inferred, the sequence is indicated in conventional order using vertical separators, such as:

'sLGv | Mp'	indicates sandy glaciolacustrine veneer deposited on morainal plain

Transitional Association

Locally, two or more terrain units are juxtaposed by reason of related origin, temporal sequence or ambiguous geomorphological distinction. In the last case, both components may or may not be present. Such situations are identified by a compound designation marked by a hyphen. Examples are:

'LG-LGL'	indicates glaciolacustrine indistinguishable from littoral and nearshore glaciolacustrine sediment

Morphological Overprint

Where a sequence of geomorphological processes has produced a multi-aspect or compound terrain fabric, the geomorphological modifier suffixes are appended in the inferred order of superposition. 'Mpy' indicates a morainal plain has been moulded into ridges and finally dissected by streams. 'FGphr' indicates a glaciofluvial plain that includes discontinuous hummocks and ridges.

Methodology

The Alberta Geological Survey conducted surficial geology field mapping in the area during 2012. Observations made during field mapping were combined with the interpretation of Light Detection and Ranging (LiDAR) bare-earth data (Figure 1) and image classification of peatlands from Landsat 7 multispectral data (Natural Resources Canada, 2004). The LiDAR digital elevation model was used to delineate landforms through shaded-relief images created from three illumination directions. The shaded relief shown as an underlay on the main map was produced by fusing shaded-relief (315° illumination azimuth, 45° declination) and slope-gradient images.

Acknowledgements

B. Hogberg and E. Brock assisted with fieldwork. M.M. Fenton and J. Weiss contributed valuable field observations made from a helicopter in 2011. K. Mckay completed the digital cartography and GIS. Spatial Data Warehouse Ltd. provided the base data.

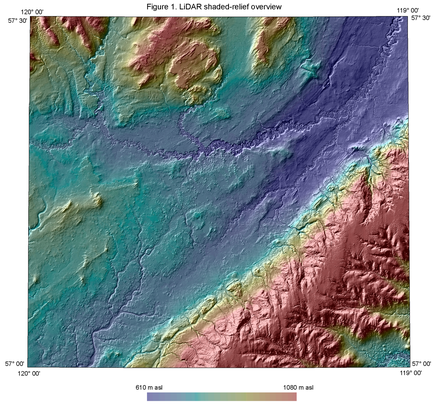
References

Atkinson, N. (2012): Surficial geology of the south Whitemud Lake area (NTS 84D/NE); Energy Resources Conservation Board, ERCB/AGS Map 558, scale 1:100 000.

Fenton, M.M., Waters, E.J., Pawley, S.M., Atkinson, N., Utting, D.J. and Mckay, K. (2013): Surficial geology of Alberta; Alberta Energy Regulator, AER/AGS Map 601, scale 1:1 000 000.

Natural Resources Canada (2004): Landsat 7 orthorectified imagery over Canada; Natural Resources Canada, Earth Observation Imagery.

Figure 1. LiDAR shaded-relief overview



Recommended Reference Format

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Alberta Geological Survey
(780) 422-1927
www.ags.gov.ab.ca

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Map 565

Surficial Geology of the Hamburg Area (NTS 84E/SW)

Geology by: D.J. Utting and S.M. Pawley

Scale 1:100 000

3 0 2 4 6 8 10 kilometres
0 1 2 3 4 5 miles

Projection: Universal Transverse Mercator
Datum: North American Datum, 1983

Alberta Energy Regulator

AGS ALBERTA GEOLOGICAL SURVEY