

Desktop Geotechnical Assessment Vacant Lots 519 and 520, Copper Ridge Whitehorse, YT



Photo credit: Aidan Allen

Prepared for:

**Government of Yukon, Community Services,
Land Development Branch**
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Project No. 106908-01

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July 4, 2022

EXECUTIVE SUMMARY

Hemmera Envirochem Inc. (Hemmera) was retained by the Government of Yukon, Community Services, Land Development Branch to conduct a desktop geotechnical investigation for development of 2 vacant parcels of land located west of Falcon Drive and south of Diamond Way at 60°41'52.9"N 135°06'29.8"W, in the Copper Ridge Neighborhood, Whitehorse, Yukon, herein referred to as the Site.

The vacant lots being considered for development are located within the City of Whitehorse approximately 4 km southwest of the city center. The vacant lots are located on a plateau southwest of the Whitehorse airport at approximately 780m above sea level. The Site is 5.9ha in size, unoccupied, with a slight slope to the north, and covered with spruce and pine trees. It does not seem to have been previously disturbed except for a cutline that runs from Falcon Drive North northwest to the Copper Ridge Place Long Term Care Facilities and a narrow cutline running south from Diamond Way to Falcon Drive south of North Star Drive.

Findings

The findings of the assessment are summarized as follows:

- The surficial geological conditions at the site consist of Glaciofluvial Morainal Till with mixed fragmented sand, mud and Gravel. The morainal or glacial till deposits generally consist of an unsorted mixture of clay, sand and gravel derived from the erosion, transport, and deposition of material by moving historical ice.
- The geomorphology or regional physiography at the site is the Yukon plateau and the bedrock geology of the site consists of granodiorite, quartz diorite, and diorite.
- Based on the site visit and available data there are no severe natural Hazards Risk to the site. Drainage is expected to be good on-site with the natural slope to the north. Nearby groundwater wells within 500m of the site have had groundwater observed between 4.5 and 6.5 mbgs.
- The zoning around the site is predominantly residential single detached with some restricted residential detached, residential multiple housing, parks and recreation, greenbelt, and neighbourhood commercial.
- No features were identified that would warrant any geotechnical setbacks. There is a light slope towards the North on-site.
- Water and sewer are serviced to the area by subsurface city utilities along Falcon Drive and Diamond Way.
- Power and internet are serviced to the area by subsurface utilities owned and operated by ATCO Electric Yukon and Northwestel with utility boxes noted near the parcel.
- The available data does not suggest that any geotechnical conditions would negatively effect building foundations.
- There are no visible geotechnical constraints to road or building construction.

Recommendations

The recommendations of the assessment are summarized as follows:

- Prior to development a geotechnical investigation should be conducted to determine the subsurface soil stratigraphy, depth to bedrock, and properties as they impact the proposed work. This investigation should be completed after the development plan has been drafted but prior to detailed design and should include the presence and condition of permafrost, potential for thaw settlement, presence of bedrock and design parameters for foundation design.

This work was performed in accordance with a Consultant Services Agreement between Hemmera Envirochem Inc. (Hemmera), a wholly owned subsidiary of Ausenco Engineering Canada Inc. (Ausenco), and Government of Yukon, Community Services, Land Development Branch (Client), dated May 3, 2022 (Contract). This report has been prepared by Hemmera, based on research conducted by Hemmera, for sole benefit and use by Government of Yukon, Community Services, Land Development Branch. In performing this work, Hemmera has relied in good faith on information provided by others and has assumed that the information provided by those individuals is both complete and accurate. The findings presented herein should be considered within the context of the scope of work and project terms of reference; further, the findings are time sensitive and are considered valid only at the time the report was produced. The conclusions and recommendations contained in this report are based upon the applicable guidelines, regulations, and legislation existing at the time the report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

This Executive Summary is not intended to be a stand-alone document, but a summary of findings as described in the following Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1.0 INTRODUCTION.....	1
1.1 Site Description	1
1.2 Scope of Work.....	1
2.0 FIELD ACTIVITIES.....	2
2.1 Site Visit	2
3.0 SITE CHARACTERISTICS.....	3
3.1 Surficial Geological Conditions	3
3.2 Geomorphology and Bedrock Geology.....	3
3.3 Natural Hazards Risk	3
3.4 Zoning, Claims and Land Dispositions.....	4
3.5 Geotechnical and Development Setbacks.....	4
3.6 Current Regional Development and Classification	4
3.7 Surface and Subsurface Utilities	5
3.8 Building Foundations.....	5
3.9 Preliminary Subdivision Development	5
4.0 RECOMMENDATIONS.....	6
4.1 Additional Geotechnical Evaluation	6
4.1.1 Geotechnical Drilling	6
5.0 CLOSURE.....	6
6.0 STATEMENT OF LIMITATIONS	7
7.0 REFERENCES.....	8

LIST OF APPENDICES

FIGURES (APPENDED)

Figure 1	Site Location
Figure 2	Surface Geological Conditions
Figure 3	Geomorphology
Figure 4	Bedrock Geology
Figure 5	Zoning, Claims and Land Disposition
Figure 6	Development Potential

APPENDICES

Appendix A	Site Photos
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1.0 INTRODUCTION

Hemmera Envirochem Inc. (Hemmera) was retained by Government of Yukon, Community Services, Land Development Branch to conduct a desktop geotechnical investigation for development of 2 vacant parcels of land located west of Falcon Drive and south of Diamond Way at 60°41'52.9"N 135°06'29.8"W, in the Copper Ridge Neighborhood, Whitehorse, Yukon, herein referred to as the Site. A site location figure is attached (**Figure 1**). Photos are included in **Appendix A**.

This work was performed in accordance with a Consultant Services Agreement between Hemmera Envirochem Inc. (Hemmera), a wholly owned subsidiary of Ausenco Engineering Canada Inc. (Ausenco), and Government of Yukon, Community Services, Land Development Branch (Client), dated May 3, 2022 (Contract). This report has been prepared by Hemmera, based on fieldwork conducted by Hemmera, for sole benefit and use by Government of Yukon, Community Services, Land Development Branch. In performing this work, Hemmera has relied in good faith on information provided by others and has assumed that the information provided by those individuals is both complete and accurate. This work was performed to current industry standard practice for similar geotechnical work, within the relevant jurisdiction and same locale. The findings presented herein should be considered within the context of the scope of work and project terms of reference; further, the findings are time sensitive and are considered valid only at the time the report was produced. The conclusions and recommendations contained in this report are based upon the applicable guidelines, regulations, and legislation existing at the time the report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

1.1 Site Description

The vacant lots being considered for development are located within the City of Whitehorse approximately 4 km southwest of the city center and Yukon River. The vacant lots are located on a plateau southwest of the Whitehorse airport at approximately 780 meters above sea level (masl) in elevation. A map showing the site location is attached (**Figure 1**).

The Site is 5.9ha in size, unoccupied, with a downwards slope towards the North-West away from a high point in the middle of the east side. The vacant parcel is covered with spruce trees, pine trees, and some low-lying willows (Photos 7 in **Appendix A**). Other than recent fire smart maintenance it does not seem to have been previously disturbed except for a cutline that runs from Falcon Drive North northwest to the Copper Ridge Place Long Term Care Facilities and a narrow cutline running south from Diamond Way to Falcon Drive south of North Star Drive. The cutlines can be seen in aerial images before Copper Ridge was developed as far back as the 1980s. The Site is abutted by residential properties immediately to the west and urban roads to the north and east. To the northwest is the Copper Ridge Place Facilities and property. There is no commercial property in the area. A map showing the details of the surrounding properties is attached (**Figure 5**).

1.2 Scope of Work

Based on discussions with Government of Yukon, and our review of the available information, the objectives and scope of the Work were as follows:

- Conduct desktop research to investigate site geotechnical characteristics
- Perform a site visit to confirm topography and general site layout
- Document the investigation activities and findings in a report
- Provide recommendations for additional geotechnical investigation.

2.0 FIELD ACTIVITIES

2.1 Site Visit

The field site visit was carried out on June 14, 2022, by Aidan Allen of Hemmera. The visit consisted of a site walkthrough and general assessment. The site has a high point on the South-East side and is generally sloped towards the North-East but does not have any apparent limiting geological features. There is a monitoring well on-site on the South side of the parcel (Photo 9 in **Appendix A**). On the South-West side of the site there is also a small infiltration drainage depression (Photo 8 in **Appendix A**).

The vacant parcel is accessible from anywhere along the South to South-East side from Falcon Drive as well as directly from Diamond Way to the North-East. There were no limitations to performing the site visit.

Select photographs from the site visit are included in **Appendix A**. A map showing some site features is also attached (**Figure 6**).

3.0 SITE CHARACTERISTICS

3.1 Surficial Geological Conditions

According to the Yukon geological surveys data, the surficial geological conditions at the site consist of Glaciofluvial Morainal Till with mixed fragmented sand, mud and Gravel. The glaciofluvial Morainal till is from the McConnell Glacial meltwater channel. Approximately 1km South of the site is primarily Morainal till surface geological conditions with sand and mud also from the McConnell Glacial meltwater channel. Approximately 1km North-East of the site are Eolian Morainal Till geological conditions with Eolian Veneer mud, sand, and gravel plain conditions.

The Atlas of Canada further expands stating that morainal or glacial till deposits generally consist of an unsorted mixture of clay, sand and gravel derived from the erosion, transport, and deposition of material by moving ice. These deposits are typically rolling and hummocky due the presence of ice with the materials during deposition. The moraine deposits are generally 4 to 10m thick.

A map showing the surface geological condition is attached (**Figure 2**).

3.2 Geomorphology and Bedrock Geology

As per the geomatics Yukon's open data, the geomorphology or regional physiography at the site is the Yukon plateau. The larger region is the Western Canada Cordillera region within the Northern plateau and mountain area. A map showing the geomorphology is attached (**Figure 3**).

According to the Yukon geological surveys data, the bedrock geology of the site consists of granodiorite, quartz diorite, and diorite. To the South-West of the site approximately 3km the bedrock geology changes to green and red greywacke, pebble conglomerate, and mudstone. A map showing the bedrock geology is attached (**Figure 4**).

3.3 Natural Hazards Risk

Based on the site visit and available data there are no severe natural Hazards Risk to the site. Flooding is a low risk because the site appears to have good drainage. For fire the site is moderately vegetated with Spruce and Pine trees (Photos 7 in **Appendix A**) but is surrounded by at least 250 m of residential development (from natural forested areas) and is not considered at risk. According to the topographic data and available soils data there is negligible risk of slope or ground movement. Drainage is expected to be good on-site with the natural slope to the north.

According to historical data from a study in 2014 which included the monitoring well on-site, groundwater was never observed in the 7.7m deep well. Nearby wells from the same study within 500m of the site have had groundwater observed between 4.5 and 6.5 meters below ground surface (mbgs).

According to a study completed in 2021 on a site 600 m away adjacent to Hamilton Blvd, there was a risk of thaw settlement due to melting of ice rich subsurface soils at that location. The presence of permafrost and ice rich soils will need to be investigated prior to development. Some frost susceptible soils are anticipated in this area, but only typical building precautions will be required to mitigate this concern.

The soils would likely be classified as Class D for seismic response based on the National Building Code of Canada (2020).

3.4 Zoning, Claims and Land Dispositions

The current zoning of lot 519 (Northern parcel on-site) is public services while lot 520 (Southern parcel on-site) is zoned parks and recreation. The zoning directly to the North-West of the site is approximately 3.7ha of public services land use. Further to the North and surrounding the property, West, South, and East is approximately 212ha of predominantly residential single detached with some restricted residential detached, residential multiple housing, parks and recreation, greenbelt, and neighbourhood commercial.

There are 3 Quartz Claim groupings in the general area. To the West, 1.8km away, there is a group of claims approximately 240ha in size. To the South, 2.4km away, there is a group of claims approximately 180ha in size. To the South-West, 2.4km, away there is a group of claims approximately 64ha in size.

The only land disposition near the site is the roadway land disposition, about 475m East of the site, is for Hamilton Boulevard. There are also Airport and institutional land dispositions in the area.

A map showing the zoning, claims, and land dispositions is attached (**Figure 5**).

3.5 Geotechnical and Development Setbacks

During the site visit the vacant parcel was examined for potential geotechnical features that would require setbacks. The site was generally flat, and no features were identified that would warrant any geotechnical setbacks. The slope away from the high point is less than 5% and should not be a limiting factor to development.

Development setbacks will vary depending on the classification that is used for the site. All development setbacks should follow the City of Whitehorse Zoning Bylaw.

3.6 Current Regional Development and Classification

There is development on all properties directly adjacent to the site. To the North-West bordering the site there is a public services property occupied by the Copper Ridge Place retirement home. On the North, West, South and East bordering the site are residential single detached properties currently developed with houses built on all the surrounding lots. Further to the South of the site there is some area developed as restricted residential detached. On the Northern border of the site is Diamond Way and on the Eastern to Southern border of the site is Falcon Drive.

The surrounding region on all sides is predominantly developed as residential single detached, restricted residential, and residential multiple housing. There is some public use further North currently occupied by Ecole Emilie-Tremblay. The region far West and East of the site is designated as environment protection.

According to the City of Whitehorse Zoning Bylaw, the classification of the surrounding sites is residential single detached. Based on the size of the lot, location, and surrounding use the site could be classified as residential single detached, residential multiple housing, restricted residential detached, or residential single detached 2.

A map showing the surrounding development is attached (**Figure 6**).

3.7 Surface and Subsurface Utilities

Water and sewer are serviced to the area by subsurface city utilities. The city water and sewer mains travel along Diamond Way and Falcon Drive so they could be easily accessible from the North, East, and South sides of the site.

Power and internet are serviced to the area by subsurface utilities owned and operated by ATCO Electric Yukon and Northwestel, respectively. ATCO Electric and Northwestel do not have open data for their subsurface utilities, but service boxes were noted surrounding the vacant site and it is assumed that they could service the site.

The anticipated soil stratigraphy at this site should not pose any challenges to the installation of subsurface and surface utilities. Utilities should be designed and installed in accordance with City of Whitehorse Servicing Standards Manual.

A map showing the water, sanitary, Northwestel, and ATCO electrical boxes is attached (**Figure 6**).

3.8 Building Foundations

It appears that the surficial geotechnical conditions on site are typical for development in the Whitehorse area. Typical building foundations could be strip or spread footings, pile foundations or raft slabs depending on geotechnical investigation and the type and size of buildings. As noted in section 3.3 natural hazards risk, if found, the presence of permafrost and ice rich soils would affect foundation design and installation.

Geotechnical investigations and foundation design should be undertaken by the property owner before construction of any buildings. Building foundations should be designed in accordance with the National Building Code of Canada (2020).

3.9 Preliminary Subdivision Development

From the site visit, area development, and the anticipated surficial geology there are no geotechnical hinderances to residential road and housing construction.

It is anticipated that underground utilities can be constructed with standard residential methods and materials. All City of Whitehorse servicing standards should be followed.

4.0 RECOMMENDATIONS

4.1 Additional Geotechnical Evaluation

4.1.1 Geotechnical Drilling

Prior to development a geotechnical investigation should be conducted to determine the subsurface soil stratigraphy, depth to bedrock and properties as they impact the proposed development. This investigation should be completed after the development plan has been drafted but prior to detailed design and should include the presence and condition of permafrost, potential for thaw settlement, presence of bedrock, and design parameters for foundation design.

Building/housing foundations should be designed in accordance with the National Building Code of Canada (2020).

5.0 CLOSURE

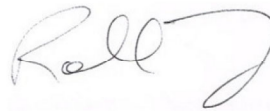
We sincerely appreciate the opportunity to have assisted you with this project and if there are any questions, please do not hesitate to contact the undersigned.

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6.0 STATEMENT OF LIMITATIONS

This work was performed in accordance with a Consultant Services Agreement between Hemmera Envirochem Inc. (Hemmera), a wholly owned subsidiary of Ausenco Engineering Canada Inc. (Ausenco), and Government of Yukon, Community Services, Land Development Branch (Client), dated May 3, 2022 (Contract). This report has been prepared by Hemmera, based on research conducted by Hemmera, for sole benefit and use by Government of Yukon, Community Services, Land Development Branch.

The conclusions and recommendations given in this report are based on information determined from desktop research. Subsurface conditions at this site have not been investigated and may vary from those anticipated in the desktop site investigation. It is recommended practice that a geotechnical investigation be conducted and a Geotechnical Engineer be retained during construction to determine the subsurface conditions specific to each construction location.

The comments made in this report are intended only for the guidance. The parties undertaking the construction should make their own interpretation of the information presented and draw their own conclusions as to how the conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

7.0 REFERENCES

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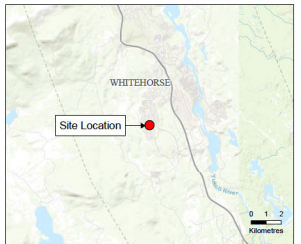
FIGURES

- Figure 1 Site Location
- Figure 2 Surface Geological Conditions
- Figure 3 Geomorphology
- Figure 4 Bedrock Geology
- Figure 5 Zoning, Claims and Land Disposition
- Figure 6 Development Potential



Desktop Planning and Geotechnical Assessment
Copper Ridge, Whitehorse, YT

Site Location



Legend

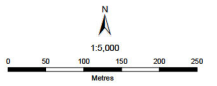
- Site Boundary
- - - Property Line

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

SOURCES

- Contains information licensed under the Open Government Licence - Yukon Territory
- Aerial Image: ESRI World Imagery
- Inset Basemap: ESRI World Topographic Map



NAD 1983 UTM Zone 8N





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106908-01 Production Date: Jun 28, 2022 Figure 1



Surface Geological Conditions

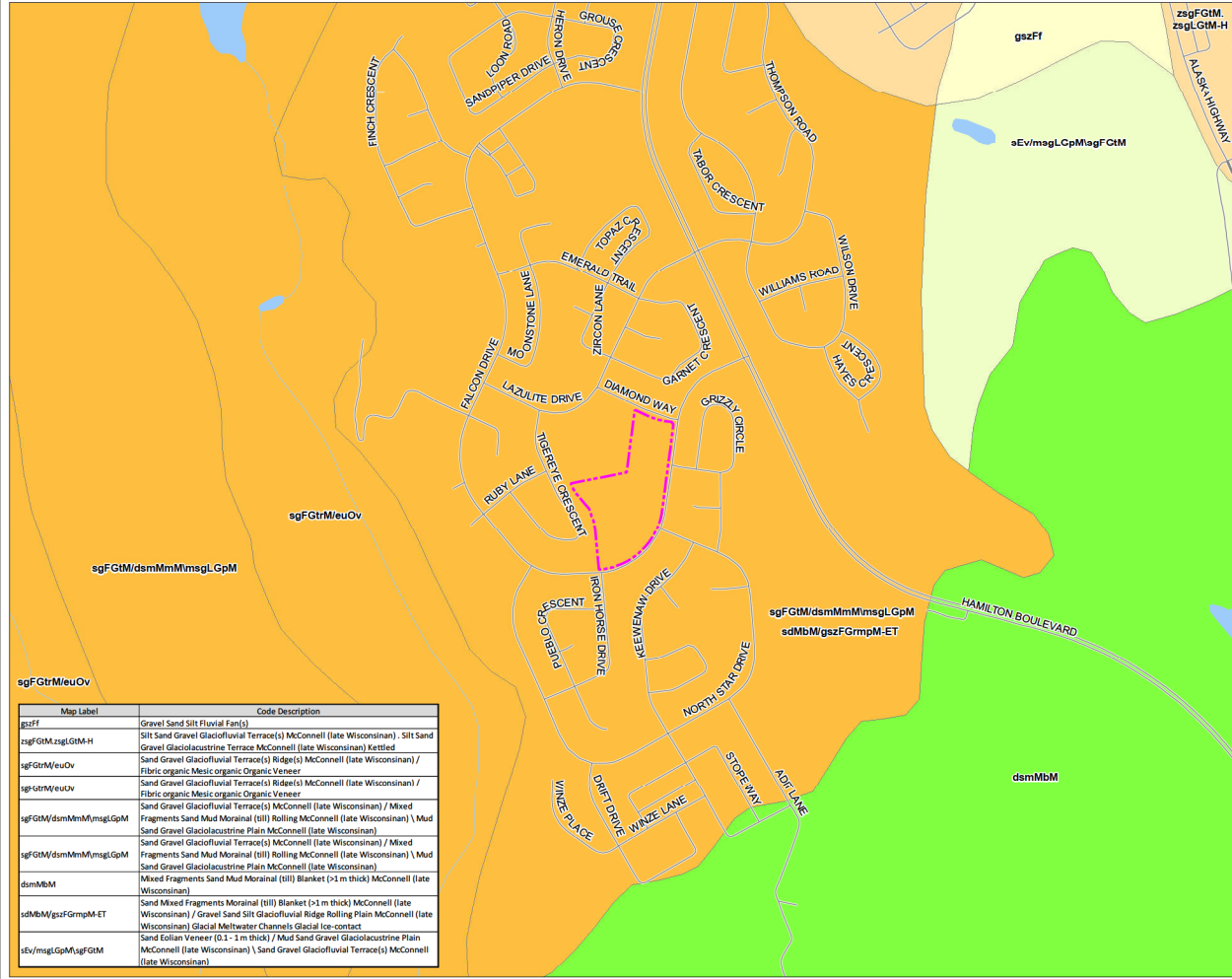
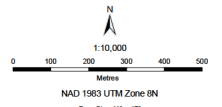
Legend

-  Site Boundary
-  Highway
-  Road
-  Watercourse
-  Waterbody
- Surficial Geology**
-  Eolian / Fluvial
-  Eolian / Glaciofluvial
-  Eolian / Morainal (fill)
-  Glaciofluvial / Morainal (fill)
-  Morainal (fill)

- Notes**
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
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Map Label	Code Description
gszFf	Gravel Sand Silt Fluvial Fan(s)
zsgFGM.zsgLGM-H	Silt Sand Gravel Glaciofluvial Terrace(s) McConnell (late Wisconsinan) \ Silt Sand Gravel Glaciolacustrine Terrace McConnell (late Wisconsinan) Kettled
sgFGtrM/euOv	Sand Gravel Glaciofluvial Terrace(s) Ridge(s) McConnell (late Wisconsinan) / Fibric organic Mesic organic Organic Veneer
sgFGtrM/euZv	Sand Gravel Glaciofluvial Terrace(s) Ridge(s) McConnell (late Wisconsinan) / Fibric organic Mesic organic Organic Veneer
sgFGM/dsmMmM/mysgLGpM	Sand Gravel Glaciofluvial Terrace(s) McConnell (late Wisconsinan) / Mixed Fragments Sand Mud Morainal (fill) Rolling McConnell (late Wisconsinan) \ Mud Sand Gravel Glaciolacustrine Plain McConnell (late Wisconsinan)
sgFGM/dsmMmM/mysgLGpM	Sand Gravel Glaciofluvial Terrace(s) McConnell (late Wisconsinan) / Mixed Fragments Sand Mud Morainal (fill) Rolling McConnell (late Wisconsinan) \ Mud Sand Gravel Glaciolacustrine Plain McConnell (late Wisconsinan)
dsmMBM	Mixed Fragments Sand Mud Morainal (fill) Blanket (>1 m thick) McConnell (late Wisconsinan)
sdMbM/gszFGmpM-ET	Sand Mixed Fragments Morainal (fill) Blanket (>1 m thick) McConnell (late Wisconsinan) / Gravel Sand Silt Glaciofluvial Ridge Rolling Plain McConnell (late Wisconsinan) / Glacial Meltwater Channels Glacial ice-contact
sEv/mysgLGpM/sgFGM	Sand Eolian Veneer (0.1 - 1 m thick) / Mud Sand Gravel Glaciolacustrine Plain McConnell (late Wisconsinan) \ Sand Gravel Glaciofluvial Terrace(s) McConnell (late Wisconsinan)

Geomorphology

Legend

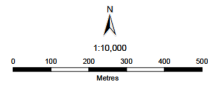
-  Site Boundary
-  Highway
-  Road
-  Watercourse
-  Waterbody
- Regional Physiography**
-  Plateau

Notes

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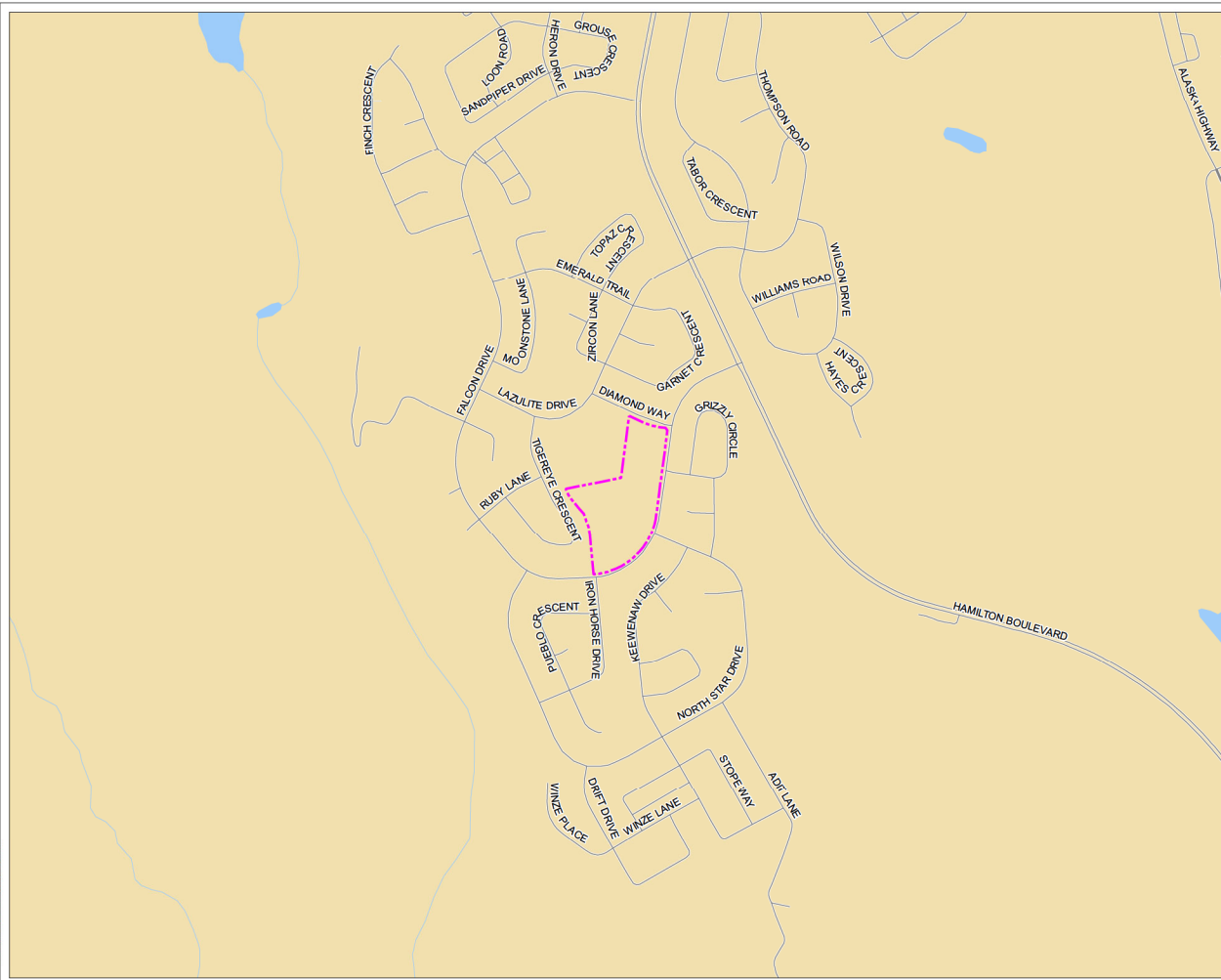
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





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Bedrock Geology

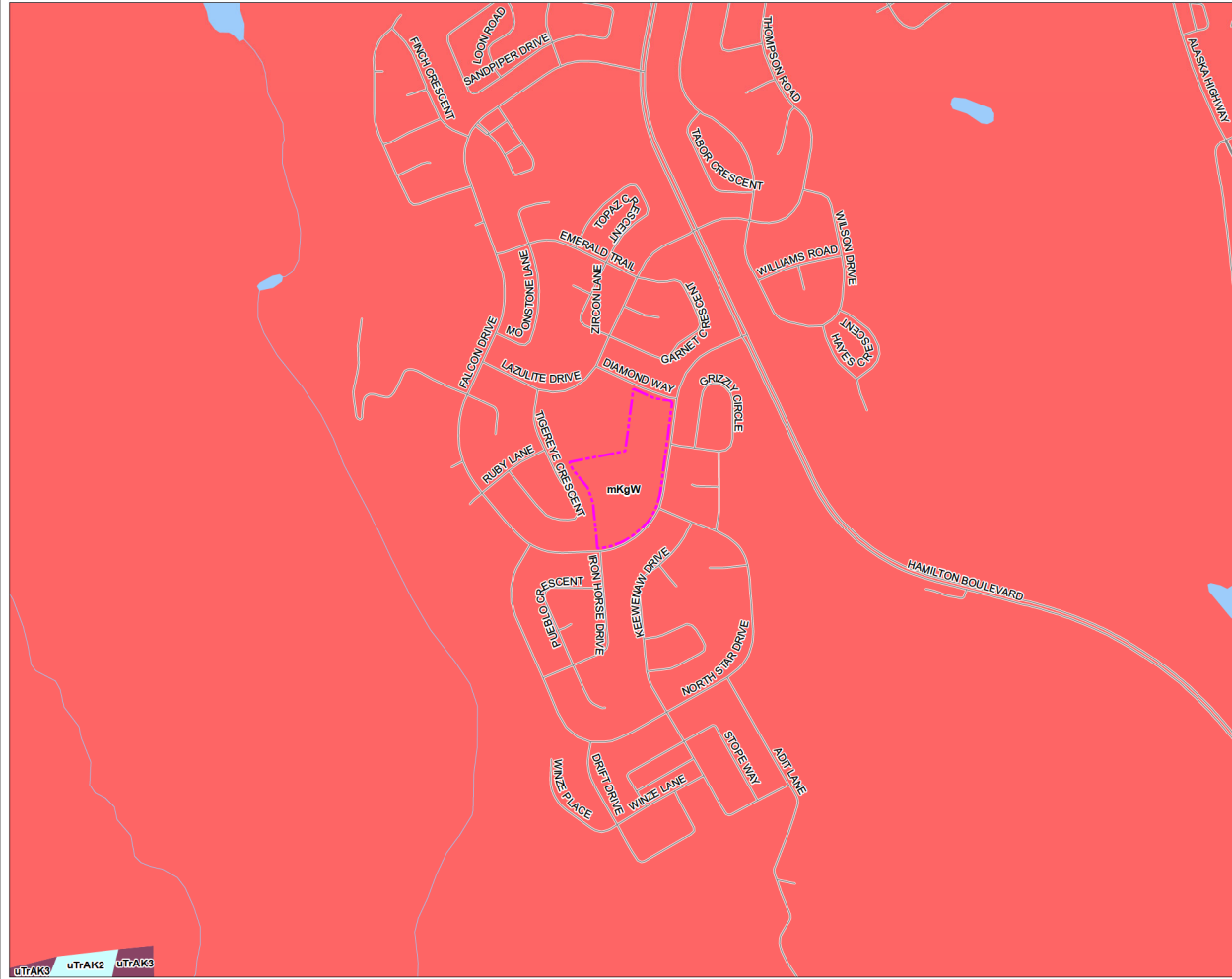
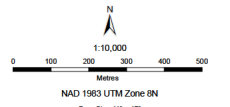
Legend

-  Site Boundary
-  Highway
-  Road
-  Watercourse
-  Waterbody
- Bedrock Geology**
-  mKgW: WHITEHORSE SUITE: Bt-Hbl granodiorite, Hbl quartz diorite and Hbl diorite
-  UTAJK3: MANUJANNA: green and red greywacke and pebbly conglomerate, mudstone
-  UTAJK2: HANCOCK: massive to thick bedded limestone

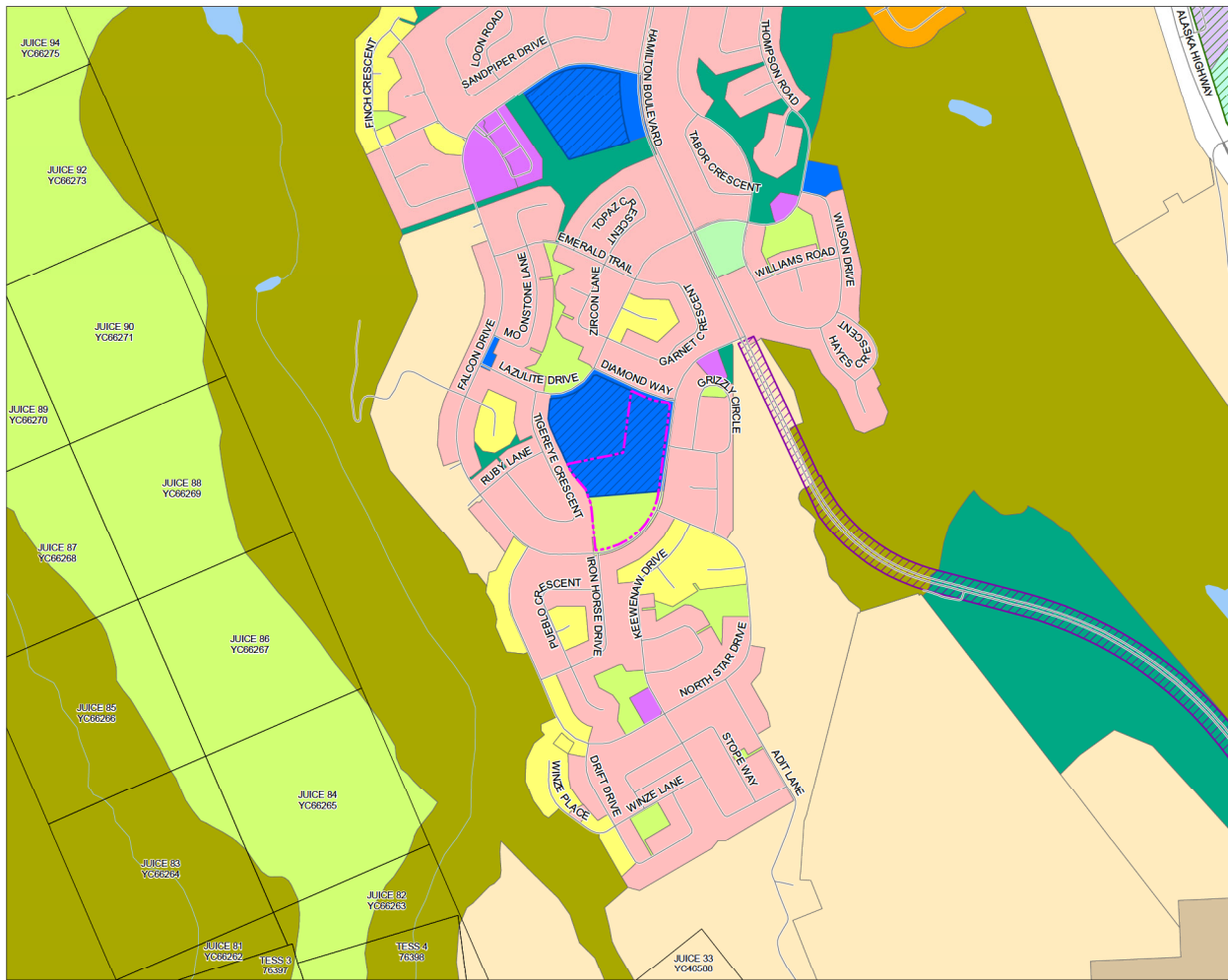
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Zoning, Claims & Land Dispositions



Legend

- Site Boundary
- Highway
- Road
- Watercourse
- Waterbody

Mining Claim

- Active Quartz Claim

Land Disposition Purpose

- Airport
- Institutional
- Roadway

Land Use Zoning

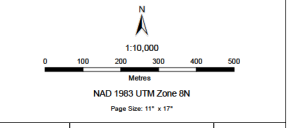
- Highway Commercial
- Neighbourhood Commercial
- Future Planning
- Airport
- Environment Protection
- Greenbelt
- Parks and Recreation
- Public Services
- Residential Multiple Housing
- Residential Mobile Home Park
- Restricted Residential Detached
- Residential Single
- Residential Single Detached 2

Notes

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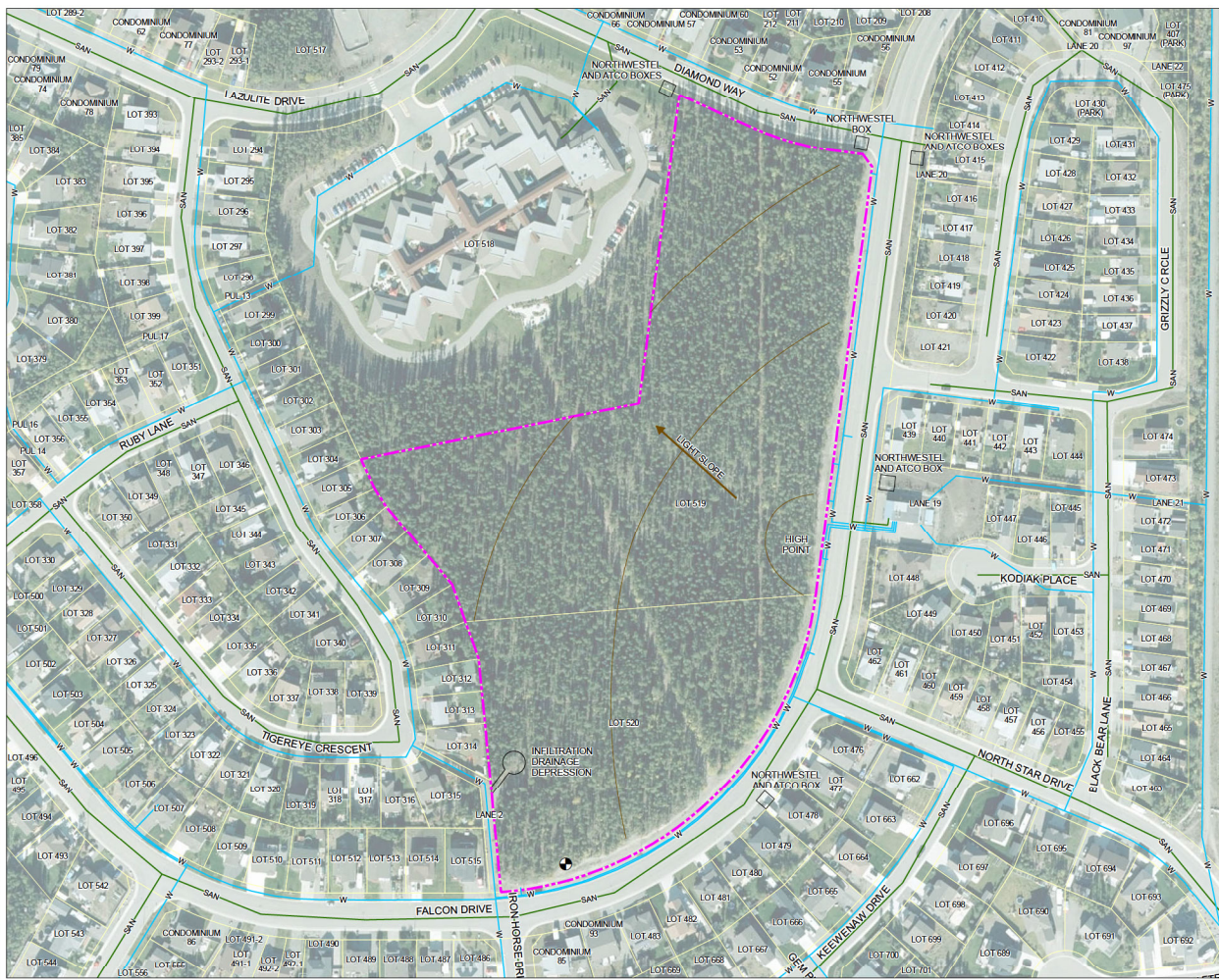
SOURCES

- Contains information licensed under the Open Government Licence - Yukon Territory, Whitehorse
- Land Use Zoning: Whitehorse, 2019



Desktop Planning and Geotechnical Assessment
Copper Ridge, Whitehorse, YT

Development Potential



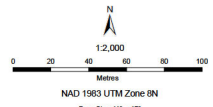
- Legend**
- Monitoring Well Location
 - Slope Direction
 - Topographic Contour
 - Site Boundary
 - Site Feature
 - SAN - Sanitary Sewer Line
 - W - Water Line
 - Property Line

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

SOURCES

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- Aerial Image: ESRI World Imagery



106908-01 | Production Date: Jun 28, 2022 | Figure 6



APPENDIX A

Site Photos



Photo 1 View of vacant parcel site facing South-West during site visit (June 15, 2022).



Photo 2 View of vacant parcel site facing North during site visit (June 15, 2022).



Photo 3 View of vacant parcel site facing West along Falcon Dr. during site visit (June 15, 2022).



Photo 4 View of North-East edge of vacant parcel site along Diamond Way during site visit (June 15, 2022).



Photo 5 View of North West side of vacant parcel site facing towards Copper Ridge Center during site visit (June 15, 2022).



Photo 6 View of cutline on vacant parcel site facing North-West during site visit (June 15, 2022).



Photo 7 View of vegetation on vacant parcel site facing North during site visit (June 15, 2022).



Photo 8 View of infiltration depression on South end of vacant lot during site visit (June 15, 2022).



Photo 9 View of stickup monitoring well on South side of vacant lot during site visit (June 15, 2022).