DELOITTE & TOUCHE INC.

TASK 22F
ROSE CREEK DIVERSION CANAL
PRELIMINARY GEOTECHNICAL EVALUATION

FARO MINE, YT

REVISION B: DRAFT FOR CLIENT REVIEW

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EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation undertaken to support the evaluation of options for increasing the capacity of the Rose Creek Diversion Canal at the Faro Mine, Yukon Territory.

The investigation included a review of existing data and reports, an engineering terrain analysis, shallow geophysical surveys, drilling of 23 boreholes at selected locations along the north and south sides of the existing canal, as well as along a proposed emergency overflow canal alignment located west of Station 46+00.

The area is underlain by metamorphic rocks, primarily a moderately strong calcareous phyllite, with igneous intrusive rocks (primarily strong gabbro) present in some locations below the existing canal. The bedrock is overlain by silty sand till and colluvial (slopewash) materials. The silty sand till contains 20 to 35 percent silt and clay size particles and is generally non-plastic. The colluvial materials vary widely in grain size distribution but in some locations contain 50 to 90 percent silt and clay size particles.

The depth to bedrock on the south (upslope) side of the existing canal ranged from 0 to a maximum of 8.7 meters in the boreholes. On the north (downslope) side of the canal, the depth to bedrock was generally greater than on the south side, and its presence could not be confirmed in some of the holes due to drilling refusal on cobbles and boulders. The maximum confirmed depth to bedrock on the north side of the canal was 12.2 metres.

Discontinuous permafrost was encountered in some of the holes drilled on the south side of the canal, between the diversion dam (Station11+00) and the left abutment of the Cross Valley Dam (Station 50+00). The permafrost in this area contains some excess ice, primarily within the upper 2 metres below ground surface. The underlying silty sand till contained very little excess ice and is expected to be thaw stable.

Permafrost which contained significant excess ice was encountered in the area west of Station 50+00, and particularly in the colluvial fan west of Station 54+00 of the existing canal. These materials would be very unstable when thawed.

The required design capacity of the diversion canal under the Probable Maximum Flood event will depend on whether or not permanent storm water retention ponds are constructed upstream from the canal. Once the required design capacity of the canal has been established, a cost benefit analysis should be undertaken to establish which of the various options for increasing the capacity of the canal will be most cost effective. It is expected that additional field investigations will be required to support the detailed design of the selected option.

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LIMITATIONS OF REPORT

This report was prepared by BGC Engineering Inc. (BGC) for Deloitte & Touche Inc., the interim receiver for Anvil Range Mining Corporation and the Faro Mine Closure Office. The material in it reflects the judgement of BGC staff in light of the information available to BGC at the time of report preparation. Any use which a Third Party makes of this report or any reliance on decisions to be based on it is the responsibility of such Third Parties. BGC accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

As a mutual protection to our client, the public, and ourselves, all reports and drawings are submitted for the confidential information of our client for a specific project and authorization for use and / or publication of data, statements, conclusions or abstracts from or regarding our reports and drawings is reserved pending our written approval.

1.0 INTRODUCTION

1.1 General

This report presents the results of a geotechnical investigation undertaken to support the evaluation of options for increasing the capacity of the Rose Creek Diversion Canal at the Faro Mine, Yukon Territory.

The investigation was undertaken by BGC Engineering Inc. at the request of Mr. Doug Sedgwick of Deloitte & Touche Inc. who are the interim receivers for Anvil Range Mining Corp.

1.2 Project Background

The Faro Mine is located in the central Yukon, approximately 200 km northeast of Whitehorse. The Mine is accessible by an all weather road from Whitehorse and is about 22 km north of the Town of Faro, as shown on the site location map (Figure 1).

Mine operations began in 1969 and ceased in 1998, when the owner, Anvil Range Mining Corporation declared bankruptcy. Deloitte & Touche Inc. were appointed the interim receivers and are working with various regulatory agencies to develop and implement a mine closure plan.

The general arrangement of the Faro Mine is shown on Figure 2. As indicated, the Rose Creek diversion canal is located along the south side of the tailings area. The diversion canal was constructed to provide room for a tailings facility that was constructed in the Rose Creek valley. The canal diverts clean water from the North and South Forks of Rose Creek, around the south side of the tailings storage facility.

Plans and profiles along the existing diversion canal are presented on Figure 3, which shows the eastern (upstream) half of the canal and Figure 4, which shows the western (downstream) section. Cross-sections along the existing canal are presented in Appendix A.

The diversion canal was constructed in two separate stages. An upstream section of the canal, from near Station 10+00 to 19+00 (Figure 3) was completed in 1974 to carry clean water past the second tailings impoundment. A longer downstream section was completed in 1981, in preparation for construction of the intermediate tailings impoundment downstream (west) of the second tailings impoundment. This second reach extended the canal by about 3800 metres from about Station 19+00 to Station 57+00 (see Figure 4), where it discharges back into Rose Creek, downstream from the Cross Valley Dam. The existing canal is therefore about 4700 metres long.

The diversion canal was designed to carry a 1 in 50 year flood event, with 1 meter of freeboard. The contingency design capacity, with no freeboard, will carry a 1 in 500 year flood event. For mine closure, the canal must be designed to carry the Probable Maximum Flood. The capacity of the existing canal could be increased by either excavating the south cut slope to widen the canal, or by increasing the vertical height of the existing north dike.

The maximum design capacity required under the Probable Maximum Flood event will depend on whether or not permanent storm water retention ponds are constructed on either or both of the North and South Forks of Rose Creek to attenuate flows into the diversion canal.

At the time this report was prepared, a decision had not been made with respect to design of the storm retention ponds and therefore the required capacity of the diversion canal was not known. Therefore, the report only provides preliminary geotechnical recommendations.

As indicated on Figures 3 and 4, the existing gradient along the canal invert between Station 46+00 and 56+00 is relatively steep, with an average slope of about 4 percent. A series of drop weirs were installed along this reach of the canal in 1981 to reduce stream velocities. The weirs were designed on the basis of a 1 in 50 year flood event and would be destroyed under the flow volumes associated with the Probable Maximum Flood event.

Therefore, it will be necessary to provide an overflow spillway and drop structure to carry high flow volumes associated with the Probable Maximum Flood. The overflow spillway will be located near Station 46+00. The emergency drop structure could be located anywhere along the south valley wall, west of Station 46+00, with an overflow canal to direct excess water from the spillway at Station 46+00 to the drop structure. A tentative alignment for the proposed overflow canal is shown on Figure 4.

Subsurface conditions can be expected to have a significant effect on which of the various options will be most cost effective. It was therefore agreed that a preliminary geotechnical investigation should be undertaken to provide a better indication of the subsurface conditions along the canal.

This report presents the results of the field investigation, together with a preliminary geotechnical evaluation of the various options currently being considered. It is expected that the information presented in this report will be used to prepare conceptual designs and preliminary cost estimates of the various options. Once the most cost effective option has been determined, detailed geotechnical design recommendations can be prepared, as appropriate.

2.0 SCOPE OF WORK

The scope of work for the preliminary geotechnical investigation included four major tasks:

1) Compile and review existing data,
2) Conduct an engineering terrain analysis using available airphotos,
3) Conduct shallow geophysical surveys along the proposed alignment of the overflow canal west of Station 46+00.
4) Undertake a field drilling and laboratory testing program to characterize subsurface conditions along the existing canal and the proposed alignment of the overflow canal.

2.1 Compile and Review Existing Data

As indicated in the list of references at the end of the text, a considerable amount of information was available with respect to the design and construction of the diversion canal. Selected reports have been reviewed and relevant information has been incorporated into this field investigation report, as appropriate.

No design or construction reports were available for the section of the canal constructed in 1974. Subsurface information was available in a design report prepared by Golder Associates (1980) for the section of the diversion canal completed in 1981. The borehole logs from this investigation are presented in Appendix B for reference.

A report that describes the construction of the 1981 section of the canal was also available (Golder Associates, 1982). The diversion canal was inspected annually following construction, and some of these inspection reports were also available for review.

It should be noted that during the period from 1981 to 2003, all references to stations along the canal were referenced to the construction chainage for which chainage 0+00 was located near the diversion dam constructed in 1981. After 2003, a new chainage benchmark was established about 1900 metres upstream from the 1981 diversion dam, along the North Fork of Rose Creek (Figure 3).The approximate 2003 Stations have been estimated by adding 1900 metres to the construction chainages given in earlier reports and drawings. The accuracy of this conversion has not been determined but is thought to be within plus or minus 50 metres.

2.2 Terrain Analysis

A terrain analysis of the area adjacent to the diversion canal was undertaken using 1 to 10,000 scale airphotos taken in 2003 (Orthoshop, 2003). The terrain analysis delineated the surficial geology, existing drainage courses, unstable slopes and other topographic features of interest.

A site inspection was carried out by Mr. Gerry Ferris, P.Eng. of BGC Engineering, during the period from September 10 and 14, 2004 to confirm the results of the airphoto interpretation.

The results of the terrain analysis are summarized on Figure 5. The bedrock geology in the vicinity of the canal is presented on Figure 6. Figure 7 is a sketch illustrating the major geological units in the area of interest.

2.3 Shallow Geophysical Survey

In the summer of 2004, shallow geophysical surveys were undertaken to determine the depth to bedrock below the proposed alignment of the overflow canal, west of Station 46+00. The survey used ground penetrating radar (GPR) and shallow seismic refraction equipment. The results of these geophysical surveys are presented in a report dated December 21, 2004 prepared by Aurora Geosciences Ltd.

Relevant information from the geophysical survey has been used to supplement observations made in the boreholes during the recent field investigation.

2.4 Field Drilling and Laboratory Testing

A site inspection was undertaken during the period from July 31 to August 4, 2005 by Messrs. G. Ferris and J. Severin (G.I.T.) of BGC Engineering Inc., to check site access for the drill rig and finalize borehole locations.

Field drilling was carried out during the period from August 8 to 20, 2005, during which time a total of 23 boreholes were drilled at selected locations as shown on Figures 3 and 4.

All holes were drilled using a CME-75 auger drill rig, owned and operated by Midnight Sun Drilling Limited of Whitehorse. The rig is equipped to drill with either hollow or solid stem augers and can recover soil samples using a Standard Penetration Test (SPT) sampler, shelby tubes or a CRREL core barrel.

All drilling and sampling was carried out under the supervision of Mr. Severin who logged each hole and collected disturbed and undisturbed soil samples at selected intervals.

In boreholes which stood open without sloughing and where fine grained soils were present, the holes were continuously cored with a CRREL barrel. Representative soil samples were taken from the recovered core. The CRREL barrel could not be used if the soil contained gravel or rocks, because the cutting teeth on the barrel would break off. At these locations, the holes were advanced using solid stem augers and disturbed samples were collected off of the auger flights.

In locations where the borehole was unstable due to sloughing soils, the holes were drilled with hollow stem augers and samples were collected with the SPT, provided the ground was not frozen. When used, SPT samples were collected every 2.5 feet to a depth of 10 feet. Below 10 feet, SPT samples were collected at 5 foot intervals to the end of the hole.

On completion of drilling, all boreholes were backfilled with drill cuttings and the borehole locations were staked. The locations and elevations of the ground surface at each hole location were determined in the field by a survey crew from Yukon Engineering Services of Whitehorse.

The water contents of the soil samples were determined. Grain size analyses and Atterberg limits tests were carried out on selected representative samples to confirm visual soil classifications.

Laboratory testing on selected frozen core samples recovered with the CRREL barrel included bulk density, water content determinations, Atterberg limits and grain size analyses. Grain size envelopes for selected overburden materials are presented on Figure 8.

The borehole logs, which include the laboratory test results, are presented in Appendix C.

3.0 SITE CONDITIONS

3.1 Topography and Drainage

As indicated on Figure 1, the Rose Creek Diversion Canal is located near the toe of the south wall of the Rose Creek Valley. The south valley wall slopes range from 8 to 15 degrees to the horizontal, with short sections ranging up to about 20 degrees. The elevation difference between the valley bottom and the crest is about 500 metres, and the distance from the toe of the slope to the valley crest is about 3 km.

The valley slopes south of the canal are treed with a moderately dense black spruce forest with tree heights ranging to a maximum of about 10 metres. The surface vegetation in most locations consists of mosses and organic material which is generally about 0.3 metres thick in well drained areas of the slope and 1 or more metres thick in poorly drained areas.

The valley slopes south of the canal are generally well drained and trafficable to bulldozers during the thaw season. The area at the east end of the canal in the vicinity of Boreholes BGC05-14 and 15 is poorly drained and has poor trafficability. Surface drainage and trafficability were also poor on the lower valley slopes in the area between Boreholes BGC05-19 and 23.

Four well defined drainage courses are present on the south valley wall, at the locations shown on Figure 8. For convenience, each drainage course has been assigned a name, as follows:

1) Gilchrist Creek which intersects the existing canal near Station 11+00,
2) Goodall Creek, which intersects the existing canal near Station 26+00,
3) Cornish Creek, which intersects the existing canal near Station 51+00, and
4) Severin Creek, which intersects the proposed overflow canal near Station 55+00.

Both Goodall Creek and Cornish Creek are known to flow throughout the winter and caused significant icing problems during construction of the diversion canal in 1981. There is no record of similar difficulties in the vicinity of Gilchrist Creek near Station 11+00. There is no information on flows in Severin Creek.

In addition to these drainage courses, significant seepage was also observed during construction of the canal in 1981 in the vicinity of Stations 19+360, 21+010, 21+670, 21+900 and 22+760.

3.2 Geological Setting

The main geological units in the vicinity of the canal are illustrated on Figure 7. The area was subjected to glaciation, which left silty sand till deposits in the lower portion of the Rose Creek valley as indicated. During de-glaciation, the Rose Creek valley was an outwash channel, which left thick deposits of fluvial sands and gravels along the bottom of the valley, which are underlain by silty sand till.

As indicated on Figure 7, during the post-glacial period, the south slopes of the Rose Creek valley were overlain by more recent deposits including colluvium (slopewash) material which directly overlies the bedrock at higher elevations and the silty sand till at lower elevations.

The following sections provide a more detailed description of the soils and rocks along the existing canal alignment.

3.3 Bedrock

As shown on Figure 6, the area below the canal is underlain by metamorphic and igneous rocks of Ordovician age (400 million years before present). Between Stations 19+00 to 40+00 the bedrock consists primarily of calcareous phyllite which is a metamorphic rock similar to slate. Gabbro (an igneous rock) is present along the canal centreline between Stations 26+00 to 30+00 and along the entire existing canal section west (downstream) from Station 40+00.

The unconfined compressive strength of these rocks has not been determined, however they are medium strong to strong and during construction in 1981, it was necessary to drill and blast the rocks before they could be excavated.

The surface of the bedrock is highly variable along the length of the canal, but is generally higher on the left (south) side of the canal and deeper on the right (north) side. The depths to bedrock, as encountered in the test holes drilled in August, 2005 are shown on Drawings 3 and 4.

The near surface rocks are known to be highly fractured and at least within the upper few metres have a relatively high hydraulic conductivity (Golder Associates, 1982).

3.4 Overburden Soils

As indicated on the borehole logs and on Figure 5, the overburden soils consist primarily of colluvium and silty sand till. Grain size envelopes for both materials are presented on Figure 8.

The silty sand till in the vicinity of the canal consists of a well graded mixture of gravel, sand and silt. The fine grained fraction (silt and clay sized particles) generally ranged from 20 to 35 percent. The material is generally low to non-plastic, indicating it contains almost no clay minerals.

A hydraulic conductivity test (Golder Associates, 1980) on a remoulded, compacted sample of the silty sand till measured a hydraulic conductivity of 3×10^{-7} cm/sec. However the conductivity of the material increased by a factor of about 15 when it was subjected of several freeze-thaw cycles. The hydraulic conductivity could increase even more under field conditions over a period of several decades.

The colluvial material is much more variable as compared to the underlying till. As shown on Figure 8, the fine grained fraction of samples taken from Borehole BGC05-21, which is located in a colluvial fan downslope from Station 58+00 on proposed overflow canal (Figure 4), ranged from 50 to 90 percent, which is significantly higher than the fine grained fraction in the silty sand till.

3.5 Permafrost

The site is located in the discontinuous permafrost zone and average annual ground temperatures range between -0.5°C and +0.5°C. The permafrost in the vicinity of the canal is relatively warm and in most cases will degrade if the surface organic layer is disturbed or removed.

North Side of Canal

Permafrost was not encountered in any of the boreholes drilled at 7 locations in August 2005 on the north (downslope) side of the diversion canal (Boreholes BGC05-to 13).

South Side of Canal

Permafrost was not encountered in Boreholes BGC05-17 and 18 on the upslope side of the canal, which are located near Stations 33+00 and 38+00, respectively. However permafrost was encountered in the other 8 holes drilled on the upslope side of the canal between Stations 10+00 and 50+00.

In the holes in which permafrost was encountered, excess ice was found mainly in the near surface 1 or 2 metres. Surface trafficability was found to be poor on the upslope side of the canal between Stations 11+00 and 16+00, but was good in all other borehole locations between Stations 16+00 and 50+00.

The silty sand till located immediately upslope from the diversion canal does not appear to contain significant excess ice, between Stations 10+00 to 50+00. The silty sand till is relatively coarse grained and it is expected to be thaw stable.

West of Station 51+00

Permafrost which contains significant excess ice appears to be widespread west of Station 50+00. Trafficability in this area was found to be very poor in August, 2005. The soils in the colluvial fan contain significant excess ice and have a relatively high silt and clay content. They are expected to be unstable when thawed.

4.0 CANAL CONSTRUCTION AND PERFORMANCE

4.1 General

This section provides a brief summary of pertinent information extracted from the design, construction and post-construction monitoring reports. For more detailed information, the reader should refer to the original reports.

4.2 Thermal Liner

During design of the diversion canal, there was concern with respect to the short and long term stability of the permafrost in the cut slope along the south side of the canal. It was recognized that if the permafrost thawed faster than the melt water could drain out of the soil, the slope would become unstable. Therefore, in order to reduce the rate of thaw of the cut slope, it was planned to over-excavate the cut slope during the winter and place a layer of granular fill over the exposed slope.

Determining the thickness of thermal liner required to prevent thaw instability is largely a matter of judgement. In the winter of 1980, a short trial section of the canal was constructed near Station 40+00 to determine the effectiveness of using 1.7 metres of gravel over the exposed permafrost. The trial section was monitored over the following thaw season to confirm the performance of the slope. It has not been possible to locate the report which describes the configuration and results of this trial. It is understood, however that the trial only used one thickness of gravel over the permafrost. Therefore, it is not known if the cut slope would have remained stable if a thinner (or no) thermal lining had been placed over it (G. Gilchrist, 2005).

4.3 Canal Construction

A simplified schedule which highlights the major construction tasks is presented in Figure 9. As indicated, construction began in early October, 1980 and was completed 12 months later.

The volumes of common and rock excavation required to construct the diversion canal in 1981, are given in Table 1 below:

Table 1 – Common and Rock Excavation Volumes
Rose Creek Diversion Canal in 1981 (Golder Associates, 1982)

Item	Description	Volume (cubic metres)
1	Common Excavation	465,000
2	Rock Excavation for Canal	55,000
3	Excavation of Rock Cutoff Trench	12,000
4	Thermal Liner	119,000

Item 1, common excavation, included all materials (including frozen and unfrozen soil and fractured rock) that could be excavated without having to be blasted. Rock excavation was any material that had to be blasted before it could be excavated.

From the point of view of interpreting the post construction performance of the canal, a number of items are worth noting.

Common excavation took place primarily during the period from November to April, when temperature records show that average daily temperatures were below freezing. As mentioned, this timing was deliberate to prevent thawing of any ice rich material in the cut slope along the south side of the canal. The gravel thermal liner was placed over the exposed cut slope before spring breakup to minimize the risk of thaw induced instability.

However, winter construction presents a number of disadvantages with respect to earthworks construction. First of all, as noted in the construction report, it was not possible to determine the extent of permafrost (including ice rich permafrost) in the native material, because even though significant volumes of unfrozen material were encountered at depth, the face of the excavation usually froze within 24 hours.

Secondly, as indicated on Figure 9, a significant portion of the fill for the north dike was placed during March and April, when average air temperatures were below freezing. It is very difficult to achieve satisfactory placement and compaction of fill materials for the dike because the material is frozen and it cannot be adequately compacted. In addition, even if great care is taken by the inspectors and earthworks contractor, ice, snow and large rocks (which appear to be frozen lumps of soil) will be incorporated into the fills.

Finally, it is worth noting that the contract incorporated a bonus / liquidated damages clause to ensure canal construction was substantially completed by October 1, 1981. The contractor would be paid $10,000 per day for each day in advance of October 1 that construction of the canal was substantially completed and $10,000 per day penalty for each day after October 1 until the canal was substantially completed. Such incentives are not uncommon; however, if the contractor believes that he cannot meet the target date, construction quality will suffer, despite the efforts of the most conscientious inspectors.

4.4 As Built Cross-Sections

Typical as built cross-sections of the diversion canal are presented on Figure 10. As shown, in locations where bedrock was not present, the south cut slope was over-excavated and trimmed to a slope of 2 horizontal to 1 vertical. About 1.7 metres of granular fill (thermal liner) was placed over the exposed permafrost to prevent it from becoming unstable during the following thaw season. The excavated material was used to construct the north dike. Silty clay till was placed on the inside slope of the north dike to reduce seepage through the dike. Riprap erosion protection was then placed over the slopes and invert of the canal to prevent erosion.

In locations where bedrock was encountered, the rock slope was trimmed to 0.5 to 1 vertical, and the overlying soil was trimmed to 2 horizontal to 1 (Figure 10). A thermal liner or riprap erosion protection was not required over the exposed rock; however it was required on top of the overlying soil as shown. The excavated material was used to construct the north dike and silty clay till was placed on the inside of the dike to reduce seepage. In locations where the north dike was constructed on bedrock, there was concern that there would be a significant amount of seepage through the near surface fractured bedrock below the dike. Therefore, a cutoff trench was excavated into the rock below the inside toe of the north dike. The trench was backfilled with compacted silty clay till to reduce seepage through the bedrock.

4.5 Canal Performance

The construction report (Golder Associates, 1982) provides an excellent summary of the performance of the canal earthworks during the period from May to September, 1981, the first thaw season after construction. Annual inspection reports since that time indicate that the canal has performed satisfactorily, requiring only minimal maintenance.

South Cut Slope

The construction report found virtually no thaw settlements or instability on the south cut slope of the canal during the first summer after construction.

During the summer of 1981, surface runoff flowed over the top of the cut slope and eroded the gravel thermal blanket in some locations, as shown on Figure 11. Drainage swales were therefore installed along the crest of the cut slope to direct surface water to rock filled drainage channels placed at strategic intervals along the cut slope.

An inspection carried out in June, 1994, identified three locations on the south side of the canal where instability was observed (Geo-Engineering MST, 1995):

1) An active slump, about 30 metres long, near Station 32+00 on Figure 3. A photo of the slump is presented on Figure 12. The slump is located near one of the till borrow sources used during canal construction. The slump is localized and may be the result of progressive melting of an ice lens within the till, or it may be a groundwater discharge area.
2) A minor slump in the vicinity of Station 35+50 (Figure 4) which appears to be associated with surface erosion at that location.
3) A fresh landslide, about 100 metres long near Station 39+00. A photo of this instability is also presented on Figure 12. The cause of this slide, which was first observed in the spring of 1994, is uncertain. The immediate cause is believed to have been water that ponded on the upslope (south) side of a construction access road at this location.

The bedrock slopes on the south slope of the diversion canal have remained stable since construction; however there are one or two locations where fractures in the rock are opening up and small scale rock falls may occur in the future.

North Dike

Cracking and settlements of the north dike were noted in a few localized areas and some minor seepage along the north toe of the dike was observed during the first thaw season after construction. None of these defects were of significant concern and continued monitoring and minor regrading of the dikes was recommended. Dike settlements were either the result of inadequate compaction of the fill materials during the previous winter or thaw settlement of ice rich permafrost within the foundation soils.

A report prepared by Golder Associates (1990) indicated that minor thaw settlements and dike slope movements were occurring in the vicinity of Stations 38+00 and 40+00. Some mitigative measures were constructed near Station 40+00 in 1989, however movements at that location were continuing at the time of the 1990 report.

In the decades since construction, the crest of the north dike between stations 31+00 and 41+00 settled a total of about 1 metre. In the summer of 2004, additional fill was placed along this section of the north dike to raise it back to its initial design elevation.

Drop Weirs

The drop weirs in the canal between stations 49+00 and 56+00 have performed satisfactorily. Some of the rock in the weirs was shifted when flows from a 1 in 40 year flood event occurred. This observation indicates that while the drop weirs conform to the design requirement of a 1 in 50 year flood event, they would most likely be damaged if higher flows were to occur.

5.0 GEOTECHNICAL EVALUATION

5.1 General

Conceptually, two basic approaches for increasing the capacity of the existing Rose Creek diversion canal can be considered:

1) Increasing the width of the canal by excavating material from the south side of the canal, or
2) Raising the height of the north dike, so that the water level in the canal can be increased.

The geotechnical aspects of the two options are discussed separately in the following sections, although it is recognized that the most cost effective approach may be to excavate material from the south side of the existing canal and use it to raise the height of the north dike.

5.2 Canal Widening

The capacity of the canal can be increased by widening the canal along the south side, as shown schematically on Figure 13.

Care should be taken during canal widening not to disturb or damage the compacted soil lining on the existing canal invert or on the slopes of the north dike. In addition, in those locations where bedrock is encountered on the invert of the widened portion of the canal, it may be necessary to extend the existing cutoff trench into the fresh bedrock excavation. This requirement would have to be confirmed by observations during construction.

It will be necessary to maintain water flow in the canal throughout construction, and in addition, it would be desirable not to damage the lining on the invert of the existing canal. Therefore, it is recommended that the invert elevation of the widened section of the canal remain about 1 metre above the normal water level in the canal during the construction season. This geometry will also cause flows to remain concentrated within the existing canal channel or, at low flows, in the pilot channel. This is particularly important during the early fall and winter to minimize icing in the canal.

For preliminary design, it is recommended that cut slopes in rock should not exceed 0.5 horizontal to 1 vertical. Slopes in bedrock should be scaled to remove loose boulders. It is expected that the rock slopes will remain stable in most locations; however the exposed rock cuts should be inspected by an experienced engineer to determine whether there are any local areas which will require slope flattening or rock reinforcement such as rock bolts or shotcrete.

For preliminary design, it is recommended that cut slopes in silty clay till be trimmed to 2 horizontal to 1 vertical. The silty clay on the cut slope and along the base of the canal section will be susceptible to erosion during periods of high flows in the canal. The requirement and class of riprap erosion projection on the cut slope and on the canal invert should be determined by a hydraulics engineer.

Observations over the past few decades, together with the information obtained from the recent geotechnical investigation, indicate that the frozen silty sand till will remain stable in most locations during the thaw season. It is expected however, that occasional pockets of ice rich soil will be encountered within the till which may result in localized sloughing in the short term. In addition, the overlying ice rich colluvial materials may have to be cut back and covered with gravel to control sloughing. It is not expected that it will be necessary to overexcavate the silty clay till and place a thick granular thermal blanket over the entire cut slope.

It is recommended that widening of the canal be undertaken during the thaw season, so that any ice rich zones can be readily identified and allowed to drain and stabilize as construction proceeds. If unstable areas are encountered in the excavation, a thermal liner can be added to those sections as necessary. Silty sand till excavated from the south side of the canal may be used in the construction of the north dike, provided it has thawed and drained before it is placed and compacted. Alternatively, the till could be used to provide a soil cover over the existing tailings.

It is expected that some fine grained, ice rich zones will be encountered on the south side of the canal, particularly in the near surface 1 to 2 metres below the natural ground surface. Those materials which contain a significant proportion of fine grained or organic material will have to be wasted. This is particularly a concern between Stations 11+00 and Station 16+00, where trafficability of the near surface soils is known to be poor.

If widening the canal proves to be the most cost effective option, It is recommended that at least one full size test excavation be constructed during the thaw season, at a suitable location in the vicinity of Station 14+00, to confirm the expected behaviour of the cut slopes as they thaw during construction. The observations made during the test excavation should be documented and the results should be made available to contractors who are considering bidding for the canal upgrading project.

As mentioned, the primary cause of erosion of the south cut slope following construction in 1981 was uncontrolled flow of surface runoff over the face of the slope (Figure 11). It is recommended that a shallow swale be constructed at the top of the slope to direct surface runoff into rock filled channels placed at strategic locations along the length of the canal. The locations of the drainage swales and rock filled channels will have to be established based on field observations made during the first few thaw seasons after construction.

It is expected that the thickness of the overburden materials over the bedrock will decrease towards the south (upslope) from the canal. However, it is not possible to provide a reliable estimate of the volumes of colluvium, silty sand till and rock that will be encountered in the excavation based on the information currently available. The volume of rock, in particular, should be determined more accurately, since it will have a significant effect on construction costs. In addition, if the most cost effective option is to both widen the canal and use the excavated material to increase the height of the north dike, it would be important to determine the volume of silty sand till as accurately as possible.

It is understood that there is concern that shallow skin flows could occur on the slopes south of the diversion canal, which could block the canal. Skin flows can be initiated by events such as forest fires or unusually heavy rainfall. It is recommended that the slopes be inspected during the late summer months by an experienced geotechnical engineer to confirm surface drainage conditions and the properties of the near surface soils. This information is required to evaluate the risk of skin flows occurring on these slopes in the future.

5.3 Raise North Dike

The second basic approach for increasing the capacity of the canal is to raise the height of the north dike of the canal, as illustrated conceptually on Figure 14. The dike could be raised by using material excavated from the south side of the canal or by importing material from designated borrow sources.

As indicated on the figure, the outside shell of the north dike can be constructed of waste rock hauled from the existing rock dumps or from rock liberated by widening the canal to the south. In any case, it will be necessary to place silty sand till on the south side of the dike to prevent seepages losses through the dike. The silty sand till could be excavated from sources located on the south side of the canal or from any other designed borrow source in the area. It may be necessary to place filter cloth or filter gravel between the silty clay liner and the outside shell of the north dike, depending on the gradation of the material used to construct the shell.

Riprap erosion protection will be required over the silty clay liner placed on the north dike to control erosion from surface precipitation as well as water flowing in the canal during design flood events. The class of riprap should be determined by a hydraulics engineer.

Care will be required during construction not to disturb the compacted silty clay liner that is present on the south slope of the existing dike.

As indicated on Figure 14, a significant portion of the enlarged north dike will extend into the area where tailings were deposited during mine operations. A comparison of the topography prior to placement of the tailings, with that which currently exists, indicates that from Stations 19+00 to 38+00, the foundation soils along the north side of the existing dike should provide adequate support for an enlarged dike.

However, in the section from Stations 38+00 to 44+00, soft, compressible tailings, which range up to 20 metres in thickness, are present close to the toe of the existing dike. These materials will not provide a stable foundation for an enlarged dike. There are three options that can be considered for overcoming this difficulty.

1) Subexcavate or densify the tailings to provide a stable foundation for the dike. This option may not be practical depending on the properties of the tailings,
2) Limit the maximum height of the dike, to a height that can be accommodated in this section, without having to extend the dike onto the tailings, and
3) Realign the section of the dike between Stations 38+00 to 44+00, as necessary, so that the dike can be enlarged without placing fill on the tailings.

It is recommended that a cost benefit analysis be undertaken during the next stage of design to determine which of these options is most cost effective.

The availability of silty clay till on the south side of the canal may limit the maximum height to which the north dike can be raised. As mentioned in the previous section, once the optimum design for increasing the capacity of the diversion canal has been established, a series of probe holes should be drilled along the south side of the canal so that a more reliable estimate of the available volume of silty clay till can be established.

5.4 Emergency Spillway and Drop Structure

As mentioned, the drop weirs in the existing canal west of Station 46+00 (Figure 4) could be eroded away under extreme flow events in the canal.

The existing drop weirs could be replaced with a single reinforced concrete drop structure in the vicinity of Station 46+00. As indicated on Figure 4, the structure would be relatively large, since the vertical drop is about 30 metres and it would have to incorporate a fish ladder to allow fish passage upstream under normal flow conditions. A reinforced concrete drop structure would be relatively expensive and in addition, would require ongoing maintenance to prevent the concrete from deteriorating. Ultimately, after many decades, it might become necessary to construct a replacement structure.

A better option would be to maintain the existing canal alignment, including the drop weirs, which are designed to allow fish passage up this section of the canal. The existing canal would carry normal stream flows up to about a 1 in 50 year event. An emergency spillway and drop structure would be provided which would be designed to carry excess flows above the 1 in 50 year event. Under this scheme, the emergency spillway and drop structure would only be rarely used.

Since bedrock occurs relatively close to the surface below the south valley wall, it should be possible to construct at least the upper portion of the drop structure in rock. Conceptually the structure could be located anywhere along the proposed alignment of the overflow canal between Station 44+00 and Borehole BGC05-23 (Figure 4).

From a geotechnical point of view it would be preferable to locate the drop structure close to the emergency spillway, somewhere between Stations 44+00 and 46+00, for the following reasons:

1) The bedrock between Stations 44+00 and 46+00 is expected to consist of gabbro, a hard igneous rock which is more durable than the calcareous phyllite that underlies the area below the south valley wall west of Station 50+00 (Figure 6).
2) Examination of the airphotos indicates that debris flows have occurred periodically in Severin Creek, which crosses near Station 55+00 of the proposed overflow canal. The data obtained in the bore hole drilled in this area indicates that at least three debris flows have occurred at this location in the past. The frequency of occurrence of the debris flows is not known, but could be in the order of every few decades or centuries, depending on climate changes.
3) Consideration was given to placing the drop structure east of Severin Creek, between Stations 49+00 and 54+00 of the proposed overflow canal. However, this option would require that a relatively large embankment be constructed between the existing canal and the bottom of the drop structure to direct storm water away from the existing canal, downstream from Station 52+00. The embankment would have to be constructed on the colluvial fan, which, as indicated on Borehole Log BGC05-23 consists of ice rich, thaw unstable soils which extend to depths of about 4 metres.

Ideally, an emergency drop structure between Stations 44+00 and 46+00, should be excavated in bedrock over its entire height. The bedrock is visible at ground surface near the existing canal in this area and was encountered at a depth of 8.6 metres in Borehole BGC05-10.

If a decision is made to locate the emergency spillway and drop structure in this area, it will be necessary to determine the surface topography of the bedrock more accurately so that the design of the emergency spillway, drop structure and outlet structures can be optimized. It is expected that this work can be accomplished by drilling probe holes in combination with geophysical methods. In addition, it is recommended that core samples be obtained of the rock below the proposed location for the drop structure, to establish the rock lithology, depth of weathering, durability, unconfined compressive strength and other properties.

A significant advantage of locating the drop structure between Stations 44+00 and 46+00 is that the outflow would be directed upstream from the Cross Valley Dam. It is understood that this dam may be breached as part of mine closure; however a final decision has not been made.

If the dam is breached, the breach should be located near the north abutment, so that remnants of the dam embankment would outflow from the emergency drop structure away from the downstream section of the existing canal. If the dam is not breached, then it would be necessary to increase the size of the existing emergency spillway located near the north abutment of the dam. If the capacity of the emergency spillway of the dam increased, the topography of the bedrock surface in the vicinity of the spillway should be determined using a combination of probe holes and geophysical methods. In addition, core samples of the rock should be obtained to confirm the properties of the rock below this area.

5.5 Pre-Design Studies

Once the required design capacity of the canal under the Probable Maximum Precipitation event has been established, it is recommended that conceptual designs for increasing the capacity of the canal and for the emergency spillway and drop structure be prepared. The conceptual designs should be based on the geotechnical recommendations presented in this report and should include cross-sections spaced at 100 to 200 metres along the canal, so that material volumes can be estimated to an acceptable level of accuracy.

Preliminary cost estimates for the various options should be prepared so that the most cost effective combination of options can be determined.

It is expected that once the most cost effective approach for increasing the capacity of the diversion canal has been determined, it will be necessary to undertaken additional field drilling to support detailed design. Detailed geotechnical design and construction recommendations can be prepared once the subsurface information from these investigations is available.

BGC Engineering Inc.

Per:

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Project Engineer

Gerry Ferris, M.Sc., P.Eng.
Review Engineer

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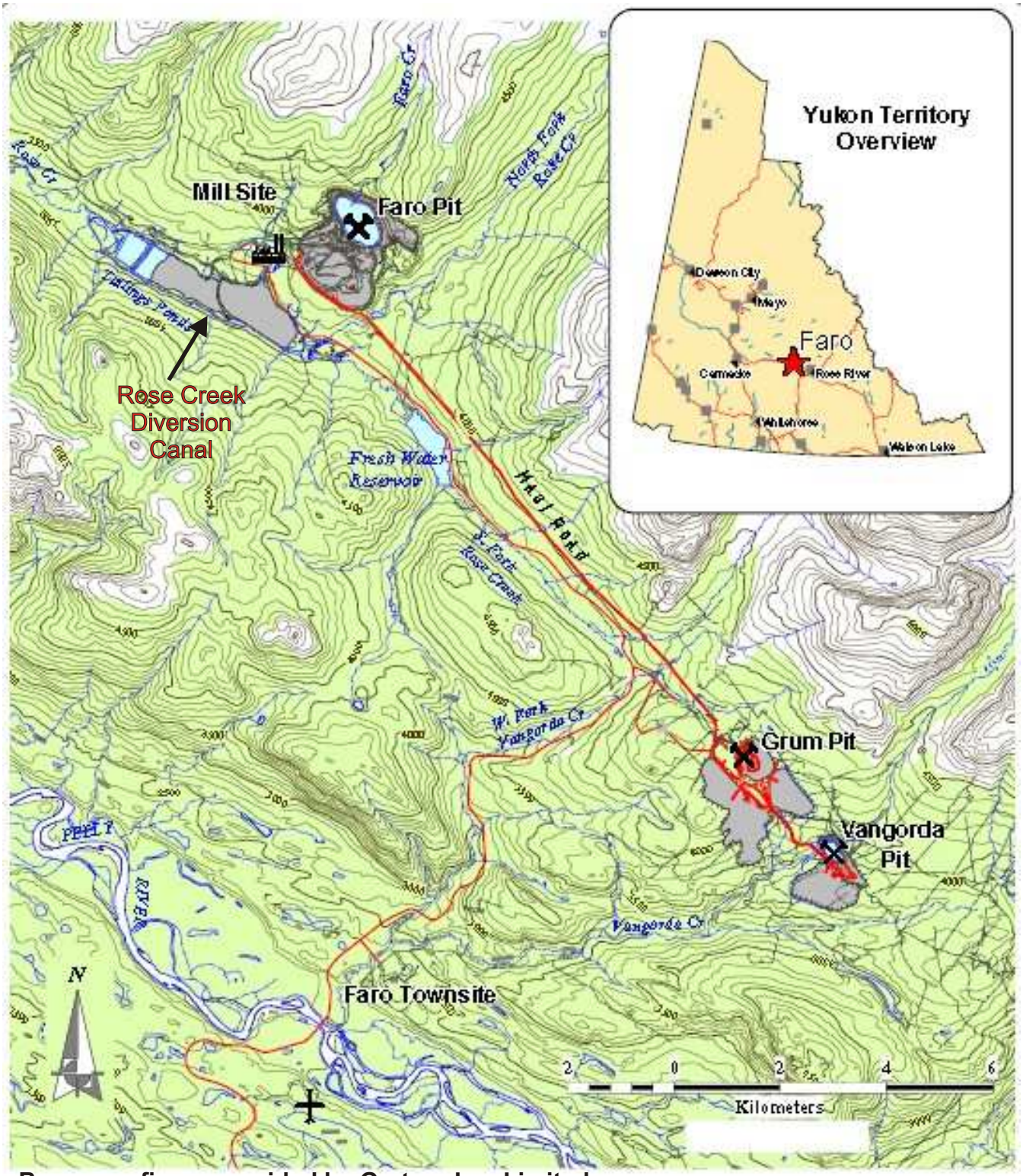
FIGURES



Note: Base map figure provided by Gartner Lee Limited.

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DATE:	JANUARY 2005	CHECKED:	GWF
DRAWN:	SLF	APPROVED:	

CLIENT: Deloitte & Touche

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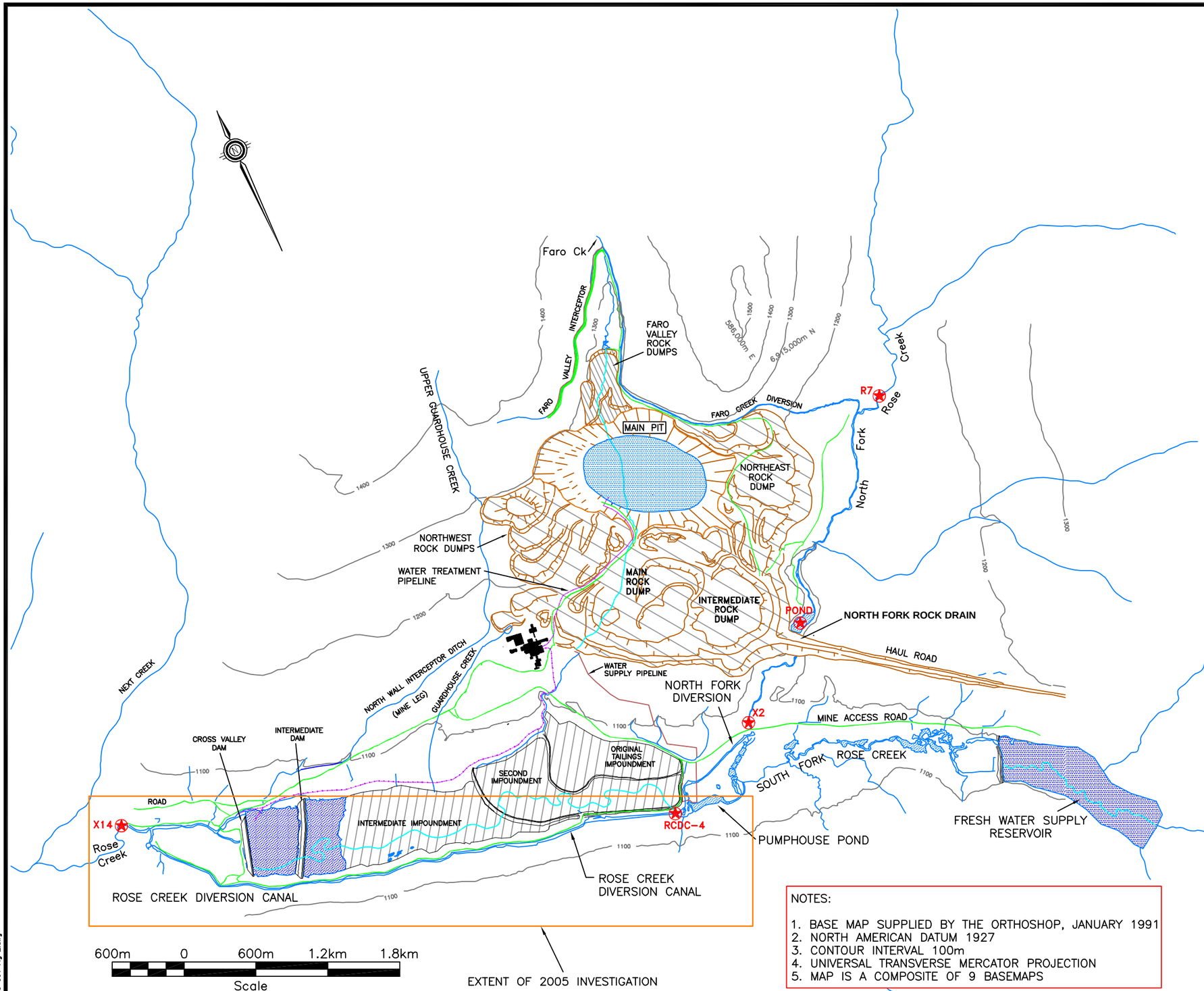
PROJECT: TASK 22F
RCDC - PRELIMINARY GEOTECH EVALUATION

TITLE: SITE LOCATION PLAN

PROJECT No.	FIGURE No.	REV.
0257-037-01	1	A



CLIENT: Deloitte & Touche

LEGEND:

- ROADS
- EXISTING DRAINAGE
- ORIGINAL DRAINAGE
- EFFLUENT PIPELINE
- PIPELINE
- WATER MONITORING SITE

REV.	DATE	REVISION NOTES	DRAWN	CHECKED	APPROVED

SCALE:	AS SHOWN
DATE:	JAN 2006
DRAWN:	JMS
DESIGNED:	LBS
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APPROVED:	

PROJECT: TASK 22F
RCDC – PRELIMINARY GEOTECHNICAL EVALUATION

TITLE: MINE PLAN

PROJECT No.	FIGURE No.	REV.
0257-037-02	2	A

NOTES:

1. BASE MAP SUPPLIED BY THE ORTHOSHOP, JANUARY 1991
2. NORTH AMERICAN DATUM 1927
3. CONTOUR INTERVAL 100m
4. UNIVERSAL TRANSVERSE MERCATOR PROJECTION
5. MAP IS A COMPOSITE OF 9 BASEMAPS

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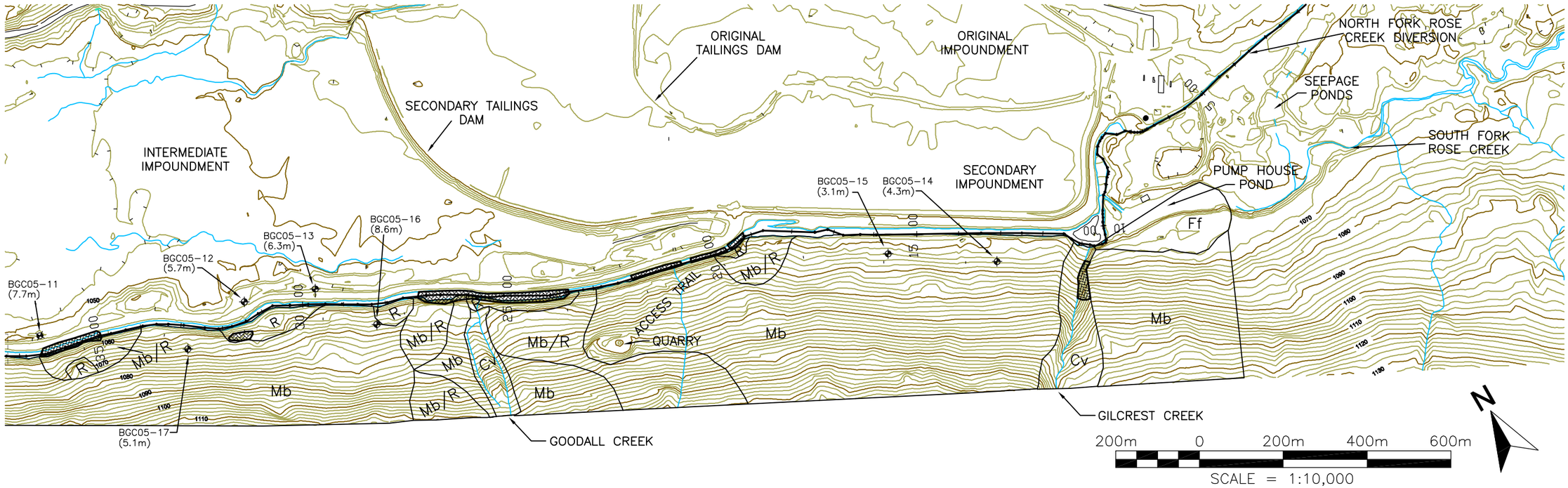
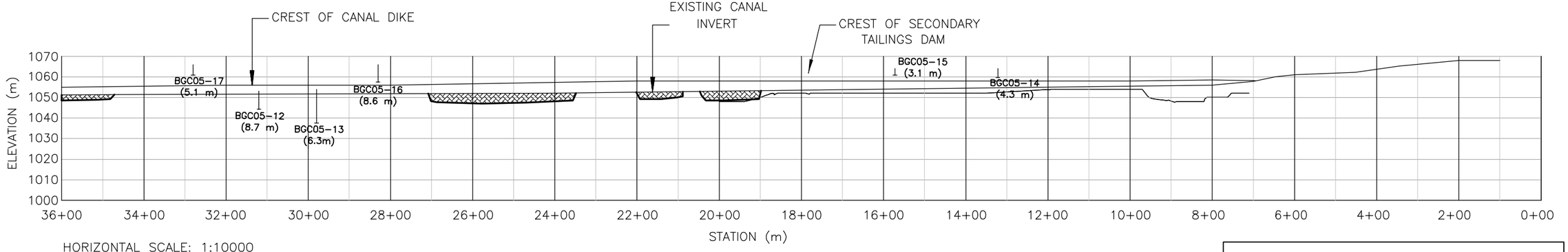
0257-023-03 001 Fig 2.dwg





Legend:

R	Bedrock
Mb/R	Morrainal Blanket over Bedrock
Mb	Morrainal Blanket
Cv	Colluvium
Ff	Fluvial Fan
	Boreholes

PROJECTION: UTM NAD27 ZONE 8

NOTES:

1. TOPOGRAPHIC BASE INFORMATION FROM RECTIFIED AIRPHOTOS, THE ORTHOSHOP 2003.
2. ELEVATIONS OF BOREHOLES FROM DIRECT SURVEY, YUKON ENGINEERING SERVICES 2005.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE	1:10,000
DATE	DEC 6, 2005
DRAWN	EBN/GCB
DESIGNED	LBS
CHECKED	GWF
APPROVED	–

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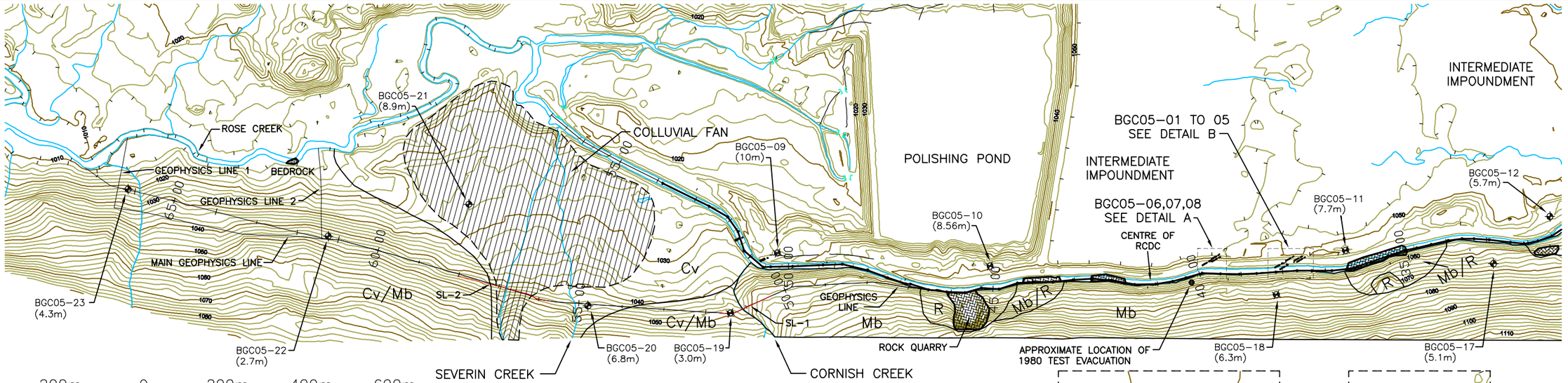
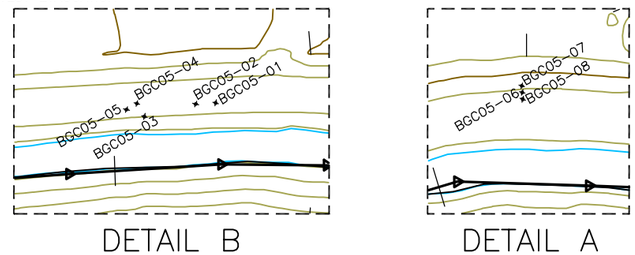
PROJECT: TASK 22F
RCDC – PRELIMINARY GEOTECHNICAL EVALUATION

TITLE: CHANNEL PLAN AND PROFILE
STATION 0+00 TO 35+00

PROJECT No.	FIGURE	REV.
0257-037-01	3	A

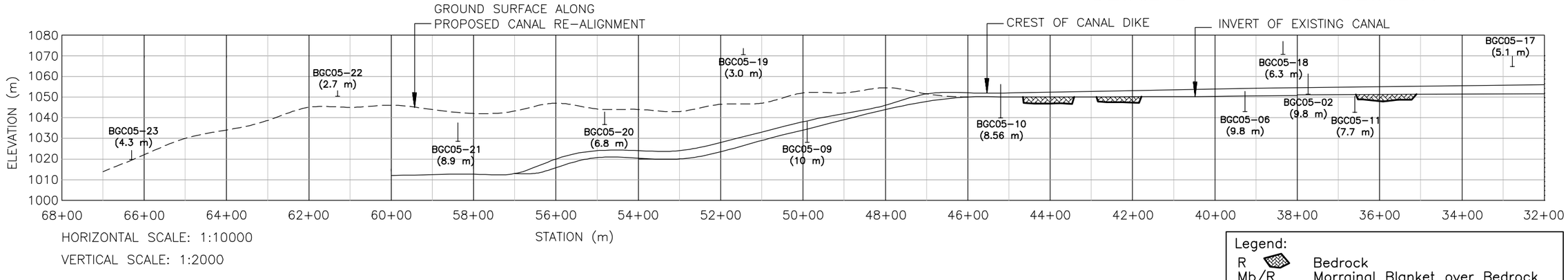
BGC Hole Locations.dwg





DETAIL B

DETAIL A



Legend:

R	Bedrock
Mb/R	Morrainal Blanket over Bedrock
Mb	Morrainal Blanket
Cv	Colluvium
Ff	Fluvial Fan
	Boreholes

PROJECTION: UTM NAD27 ZONE 8

NOTES:

1. TOPOGRAPHIC BASE INFORMATION FROM RECTIFIED AIRPHOTOS, THE ORTHOSHOP 2003.
2. ELEVATIONS OF BOREHOLES FROM DIRECT SURVEY, YUKON ENGINEERING SERVICES 2005.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE	1:10,000
DATE	DEC. 6, 2005
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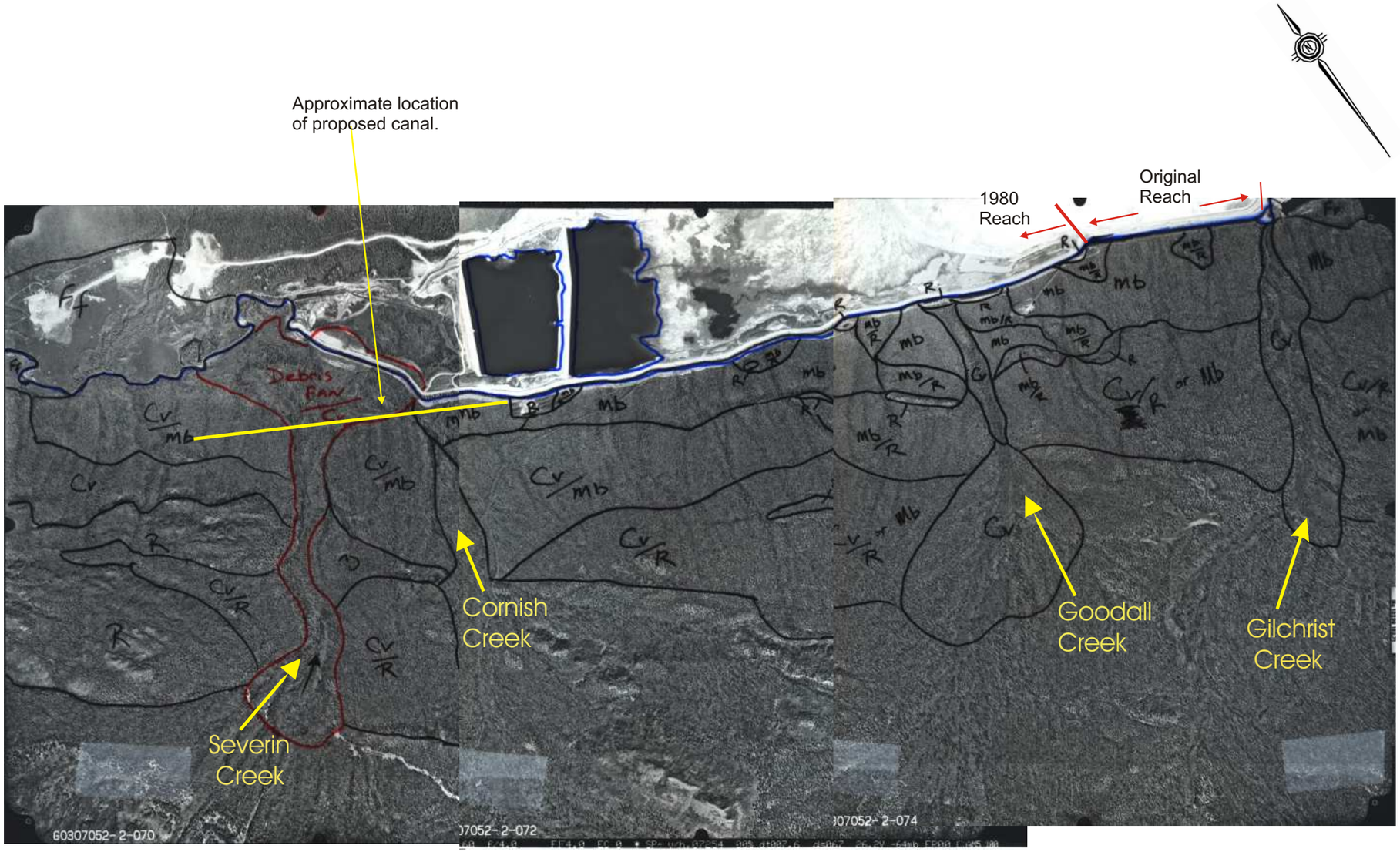
PROJECT: TASK 22
RCDC – PRELIMINARY GEOTECHNICAL EVALUATION

TITLE: CANAL PLAN AND PROFILE
STATION 35+00 TO 60+00

PROJECT No.	FIGURE	REV.
0257-037-01	4	A

BGC Hole Locations.dwg



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The Orthoshop, Calgary, AB

Legend:
Ff- Fluvial Fan
Cv - Colluvium
R - Rock
Cv/R - Thin Colluvium Overlying Rock
Mb - Moraine
Mb/R - Thin Moraine overlying Rock
Cv/Mb - Thin Colluvium Overlying Moraine

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DATE:	JANUARY 2005
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PROJECT
TASK 22F
RCDC - PRELIMINARY GEOTECH EVALUATION

TITLE
TERRAIN ANALYSIS

PROJECT No.	FIGURE No.	REV.
0257-037-01	5	A

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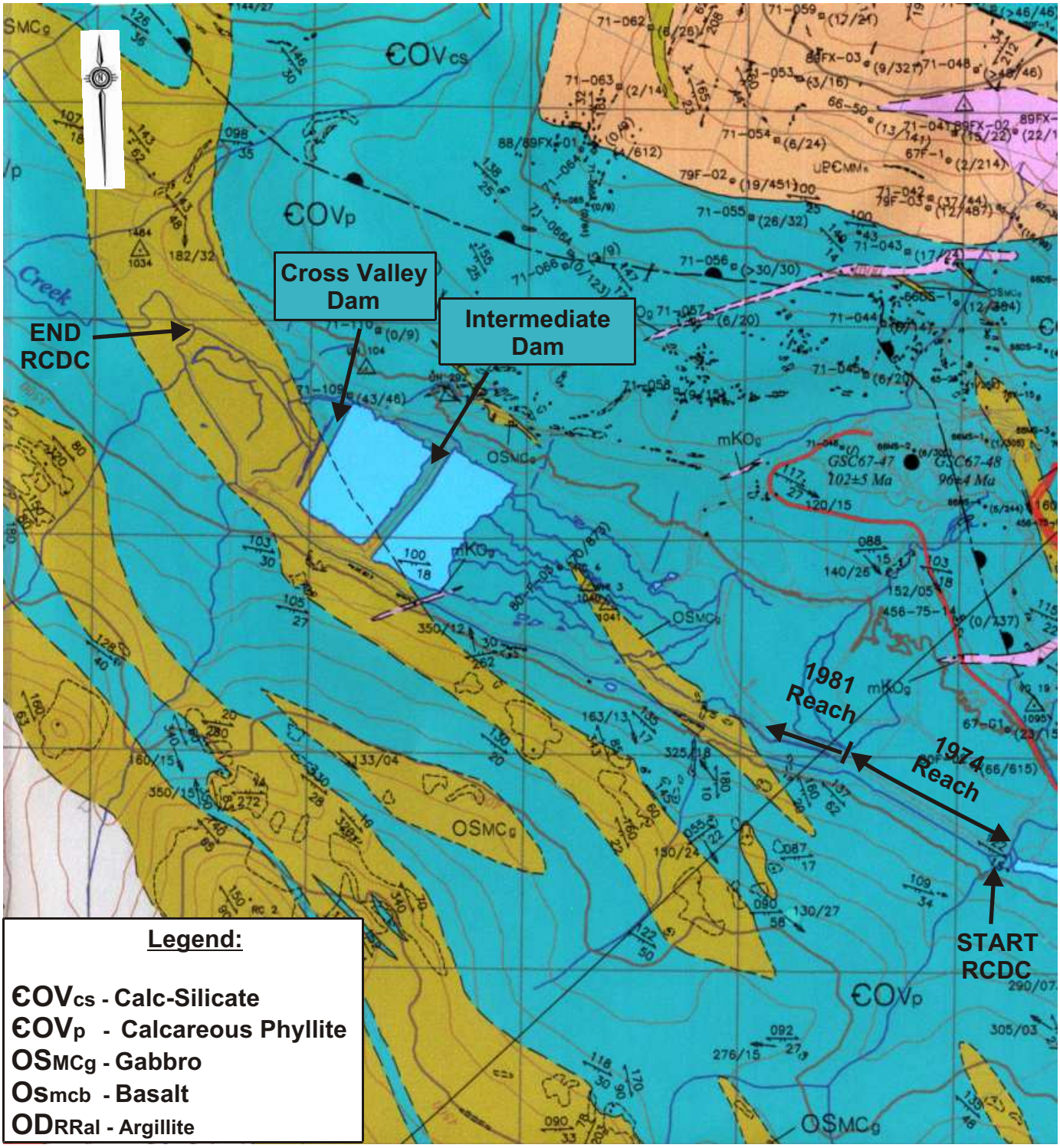

Source: Pigage, L.C. 2001

SCALE:	N/A	DESIGNED:	LBS
DATE:	JANUARY 2006	CHECKED:	GWF
DRAWN:	JMS	APPROVED:	

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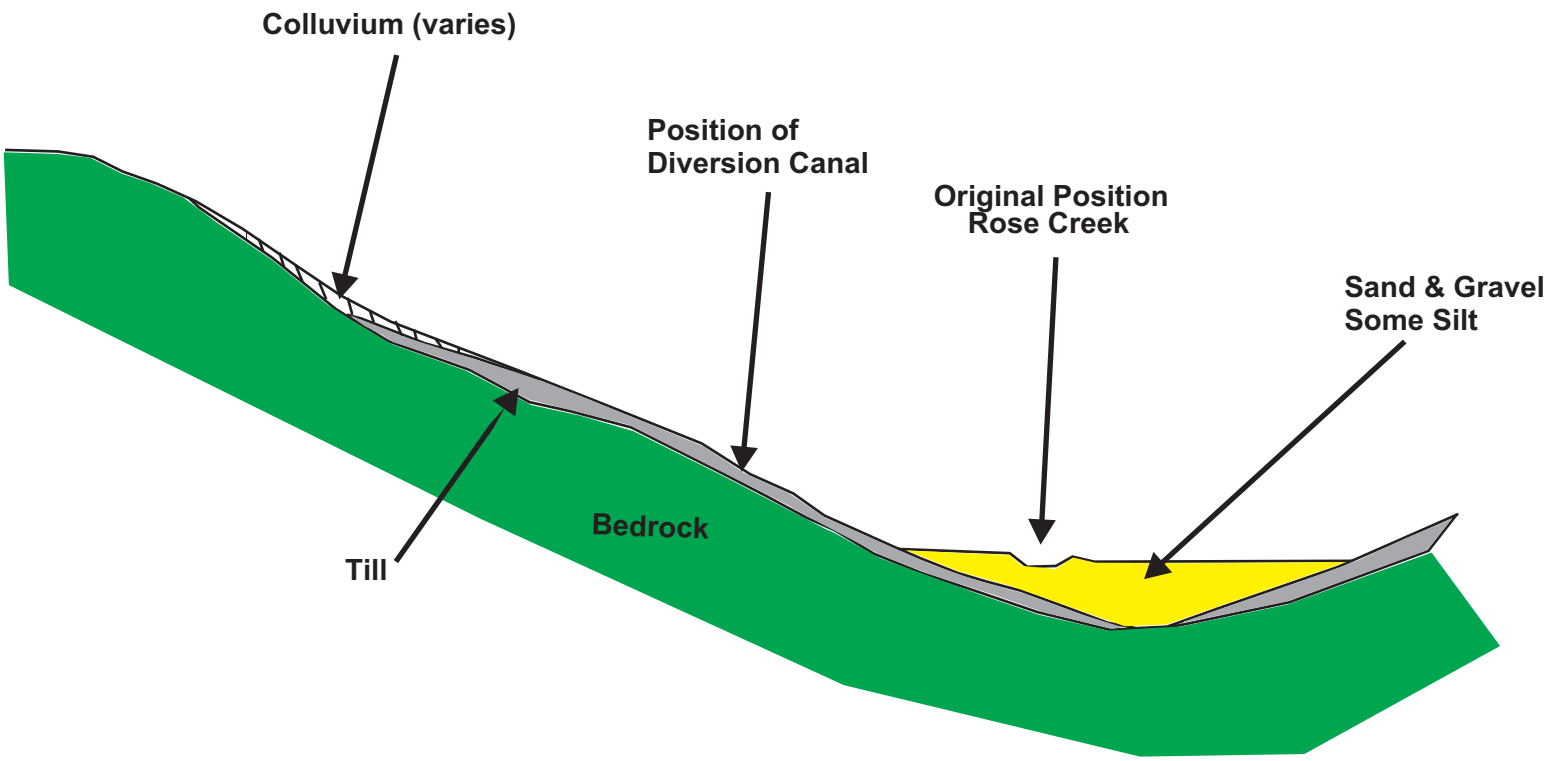
PROJECT: TASK 22F
RCDC - PRELIMINARY GEOTECH EVALUATION

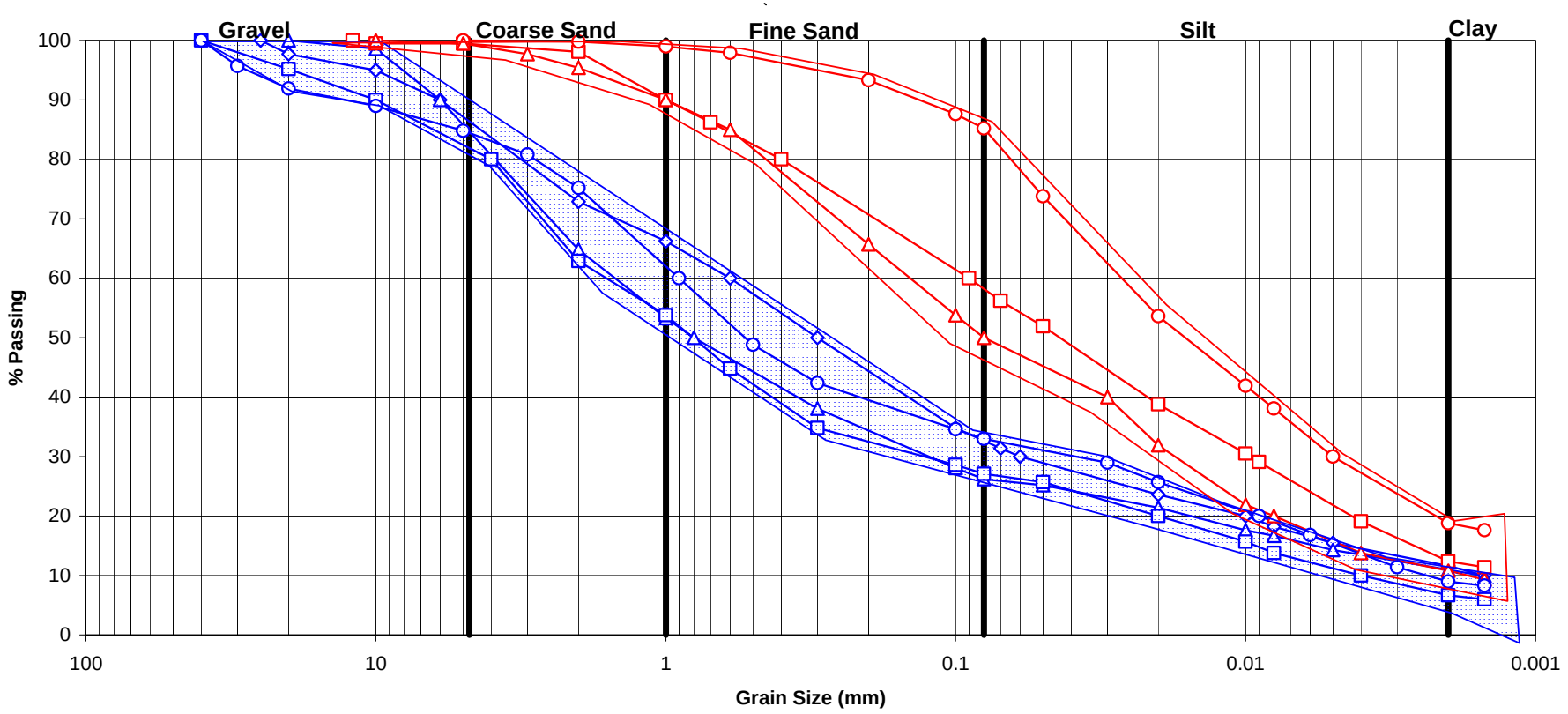
TITLE: BEDROCK GEOLOGY

PROJECT No.	DWG. No.	REV.
0257-037-01	6	0

Overall Slope Angle Ranges from 8 to 15 with short sections up to 20 .



DATE: JAN. 2006	DRAWN SLF	BGC ENGINEERING INC. AN APPLIED EARTH SCIENCES COMPANY Calgary, Alberta Phone: (403) 250-5185	PROJECT TASK 22F RCDC - PRELIMINARY GEOTECH EVALUATION
REFERENCED DRAWING DESCRIPTION			TITLE SKETCH OF GEOLOGICAL CROSS-SECTION
		CLIENT Deloitte & Touche	PROJECT No. 0257-037-01 / FIGURE No. 7 / REV. A



Legend:

- JMS 96
- JMS 60
- JMS 88
- JMS 108
- JMS 123
- JMS 95B
- JMS 101

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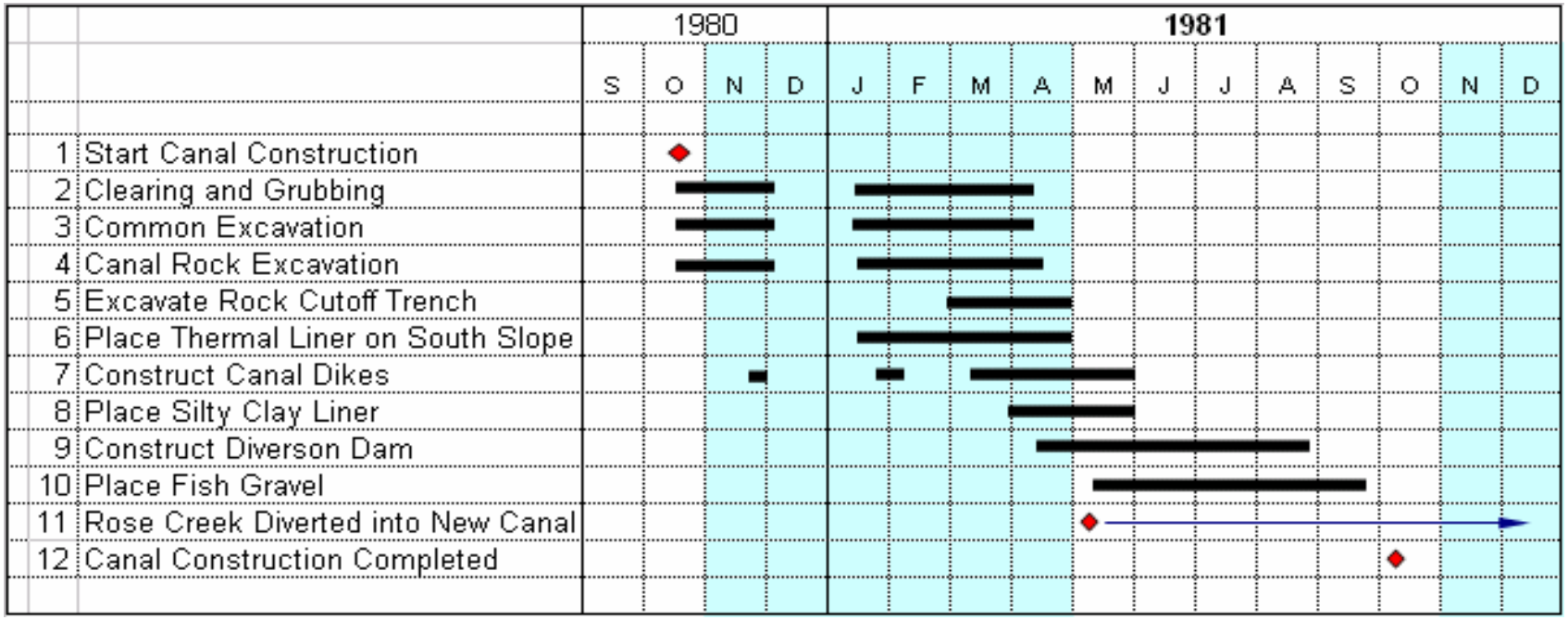
Project: TASK 22F RCDC – PRELIMINARY GEOTECHNIAL EVALUATION

Title: GRAIN SIZE ANALYSIS ENVELOPES

Project #:	Date:	Scale:	Drawn:	Approved:	Figure:
0257-037-01	JAN 2006	NA	JMS	GWF	8



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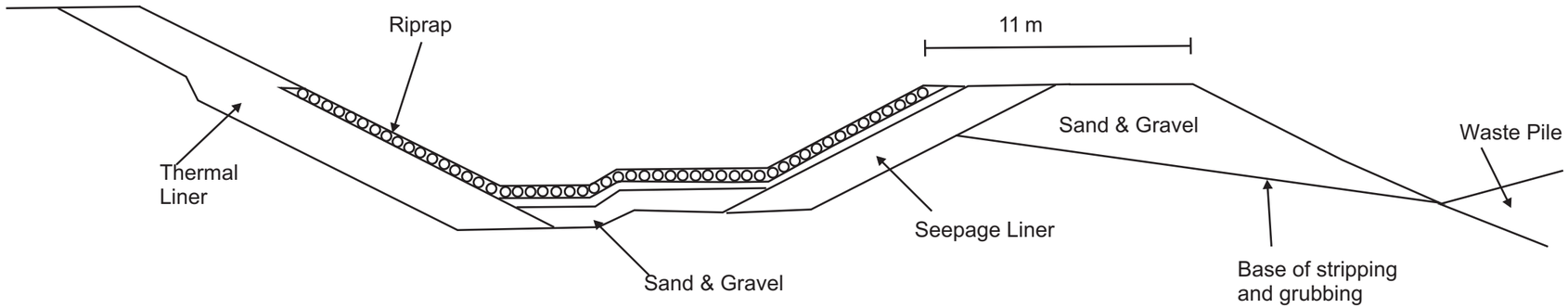
Project: TASK 22F RCDC – PRELIMINARY GEOTECHNIAL EVALUATION

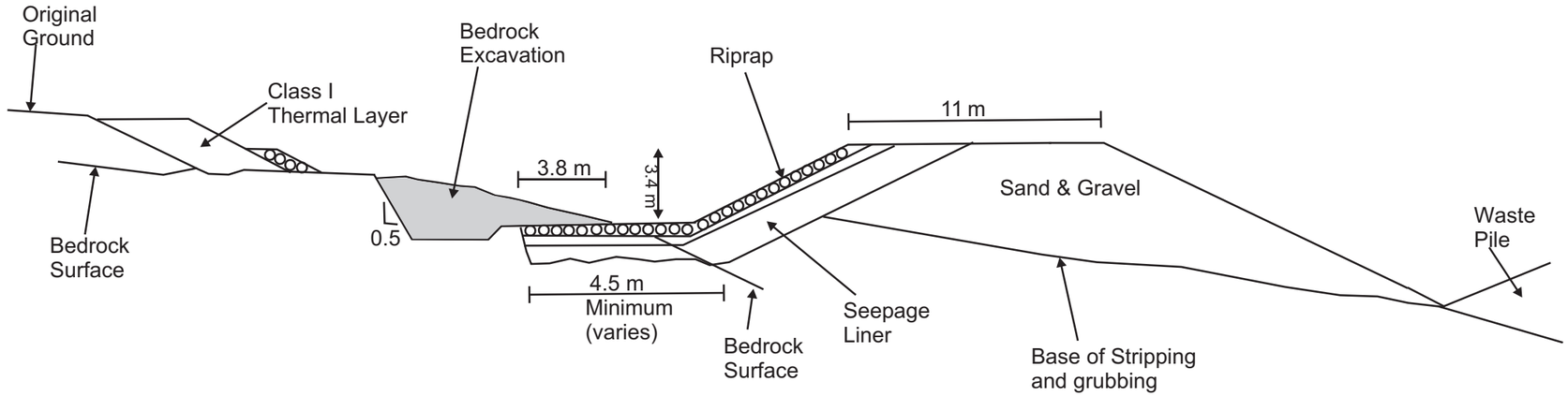
Title: SIMPLIFIED CONSTRUCTION SCHEDULE

Project #:	Date:	Scale:	Drawn:	Approved:	Figure:
0257-037-01	JAN 2006	NA	JMS	GWF	9

Common Excavation - Seepage Liner



Rock Excavation - Seepage Liner



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DATE:	DECEMBER 2005
DRAWN:	SLF
DESIGNED:	GWF
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APPROVED:	GWF

PROJECT: RCDC - SITE INVESTIGATION

TITLE:

PROJECT No.	FIGURE No.	REV.
0257-037-01	10	0

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Source: 1982 Hydrocon Report

SCALE:	N/A	DESIGNED:	JBS
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PROJECT: TASK 22F
RCDC - PRELIMINARY GEOTECH EVALUATION

TITLE: SURFACE EROSION OF THERMAL BLANKET 1982

PROJECT No.	FIGURE No.	REV.
0257-037-01	11	A

Source: Geo-Engineering 1994

SCALE:	N/A	DESIGNED:	JBS
DATE:	JANUARY 2006	CHECKED:	GWF
DRAWN:	SLF	APPROVED:	

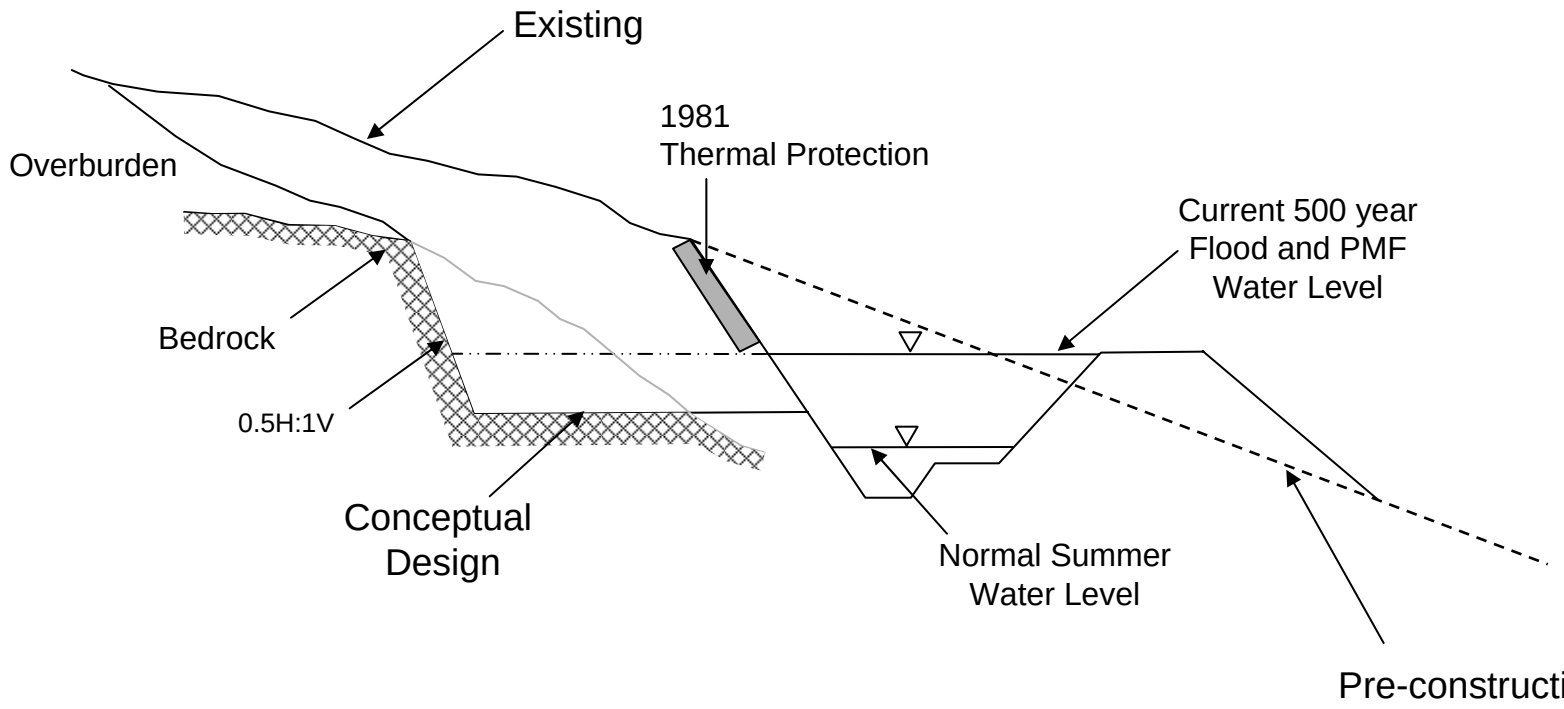
CLIENT: Deloitte & Touche

BGC Engineering Inc.
AN APPLIED EARTH SCIENCES COMPANY
Calgary, Alberta. Phone: (403) 250-5185

PROJECT
TASK 22F
RCDC - PRELIMINARY GEOTECH EVALUATION

TITLE
INSTANCES OF INSTABILITY IN CANAL BACKSLOPE (1994)

PROJECT No.	FIGURE No.	REV.
0257-037-01	12	A



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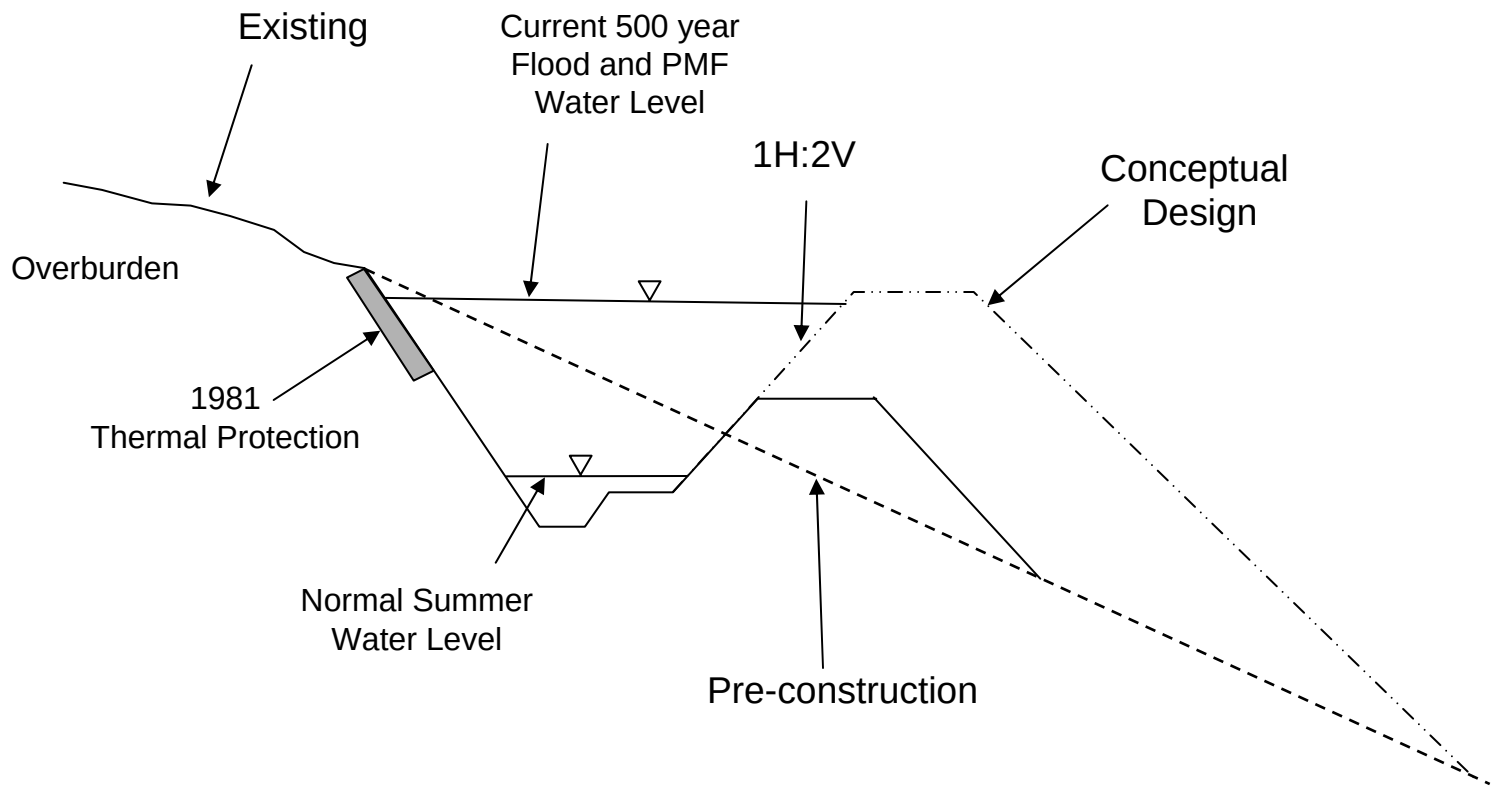
Client: Deloitte & Touche

Project:
TASK 22F RCDC – PRELIMINARY GEOTECHNIAL EVALUATION

Title:
CONCEPTUAL CROSS-SECITION – CANAL WIDENING

Project #:	Date:	Scale:	Drawn:	Approved:	Figure:
0257-037-01	JAN 2006	NA	JMS	GWF	13



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Client: Deloitte & Touche

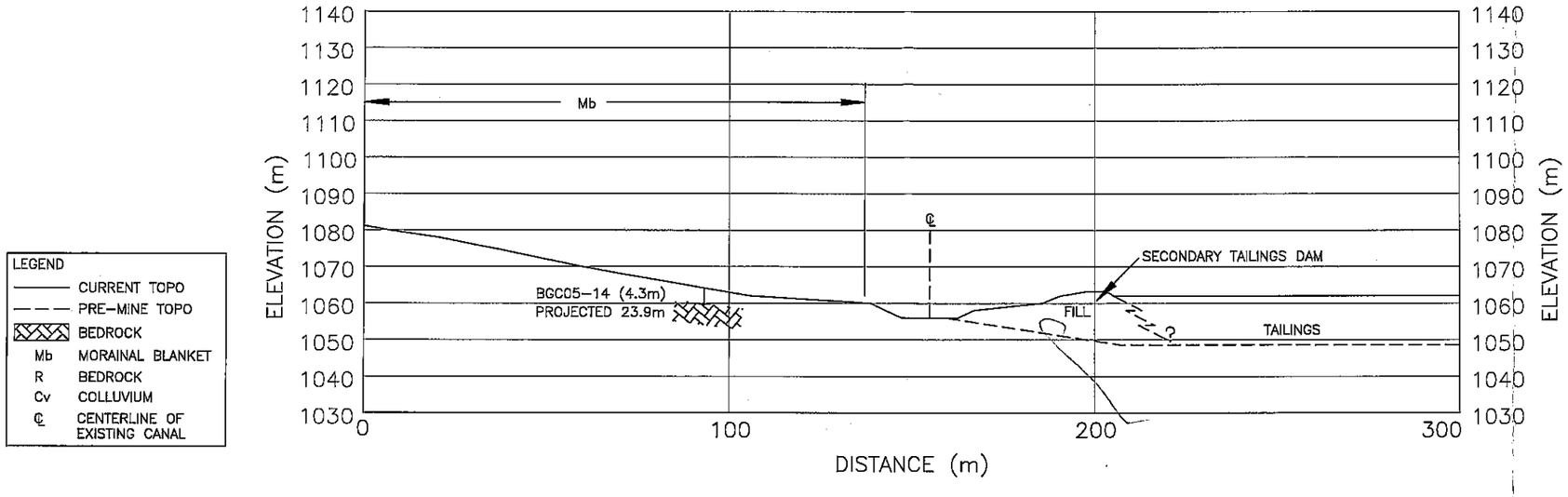
Project: TASK 22F RCDC PRELIMINARY GEOTECHNICAL EVALUATION

Title: CONCEPTUAL CROSS-SECTION- DIKE RAISE

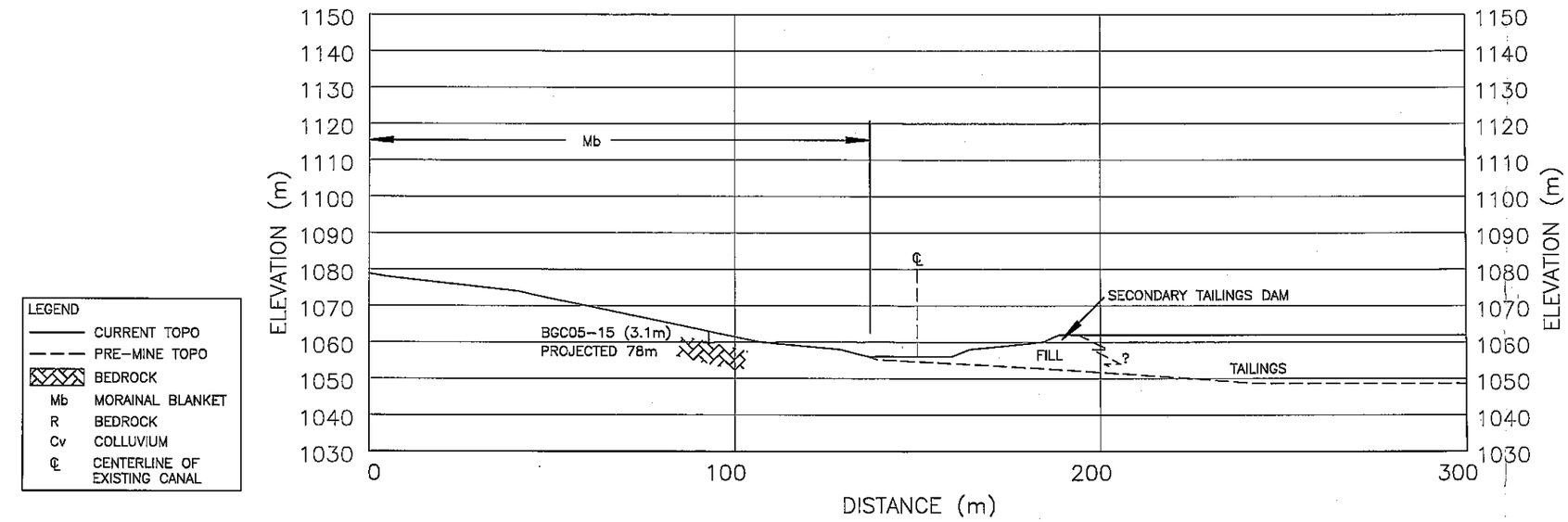
Project #:	Date:	Scale:	Drawn:	Approved:	Figure:
0257-037-01	JAN 2006	NA	JMS	GWF	14

APPENDIX A - CANAL CROSS-SECTIONS

STATION 13+00



STATION 15+00



REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE	1:1500
DATE	DEC. 9, 2005
DRAWN	EBN
DESIGNED	EBN
CHECKED	GWF
APPROVED	GWF

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CLIENT **Deloitte & Touche**

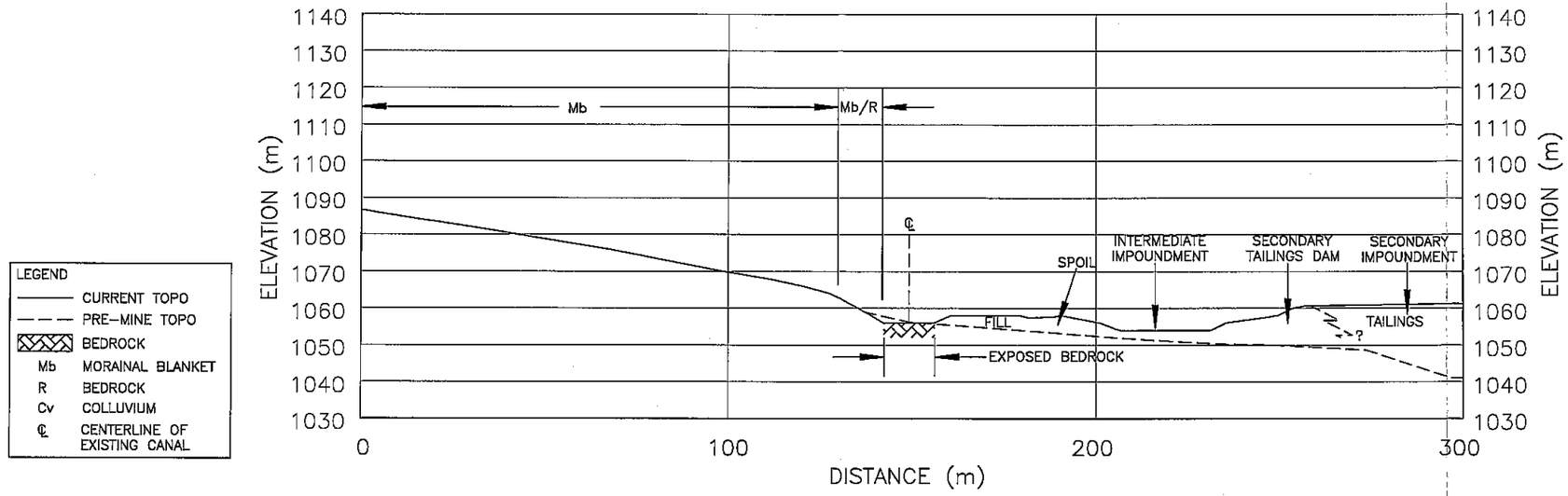
PROJECT
FARO MINE – ROSE CREEK DIVERSION CANAL

TITLE
SECTION AT 13+00 AND
SECTION AT 15+00

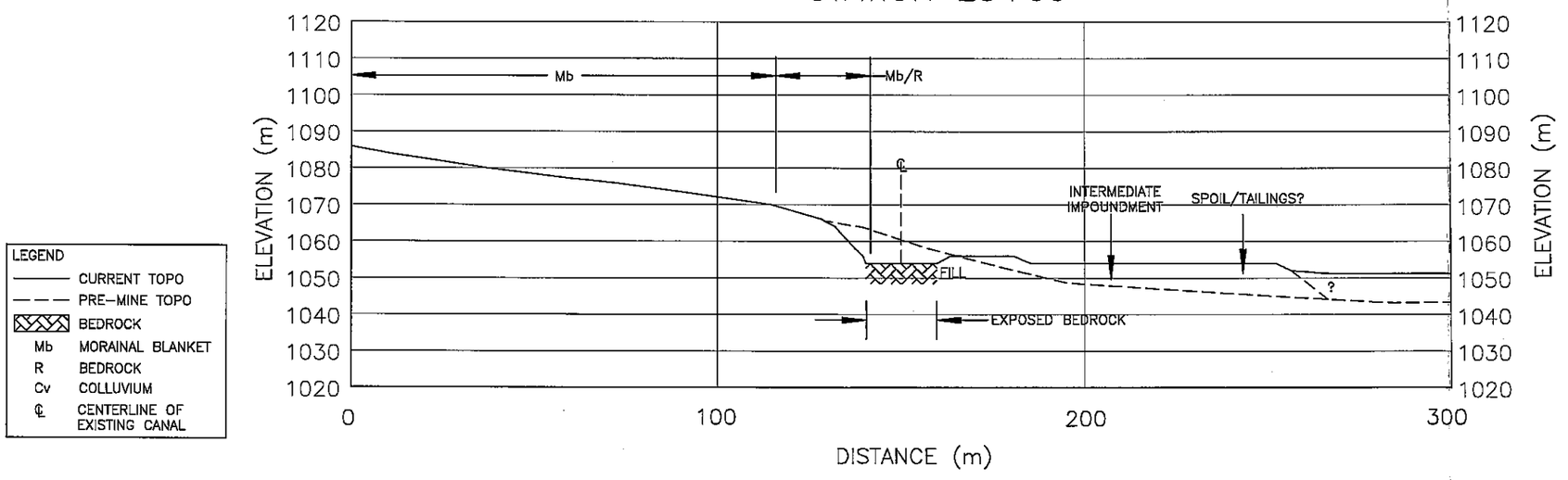
PROJECT No.	FIGURE	REV.
0257-037-02	A.1	A

0257-037-02 - RCDC Canal Sections.dwg

STATION 20+00



STATION 25+00



REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE	1:1500
DATE	DEC. 9, 2005
DRAWN	EBN
DESIGNED	EBN
CHECKED	GWF
APPROVED	GWF

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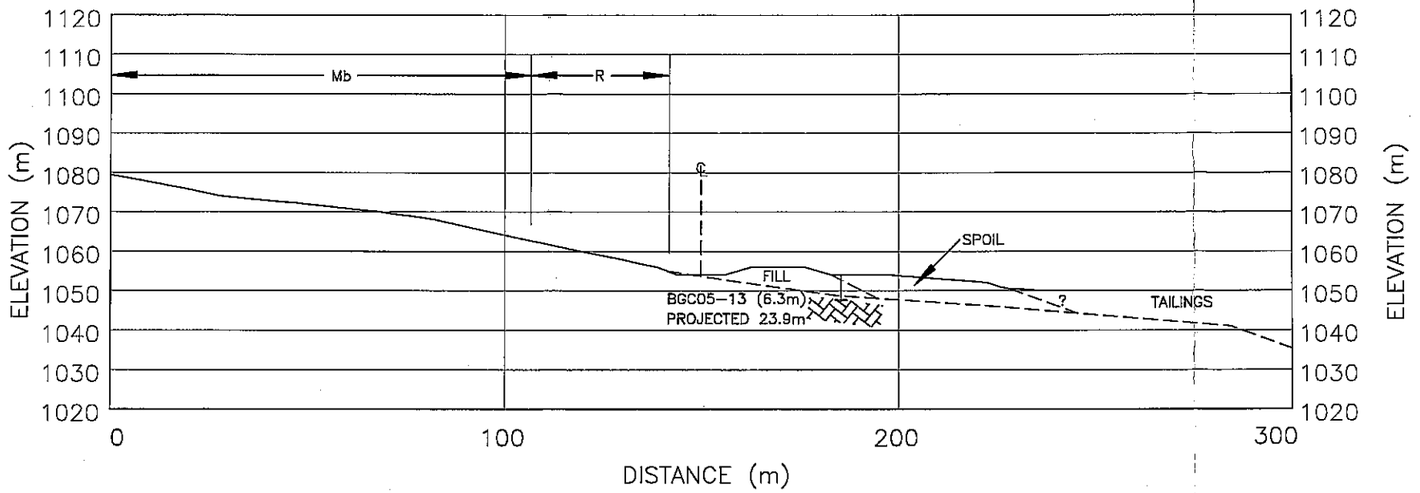
PROJECT
FARO MINE – ROSE CREEK DIVERSION CANAL

TITLE
SECTION AT 20+00 AND
SECTION AT 25+00

PROJECT No.	FIGURE	REV.
0257–037–02	A.2	A

0257-037-02 -- RCDC Canal Sections.dwg

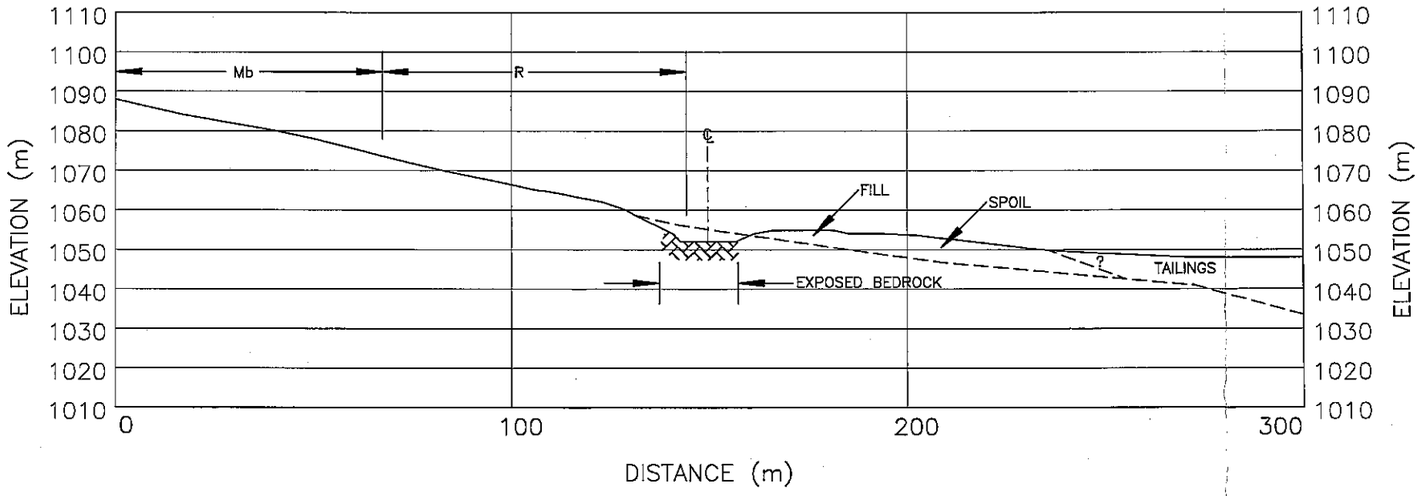
STATION 30+00



LEGEND

———	CURRENT TOPO
— — —	PRE-MINE TOPO
▨	BEDROCK
Mb	MORAINAL BLANKET
R	BEDROCK
Cv	COLLUVIUM
℄	CENTERLINE OF EXISTING CANAL

STATION 35+00



LEGEND

———	CURRENT TOPO
— — —	PRE-MINE TOPO
▨	BEDROCK
Mb	MORAINAL BLANKET
R	BEDROCK
Cv	COLLUVIUM
℄	CENTERLINE OF EXISTING CANAL

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE	1:1500
DATE	DEC. 13, 2005
DRAWN	EBN
DESIGNED	EBN
CHECKED	GWF
APPROVED	GWF

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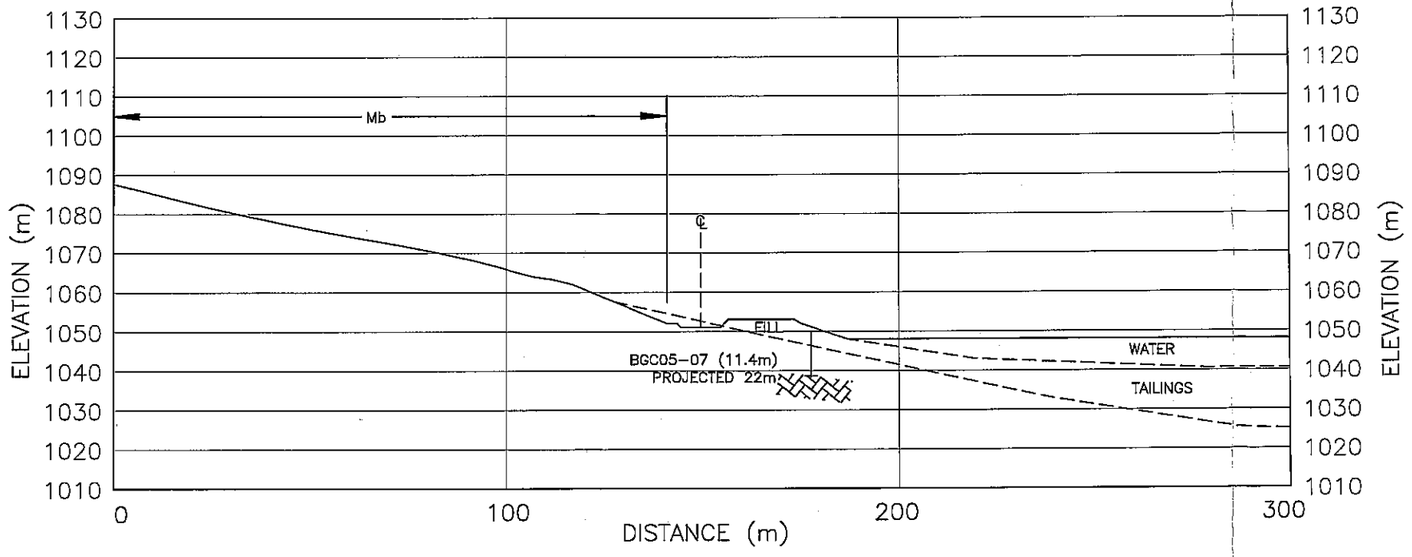
PROJECT: FARO MINE – ROSE CREEK DIVERSION CANAL

TITLE: SECTION AT 30+00 AND SECTION AT 35+00

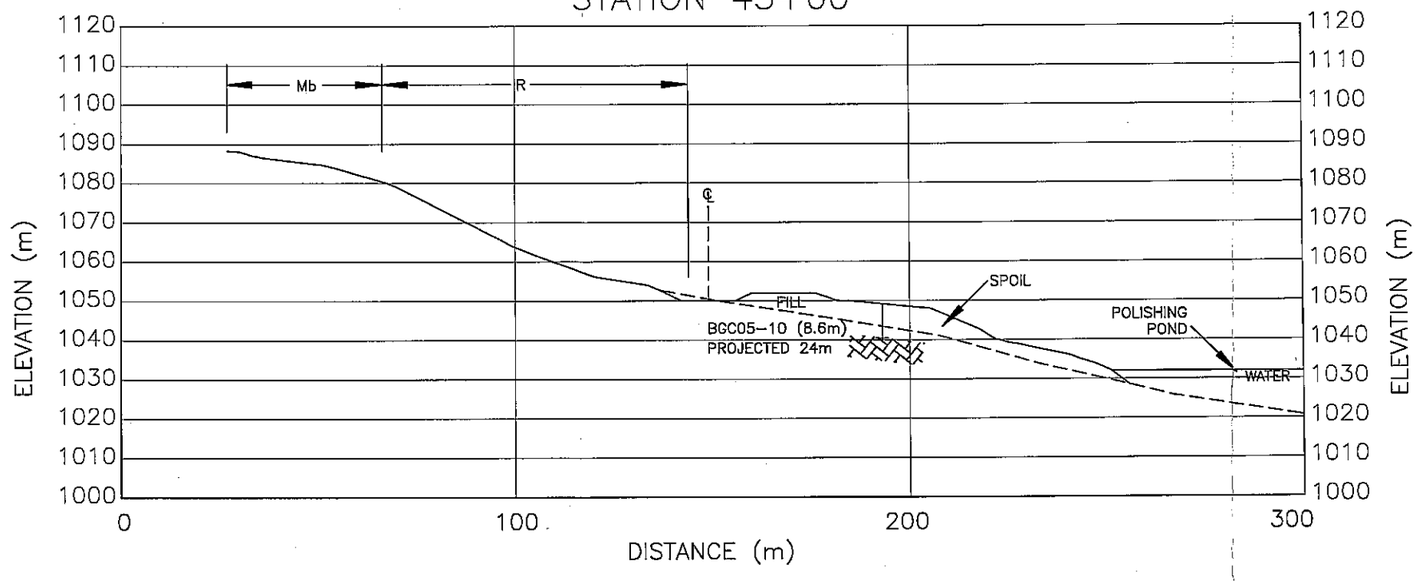
PROJECT No.	FIGURE	REV.
0257-037-02	A.3	A

0257-037-02 – RCDC Canal Sections.dwg

STATION 40+00



STATION 45+00



REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE	1:1500
DATE	DEC. 13, 2005
DRAWN	EBN
DESIGNED	EBN
CHECKED	GWF
APPROVED	GWF

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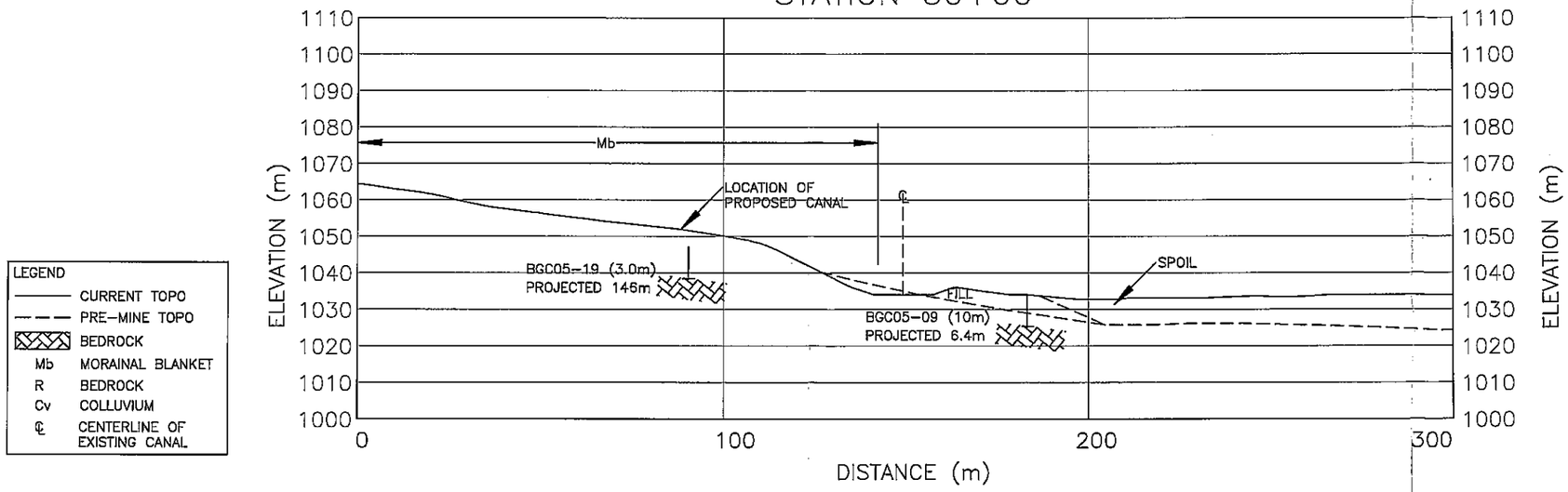
PROJECT
FARO MINE – ROSE CREEK DIVERSION CANAL

TITLE
SECTION AT 40+00 AND
SECTION AT 45+00

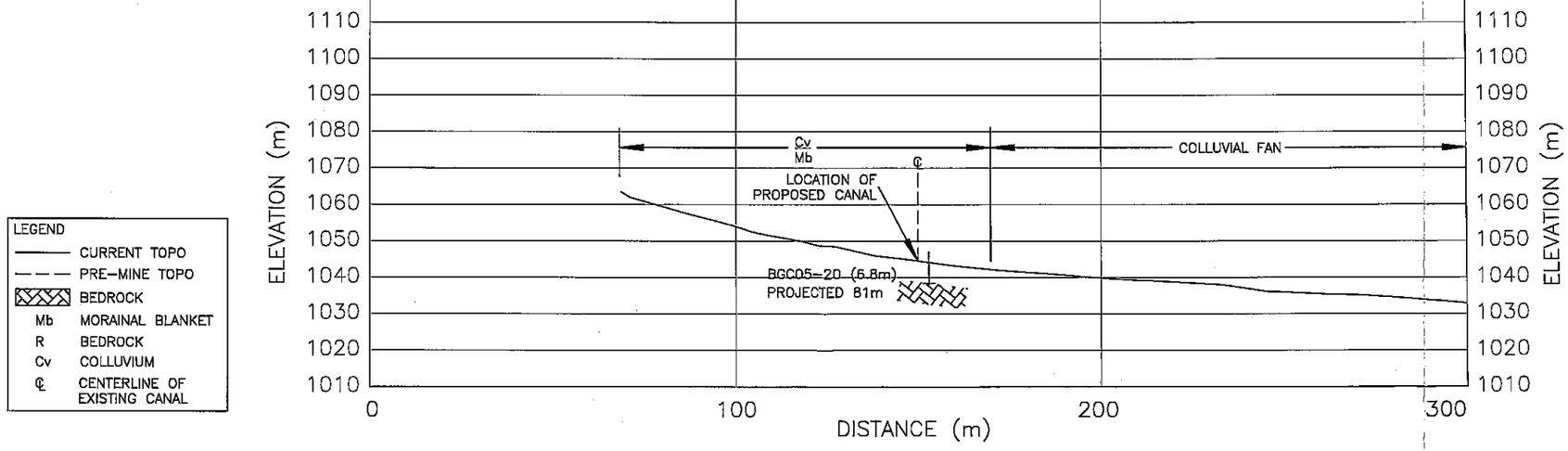
PROJECT No.	FIGURE	REV.
0257–037–02	A.4	A

0257–037–02 – RCDC Canal Sections.dwg

STATION 50+00



STATION 55+00



REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE	1:1500
DATE	DEC. 13, 2005
DRAWN	EBN
DESIGNED	EBN
CHECKED	GWF
APPROVED	GWF

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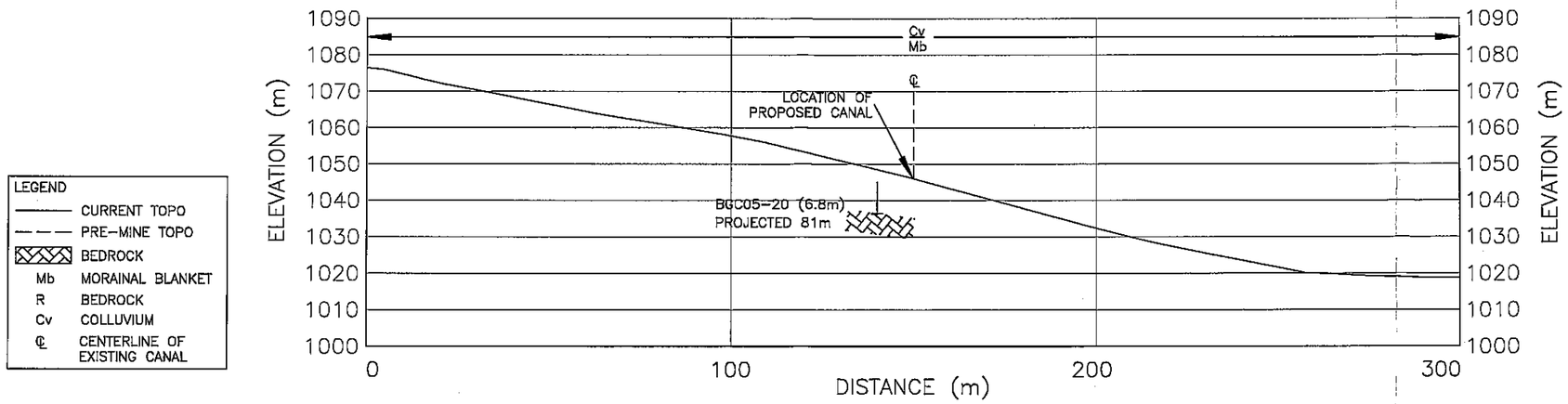
PROJECT
FARO MINE – ROSE CREEK DIVERSION CANAL

TITLE
SECTION AT 50+00 AND SECTION AT 55+00

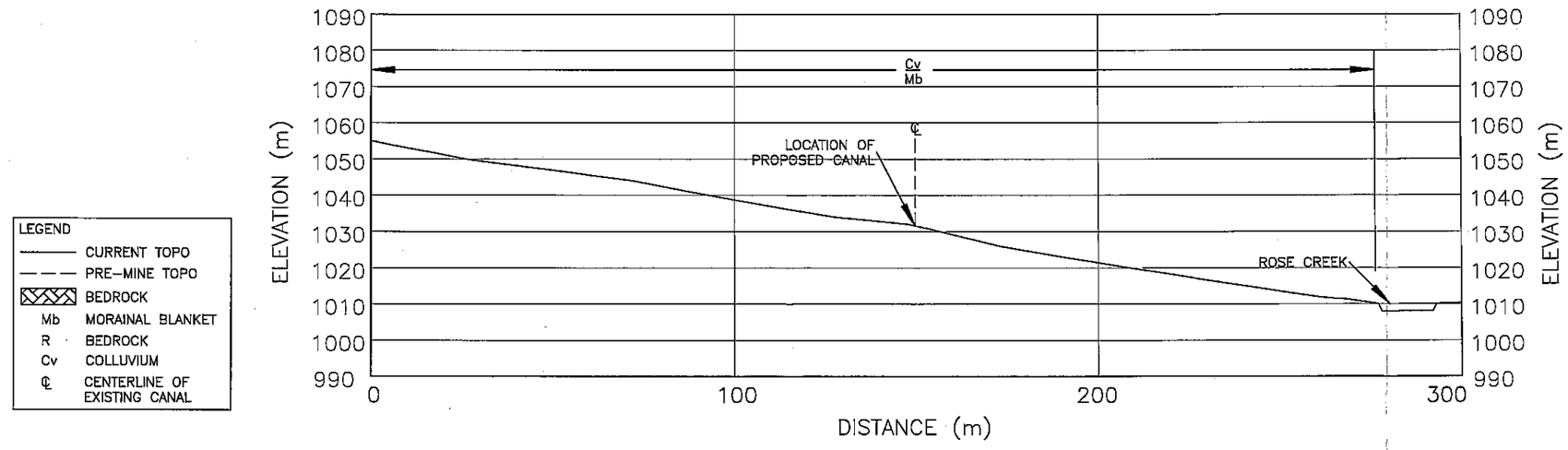
PROJECT No.	FIGURE	REV.
0257-037-02	A.5	A

0257-037-02 – RCDC Canal Sections.dwg

STATION 60+00



STATION 65+00



REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE	1:1500
DATE	DEC. 13, 2005
DRAWN	EBN
DESIGNED	EBN
CHECKED	GWF
APPROVED	GWF

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PROJECT
FARO MINE – ROSE CREEK DIVERSION CANAL

TITLE
SECTION AT 60+00 AND
SECTION AT 65+00

PROJECT No.	FIGURE	REV.
0257-037-02	A.6	A

0257-037-02 – RCDC Canal Sections.dwg

APPENDIX B - BOREHOLE LOGS DRILLED IN 1979 (Golder Associates, 1980)

A drawing showing the location
of these borehole logs is currently
under preparation.

Project No. 792-2025

RECORD OF BOREHOLE 79-8

1806·18N ; -92·71E
LOCATION (See Figure 3)

BORING DATE Aug. 2, 1979

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 120 mm

SAMPLER HAMMER WEIGHT 63.5 kg. DROP 76.2 cm DATUM Ground Surface

ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEVATION SCALE	WATER CONTENT PERCENT (Wp, W, WL; 10 20 30 40)	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
								Cleared surface
1078·80 / 0.0	Cleared Surface Some boulders							
	Frozen greenish grey sandy silt TILL, no visible ice		1	51mm O.D.	48			G-20 S-34 M-36 C-10
			2	"	>62			G-20 S-30 M-34 C-16 Sand backfill
			3	"	86			G-12 S-33 M-35 C-20 25mm P.V.C. pipe
	] boulder [		4	"	>100			G-37 S-34 M-24 C-5
	] ice [Drills more easily - may not be frozen		5	"	>100			G-15 S-40 M+C-45
1068.43 / 10.37			6	"	>100			Caved-in material
	Brown to red-brown medium to coarse sand (alluvium) probably frozen							
1066.0 / 12.8	] cobble / boulder [ ] cobble [							
	shist bedrock							
1062.65 / 16.15	End of Borehole							

VERTICAL SCALE 1:125

Golder Associates B.H. 79-8

DRAWN R.D.
CHECKED JG

Project No. 792-2025

RECORD OF BOREHOLE 79-22

1869·83 N ; −198·86 E
LOCATION (See Figure 3)

BORING DATE 19 Aug 1979

BOREHOLE TYPE Rotary with mud

BOREHOLE DIAMETER 114 mm

SAMPLER HAMMER · WEIGHT 63·5 kg DROP 76·2cm DATUM Cleared ground surface

SOIL PROFILE									PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300 mm	ELEVATION SCALE	WATER CONTENT PERCENT W_P W W_L		
1079·20 0·00	Cleared ground surface								
	Frozen olive brown to grey fine sandy SILT TILL, occ. coarse sand and gravel pockets		1	76mm DIA	>100			G-59 S-26 M+C -15	No installations
			2	"	>100				
1070·06 9·14	End of Borehole								

NOTE: Borehole abandoned due to loss of pit seal. Four boreholes were attempted with mud in this area, but all had to be abandoned. Borehole 79-22A was drilled with air

VERTICAL SCALE 1:125

Golder Associates BH. 79-22

DRAWN RK
CHECKED DG

Project No. 792 2025

RECORD OF BOREHOLE 79-22A

1840·84 N; -185·90 E
LOCATION (See Figure 3)

BORING DATE 21 Aug 1979

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 114 mm

SAMPLER HAMMER WEIGHT 63·5 kg DROP 76·2 cm DATUM Cleared ground surface

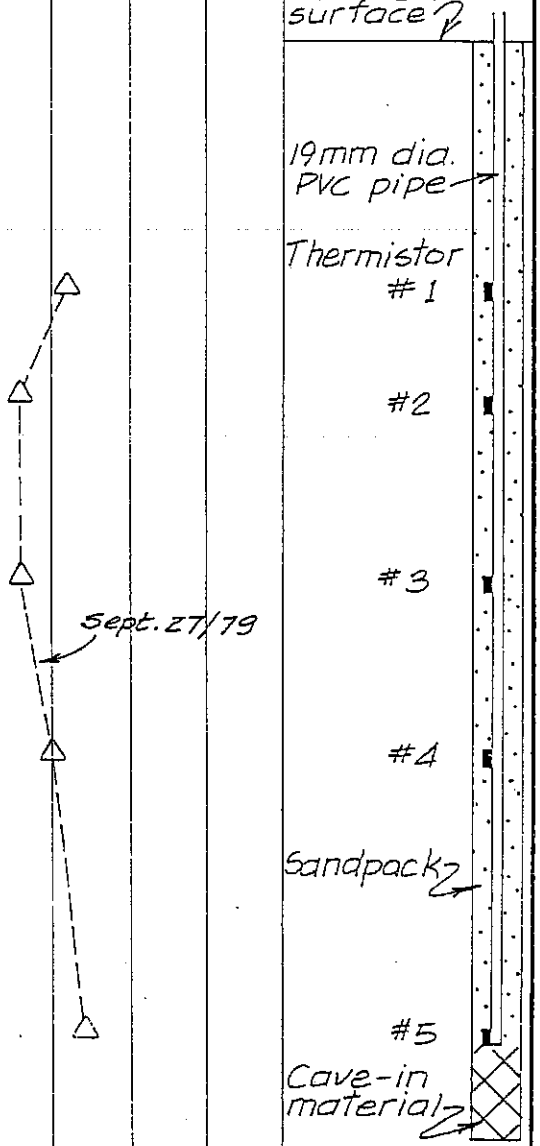
ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300 mm
1081·90	Cleared ground surface				
0·00	Frozen alternating brown & grey fine sandy SILT TILL, non-plastic to low plasticity, occ. organic layers				
1079·46					
2·44	Frozen grey to greenish grey sandy SILT TILL				
	easier drilling				
1066·66					
15·24	= organic				
	Dark grey SILT, non-plastic, occ. cobble or pebble		1	W.S	
1063·61					
18·29	End of Borehole				

ELEVATION SCALE

TEMPERATURE, °C
-0·5 0 +0·5 +1·0

WATER CONTENT PERCENT
W_P W W_L

PIEZOMETER OR STANDPIPE INSTALLATION
ADDITIONAL LAB. TESTING



VERTICAL SCALE 1:125

Golder Associates BH. 79-22A

DRAWN RK
CHECKED DG

Project No. 792-2025

RECORD OF BOREHOLE 79-23

1910.41 N ; -387.72 E
LOCATION (See Figure 3)

BORING DATE 22 Aug 1979

BOREHOLE TYPE Rotary with mud to 2.2m; air to 18.29 m

BOREHOLE DIAMETER 114 mm

SAMPLER HAMMER WEIGHT 63.5 kg DROP 76.2 cm DATUM Cut ground surface

ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300 mm	ELEVATION SCALE	WATER CONTENT PERCENT W_P W W_L (10 20 30 40)	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
1083.17	Cut ground surface							Ground surface
0.00	Ice seams to 12 mm thickness		1	76 mm D.O.	>100			19 mm dia. PVC pipe; G-35 S-31 M+C-34
	Frozen brown to grey fine sandy SILT TILL, some visible ice near surface		2	"	>100			Peltonite seal; Cbl-1 G-29 S-46 M+C-24
	organic							Sandpack
1074.03			3	"	90			Cbl-G G-45 S-36 M+C-13; W.L. 27 Sept 79
9.14	organic black fine to coarse SAND & GRAVEL (appears to be unfrozen)							Petur pneumatic piezometer
	cobble							
1070.06	SAND & GRAVEL							
13.11	Grey fine sandy SILT TILL							
	Boulder							
1064.88								
18.29	End of Borehole							

NOTE: Borehole abandoned due to rotting of permafrost & caving. Hole size at surface ≈ 0.7m dia.

NOTE: Piezometer installed in auxilliary borehole drilled with air, about 4m East of BH. 79-23

VERTICAL SCALE 1:125

Golder Associates BH. 79-23

DRAWN RK
CHECKED DG

PROJECT No. 792-2025

RECORD OF BOREHOLE 79-24

1161·40 N ; 1222·52 E
LOCATION (See Figure 3)

BORING DATE 22 Aug 1979

DATUM Cleared ground surface

BOREHOLE TYPE Rotary with mud

BOREHOLE DIAMETER 114 mm

SAMPLER HAMMER WEIGHT 63·5 kg DROP 76·2 cm

PEN. TEST HAMMER WEIGHT DROP

ELEVN. / DEPTH (m)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/300 mm	ELEVATION SCALE
1084·64	Ground surface					
0·00	Olive brown fine sandy SILT TILL, compact to dense		1	76mm O.D.	29	
1082·35						
2·29	Grey fine sandy SILT TILL, low plasticity, fissured, compact to dense (cold but not frozen)		2	"	18	
			3	"	25	
			4	"	31	
	] sample seems frozen		5	"	>100	
1075·80						
8·84	Grey clayey SILT to sandy SILT TILL, hard					
1070·01						
14·63	Blue sandy to clayey SILT TILL, hard					
1067·88						
16·76	Light grey clayey SILT TILL, low to medium plasticity, hard					
1061·78						
22·86	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS/FT.

SHEAR STRENGTH C_u, LB./SQ.FT.

TEMPERATURE, °C
-0·5 0 +0·5 +1·0

WATER CONTENT, PERCENT
W_P W W_L
10 20 30 40

G_s = 2.74

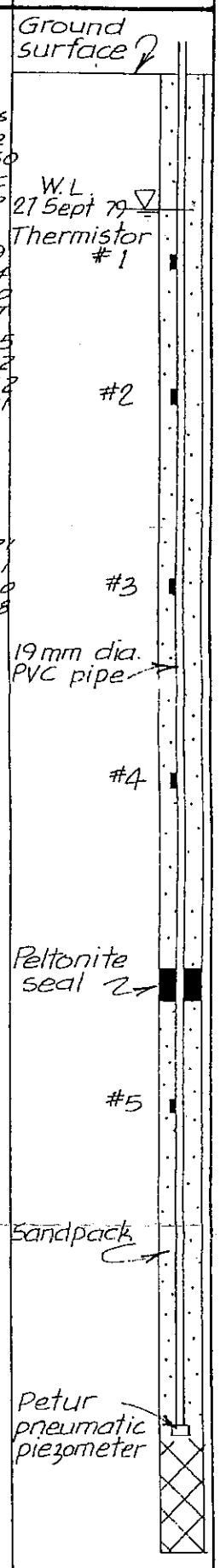
Composite sample formed from samples 2, 3, and 5 for strength testing. $\phi' = 33°$

Sept. 27/79

15 5 10 Percent axial strain at failure

ADDITIONAL LAB. TESTING
Cbl 6
G-52
S-30
M+C 12
G-19
S-24
M-40
C-17
G-15
S-32
M-32
C-21
G-21
S-31
M-30
C-18

PIEZOMETER OR STANDPIPE INSTALLATION



VERTICAL SCALE
1 : 100

Golder Associates BH. 79-24

DRAWN RK
CHECKED DG

Project No. 792-2025

RECORD OF BOREHOLE 79-25

1050·57 N; 1432·59 E
LOCATION (See Figure 3)

BORING DATE 27 Aug 1979

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 114 mm

SAMPLER HAMMER WEIGHT 63·5 kg DROP 76·2 cm DATUM Cleared ground surface

SOIL PROFILE ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / 300 mm	ELEVATION SCALE	TEMPERATURE, °C (-0.5 0 +0.5 +1.0) / WATER CONTENT PERCENT (Wp W WL)	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
1087.00	Cleared ground surface							Ground surface
0.00 / 1086.09	Organic SILT & debris							Thermistor #1
0.91 / 1085.48	Sandy SILT TILL							#2
1.52 / 1082.73	Frozen SILT TILL and schisty TILL						Sept. 27/79	27 Sept 79 W.L.
4.27 / 1080.90	SCHIST BOULDER							#3
6.10	Sandy SILT TILL							#4 Peltonite seal
6.55 / 1079.68	SCHIST BEDROCK							#5
7.32 / 1076.64	Relatively hard SCHIST BEDROCK							#6
10.36 / 1074.81	Relatively soft SCHIST BEDROCK							#7
12.19	End of Borehole							#8
								#9 Petur pneumatic piezometer

VERTICAL SCALE 1: 100

Golder Associates BH. 79-25

DRAWN RK
CHECKED DG

PROJECT No. 782-2021

RECORD OF BOREHOLE 79-32

1578.76 N 235.42 E
LOCATION (See Figure 3)

BORING DATE Dec. 4, 1979

DATUM Project

BOREHOLE TYPE Cased Rotary with Air

BOREHOLE DIAMETER 149 mm

SAMPLER HAMMER WEIGHT 63.5 Kg DROP 76.2 cm.

PEN. TEST HAMMER WEIGHT DROP

SOIL PROFILE ELEVN./DEPTH	SOIL PROFILE DESCRIPTION	SOIL PROFILE STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FT. / SHEAR STRENGTH C_u, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY k, CM./SEC. / WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
1085.37	Cleared Ground Surface									
0.00	Brown SAND & Gravel TILL		1	CS						
1082.63										
2.74	Greenish grey schist BEDROCK occ. silty layer		2	WS						Dry
			3	"						
1077.44			4	"						
7.93	End of borehole									

15-○-5 Percent axial strain at failure
10

VERTICAL SCALE
1:125

Golder Associates B.H. 79-32

DRAWN R.W.
CHECKED DG

Project No. 782 2025

RECORD OF BOREHOLE 80-47

Canol Sta. 2+370
1600.2 N 164.8 E
LOCATION (See Figure 3)

BORING DATE Feb. 23, 1980

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 100 mm

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 IN.

DATUM Cleared ground surface

ELEV. / DEPTH (m.)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEVATION SCALE	WATER CONTENT PERCENT Wp W WL (10 20 30 40)	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
1090.66	Cleared ground surface							
0.0 1090.06 0.6	Brown, organic SILT, frozen — Frozen —] organic layer							
	Greenish-brown to brown SAND and GRAVEL TILL (frozen)] Brown fine SAND becoming dry						No testing	Backfilled with cuttings Bentonite seal Sand & gravel pack Slotted 20mm PVC pipe
1084.56 6.1 1083.36	Brown to very light grey disturbed BEDROCK, dry							
7.3 1079.96	Schisty BEDROCK with brown silt infilling in joints or layers.							
10.7	End of Borehole							Dry at 10.0 m March 8/80

VERTICAL SCALE 1:100

Golder Associates B.H. 80-47

DRAWN RW
CHECKED DG

Project No. 782 2025

RECORD OF BOREHOLE B.H. 80-48

Canal Sta. 2+300
1568.5N 227.7E
LOCATION (See Figure 3)

BORING DATE Feb. 23, 1980

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 100 mm

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 IN.

DATUM Cleared ground surface

SOIL PROFILE ELEV. DEPTH (metres)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEVATION SCALE	WATER CONTENT PERCENT W_P W W_L 10 20 30 40	PIEZOMETER OR STANDPIPE INSTALLATION ADDITIONAL LAB. TESTING
1089.29	Cleared ground surface							
0.00 1089.29	Frozen organic SILT							
0.6 1083.79	Frozen, greenish-brown SAND & GRAVEL TILL, some ice in cuttings							Cuttings backfill; Bentonite seal; sand & gravel pack; Slotted 20mm PVC pipe
6.1 1082.59	Disturbed bedrock							
7.3 1080.79	Grey, schisty, BEDROCK		1	W.S.				
9.1	End of Borehole							Dry at 8.2 m March 8/80

VERTICAL SCALE 1:100

Golder Associates B.H. 80-48

DRAWN R.W.
CHECKED JG

Project No. 792 2025

RECORD OF BOREHOLE B.H. 80-49

Canal Sta. 2+220
1528.8 N 299.2 E
LOCATION (See Figure 3)

BORING DATE Feb 23, 1980

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 100 mm

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 IN.

DATUM Cleared ground surface

ELEV. DEPTH (metres)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEVATION SCALE	WATER CONTENT PERCENT W_P W W_L (10 20 30 40)	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
1088.83	Cleared ground surface							
0.0 1088.23	Frozen organic SILT							
0.6	boulder [boulder Greenish-brown to brown SAND and GRAVEL TILL frozen to about 4m. depth Very dry (possibly disturbed bedrock)						No testing	Cuttings backfill Bentonite seal Sand & gravel backfill
1079.73								
9.1 1078.13	Grey schisty BEDROCK							Slotted 20mm PVC pipe
10.7	End of Borehole							Dry at 10.0 m March 8/80

VERTICAL SCALE 1:100

Golder Associates B.H. 80-49

DRAWN RW.
CHECKED DG

Project No. 792-2045

RECORD OF BOREHOLE B.H. 80-50

Canal Sta. 2+100
1475.8 N 404.4 E
LOCATION (See Figure 3)

BORING DATE February 23, 1980

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 100 mm.

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 IN.

DATUM Cleared ground surface

ELEV. / DEPTH (metres)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEVATION SCALE	WATER CONTENT PERCENT W_P W W_L (10 20 30 40)	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
1085.66	Cleared ground surface							
0.0 / 1084.46	Frozen brown organic SILT							
1.2 / 1083.26	Greenish brown SAND and GRAVEL TILL (unfrozen)							Cuttings backfill
2.4 / 1080.76	Brown SAND and GRAVEL, unfrozen						No testing	Bentonite seal; Sand & gravel backfill; Slotted 20mm PVC pipe
4.9 / 1077.76	Grey silt and sand cuttings, probably disturbed BEDROCK, very dry, probably rippable							
7.9 / 1076.56	Schisty BEDROCK							
9.1	End of Borehole							Dry at 8.0 m March 8/80

VERTICAL SCALE 1:100

Golder Associates B.H. 80-50

DRAWN R.W.
CHECKED DG

Project No. 792-2025

RECORD OF BOREHOLE B.H. 80-51

Canol Sta. 2+000
1438.0 N 482.5 E
LOCATION (See Figure 3)

BORING DATE Feb. 23, 1980

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 100 mm

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 IN.

DATUM Cleared ground surface

ELEV. DEPTH (metres)	DESCRIPTION
1089.54	Cleared ground surface
0.0 1088.34	Frozen, brown, organic SILT
1.2	Greenish-grey, frozen SAND and GRAVEL TILL, bits of ice in cuttings
	Till as above but with several boulders
1078.84	possibly fractured or disturbed BEDROCK
10.7 1075.84	Grey schisty BEDROCK
13.7	End of Borehole

SOIL PROFILE

STRATIGRAPHY PLOT

SAMPLE NUMBER

SAMPLE TYPE

BLOWS / FOOT

ELEVATION SCALE

Temperature °C
-2 -1 0 +1

WATER CONTENT PERCENT
W_P W W_L
10 20 30 40

March 8/80
March 26/80
April 30/80
No testing

PIEZOMETER OR STANDPIPE INSTALLATION

ADDITIONAL LAB. TESTING

Cuttings backfill
Thermistor #1
Bentonite seal
#2
#3
Sand & gravel backfill (probably fill is discontinuous)
#4
Slotted 20mm PVC pipe
#5

Dry at 13.4 m March 8/80

VERTICAL SCALE 1:100

Golder Associates BH 80-51

DRAWN RW
CHECKED JG

Project No. 792 2025

RECORD OF BOREHOLE B.H. 80-52

Canal Sta. 1+890
1369.5 N 618.5 E
LOCATION (See Figure 3)

BORING DATE Feb. 23, 1980

BOREHOLE TYPE Rotary with air

BOREHOLE DIAMETER 100mm

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 IN.

DATUM Cleared Ground Surface

SOIL PROFILE ELEV. / DEPTH (metres)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEVATION SCALE	WATER CONTENT PERCENT W_P W W_L (10 20 30 40)	PIEZOMETER OR STANDPIPE INSTALLATION / ADDITIONAL LAB. TESTING
1089.41	Cleared ground surface							
1088.81	Frozen, bwn., organic SILT							
0.6	Frozen, greenish-grey, SAND and GRAVEL TILL					No testing		Sand & gravel pack Bentonite seal Sand & gravel pack Slotted 20 mm PVC pipe
1083.31								
6.1	SAND and GRAVEL TILL with sandy silt pockets (unfrozen)							
1080.31								
9.1	End of Borehole Note: Log based on driller's observations							Dry at 7.8m March 8/80

VERTICAL SCALE 1:100

Golder Associates B.H. 80-52

DRAWN R.W.
CHECKED DG

RECORD OF TEST PIT SHEETS

Other Than Along Diversion Canal

Test Pit No. 1 to 20 incl.
23 to 25 incl.

Project No. 792-2025

RECORD OF TEST PIT T.P. 79-5

2503.4 N -589.3 E LOCATION (See Figure)

DATE 6 Aug 1979

DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper

PROJECT DOWN VALLEY

ELEV N. / DEPTH (m)	DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING
1055.83 / 0.00	Ground surface			
	Organic SILT & debris			
0.25	White volcanic ash			
0.46	Brown to brown grey dense coarse sandy GRAVEL	1	C.S.	
1053.33 / 2.50	Frozen, oxidized med. to coarse SAND, some gravel (to .1m. dia.), dense, thaws quickly	2	C.S.	G-49 S-49 M+C-2
1051.83 / 4.0	Olive brown fine to coarse SAND, little med. gravel	3	C.S.	G-48 S-50 M+C-2
1049.83 / 6.00	Bottom of Test Pit			

STRATIGRAPHY PLOT

ELEVATION SCALE

WATER CONTENT, PERCENT
W_P W W_L
10 20 30 40

GROUNDWATER CONDITIONS

VERTICAL SCALE 1:50

Golder Associates T.P. 79-5

DRAWN RK

CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 79-6

2300.2N 467.9E LOCATION (See Figure) | DATE 7 Aug 1979 | DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper | PROJECT DOWN VALLEY

SOIL PROFILE ELEV N. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L (10 20 30 40)	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1055.69	Ground surface							
0.00 / 1055.39	Organic SILT & debris, moss							
0.30	White volcanic ash							
0.51 / 1052.49	Brown coarse sandy GRAVEL, (max. size 0.5 m)							
3.20 / 1050.09	Brown grey med. to coarse SAND, some frozen, some gravel to .3 m dia., becoming sandier with depth		1	C.S.		O	Cb1-10 G-54 S-35 M+C = 1%	
			2	C.S.		O		
5.60	Bottom of Test Pit							

VERTICAL SCALE 1:50

Golder Associates T.P. 79-6

DRAWN RK CHECKED JG

Project No. 792-2025

RECORD OF TEST PIT T.P. 79-7

2041.7N 380.7E
LOCATION (See Figure)

DATE 8 Aug 1978

DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper

PROJECT DOWN VALLEY

ELEVN. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1057.58	Ground surface							
0.00 / 1057.28	Moss & organic debris							
0.30	Black frozen organic SILT $w >> WP$, material flows when thawed							
1056.36								
1.22	Brown gravelly SAND becoming finer with depth		1	C.S.			G-78 SM, C-22	
1054.23								
3.35	Bottom of Test Pit							
	Depth varies along length of pit							

VERTICAL SCALE 1:50

Golder Associates T.P. 79-7

DRAWN RK
CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 79-11

2131.4N -641.5E
LOCATION (See Figure)

DATE 25 Aug 1979

DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper

PROJECT DOWN VALLEY

SOIL PROFILE								
ELEV N. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1060.82	Ground surface							
0.00	Frozen organic SILTS & debris with moss at top of stratum, some fine & medium to coarse sand pockets							
1059.30								
1.52	Frozen gravelly SAND (no cobbles or coarse gravel)							
1057.16								
3.66	Bottom of Test Pit							

VERTICAL SCALE 1:50

Golder Associates T.P. 79-11

DRAWN RK
CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 79-12

2060.2N-287.2E.
LOCATION (See Figure 3)

DATE 25 Aug 1979

DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper

PROJECT Down valley

SOIL PROFILE								
ELEV N. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L 10 20 30 40	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1057.36	Ground surface							
0.00 / 1057.06	Surficial organics							
0.30	Sandy fine GRAVEL with occ. silty pockets & organic inclusions, material is highly variable							
1055.99								
1.37	Bottom of Test Pit							Pit abandoned due to seepage

VERTICAL SCALE 1:50

Golder Associates T.P. 79-12

DRAWN RK

CHECKED JG

Project No. 792-2025

Canal Sta. 1+915
1408 N 578 E
LOCATION (See Figure 3)

RECORD OF TEST PIT T.P 79-21

DATE Dec. 12. 1979 DATUM Ground Surface

METHOD OF EXCAVATION D-8 Cat & Ripper PROJECT Down Valley Tailings

SOIL PROFILE: ELEVN. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT (W_P — W — W_L) 10 20 30 40	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1087.4	Ground Surface							
0.0 1086.8	Frozen organic silt & debris							
0.6 1083.4	Frozen greenish grey SAND & GRAVEL TILL occasional ice lenses, most of material is highly friable		1	CS		Several samples taken ○	δ_W = 1999 kg/m³ δ_W = 1917 kg/m³ δ_W = 1781 kg/m³ δ_W = 2082 kg/m³ δ_N = 1866 kg/m³	Frozen Dry
4.0	End of Test Pit NOTE: This pit subsequently incorporated into the test excavation.							

VERTICAL SCALE 1:50

Golder Associates TP 79-21

DRAWN R.W.
CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 0+045

LOCATION (See Figure) DATE 26 Aug 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down valley

ELEV N. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT (W_P W W_L) 10 20 30 40	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1091.3	Ground surface							
0.00	Moss & organic debris							
0.30	Frozen organic SILT, volcanic ash, some boulders							
1090.2								
1.07	Frozen brown sandy GRAVEL (ALLUVIUM), some silty pockets		1	C.S.		O	Cbl-5 G-47 S-39 M+C-9	
1087.6								
3.66	Bottom of Test Pit Surveyed pit bottom elevation 1088.0							

VERTICAL SCALE 1:50

Golder Associates T.P. 0+045 DRAWN RK CHECKED DG

RECORD OF TEST PIT T.P. 0+195

Project No. 792-2025

LOCATION (See Figure) DATE 26 August 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down valley

ELEVN. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L (10 20 30 40)	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1092.3	Ground surface							
0.00	Organic debris & moss							
0.28	Brown silty GRAVEL TILL, high proportion of schist rock boulder lag at approx. 1.83 m		1	C.S.			G-73 S-18 M-9	non-plastic
1089.9								
2.44	Bottom of Test Pit							
	Surveyed pit bottom elevation 1090.2							

VERTICAL SCALE 1:50

Golder Associates T.P. 0+195

DRAWN RK

CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 0+760

LOCATION (See Figure) DATE 26 Aug 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down Valley

ELEVN. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L (10 20 30 40)	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1091.9	Ground surface							
	Organic debris & moss							
0.15	White volcanic ash							
	Greenish brown silty fine SAND TILL		1	C.S.			G-51 S-28 M-20 C-1	non-plastic
1090.22								
1.68	Greenish grey massive metavolcanic rock dipping into slope							
1087.94								
3.96	Bottom of Test Pit							
	surveyed pit bottom elevation 1088.8							

VERTICAL SCALE 1:50

Golder Associates T.P. 0+760

DRAWN RK CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 1+095

LOCATION (See Figure) DATE 26 Aug 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down Valley

ELEV N. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT (W_P W W_L) 10 20 30 40	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1089.5	Ground surface							
0.00 / 1089.2	Moss & organic debris							
0.30	Olive brown fine sandy SILT TILL (frozen below 1.22 m)							
	Frozen black organic SILT							
1.92 / 1087.1	Frozen SAND & GRAVEL							
2.44	Frozen, greenish brown fine sandy SILT TILL		1	C.S.		O	G-51 S-35 M-13 C-1	
1084.6								
4.88	Bottom of Test Pit							
	Surveyed pit bottom elevation 1085.4							

VERTICAL SCALE 1:50

Golder Associates T.P. 1+095

DRAWN RK

CHECKED DG

RECORD OF TEST PIT T.P. 1+680

Project No. 792-2025

LOCATION (See Figure) DATE 26 Aug 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down valley

ELEV. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L (10 20 30 40)	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1086.5	Ground surface							
0.00 / 1086.1	Organic debris & moss							
0.43 / 1085.3	Frozen organic SILT & Brown sandy SILT COLLUVIUM							
1.22 / 1084.7	Brown sandy SILT to silty fine SAND COLLUVIUM with several organic seams		1	C.S.			G-39 S-32 M-28 C- 1	
1.83 / 1082.2	Greenish brown fine sandy SILT TILL		2	C.S.			G-53 S-30 M-15 C- 2	
4.27	Bottom of Test Pit							
	Surveyed pit bottom elevation 1082.6							

VERTICAL SCALE 1:50

Golder Associates T.P. 1+680

DRAWN RK CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 2+155

LOCATION (See Figure) DATE 25 Aug 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down Valley

ELEV N. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT (W_P — W — W_L) 10 20 30 40	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1084.0	Ground surface							
0.00 / 1083.7	Moss & organic debris							
0.30	Frozen, mixed brown sandy SILT (TILL) COLLUVIUM & organic SILT, some visible ice		1	C.S.		O	G-25 S-34 M-32 C-9	
1080.65 / 3.05	Brown silty SAND						G-35 S-38 M-24 C-3	
1076.69 / 3.96	Blue green massive BEDROCK		2	C.S.		O		
1072.42 / 4.27	Bottom of Test Pit							

NOTE: Test pit elevation estimated from diversion canal baseline profile.

VERTICAL SCALE 1:50

Golder Associates T.P. 2+155

DRAWN RK CHECKED JG

Project No. 792-2025

RECORD OF TEST PIT T.P. 2+515

LOCATION (See Figure) DATE 25 Aug 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down Valley

ELEVN. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L (10 20 30 40)	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1083.5	Ground surface							
0.00	Moss & organic SILT							
1083.1								
0.41	Brown fine sandy SILT TILL, non-plastic to low plasticity, friable boulder layer at 5.5 m		1	C.S.			G-45 S-25 M-25 C-5	
			2	C.S.			G-45 S-34 M-20 C-1	
			3	C.S.				
1076.7			4	C.S.				
6.83	Bottom of Test Pit							

VERTICAL SCALE 1:50

Golder Associates T.P. 2+515

DRAWN RK CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 2+910

LOCATION (See Figure) DATE 25 Aug 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down Valley

SOIL PROFILE ELEV N. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L (10 20 30 40)	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1086.0	Ground surface							
0.00 / 1085.7	Organic debris & moss							
0.30 / 1085.09	Frozen olive brown fine sandy SILT COLLUVIUM							
0.61	Frozen brown sandy SILT COLLUVIUM, contains visible ice crystals, organic layer & cobbles at 1.2 m							
1083.57 / 1.52	Frozen brown sandy SILT TILL, ice rich, non plastic to low plasticity							
1079.91 / 3.66	Frozen grey & brown fine sandy SILT TILL, organic seam at 4.6 m		1	C.S.		o	G-19 S-36 M-39 C-6	NOTE: Surficial mud flows occurring thawing progresses
1074.73 / 5.18	Bottom of Test Pit							
	NOTE: Test pit elevation estimated from diversion canal base-line profile.							

VERTICAL SCALE 1:50

Golder Associates T.P. 2+910

DRAWN RK CHECKED DG

Project No. 792-2025

RECORD OF TEST PIT T.P. 3+160

LOCATION (See Figure) DATE 25 Aug 1979 DATUM Ground surface

METHOD OF EXCAVATION D8 Cat & ripper PROJECT Down Valley

SOIL PROFILE ELEV N. / DEPTH (m)	DESCRIPTION	STRATIGRAPHY PLOT	SAMPLE NUMBER	SAMPLE TYPE	ELEVATION SCALE	WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	GROUNDWATER CONDITIONS
1072.3	Ground surface							
0.00	Frozen organic SILT & debris & thin volcanic ash seams, cobble lag at base of stratum							
1071.69								
0.61	Frozen brown grey fine sandy SILT with organic seams at approx. .15 m intervals some coarse sand seams adjacent to organics							
1069.25								
2.44	Unfrozen GRAVEL & SAND with boulder lag at top of stratum, some silty pockets							
1065.59								
3.66	Bottom of Test Pit							

NOTE:
Test pit elevation estimated from diversion canal baseline profile.

VERTICAL SCALE 1:50

Golder Associates T.P. 3+160

DRAWN RK

CHECKED DG

APPENDIX C - BOREHOLE LOGS DRILLED IN 2005

BOREHOLE # BGC05-01

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580888.50E, 6913408.70N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 02 Aug 05
Finish Date : 02 Aug 05
Final Depth of Hole (m) : 2.4
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SAND (FILL) Some Gravel, trace Silt. Dense, non-plastic, moist, reddish brown.			
1		JMS 01		UF	SILT (FILL) Some Gravel, some Sand. Dense, non-plastic to low plasticity, grey. at 1.3 m, some oxidation, white powdery crystals.	Cuttings		33
2		JMS 02						30
		JMS 03						100
3					End of Hole: 2.4 m, auger refusal on cobble/boulder.. At 2.3 m, SPT gives 50 blows for 2 inches. Abandoned hole. No water observed. No sloughing observed.			
4								
5								

Su - kPa: 40, 80, 120, 160

VANE FIELD LAB — PEAK ◆ ■ — REMOLD ◇ □ — ▲ UC/2 — △ Pocket Pen /2

★ % Fines — ● SPT (blows/300mm)

Moisture Content & SPT N: W_p% × — W% ○ — W_L% ×; 20, 40, 60, 80

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
Calgary, AB Phone (403) 250 5185

Client: Deloitte & Touche

BOREHOLE # BGC05-02

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580881.10E, 6913412.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 02 Aug 05
Finish Date : 02 Aug 05
Final Depth of Hole (m) : 9.8
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					See BGC05-01 Borehole Log.	Concrete		
						Cuttings		
2		JMS 05		UF	SILT (FILL) Some Sand, some Gravel. Compact, non-plastic, moist, grey.			27
3		JMS 07				Bentonite		20
		JMS 06			SAND (TILL) Some Gravel, some Silt. Compact, non-cohesive, moist, reddish brown.			
4		JMS 08			At 4.0 m, SILT, some Sand. Visible quartz and biotite gravel fragments.	Sand		23
		JMS 09			at 4.7 m, some iron staining.			19
5								

Su - kPa: 40, 80, 120, 160
VANE: FIELD PEAK ◆, REMOLD ◇; LAB ■, □; ▲ UC/2; △ Pocket Pen /2
★ % Fines; ● SPT (blows/300mm)
Moisture Content & SPT N: W_p% × — W% o — W_L% ×; 20, 40, 60, 80

(Continued on next page)

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
Calgary, AB Phone (403) 250 5185

Client: Deloitte & Touche

BOREHOLE # BGC05-02

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580881.10E, 6913412.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 02 Aug 05
Finish Date : 02 Aug 05
Final Depth of Hole (m) : 9.8
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5								
6		JMS 10			at 6.1 m, higher moisture content, 1.5 inch thick layer of grey silt, slightly higher fines content than above, less sand and gravel, mottled grey with brown and buff tan layers.	Bentonite		18
7				UF		Cuttings		
8		JMS 11			at 7.6 m, iron staining, schistosic gravel clasts, mottled greenish grey brown.			33
9		JMS 12			at 9.1 m, on rock?, less gravel, silt content increases, trace clay, low plasticity.	Bentonite / Sand		100
10					at 9.6 m, clayey silt cuttings before drill refusal			

Su - kPa: 40, 80, 120, 160

VANE	FIELD	LAB	
PEAK	◆	■	▲ UC/2
REMOLD	◇	□	△ Pocket Pen /2
★ % Fines			● SPT (blows/300mm)

Moisture Content & SPT N: W_P% × — — — ○ W% — — — × W_L%; 20, 40, 60, 80

(Continued on next page)

BOREHOLE # BGC05-02

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580881.10E, 6913412.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 02 Aug 05
Finish Date : 02 Aug 05
Final Depth of Hole (m) : 9.8
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
10					End of Hole: 9.75 m, drill refusal, likely on cobbles/boulders. SPT at 9.75 m: 10 blows for 0 inches. Hole sloughed 10 cm at bottom of hole. No water observed. at 9.4 m: Piezometer (RST P100 - 030137) installed. Piezometer installed in 25 mm diameter protective PVC. Stick up of PVC is 0.55 m. Protective casing installed at surface. 10-20 Frac Sand.	Slough		
11								
12								
13								
14								
15								

Su - kPa: 40, 80, 120, 160

VANE: FIELD PEAK ◆, REMOLD ◇; LAB PEAK ■, REMOLD □; ▲ UC/2; △ Pocket Pen /2

★ % Fines; ● SPT (blows/300mm)

Moisture Content & SPT N: W_p% × — W% o — W_L% ×; 20, 40, 60, 80

BOREHOLE # BGC05-03

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580868.50E, 6913418.40N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 03 Aug 05
Finish Date : 03 Aug 05
Final Depth of Hole (m) : 4.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					Hole drilled for the installation of Piezometer (RST P100 - 030139) at depth 4.0 m. Hole drilled with Hollow Stem Auger to 4.7m. Cuttings appeared consistent with BGC05-01 and BGC05-02, No sampling.	Concrete		
1						Cuttings		
2				UF				
3					End of Hole: 4.7 m at target depth. No sloughing observed. No water observed. at 4.0 m: Piezometer (RST P100 - 030139) installed. Piezometer installed in 25 mm diameter protective PVC. Stick up of PVC is 0.5 m. Protective casing installed at surface. 10-20 Frac Sand.	Bentonite		
4						Sand		
5								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_L%
20 40 60 80

BOREHOLE # BGC05-04

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580864.70E, 6913420.20N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 03 Aug 05
Finish Date : 04 Aug 05
Final Depth of Hole (m) : 12.1
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					Hole drilled for the installation of Thermistor (BGC05-02). Hole drilled with Hollow Stem Auger to 12.1m. Cuttings appeared consistent with BGC05-01 and BGC05-02, No sampling.	Concrete		
1						Bentonite and Cement		
2				UF				
3								
4								
5								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_l%
20 40 60 80

(Continued on next page)

BOREHOLE # BGC05-04

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580864.70E, 6913420.20N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 03 Aug 05
Finish Date : 04 Aug 05
Final Depth of Hole (m) : 12.1
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5								
6								
7				UF				
8						Bentonite and Cement		
9								
10								

Su - kPa
40 80 120 160
VANE FIELD LAB
PEAK ◆ ■
REMOLD ◇ □
▲ UC/2
△ Pocket Pen /2
★ % Fines
● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_L%
20 40 60 80

(Continued on next page)

BOREHOLE # BGC05-04

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580864.70E, 6913420.20N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 03 Aug 05
Finish Date : 04 Aug 05
Final Depth of Hole (m) : 12.1
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
10						Bentonite and Cement		
11								
12				UF				
13					End of Hole: 12.1 m at target depth. No sloughing observed. Protective casing installed at surface. Thermistor installed at 11.9 m in a 1 inch protective PVC casing. Zero marker on thermistor located 0.09 m above ground surface. Thermistor beads located at 0.41 m, 0.66 m, 0.91 m, 1.91 m, 2.91 m, 3.91 m, 5.91 m, 9.91 m, and 11.91 m below ground surface. Stick-up of PVC protective casing 0.23 m.			
14								
15								

Su - kPa
40 60 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

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Client: Deloitte & Touche

BOREHOLE # BGC05-05

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580862.30E, 6913421.70N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 04 Aug 05
Finish Date : 04 Aug 05
Final Depth of Hole (m) : 10.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					Hole drilled for the installation of 2.75 inch PVC Slope Indicator Casing. Hole drilled with Hollow Stem Auger to a depth of 10.7m. Cuttings appeared consistent with BGC05-01 and BGC05-02, No sampling.	Concrete		
1								
2								
2				UF				
3						Bentonite and Cement		
4								
5								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_l%
20 40 60 80

(Continued on next page)

BOREHOLE # BGC05-05

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580862.30E, 6913421.70N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 04 Aug 05
Finish Date : 04 Aug 05
Final Depth of Hole (m) : 10.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm	Su - kPa: 40, 80, 120, 160 / VANE PEAK FIELD ◆ LAB ■ / REMOLD FIELD ◇ LAB □ / ▲ UC/2 / △ Pocket Pen /2 / ★ % Fines / ● SPT (blows/300mm) / Moisture Content & SPT N: W_p% × — W% — O — W_L% × : 20, 40, 60, 80
5									
6									
7				UF		Bentonite and Cement			
8									
9									
10									

(Continued on next page)

BOREHOLE # BGC05-05

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580862.30E, 6913421.70N
Co-ordinates in NAD 27
Ground Elevation (m) : 1054.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 04 Aug 05
Finish Date : 04 Aug 05
Final Depth of Hole (m) : 10.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
10								
11					End of Hole: 10.7 m due to drill refusal in sloughing gravel. Hole sloughed at 10.5 m. Water level observed at 9.1 m. 2.75 inch PVC Slope Indicator Casing installed at a depth of 11.1 m, casing sunk into slough with applied weight. A^0 at 26 ^{0} (wrt magnetic north). Fall line of slope at 26^0 (wrt magnetic north). Stick up of 0.73 m.			
12								
13								
14								
15								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

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Client: Deloitte & Touche

BOREHOLE # BGC05-06

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580715.30E, 6913517.50N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.3 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 05 Aug 05
Finish Date : 05 Aug 05
Final Depth of Hole (m) : 9.8
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SAND (FILL) Some Gravel, trace Silt. Medium grained sand, loose, non-plastic, moist, light brown.	Concrete		
1		JMS 13				Cuttings		8
2		JMS 14						9
		JMS 15		UF	at 2.3 m, gravel up to 15 mm, compact.	Bentonite		14
3		JMS 16				Sand		15
4						Bentonite		
5		JMS 17						22

Su - kPa: 40, 80, 120, 160

VANE: FIELD PEAK ◆, REMOLD ◇ | LAB PEAK ■, REMOLD □ | ▲ UC/2 | △ Pocket Pen /2

★ % Fines | ● SPT (blows/300mm)

Moisture Content & SPT N: W_p% × — W% ○ — W_L% ×; 20, 40, 60, 80

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Client: Deloitte & Touche

BOREHOLE # BGC05-06

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580715.30E, 6913517.50N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.3 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 05 Aug 05
Finish Date : 05 Aug 05
Final Depth of Hole (m) : 9.8
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5					SILT and SAND (TILL) Some Gravel, trace Clay. Compact, low plasticity to non-plastic, moist, greenish brown.			
					at 5.5 m, Driller's Note: Easier drilling.			
6					at 6.1 m, Driller's Note: Material is squeezing and sticking to rods.			
		JMS 18				Cuttings		10
7								
				UF				
		JMS 19			at 7.7 m, large schist rock fragment in SPT.	Bentonite		22
8								
						Sand		
9					at 9.1 m, some oxidation, dry.			
		JMS 20				Bentonite		15
		JMS 21			Schist Bedrock			50
10								

Su - kPa: 40, 80, 120, 160
VANE: FIELD PEAK ◆, FIELD REMOLD ◇, LAB PEAK ■, LAB REMOLD □, ▲ UC/2, △ Pocket Pen /2
★ % Fines, ● SPT (blows/300mm)
Moisture Content & SPT N: W_P% × — W% ○ — W_L% ×; 20, 40, 60, 80

(Continued on next page)

BOREHOLE # BGC05-06

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580715.30E, 6913517.50N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.3 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 05 Aug 05
Finish Date : 05 Aug 05
Final Depth of Hole (m) : 9.8
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm	Su - kPa: 40, 80, 120, 160; VANE PEAK ◆ FIELD ■ LAB; REMOLD ◇ □; ▲ UC/2; △ Pocket Pen /2; ★ % Fines; ● SPT (blows/300mm); Moisture Content & SPT N: W_P% × — W% — o — W_L% ×; 20, 40, 60, 80
10					End of Hole: 9.8 m, drill refusal in bedrock. No sloughing observed. No water observed. Protective casing installed at surface. at 3.5 m: Piezometer (RST P100 - 030138) installed. Piezometer installed in 25 mm diameter protective PVC. Stick up of PVC is 0.5 m. at 8.8 m: Piezometer (RST P100 - 030136) installed. Piezometer installed in 25 mm diameter protective PVC. Stick up of PVC is 0.5 m.				
11									
12									
13									
14									
15									

BOREHOLE # BGC05-07

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580714.00E, 6913518.10N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.3 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 06 Aug 05
Finish Date : 06 Aug 05
Final Depth of Hole (m) : 11.1
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					Hole drilled for the installation of Thermistor (BGC05-01). Hole drilled with Hollow Stem Auger to 11.4 m. Cuttings appeared consistent with BGC05-06, no sampling.	Concrete		
1						Bentonite and Cement		
2				UF				
3								
4								
5								

Su - kPa
40 80 120 160
VANE FIELD LAB — UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

(Continued on next page)

BOREHOLE # BGC05-07

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580714.00E, 6913518.10N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.3 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 06 Aug 05
Finish Date: 06 Aug 05
Final Depth of Hole (m) : 11.1
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5						Bentonite and Cement		
6								
7				UF				
8								
9								
10								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

(Continued on next page)

BOREHOLE # BGC05-07

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580714.00E, 6913518.10N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.3 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 06 Aug 05
Finish Date : 06 Aug 05
Final Depth of Hole (m) : 11.1
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
10								
11		JMS 22 A & B		UF	Phyllite / Schist Bedrock Moist, weathered	Bentonite and Cement		21
12					End of Hole: 11.4 m due to auger refusal in bedrock. No sloughing observed. No water observed. Thermistor installed in 1 inch protective PVC casing. Zero marker on thermistor located 0.66m above ground surface. Thermistor beads located at 0.09 m, 0.34 m, 0.84 m, 1.34 m, 2.34 m, 3.34 m, 5.34 m, 9.34 m, and 11.34 m below ground surface. Stick-up of PVC 0.38 m.			
13								
14								
15								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

BOREHOLE # BGC05-08

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580712.10E, 6913518.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.4 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 07 Aug 05
Finish Date : 07 Aug 05
Final Depth of Hole (m) : 12.2
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					Hole drilled for the installation of 2.75 inch PVC Slope Indicator Casing. Hole drilled with Hollow Stem Auger to a depth of 12.2 m. Cuttings appeared consistent with BGC05-06 and BGC05-07, no sampling.	Concrete		
1						Bentonite and Cement		
2				UF				
3								
4								
5								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

(Continued on next page)

BOREHOLE # BGC05-08

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580712.10E, 6913518.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.4 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 07 Aug 05
Finish Date : 07 Aug 05
Final Depth of Hole (m) : 12.2
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5						Bentonite and Cement		
6								
7				UF				
8								
9								
10								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

(Continued on next page)

BOREHOLE # BGC05-08

Project : Instrument Replacement

Project No. : 0257-035-01

Location : Faro, YT
Co-ordinates (m) : 580712.10E, 6913518.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1050.4 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter : 20 cm

Start Date : 07 Aug 05
Finish Date: 07 Aug 05
Final Depth of Hole (m) : 12.2
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
10						Bentonite and Cement		
11								
12				UF		Slough		
13					End of Hole: 12.2 m at target depth. Hole sloughed at 10.5 m. Depth to water 9.1 m. 2.75 inch PVC Slope Indicator Casing installed at a depth of 12.2 m as casing sunk into slough with applied weight. A^0 was not measured but is approximately coincident with the fall line of the slope. Stick up 1.52 m.			
14								
15								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_l%
20 40 60 80

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Client: Deloitte & Touche

BOREHOLE # BGC05-09

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 579824.40E, 6914048.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1032.8 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 08 Aug 05
Finish Date : 08 Aug 05
Final Depth of Hole (m) : 10
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SAND (FILL) Some Cobbles, some Gravel. Compact, non-plastic, moist, grey brown.			
1		JMS 23			SILT and SAND (FILL) Some Gravel, trace Clay. Dark brown, minor oxidation.			14
2		JMS 24 A&B			SAND and SILT (FILL) Some Gravel, trace Clay. Compact to Loose, low plasticity, reddish brown, minor oxidation.			14
		JMS 25		UF				9
3					at 2.9 m, clay content increases slightly. at 3.1 m, organic material present mixed with Sand. Non-plastic, dark brown, musty smell, fibrous. Possible Original Ground Surface	Cuttings		
		JMS 26 A&B			SAND and SILT (TILL) Some Gravel, trace Clay. Loose, low plasticity, reddish brown, minor oxidation.			8
4								
		JMS 27						10
5					SAND and GRAVEL			

Su - kPa: 40, 60, 120, 160

VANE: FIELD PEAK ◆ REMOLD ◇ LAB PEAK ■ REMOLD □ ▲ UC/2 △ Pocket Pen /2

★ % Fines ● SPT (blows/300mm)

Moisture Content & SPT N: W_p% W% W_l% 20, 40, 60, 80

(Continued on next page)

BOREHOLE # BGC05-09

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 579824.40E, 6914048.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1032.8 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 08 Aug 05
Finish Date : 08 Aug 05
Final Depth of Hole (m) : 10
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5					trace Silt. Compact, non-plastic, moist, light brown, well-sorted.	Cuttings		
6		JMS 28						15
7				UF				
8		JMS 29			at 7.9 m, gravel content increases slightly. Gravel 48% Sand 42% Silt 10% Clay 0%			26
9		JMS 30			SAND and SILT Trace Clay Compact, tan, stratified. Silt begins to dominate below 9.4 m, organics within laminations.			17
10					at 9.9 m, non-laminated SILT and SAND.			

Su - kPa: 40, 80, 120, 160

VANE FIELD LAB — UC/2
PEAK ◆ ■
REMOLD ◇ □ — Pocket Pen /2

★ % Fines — SPT (blows/300mm)

Moisture Content & SPT N
W_p% W% W_L%
20, 40, 60, 80

(Continued on next page)

BOREHOLE # BGC05-09

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 579824.40E, 6914048.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1032.8 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 08 Aug 05
Finish Date : 08 Aug 05
Final Depth of Hole (m) : 10
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm	Su - kPa (40, 80, 120, 160) / VANE FIELD LAB / PEAK / REMOLD / ▲ UC/2 / △ Pocket Pen /2 / * % Fines / ● SPT (blows/300mm) / Moisture Content & SPT N (W_p% × — — — — O — — — — × W_L%) (20, 40, 60, 80)
10		JMS 31			Biotite Schist Top 1 inch weathered surface in contact with SAND and SILT. End of Hole: 9.9 m, auger refusal in possible bedrock. Sample taken below 9.9 m by SPT. Depth to water 9.1 m. Sloughing not observed due to Hollow Stem Auger.			93	O
11									
12									
13									
14									
15									

7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

Sieve Size (mm)	% Passing
200	
150	
100	
80	
50	
40	100.0
25	69.7
20	60.5
12.5	58.2
10	58.2
5	51.9
2.5	42.3
1.25	32.1
0.63	20.8
0.315	16.1
0.16	12.1
0.08	9.5

Client BGC Engineering Inc.

Address Suite 1605, 840 - 7th Avenue S.W.
Calgary, Alberta T2P 3G2

Attention Mr. Jordan Severin

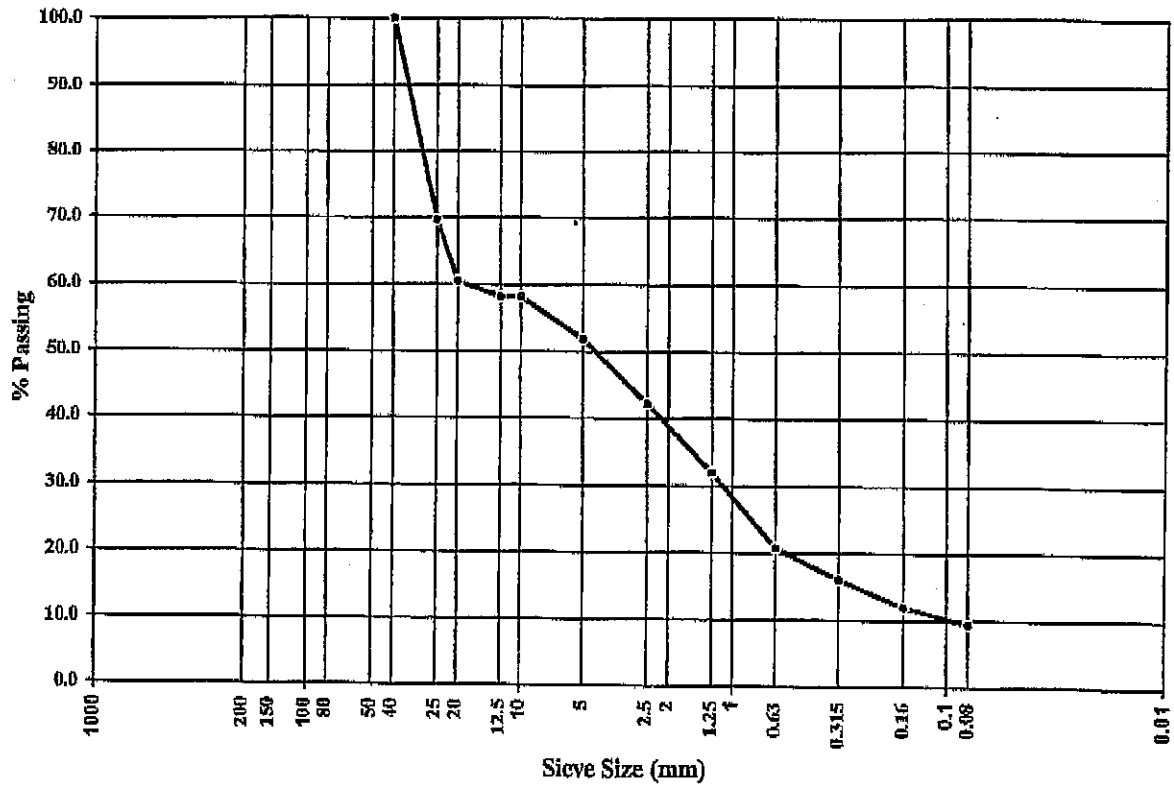
Project BGC # 0257-037-01 **Job #** 55-099-02-1

Date Sampled Rec'd Oct.3/05 **By** CBL

Date Tested Oct.6/05 **By** ML

Aggregate Type Sand & Gravel

Comments JMS-29
Moisture Content = 4.9%



BOREHOLE # BGC05-10

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 580245.80E, 6913763.70N
Co-ordinates in NAD 27
Ground Elevation (m) : 1049.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 08 Aug 05
Finish Date : 08 Aug 05
Final Depth of Hole (m) : 8.6
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SILT and SAND (FILL/SPOIL) Some Gravel. Gravel is angular, compact, non-plastic, moist, grey brown, slight oxidation.			
1		JMS 32						10
					at 1.2 m, Driller's Notes: Chunky / Bony Drilling. at 1.3 m, sandy cuttings.			
		JMS 33						13
2					at 2.1 m, cuttings become dark brown.			
		JMS 34		UF	SILT (FILL) Some Sand, some Gravel, trace Clay. Compact, non-plastic, moist, dark brown, red and white streaks, some oxidation, musty smell, organic particles throughout sample JMS 34 (mostly 6 inches from base).	Cuttings		15
3					at 3.1 m, sporadic oxidation, few organics present. at 3.4 m, some organics present.			
		JMS 35			Possible Original Ground Surface			21
					SILT (TILL) Some Sand, some Gravel. Compact to dense, low plasticity, moist, green brown, some oxidation, organic material present.			
4								
		JMS 36						45
5								

Su - kPa: 40, 80, 120, 160

VANE FIELD LAB — ▲ UC/2; PEAK ◆ ■; REMOLD ◇ □ △ Pocket Pen /2

★ % Fines — ● SPT (blows/300mm)

Moisture Content & SPT N: W_p% × — W% o — W_L% ×; 20, 40, 60, 80

(Continued on next page)

BOREHOLE # BGC05-10

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 580245.80E, 6913763.70N
Co-ordinates in NAD 27
Ground Elevation (m) : 1049.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 08 Aug 05
Finish Date : 08 Aug 05
Final Depth of Hole (m) : 8.6
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5					at 5.8 m, Driller's Notes: Chunky / Bony drilling.			
6		JMS 37			Phyllite (BEDROCK) Weak, highly weathered with quartz veins, some oxidation. No distinct discontinuities.			15
7				UF		Cuttings		
8		JMS 38						34
9					End of Hole: 8.56m, auger refusal in bedrock. No water observed. Sloughing not observed due to Hollow Stem Auger.			
10								

Su - kPa: 40, 80, 120, 160

	FIELD	LAB	
VANE			▲ UC/2
PEAK	◆	■	
REMOLD	◇	□	△ Pocket Pen /2
★ % Fines			● SPT (blows/300mm)

Moisture Content & SPT N: W_p% — W% — W_L%; 20, 40, 60, 80

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AN APPLIED EARTH SCIENCES COMPANY
Calgary, AB Phone (403) 250 5185

Client: Deloitte & Touche

BOREHOLE # BGC05-11

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581001.40E, 6913375.90N
Co-ordinates in NAD 27
Ground Elevation (m) : 1051.6 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 09 Aug 05
Finish Date : 09 Aug 05
Final Depth of Hole (m) : 9.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SAND (FILL / SPOIL) Some Silt, some Gravel, some Cobbles. Dense, moist, light brown.			
1		JMS 39						24
		JMS 40			at 1.5 m, some oxidation and organic materials, compact.			12
2		JMS 41		UF	at 2.3 m, fines content increases, some oxidation.			12
3		JMS 42			SILT and SAND (FILL) Some Gravel. Compact, low plasticity, moist, brown.	Cuttings		10
4								
5		JMS 43						17

Su - kPa: 40, 80, 120, 160
VANE: FIELD PEAK ◆ REMOLD ◇ | LAB ■ □ | ▲ UC/2 | △ Pocket Pen /2
★ % Fines | ● SPT (blows/300mm)
Moisture Content & SPT N: W_P% × — W% o — W_L% × ; 20, 40, 60, 80

(Continued on next page)

BOREHOLE # BGC05-11

Project : Rose Creek Diversion Canal Investigation
Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581001.40E, 6913375.90N
Co-ordinates in NAD 27
Ground Elevation (m) : 1051.6 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 09 Aug 05
Finish Date : 09 Aug 05
Final Depth of Hole (m) : 9.7
Logged by : J.Severin
Reviewed by : G. Ferris

Legend: Su - kPa (40, 80, 120, 160); VANE: FIELD / LAB; PEAK ◆ ■; REMOLD ◇ □; ▲ UC/2; △ Pocket Pen /2; ★ % Fines; ● SPT (blows/300mm); Moisture Content & SPT N: W_p% × — W% ○ — W_L% × (20, 40, 60, 80)

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm	Moisture Content & SPT N
5–5.8				UF	at 5.8 m, organic material in cuttings, dark brown colour, easy drilling. Possible Original Ground Surface	Cuttings	Cuttings		
5.8–7.9	SPT	JMS 44 (≈6.1–6.5 m)		UF	SAND and SILT (TILL) Some Gravel. Compact, low plasticity, moist, light brown, some oxidation.	Cuttings	Cuttings	19	○
					at 7.4 m, wet.				
	SPT	JMS 45 (≈7.6–8.0 m)		UF		Cuttings	Cuttings	20	○
7.9–9.7				UF	Phyllite / Schist Dark grey, weak, slightly weathered (W 5/6), some oxidation, distinct foliation across SPT sample.	Cuttings	Cuttings		
					at 8.5 m, rock becomes more competent.				
	SPT	JMS 46 (≈9.1–9.6 m)		UF		Cuttings	Cuttings	50	○
9.7					End of Hole: 9.7 m, auger refusal in bedrock.				

(Continued on next page)

BOREHOLE # BGC05-11

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581001.40E, 6913375.90N
Co-ordinates in NAD 27
Ground Elevation (m) : 1051.6 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 09 Aug 05
Finish Date : 09 Aug 05
Final Depth of Hole (m) : 9.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm	Su - kPa: 40, 80, 120, 160 / VANE FIELD LAB / PEAK ◆ ■ / REMOLD ◇ □ / ▲ UC/2 / △ Pocket Pen /2 / ★ % Fines / ● SPT (blows/300mm) / Moisture Content & SPT N: W_p% W% W_L% 20, 40, 60, 80
10					Depth to water 7.4 m. Sloughing not observed due to Hollow Stem Auger.				
11									
12									
13									
14									
15									

BOREHOLE # BGC05-12

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581467.20E, 6913201.00N
Co-ordinates in NAD 27
Ground Elevation (m) : 1053.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 09 Aug 05
Finish Date : 09 Aug 05
Final Depth of Hole (m) : 5.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SAND and SILT (TILL) Some Gravel, trace Clay. Dense, low plasticity, moist to wet, dark brown, well graded to gap graded, well rounded gravel clasts.	Cuttings		
1		JMS 47			at 0.7 m, Gravel, trace Sand.			38
2		JMS 48			at 1.8 m, silt content increases, not as moist.			20
3		JMS 49		UF	at 2.5 m, dry to moist.			35
4		JMS 50			at 3.0 m, faster drilling, wet.			29
5								

Su - kPa: 40, 80, 120, 160

VANE: FIELD PEAK ◆ REMOLD ◇ LAB PEAK ■ REMOLD □ — ▲ UC/2 — △ Pocket Pen /2

★ % Fines — ● SPT (blows/300mm)

Moisture Content & SPT N: W_p% — W% — W_L% (20, 40, 60, 80)

(Continued on next page)

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Client: Deloitte & Touche

BOREHOLE # BGC05-12

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581467.20E, 6913201.00N
Co-ordinates in NAD 27
Ground Elevation (m) : 1053.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 09 Aug 05
Finish Date : 09 Aug 05
Final Depth of Hole (m) : 5.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5				UF				
					End of Hole: 5.7 m, auger refusal on cobbles/boulders or bedrock. Depth to water 3.0 m. Sloughing not observed due to Hollow Stem Auger.			
6								
7								
8								
9								
10								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

BOREHOLE # BGC05-13

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581627.40E, 6913145.80N
Co-ordinates in NAD 27
Ground Elevation (m) : 1052.4 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 09 Aug 05
Finish Date : 09 Aug 05
Final Depth of Hole (m) : 6.5
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SAND (FILL) Silty, some Gravel, some Cobbles. Dense to compact, non-plastic, moist, light brown.			
1		JMS 51						27
2		JMS 53 JMS 52						11
		JMS 54		UF	at 2.3 m, some oxidation.			10
3					Possible Original Ground Surface	Cuttings		
		JMS 55			SILT (TILL) Sandy, some Gravel. Loose, low plasticity, moist, dark brown, some oxidation, few organics present.			9
4								
		JMS 56			at 4.6 m, wet.			8
5								

Su - kPa: 40, 80, 120, 160

VANE	FIELD	LAB	
PEAK	◆	■	▲ UC/2
REMOLD	◇	□	△ Pocket Pen /2
★ % Fines			● SPT (blows/300mm)

Moisture Content & SPT N: W_p% — W% — W_l%; 20, 40, 60, 80

(Continued on next page)

BOREHOLE # BGC05-13

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581627.40E, 6913145.80N
Co-ordinates in NAD 27
Ground Elevation (m) : 1052.4 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : Hollow Stem Auger
Sampling Method : Standard Penetration Test
Boring Diameter :

Start Date : 09 Aug 05
Finish Date: 09 Aug 05
Final Depth of Hole (m) : 6.5
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5				UF				
6		JMS 57			SAND Some Silt. Loose, non-cohesive, wet, grey brown, massive, well sorted.			80
					Phyllite (BEDROCK) Weak, weathered (W5), no oxidation. End of Hole: 6.48m, auger refusal in bedrock.			
7					Depth to water 4.6 m. Sloughing not observed due to Hollow Stem Auger.			
8								
9								
10								

Su - kPa: 40, 80, 120, 160

VANE	FIELD	LAB	
PEAK	◆	■	▲ UC/2
REMOLD	◇	□	△ Pocket Pen /2
★ % Fines			● SPT (blows/300mm)

Moisture Content & SPT N: W_p% × — W% o — W_L% ×; 20, 40, 60, 80

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Client: Deloitte & Touche

BOREHOLE # BGC05-14

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 583072.10E, 6912389.00N
Co-ordinates in NAD 27
Ground Elevation (m) : 1063.9 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 10 Aug 05
Finish Date : 10 Aug 05
Final Depth of Hole (m) : 4.3
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0				UF	SAND (TOP SOIL) Silty, high organic content (approx. 35%) Peat, Roots, Wood Fragments, Moss. Loose, non-plastic, wet, dark brown, cold to touch.			
					SAND (TILL) Some Silt, some Gravel, trace Clay, Organic material present (approx 20%). Low plasticity, wet, dark brown, Phyllite inclusions.			
1		JMS 58						
		JMS 59			at 1.6 m, Vx = 5%			
2		JMS 60			at 2.1 m, Vx = 5% Gravel 17% Sand 56% Silt 20% Clay 7%	Cuttings		
3		JMS 61			at 2.75 m, CRRL Barrel had to be replaced by Solid Stem Auger due to rocks. at 2.9 m, Vx = 2% @ 3.05 m, cobble/boulder encountered. @ 3.38 m, cobble/boulder encountered.			
4		JMS 62						
5					End of Hole: 4.3m auger refusal on cobble/boulder or bedrock. No water observed. Hole sloughed below 3.0 m.			

Su - kPa: 40, 80, 120, 160

	FIELD	LAB	
VANE			▲ UC/2
PEAK	◆	■	
REMOLD	◇	□	△ Pocket Pen /2

★ % Fines ● SPT (blows/300mm)

Moisture Content & SPT N: W_P% × — W% ○ — W_L% ×; 20, 40, 60, 80

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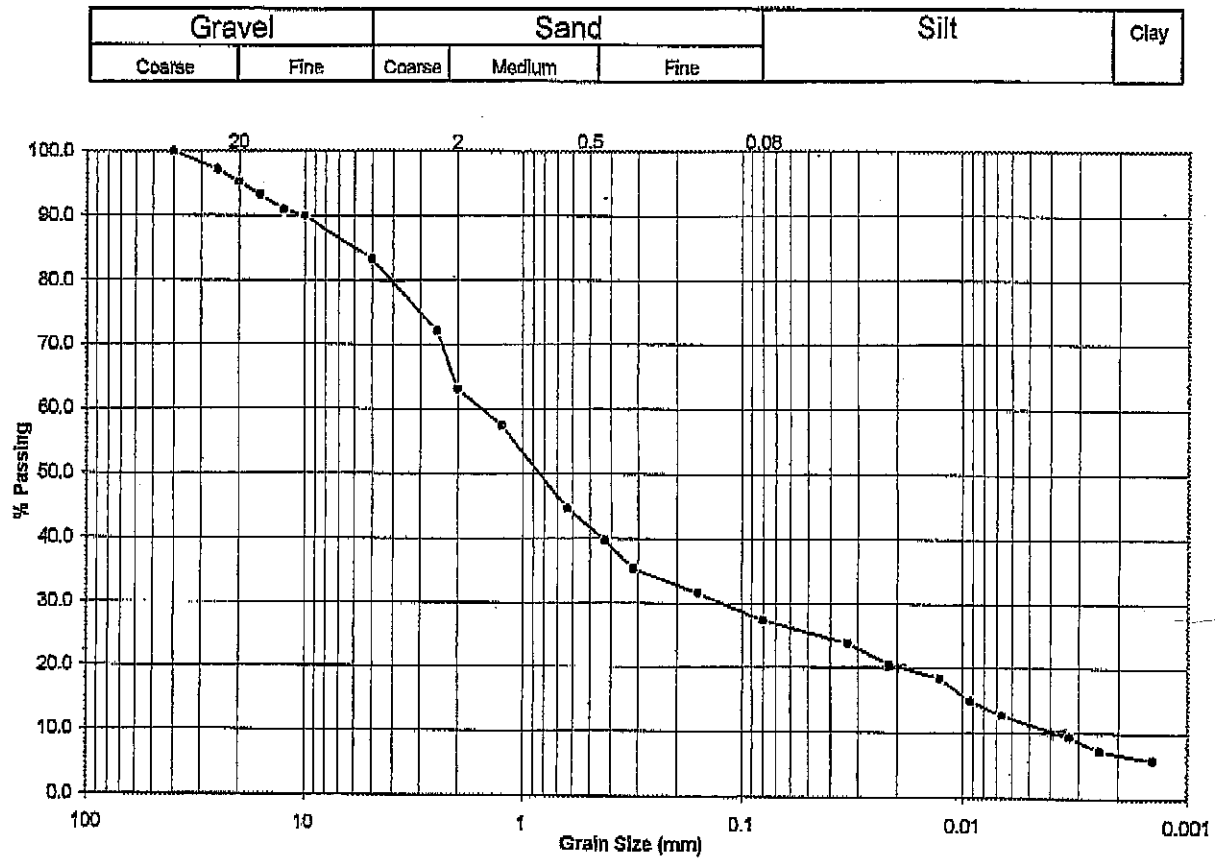
Client: Deloitte & Touche

ALMOR
7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Grain Size Distribution

Project	BGC # 0257-037-01			**Test Hole #**	JMS-60
Client	BGC Engineering Inc.			**Depth**	
Job #	55-099-02-1		**Description**	SAND, some silt, some gravel, trace of clay	
Date Sampled	Rec'd Oct.3/05				
Date Tested	Oct.5/05				
		Gravel	16.7%	**Natural Water Content**	9.9%
Remarks		**Sand**	55.9%	**Liquid Limit**	24
		Silt	20.2%	**Plastic Limit**	23
ML		**Clay**	7.2%	**Plasticity Index**	1
				Specific Gravity	2.68



BOREHOLE # BGC05-15

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 582856.10E, 6912526.10N
Co-ordinates in NAD 27
Ground Elevation (m) : 1063.5 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 11 Aug 05
Finish Date : 11 Aug 05
Final Depth of Hole (m) : 4
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0				UF	SAND (TOP SOIL) Some Silt, trace Clay, Organic content (approx 20%), Moss, Grass, Roots, Wood Fragments. Loose, non-plastic, wet, dark brown	Cuttings		
		JMS 63			SILT (COLLUVIUM) Sandy, some Gravel, trace Clay, Organic materials present (approx. 25%). Moist, dark brown, Phyllite clasts very angular.			
1					from 0.3 to 1.5 m, Core Frozen, Nbn			
		JMS 65						
		JMS 64						
2		JMS 66			SAND (TILL) Some Silt, some Gravel, trace Clay. Moist, light brown.			
		JMS 68			@ 2.8 m, Organic material present (0.2m).			
3		JMS 69		UF	@ 2.9 m, Sand lense (0.3 cm), dry to moist.			
		JMS 67			PHYLLITE Fine-grained, greenish grey, weak, weathered (W 4/5), oxidized layers, friable.			
		JMS 70						
4					End of Hole: 4.0 m, auger refusal in bedrock. No water observed. No sloughing observed.			
5								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_l%
20 40 60 80

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
Calgary, AB Phone (403) 250 5185

Client: Deloitte & Touche

BOREHOLE # BGC05-16

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581714.00E, 6912992.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1064.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 11 Aug 05
Finish Date: 11 Aug 05
Final Depth of Hole (m) : 8.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0		JMS 73		UF	SAND (TOP SOIL) Silty, Organic material present (Wood, Peat, Moss). Loose, wet, dark brown, frozen.			
1		JMS 71 JMS 72			SAND (TILL) Some Silt, some Gravel, trace Clay. Dense, non-plastic, moist, light brown, frozen. from 0.7 to 1.8 m, Core Frozen, Nbn.			
2		JMS 75 JMS 74 JMS 76						
3		JMS 77 JMS 78 JMS 79		UF	at 3.5 m, Vx = 5% at 3.8 m, swiched to Solid Stem Auger drilling.	Cuttings		
4		JMS 80		UF	at 4.1 m, zone of oxidation, 200 mm thick.			
5								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_L%
20 40 60 80

(Continued on next page)

BOREHOLE # BGC05-16

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581714.00E, 6912992.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1064.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 11 Aug 05
Finish Date : 11 Aug 05
Final Depth of Hole (m) : 8.7
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5						Cuttings		
6								
		JMS 61		UF				
7								
8					at 8.5 m, silt-rich, looks like decomposed rock.			
		JMS 62						
9					End of Hole: 8.69 m, auger refusal in possible bedrock. No water observed. No sloughing observed.			
10								

Su - kPa

40 80 120 160

VANE	FIELD	LAB	
PEAK	◆	■	▲ UC/2
REMOLD	◇	□	△ Pocket Pen /2
✶ % Fines			● SPT (blows/300mm)

Moisture Content & SPT N

W_p% W% W_l%

20 40 60 80

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Client: Deloitte & Touche

BOREHOLE # BGC05-17

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581288.30E, 6913174.20N
Co-ordinates in NAD 27
Ground Elevation (m) : 1065.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 12 Aug 05
Finish Date : 12 Aug 05
Final Depth of Hole (m) : 5.6
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SILT (TOP SOIL) Sandy, trace Clay, Organic Material (Moss, Peat, Wood chips). Loose, low plasticity, moist, dark brown.			
		JMS 83						
1		JMS 84A			SAND (TILL) Some Silt, some Gravel, some Clay. Moist to wet, light brown.			
					at 1.8 m, Gravelly, red decomposed clasts and Phyllite clasts (15-25%).			
2		JMS 84B						
				UF	at 2.7 m, trace Gravel, 5%.	Cuttings		
		JMS 85						
3		JMS 86						
					at 3.4 m, Gravelly, 15-20%, materials oxidized.			
		JMS 87						
4								
		JMS 89			Gravel 13% Sand 61% Silt 15% Clay 11%			
		JMS 88						
5								

Su - kPa: 40, 80, 120, 160

VANE	FIELD	LAB	
PEAK	◆	■	▲ UC/2
REMOLD	◇	□	△ Pocket Pen /2
★ % Fines			● SPT (blows/300mm)

Moisture Content & SPT N: W_P% — W% — W_L%; 20, 40, 60, 80

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Client: Deloitte & Touche

BOREHOLE # BGC05-17

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 581288.30E, 6913174.20N
Co-ordinates in NAD 27
Ground Elevation (m) : 1065.2 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 12 Aug 05
Finish Date : 12 Aug 05
Final Depth of Hole (m) : 5.6
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5		JMS 90						
		JMS 91		UF	PHYLLITE (BEDROCK) Fine-grained, greenish grey colour, weak, slightly weathered (W5), no visible fabric. at 5.4 m, switched to Solid Stem Auger.			
					End of Hole: 5.64m, auger refusal in bedrock. No water observed. Hole sloughes below 3.0 m.			
6								
7								
8								
9								
10								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

ALMOR
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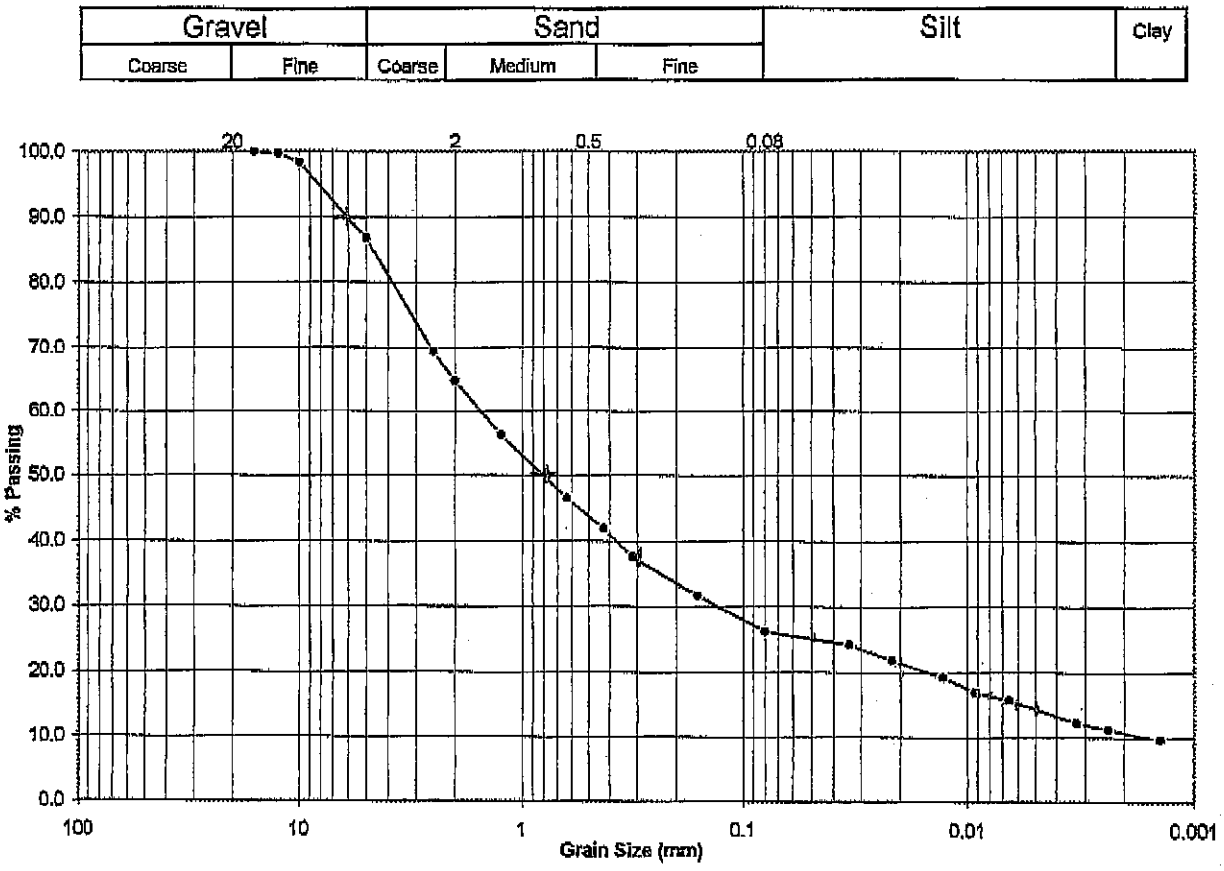
Calgary, Alberta T2C 2H5
Telephone: (403) 236-6880

Grain Size Distribution

Project	BGC # 0257-037-01			**Test Hole #**	JMS-88
Client	BGC Engineering Inc.			**Depth**	
Job #	55-099-02-1		**Description**	SAND, some silt, some gravel, some clay	
Date Sampled	Rec'd Oct.2/05				
Date Tested	Oct.5/05				
		Gravel	13.2%	**Natural Water Content**	10.5%
Remarks		**Sand**	60.6%	**Liquid Limit**	25
		Silt	15.1%	**Plastic Limit**	20
CL - ML		**Clay**	11.1%	**Plasticity Index**	5
				Specific Gravity	2.68



BOREHOLE # BGC05-18

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 580808.00E, 6913361.80N
Co-ordinates in NAD 27
Ground Elevation (m) : 1067.4 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 12 Aug 05
Finish Date : 12 Aug 05
Final Depth of Hole (m) : 6.3
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SILT Sandy, Organic Materials (Moss, Peat, Wood Fragments). Loose, moist, dark brown.			
		JMS 93						
1		JMS 92			SAND (TILL) Silty, some Gravel, trace Clay. Low plasticity to non-plastic, moist, light brown. Phyllite clasts up to 7cm with platy shape.			
				UF				
2		JMS 94			at 1.8 m, some oxidation.			
3		JMS 95			@ 3 m, groundwater encountered, wet.	Cuttings		
		JMS 96			at 3.3 m, possible thin frozen zone (0.1 m). at 3.4 m, switch to solid stem auger drilling. No samples recovered below this depth due to soft wet nature. Gravel 15% Sand 51% Silt 24% Clay 10%			
4				UF				
5								

Su - kPa: 40, 80, 120, 160
VANE FIELD LAB — PEAK — REMOLD — UC/2 — Pocket Pen /2
★ % Fines — SPT (blows/300mm)
Moisture Content & SPT N: W_P% — W% — W_L%; 20, 40, 60, 80

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Client: Deloitte & Touche

BOREHOLE # BGC05-18

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 580808.00E, 6913361.80N
Co-ordinates in NAD 27
Ground Elevation (m) : 1067.4 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 12 Aug 05
Finish Date : 12 Aug 05
Final Depth of Hole (m) : 6.3
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5				UF		Cuttings		
6					End of Hole: 6.3 m, auger refusal, possible bedrock surface. Depth to water 3 m. Hole sloughed below 3.4 m.			
7								
8								
9								
10								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

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Client: Deloitte & Touche

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Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Grain Size Distribution

Project	BGC # 0257-037-01
Client	BGC Engineering Inc.
Job #	55-099-02-1
Date Sampled	Rec'd Oct.3/05
Date Tested	Oct.11/05

Test Hole # JMS-96
Depth

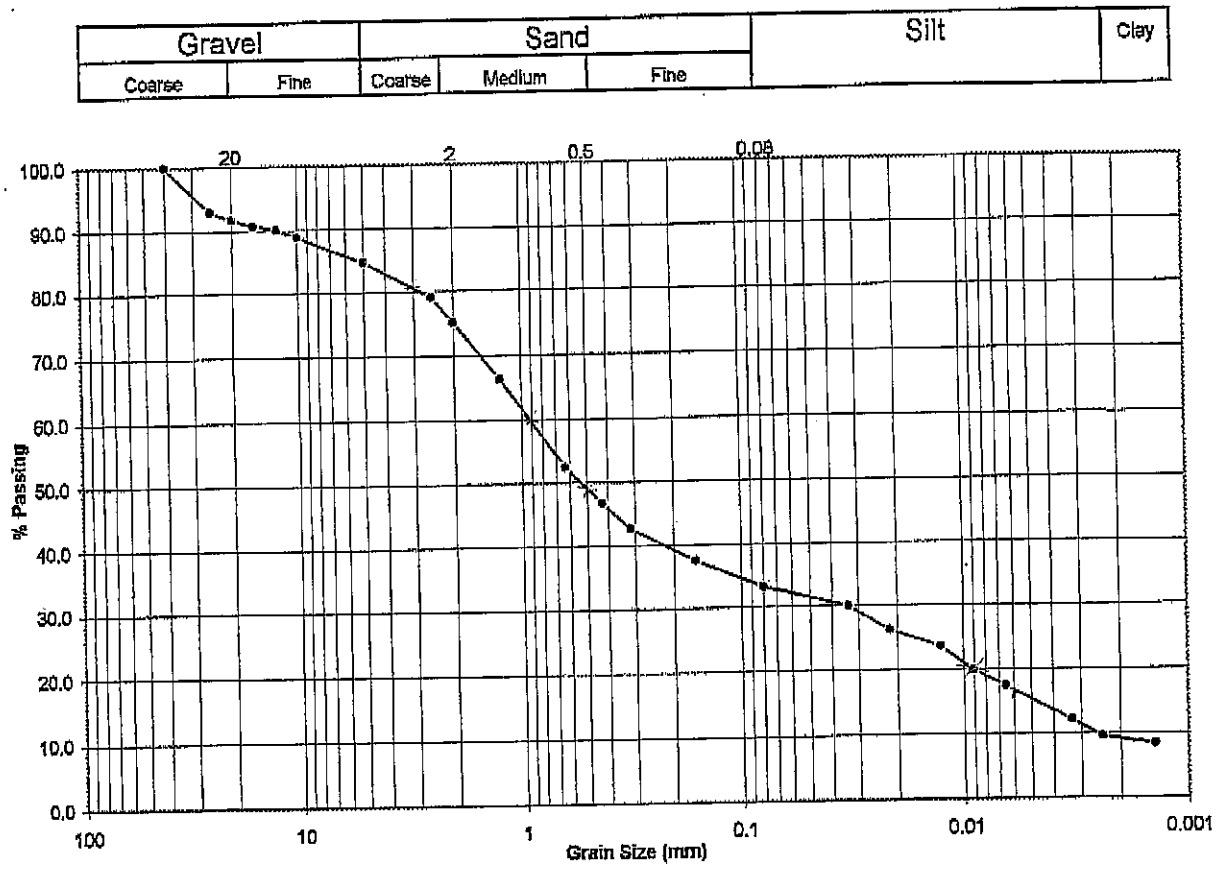
Description Silty SAND, some gravel, trace of clay

Remarks

ML

Gravel	15.3%
Sand	51.4%
Silt	23.7%
Clay	9.6%

Natural Water Content	26.2%
Liquid Limit	40
Plastic Limit	32
Plasticity Index	8
Specific Gravity	2.66



BOREHOLE # BGC05-19

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 579662.90E, 6913972.00N
Co-ordinates in NAD 27
Ground Elevation (m) : 1049.0 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 16 Aug 05
Finish Date: 16 Aug 05
Final Depth of Hole (m) : 3
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0					SAND (TOP SOIL) Silty, Organic Materials (Moss, Wood fragments, Bark). Loose, low plasticity, wet, dark brown.			
				UF	SILT and SAND (COLLUVIUM) Some Clay, trace Gravel, occasional Organic interbeds . Low plasticity, moist, medium brown.			
		JMS 95B						
		JMS 94B						
		JMS 96B			Gravel 1% Sand 41% Silt 45% Clay 13%			
1					at 1.4 m, Vs = 10%, 1-2 cm ice lenses.			
					at 1.6 m, Vs = 15%, 3-5 cm ice lenses.			
		JMS 98						
2					at 2.1 m, stratified sand, silt, and organic material.			
		JMS 100						
3					at 2.9 m, Vs = 5%, 2-3 mm ice lenses along organic beds.	Cuttings		
					End of Hole: 2.97m, auger refusal on possible bedrock. No water observed. No sloughing observed. Three attempts made in area. Auger refusal at 2.9, 2.1 and 2.7 m.			
4								
5								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_L%
20 40 60 80

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Calgary, AB Phone (403) 250 5185

Client: Deloitte & Touche

ALMOR
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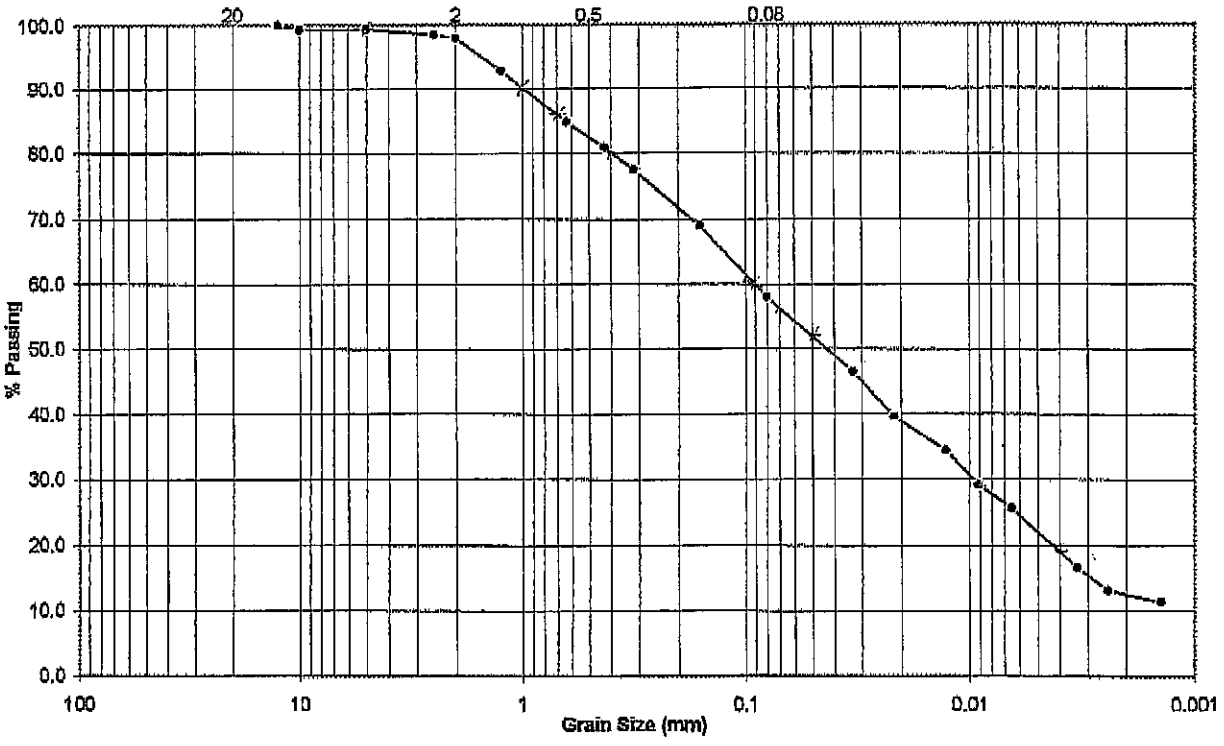
Telephone: (403) 236-8880

Grain Size Distribution

Project	BGC # 0257-037-01	**Test Hole #**	JMS-95B
Client	BGC Engineering Inc.	**Depth**	
Job #	55-099-02-1	**Description**	SILT & SAND, some clay, trace of gravel
Date Sampled	Rec'd Oct.3/05		
Date Tested	Oct.11/05		

	Gravel	0.6%	**Natural Water Content** 40.6%
Remarks	**Sand**	41.4%	**Liquid Limit** 49
	Silt	44.8%	**Plastic Limit** 41
ML	**Clay**	13.2%	**Plasticity Index** 8
			Specific Gravity 2.63

Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		



BOREHOLE # BGC05-20

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 579300.10E, 6914219.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1047.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 17 Aug 05
Finish Date : 17 Aug 05
Final Depth of Hole (m) : 6.8
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0				UF	SAND and SILT (TOPSOIL) Organic Materials (Wood, Peat, Moss). Loose, non-plastic, wet, dark brown.			
					SAND (COLLUVIUM) Silty, some Clay, trace Gravel, some organic materials (Peat, Moss, Wood). at 0.6 m, Vs = 10%, ice lense up to 5 cm.			
1		JMS 101 JMS 102			Gravel <1% Sand 49% Silt 39% Clay 11% at 1.2 m, gravelly, with coarse sand.			
2		JMS 103		UF				
		JMS 105			at 2.7 m, Vs = 5%. at 2.8 m, Vs = 10%.	Cuttings		
3		JMS 104			at 3.1 m, switched to Solid Stem Auger drilling due to cobbles.			
4				UF				
					SAND (TILL) Some Silt, some Gravel, some Clay, scattered Organics.			
5								

Su - kPa: 40, 80, 120, 160

VANE	FIELD	LAB	
PEAK	◆	■	▲ UC/2
REMOLD	◇	□	△ Pocket Pen /2
★ % Fines			● SPT (blows/300mm)

Moisture Content & SPT N: W_P% × — W% o — W_L% ×; 20, 40, 60, 80

(Continued on next page)

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Calgary, AB Phone (403) 250 5185

Client: Deloitte & Touche

BOREHOLE # BGC05-20

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 579300.10E, 6914219.60N
Co-ordinates in NAD 27
Ground Elevation (m) : 1047.1 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 17 Aug 05
Finish Date : 17 Aug 05
Final Depth of Hole (m) : 6.8
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
5		JMS 107			Low plasticity, wet, grey brown.	Cuttings		
		JMS 106						
		JMS 108		UF	Gravel 12% Sand 56% Silt 20% Clay 12%			
6								
7					End of Hole: 6.78m, auger refusal on possible bedrock. No water observed. Sloughing observed below 5.8 m. Six attempts made in area. Auger refusal for all attempts above 6.78 m.			
8								
9								
10								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_P% W% W_L%
20 40 60 80

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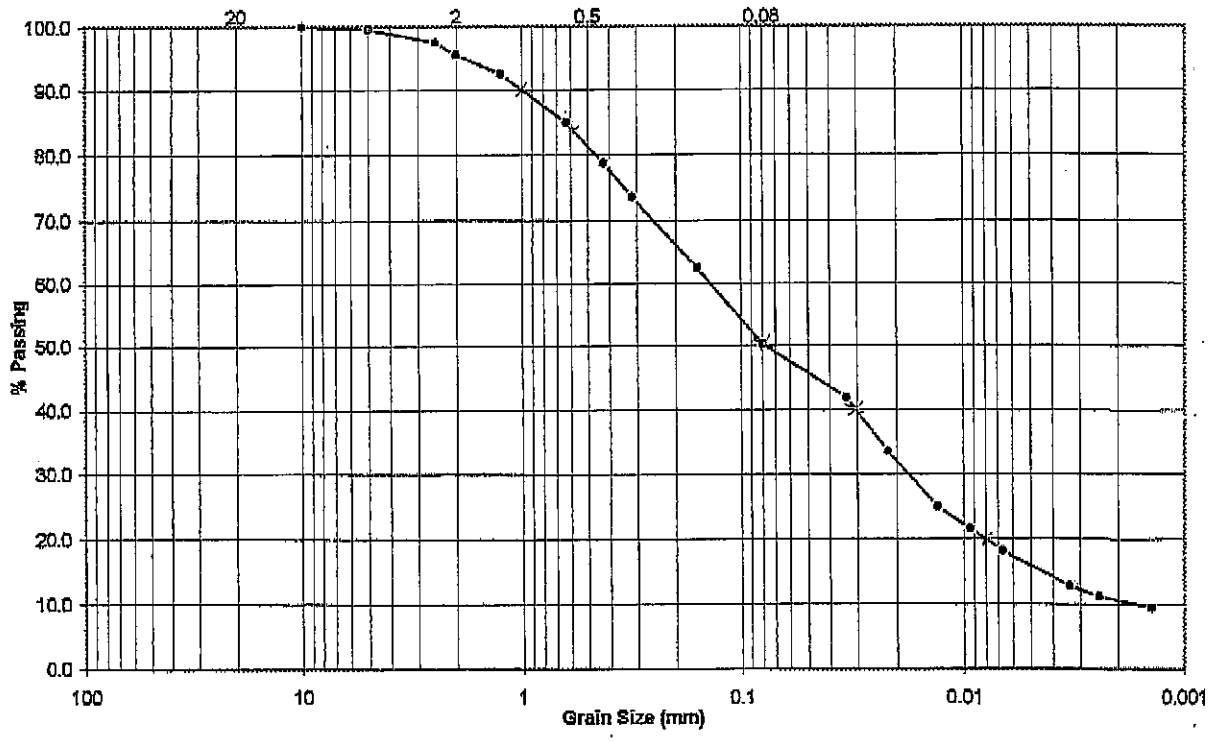
Grain Size Distribution

Project	BGC # 0257-037-01		**Test Hole #** JMS-101
Client	BGC Engineering Inc.		**Depth**
Job #	55-099-02-1	**Description**	Silty SAND, some clay, trace of gravel
Date Sampled	Rec'd Oct.3/05		
Date Tested	Oct.11/05		

	Gravel	0.4%	**Natural Water Content** 70.4%
Remarks	**Sand**	49.2%	**Liquid Limit** 51
	Silt	39.2%	**Plastic Limit** 46
MH - ML	**Clay**	11.2%	**Plasticity Index** 5
			Specific Gravity 2.63

Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		



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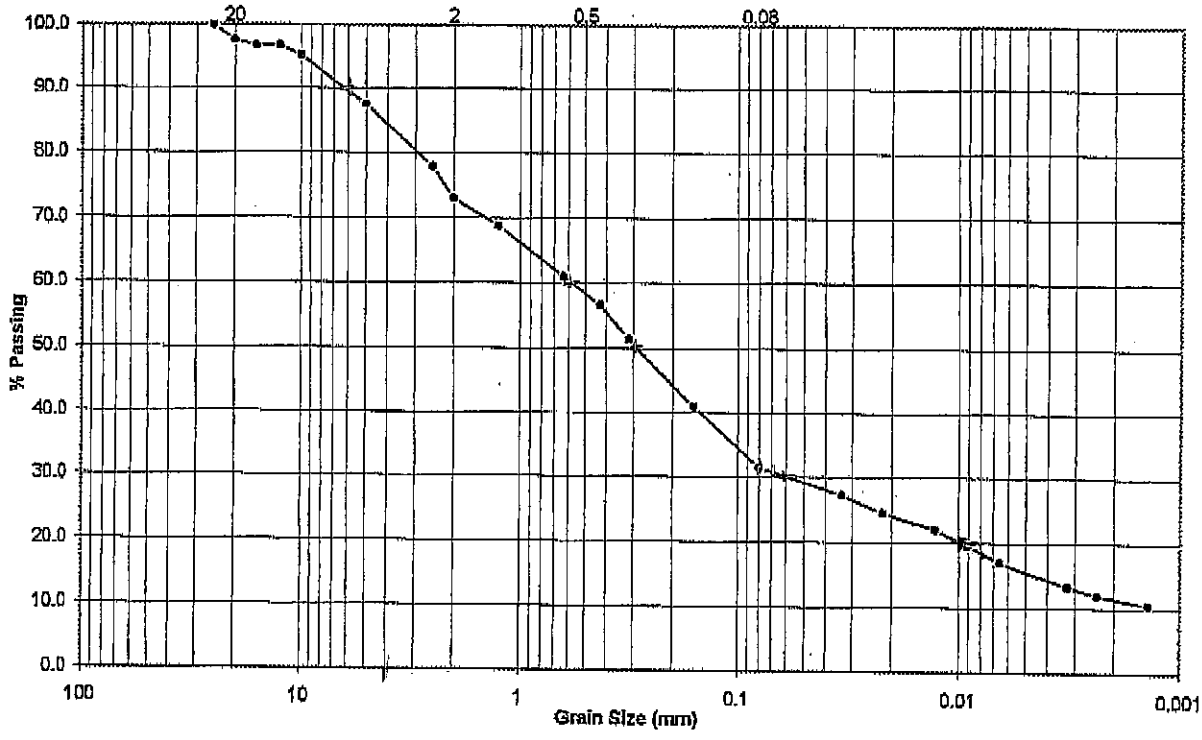
Grain Size Distribution

Project	BGC # 0257-037-01		**Test Hole #** JMS-108
Client	BGC Engineering Inc.		**Depth**
Job #	55-099-02-1	**Description**	SAND, some silt, some gravel, some clay
Date Sampled	Rec'd Oct.3/05		
Date Tested	Oct.5/05		

	Gravel	12.4%	**Natural Water Content**	10.4%
Remarks	**Sand**	56.1%	**Liquid Limit**	18
	Silt	19.5%	**Plastic Limit**	17
ML	**Clay**	12.0%	**Plasticity Index**	1
			Specific Gravity	2.68

Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		



BOREHOLE # BGC05-21

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 579246.20E, 6914517.30N
Co-ordinates in NAD 27
Ground Elevation (m) : 1026.7 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 18 Aug 05
Finish Date : 18 Aug 05
Final Depth of Hole (m) : 8.9
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0				UF	SAND (TOPSOIL) Silty, Organic material (Wood chips, Moss) present (approx 30%). Loose, non-plastic, wet, dark brown.			
		JMS 112			CLAY - Organics present, dense, green.			
		JMS 113			SILT (ASH) Low plasticity, wet, white.			
		JMS 114			at 0.4m, Vs = 20%, ice lense up to 3mm.			
		JMS 115			SILT (COLLUVIUM) Some Clay, some Sand, Organic Material (Moss, Wood).			
1		JMS 116			Dense, non-plastic, dark grey brown. at 0.6 m, Vx = 5%, ice crystals up to 4 mm. at 1.0 m, Vx = 25%, up to 2 cm. at 1.2 m, Sand, some Silt. Stratified with lenses of fines and organic materials.			
		JMS 117						
		JMS 118						
2		JMS 119						
		JMS 120						
		JMS 121						
3		JMS 122			at 3.1 m, Vs = 20%, ice lenses up to 1 cm.	Cuttings		
		JMS 123			Gravel 0% Sand 15% Silt 65% Clay 20%			
4								
		JMS 124						
5								

Su - kPa: 40, 80, 120, 160

VANE	FIELD	LAB	
PEAK	◆	■	▲ UC/2
REMOLD	◇	□	△ Pocket Pen /2

★ % Fines ● SPT (blows/300mm)

Moisture Content & SPT N: W_p% × — W% o — W_L% ×; 20, 40, 60, 80

(Continued on next page)

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Calgary, AB Phone (403) 250 5185

Client: Deloitte & Touche

BOREHOLE # BGC05-21

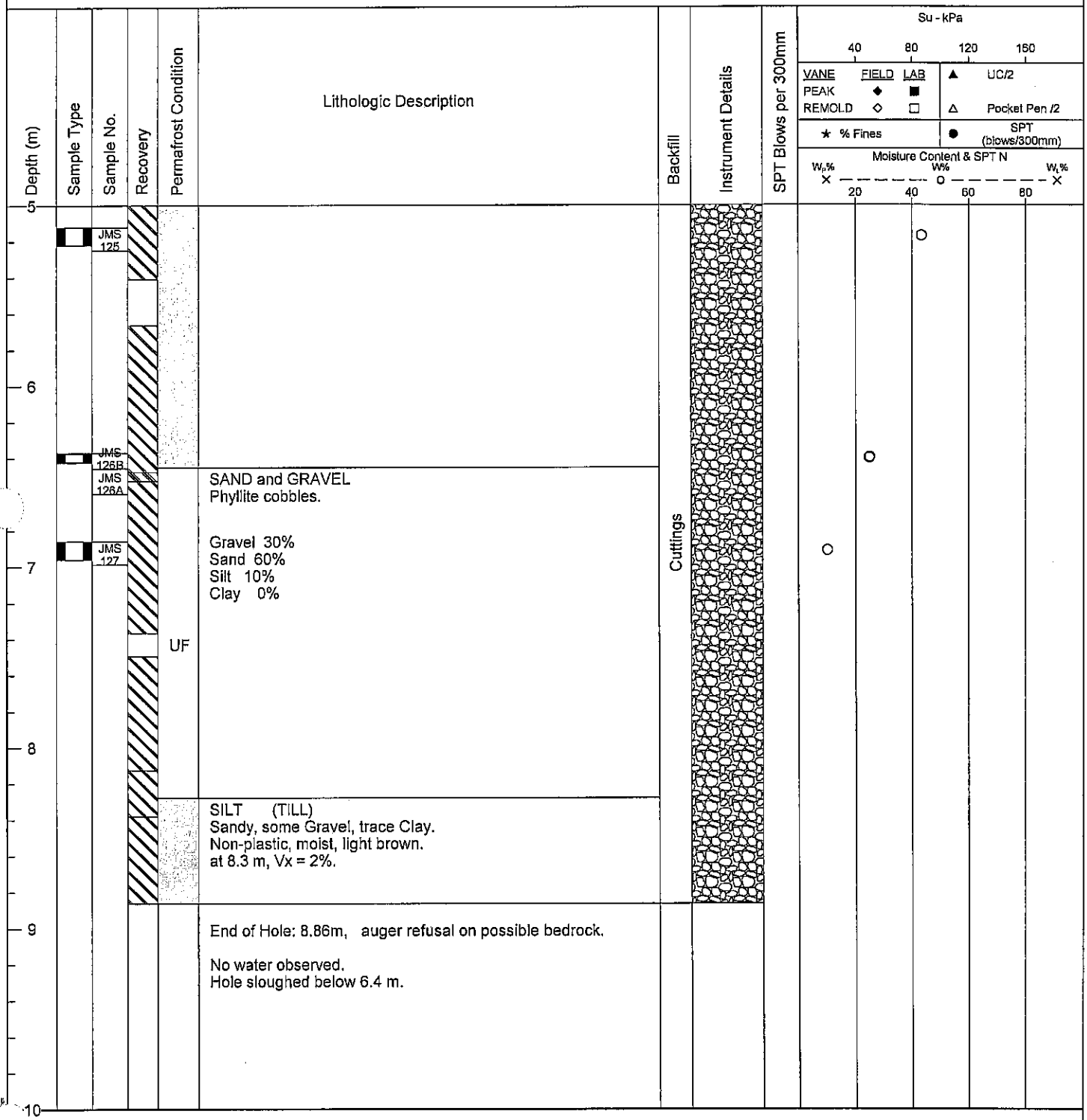
Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 579246.20E, 6914517.30N
Co-ordinates in NAD 27
Ground Elevation (m) : 1026.7 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 18 Aug 05
Finish Date : 18 Aug 05
Final Depth of Hole (m) : 8.9
Logged by : J.Severin
Reviewed by : G. Ferris



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Client: Deloitte & Touche

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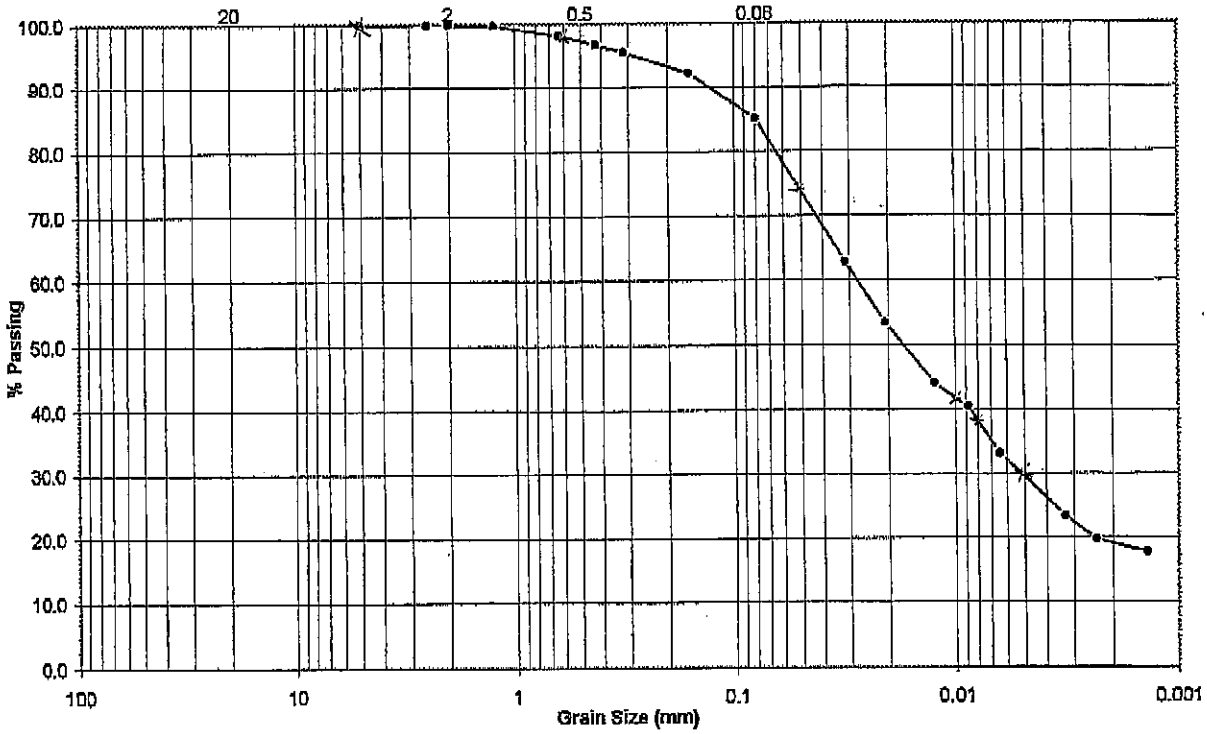
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Grain Size Distribution

Project	BGC # 0257-037-01	**Test Hole #**	JMS-123
Client	BGC Engineering Inc.	**Depth**	
Job #	55-099-02-1	**Description**	SILT, some clay, some sand
Date Sampled	Rec'd Oct.3/05		
Date Tested	Oct.11/05		

	Gravel	0.0%	**Natural Water Content** 29.1%
Remarks	**Sand**	15.0%	**Liquid Limit** 30
	Silt	65.3%	**Plastic Limit** 25
ML	**Clay**	19.7%	**Plasticity Index** 5
			Specific Gravity 2.63

Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

Sieve Size (mm)	% Passing
200	
150	
100	
80	
50	
40	
25	100.0
20	94.0
12.5	83.0
10	81.4
5	68.2
2.5	56.6
1.25	41.1
0.63	23.5
0.315	16.7
0.16	12.5
0.08	9.4

Client BGC Engineering Inc.

Address Suite 1605, 840 - 7th Avenue S.W.
Calgary, Alberta T2P 3G2

Attention Mr. Jordan Severin

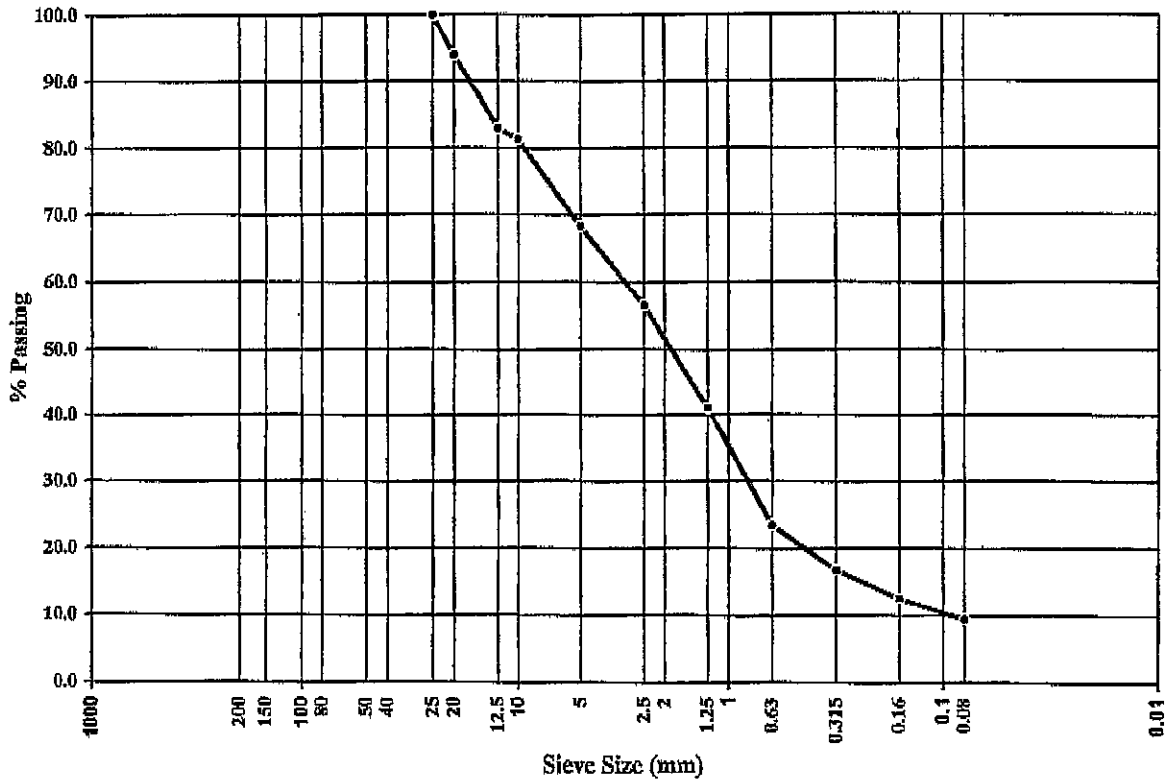
Project BGC # 0257-037-01 **Job #** 55-099-02-1

Date Sampled Rec'd Oct.3/05 **By** CBL

Date Tested Oct.6/05 **By** ML

Aggregate Type Sand & Gravel

Comments JMS-127
Moisture Content = 8.4%



BOREHOLE # BGC05-22

Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 578921.00E, 6914612.70N
Co-ordinates in NAD 27
Ground Elevation (m) : 1045.6 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 19 Aug 05
Finish Date: 19 Aug 05
Final Depth of Hole (m) : 3.3
Logged by : J.Severin
Reviewed by : G. Ferris

Depth (m)	Sample Type	Sample No.	Recovery	Permafrost Condition	Lithologic Description	Backfill	Instrument Details	SPT Blows per 300mm
0				UF	SAND (TOPSOIL) Silty, trace Clay, Organic Materials (Moss, Peat, Wood). Loose, non-plastic, wet, dark brown.			
					SAND (COLLUVIUM) Silty, some Gravel, trace Clay. Low plasticity, light brown, ice stratified. at 0.5 m, Vs = 30%, ice lenses 1-2 cm.			
		JMS 128						
		JMS 129			at 0.9 m, Vs = 40%, ice lenses up to 3 cm.			
1					from 1.0 m to 1.5 m, Vx = 20%, ice lenses up to 1 cm.			
		JMS 130			at 1.8 m, Vs = 40%, ice lenses up to 3 cm.	Cuttings		
2								
		JMS 131						
				UF	Phyllite (BEDROCK) Fine grained, green colour, no distinct fabric or discontinuities.			
3								
					End of Hole: 3.3m, drill refusal in bedrock. No water observed. Hole sloughing observed. Two attempts made. Drill refusal at 3.3 and 1.8 m.			
4								
5								

Su - kPa
40 80 120 160
VANE FIELD LAB ▲ UC/2
PEAK ◆ ■
REMOLD ◇ □ △ Pocket Pen /2
★ % Fines ● SPT (blows/300mm)
Moisture Content & SPT N
W_p% W% W_L%
20 40 60 80

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
Calgary, AB Phone (403) 250 5185

Client: Deloitte & Touche

BOREHOLE # BGC05-23

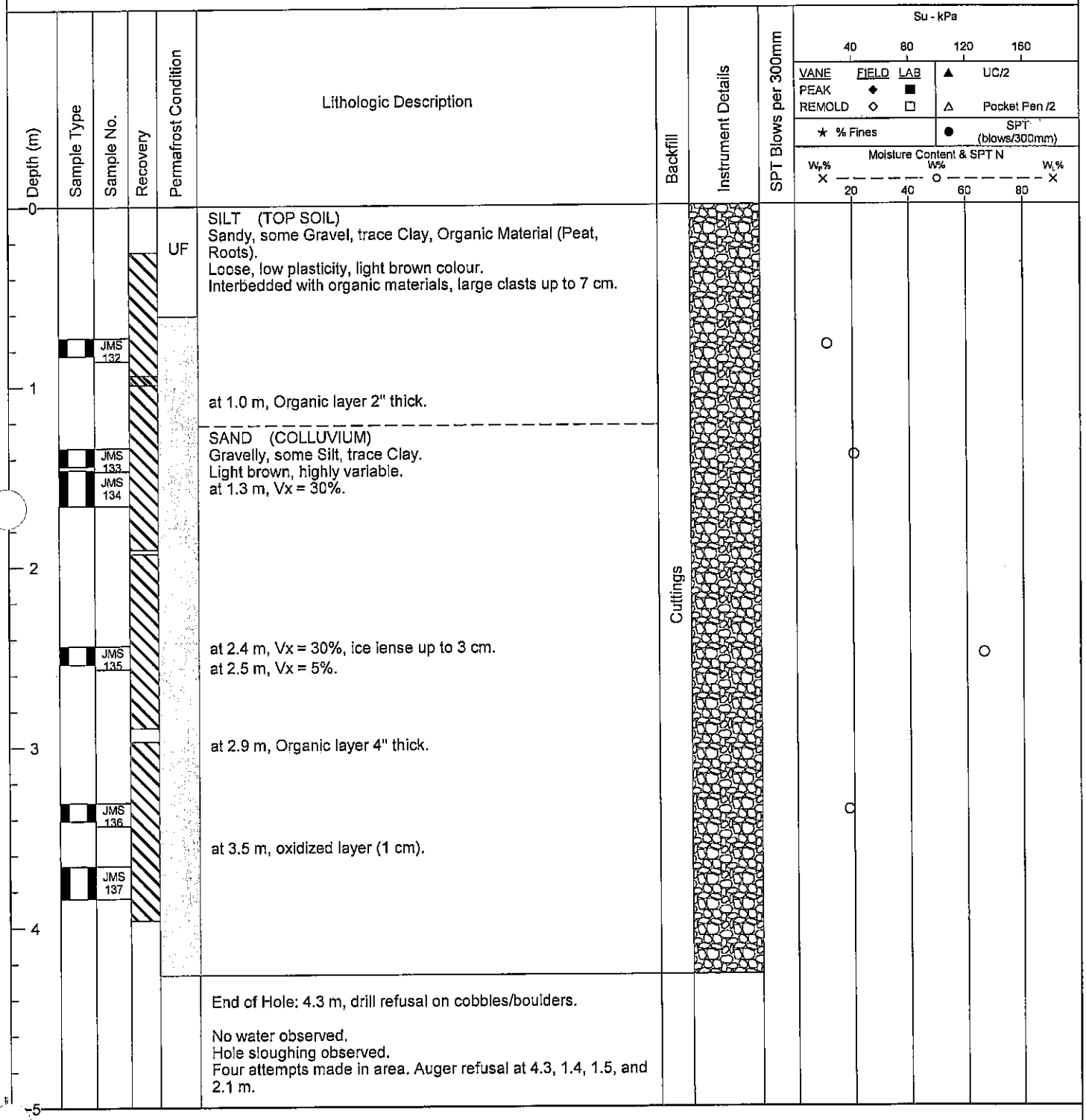
Project : Rose Creek Diversion Canal Investigation

Project No. : 0257-037-01

Location : Faro, YT
Co-ordinates (m) : 578561.90E, 6914958.40N
Co-ordinates in NAD 27
Ground Elevation (m) : 1021.5 AMSL

Drill Designation : CME 75
Drilling Contractor : Midnight Sun Ltd
Drill Method : CRRL / Solid Stem Auger
Sampling Method : CRRL / Solid Stem Auger
Boring Diameter :

Start Date : 19 Aug 05
Finish Date : 19 Aug 05
Final Depth of Hole (m) : 4.3
Logged by : J.Severin
Reviewed by : G. Ferris



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Client: Deloitte & Touche