Yukon Government

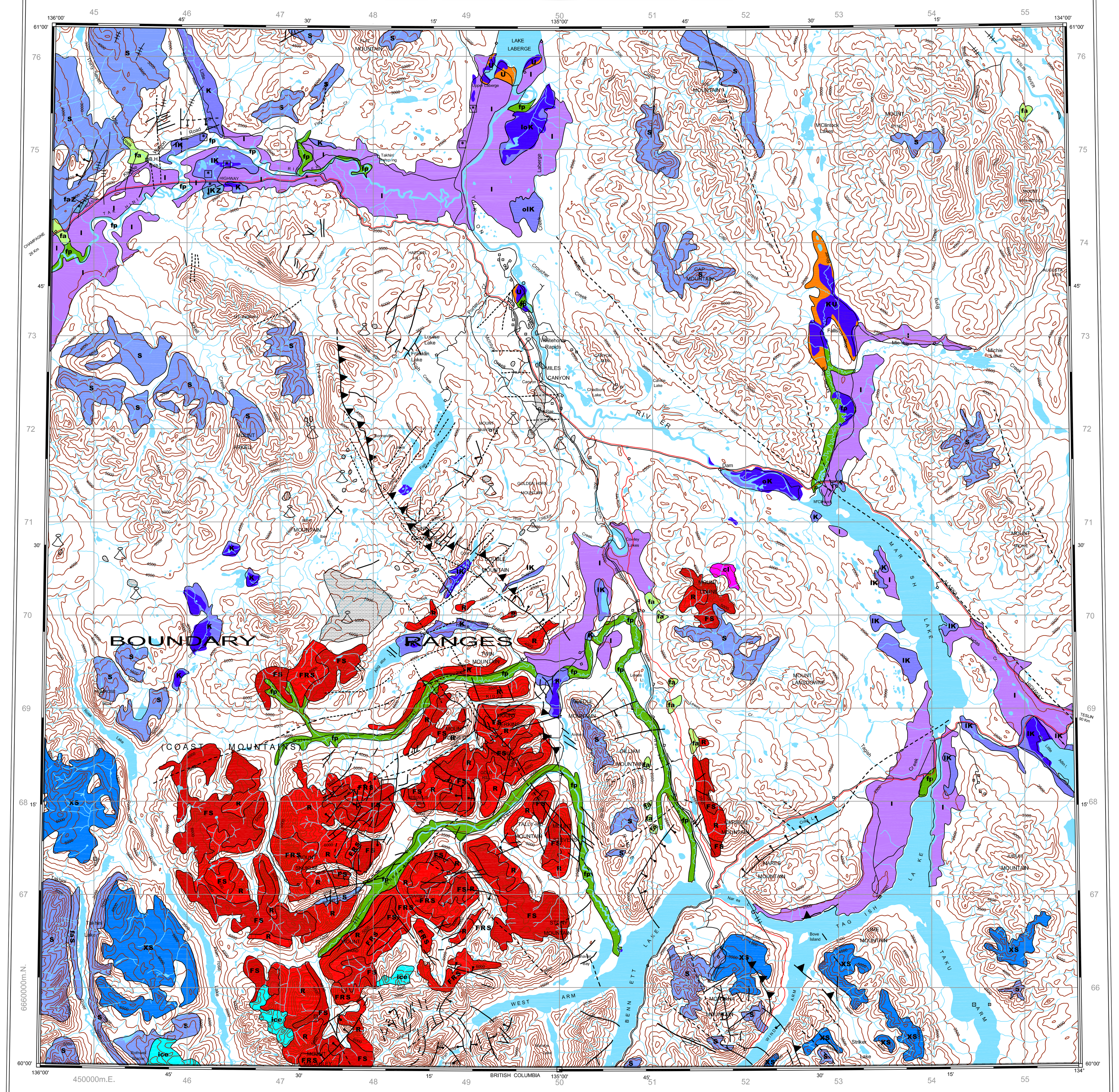
YUKON GEOLOGY PROGRAM

Canada

NATIONAL TOPOGRAPHIC SERIES NTDB (1995)

D.I.A.N.D. N.A.P. LAND RESOURCES

CANADA SHEET 105D



TEN THOUSAND METRE UNIVERSAL TRANSVERSE MERCATOR GRID NAD 83

ZONE 8

NOTE: THIS MAP HAS BEEN PRODUCED BY THE COMPILATION OF DATA FROM VARIOUS SOURCES. IT IS NOT TO BE USED TO DEFINE LEGAL BOUNDARIES.

THIS MAP IS ISSUED AS A PRELIMINARY GUIDE FOR WHICH THE DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT WILL ACCEPT NO RESPONSIBILITY FOR ANY ERRORS, INACCURACIES OR OMISSIONS WHATSOEVER.

EDITION: 2 PRINT DATE: 99/07/20

WHITEHORSE

YUKON TERRITORY

105D

Scale

10 0 10 20 30 km

5 0 5 10 15 miles

CONTOUR INTERVAL 500 FEET Elevations in Feet above Mean Sea Level

North American Datum 1983 Transverse Mercator Projection

Universal Transvers Mercator Grid ZONE 8

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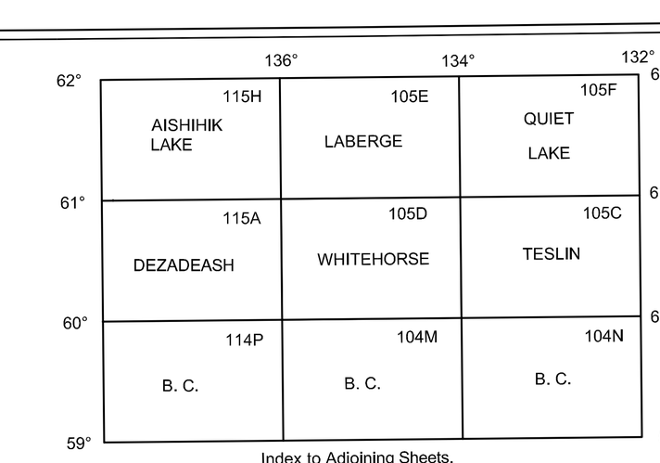

Index to Adjoining Sheets.

Magnetic Declination 1979 varies from 30° 42' easterly at the centre of the west edge to 31° 09' easterly at the centre of the east edge. Mean annual change 20.4' westerly.

GEOPROCESS FILE - SUMMARY REPORT

WHITEHORSE MAP AREA - NTS 105D

INTRODUCTION

The GEOPROCESS File is a compilation of information and knowledge on geological processes and terrain hazards, including mass movement processes, permafrost, flooding risks, faults, seismic activity and recent volcanism, etc. Please refer to the GEOPROCESS File User Guide for more in-depth information on how the maps were developed, which other GEOPROCESS File maps are available, how to utilize this inventory and how to interpret the legend. Special interest should be taken in the detailed description of the terrain hazard map units. Appendices in the User Guide include summary papers on the geological framework, permafrost distribution, and Quaternary geology in Yukon and a list of comprehensive GEOPROCESS File references.

This report includes a brief discussion of the scope and limitations of the GEOPROCESS File compilation maps followed by summaries of the bedrock geology, surficial geology and terrain hazards for this NTS map area, and a list of references.

Geological Processes and Terrain Hazard Compilation Maps

The GEOPROCESS File map units were drafted on the 1:250 000 topographic base maps through interpretation from bedrock geology maps, surficial geology maps and in some cases terrain hazard maps at various scales. The compilation maps have a confidence level reflecting the original source material. All materials used to produce the maps are listed in the references on each map. A file containing the documentation used to construct these maps is available at Exploration and Geological Services Division, Indian and Northern Affairs Canada in Whitehorse, Yukon. Areas for which no surficial geology or terrain hazard information is published were left blank. Summary reports on surficial geology and terrain hazards for these map sheets were written by extrapolating the data from adjacent map sheets or smaller scale maps. Information from small scale (e.g. 1:1 000 000) maps was used for the summary reports, but not redrafted onto the 1:250 000 GEOPROCESS File maps.

The GEOPROCESS File compilation maps are intended as a first cut planning tool; the legend on the maps describes the general aspects of terrain hazards (also see below) and associated geological processes. **These maps should never replace individual site investigations for planning of site specific features, such as buildings, roads, pits, etc.**

Bedrock Geology Summaries

Each 1:250 000 NTS map area is described according to morphogeological belts and terranes defined by Gabrielse et al. (1991) and Wheeler et al. (1991). Bedrock geology, geological structures and mineral occurrences are briefly described and taken largely from the referenced, most recent 1:250 000 geological map with additional contributions from Wheeler and McFeely (1991), and Yukon MINFILE (1993). A summary paper ("A Geological Framework for Yukon") in Appendix A provides a framework and context for each of the bedrock summaries.

The level of knowledge and understanding of Yukon geology is constantly evolving with more detailed mapping and development of geological models. Names, ages and terrane affinities of rock units on the most recent 1:250 000 geological maps may, in some cases, now be considered incorrect. Thus information contained within some of the bedrock geology summaries may be out of date. Although much of the information reflects the knowledge at the time that the source map was published, additional information has been inserted whenever possible to assist the user in merging the information with current geological maps, concepts and understanding. The age ranges for similar packages of rocks may also vary between map areas since the actual rocks, or at least the constraints on their age, may vary between map areas.

BEDROCK GEOLOGY (Wheeler 1961)

Most of the Whitehorse map area is in the Intermontane Belt except the southwestern portion which is in the Coast Belt. The Intermontane portion of the map area is characterized by rounded mountainous topography of the Teslin Plateau while the Coast Belt regions are rugged with much greater relief and outcrop exposure. The Yukon River valley and headwater lakes are the most notable physiographic features.

The Intermontane portion of the map area is underlain by the volcanic and sedimentary rocks of Stikinia and Cache Creek Terrane. Stikinia forms a northwest-trending belt that comprises the bulk of the map area and is composed of 230-200 million year old Lewes River Group basalt flows, andesite and associated pyroclastic rocks. These rocks are overlain by 200-160 million year old Whitehorse Trough Lewes River Group greywacke, siltstone, argillite, conglomerate, tuff and limestone, and Laberge Group greywacke, arkose, quartzite, conglomerate, siltstone, argillite and hornfels. Cache Creek Terrane rocks occur in the southeastern part of the map area and are faulted against rocks of Stikinia. Cache Creek rocks include 360-180 million year old greenstone flows, pyroclastic rocks, limestone, limestone breccia, chert and metamorphosed volcanic rocks containing numerous variably serpentinized bodies of dunite, peridotite and pyroxenite. Tantalus Formation (100-60 million years old) arkose, siltstone, chert-pebble conglomerate argillite and coal occur as numerous small exposures along the western margin of Stikinia.

The Coast Belt portion of the map area is composed of ancient, metasedimentary rocks and more recent felsic plutonic rocks. The pre-550 to 320 million year old metasedimentary quartz-mica, quartz-chlorite, and mica schists, quartzite, micaceous quartzite, gneiss, marble and amphibolite used to be called the Yukon Group, but now are grouped as rocks of the Nisling and Nasina Assemblages of Yukon Tanana Terrane. The plutonic rocks consist of 180-50 million year old granite, granodiorite, quartz monzonite, quartz diorite, diorite and syenite of the Coast Plutonic Complex. Similar plutons also intrude Stikinia and Cache Creek Terrane rocks throughout the map area. Coarse-grained 55 million year old alaskite in the western part of the map area is crumbly weathering and shows well-defined joint surfaces. Volcanic rocks of the 95-70 million year old Hutshi Group (Mount Nansen and Carmacks groups) and 55 million year old Skukum Group include andesite, basalt, rhyolite, breccia and tuffs that are scattered through the map area. The youngest rocks in the map area are 2-9 million year old Miles Canyon columnar jointed olivine basalt and minor pyroclastic rocks which form numerous exposures, particularly near Whitehorse where they are known to overlie unconsolidated gravels.

Mineral Deposits and Occurrences

There are 196 mineral prospects listed in Yukon MINFILE for the Whitehorse map area. Most of these are fairly small, gold-silver veins of the Wheaton River area or copper-molybdenum skarns in Lewes River Group limestone adjacent to 115 million year old granodiorite plutons of the Whitehorse Copper Belt. Greater than 123 000 tonnes of copper, 90 tonnes of silver and 7 tonnes of gold were extracted from over 10 million tonnes of ore from seven deposits within the copper belt. Gold-silver mines included the Mount Skukum mine which produced 2622 kg of gold from 201 461 tonnes; the Venus mine on Montana Mountain which produced 383 kg of gold, 12 tonnes of silver, 2440 tonnes of lead and 1650 tonnes of zinc from 66 000 tonnes of ore; and the Arctic Caribou deposit, also on Montana Mountain, which produced 543 kg of gold and 18 tonnes of silver from 53 500 tonnes of ore.

Reserves are reported for the following mineral deposits:

Deposit	Tonnes	Commodity
Becker-Cochran	127 273	4% antimony
Arctic Caribou	74 575	13.4g/t Au, 350 g/t Ag
Mount Skukum	100 000	14.7 g/t Au
Skukum Creek	800 150	7.6 g/t Au, 275 g/t Ag
Venus	100 000	8.37 g/t Au, 247 g/t Ag 2.1% lead, 1.4% zinc
Whitehorse Copper (in several deposits)	3 000 000	1% Cu, 0.06% molybdenum 0.1 g/t Au, 3.7 g/t Ag

The area also hosts copper-gold, antimony and lead-silver veins as well as uranium and asbestos occurrences. Numerous coal occurrences are associated with Tantalus Formation strata southwest of Whitehorse including reserves of 500 000 tonnes at the Whitehorse Coal deposit.

Limited placer mining has been carried out on Sheldon Creek which drains into the Teslin River. A few attempts at placer mining have taken place on the Wheaton River.

SURFICIAL GEOLOGY

The Whitehorse map area lies within the limits of the McConnell Glaciation (Bostock, 1966). Subsequent to the maximum extent of McConnell ice, deglaciation produced disrupted drainage systems and large glacial lakes as a result of a complex assemblage of ice lobes restricted to valley bottoms which were controlled by the local topography. In the Whitehorse map area, representative sequences of Quaternary deposits are found in many major valleys such as the Yukon River valley, the Takhini River valley, and the M'Clintock River valley. Typically, morainic and colluvial blankets overlying the bedrock are found at high elevations above valley bottoms. Glaciofluvial sand and gravel terraces flank the valley sides and pitted or hummocky deposits of sand and gravel deposits line the bottom of some valleys. In the Takhini River and the Tagish River valleys, glacial lake Champagne deposited up to 75 m of silt and clay. These fine-grained, soft sediments are easily eroded and are susceptible to slumping, thermokarsting and frost heaving. Strandlines (beach deposits) can also be seen on valley sides at average elevations of 2500 ft above sea level.

The major sources of information for the compilation of terrain hazards and processes map include 1) the Southern Lakes ecological land classification mapping (Morison and McKenna, 1981), and 2) the surficial geology maps by Morison and Klassen (1991) and various soil surveys by Mougeot and Smith (1992) and Rostad, et al. (1977).

TERRAIN HAZARDS

Geological processes within the Whitehorse map area that present the most immediate hazard to human activity are related to extreme topography, primarily in the Coast Mountains in the southwestern portion of the map area. Steep ridges, debris-filled cirques, remnants of alpine glaciers, and steep precipitous walls are common.

Seismicity

One magnitude 4-5 earthquake and three magnitude 2-3 earthquake epicentres have been recorded in the southern portion of the map area. No evidence of landslide activity or fault movement related to these events has been noted. There is, however, concern over the presence of clay and silt substratum under the City of Whitehorse, since they are a good transmitter of S-waves. The effects of large magnitude earthquakes in the Gulf of Alaska are, as a result, commonly felt in the City of Whitehorse.

Mass Movement Processes

Rapid mass movement hazards include slope failures, avalanches and rockfalls. These active processes are considered severe hazards and should be considered in development activities in the Whitehorse map area. Periglacial processes such as solifluction, nivation and thermokarst may impact the stability of slopes covered by colluvial and morainal deposits, as well as the stability of river banks cut into silty sediments.

Snow slides affect the south Klondike Highway just north of the British Columbia-Yukon border. These are monitored on a regular basis and the highway is closed when hazards reach unacceptable levels.

Permafrost

The Whitehorse map sheet is part of the scattered permafrost zone (Brown, 1978). Generalized comments about permafrost distribution can be inferred from information available in adjoining map sheets (Heginbottom and Radburn, 1992). Permafrost is probably more common at high elevations, in morainal and colluvial deposits with visible ice, and nivation and cryoplanation features. At lower elevations, alluvial and glaciolacustrine sediments may have less extensive permafrost but higher ice content. Thermokarsting can develop in fine-grained glaciolacustrine sediments and fine-grained alluvial sediments in areas such as the Takhini valley (Rampton, 1972; Klassen, 1979).

Flooding Risks

Flooding in the Whitehorse map area is caused by unusually high precipitation, snowmelt runoff or ice jams during break-up time. Ice jams commonly occur along the Yukon River, below Lake Laberge (Underwood McLelland, 1983). The Marwell area, located at the north end of the City of Whitehorse, is often flooded during late fall and early spring because of ice dams on the Yukon River. Minor flooding may occur at the mouth of the Takhini River into the Yukon River.

Other

Areas underlain by loosely consolidated boulder tills containing large granitic boulders can produce significant levels of radon gas in houses. This problem is easily overcome by using proper construction and ventilation techniques.

NOTE: A new digital compilation of Yukon Geology is now available by Steve Gordey and Andrew Makepeace (GSC Open File D3826 and/or DIAND Open File 1999-1(D)), and more recent MINFILE updates should also be verified (Yukon MINFILE, 2001).

References - Whitehorse Map Area NTS 105D

Note: To be thorough, check the references for adjacent NTS map sheets and the General Reference List. Most of the following references should be available for viewing in the DIAND library on the third floor of the Elijah Smith building in Whitehorse. The library and call number of some internal government reports are listed.

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* References used in the compilation of this map.

LEGEND

LEGEND TERRAIN HAZARDS

MAP SYMBOL	TERRAIN HAZARDS	ASSOCIATED RISK LEVELS, COMMENTS
	Mass Movement Processes	
A	Snow Avalanched.	high
F	Extremely slow to moderate rates of failure in soil and bedrock, including soil creep, rock creep, earthflow, soil or rock slump, debris or rock slide.	low to intermediate
R	Moderate to extremely rapid rates of failure in soil and bedrock (1.5 m/d to >3 m/s), including rock slump, debris slide, rock slide, debris flow, debris torrent, debris avalanche, rockfall, rock avalanche.	high
	Arctic, Alpine and Periglacial Processes	
X	Permafrost present.	low
K	Thermokarst present.	low
S	Solifluted.	low to intermediate
Z	Grouped, cryoturbated, solifluted, nivated.	low to intermediate
	Fluvial Processes	
B	Braided, unstable channels, risk of flooding.	intermediate to high
E	Fluvial erosion, deposition and low risk of flooding.	low to intermediate
J	Anastomosing.	intermediate to high
U	Flooded regularly.	intermediate to high
	Miscellaneous Erosion Processes	
T	Karst.	intermediate
P	Piping.	intermediate to high
V	Gullied.	low to intermediate

On Site Symbols	Risk Level
Unit boundary (defined, approximate).	
Erosional escarpment.	high
Landslide escarpment.	high
Landslide (includes source and runout areas).	high
Pingo.	high
Rock glacier.	high
Spring or saline seep.	low
Observation of frozen soil or ground ice.	low
Rapid mass movements (debris torrent) with known point source. Limits of runout not implied by symbol.	high
Slow mass movement (earth flow) with landslide, escarpment source. Limits of landslide runout not implied by symbol.	intermediate to high

LEGEND SEISMIC EVENTS

SYMBOL	MAGNITUDE REPRESENTED	SYMBOL	MAGNITUDE REPRESENTED
⊡	<2.0	⊡	4.0 to 4.999
⊡	2.0 to 2.999	⊡	5.0 to 5.999
⊡	3.0 to 3.999	⊡	>6.0

LEGEND GEOLOGICAL PROCESSES

MAP SYMBOL	DESCRIPTION	INFERRED HAZARDS
cf	Talus fan or apron, moderate to steep slope, coarse angular bedrock fragments, sources are often areas of rapidly disintegrating bedrock.	Rock fall and debris flows common on active fans, steep slopes generally unstable to traffic.
cl	Landslide, moderate slope, varies from large blocks of bedrock to finer material.	Landslides generally are recurrent in susceptible areas and may be become active if disturbed.
cs	Colluvium covered slope, gentle to moderate slope, underlain by unsorted rubble, solifluction and other periglacial features common.	Areas of fine textured materials and gentle slopes at high elevations, where there is ground ice will be susceptible to high solifluction rates and thermokarst if disturbed.
fa	Alluvial fan, active.	Subject to shifts in channel and bar positions, occasionally subject to flooding.
fp	Floodplain.	Subject to shift in channel and bar positions, occasionally subject to flooding.
ice	Glacier ice.	Crevasses.
im	Mountain ice caps.	Avalanches, ice and rock falls, and crevasses.
is	Cliff glacier.	Avalanches, ice and rock falls.
l	Lacustrine or glaciolacustrine sediments.	Silt and clay, usually susceptible to frost heaving and, if permafrost present, to thermokarsting when disturbed.
m/i	Rock glacier, debris covered glacier.	Ice at depth make surface susceptible to thermokarst, unstable slopes.
o	Organic.	Thick organic matter is often underlain by permafrost. Disturbance of permafrost may cause poor drainage and thermokarsting.

LEGEND FAULTS

Fault defined, approximate, assumed, extrapolated beneath overburden

Fault Solid circle indicates downthrown side Arrows indicate relative movement

Thrust Fault (teeth indicate upthrust side)

Airphoto Lineament

LEGEND QUATERNARY VOLCANISM

all units shown are Miles Canyon Basalt Miocene-Pliocene (8.8 Ma, 2.4Ma K/Ar)

OTHER FEATURES

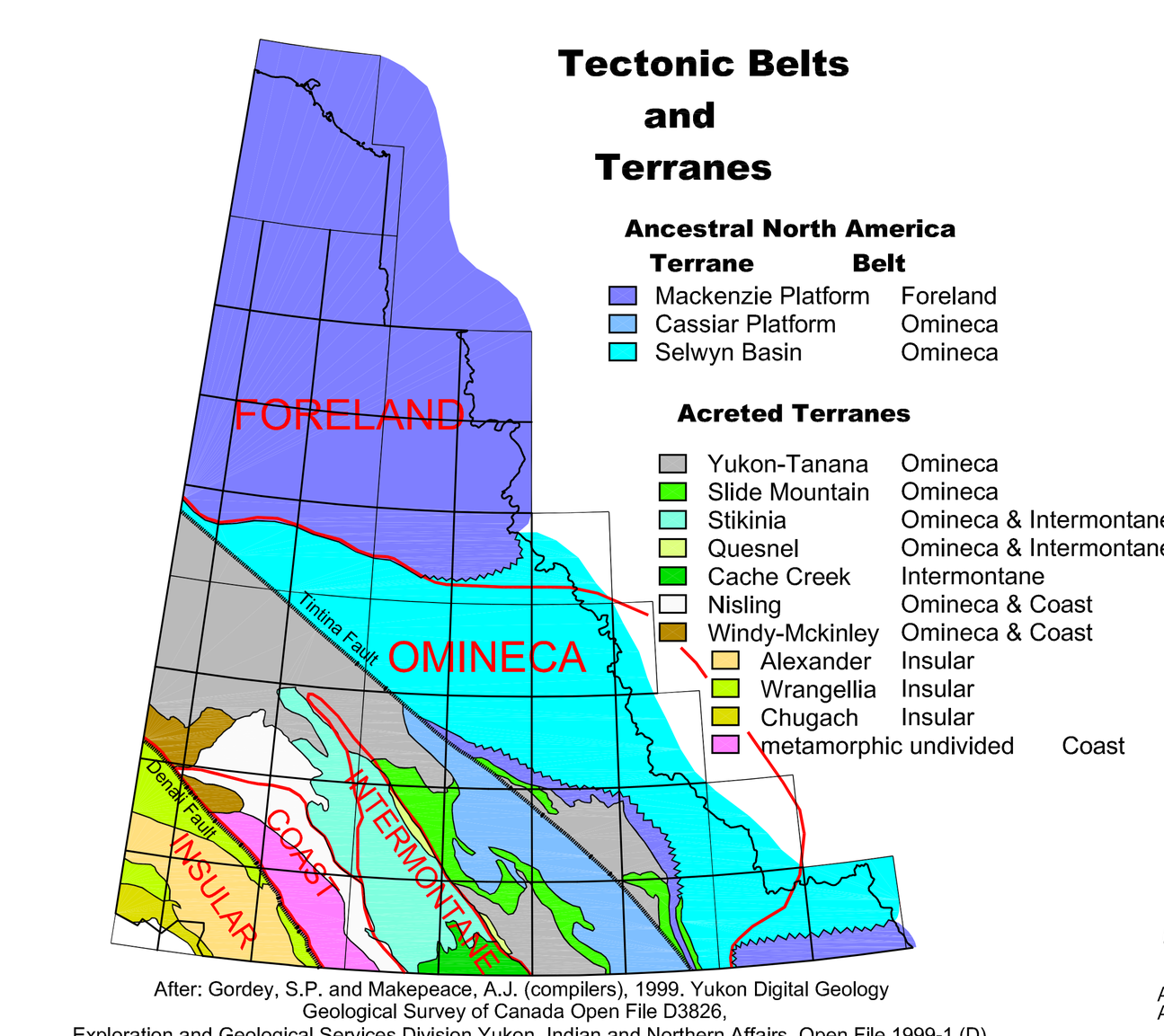
Roads

Streams

Lakes

Marsh

NOTE: Where areas have more than one identified process or hazard, the colour of the encompassing polygon is assigned based on a hierarchical scheme relating to the severity of the hazard. The relative order of severity is: Terrain Hazards (Mass Movement Processes then Fluvial Processes then Arctic, Alpine and Periglacial Processess) followed by Geological Processes.



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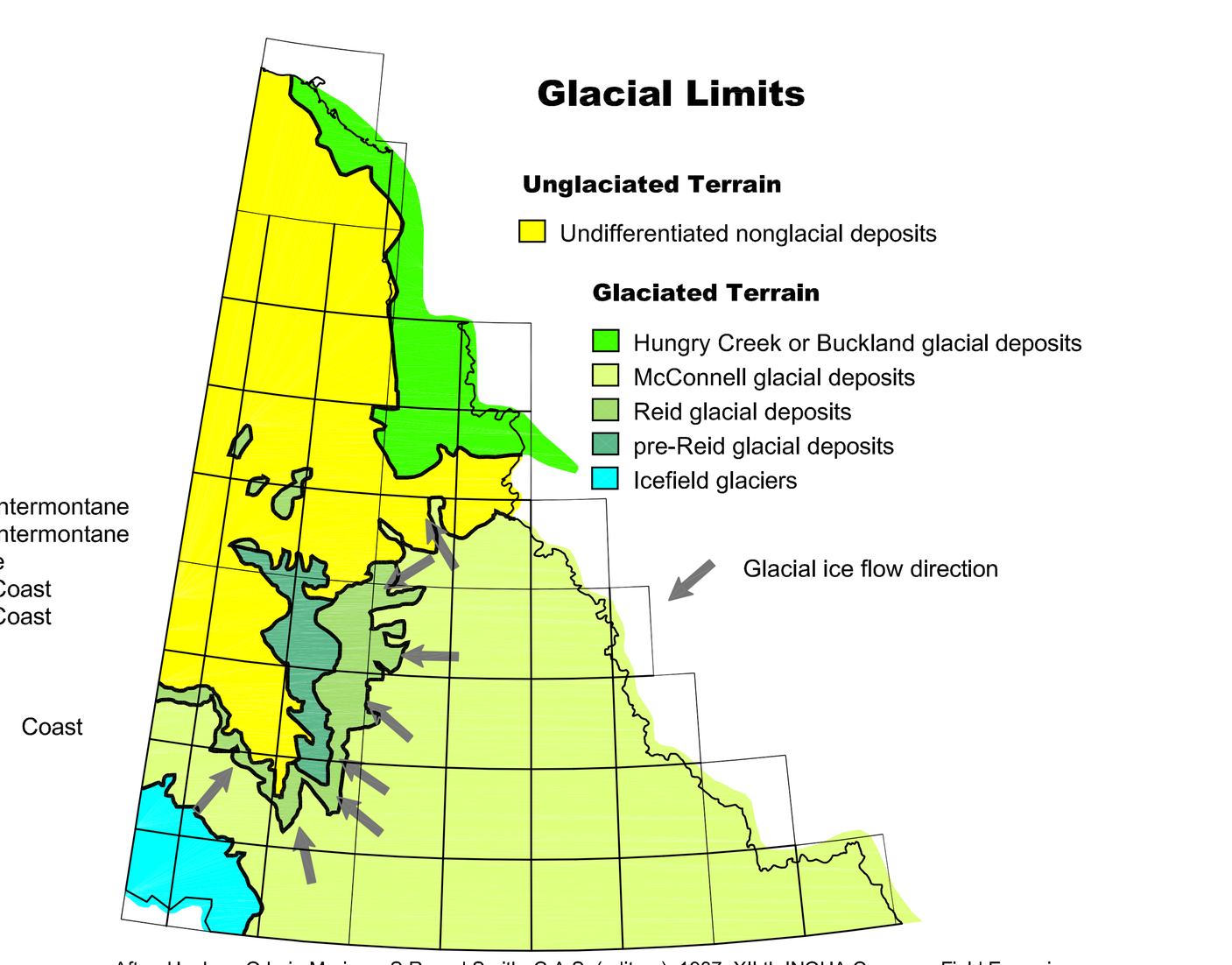

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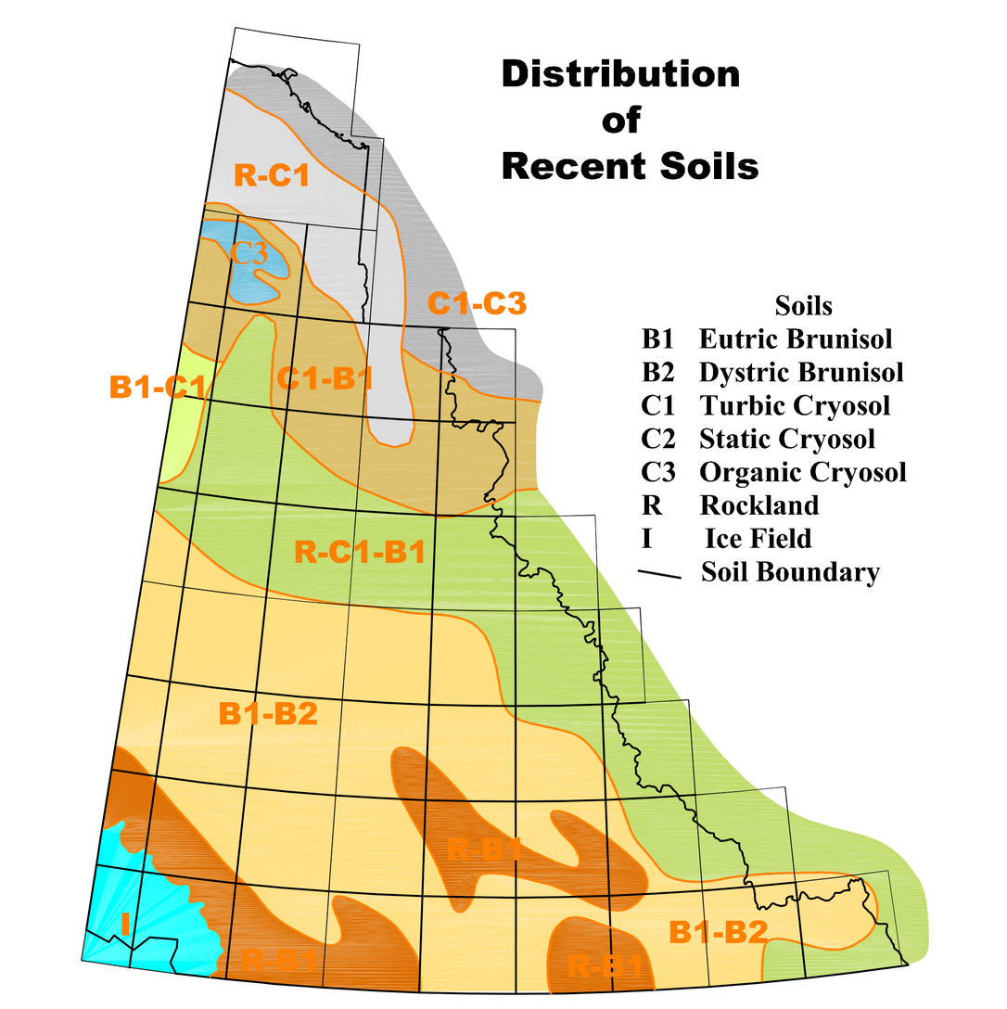

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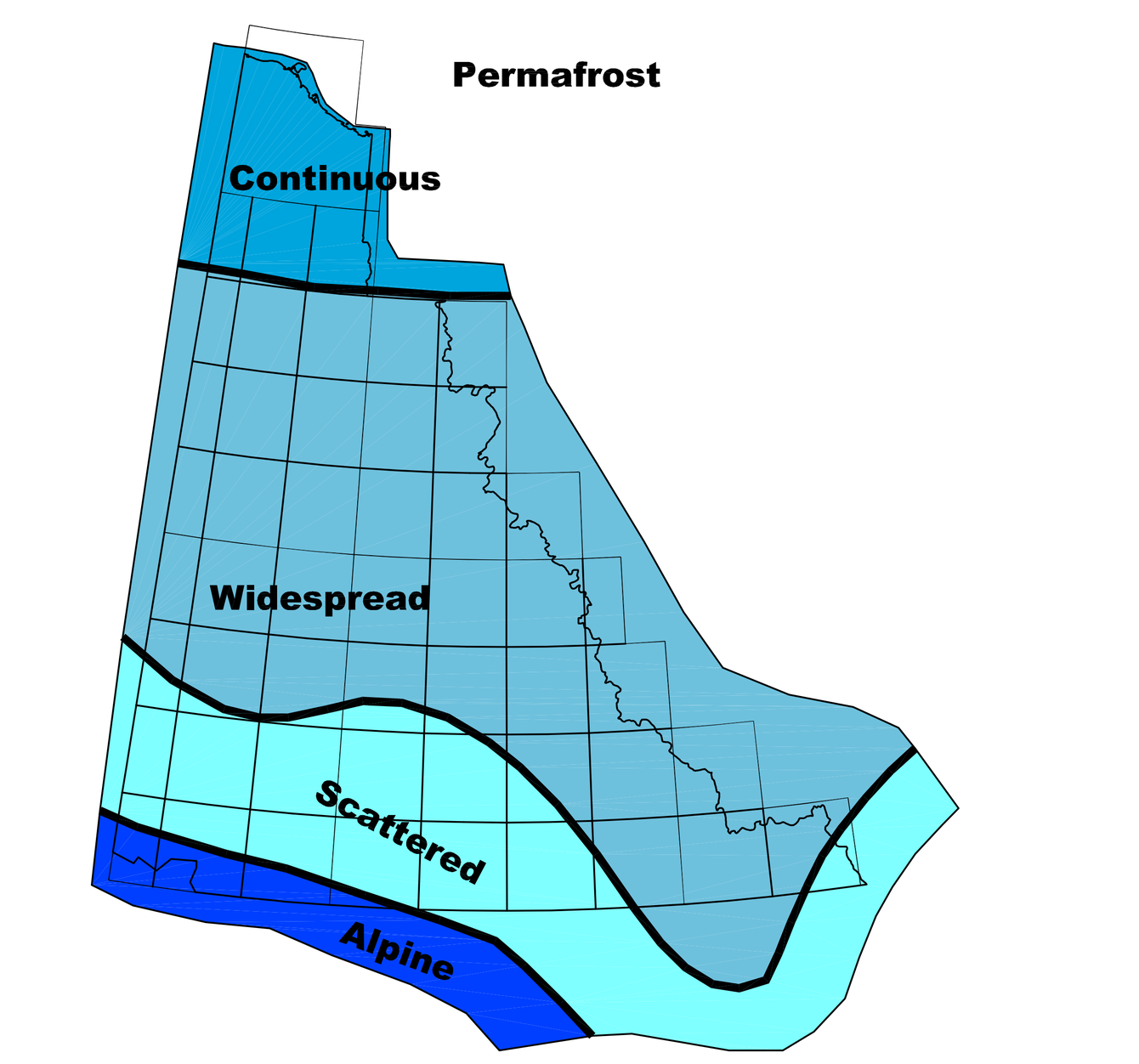

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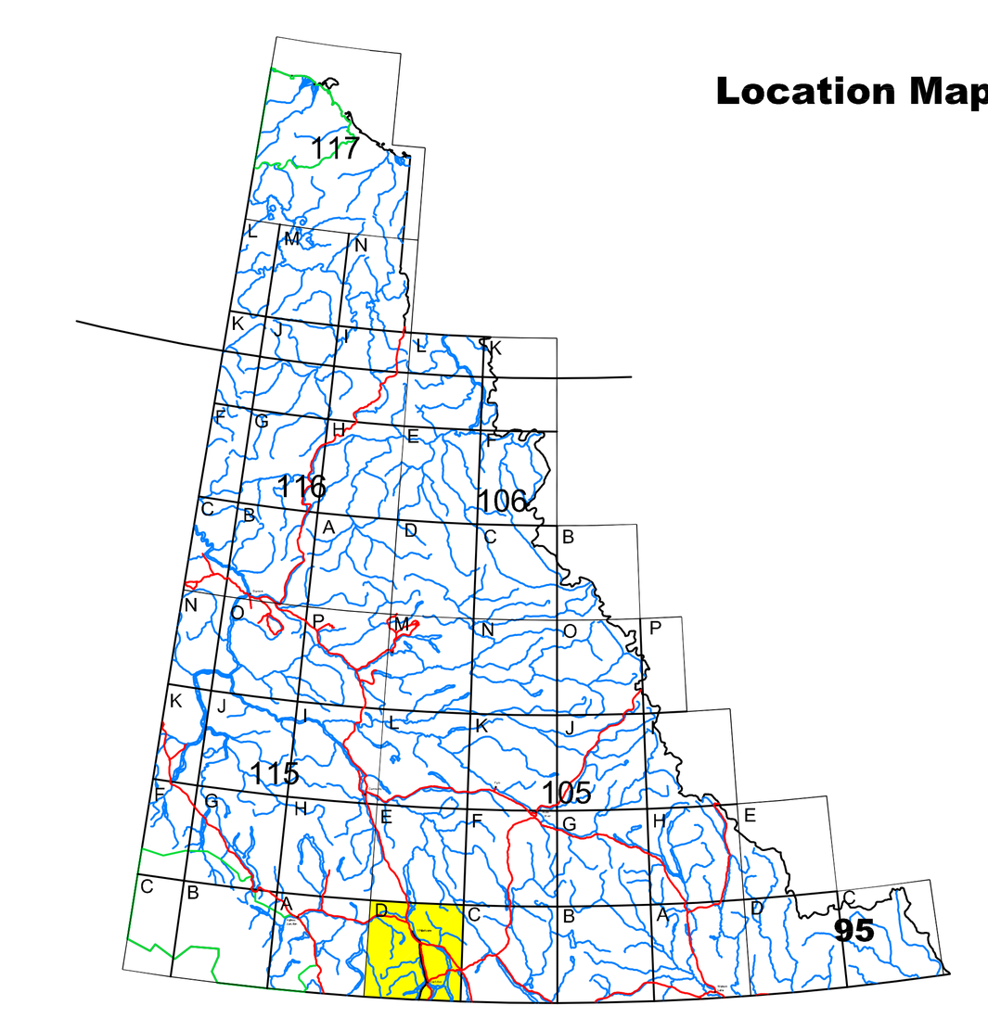

Exploration and Geological Services Division

Yukon Region

Indian and Northern Affairs Canada

Yukon GEOPROCESS File

Geological Processes and Terrain Hazards of Whitehorse 105D

by

Doherty, R.A., Mougeot, C.M. and vanRanden, J.A.

Copies of this map may be obtained from Geoscience and Information Sales c/o Whitehorse Mining Recorder, Indian and Northern Affairs Canada, Room 102, 300 Main Street, Whitehorse, Yukon Y1A 2B5 (867) 667-3266; FAX; (867) 667-3267

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