

HOGGAN ENGINEERING & TESTING (1980) LTD.

**GEO TECHNICAL INVESTIGATION (1993)
PROPOSED HILLCREST AREA "D" SUBDIVISION
WHITEHORSE, YUKON TERRITORY**

1993

HOGGAN ENGINEERING & TESTING (1980) LTD.

REPORT NO. 8002-121A

GEOTECHNICAL INVESTIGATION (1993)

HILLCREST AREA "D" SUBDIVISION

WHITEHORSE, YUKON TERRITORY

February, 1993

HOGGAN ENGINEERING & TESTING (1980) LTD.
14 BURNS ROAD
WHITEHORSE, YUKON TERRITORY

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HOGGAN ENGINEERING & TESTING (1980) LTD.**GEOTECHNICAL INVESTIGATION**

PROJECT: Proposed Hillcrest Area "D" Residential Subdivision

LOCATION: South of Logan Neighbourhood
West of Hamilton Boulevard
Whitehorse, Yukon Territory

CLIENT: GOVERNMENT OF YUKON
Community and Transportation Services
Municipal Engineering Branch M-4
Box 2703
Whitehorse, Yukon Territory

ATTENTION: Mr. Jim Mayoh, P. Eng.

INTRODUCTION

This report presents the results of the soils investigation undertaken for the proposed Hillcrest Area "D" residential development. The investigation covers the north half of the subdivision located south of and adjacent to the Logan Neighbourhood in Whitehorse, Yukon Territory. The objectives of this investigation are to determine the subsurface soil conditions to provide recommendations for design and construction aspects of the subdivision including the following:

- i) **Underground Utilities Installation**
 - Trench backfill materials
 - Compaction
- ii) **Surface Utility Construction**
 - Roadway and sidewalk subgrade and base requirements
 - Pavement structure design

As part of the field investigation, 7 testholes have been drilled to furnish subsurface information for the proposed water trunk main extending south of the study area. Information including soils logs and recommendations for the trunk main can be found in Hoggan Engineering & Testing (1980) Ltd. Report No. 8002-121B, "Geotechnical Investigation, Proposed Water Trunk Main, South Hillcrest Area "D".

Authorization to proceed was granted by Mr. Jim Mayoh, P. Eng., of Government of Yukon, Community and Transportation Services, Municipal Engineering Branch. Field work commenced on January 13 and concluded on January 20, 1993.

HOGGAN ENGINEERING & TESTING (1980) LTD.**SITE CONDITIONS**

The proposed Hillcrest Area "D" residential subdivision is situated south of Logan Neighbourhood and west of Hamilton Boulevard in Whitehorse, Yukon Territory. The road R.O.W.'s throughout the north half of the subdivision have been cleared. The remaining areas remain undisturbed and covered with a moderate to dense population of spruce.

The general land formation in this area appears to be gently rolling ground moraine. No defined drainage patterns throughout the area are evident. General topographical relief appears to dip in a westerly direction.

Approximately 30 centimeters of snow cover was encountered in the open R.O.W.'s at the time of drilling. Access to and throughout the site was achieved with a 4X4 truck and trackmounted drilling unit.

FIELD AND LABORATORY INVESTIGATION

The field drilling program consisted of drilling and sampling a total of 41 testholes throughout the north half of the Hillcrest Area "D", Testholes 8-93 through 48-93 inclusive. All testhole locations and depths were predetermined by the client prior to drilling.

The field investigation was undertaken utilizing a CME 750 trackmounted drill rig owned and operated by IBEX Contracting Ltd. of Whitehorse, Yukon. All testholes were advanced with 150 millimeter diameter solid stem augers to the specified termination depth. Specified testhole depths ranged from 3.5 to 8.0 meters below the ground surface.

Continuous visual soil logs were recorded during the drilling program. Noted were soil types, relative grain sizes, moisture conditions, density conditions, color, and transition zones. Disturbed samples were removed from the auger cuttings at depth intervals of approximately 1 meter. These samples were returned to the laboratory for classification and moisture content determination.

Selected samples were further tested for grain size distribution. Slotted piezometric standpipes were inserted into selected testholes following drilling for groundwater table level monitoring.

HOGGAN ENGINEERING & TESTING (1980) LTD.**SUBSURFACE SOIL CONDITIONS**

A detailed description of the soils encountered and testing performed is provided on the attached testhole logs. In general, a surface mantle of moist loose silts were noted, ranging in thickness from 0.1 meters to 0.45 meters and averaging 160 millimeters. A trace of organics within the silt was encountered in some testholes. The presence of these silts at roadway elevation are not desirable owing to their sensitivity to moisture changes and difficulties anticipated with handling. However, given the relatively limited depth of the surface silts encountered, it is probable that most areas will be sufficiently mixed with the underlying tills during trenching and backfilling operations.

The underlying base material encountered to termination depth of all testholes was found to be a glacial till. The tills were found to vary in content from sandy silts with some gravel to silty sandy gravels. The quantities of gravel to cobble size materials were not available owing to the method of subsurface excavation utilized for the investigation. The presence of cobble sizes were apparent in many testholes owing to difficulties encountered with auger penetration. Past experience with testpits in neighbouring subdivisions revealed cobble and boulder contents to vary randomly from nonexistent to high density.

The tills were found to be of medium to compact density and yielding moisture contents estimated to be in the order of 3 to 4 percent below optimum moisture. The optimum moisture content of the tills in most areas is anticipated to be in the order of 10 percent.

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Slotted standpipes were inserted into selected testholes for water table level determination. Results are summarized as follows:

<u>TESTHOLE NO.</u>	<u>TESTHOLE DEPTH (m)</u>	<u>DEPTH TO WATERLEVEL (m)</u>	
		<u>0 Hour</u>	<u>7 Days</u>
8-93	4.9m	Dry	Dry
14-93	5.5m	Dry	Dry
15-93	5.5m	Dry	Dry
16-93	4.0m	Dry	Dry
20-93	7.5m	Dry	Dry
27-93	5.5m	Dry	Dry
32-93	5.05m	Dry	Dry
40-93	5.05m	Dry	Dry
47-93	5.05m	Dry	Dry

No actual presence of subsurface groundwater was noted during this investigation either during drilling or during piezometric standpipe monitoring. However, our past experience with the various neighbourhoods of Hillcrest Subdivision have shown that discontinuous and or seasonal water seepage zones may exist.

The possible presence of a seepage zone may be at TestHole 19-93 location where Sample #149 showed a marked moisture content increase from adjacent samples.

DISCUSSIONS AND RECOMMENDATIONS**A. Underground Utilities**

1. The ground conditions are considered suitable for the installation underground utilities. No significant problems with excavations are anticipated.
2. Trench walls should be cut back in accordance with the Yukon Occupational Health and Safety Standards. Trench walls should be closely monitored for signs of sloughing, particularly during and after rainfall periods or if groundwater is encountered. In situations where deep or confined trenches mitigate adequate cutback angles, a trench shoring system or use of a cage is recommended. Trenches should be wide enough to accommodate compaction equipment. Spill piles and moving vehicles should be kept at least 0.6 meters away from all trenches.
3. It is recommended that all underground utilities be supported by an imported pipe bedding. The bedding should conform to specifications outlined in Appendix IV of this report. All bedding material should be compacted to 95 percent of the Standard Proctor density at or near optimum moisture content.

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4. The native soils encountered during the soils investigations are considered satisfactory for use as trench backfill. It is emphasized, however, that the soil conditions are known only at testhole locations. Any layers or patches of organic cover remaining must be removed from the site prior to trenching. Past experience has shown that the tills in this area may yield cobble to boulder size stones. It is recommended that any stones exceeding diameters of 300 millimeters be omitted from use as trench back fill material. No cobbles larger than 200 millimeters should be used for fill materials placed within 1.0 meter above the pipe. No materials larger than 100 millimeters should be placed within 1.0 meter of subgrade elevation.
5. Trench backfill should be placed in lifts not exceeding 300 millimeters (before compaction). The recommended compaction criteria for the fill placed 1.0 meter or more below the groundsurface is a minimum of 95 percent of the Standard Proctor density. The recommended compaction criteria for fill materials placed within 1.0 meter of roadway or sidewalk subgrade elevation should be increased to 98 percent of the Standard Proctor density at or near optimum moisture content.

With the type(s) of materials present on this site moisture content will be critical during trench backfill compaction. Some addition of water to the native materials may be required to obtain recommended percent of Standard Proctor density. Alternately, drying may be required, if excessive water is added or if soils become saturated by rainfall or groundwater seepage

6. Past experience in previous Hillcrest subdivision developments has shown that seepage conditions may arise in localized areas. To accommodate for such conditions, a washed rock bedding material should be readily available. Provisions for trench dewatering is also recommended.
7. There is little chance of sulfate attack from the soils encountered throughout this site. C.S.A. Type 10, normal Portland cement may be used for all concrete in direct contact with the soil.

B. Surface Utilities

1. The native silty, sandy, and gravelly glacial till materials are considered fair to good for use as road subgrade materials. However, should moisture be allowed to permeate into these materials, structural capacity of the overall pavement structure may be reduced. Also, due to the high silt content of some of the native materials, a reduction in pavement structural capacity will be noted during spring thaw.
2. The recommended pavement structure varies with the type of roadway. Typical pavement structure "A" is recommended for major collector roadways and typical pavement structure "B" is recommended for local and minor collector roadways.

Typical Structure "A" (Major Collector)

In general, the area should be subcut 475 millimeters below final grade. A pavement structure consisting of the following should be utilized.

****75mm - 12.5mm (maximum size) Asphaltic Concrete**
over
100mm - 20mm (maximum size) Crushed Gravel Base
over
300mm - 50mm Crushed Gravel Sub-Base
over
150mm - Prepared Subgrade (Native)

Typical Structure "B" (Local and Minor Collector)

In general, the area should be subcut 325 millimeters below final grade, a pavement structure consisting of the following should be utilized.

****75mm - 12.5mm (maximum size) Asphaltic Concrete**
over
100mm - 20mm (maximum size) Crushed Gravel Base
over
150mm - 50mm Crushed Gravel Sub-Base
over
150mm - Prepared Subgrade (Native)

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**Asphaltic concrete may be placed in 1, 75 millimeter lift compacted to a minimum of 98 percent of a 50 Blow Marshall density.

3. All subgrade, sub-base and base material should be compacted to a minimum of 98 percent of the corresponding Standard Proctor density at optimum moisture. Materials should not be placed in lifts exceeding 150 millimeters after compaction.

Native subgrade materials should be scarified to 150 millimeters below final subgrade elevation and optimum moisture content obtained prior to compaction.

To insure adequacy of subgrade materials, it is recommended that the prepared subgrade be proof rolled prior to the placement of subsequent lifts of sub-base and base gravels. If excessive deflections are noted additional subexcavation may be required.

4. The width of roadway subexcavation and structure should extend to 0.3 meters horizontally from back of curb. If monolithic curb and walk are being considered, roadway subexcavation and structure should extend to 0.3 meters horizontally from back of walk. If roadway subexcavation and structure are not extended to the recommended width some method of accounting for differential movements between curb and walk should be designed for.
5. Walkways separate from curb and not designed to carry vehicle traffic may be supported by 150 millimeters of 20 millimeter crushed gravel base over 150 millimeters of prepared native subgrade. The gravel base and subgrade should be compacted to a minimum of 98 percent of the corresponding Standard Proctor density at optimum moisture.
6. There is little chance of sulphate attack from the adjacent soils. We recommend that Type 10 Normal cement be utilized for all concrete. The concrete should be air entrained and have a minimum compressive strength of 25 megapascals when exposed to de-icing chemicals and frequent thaw cycles.

HOGGAN ENGINEERING & TESTING (1980) LTD.**CLOSURE**

This report is intended for the confidential and exclusive use of Government of Yukon, Community and Transportation Services, Municipal Engineering Branch and applies only to the proposed Hillcrest Area "D" residential subdivision development. Soil conditions are known only at testhole locations. No interpolation of soil conditions has been made or implied. The recommendations given are based on subsurface conditions encountered and generally accepted engineering practices. No other warrantee expressed is made or implied. During construction, should other soils be encountered, the recommendations may be altered or modified in writing by the undersigned.

CONCLUSIONS

1. The native materials located on this site are considered suitable for the construction of underground and surface utilities.
2. Excavation difficulties may be expected, in some locations, due to the presence of medium dense to compact glacial tills and/or cobbles and boulders.
3. Because of the relatively high insitu density of native materials, it is critical that recommended compaction requirement be met to minimize differential subsidence between native undisturbed and trench backfill materials.
4. The native materials should provide suitable structural capacity as road subgrade. However, due to the nature of soils, moisture contents will be critical both during construction in obtaining compaction requirements and during the life of the pavement structure as strength reduction occurs during spring thaw.
5. Two pavement structures have been recommended for the roadways. The pavement structures will vary according to expected variations in traffic levels on roadways.

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We trust the above is satisfactory for your purpose. If you should have any questions of comments, please feel free to contact the undersigned.

Yours truly,

Al Lang
Al Lang, P. Eng.

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Reviewed by,
Wilbur C. Kofoed
Wilbur C. Kofoed, P. Eng.

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