

### COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

### GEOTECHNICAL INVESTIGATIONS AND INTERPRETATIVE GEOTECHNICAL AND TUNNELLING CONDITIONS (REF. NO. 13844/1-1)

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### GEOTECHNICAL INVESTIGATIONS AND INTERPRETATIVE GEOTECHNICAL AND TUNNELLING CONDITIONS (REF. NO. 13844/1-1)

#### SECTION 1.0 - INTRODUCTION

Coast Mountain Hydro Corporation is planning the development of the Forrest Kerr Hydroelectric Project comprising a Run-of-River power generation scheme on the Iskut River in northwestern British Columbia. The project involves the construction of over 3.5 km of underground excavations including an intake tunnel, a bypass tunnel, the main power tunnel, an access tunnel, an underground powerhouse cavern and a tailrace tunnel. The main tunnels are planned with widths of 6-7 meters and heights of 6-9 meters. The powerhouse is planned with a width of 22m, a height of 16 m and a length of 40 m. The general arrangement of the project and tunnel alignment is shown on Figure 1.1.

Knight Piésold has undertaken an appraisal of the geotechnical and expected tunnelling conditions for the main underground components of the project. Geotechnical site investigations including the completion of five drill holes along with field and laboratory testing as described herein were completed in October 2001 as part of the geotechnical appraisal. The investigations comprised the completion of four drill holes at the intake area situated approximately 350 m upstream of the confluence of the Iskut River with Forrest Kerr Creek and one drill hole along the northern part of the tunnel alignment, as shown on Figure 1.2. No investigations were completed along the southern part of the tunnel alignment and at the powerhouse area.

This report presents a short discussion on previous studies undertaken in the project area, the findings of the completed geotechnical investigations, discussion of the expected geotechnical conditions and construction issues relating to the main components of the project and recommendations for further work during construction.

### SECTION 2.0 - REVIEW OF EXISTING STUDIES

A significant amount of geotechnical work was previously completed in the project area by BC Hydro for the investigation of the Stikine-Iskut development scheme from 1979 to 1983. A review of the information from these earlier studies was undertaken as part of the planning for the investigations completed for this study and the assessment of the geotechnical conditions affecting construction of the proposed Forrest Kerr Hydroelectric Project. The approximate locations of relevant drill holes completed as part of these earlier studies are included in Figure 1.1.

The geology at the intake site is characterized by various basalt flows that overlie basement bedrock that is thought to be comprised of tuffaceous siltstones and volcanic andesites. The basalt flows are overlain by a thin deposit of organic overburden that is described in previous studies as being comprised of sands and silts. Individual basalt flows are in the order of 5 m in thickness and the combined thickness of basalt flows in the project area extends to 230 m based on the findings of the previous investigations. Unconsolidated alluvial materials are known to be present between the basement bedrock and the overlying basalt flows as well as between the basalt flows in the project area. However, these alluvial materials were not encountered at the intake area during the recently completed investigations.

The Forrest Kerr Fault is located within the project area as shown in Figure 1.2 and strikes north-south or perpendicular to the proposed intake tunnel and dips sub-vertically towards the Iskut River. The Forrest Kerr Fault is described in previous studies as a major regional fault that is located within the underlying basement bedrock. There are no indications of this fault within the overlying basalt flows in the project area. No other faults have been identified along the proposed tunnel alignment based on a review of previous studies. A limited number of minor shear and fracture zones and a single major shear zone have been identified from previous studies and will likely intersect the proposed tunnel alignment.

The geology along the northern and central parts of tunnel alignment as well as near the powerhouse has been reviewed on the basis of findings of the previous studies. The geology along the northern and southern sections of the power tunnel alignment is



characterized by tuffaceous siltstones and minor volcanic andesite breccias. Weak, foliated interbedded argillite layers have been observed in some drill holes and along the Iskut River canyon walls within these rock types as reported from the previous studies. The geology in the powerhouse area is characterized by mixed tuffaceous and volcanic breccia.

### SECTION 3.0 - FIELD INVESTIGATIONS AND TESTING

### 3.1 <u>GEOTECHNICAL DRILLING</u>

Geotechnical site investigations were completed in October 2001 as part of the geotechnical appraisal. The investigations comprised the completion of four drill holes at the intake area situated approximately 350 m upstream of the confluence of the Iskut River with Forrest Kerr Creek and one drill hole along the northern part of the tunnel alignment at CH 0 + 400 along with in situ rock mass permeability, field rock strength and laboratory rock strength testing. A summary of the drilling information is presented in Table 3.1 and the locations of the drill holes are shown in Figures 1.1 and 1.2. The geotechnical drilling was carried out using HQ3 triple tube diamond drilling over a period of 10 days by HYTECH Drilling Ltd. of Smithers, B.C. and utilized a helicopter for the movement of equipment to the site and between drill holes.

#### 3.2 <u>GEOTECHNICAL LOGGING</u>

Drill core from each hole was logged for geotechnical information including core recovery, rock quality designation (RQD), rock type, degree of weathering, joint types, joint condition and rock strength. Estimates of the rock mass quality were made using the Rock Mass Rating (RMR) classification system (Bieniawski, 1989). The Rock Mass Rating (RMR) system is based on five key parameters as follows:

- intact rock strength (uniaxial compressive strength),
- rock quality designation,
- fracture spacing,
- fracture condition and,
- groundwater conditions.

Ratings are assigned to each of the five key parameters and the sum of these ratings defines the rock mass quality as an RMR value. RMR values range from 0 (equating to extremely poor rock) to 100 (equating to extremely good rock). A description of the RMR (1989) classification with the categories, weighting values and rock mass quality

classes is presented in Figure 3.1. Intact rock strengths were estimated from both field tests and point load strength tests on selected drill core.

Rock quality designation (RQD) values were determined by summing up the lengths of core that were greater than 4 inches (10cm) long within a drill run and presenting this total as a percentage of the length of the drill run. The joint spacing in each drill run was determined by dividing the total number of natural joints counted in each run by the length of the run.

The joint conditions in each drill run were assessed from an evaluation of joint persistence, roughness, infilling, aperture and weathering. Groundwater conditions for each drill run were rated from "DRY" to "DRIPPING" according to their respective location in relation to the groundwater table. Descriptive geotechnical and rock mass rating (RMR) logs for each of the drill holes are included in Appendix A and photographs of the drill core are included in Appendix C.

### 3.3 PACKER PERMEABILITY TESTING

A total of five packer permeability tests were carried out at selected intervals within drill holes GT01-C and GT01-E using a descending stage thru-the-bit packer testing system. A total of five falling head permeability tests were carried out in zones of high permeability in drill holes GT01-A, GT01-B and GT01-C. A summary of the packer permeability and falling head permeability tests is presented in Table 3.2. Packer permeability test results are included in Appendix B and falling head permeability test results are included in Appendix D.

PVC standpipe piezometers were installed in the four drill holes completed near the intake area to determine static water levels and perform falling heads tests on completed holes. Construction details of the piezometers are included in Appendix E.

### 3.4 LABORATORY TESTING

A total of five uniaxial compressive strength tests were carried out on selected samples of drill core from the drill holes. Testing was carried out at an approved laboratory in



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Vancouver. A summary of the laboratory testing results is presented in Table 3.3. The details of the samples and test results as well as photographs of the samples are included in Appendix F.

### SECTION 4.0 - GEOTECHNICAL AND TUNNELLING CONDITIONS

### 4.1 <u>GENERAL</u>

The expected geotechnical conditions at the intake area, at tunnel elevation along the power tunnel alignment, and at the powerhouse location have been interpreted based on an evaluation of the recently completed drilling and testing data as well as a review of existing information from previous studies.

The rock types along the intake, power tunnel, and powerhouse areas comprise a mixture of generally competent, and very strong, tuffaceous siltstones, lapilli tuffs, volcanic breccia and vesicular basalt. Zones of  $b_{roken}$  and weathered rock fragments were intersected both above and below tunnel elevation in three of the four drill holes completed in the intake area. A summary of the findings of the recently completed geotechnical investigations is presented in Table 4.1.

The average rock mass quality at the tunnel elevation for the completed drill holes can generally be described as "GOOD" with rock mass rating (RMR) values ranging from approximately 65 to 75. This information indicates that tunnelling conditions can therefore be expected to be favourable along most of these areas.

Laboratory testing of vesicular basalt samples from drill holes GT01-A, GT01-B, GT01-C and GT01-D have confirmed intact rock strengths indicating that the basalt is very strong with uniaxial compressive strengths ranging from 120 to 150 MPa.

A sample of tuffaceous siltstone from drill hole GT01-E at a depth 66 meters indicated an intact strength of 50 MPa from laboratory testing. In comparison, point load strength index tests that were carried out on drill core from this drill hole ranged between 110 to 140 MPa. Several micro-fractures were observed within the laboratory test sample and therefore a lower intact strength was expected. The micro-fractures in this sample may be due to the minor fault/shear zone identified in this drill hole.

Detailed comments on the geotechnical and expected tunnelling conditions for each of the main areas of the project are provided below.



### 4.2 <u>INTAKE AREA</u>

Four drill holes (GT01-A to GT01-D) were completed at the intake area to assess geotechnical and the tunnelling conditions at this area. The drill hole locations are summarized on Table 4.1 and shown on Figure 1.2. PVC standpipe piezometers were installed in four drill holes at the intake area.

The geotechnical conditions encountered at the intake area comprise sandy organic topsoil up to 2 m thick, which is underlain by vesicular basalt. Drill hole GT01-A was completed in the left bank in the area of the proposed intake structure and indicates competent and very strong, slightly to moderately vesicular basalt to tunnel elevation at a depth of 24 m. These rock conditions generally represent "GOOD" conditions for tunnelling and no significant problems should be associated with underground or open cut excavation of the intake structure. Photograph 4.1 shows relatively good rock conditions forming the near vertical cliffs along the Iskut River at the Intake area. Vertical walls can be excavated in the competent basalt rock and nominal rock support in the form of pattern rock bolts in conjunction with wire mesh with shotcrete can be expected to be required for permanent support for both open cut and underground excavation.

Drill holes GT01-B and GT01-C were completed approximately 40m along the intake tunnel and intersected competent and very strong, slightly to moderately vesicular basalt at tunnel elevation. These rock conditions generally represent "GOOD" conditions for tunnelling and nominal rock support would again be required for permanent support given the planned size of the intake tunnel. Highly fractured and broken rock fragments were however intersected in both of these drill holes just below tunnel invert elevation. No evidence of fault gouge was observed within these zones of fractured and broken rock fragments of drill core. These zones can be described as "POOR" to "VERY POOR" with rock mass rating (RMR) values ranging from 5 to 25. These conditions are believed to represent the upper paleo-weathered zone of the older, underlying basalt flow or possible tephra layers of loose volcanic materials. A schematic long section of the interpreted geology at the intake area is presented on Figure 1.2.

The thickness and orientation of these fractured zones in relation to the tunnel is unknown since the drill holes did not penetrate through them. Most importantly, the length over which the tunnel may intersect these conditions is unknown. Both the basalt flows and these fractured zones in the intake area are interpreted to be subhorizontal as reported from previous studies. The contacts of the zones of fractured and broken rock fragments may however be undulating and therefore may be encountered at tunnel elevation in the Intake area. The thickness of the basalt flows in the intake area is generally in the order of 5 metres and the thickness of the upper paleo-weathered zones within an individual flow are expected to range from 2 to 6 metres based on previous studies. The thickness of tephra layers of loose volcanic materials can be as much as 5 to 10 metres based on information from previous studies.

These fractured conditions represent adverse or "POOR" to "VERY POOR" conditions for tunnelling. Special heavy tunnel support in the form of steel arch ribs and shotcrete will be required for the permanent stability of the tunnel in the event these broken rock conditions are encountered at tunnel elevation. The length over which these tunnel support measures may be required is unknown and cannot be determined or predicted at this time. However, given the planned size of the power tunnel it would be prudent to expect that such special tunnel support measures may be required to be installed over lengths as much as tens of meters along the tunnel alignment. In addition, these sections along the tunnel may require pre-support in advance of tunnelling. Methods that are commonly used for these conditions include forepoling (the installation of an umbrella of grouted steel support bars over the crown and sides of the tunnel) and/or injection of grout from the advancing tunnel face. Grout injection through drill holes from surface may also be effective as a means of presupporting these adverse tunnelling conditions given the relatively shallow depth to tunnel elevation in the intake area. These adverse tunnelling conditions could also be intersected at other locations along the intake tunnel area and require similar tunnel support measures. The locations and lengths of these sections cannot however be determined or predicted based on the limited drilling completed to date.

Drill hole GT01-D was completed further along the intake tunnel alignment and approximately 50 m to the southwest from drill hole GT01-C. This drill hole was only completed to a depth of 17 m due to the intersection of broken rock fragments and the concern of the drill rods becoming stuck and lost within the drill hole. These rock conditions are believed to also represent the upper paleo-weathered section of a basalt flow with pink/red discolouration at this elevation at approximately 15 m above the crown elevation of the tunnel. The thickness of this zone of broken rock fragments is at least the 4 metres as indicated in the recovered drill core. The broken rock fragments in this section of drill core also represent adverse or "POOR" to "VERY POOR" conditions for tunnelling and the true thickness of these conditions is also unknown at this location. In particular, the extent of these conditions along the tunnel alignment beyond drill hole GT01-D to the start of the Bypass Tunnel is unknown. Further mixed basalt flows are expected to be present over this section of the Intake tunnel alignment based on field mapping completed as part of previous studies. The presence of these adverse or "POOR" to "VERY POOR" conditions at tunnel elevation over this section of the Intake Tunnel alignment cannot be excluded.

As noted, if these "POOR" to "VERY POOR" rock conditions are encountered within the tunnel alignment, special heavy tunnel support will be required for the permanent stability of the tunnel. The length over which these tunnel support measures may be required is unknown and cannot be determined or predicted at this time. However, given the planned size of the power tunnel it would be prudent to expect that such measures may be required to be installed over lengths as much as tens of meters along the tunnel alignment.

The groundwater table along the intake area is shown in the longitudinal section of Figure 2 and has been based on measured static water levels in the completed drill holes. These findings show that most of the intake tunnel is expected to be below the groundwater table. The rock mass permeability of the competent vesicular basalt is high, ranging from  $10^{-3}$  to  $10^{-4}$  cm/s based on packer permeability and falling head tests. The paleo-weathered zones of the basalt flows can be expected to have higher rock mass permeability in the order of  $10^{-2}$  cm/s based on attempted testing in drill holes GT01-C and GT01-D.

The groundwater testing indicates that moderate seepage inflows or "WET" to "DRIPPING" conditions can be expected during tunnelling within the competent vesicular basalt in the intake area. Significant water inflows, requiring major pumping, may however be expected during tunnelling through the broken rock of the paleoweathered zones of the basalt flows along the intake area.

The highly fractured and permeable nature of some of the rock conditions intersected within the drill holes along the Intake Tunnel requires the construction of concrete lining over some sections of the Intake Tunnel in order to prevent excessive leakage. The required total length of concrete lining is unknown due to the uncertainty of the extent of these conditions and can only be determined upon completion of the initial excavation through this section. For the purposes of preliminary costing and design it is considered prudent to assume that concrete lining will be required over the entire length of the Intake Tunnel.

### 4.3 <u>POWER TUNNEL - NORTH</u>

The geological contact between the underlying basement bedrock of mixed tuffaceous siltstones/volcanic breccia and the overlying basalt flows is interpreted to be located at approximately CH 0 + 250 based on field mapping completed as part of previous studies. The first 250 meters of the northern section of the power tunnel from the intersection of the Bypass Tunnel is expected to comprise mixed basalt flows. The presence of adverse or "POOR" to "VERY POOR" conditions associated with the basalt flows cannot be excluded along the alignment of this section of the power tunnel alignment. If these rock conditions are encountered special heavy tunnel support will be required for the permanent stability of the tunnel. As noted for the Intake Tunnel, concrete lining is deemed necessary to prevent excessive leakage over this section of the power tunnel.

Drill hole GT01-E was completed at chainage 0 + 400m along the tunnel alignment as shown on Figure 1.1. The objective of this drill hole was to obtain a sam ple of the rock for geochemical tests to determine the potential for acid rock drainage (ARD) from the waste rock that would be generated from the tunnel excavation. The drill core from

this drill hole was also logged for geotechnical information to assess the tunnelling conditions along the northern section of the power tunnel alignment.

The overburden at drill hole GT01-E was approximately 6 m thick and comprised loose medium sand below thin organic topsoil. Below the overburden, the drill hole intersected competent, very strong, tuffaceous siltstones/andesites throughout the remaining length of the hole to a depth of 74m at tunnel elevation. A minor fault/shear zone was intersected at a depth of 73 meters. This fault/shear zone is believed to subvertical.

The rock conditions at tunnel elevation at this location and along the northern section of the power tunnel from CH 0 + 250m where similar rock conditions are expected can be generally described as "GOOD" to "FAIR". No significant problems are expected with tunnelling in this type of rock conditions. Nominal rock support in the form of spot bolting in conjunction with shotcrete and mesh can be expected to be required over most of this section for the planned size of the power tunnel.

Interbeds of weak and foliated argillite have however been reported to be present with these rock types. The presence of continuous weak and foliated argillite layers represent adverse conditions that may influence the stability of the roof and walls of the power tunnel if these conditions are encountered. Pattern rock bolting in conjunction with shotcrete and mesh can be expected to be required if these conditions are encountered as well as at the intersection of fault/shear or highly fractured zones.

The groundwater level in drill hole GT01-E was measured at a depth 18 m. Rock mass permeability values measured from packer tests through the tunnel zone ranged from  $10^{-5}$  cm/s to  $10^{-4}$  cm/s. This indicates that minor seepage inflows or "DAMP" conditions can be expected during tunnelling within the competent volcanic andesite along the northern section of the power tunnel.

### 4.4 POWER TUNNEL - SOUTH

No drill holes were completed along the southern section of the power tunnel as part of the recent geotechnical investigations.

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The geotechnical and tunnelling conditions along the southern section of the power tunnel are generally expected to be similar to those along the northern section described above. Nominal rock support in the form of spot bolting in conjunction with shotcrete and mesh can be expected to be required over most of this section for the planned size of the power tunnel if similar rock conditions to those in drill hole GT01-E are encountered. Pattern rock bolting in conjunction with shotcrete and mesh can be expected to be required over and foliated argillite are encountered.

Major fault/shear zones are believed to transect the tunnel alignment at approximately CH 1 + 900 and CH 2 + 900 a shown in Figure 1.1. The major fault/shear zone at CH 1 + 900 has been reported as typically consisting of a gouge, chloritized, slickensided, cataclastic zone. The major fault/shear zone at CH 2 + 900 has been interpreted as the contact between the tuffaceous rocks and the underlying volcanic andesites and has been reported as comprised of thickly bedded weak argillite. The thicknesses of these zones have not been reported and are unknown. Special tunnel support measures including steel arch ribs in conjunction rock bolts, shotcrete and mesh can be expected to be required over local areas at the intersection of these fault/shear or highly fractured zones. Pre-support measures may also be required at these locations.

Minor seepage inflows or "DAMP" conditions can be expected during tunnelling along most of southern section of the power tunnel. Significant seepage inflows or "FLOWING" conditions, possibly as much as over 100 litres/second, can be expected at the intersection of the major fault/shear zones.

### 4.5 <u>UNDERGROUND POWERHOUSE CAVERN</u>

No drill holes were completed at the powerhouse location as part of the recent geotechnical investigations. The rock types to be expected at the powerhouse location comprise generally massive and competent andesite breccia with minor basalt flows.

These rock conditions are interpreted to represent "GOOD" conditions for excavation of the powerhouse. No major fault or shear zones have been identified in the

powerhouse area from previous studies. Minor seepage inflows or "DAMP" conditions can generally be expected during excavation of the powerhouse cavern.

Continuous rock support in the form of pattern rock bolts in conjunction with shotcrete and mesh can be expected to be required for the permanent support of the powerhouse cavern given the planned dimensions of the powerhouse. All permanent rock support should be integrated wherever possible with internal structural concrete.

No information is available from the previous studies regarding the orientation of the main joint sets within the andesite breccia at the powerhouse location. Geotechnical mapping of the rock conditions near the powerhouse cavern should therefore be carried out during the early stages of excavation of the powerhouse access tunnel in order to investigate the presence of any adversely oriented joints and/or fault/shear zones that may influence the stability of the powerhouse cavern and require significant permanent rock support measures. Adversely oriented joint sets in relation to the powerhouse cavern may result in the formation of large potentially unstable rock wedge blocks along the roof and/or walls of the powerhouse.

In the event that adversely oriented joints and/or fault/shear zones are identified during the early stages of construction it may appropriate to revise the orientation of the powerhouse cavern. This will allow for the optimization of the powerhouse cavern in terms of stability and minimize the permanent rock support measures as part of the final design process.

### SECTION 5.0 – CONCLUSIONS AND RECOMMENDATIONS

Geotechnical investigations comprising the completion of five triple tube HQ3 diamond drill holes, in situ rock mass permeability testing, field rock strength testing and laboratory rock strength testing were carried out for the Intake tunnel and northern section of the power tunnel in October 2001 as part of a geotechnical appraisal of tunnelling conditions for the project.

The geotechnical and expected tunnelling conditions at the intake area, at tunnel elevation along the power tunnel alignment, and at the powerhouse location have been interpreted based on an evaluation of the recently completed drilling investigations and testing as well as a review of existing information from previous studies completed by BC Hydro.

The rock types along the intake tunnel, power tunnel, and powerhouse areas comprise a mixture of generally competent, and very strong, tuffaceous siltstones, lapilli tuffs, volcanic breccia and vesicular basalt. Zones of broken and weathered rock fragments were intersected both above and below tunnel elevation in three of the four drill holes completed in the intake area.

The rock conditions at tunnel elevation along the Intake Tunnel can generally be described as "GOOD" with rock mass rating (RMR) values ranging from approximately 65 to 75 based on the findings from the geotechnical drill holes. Zones of broken and weathered rock fragments near tunnel elevation can be described as "POOR" to "VERY POOR" with rock mass rating (RMR) values ranging from 5 to 25. This information indicates that tunnelling conditions can therefore generally be expected to be favourable along some of these areas and unfavourable if zones of broken and weathered rock fragments are encountered. The length of such possible zones is unknown and cannot be determined or predicted due to the limited drilling carried out to date. Nominal rock support can be expected to be required over some of these sections however special tunnel support and possibly pre-support measures may be required if zones of broken and weathered rock fragments are encountered. Moderate seepage inflows or "WET" to "DRIPPING" conditions can generally be

expected however significant water inflows may occur upon the intersection of unfavourable rock conditions based on in situ rock mass permeability test results.

Highly fractured and permeable rock conditions have been intersected in sections of the drill holes completed within the mixed basalt flows in the Intake area. Basalt flows are expected to be encountered along the entire Intake Tunnel and to CH 0 + 250 meters of the power tunnel. The extent of these highly fractured and permeable conditions along this section of the tunnel alignment is uncertain. The construction of concrete lining is deemed necessary over these sections in order to prevent potentially excessive leakage. The total length of concrete lining can only be determined upon completion of the initial excavation through this section. For the purposes of preliminary costing and design it is considered prudent to assume that concrete lining will be required over the entire length of the Intake Tunnel and to chainage CH 0 + 250 meters of the power tunnel.

The rock conditions along the northern and southern sections of the power tunnel can be generally described as "GOOD" to "FAIR". Mixed basalt flows and associated broken and weathered rock fragments are expected to be encountered along the first 250 meters of the northern section of the power tunnel. The extent of these adverse conditions is unknown. Nominal rock support can be expected to be required over some of these sections however special tunnel support and possibly pre-support measures may be required if zones of broken and weathered rock fragments are encountered.

Two major fault/shear zones have been identified along the southern section of the power tunnel. Nominal rock support can be expected to be required over most of these sections however special tunnel support and possibly pre-support measures may be required over local areas at the intersection of these fault/shear or highly fractured zones. Minor seepage inflows or "DAMP" conditions can be expected during tunnelling over most sections and significant seepage inflows can be expected at the intersection of the fault/shear zones.

The rock types to be expected at the powerhouse location comprise generally massive and competent andesite breccia with minor basalt flows. These rock conditions are interpreted to represent "GOOD" conditions for excavation of the powerhouse. Minor

seepage inflows or "DAMP" conditions can generally be expected during excavation of the powerhouse cavern.

Geotechnical mapping of the rock conditions near the powerhouse cavern should be carried out during the early stages of excavation of the powerhouse access tunnel. In the event that adversely oriented joints and/or fault/shear zones are identified during the early stages of construction it may appropriate to revise the orientation of the powerhouse cavern in order to optimize the stability and minimize the permanent rock support measures as part of the final design process.

Appropriate technical specifications should be included in the construction documents to require the completion of minimum length probe drill holes in advance of tunnelling along the Intake Tunnel and to extend to CH 0 + 250 and near the interpreted locations of the major fault/shear zones along the southern section of the power tunnel.

Geotechnical mapping and inspection of the rock conditions exposed in the underground excavations should be carried out during the early stages of construction to provide key data to confirm preliminary design assumptions for rock support. Periodic inspections and geotechnical mapping should be carried out during construction to identify any potentially adverse geotechnical conditions that may require adjustments to the rock support designs for the tunnels and powerhouse cavern.

Geotechnical instrumentation should be installed and monitored during construction of the powerhouse cavern to confirm the suitability of the permanent rock support.



### SECTION 6.0 - REFERENCES

Geotex Consultants Report: Iskut Canyon Project - Regional Geology, March 1983

BC Hydro Report: Stikine-Iskut Development, Summary of Information for Advisory Board Meeting No. 3, September 13-16, 1983.

BC Hydro Report: Stikine-Iskut Development, Iskut Canyon & More Creek Projects Preliminary Design Study Phase 1 Interim Report, August 1984.

Bieniawski, Z.T. 1989. Engineering Rock Mass Classification.



### SECTION 7.0 - CERTIFICATION

This report was prepared and approved by the undersigned.



Prepared by:

Dean R. Brox,, P.Eng.

Senior Geotechnical/Tunnelling Engineer

Approved by:

Tom Vernon, P.Eng. Principal

This report was prepared by Knight Piésold Ltd. for the account of Coast Mountain Hydro Corporation. The material in it relies on information provided to Knight Piésold by the operators of the project, and Knight Piésold's best judgement in light of such information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Knight Piésold Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This numbered report is a controlled document. Any reproductions of this report are uncontrolled and may not be the most recent revision.

### SECTION 5.0 - CERTIFICATION OF DEAN R. BROX. P. ENG.

I, Dean R. Brox of Suite 1450 - 750 W. Pender Street, British Columbia hereby certify that:

- 1. I was a consulting Geotechnical Engineer with Knight Piésold Ltd. at the time of the compilation of the project.
- 2. I am a graduate of the University of British Columbia with a B.A.Sc. in Geological Engineering (1985).
- 3. I am a member in good standing as a Professional Engineer, in the Association of Professional Engineers and Geoscientists of the Province of British Columbia.
- 4. I have practiced my profession as a geotechnical engineer since 1985.
- 5. I have had experience in many geotechnical investigation projects and am qualified to prepare this report.
- 6. This report was prepared by me on behalf of Knight Piésold Ltd. for VTEC Capital Corp. To prepare this report, a review of, and reliance on, the work of other experienced specialist professionals that, although not supervised by me, was considered to be reliable enough on the basis of my own experience and their respective qualifications and reputations to accept their work for the purposes of this technical and economic evaluation.
- 7. I have no interest in the companies: Coast Mountain Hydro Corp. or VTEC Hydro Corp. nor do I intend to do so.

KNIGHT PIESOLD LTD.

Dean R. Brox, P.Eng.

Dated this 31 May, 2002 Vancouver, British Columbia

DRB/yp

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#### **TABLE 3.1**

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18-Oct-01

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### COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

### GEOTECHNICAL INVESTIGATIONS OF INTAKE AND UPPER TUNNEL AREAS

#### SUMMARY OF DRILLHOLE INFORMATION

M:\13844\1\Data\[Tabs 3.1 & 4.1\_r0 x1s]Table 3.1

Drillhole	Coordinates (U			Inclination	Azimuth	Completed Depth	Objective
	Northing	Easting	Elevation	(degrees)	(degrees)	(m)	· · · · · · · · · · · · · · · · · · ·
GT01-A	6,289,115	399,138	250	-90	n/a	24	Intake Structure Geology
GT-01-B	6,289,128	399,091	260	-90	n/a	31	Tunneling Conditions
GT01-C	6,289,128	399,091	260	-60	247	37.2	Tunneling Conditions
GT01-D	6,289,114	399,045	270	-90	n/a	17	Tunneling Conditions
GT01-E	6,288,680	398,830	300	-90	n/a	74.4	Tunneling Conditions and Geochemistr

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Note:

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1. Drillhole coordinates are approximate and were obtained using a hand held GPS unit and compass and hip chain measurements.

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TABLE 3.2 COAST MOUNTAIN HYDROELECTRIC CORPORATION

### FORREST KERR HYDROELECTRIC PROJECT SUMMARY OF PERMEABILITY TESTING RESULTS

M:\13844\1\Da	ata\[Tab 3.2 & 3.3_r0.xls]Table 3.2_r(	D	Printed Revised	18-Oct-0 18-Oct-0
Drill Hole	Test Type	Test Number	Mid-section Test Depth, m.	Permeability cm/s
GT01-A	Falling Head	1	4.3	8.0 x 10 <sup>-4</sup>
	Falling Head	2	13.5	1.0 x 10 <sup>-4</sup>
	Falling Head (in piezometer)	3	22.0	2.0 x 10 <sup>-5</sup>
GT01-B	Falling Head	1	19.0	2.0 x 10 <sup>-3</sup>
GT01-C	Packer	1	12.5	4.1 x 10 <sup>-4</sup>
	Falling Head	2	18.3	4.0 x 10 <sup>-5</sup>
	Packer	3	31.1	7.2 x 10 <sup>-4</sup>
GT01-D	-	-	-	-
GT01-E	Packer	1	59.4	1.1 x 10 <sup>-5</sup>
		2	65.2	9.3 x 10 <sup>-6</sup>
		3	71.4	1.1 x 10 <sup>-5</sup>

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### TABLE 3.3 COAST MOUNTAIN HYDROELECTRIC CORPORATION

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### FORREST KERR HYDROELECTRIC PROJECT SUMMARY OF LABORATORY ROCK STRENGTH TESTING RESULTS

M:\13844\1\Data\[Tab 3.2 & 3.3\_r0.xis]Table 3.3\_r0

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Printed on: 18-Oct-01 Revised on: 18-Oct-01

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Sample No.	Depth	Sample Type	Natural Moisture	Dry Density	Saturated Density	Unconfined Compressive	Comments
			Content	1		Strength (UCS)	
	(m)		(%)	kg/m³	kg/m3	MPa	
GT01-B-1	16.5 - 16.8	Basalt	0.3	2806	2814	121	Failed with multi vertical fractures
GT01-B-2	26.5 - 26.8	Basalt	0.2	2845	2850	140	Conical failure
GT01-C-I	21.9 - 22.1	Basalt	0.5	2823	2837	153	Conical failure
GT01-C-2	25 - 25.3	Basalt	0.7	2776	2795	120	Conical failure
GT01-E-1	66.4 - 66.8	Tuffaceous Siltstone	0.2	2762	2767	51	Failed along micro-fractures



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### **TABLE 4.1**

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### COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

### GEOTECHNICAL INVESTIGATIONS OF INTAKE AND UPPER TUNNEL AREAS

#### SUMMARY OF RESULTS OF GEOTECHNICAL INVESTIGATIONS

M:\13844\1\Data\[Tabs 3.1 & 4.1\_r0.xls]Table 4.1

18-Oct-01

	Revised	Oct.	17,	2001	
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Drillhole	Inclination (degrees)	Azimuth (degrees)	Completed Depth (m)	Average Rock Mass Quality at Tunnel Elevation (See note 1)	Rock Mass Quality Description	Static Water Level (MASL)	Average Permeability (cm/s)
GT01-A	vertical		24	65	GOOD	229.05	10 <sup>-4</sup>
GT-01-B	vertical	п/а	31	76	GOOD	237.99	10-3
GT01-C	60	247	37.2	73	GOOD	243.56	> 10 <sup>-4</sup>
GT01-D	vertical	п/а	17	N/A (see note 2)	N/A (see note 2)	>253	>10.1
GT01-E	vertical	n/a	74.4	74	GOOD	281.92	10-5
······································							

Notes:

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1. Tunnel elevation is considered to range from El. 241 m to El. 236.5 m in the intake area and from El. 270 m to El. 200 m over the remaining section.

2. Drillhole DH-D was stopped at 17 m due to serious concerns over drill rods becoming stuck in very poor ground (RMR < 5).





- 1. All dimensions in metres unless otherwise stated.
- 2. Contour interval is 5 metres.
- 3 Horizontal datum to NAD 83 UTM Zone 9.
- 4 Vertical datum geodetic.
- Dribhole positions shown are approximate based on "hip chain and compass" measurements in the field.
- 6 Basemap and tunnel layout provided by Sigma Engineering Ltd.
- The geological section represents interpreted conditions. Actual field conditions may vary from those shown.

LEGET	M2:
	Woter
	Overburden
	Vesicular Basalt (alightly to moderately vesicular)
	Palea – weathered Basalt or Tephra
٠	Drillhole/Piezometer G101-A
-	Treeline
~	Forrest Kerr Fault
	Tunnel
	Inferred geological contact
-	Interned groundwater table

ç	10	0	20	40	60	80	100 M	tefres	Constitution of the
Scole A	0 5	0	10	20	30	40	50 M	letres	C HI LAN HADR
	F				N HYD			RATION	
			2001 0	GEOTE	CHNICA RED G	EOLOG	ILLHOL		
5		Kn	ight	Pié	sold	1	3844/1	NO7_140. 1	2
2)	1	CONBULTING				FIGU	RE 1.2	2	



MILLINAR THREATHER 3 LENGTH DATA SHEET

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1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	FLST	10	в	6.5	5.5	5	4.5	3	2	1.1	<t< th=""><th>ALUE RATING</th></t<>	ALUE RATING
Intact Rock Strength	UCS, MPa Field Est		200 ay hammie	160	140 W blows by	125	\$10	75	50	25	< 25 at kriife	
Serengen	RATING	15	14	13	12	tammer to I	10	single 8	6	4	< 3	
	J Specing	> 200	40	20	14	10	8	1 7 1	6	8	4	
ROD	RQD %	100	90	80	70	60	50	40	30	20	0	
	RATING	20	18	18	14	12	10	4	5	4	3	
Joint Specing	Js, om BATING	+ 200 20	40	20	14	10	8	7	8	5	4	
apecing	HATING	64	10	10	14	14	10	4	10.5	1.00	100000	
								Orientation	Set 1	Set 2	Set 3	
	Perais		<1m	1-3m	3 - 10m	10 - 20 m	> 20m	J Spacing		-		
	HAT		6	4	2	1.0	0			-		
	Aper		None 6	< 0.1 mm 5	4	1.5	5.10	1 I				
Joint	Rough	hness	V Rough	Rough	SL Rough	Smooth	Slicks	1 1	-			
Condition	FIAT		6	5 Hard	3 Intiling	1 Rolt I	0 philing			-		
	Infi		None	< 5 mm	> 5 mm	< 6mm	>5mm	1				
	FIAT	ing	FRESH	4 SW	3 MW	2 HW	0 CW	+ +		-		
	FIAT		6	5	2	1	0	1	_			
								Sub-Total				
	Inflow	http://www.com/article	206		10	1	- 25	25 -	104		125	-
Groundwate	limin/10m		lay		NTID .		Aet .	Dripp			wing	
	RATING	1	5		10		7				0	
Adjustmen	t for Joint Or	ientation		0 - 20		DIF OF A	DVERSE J 20 - 45	OINT SET		45.90		
Strike Perpe				Unfavourab	ła		Favourable		V	ery Favoura	bie	
Strike Parpe	rive with Dip reficular to T		31.00	-10 Unlavourab	ia .	21	-2 Untawourabi		100	0. Fair		
	e against Di		1000	-10	1		-10			-5		
Strike	Parallel to Ta	Innel	1. A	Unfavounab -10	ie .		Fair -6		Ve	ry Urdavour -12	with	
R	IR RATING	()	80	100		80	40	- 60	20	- 40	0 - 20	1
	SCRIPTION		VERY	6000	GO	OD	11	NR	PC	DOR .	VERY POO	PR
H	JUK CLASS			1	-	2		3		4	E.	
								COAS	T MOU	VTAIN HY	DRO-ELECT	RIC CORPOR
									FOREST	ROCK	YDRO-ELECT MASS RAT CRIPTIONS	
									FOREST	ROCK	YDRO-ELECT	TRIC PROJEC





PHOTO 4.1 - Good Rock Conditions exposed along the Banks of the Iskut River near the Intake Area

COAST MOUNTAIN HYDRO-ELECTRIC CORPORATION FOREST KERR HYDRO-ELECTRIC PROJECT

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Knight Piésold

### APPENDIX A

### GEOTECHNICAL AND ROCK MASS QUALITY DRILL LOGS

#### GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET (NON-ORIENTED DRILLCORE)

Date:	26 September , 2001	inspector:	RAD / DM	Hole No.:	GT01-A	Northing:	6289080	Sheet:	1	of	1
Client:	Coast Mountain Hydro	Contractor:	Hy-Tech	Hole Diamete	er HQ(3)	Easting:	399148				
Project:	Forest Kerr	Drill Type:		Azimuth:	N/A	Elevation;	250				
Location:	Intake Structure			Inclination:	-90						

#### Mt/13844/1/Data/(Rock Core Log Data Sheet - DH-Axis)RMR Sheet

Intact Rock Hardness									
Hardness	Estimated UCS, MPa	Description	Field Performance						
	0.25 - 1.0	Extremely weak rock	Indented by thumbnail						
N. S.	1.0 - 5.0	Very weak rock	Crumbles under firm blows with the point of a geological pick; can be peeled with a pocket						
	5.0 - 25	Weak rock	Can be peeled with a pocket knile with difficulty; shallow indentations made by firm blow of geological pick						
8	26 - 50	Medium Strong rock	Cannot be scrapped or peeled with a pocket knile; specimen can be fractured with a single blow of geological pick						
	50 - 100	Strong rock	Specimen requires more than one blow with hammer and/or geological pick to fracture it						
5	100 - 250	Very strong rock	Specimen requires many blows of hammer and/or geological pick to fracture it						
8	> 250	Extremely strong rock	Specimen can only be chipped with geological p						

	Joir	t Cond	tion		
PERSISTENCE	<1m	1 - 3m	3 - 10m	10 - 20 m	> 20m
Rating	6	4	2	Sugar Barry	0
APERTURE	None	< 0.1 mn	0.1 - 1.0	1-5	5 - 10
Rating	6	5	(11)4 (1)	12 States	.0
ROUGHNESS	V Rough	Rough	SL Rough	Smooth	Slicks
Rating	6	5	13		. 0
INFILLING	None	Hard	Infilling	Soft I	nfilling
		< 5 mm	> 5 mm	< 5mm	> 5 mm
Rating	6	4	3	2	in 0
WEATHERING	Unweathered	SW	MW	HW	Decompose
Rating	···· 6	5	3 .		and Ourfit
	Gr	oundwa	iter		
Description	Dry	Damp	Wet	Dripping	Flowing
Rating	15	10	7.0	1962 4 A.	0

	Joint Weathering	1
Rating	Description	
0	Completely weathered - original labric and relict structures remain but, rock is decomposed and friable	
1	Highly weathered - rock is discolored and strengt is significantly reduced by weathering	h
3	Moderately woathered - rock is discolored, but strength is only slightly affected, discontinuities weathered	
5	Slightly weathered - rock strength unchanged, weathering on joints only	
6	Fresh and Unweathered	

Joint Roughness						
Rating	Description					
0	Polished or Silckensided					
1	Smooth, Planar					
3.6312	Slightly Rough, Undulating					
5	Rough Undulating/Stepped					
6	Very Rough, Stepped					

BOX	INTI	ERVAL	(m)	RECO	VERY	R	D	No.	Joint	Typical	Wthr	Hard		JOIN	T COND	ITION		Ground	Geological Description
	FROM	то	LENGTH	m	%	m	%	Joints	Angle	Joints			PERSIS	APER	ROUGH	INFILL	WTHR	Water	(Rock Type, Colour, Texture, Alteration, Structure)
1	0.6	1.5	0.9	0.2	22	0.0	0	3	RND	RND	3	3							-organics @ top of run.
1	1.5	2.7	1.2	0.2	19	0.0	0	7	RND	RND	3	3	6	4	6	6	3	10	-vesicular basalt clay seam @ 10 ft. (5 cm wide)
1	2.7	3.7	0.9	0.2	25	0.0	0	20	RND	RND	3	3	6	4	6	6	3	10	-highly frac, vesicular basalt
1	3.7	4.0	0.3	0.2	58	0.0	0	20	RND	RND	3	3	6	4	6	6	3	10	-highly frac. vesicular basalt
1	4.0	5.8	1.8	1.3	69	0.5	25	13	RND	RND	3	3	6	4	5	6	5	10	-ox. on joint surface
1	5.8	6.3	0.5	0.0	6	0.0	0	20	RND	RND	3	3	6	4	5	6	5	10	-highly fractured
2	6.3	7.3	1.1	0.8	76	0.4	36	8	RND	RND	3	3	6	4	5	6	6	10	-cooked meta seds @ 21' - rubbly 2 in wide
2	7.3	8.8	1.5	1.4	92	0.7	46	15	RND	RND	3	4	6	4	5	6	6	10	
1942	8.8	10.4	15	清1.3	83	0.4	28	- 17 M	AND	AND	3	4 11	6	1-4	611	6	6	10	
34-3 m	10.4	11.9	1.5	1.5	100 %	0.2	15	15	BND,	RND	6.4	24	6	A	*15-	6	6	10	-vesicular pasall - vertical joints
"你的"当你的	119	13.3	14	PARA S	100	1.0	74	8	END	BND.	6	4	6	4	5	6	8.85	. 10	vesicular basalt - vertical joints
3/4	13.31	14.9	Th Zak	1.5	- 91 -	(Trail	64 5	7	- RND	BND	6.4	4	6	4	5	6	6	10	-veskular basalt - vertical joints
4	14.9	16.5	1.5	1.5	100	1.4	93	5	RND	RND	6	4	6	4	5	6	6	10	-vesicular basalt - columnar joints
4	16.5	18.0	1.5	1.5	100	1.3	88	6	RND	RND	6	4	6	4	5	6	6	10	-vesicular basalt - fewer vesicles
4/5	18.0	19.5	1.5	1.5	100	1.2	78	8	RND	RND	6	4	6	4	5	6	6	10	-vesicular basalt - fewer vesicles
5	19.5	21.0	1.5	1.5	100	0.9	58	7	RND	RND	6	4	6	4	5	6	6	10	-vesicular basalt - sub-horiz joints (columnar?)
5/6	19.5	22.6	3.0	1.5	50	0.5	17	9	RND	RND	6	4	6	4	5	6	6	10	-vesicular basalt - long sub-horiz joints
6	22.6	24.1	1.5	1.5	100	1.4	90	5	RND	RND	6	4	6	4	5	6	6	10	-vesicular basalt - long sub-horiz joints No water return during drilling of entire hole

Indicates tunnel elevation

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Printed: 10/17/01 Rev'd: Oct. 15, 2001 Rev 0

#### GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET (NON-ORIENTED DRILLCORE)

Date:	September 29, 2001	Inspector:	DM / RAD	Hole No.:	GT01-B	Northing:	6289105	Sheet:	1	of	1
Client:	Coast Mountain Hydro	Contractor:	HyTech	Hole Diamet	er HQ (3)	Easting:	399100				
Project:	Forest Kerr	Drill Type:		Azimuth:	N/A	Elevation;	260				
Location:	Intake Tunnel			Inclination:	-90						

#### M:\13844\1\Data\[Rock Core Log Data Sheet - DH-B.xls]RMR Sheet

		Intact Rock	Hardness
Hardness	Estimated UCS, MPa	Description	Field Performance
0	0.25 - 1.0	Extremely weak rock	Indented by thumbnail
. A	1.0 - 5.0	Very weak rock	Crumbles under firm blows with the point of a geological pick; can be peeled with a pocket
2	5.0 - 25	Weak rock	Can be peeled with a pocket knile with difficulty: shallow indentations made by firm blow of geological pick
•	25 - 50	Medium Strong rock	Cannot be scrapped or peeled with a pocket knile; specimen can be fractured with a single blow of geological pick
	50 - 100	Strong rock	Specimen requires more than one blow with hammer and/or geological pick to fracture it
5	100 - 250	Very strong rock	Specimen requires many blows of hammer and/or geological pick to fracture it
. B	> 250	Extremely strong rock	Specimen can only be chipped with geological p

	Joir	nt Condi	tion		
PERSISTENCE	<1m	1 - 3m	3 - 10m	10 - 20 m	> 20m
Rating	6	4	2		0
APERTURE	None	< 0.1 mn	0.1 - 1.0	1-5	5 - 10
Rating	6	- 5	4	编行进行的	0
ROUGHNESS	V Rough	Rough	SL Rough	Smooth	Slicks
Rating	6	5	. 3	1	0
INFILLING	None	Hard	nfilling	Soft I	nfilling
		< 5 mm	> 5 mm	< 5mm	> 5 mm
Rating	. 6	4	5.3	2	0
WEATHERING	Unweathered	SW	MW	HW	Decompose
Rating	1.5 6	5	3	1923 1927	0

Description	Dry	Damp	Wet	Dripping	Flowing
Rating	1001508	10	7	4	0

	Joint Weathering						
Rating	Description						
0	Completely weathered - original labric and relict structures remain but, rock is decomposed and triable						
1	Highly weathered - rock is discolored and strength is significantly reduced by weathering						
3	Moderately weathered - rock is discolored, but strength is only slightly affected, discontinuities weathered						
5	Slightly weathered - rock strength unchanged, weathering on joints only						
6	Fresh and Unweathered						

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Joint Roughness										
Rating	Description									
0	Polished or Slickensided									
1.1.2.5	Smooth, Planar									
45 <b>3</b> .	Slightly Rough, Undulating									
5	Rough Undulating/Stepped									
6	Very Rough, Stepped									

BOX	INTE	RVAL	(m)	RECO	VERY	R	D	No.	Joint	Typical	Wthr	Hard		JOINT CONDITION		Ground	Geological Description		
	FROM	то	LENGTH	m	%	m	%	Joints	Angle	Joints			PERSIS	APER	ROUGH	INFILL	WTHR	Water	(Rock Type, Colour, Texture, Alteration, Structure)
1.0	0.6	2.1	1.5	1.3	83	0.0	0		RND	RND	MW	2	6	4	5	6	3	10	-cobbles / gravel pushed into casing
1.0	2.1	3.7	1.5	1.1	72	0.5	30	11	RND	RND	MW	2	6	6	4	6	3	10	-vesicular basalt clay seam at 10 feet Highly waethered
1.0	3.7	5.2	1.5	1.5	100	0.6	37	12	RND	RND	MW	2	6	6	4	6	3	10	-highly Fractured vesicular basalt
2.0	5.2	6.7	1.5	1.5	100	1.2	80	11	RND	RND	MW	3	6	6	4	6	5	10	-vesicular basait - highly fractured
2.0	6.7	8.2	1.5	1.5	100	0.7	48	12	RND	RND	SW	4	6	6	4	6	5	10	-vesicular basalt - weathered on joints
2/3	8.2	9.8	1.5	1.5	100	0.7	48	8	RND	RND	UW	4	6	6	4	6	5	10	-vesicular basalt
3.0	9.8	11.3	1.5	1.5	100	1.2	78	5	RND	RND	UW	4	6	6	4	6	5	10	-Return water gauge vesicular basalt
3/4	11.3	12.8	1.5	1.5	100	0.8	52	7	RND	RND	UW	4	6	6	4	6	5	10	-vesicular baselt - RW - 50 psi
4.0	12.8	14.3	1.5	1.5	100	0.5	36	12	RND	RND	UW	4	6	6	4	6	6	15	-vesicular basalt - RW OK - fewer vesicles
4.0	14.3	15.9	1.6	1.5	97	0.5	34	7	RND	RND	UW	4	6	6	4	6	6	15	- fewer vesicles
4/5	15.9	17.4	1.5	1.5	100	0.9	62	4	RND	RND	UW	4	6	6	4	6	6	15	-vesicular basalt - sample
5.0	17.4	18.9	1.5	1.5	100	1.2	77	5	RND	RND	UW	4	6	6	4	6	6	15	-vesicular basalt - no water return
6.0	18.9	- 20,4	1.1.6	1.5	100	二 元 1 型	- 72	1. 1. 6 L	RND	RND	UW	ALC: A	6	6	19 14 19	6	6	15!	vesicular basalt - very faw vesicles
. 5.6.0	20.4	22.0 4	1.5	1.5	100	1.2	377	В	RND	AND	WU	4		6	4	State State	6	15	-vesicular basalt - no water return - no pressure
6.0	22.0	23.5	1.5	1.5	100	A 14	.93	3	AND	FIND	WU -	<b>以近4</b> 年	6	6		B	6	15-	-vesicular basalt - more vesicles
6/7	23.6	25.0	1.5 .	1.5	100	0.5	35	7	45	RND.	WW	4	6	6	r A	6	6	- E	-vesicular basalt - more vesicles
7.0	25.0	26.5	1.5	1.5	100	1.1	70	13	75	75	UW	4	6	6	4	6	6	15	-vesicular basalt - more vesicles
7.0	26.5	28.0	1.5	1.5	100	1.5	100	5	80	80	UW	4	6	6	4	6	6	15	-good vesicular basalt - few vesicles (sample)
7/8	28.0	29.9	1.8	1,5	83	0.9	49	12	RND	RND	HW	3	6	6	4	6	3	7	-highly weathered vesicles (97-98)
8.0	29.9	31.1	1.2	1.2	98	0.0	0	25	RND	RND	HW	2	6	6	4	6	3	7	-gravel sized rock basalt fragments at 98-101 - vesicular basalt 101-102. Loss of water during drilling

Indicates tunnel elevation

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Printed: 10/17/01 Rev'd: Oct 17, 2001 Rev. 0

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#### GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET (NON-ORIENTED DRILLCORE)

Date:	September, 28, 2001	Inspector:	RAD / DM	Hole No.:	GT01-C	Northing:	6289105	Sheet:	1	of 1
Client:	Coast Mountain Hydro	Contractor:	Hy Tech	Hole Diamet	er HQ(3)	Easting:	399100			
Project:	Forrest Kerr	Drill Type:		Azimuth:	247	Elevation;	260			
Location:	Intake Area			inclination:	-60					

M\10010/SWew Field Manual/Appendix C - SI and Testing of Groundwater/C3\Spreadsheets\(SS-C3-1 - Falling Head Spreadsheet.xla)FH-1

		Intact Rock	Hardness
Hardness	Estimated UCS, MPa	Description	Field Performance
Dist	0.25 - 1.0	Extremely weak rock	Indented by thumbnall
19.1	1.0 - 5.0	Very weak rock	Crumbles under firm blows with the point of a geological pick; can be peeled with a pocket
2	5.0 - 25	Weak rock	Can be peeled with a pocket knille with difficulty; shallow indentations made by tirm blow of geological pick
e	25 - 50	Medium Strong rock	Cannot be scrapped or peeled with a pocket knile; specimen can be fractured with a single blow of geological pick
11	50 - 100	Strong rock	Specimen requires more than one blow with hammer and/or geological pick to fracture it
5	100 - 250	Very strong rock	Specimen requires many blows of hammer and/or geological pick to fracture it
16 10	> 250	Extremely strong rock	Specimen can only be chipped with geological p

Spreadsheet.xls)FH-1							
	Joir	nt Cond	tion				
PERSISTENCE	<1m	1 - 3m	3 - 10m	10 - 20 m	> 20m		
Rating	6	4	2.	As. As in			
APERTURE	None	< 0.1 mn	0.1 - 1.0	1-5	5 - 10		
Rating	6	. 6	4.5	2月1日2月1日	, 0		
ROUGHNESS	V Rough	Rough	SL Rough	Smooth	Slicks		
Rating	6 6	5	3	常計測	0		
INFILLING	None	Hard	Infilling	Soft Infilling			
		< 5 mm	> 5 mm	< 5mm	> 5 mm		
Rating	6	同部;4倍信	3	2	. 0		
WEATHERING	Unweathered	SW	MW	HW	Decomposi		
Rating	6	6	3	同时的	) O		
	Gr	oundwa	ater				
Description	Dry	Damp	Wet	Dripping	Flowing		
Rating	15	10	111 7	13.4.04	0.		

	Joint Weathering
Rating	Description
0	Completely weathered - original fabric and relict structures remain but, rock is decomposed and friable
1.42	Highly weathered - rock is discolored and strength is significantly reduced by weathering
3	Moderately weathered - rock is discolored, but strength is only slightly affected, discontinuities weathered
5	Slightly weathered - rock strength unchanged, weathering on joints only
6	Fresh and Unweathered



BOX	INT	FERVAL	. (m)	RECO	VERY	R	D	No.	Joint	Typical	Wthr	Hard		JOIN	T COND	ITION		Ground	Geological Description
	FROM	то	LENGTH	m	%	m	%	Joints	Angle	Joints			PERSIS	APER	ROUGH	INFILL	WTHR	Water	(Rock Type, Colour, Texture, Alteration, Structure)
1	0.3	2.1	1.8	0.7	37	0.00	0	5		RND	FR	4	4	6	5	6	6	15	-vescular basalt
1	2.1	3.4	1.2	1.2	100	0.36	29	6		RND	FR	4	4	6	5	6	6	15	-vesular Basalt - no water return
1	3.4	4.9	1.5	1.5	98	0.61	40	8		RND	FR	4	4	6	5	6	6	15	-vesicular basalt - columnar jnts - no water return
1/2	4.9	6.4	1.5	1.5	98	1.32	87	6		RND	FR	4	4	6	3	6	6	15	- no water return - vesicular basalt
2	6.4	7.9	1.5	1.5	100	1.04	68	6		RND	FR	4	4	6	4	6	6	15	-vesicular basalt - no water return
2/3	7.9	9.5	1.5	1.5	100	0.81	53	10		RND	FR	4	4	6 ·	4	0	6	15	- vesicular basalt - no water return - clay in some joints
3	9.5	11.0	1.5	1.5	100	1.22	81	6		RND	FR	4	4	6	3	2	5	10	- vesicular basalt - no water return - clay in joints
3	11.0	12.5	1.5	1.5	100	0.97	63	7		RND	FR	4	4	6	4	2	5	10	- vesicular basalt - no water return
3/4	12.5	14.0	1.5	1.5	100	0.66	44	7		RND	FR	5	4	6	3	6	6	10	- water pressure buildup in drillrods; no water return
4	14.0	15.5	1.5	1.5	100	0.81	54	9		RND	FR	5	4	6	3	6	6	15	- drilling water pressure = 50psi
4	15.5	16.8	1.2	1.2	100	0.81	67	8		RND	FR	5	4	6	3	6	6	15	- vesicular basalt
5	16.8	18.3	1.5	1.5	100	1.27	83	5		RND	FR	5	4	6	4	6	6	15	- vesicular basalt - drill frac in top 2 ft of core
5	18.3	19.8	1.5	1.5	100	0.84	55	6		RND	FR	5	4	6	4	6	6	15	- vesicular basalt - sub horiz joints in top 1 ft of core on jts
6	19.8	21.3	1.5	1.5	100	0.97	63	7	-	RND	FR	5	4	6	4	6	6	15	- vesicular basalt - no water return
6	21.3	229	19.11音	ms	100	1,02	67	e er		FRID	<b>FR</b>	5	12 年 1	6	A	6 8	6	15	- vesicular basalt - sub horiz jnts @ 74' - slight ????
6/7	22.9	124.4	15	0.3	17	dia et	93	NER DE		FIND	ER.	5		6		6	6		- vesicular basalt - slight weathering on joints
7	24.4	25.6	12	12	100	0.94		7		END	DR.	1.105	4	6	A	6	6	115	- vesicular basalt - no water return
76	25.6	271	115	1.5	100	0.76	50	9		RND	FB	5		6	A	6 6	6	15	- vesicular basalt - no water return
7/8	271	28.0	0.9	0.9	100	0,26	28	5	175年1月	RND	一曲	5		6	4	6	6	15	- vesicular baselt - no water return
8	28.0	29.6	1.5	1.5	100	1.07	70	12	1.1.1.1	RND	FR	5	4	6	4	6	6	15	- vesicular basalt - no water return
8	29.6	31.1	1.5	1.5	100	1.40	92	9		RND	FR	5	4	6	4	6	6	15	- vesicular basalt - no water return
8	31.1	32.6	1.5	1.5	100	1.35	88	5		RND	FR	5	4	6	4	6	6	15	- vesicular basalt - no water return
8	32.6	34.1	1.5	1.5	100	0.86	57	8		RND	FR	5	4	6	4	6	6	15	- vesicular basalt - vesicles much denser from 108' down rubble @ 108'
8	34.1	34.6	0.5	0.0	0	0.00	0	50		RND	HW	2							- No recovery
8	34.6	36.3	1.7	0.0	0	0.00	0	50		RND	HW	2							- No recovery
8	36.3	36.9	0.6	0.6	100	0.10	17	50		RND	HW	2	1						- gravel sized weathered rock fragments

Indicates tunnel elevation


#### GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET (NON-ORIENTED DRILLCORE)

Date:	September 29, 2001	Inspector:	DM	Hole No.:	GT01-D	Northing:	6289100	Sheet:	1	of	1
Client:	Coast Mountain Hydro	Contractor:	Hytech Drilling	Hole Diamete	er: HQ(3)	Easting:	399050				
Project:	Forrest Kerr	Drill Type:		Azimuth:	N/A	Elevation;	270				
Location:	Intake			Inclination:	-90						

#### M:\13844\1\Data\[Rock Core Log Data Sheet - DH-D.xis]RMR Sheet

		Intact Rock	Hardness
Hardness	Estimated UCS, MPa	Description	Field Performance
0 4	0.25 - 1.0	Extremely weak rock	Indented by thumbnail
	1.0 - 5.0	Very weak rock	Crumbles under firm blows with the point of a geological pick; can be peeled with a pocket
2	5.0 - 25	Weak rock	Can be peeled with a pocket knife with difficulty. shallow indentations made by firm blow of geological pick
3	25 - 50	Medium Strong rock	Cannot be scrapped or peeled with a pocket knife; specimen can be iractured with a single blow of geological pick
	50 - 100	Strong rock	Specimen requires more than one blow with hammer and/or geological pick to fracture it
in Sugar	100 - 250	Very strong rock	Specimen requires many blows of hammer and/or geological pick to fracture it
1	> 250	Extremely strong rock	Specimen can only be chipped with geological p

	Joi	nt Condi	tion		
PERSISTENCE	< 1 m	1 - 3m	3 - 10m	10 - 20 m	> 20m
Rating	6	- 4	2	彩的1260	in <b>O</b> (1
APERTURE	None	< 0.1 mm	0.1 - 1.0	1-5	5 - 10
Rating	6	5	4	1	0
ROUGHNESS	V Rough	Rough	<b>SL Rough</b>	Smooth	Slicks
Rating	···· 6	5	3	100 A	0
INFILLING	None	Hard	nfilling	Soft I	nfilling
		< 5 mm	> 5 mm	< 5mm	> 5 mm
Rating	6	<b>4</b> (4)	3	2	0
WEATHERING	Unweathered	SW	MW	HW	Decomposed
Rating	6	5	3		Page 0 Page
r	G	oundwa	ter		
Description	Dry	Damp	Wet	Dripping	Flowing
Rating	15	10	7.5	4	0

	Joint Weathering
Rating	Description
0	Completely weathered - original fabric and relict structures remain but, rock is decomposed and frieble
	Highly weathered - rock is discolored and strength is significantly reduced by weathering
3	Moderately weathered - rock is discolored, but strength is only slightly affected, discontinuities weathered
5	Slightly weathered - rock strength unchanged, weathering on joints only
- 6.	Fresh and Unwealhered

	Joint Roughness
Rating	Description
0	Polished or Slickensided
1.	Smooth, Planar
3	Slightly Rough, Undulating
5	Rough Undulating/Stepped
6	Very Rough, Stepped

BOX	INT	TERVAL	(m)	RECO	VERY	R	DC	No.	Joint	Typical	Wthr	Hard		JOIN	IT COND	TION		Ground	Geological Description
	FROM	TO	LENGTH	m	%	m	%	Joints	Angle	Joints			PERSIS	APER	ROUGH	INFILL	WTHR	Water	(Rock Type, Colour, Texture, Alteration, Structure)
	1.5	3.4	1.8	0.3	17	0.0	0	100			HW								-cobbles - washed out sand / silt
	3.4	4.3	0.9	0.3	33	0.0	0	50			HW								cobbles - rubble vesicular basait @ bottom of run
	4.3	4.6	0.3	0.3	100	0.0	0	50			HW								light brown clay residue on surface
	4.6	5.2	0.6	0.6	100	0.3	50	10		RND	MW	3	4	6	4	6	3	10	- weathered vesicular basalt
	5.2	6.7	1.5	1.3	88	0.4	27	12		RND	MW	3	4	6	4	6	3	10	- fractured vesicular basalt staining on joints, rubbly @ top of run
	6.7	8.2	1.5	1.5	100	0.7	43	15		RND	SW	3	4	6	4	6	5	10	- slight weathering on joint surfaces - vesicular basalt
	8.2	9.8	1.5	1.5	100	1.0	67	13		RND	SW	3	4	6	4	6	5	10	slight weathering      vesicular basalt - minor vesicles
	9.8	12.2	2.4	1.5	62	0.9	35	13		RND	SW	2	4	8	4	6	5	15	- vesicular basalt - 90 cm core loss @ 40'
	12.2	12.8	0.6	0.6	100	0.1	21	9		RND	SW	2	4	6	4	6	5	10	- vesicular basalt - no water return
	12.8	14.3	1.5	0.4	28	0.0	0				HW								- vesicular basalt - gravel sized fragments. No water return
	14.3	15.9	1.5	0.8	50	0.0	0				HW								- vesicular basalt - gravel sized fragments. No water return
	15.9	17.1	1.2	0.9	73	0.0	0				HW								- vesicular basalt - gravel sized fragments. No water return during drilling of entire hole

Indicates tunnel elevation

A-4

### GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET

(NON-ORIENTED DRILLCORE)

Date:	24 September, 2001	Inspector:	RAD	Hole No.:	GT01-E	Northing:	6288680	Sheet:	3	of	3
Client:	Coast Mountain Hydro	Contractor:	Hylech	Hole Diamet	er:HQ(3)	Easting:	398830				
Project:	Forrest Kerr Project	Drill Type:		Azimuth:	N/A	Elevation;	300				
Location:	Tunnel Alignment			Inclination:	-88						

		Intact Rock	Hardness
Hardness	Estimated UCS, MPs	Description	Field Performance
0	0.25 - 1.0	Extremely weak rock	Indented by Inumbneil
ALL ALL ALL A	1.0 - 5.0	Very weak rock	Crumbles under firm blows with the point of a geological pick; can be peeled with a pockat
	5.0 - 25	Weak rock	Can be peeled with a pocket knife with difficulty; shallow indentations made by firm blow of geological pick
	25 - 50	Medium Strong rock	Cannot be scrapped or peeled with a pocket knife; specimen can be fractured with a single blow of geological pick
1	50 - 100	Strong rock	Specimen requires more than one blow with hammer and/or geological pick to fracture it
5	100 - 250	Very strong rock	Specimen requires many blows of hemmer and/or geological pick to fracture it
6	> 250	Extremely strong rock	Specimen can only be chipped with geological

	Joint	Conditio	n		
PERSISTENCE	<1m	1 - 3m	3 - 10m	10 - 20 m	> 20m
Rating	8	INTER A DUM	2	建筑的自主的总	0
APERTURE	None	< 0.1 mm	0.1 - 1.0	1-5	5 - 10
Rating	6	10015 al	4.16	141	0
ROUGHNESS	V Rough	Rough	SL Rough	Smooth	Slicks
Rating	D. G	5	3	CONTRACT.	0
INFILLING	None	Hard	Infilling	Soft I	nfilling
		< 5 mm	> 5 mm	< 5mm	> 5 mm
Rating	6 . C.	4	3	2 1	0
WEATHERING	Unweathered	SW	MW	HW	Decompose
Rating	6	5	. 3 .	1.1	D
	Gro	undwate	r		
Description	Dry	Damp	Wel	Dripping	Flowing
Rating	15	10 10	7	INSIGNATION OF THE OWNER OF THE O	0.

	Joint Weathering	
Rating	Description	
<b>0</b> 54	Completely weathered - original fabric and relict siructures remain but, rock is decomposed and triable	C. C. C.
	Highly weathered - rock is discolored and strength is significantly reduced by weathering	
3	Moderately weathered - rock is discolored, but strength is only slightly affected, discontinuities weathered	and the
5	Slightly weathered - rock strength unchanged, weathering on joints only	日本
6	Fresh and Unweathered	18

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	Joint Roughness	
Rating	Description	
0	Polished or Silckensided	
<b>4</b>	Smooth, Planar	
3	Slightly Rough, Undulating	
5	Rough Undulating/Slepped	
6	Very Rough, Stepped	

BOX	INT	ERVAL	(m)	RECO	VERY	R	QD	POINT	LOAD	No.	Joint	Typical	Wthr	Hard		JOIN	T CONDI	TION		Ground	Geological Description
	FROM	TO	LENGTH	m	%	m	%	STRE			Angle	Joints			PERSIS	APER	ROUGH	INFILL	WTHR	Water	(Rock Type, Colour, Texture, Alteration, Structure)
								Gauge(psi)	UCS (MPa)												
13/14	59.1	60.7	1.5	1,5	98	1.5	98	600	66	3	40	40	FR	5	4	6	3	4	6	15	CaCO2 filled ???
14	60.7	62.2	1.5	1.5	100	1.1	75	1000	110	4	35	40	FR	5	4	6	4	2	6	15	
14	62.2	63.7	1.5	1.5	98	1.5	97	1300	143	6	80	80	FR	5	4	6	5	2	6	15	- Shear at 207.5' - some gouge
14/15	63.7	65.2	1.5	1.5	100	1.3	83	1300	143	10	40	40	FR	5	4	6	5	2	6	15	- shear at 213' - chlorite gauge
15	65.2	66.8	1.5	1.5	98	1.3	88	1200	132	11	50	50	FR	5	4	6	5	2	6	15	- greenstone
15/16	66.8	68.3	1.5	1.5	98	1.4	90	1000	110	5	45	45	FR	5	. 4	6	5	2	6	15	- greenstone (metased)
16	68.3	69.8	1.5	1.5	98	1.5	98	1100	121	3	30	30	FR	5	4	6	5	2	6	15	- greensione (melased)
18	69.8	71.3	1.5	15	98	L. na	88	1200	112.1	FO. E	10-70	10	E F F	5		6	5	2	8	15	-greenstone - parallel jointe
16/17	713	72.9	1.5	16	4.98	0.9	57	NA .			0.08		FR	2	4	an an ann	30	. 0	6	15	Highly fractured shear zone with gouge, 41 long
17	72.9	74.4	1,5	1.6	100	11	75			2	20-80	70	ER		<b>新客</b> 篇	5	1. 3 m	0	8	15	- end of shear at top of run. Steep dipping joints.

Indicates tunnel elevation

#### GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET (NON-ORIENTED DRILLCORE)

Distant in

and the second second

Date:	24 September, 2001	Inspector:	RAD	Hole No.:	DH-E	Northing:	6288680	Sheet:	1	of	3
Client:	Coast Mountain Hydro	Contractor:	Hytech	Hole Diamet	er:HQ(3)	Easting:	398830				
Project:	Forrest Kerr Project	Drill Type:		Azimuth:	N/A	Elevation;	300				
Location:	Tunnel Alignment			Inclination:	-88						

M:\13844\1\Data\/Rock Core Lo	g Dala Sheet - DH-E	xis RMR Shee
	Intect Book I	Inclusor

Hardness	Estimated UCS, MPa	Description	Field Performance
0	0.25 - 1.0	Extremely weak rock	Indented by thumbnell
課峰	1.0 - 5.0	Very weak rock	Crumbles under firm blows with the point of a geological pick; can be peeled with a pocket
	5.0 - 25	Weak rock	Can be peeled with a pocket knile with difficulty; shallow indentations made by firm blow of geological pick
3	25 - 50	Medium Strong rock	Cannot be scrapped or peeled with a pocket knife; specimen can be fractured with a single blow of geological plok
4	50 - 100	Strong rock	Specimen requires more than one blow with hammer and/or geological pick to fracture it
5	100 - 250	Very strong rock	Specimen requires many blows of hammer and/or geological pick to fracture it
6	> 250	Extremely strong rock	Specimen can only be chipped with geological

	Joint	Conditio	n		
PERSISTENCE	<1 m	1 - 3m	3 - 10m	10 - 20 m	> 20m
Rating	6	4	2	SHILL NO.	del O late.
APERTURE	None	< 0,1 mm	0.1 - 1.0	1-5	5 - 10
Rating	6	5 .2	4	AN11/189	0
ROUGHNESS	V Rough	Rough	SL Rough	Smooth	Slicks
Rating	6	6	3.0	Res DEs	0
INFILLING	None	Hard I	infilling	Soft I	nfilling
		< 5 mm	> 5 mm	< 5mm	> 5 mm
Rating	6	4	3	2	0
WEATHERING	Unweathered	SW	MW	HW	Decomposed
Rating	: B	通知5000	3 .	1.5.1.000	0
	Carro	undwate			
Deserved				1677	
Description	Dry	Damp	Wet	Unpping	Flowing
Rating	10045680	1 10	Stor Z and	124.46	0

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	Joint Weathering	
Rating	Description	Rating
0	Completely weathered - original fabric and relict structures remain but, rock is decomposed and friable	0
1	Highly weathered - rock is discolored and strength is significantly reduced by weathering	
3	Moderately weathered - rock is discolored, but strength is only slightly affected, discontinuities weathered	3
-5	Sighly weathered - rock strength unchanged, weathering on joints only	5
6	Fresh and Unweathered	(a) (B) (b) (b)

Contraction of the

	Joint Roughness	
Rating	Description	
0	Polished or Slickensided	
1.1	Smoolh, Planar	
3	Slightly Rough, Undulating	
5	Rough Undulating/Slepped	
6	Very Rough, Stepped	

BOX		ERVAL			VERY	R	QD	POINT	LOAD	No.	Joint	Typical	Wthr	Hard		JOIN	T COND	TION		Ground	Geological Description
	FROM	TO	LENGTH	m	%	m	%	STRE			Angle	Joints			PERSIS	APER	ROUGH	INFILL	WTHR	Water	(Rock Type, Colour, Texture, Alteration, Structure)
								Gauge(psi)	UCS (MPa)												(
1	0.0	7.0	7.0	0,0	0	0.0	0						н								-0/8
1	7.0	8.5	1.5	1.5	100	0.8	51	1500	165	8	50		м	4	4	5	1	1	1	7	- metasediments
1	8.5	9.8	1.3	1.3	100	1.3	98	1400	154	3	90		м	4	4	5	5	3	1	7	- metasediments
1	9.8	11.0	1.2	0.9	75	0.9	75	1350	149	1	80		м	4	4	5	5	3	1	7	- metaseds - viened (Qtz)
2	11.0	12.5	1.5	1.5	100	0.8	50	1100	121	6	60	0	н	4	4	4	3	0	0	10	- weathered metased
2	12.5	14.0	1.5	1.5	100	1.0	66	1100	121	8	0-80	10	м	4	• 4	4	3	0	0	10	- highly weathered metased
2/3	14.0	15.5	1.5	1.5	100	1.3	90	1200	132	6	10-80	70	υ	4	4	5	4	2	6	10	- fresh metased
3	15.5	16.5	0.9	0.8	89	0.6	67	1100	121	4	80	80	U	4	4	5	4	2	6	10	- fresh metased
3	16.5	18.0	1.5	1.5	100	1.5	100	750	83	5	40-80	50	U	4	4	5	6	6	6	10	- fresh metased
3/4	18.0	19.5	1.5	1.5	100	1.5	100	800	88	4	70	70	FR	4	4	5	6	6	6	15	- metasediments
4	19.5	21.0	1.5	1.5	100	1.5	100	900	99	2	75	75	FR	5	4	5	6	6	6	15	-metasediments
4	21.0	22.6	1.5	1.5	97	1.4	92	1300	143	3	80	80	FR	5	·4	5	6	4	6	15	-metasediments
4/5	22.6	24.1	1.5	1.5	100	1.5	100	1200	132	2	70	70	FR	5	4	6	5	6	6	15	-metasediments
5	24.1	25.6	1.5	1.5	100	1.5	100	1150	127	4	50	50	FR	5	4	6	5	6	6	15	-metasediments
5/6	25.6	27.1	1.5	1.5	100	1.5	100	1150	127	3	70	70	FR	5	4	6	5	6	6	15	- fine grained metasediments
6	27.1	28.7	1.5	1.4	93	1.4	90	1100	121	4	75	75	FR	5	4	6	5	6	6	15	- shear (oxidized) at 93'
6	28.7	30,2	1,5	1.5	100	1.5	100	1100	121	2	60	60	FR	5	4	6	5	6	6	15	- fine metased - qtz viens
6/7	30.2	31.7	1.5	1.5	100	1.5	100	1300	143	0			FR	5	4						- fine grained metasediments

Indicates tunnel elevation

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Contraction of the

## GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET (NON-ORIENTED DRILLCORE)

Lest     Out Mouthin Yarge     Destruction:     Yarge     Mouthin Yarge		Date:		24 Septe	mber, 200	1	1	Inspect	or:	RAD				Hole No	<b>D.:</b>	DH-E				Nort	thing:	6288680		Sheet:	2	of	3	
Locitiin:       Turu Mayment       Indication:       4d         Augure Market Strange M		Client:		Coast Mo	ountain Hy	dro		Contra	ctor:	Hytech				Hole Di	ameter	:HQ(3)				Eas	ting:	398830						
		Project	t;	Forrest K	err Projec	t		Drill Ty	pe:					Azimuth	12	N/A				Eleva	ation;	300						
United		Locatio	on:	Tunnel A	lignment					1.				Inclinati	on:	· -88	Commenced						•					
United																1.												
Number         Owners         Number         Numer         Numer         Numer <td>M:\13844\1\D</td> <td>ala\Rock Co</td> <td>ore Log Date</td> <td>Sheet - DH</td> <td>-E.xis)RMR</td> <td>Sheel</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>•</td> <td></td>	M:\13844\1\D	ala\Rock Co	ore Log Date	Sheet - DH	-E.xis)RMR	Sheel										•												
<ul> <li> <ul> <li></li></ul></li></ul>			Int	act Rock	Hardnes	18						Joint	Conditio	n				1		Join	t Weather	ring		Joint R	oughness	3		
B         B         B         B         Worked by Novael         Filted by	Hardness		Desc	ription		Field Perf	omance																		Descriptio	n		
			Extremely	weak rock	Indented by	thumbnell								120000000000000000000000000000000000000	DOMESTIC: NO.								.0	Po	ished or Slicke	insided		
N         N	1. 1. 1.	1.0 - 5.0	Very w		Crumbles u	nder firm blo	we with the p	a lo Inice		Rating	3	10 <b>6</b> 3 10	5.					1		friable			· 和赵君皇					
Normality         Mature hyperbala	10112	5.0 - 25	Wea	k rock				_											添加的				dial disc		Smooth, Pla	nar	_	
Note         Note         Note         State         St	<b>MARSE</b>				difficulty; sh	allow indents													3		Contraction of the local division of the loc	the second se	CLA MYPEROXYMPERO	Stin	htly Bough Ur	dulating		
No.         No. <td></td> <td>25 - 50</td> <td>Madium</td> <td>drann rock</td> <td></td> <td></td> <td>anind with a</td> <td>ooskal</td> <td></td> <td>0.1</td> <td></td> <td></td> <td></td> <td></td> <td>&lt; 5mm</td> <td></td> <td></td> <td></td> <td>Sec. Sec. Sec.</td> <td>strength is o</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		25 - 50	Madium	drann rock			anind with a	ooskal		0.1					< 5mm				Sec. Sec. Sec.	strength is o								
No. 10         Provide graphing plant and plant and provide graphing plant and	Street and and and			a ang rook	knite; speck	men can be f	ractured with	a single				APPROX APPROX APPROX		KIBBHAL/UPDIA	HW	1-100 B-242-0			的复数数据		lbarad - mek s	transh unchanged	and a strength	Base	ah I bah dating	Pleased		
Image         Image <th< td=""><td></td><td></td><td></td><td></td><td>blow of geol</td><td>ogical pick</td><td></td><td></td><td></td><td></td><td></td><td>Laborhouse</td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td>weathering a</td><td>on joints only</td><td>eengen unchanged,</td><td>State Ball</td><td>Hou</td><td>gh Undulating</td><td>stepped</td><td></td><td></td></th<>					blow of geol	ogical pick						Laborhouse							0	weathering a	on joints only	eengen unchanged,	State Ball	Hou	gh Undulating	stepped		
Image: No. 200         Image:	1214	50 - 100	Stron	g rock														1	6	Fresh and U	Inweathered		6	v	ery Rough, Sl	epped		
more         more <th< td=""><td>5</td><td>100 - 260</td><td>Very str</td><td>ong rock</td><td></td><td></td><td></td><td></td><td></td><td>Decodel</td><td>lon</td><td>and the same is a sub-</td><td></td><td></td><td>Delester</td><td>Claudes.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	5	100 - 260	Very str	ong rock						Decodel	lon	and the same is a sub-			Delester	Claudes.												
Normal bit         Normal														7														
FROM         TO         ENOTE         TM         %         m         %         STRENCT         Joins         Ange         Joins		> 250	Extremely	strong rock	Specimen c	an only be cl	hipped with g	eological p						Annual Barrook														
FROM         TO         ENOTE         TM         %         m         %         STRENCT         Joins         Ange         Joins	BOX	INT	EDVAL	(m)	DECO	VEDY I	DO	0	DOINT	040	Al.	1.h.h	T	SATAL														
r         r         r         r         Gauge(pi)         UCS (MPa)         r														winr		DEDEIE				WITHO		(5-						
7       317       332       15       15       16       100       1.6       100       176       2       45, 9       45       FR       5       4       5       3       4       5       10       -oxdized joint         7       332       348       15       15       98       100       176       4       45       FR       5       4       5       10       -oxdized joint         7/8       348       363       15       15       16       10       1300       143       4       50,00       50       FR       5       4       5       10       -metased         8       37.8       38.3       1.5       1.5       100       150       176       4       30       30       FR       5       4       5       10       -metased         9       40.9       1.5       1.5       100       1.5       100       122       7       -       HW       3       4       4       3       3       1       4       -elettered core at 132'         9       40.9       41.9       1.0       100       0.4       43       500       55       7       0-400											UOIIILU	Angle	Contra			renoio	AFER	noogn	INFILL	WINA	water	(HO	CK Type, Co	nour, rext	ure, Alteri	ation, S	tructure	2
7       332       348       15       15       98       1600       176       4       45       45       77       5       4       5       5       4       5       10	7	31.7	33.2	1.5	1.5	100	1.5	100	1600	176	2	45.90	45	FB	5	4	5	3	4	5	10	ovidized joint						
7/8       34.8       36.3       1.5       1.5       100       1.5       100       1300       143       4       50,0       50       FR       5       4       5       5       10	7	33.2	34.8	1.5	1.5	98	1.5	98	1600																			
8       36.3       37.8       1.5       1.5       98       1.3       83       1150       127       6       80,50       50       FR       5       4       5       10       Images         8       37.8       39.3       1.5       1.5       100       1.5       100       127       6       80,50       50       FR       5       4       5       10       Images         8       37.8       39.3       1.5       1.5       100       1.5       100       127       6       80,50       50       FR       5       4       5       3       4       5       10       Images         8/9       39.3       40.8       1.5       1.0       0.8       49       1200       132       7       -       HW       3       4       4       3       3       1       4       -ebitterd core at 132'         9       40.9       1.8       1.8       1.0       0.0       0.4       43       500       76       7       0-90       80       HW       3       4       4       3       3       1       4       -ebitterd core at 132'         9       40.9       180 <td>7/8</td> <td>34.8</td> <td>36.3</td> <td>1.5</td> <td>1.5</td> <td>100</td> <td></td> <td></td> <td></td> <td></td> <td>4</td> <td></td>	7/8	34.8	36.3	1.5	1.5	100					4																	
8       37.8       38.3       1.5       1.5       100       1.5       100       100       176       4       30       30       FR       5       4       6       3       6       6       15	8	36.3			and the second second																							
6/9         39.3         40.9         1.6         1.5         94         0.8         49         1200         132         7         0.6         0         1         0         0         0         13         1 metasodravita's greations (magrander)           9         40.9         41.9         1.0         1.0         100         0.4         43         500         55         7         0.40         80         HW         3         4         4         3         3         1         4         -shattered core at 132'           9         41.9         43.4         1.5         1.5         100         0.8         52         660         72         7         0.40         45         Whr         3         4         4         3         3         1         7         -altered core at 132'           10         43.4         45.0         1.8         1.8         100         0.5         30         1000         110         7         40         40         FR         4         4         6         1         4         5         4         -metasediments - prite visible           10/11         48.8         48.2         1.5         1.5         1.5 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>1100</td><td>12/</td><td></td><td></td><td>60</td><td>60</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>									1100	12/			60	60														
9         40.9         41.9         1.0         0.0         0.4         4.3         5         7         0.90         80         HW         3         4         4         3         3         1         4         - shattered core at 132           9         41.9         43.4         1.5         1.5         100         0.4         52         650         72         7         0.40         45         Wihr         3         4         4         5         3         1         4         - shattered core at 132           10         43.4         45.0         1.6         1.6         1.0         0.5         30         1000         110         7         40         40         MW         4         4         4         5         3         2         3         7         -oxidized joints           10         45.0         46.8         1.6         1.5         1.5         1.5         1.5	8/9				1.0				1600	176						<u> </u>				5	10	- metaseds						
9       41.9       43.4       1.5       1.5       100       0.8       52       650       72       7       0.40       40       44       4       3       3       1       4       - all open joints rut 32/         10       43.4       45.0       1.8       1.0       0.5       30       1000       110       7       40       40       MW       4       4       3       3       1       7       -all open joints rut 32/         10       43.4       45.0       1.8       1.0       0.5       30       1000       110       7       40       40       MW       4       4       5       3       2       3       7       -adjate adjoints rut 32/// adjoints rut 32//// adjoints rut 32//		0.014			1.5	04		1.1111		and the second s	4			FR	5	• 4	6	3	8	5	10 15	- metaseds - metasediments - green	nstone (fine gr	ained)				
10       43.4       45.0       1.8       100       0.5       0.6       0.60       12       1       0.40       40       41       4       4       3       3       1       7       - Bit open joints rule coloured. Helum 7777         10       43.4       45.0       1.8       100       0.5       30       1000       110       7       40       40       MW       4       4       5       3       2       3       7       - Oxidized joints         10       45.0       46.6       1.7       1.6       94       1.3       80       1500       165       6       40       40       FR       4       4       6       1       4       5       4       - matesediments - pytite visible         10/11       45.6       48.2       1.5       1.5       98       1.4       95       1500       165       7       45       45       FR       4       4       6       1       6       5       15         11       48.2       49.8       1.7       1.7       98       1.4       95       1300       143       7       45       45       FR       4       4       8       1       <		40.0					0.8	49	1200	132	4	30	30	FR HW	5	· 4 4	6	3 3	8 3	5 6 1	10 15 4	- metaseds - metasediments - green - shattered core at 132'	nstone (fine gr	ained)				
10       45.0       48.6       1.7       1.6       94       1.3       80       1500       165       6       40       47       6       6       1       4       5       4	0		41.9	1.0	1.0	100	0.8 0.4	49 43	1200 500	132 55	4 7 7	30 0-90	30 80	FR HW HW	5 3 3	· 4 4 4	6 4 4	3 3 3	6 3 3	5 6 1 1	10 15 4 4	- metaseds - metasediments - green - shattered core at 132'	nstone (fine gr	ained)				
10/11       48.6       48.2       1.5       1.5       98       1.4       95       1500       105       7       45       45       FR       4       4       6       1       6       5       15       -Conjugate joints @ 45deg.         11       48.2       49.8       1.7       1.7       98       1.5       92       1550       171       4       50       50       FR       4       4       6       1       6       5       15       -Conjugate joints @ 45deg.         11       49.8       51.4       1.5       98       1.4       95       1300       143       7       45       45       FR       4       4       6       1       6       5       15       -conjugate joints @ 45deg.         11/12       51.4       53.0       1.7       1.6       95       1.6       95       1500       165       2       45       45       FR       4       4       8       3       6       6       15       -conjugate joints at 45deg.         11/12       51.4       53.0       1.7       1.6       95       1.6       95       1500       165       FR       4       4       6       <		41.9	41.9 43.4	1.0 1.5	1.0 1.5	100 100	0.8 0.4 0.8	49 43 52	1200 500 650	132 55 72	4 7 7 7	30 0-90 0-80	30 80 45	FR HW HW Wthr	5 3 3 3	· 4 4 4	6 4 4 4	3 3 3 3	8 3 3 3	5 6 1 1	10 15 4 4	metaseds     metasediments - green     shattered core at 132'     shattered core at 132'						
11       482       498       1.7       1.7       98       1.5       92       1550       171       4       5       1       6       5       15       -conjugate joints of 4508g.         11       49.8       51.4       1.5       1.4       95       1300       143       7       45       45       FR       4       4       6       1       6       5       15         11/12       51.4       5.5       1.6       95       1.60       143       7       45       45       FR       4       4       6       1       6       5       15         11/12       51.4       53.0       1.7       1.6       95       1.6       95       1500       165       2       45       45       FR       4       4       6       5       15       -conjugate joints at 45deg.         11/12       51.4       53.0       1.7       1.6       95       1.6       95       1500       165       2       45       45       FR       4       4       6       3       6       6       15       -conjugate joints at 45deg.         12       53.0       54.6       1.5       1.5 <td< td=""><td>10</td><td>41.9 43.4</td><td>41.9 43.4 45.0</td><td>1.0 1.5 1.6</td><td>1.0 1.5 1.6</td><td>100 100 100</td><td>0.8 0.4 0.8 0.5</td><td>49 43 52 30</td><td>1200 500 650 1000</td><td>132 55 72 110</td><td>4 7 7 7 7 7</td><td>30 0-90 0-80 40</td><td>30 80 45 40</td><td>FR HW HW Wthr MW</td><td>5 3 3 3</td><td>· 4 4 4</td><td>6 4 4 4</td><td>3 3 3 3</td><td>8 3 3 3</td><td>5 6 1 1</td><td>10 15 4 4 7</td><td>metaseds     metasediments - green     shattered core at 132'     shattered core at 132'     all open joints rust colo</td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	10	41.9 43.4	41.9 43.4 45.0	1.0 1.5 1.6	1.0 1.5 1.6	100 100 100	0.8 0.4 0.8 0.5	49 43 52 30	1200 500 650 1000	132 55 72 110	4 7 7 7 7 7	30 0-90 0-80 40	30 80 45 40	FR HW HW Wthr MW	5 3 3 3	· 4 4 4	6 4 4 4	3 3 3 3	8 3 3 3	5 6 1 1	10 15 4 4 7	metaseds     metasediments - green     shattered core at 132'     shattered core at 132'     all open joints rust colo						
11       498       51.4       1.5       98       1.4       95       1300       143       7       45       45       FR       4       4       6       1       6       5       15       -conjugate joints at 45deg.         11/12       51.4       53.0       1.7       1.6       95       1.6       95       1500       165       2       45       45       FR       4       4       6       1       6       5       15       -conjugate joints at 45deg.         12       53.0       54.6       1.5       1.5       98       1.600       154       0       FR       4       4       6       6       6       15         12/3       54.6       55.1       1.5       98       1.5       98       1400       154       0       FR       4       4       4       1       4       6       15         12/13       54.6       55.1       1.5       98       1.500       165       2       40       40       FR       4       4       1       4       6       15       -Ott filled joints         12/13       54.6       57.6       1.5       1.5       98       1500 </td <td>10 10</td> <td>41.9 43.4 45.0</td> <td>41.9 43.4 45.0 48.6</td> <td>1.0 1.5 1.6 1.7</td> <td>1.0 1.5 1.6 1.6</td> <td>100 100 100 94</td> <td>0.8 0.4 0.8 0.5 1.3</td> <td>49 43 52 30 80</td> <td>1200 500 650 1000 1500</td> <td>132 55 72 110 165</td> <td>4 7 7 7 7 7</td> <td>30 0-90 0-80 40</td> <td>30 80 45 40</td> <td>FR HW HW Wihr MW FR</td> <td>5 3 3 3 4</td> <td>- 4 4 4 4 4</td> <td>6 4 4 4 5</td> <td>3 3 3 3</td> <td>8 3 3 3 2</td> <td>5 6 1 1 1 3</td> <td>10 15 4 7 7 7</td> <td>metaseds     metasediments - green     shattered core at 132'     shattered core at 132'     all open joints rust colo     oxidized joints</td> <td>oured. Return</td> <td></td> <td></td> <td></td> <td></td> <td></td>	10 10	41.9 43.4 45.0	41.9 43.4 45.0 48.6	1.0 1.5 1.6 1.7	1.0 1.5 1.6 1.6	100 100 100 94	0.8 0.4 0.8 0.5 1.3	49 43 52 30 80	1200 500 650 1000 1500	132 55 72 110 165	4 7 7 7 7 7	30 0-90 0-80 40	30 80 45 40	FR HW HW Wihr MW FR	5 3 3 3 4	- 4 4 4 4 4	6 4 4 4 5	3 3 3 3	8 3 3 3 2	5 6 1 1 1 3	10 15 4 7 7 7	metaseds     metasediments - green     shattered core at 132'     shattered core at 132'     all open joints rust colo     oxidized joints	oured. Return					
11/12     51.4     53.0     1.7     1.8     95     1.6     95     1 500     165     2     4.5     4.5     FR     4.4     4.6     3     6.6     1.5     0       12     53.0     54.6     1.5     98     1.5     98     1400     154     0     FR     4.4     4.6     3     6.6     1.5       12     53.0     54.6     1.5     1.5     98     1400     154     0     FR     4.4     4.6     3     6.6     1.5       12/13     54.8     56.1     1.5     1.5     98     1400     154     2     40     40     FR     4.4     4     1     4.6     15     -Otz filled joints       13     56.1     57.6     1.5     1.5     98     1500     165     2     10,45     FR     4.4     4.6     5.4     6.5     15     -Otz filled joints	10 10 10/11	41.9 43.4 45.0 46.6	41.9 43.4 45.0 46.6 48.2	1.0 1.5 1.8 1.7 1.5	1.0 1.5 1.6 1.6 1.5	100 100 100 94 98	0.8 0.4 0.8 0.5 1.3 1.4	49 43 52 30 80 95	1200 500 650 1000 1500 1500	132 55 72 110 165	4 7 7 7 7 6	30 0-90 0-80 40 40	30 80 45 40 40	FR HW HW Wihr MW FR	5 3 3 4 4	- 4 4 4 4 4	6 4 4 4 5 6	3 3 3 3 3 1	8 3 3 2 4	5 6 1 1 3 5	10 15 4 7 7 4	motaseds     motasediments - green     shattered core at 132'     shattered core at 132'     all open joints rust colo     oxidizad joints     metasediments - pyrite	oured. Return visible					
11/12       51.4       53.0       1.7       1.6       95       1.6       95       1500       195       2       45       45       FR       4       4       8       3       6       6       15         12       53.0       54.6       1.5       15       98       1.5       98       1400       154       0       -       FR       4       4       6       3       6       6       15         12/13       54.8       56.1       1.5       1.5       98       1.60       154       2       40       40       FR       4       4       4       6       15       -Chz filled joints         13       56.1       57.6       1.5       1.5       98       1.500       165       2       10,45       FR       4       4       4       6       15       -Chz filled joints         13       56.1       57.6       1.5       1.5       98       1500       165       2       10,45       FR       4       4       6       5       4       6       15       -Chz filled joints	10 10 10/11 11	41.9 43.4 45.0 46.6 48.2	41.9 43.4 45.0 46.6 48.2 49.8	1.0 1.5 1.6 1.7 1.5 1.7	1.0 1.5 1.6 1.6 1.5	100 100 100 84 98 98	0.8 0.4 0.8 0.5 1.3 1.4	49 43 52 30 80 95	1200 500 650 1000 1500 1500	132 55 72 110 165 165	4 ? ? ? ? 6 7	30 0-90 0-80 40 40 45	30 80 45 40 40 45	FR HW HW Wihr MW FR FR	5 3 3 4 4 4	· 4 4 4 4 4 4 4	6 4 4 5 6 6	3 3 3 3 1 1	8 3 3 2 4 6	5 6 1 1 3 5 5	10 15 4 7 7 4 15	motaseds     motasediments - green     shattered core at 132'     shattered core at 132'     all open joints rust colo     oxidizad joints     metasediments - pyrite	oured. Return visible					
12/13     54.8     58.1     1.5     1.5     98     1.6     98     1400     154     2     40     40     FR     4     4     4     1     4     6     15     -Otz filled joints       13     56.1     57.6     1.5     1.5     98     1.5     98     1500     165     2     10,45     FR     4     4     6     5     4     6     15     -Otz filled joints	10 10 10/11 11	41.9 43.4 45.0 46.6 48.2 49.8	41.9 43.4 45.0 46.6 48.2 49.8	1.0 1.5 1.6 1.7 1.5 1.7	1.0 1.5 1.6 1.6 1.5 1.7	100 100 100 84 98 98	0.8 0.4 0.8 0.5 1.3 1.4 1.5	49 43 52 30 80 95 92	1200 500 650 1000 1500 1500 1550	132 55 72 110 165 165 171	4 ? ? ? ? 6 7 4	30 0-90 0-80 40 40 45 50	30 80 45 40 40 45 50	FR HW HW Wihr MW FR FR FR FR	5 3 3 4 4 4 4 4	- 4 4 4 4 4 4 4 4 4	6 4 4 5 6 6 8	3 3 3 3 1 1 1	8 3 3 2 4 6	5 6 1 1 3 5 5 5	10 15 4 7 7 4 15 15	rnetaseds     relasediments - green     rehatiered core at 132'     all open joints rust colo     voldized joints     rnatasediments - pyrite     Conjugate joints @ 456	ured. Return visible deg.					
13 56.1 57.6 1.5 1.5 98 1.5 98 1.5 98 1.50 165 2 10.45 FR 4 4 6 5 4 6 15 -Cizined pints	10 10 10/11 11 11	41.9 43.4 45.0 46.6 48.2 49.8	41.9 43.4 45.0 48.8 48.2 49.8 51.4	1.0 1.5 1.6 1.7 1.5 1.7 1.5	1.0 1.5 1.8 1.6 1.5 1.7 1.5	100 100 100 94 98 98 98	0.8 0.4 0.8 0.5 1.3 1.4 1.5 1.4	49 43 52 30 80 95 92 95	1200 500 650 1000 1500 1550 1300	132 55 72 110 165 165 171 143	4 7 7 7 7 7 6 7 6 7 4 7	30 0-90 0-80 40 40 45 50 45	30 80 45 40 40 40 45 50 45	FR HW HW Wihr MW FR FR FR FR FR	5 3 3 4 4 4 4 4 4	- 4 4 4 4 4 4 4 4 4 4 4	6 4 4 5 6 6 6 8	3 3 3 3 1 1 1 1 1	8 3 3 2 4 6	5 6 1 1 1 3 5 5 5 5 5	10 15 4 7 7 4 15 15 15	rnetaseds     relasediments - green     rehatiered core at 132'     all open joints rust colo     voldized joints     rnatasediments - pyrite     Conjugate joints @ 456	ured. Return visible deg.					
13 58.1 57.6 1.5 1.5 98 1.5 98 1500 165 2 10,45 FR 4 4 6 5 4 6 15 -Otz filled joints	10 10 10/11 11 11 11/12	41.9 43.4 45.0 48.8 48.2 49.8 51.4	41.9 43.4 45.0 46.6 48.2 49.8 51.4 53.0	1.0 1.5 1.8 1.7 1.5 1.7 1.5 1.7 1.5	1.0 1.5 1.8 1.6 1.5 1.7 1.5 1.6	100 100 94 98 98 98 98	0.8 0.4 0.8 0.5 1.3 1.4 1.5 1.4 1.5 1.4	49 43 52 30 80 95 92 95 95 95	1200 500 650 1000 1500 1500 1550 1300 1500	132 55 72 110 165 165 171 143 165	4 7 7 7 7 7 6 7 6 7 4 7 4 7 2	30 0-90 0-80 40 40 45 50 45	30 80 45 40 40 40 45 50 45	FR HW HW Wihr MW FR FR FR FR FR FR FR	5 3 3 4 4 4 4 4 4 4 4	· 4 4 4 4 4 4 4 4 4 4 4 4 4	6 4 4 4 5 6 6 6 8 8	3 3 3 3 1 1 1 1 1	8 3 3 2 4 6	5 6 1 1 1 3 5 5 5 5 5	10 15 4 7 7 4 15 15 15	rnetaseds     relasediments - green     rehatiered core at 132'     all open joints rust colo     voldized joints     rnatasediments - pyrite     Conjugate joints @ 456	ured. Return visible deg.					
12 576 E01 15 15 100 10 20 100 10 10 10 10 100 100 100 1	10 10/11 11 11 11/12 12	41.9 43.4 45.0 46.6 48.2 49.8 51.4 53.0	41.9 43.4 45.0 48.6 48.2 49.8 51.4 53.0 54.6	1.0 1.5 1.6 1.7 1.5 1.7 1.5 1.7 1.5	1.0 1.5 1.6 1.5 1.7 1.5 1.6 1.5	100 100 94 98 98 98 98 98 98	0.8 0.4 0.8 0.5 1.3 1.4 1.5 1.4 1.6 1.5	49 43 52 30 80 95 92 95 95 98	1200 500 660 1000 1500 1500 1550 1300 1500 1400	132 55 72 110 165 165 171 143 165 154	4 ? ? ? ? ? 6 ? 4 ? 2 0	30 0-90 0-80 40 45 50 45 45	30 80 45 40 40 45 50 45 45	FR HW HW Whr FR FR FR FR FR FR FR FR	5 3 3 4 4 4 4 4 4 4 4 4 4	· 4 4 4 4 4 4 4 4 4 4 4 4 4	6 4 4 5 6 6 6 8 8 8 8	3 3 3 3 1 1 1 1 1	8 3 3 2 4 6 6 6 6 6	5 6 1 1 1 3 5 5 5 5 6	10 15 4 7 7 4 15 15 15 15 15	rnetaseds     rnetasediments - green     ehattered core at 132'     ehattered core at 132'     ehattered core at 132'     all open joints rust colo     oxidized joints     rnetasediments - pyrite     Conjugate joints at 45d	ured. Return visible deg.					
	10 10/11 11 11/12 12 12/13	41.9 43.4 45.0 48.6 48.2 49.8 51.4 53.0 54.8	41.9 43.4 45.0 48.6 48.2 49.8 51.4 53.0 54.6 56.1	1.0 1.5 1.6 1.7 1.5 1.7 1.5 1.7 1.5 1.5	1.0 1.5 1.8 1.6 1.5 1.7 1.5 1.6 1.5 1.5	100 100 94 98 98 98 98 98 98 98 98 98	0.8 0.4 0.8 0.5 1.3 1.4 1.5 1.4 1.5 1.5 1.5	49 43 52 30 80 95 92 95 95 95 98 98	1200 500 660 1000 1500 1500 1550 1300 1500 1400	132 55 72 110 165 165 171 143 165 154 154	4 7 7 7 7 7 6 7 4 7 2 0 2	30 0-90 0-80 40 45 50 45 45 45 40	30 80 45 40 40 45 50 45 45	FR HW HW Whr MW FR FR FR FR FR FR FR FR	5 3 3 4 4 4 4 4 4 4 4 4 4	· 4 4 4 4 4 4 4 4 4 4 4 4 4 4	6 4 4 5 6 6 6 8 8 8 8 8	3 3 3 3 1 1 1 1 3 1	6 3 3 2 4 6 6 6 6 6	5 6 1 1 3 5 5 5 5 6 6	10 15 4 7 7 4 15 15 15 15 15 15 15 15	rnetaseds     rnetasediments - green     ehattered core at 132'     ehattered core at 132'     all open joints rust colo     oxidized joints     rnetasediments - pyrite     Conjugate joints at 45d     onigate joints at 45d     Otz filled joints	ured. Return visible deg.					

Indicates tunnel elevation

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### ROCK MASS RATING CLASSIFICATION - GEOTECHNICAL DRILLHOLE GT01-A

			-														Printed on:		18-Oct-01
M:\13844\					the state of the s	of the local division in which the local division in which the local division in the loc											Revised on:		18-Oct-01
	TERVA	The second se	the second s	VERY	R	QD	UCS	UCS	RQD	JSPAC	Rating			Joint Rating			JCOND	WATER	RMR
FROM	то	LENGTH	m	%	m	%		Rating	Rating			Persistence	Aperature	Roughness	Infilling	Weathering		Rating	
(m)	(m)						(MPa)			(mm)							Sub-total		
0.6	1.5	0.9	0.2	22	0.0	0	75	7.5	1.4	13.6	0.4	0	0	0	0	0	0	0	9
1.5	2.7	1.2	0.2	19	0.0	0	75	7.5	1.4	13.6	0.4	6	4	6	6	3	25	10	44
2.7	3.7	0.9	0.2	25	0.0	0	75	7.5	1.4	13.6	0.4	6	4	6	.6	3	25	10	44
3.7	4.0	0.3	0.2	58	0.0	0	75	7.5	1.4	13.6	0.4	6	4	6	6	3	25	10	44
4.0	5.8	1.8	1.3	69	0.5	25	75	7.5	6.1	37.5	5.5	6	4	5	6	5	26	10	55
5.8	6.3	0.5	0.0	6	0.0	0	75	7.5	1.4	13.6	0.4	6	4	5	6	5	26	10	45
6.3	7.3	1.1	0.8	76	0.4	36	75	7.5	8.1	47.7	6.7	6	4	5	6	6	27	10	59
7.3	8.8	1.5	1.4	92	0.7	46	140	11.7	10.0	57.4	7.7	6	4	5	6	6	27	10	66
8.8	10.4	1.5	THE PARTY OF	83	0.4		140	11.7* 3	6.7	40.7	5.9		4	学生学习5-17-10	6		27	10	61
E LOBARI	11.9		1.15	100	0.2	15	140		1 4 2 5 1	27.9	4.0			5	6	6	27	- 10	57
INDER 2001	10.0			0.0	1.0	- 74 -	140-	NUMBER OF	15,2	106.3	10.8	6		11. 15 TO 2	6	6	27	-10	75
BAR STAR	ARA SAN		101.5		能够到印度	64	影 <b>里40</b> 影	117	and the state	79.0	1 9 A	6	4	5	6		27	10	
國際自我認知	16,5		4月1月1日	and the second	14	<b>93</b>	140	11.7	1848	259.1	15.3	6		5	6	.6	27	10	83
16.5	18.0	1.5	1.5	100	1.3	88	140	11.7	17.9	179.0	13.4	6	4	5	6	6	27	10	80
18.0	19.5	1.5	1.5	100	. 1.2	78	140	11.7	16.0	113.9	11.1	6	4	5	6	6	27	10	76
19.5	21.0	1.5	1.5	100	0.9	58	140	11.7	12.3	69.3	8.6	6	4	5	6	6	27	10	70
19.5	22.6	3.0	1.5	50	0.5	17	140	11.7	4.5	29.5	4.3	6	4	5	6	6	27	10	58
22.6	24.1	1.5	1.5	100	1.4	90	140	11.7	18.2	201.2	14.0	6	4	5	6	6	27	10	81

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Indicates tunnel elevation

#### ROCK MASS RATING CLASSIFICATION - GEOTECHNICAL DRILLHOLE GT01-B

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																	Printed on:		18-Oct-01
M:\13844\1	Data\[R	ock Core Lo	og Data Sh	eet - DH-E	3.xls]RMR	Sheet											Revised on:	-	18-Oct-01
IN	TERVA	L	RECO	VERY	R	QD	UCS	UCS	RQD	JSPAC	Rating			Joint Rating			JCOND	WATER	RMR
FROM	то	LENGTH	ft	%	ft	%		Rating	Rating			Persistence	Aperature	Roughness	Infilling	Weathering		Rating	
							(MPa)			(mm)							Sub-total		
0.6	2.1	1.5	1.3	83	0.0	0	25	3.1	1.4	13.6	0.4	6	4	5	6	3	24	10	39
2.1	3.7	1.5	1.1	72	0.5	30	25	3.1	7.0	42.2	6.1	6	6	4	6	3	25	10	51
3.7	5.2	1.5	1.5	100	0.6	37	25	3.1	8.3	48.6	6.8	6	6	4	6	3	25	10	53
5.2	6.7	1.5	1.5	100	1.2	80	130	11.2	16.3	118.9	11.4	6	6	4	6	5	27	10	76
6.7	8.2	1.5	1.5	100	0.7	48	130	11.2	10.4	59.8	7.9	6	6	4	6	5	27	10	66
8.2	9.8	1.5	1.5	100	0.7	48	130	11.2	10.4	59.8	7.9	6	6	4	6	5	27	10	66
9.8	11.3	1.5	1.5	100	1.2	78	130	11.2	16.0	113.9	11.1	6	6	4	6	5	27	10	75
11.3	12.8	1.5	1.5	100	0.8	52	130	11.2	11.1	63.0	8.1	6	6	4	6	5	27	10	67
12.8	14.3	1.5	1.5	100	0.5	36	130	11.2	8.1	47.7	6.7	6	6	4	6	6	28	15	69
14.3	15.9	1.6	1.5	97	0.5	34	130	11.2	7.8	46.2	6.6	6	6	4	6	6	28	15	69
15.9	17.4	1.5	1.5	100	0.9	62	130	11.2	12.9	72.5	8.9	6	6	4	6	6	28	15	76
17.4	18.9	1.5	1.5	100	1.2	77	130	11.2	15.7	110.3	11.0	6	6	4	6	6	28	15	81
18.9	20:4	1.5	1.5	100	1:1	72	130	n/~ 11,2 mm	14.8	103,1	<b>*10,6</b> *	AN AN AN AN AN	1000 B 6 10 10 10	高品的4.4%的高	间的现在形态的	6	/ 28	15	80
國 20.4 里	22.0 :	15	1.5	100	1.2	<i>. 1</i> 9	180	2.00.2	15.7	110.3	11:0	6	. 6	4	6	6	28	15	8t
22.0	23,5	i sids d	1.5	a 100	a 1.4	93	130	1112	18.8	2590	153	6	6	4	6	6	28	- 15	88
23.5	25.0	15	at 1.5 st	100	0.5	35 -	國130 個	11.2	8.0	47.0	6.7	6	6	1785 × 4 × 72 × 1	6	6	28	15	69
25.0	26.5	1.5	1.5	100	1.1	70	130	11.2	14.5	100.5	10.5	6	6	4	6	6	28	15	79
26.5	28.0	1.5	1.5	100	1.5	100	130	11.2	20.0	944.3	21.9	6	6	4	6	6	28	15	96
28.0	29.9	1.8	1.5	83	0.9	49	25	3.1	10.5	60.0	7.9	6	6	4	6.	3	25	7	53
29.9	31.1	1.2	1.2	98	0.0	0	2.5	3.1	1.4	13.6	0.4	6	6	4	6	3	25	7	37

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Indicates tunnel elevation

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#### ROCK MASS RATING CLASSIFICATION - GEOTECHNICAL DRILLHOLE GT01-C

																	Printed on:		18-Oct-01
M:\13844\1	I\Data\[Re	ock Core Lo	og Data Sh	eet - DH-C		Sheet											Revised on:		18-Oct-01
IN	TERVA	L	RECO	VERY	RÇ	)D	UCS	UCS	RQD	JSPAC	Rating			Joint Rating			JCOND	WATER	RMR
FROM	то	LENGTH	m	%	m	%		Rating	Rating			Persistence	Aperature	Roughness	Infilling	Weathering		Rating	
(m)	(m)	(m)					(MPa)			(mm)							Sub-total		
0.3	2.1	1.8	0.7	37	0.0	0	25	3.1	1.4	13.6	0.4	4	6	5	6	6	27	15	47
2.1	3.4	1.2	1.2	100	0.4	29	100	9.3	6.9	41.4	6.0	4	6	5	6	6	2.7	15	64
3.4	4.9	1.5	1.5	98	0.6	40	100	9.3	8.9	51.8	7.1	4	6	5	6	6	27	15	67
4.9	6.4	1.5	1.5	98	1.3	87	100	9.3	17.6	160.6	12.9	4	6	3	6	6	25	15	80
6.4	7.9	1.5	1.5	100	1.0	68	100	9.3	14.1	97.0	10.3	4	6	4	. 6	6	26	15	75
7.9	9.5	1.5	1.5	100	0.8	53	100	9.3	11.4	64.5	8.3	4	6	4	0	6	20	15	64
9.5	11.0	1.5	1.5	100	1.2	81	100	9.3	16.6	123.9	11.6	4	6	3	2	5	20	10	67
11.0	12.5	1.5	1.5	100	1.0	63	100	9.3	13.2	77.2	9.2	4	6	4	2	5	21	10	63
12.5	14.0	1.5	1.5	100	0.7	44	135	11.4	9.6	55.7	7.5	4	6	3	6	6	25	10	64
14.0	15.5	1.5	1.5	100	0.8	54	135	11.4	11.5	65.4	8.3	4	6	3	6	6	25	15	71
15.5	16.8	1.2	1.2	100	0.8	67	135	11.4	13.8	92.3	10.1	4	6	3	6	6	25	15	75
16.8	18.3	1.5	1.5	100	1.3	83	135	11.4	16.9	134.4	12.0	4	6	4	6	6	26	15	81
18.3	19.8	1.5	1.5	100	0.8	55	135	11.4	11.7	66.1	8.4	4	6	4	6	6	26	15	72
19.8	21.3	1.5	1.5	100	1.0	63	135	11.4	13.2	77.2	9.2	4	6	4	6	6	26	15	75
1213	22.9	2415	1.5-0	100	10	67	ES .		6.16.8	92.3	10,1		6	- 4 de 1990	1 12 cp 6	1	- 26	國國加5部黨	76
22.9	24.4	1.5	403			93	185	(D) Y	1. 218.8	258 6	11518	目的出现的4月1月1日的	6	4. 1. 15.	6	6 14 19	26	15	+51-87
24.4	an 25.6 fr	1.2	可用力也感	100 M	0.9	70	135	$\sim 104$	15.8	111.0	·····································	and the second	6-43	管禁告4 中心	1 Mar 6	6	26	1.5	79
25.6	~27.1	1.15	1.5	100	0.8	50	135	11,4	10.7	61.3	8.0	4	6-		6	6	26	15	71
271	28.0	P 0.9	0.0	100 fee	当中 0.3年代	28 -	135	学校出现和国际	6.6	401	5.9 1	4	6	A	and the Called State	的现在分词的6.10000000	26	15	65
28.0	29.6	1.5	1.5	100	1.1	70	135	11.4	14.5	100.5	10.5	4	6	4	6	6	26	15	77
29.6	31.1	1.5	1.5	100	1.4	92	135	11.4	18.5	227.3	14.6	4	6	4	6	6	26	15	86
31.1	32.6	1.5	1.5	100	1.3	88	135	11.4	17.9	178.8	13.4	4	6	4	6	6	26	15	84
32.6	34.1	1.5	1.5	100	0.9	57	135	11.4	12.0	67.7	8.5	4	6	4	6	6	26	15	73
34.1	34.6	0.5	0.0	0	0.0	0	25	3.1	1.4	13.6	0.4	0	0	0	0	0	0	0	5
34.6	36.3	1.7	0.0	0	0.0	0	25	3.1	1.4	13.6	0.4	0	0	0	0.	0	0	0	5
36.3	36.9	0.6	0.6	100	0.1	17	25	3.1	4.5	29.5	4.3	0	0	0	0	0	0	0	12

Indicates tunnel elevation

#### ROCK MASS RATING CLASSIFICATION - GEOTECHNICAL DRILLHOLE GT01-D

											Ŷ.						Printed on:		18-Oct-01
M:\13844\	I\Data\[R	ock Core L	og Data Sh	eet - DH-I	D.xls]RMR	Sheet											Revised on:		15-Oct-01
	TERVA	and the second se	RECO	the second s		2D	UCS	UCS	RQD	JSPAC	Rating			Joint Rating			JCOND	WATER	RMR
FROM	то	LENGTH	ft	%	ft	%		Rating	Rating			Persistence	Aperature	Roughness	Infilling	Weathering		Rating	
							(MPa)	_		(mm)							Sub-total		
1.5	3.4	1.8	0.3	17	0.0	0		0.5	1.4	13.6	0.4	0	0	0	0	0	0	0	2
3.4	4.3	0.9	0.3	33	0.0	0		0.5	1.4	13.6	0.4	0	0	0	0	0	0	0	2
4.3	4.6	0.3	0.3	·100	0.0	0		0.5	1.4	13.6	0.4	0	0	0	0	0	0	0	2
4.6	5.2	0.6	0.6	100	0.3	50	100.0	9.3	10.7	61.3	8.0	4	6	4	6	3	23	10	61
5.2	6.7	1.5	1.3	88	0.4	27	100.0	9.3	6.4	39.1	5.7	4	6	4	6	3	23	10	54
6.7	8.2	1.5	1.5	100	0.7	43	100.0	9.3	9.5	55.0	7.5	4	6	4	6	5	25	10	61
8.2	9.8	1.5	1.5	100	1.0	67	100.0	9.3	13.8	92.3	10.1	4	6	4	6	5	25	10	68
9.8	12.2	2.4	1.5	62	0.9	35	100.0	9.3	8.0	47.4	6.7	4	6	4	6	5	25	15	64
12.2	12.8	0.6	0.6	100	0.1	21	25.0	3.1	5.3	33.5	4.9	4	6	4	6	5	25	10	48
12.8	14.3	1.5	0.4	28	0.0	0	25.0	3.1	1.4	13.6	0.4	0	0	0	0	0	0	0	5
14.3	15.9	1.5	0.8	50	0.0	0	25.0	3.1	1.4	13.6	0.4	0	0	0	0	0	0	0	5
15.9	17.1	1.2	0.9	73	0.0	0	25.0	3.1	1.4	13.6	0.4	0	0	0	0	0	0	0	5

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Indicates tunnel elevation

Drill Hole terminated above tunnel elevation due to poor rock conditions

#### ROCK MASS RATING CLASSIFICATION - GEOTECHNICAL DRILLHOLE GT01-E

	and the second se	ock Core Lo	<u>v</u>			the second s											Printed on: Revised on:		17-Oct-01 15-Oct-01
FROM	TO	L LENGTH	RECO m	VERY %	m	2D %	UCS	UCS Rating	RQD Rating	JSPAC	Rating	Persistence	Aperature	Joint Rating Roughness	Infilling	Weathering	JCOND	WATER Rating	RMR
							(MPa)			(mm)							Sub-total		
0.0	7.0	7.0	0.0	0	0.0	0	0.0	0.5	1.4	13.6	0.4	0	0	0	0	0	0	0	2
7.0	8.5	1.5	1.5	100	0.8	51	165.0	12.9	10.9	62.1	8.1	4	5	1	1	1	12	7	51
8.5	9.8	1.3	1.3	100	1.3	98	154.0	12.4	19.6	444.8	18.0	4	5	5	3	1	18	7	75
9.8	11.0	1.2	0.9	75	0.9	75	148.5	12.1	15.4	107.5	10.9	4	5	5	3	1	18	7	63
11.0	12.5	1.5	1.5	100	0.8	50	121.0	10.6	10.7	61.3	8.0	4	4	3	0	0	11	10	50
12.5	14.0	1.5	1.5	100	1.0	66	121.0	10.6	13.7	90.1	10.0	4	4	3	. 0	0	11	10	55
14.0	15.5	1.5	1.5	100	1.3	90	132.0	11.3	18.1	197.5	13.9	4	5	4	2	6	21	10	74
15.5	16.5	0.9	0.8	89	0.6	67	121.0	10.6	13.8	92.3	10.1	4	5	4	2	6	21	10	66
16.5	18.0	1.5	1.5	100	1.5	100	82.5	8.1	20.0	944.3	21.9	4	5	6	6	6	27	10	87
18.0	19.5	1.5	1.5	100	1.5	100	88.0	8.5	20.0	916.3	21.7	4	5	6	6	6	27	15	92
19.5	21.0	1.5	1.5	100	1.5	100	99.0	9.2	20.0	944.3	21.9	4	5	6	6	6	27	15	93
21.0	22.6	1.5	1.5	97	1.4	92	143.0	11.8	18.5	227.3	14.6	4	5	6	4	6	25	15	85
22.6	24.1	1.5	1.5	100	1.5	100	132.0	11.3	20.0	916.3	21.7	4	6	5	6	6	27	15	95
24.1	25.6	1.5	1.5	100	1.5	100	126.5	11.0	20.0	944.3	21.9	4	6	5	6	6	27	15	95
25.6	27.1	1.5	1.5	100	1.5	100	126.5	11.0	20.0	944.3	21.9	4	6	5	6	6	27	15	95
27.1	28.7	1.5	1.4	93	1.4	90	121.0	10.6	18.2	200.9	14.0	4	6	5	6	6	27	15	85
28.7	30.2	1.5	1.5	100	1.5	100	121.0	10.6	20.0	944.3	21.9	4	6	5	6	6	27	15	95
30.2	31.7	1.5	1.5	100	1.5	100	143	11.8	20.0	916.3	21.7	4	0	0	0	0	4	0	58
31.7	33.2	1.5	1.5	100	1.5	100	176	13.3	20.0	944.3	21.9	4	5	3	4	5	21	10	86
33.2	34.8	1.5	1.5	98	1.5	98	176	13.3	19.7	561.3	19.2	4	5	5	4	5	23	10	85
34.8	36.3	1.5	1.5	100	1.5	100	143	11.8	20.0	944.3	21.9	4	5	5	4	5	23	10	87
36.3	37.8	1.5	1.5	98	1.3	83	127	11.0	16.9	134.4	12.0	4	5	3	4	5	21	10	71
37.8	39.3	1.5	1.5	100	1.5	100	176	13.3	20.0	944.3	21.9	4	6	3	6	6	25	15	95
39.3	40.9	1.5	1.5	94	0.8	49	132	11.3	10.6	60.6	7.9	4	4	3	3	1	15	4	49
40.9	41.9	1.0	1.0	100	0.4	43	55	5.9	9.5	54.8	7.4	4	4	3	3	1	15	4	42
41.9	43.4	1.5	1.5	100	0.8	52	72	7.2	11.2	63.7	8.2	4	4	3	3	1	15	7	49
43.4	45.0	1.6	1.6	100	0.5	30	110	10.0	7.1	42.4	6.1	4	5	3	2	3	17		47
45.0	46.6	1.6	1.6	94	1.3	80	165	12.9	16.4	119.9	11.4	4	6	1	4	5	20	4	65
46.6	48.2	1.5	1.5	98	1.4	95	165	12.9	19.1	295.2	16.0	4	6	1	6	5	22	15	85 84
48.2	49.8	1.7	1.7	98	1.5	92	171	13.1	18.6	240.9	14.9	4	6	1	6		22	15	84
49.8	51.4	1.5	1.5	98	1.4	95	143	11.8	19.1	295.2	16.0	4	6	1	6	5	22	15	84
51.4	53.0	1.6	1.6	95	1.6	95	165	12.9	19.2	306.2	16.2	4	6	3	6	6	25	0	55
53.0 54.6	54.6	1.5	1.5	98 98	1.5	98 98	154	12.4	19.7	561.3	19.2	4 4	0	1	0 4	0	19	15	85
56.1	57.6	1.5	1.5	· 98	1.5	98	154	12.4	19.7	544.7	19.2	4	6	5	4	6	25	15	92
57.6	59.1	1.5	1.5	100	1.5	80	165	12.9	16.3	118.8	19.1	4	4	3	4	6	23	15	76
59.1	60.7	1.5	1.5	98	1.2	98	66	6.8	10.3	561.3	11.4	4	6	3	4	6	21	15	84
60.7	62.2	1.5	1.5	100	1.5	75	110	10.0	19.7	107.5	19.2	4	6	4	2	6	23	15	73
62.2	63.7	1.5	1.5	98	1.1	97	143	11.8	19.4	313.9	16.3	4	6	5	2	6	22	15	86
63.7	65.2	1.5	1.5	100	1.3	83	143	11.8	19.4	134.4	10.3	4	6	5	2	6	23	15	79
65.2	66.8	1.5	1.5	98	1.3	88	143	11.8	17.9	134.4	13.4	4	6	5	2	6	23	15	81
66.8	68.3	1.5	1.5	98	1.3	90	132	10.0	17.9	200.9	13.4	4	6	5	2	6	23	15	80
68.3	69.8	1.5	1.5	98	1.4	90	121	10.0	18.2	561.3	14.0	4	6	5	2	6	23	15	88
69.8	09.8	1.5	1.5	98	1.5	88	121	10.0	19.7	178.8	19.2		6		2 10 2	0 4 6	23	15	81
71.3	72.9	15	115	98	0.9	57	目的同时的科学	0.5	12:0	677	85				0	6	18	15	54
72.9	74.4	1.5		100		75	0	0.5	15.4	167.5	10.9				0	6	18	15	60
CONTRACTOR OF THE OWNER OF	a distante di		Distanting of the local	a la assa a su assa	in the second second			a lot of the second second	NA MORE CAL	AND ADDRESS OF	Contraction of the local distance of the loc	a substances availabilit	na menorenen en anteres de la constante de la c	AND DESCRIPTION OF THE PARTY OF	IN CONTRACTOR OF CALL	STATISTICS AND ADDRESS OF ADDRES	10	State of the state	00 -

Indicates tunnel elevation

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### APPENDIX B

### PACKER PERMEABILITY TEST RESULTS

							DATA			Knigh	ONSUL	TING
PROJECT:		Forres	t Kerr P	roject		PROJ	ECT NO:	138	44/1	DRILLHOLE	GT	01-C
AREA:				Ŀ	ntake Ar	rea				]	TEST NO:	
DIP: (	60 FROM HORIZONT	]•	DEPTH (	ROUND	VATER:	6.1	] _		top of	TEST INTERVAL:		9.45 m (DOWN HO
	GAUGE HEIGH	IT ABOVE	GROUND:			2.0	m		BOTTOM	OF TEST INTERV	AL:	15.55 in (DOWN HO
GAUGE P	TIME	min	0	1	2	3	4	5			AVERACE FLOW	LUCEON
(BAR)	PLOWMETER	litres	*****	9513	9547	9579	9611	9645			litres/min	C.C.C. SHORN
0.69	TAKE	litres		35.00	34.00	32.00	32.00	34.00			33.40	38.63
GAUGE P	TIME	min	0	1	2	3	4	5			AVERACE FLOW	LUCEON
(BAR)	FLOWMETER	litres	9685	9724	9761	9798	9836	9873			litres/min	-
0.86	TAKE	litres		39.00	37.00	37.00	38.00	37.00			37.60	38.83
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	9913	9955	9998	10043	10087	10132	DATA		litres/min	
1.03	TAKE	litres		42.00	43.00	45.00	44.00	45.00			43.80	40.86
GAUGE P	TIME	min	0	1	2	3	4	5			AVERACE FLOW	LUGEON
(BAR)	FLOWMETER	litres	10190	10234	10274	10315	10356	10398			litres/min	
0.86	TAKE	litres		44.00	40.00	41.00	41.00	42.00			41.60	42.96
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE PLOW	LUGEON
(BAR)	FLOWMETER	litres	10600	10640	10680	10718	10750	10787			litres/min	
0.69	TAKE	litres		40.00	40.00	38.00	32.00	37.00			37.40	43.26
40.0				• 3			42.0					
35.0 - (1930.0 - 1930.0 - 25.0 - 15.0 - 10.0 - 5.0 - 0.0 -			1.0		37.6 37.37.6 3.4		42.0 41.0 39.0 38.0 37.0 36.0					
35.0 - (1) 35.0 - (1) 35.0 - 15.0 - 15.0 - 10.0 - 5.0 - 0.0 - 0.0			1.0 ISSURG (BARS		5	2.0	41.0 39.0 38.0 37.0 36.0			ge Gange Pressure (BA)	0.95	0.69
35.0 - (1930.0 - 1930.0 - 25.0 - 15.0 - 10.0 - 5.0 - 0.0 -				1. 0 =	5 WATER T/		41.0 39.0 39.0 39.0 39.0 30.0	0.89 10 (BAF TEST PRE	Sta 25]	4 1.03 ge Gange Pressure (BA)	0.85	0.60
35.0 - (1) 35.0 - (1) 35.0 - 15.0 - 15.0 - 10.0 - 5.0 - 0.0 - 0.0			ssure (BARS	1. 0 =	5 WATER T/	2.0 2.0 XKE (1/mi XNOTH (m)	41.0 39.0 39.0 39.0 39.0 30.0	10 (BAF	Sta 25]	an Gauge Presence (BA)		
35.0	ATION:		ssure (BARS	1. 0 =	5 WATER T/	2.0 2.0 XKE (1/mi XNOTH (m)	41.0 30.0 38.0 37.0 38.0 X	10 (BAF TEST PRE	Sta 25]	an Gauge Presence (BA)	R)	
35.0	ATION: t LEVEL TION:		ssure (BARS	1. 0 =	5 WATER T/	2.0 2.0 XKE (1/mi XNOTH (m)	41.0 30.0 30.0 30.0 30.0 30.0 30.0 30.0 3	10 (BAF TEST PRE 43.26	Sta 25]	an Gauge Presence (BA)	PERMEABILI	TY, cm/s
35.0	ATION: R LEVEL TION: ATION		ssure (BARS	1. 0 =	5 WATER T/	2.0 2.0 XKE (1/mi XNOTH (m)	41.0 30.0 30.0 30.0 30.0 30.0 30.0 X LUGEONS MAX Lu=	10 (BAF TEST PRE 43.26	Sta 25]	ge Gange Pressure (BAI	PERMEABILI MAX k= [	TY, cm/s 4.3E-04 3.9E-04
35.0	ATION: LEVEL TION: ATION S ATION DW:		R ) LENT PULL	1. 0 =	5 WATER T/	2.0	41.0 30.0 30.0 30.0 30.0 X LUGEONS MAX Lu= MIN Lu=	10 (BAF TEST PRE 43.26 38.63 40.86	Sta 23. SSURE (E	ge Gange Pressure (BAI	R) PERMEABILI MAX k= [ MIN k= [	TY. cm/s 4.3E-04
35.0 - 23.0 - 0.0	ATION: LEVEL TION: ATION S ATION DW:	LUGEO LAMINA TURBUI DILATIC WASH-C VOID FI	R ) LENT P ULING P	1.0 	5 WATER T/	2.0	41.0 30.0 30.0 30.0 30.0 X X LUGEONS MAX Lu= MIN Lu= AVG Lu=	10 (BAF TEST PRE 43.26 38.63 40.86	Sta 23. SSURE (E	ge Gange Pressure (BAI	R) PERMEABILI MAX k= [ MIN k= [	TY, cm/s 4.3E-04 3.9E-04

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SHEET 2	OF 2	]	LUGE	ON T	EST F	IELD	DATA	SHEE	T	Knigh	t Pié	sold
PROJECT:		Forres	t Kerr P	roject		] proj	ECT NO:	138	44/1	DRILLHOLE:	G1	01-C
AREA:				lr	atake Ar	ea				]	TEST NO:	2 (j
DIP:	60	]	DEPTH C	ROUNDW	ATER:	6.7	] m		top of	TEST INTERVAL:		28.04 m (DOWN HOL
	GAUGE HEIGS	T ABOVE	GROUND:			2.0	m		BOTTON	I OF TEST INTERV	AL:	34.10 m (DOWN HOL
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	11220	11281	11336	11391	11445	11490			litres/min	Contraction of the second
0.34	TAKE	litres		61.00	55.00	55.00	54.00	45.00			54.00	79.54
GAUGE P	TIME	min	0	1	2	3	4	5	1.1. P. 100 (201		AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	11572	11635	11699	11763	11827	11892			litres/min	a termination
0.69	TAKE	lkres		63.00	64.00	64.00	64.00	65.00			64.00	71.83
GAUGE P	TIME	min	0	1	2	3	4	5	A Second 1.1		AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	11950	12055	12156	12258	12368	12467	- 1998. - Ar 202		litres/min	
1.03	TAKE	litres		105.00	101.00	102.00	110.00	99.00			103.40	94.26
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	12510	12610	12660	12698	12761	12824			litres/min	
0.69	TAKE	litres		100.00	50.00	38.00	63.00	63.00			62.80	70.49
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	12890	12924	12958	12995	13027	13062			litres/min	
0.34	TAKE	litres		34.00	34.00	37.00	32.00	35.00			34.40	50.67
100.0 - 80.0 - 60.0 - 20.0 - 20.0 - 0.0 -			1.0		82.8	2.0	80.0 70.0 60.0 50.0 40.0 20.0 10.0 0.0	0.34	0.69		0.69	0.34
NTERPRET	ATION		N VALUE		WATER T	AKE (1/mi	x	10 (BAI		afe canfe tressure (pr		
A SHAREL						ENGTH (m	)	TEST PRE				
							LUGEONS				PERMEABU	
							MAX Lu=				MAX k=	9.45-04
TATIC WTI DETERMINA	TION:						MAX Lu= MIN Lu=				MAX k= MIN k=	9.4E-04
ETERMIN/	ATION:											5.1E-04
DETERMINA NTERPRET REFERENCI NTERPRET TPE OF FL	ATION: E: ATION OW:		LENT DN DUT ILLING	YES NO NO NO NO	4		MIN Lu=	50.67 71.92		-	MIN k=	5.1E-04
ETERMINA NTERPRET EFERENCI NTERPRET YPE OF FL	ATION: ATION 5: ATION	TURBU DILATIX WASH-0 VOID F	LENT DN DUT ILLING	NO NO NO	4		MIN Lu= AVG Lu= e: Permeabi	50.67 71.92			MIN k=	5.1E-04
DETERMIN/ NTERPRET EFERENCI NTERPRET. YPE OF FL BRILLING / NOOD test - N	ATION: ATION 5: ATION OW: TEST RESU	TURBU DILATIX WASH-0 VOID F	LENT DN DUT ILLING	NO NO NO		deper	MIN Lu= AVG Lu= e: Permeabi	50.67 71.92			MIN k=	

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	OF 3	]	LUGE	ON T	EST F	TELD	DATA	SHEE	r	Knigh	NSUL	TING
PROJECT:		Forres	t Kerr Pr	roject		PROJ	ECT NO:	138	44/1	DRILLHOLE:	G1	01-Е
AREA:				Tu	nnel Sec	tion					TEST NO:	1
DIP:	90 FROM HORIZONTA	].	DEPTH G	ROUNDV	WATER:	16.7	] <b>m</b>		TOP OF	iest interval:		56.70 m (DOWN HOL
	GAUGE HEIGH	T ABOVE	GROUND:			1.2	m		BOTTOM	OF TEST INTERV	AL:	62.10 m (DOWN HOL
GAUGE P	TIME	min	o	.1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	*****	7703	7704	7706	7707.5	7709			litres/min	N HER COMPANY
2.06	TAKE	litres		1.60	1.70	1.60	1.60	1.60			1.62	0.78
GAUGE P	TIME	min	0	1	2	3	4	5		CHAN STOLEN AND	AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	likres	7712	7716	7720	7724	7727.2	7731			litres/min	ALC: NO BOOM
4.13	TAKE	litres		3.80	3.70	3.70	3.70	3.70			3.72	1.16
GAUGE P	TIME	min	0	1	2	3	4	5	al janezez		AVERAGE FLOW	LUGEON
(BAR)	PLOWMETER	litres	7741	7748	7755	7762	7767.4	7773	14		litres/min	
6.9	TAKE	litres		7.20	6.70	6.60	5.90	5.20			6.32	1.35
GAUGE P	TIME	min	0	1	2	3	4	5	-746.7 (Th	10 CONTRACTOR	AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	7776	7780	7783	7787	7790	7793			litres/min	
4.13	TAKE	litres		3.50	3.60	3.40	3.50	3.40			3.48	1.09
GAUGE P	TIME	min	0	1	2	3	<b>4</b>	5		n de la part d'an	AVERAGE FLOW	LUGEON
man		litres	7796	7798	7800	7802	7804.5	7807			litres/min	Sec. Sec. 18
(BAR) 2,06	PLOWMETER	litres	12.2.5.7.1	2.20	2.30	2.30	2.10	2.20			2.22	1.07
122000				2.20	2.30	2.30	2.10					
122000	TAKE	litres	SUS PRES			2.30	2.10		GE PRES	SURE VERSUS LUG		
2,06	TAKE	litres							GE PRES	SURE VERSUS LUG		
7.0	TAKE	litres			от		L8		GE PRES	SURE VERSUS LUG		
7.0 6.0 - 5.0 - (MIW/N)	TAKE	litres			от				GE PRES	SURE VERSUS LUG		
7.0 6.0 - 5.0 - (MIW/N)	TAKE	litres			от							
7.0 6.0 - 5.0 - (MIW/N)	TAKE	litres			от							
7.0 6.0 5.0 (14.0 9.0 9.0	TAKE	litres			от		L6 L4 L2 L0 sugges L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2		GE PRES			
7.0 8.0 5.0 5.0 9 3.0 1.0 0 0.0	TAKE FLC	litres	SUS PRES	SURE PL	от б.	3	L.6 L.4 L.2 L.0 U.0 U.0 U.0 U.0 U.0 U.0 U.0 U.0 U.0 U	STA			EON VALUE	5 
21,06 7.0 6.0 5.0 5.0 - (muury) 9.3.0 - 2.0 - 1.0 -	TAKE	Lires	SUS PRES	SURE PL	от		L.6 L.4 L.2 L.0 U.0 U.0 U.0 U.0 U.0 U.0 U.0 U.0 U.0 U		4.13	SURE VERSUS LUG	EON VALUE	
2,06	таке  	Litres	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3	L6 L4 L2 L0 0.0 0.0 0.0 0.0 0.0	STA	4.13 Sta	6.9 go Gango Pressue (BA)	EON VALUE	5 
2,06	таке  	Litres	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3 	L6 L4 L2 L0 0.0 0.0 0.0 0.0 0.0	STA	4.13 95a RSJ	6.9 go Gango Pressue (BA)	EON VALUE	5 
2,06	TAKE FLC 2.0 CATION: R LEVEL	Litres	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3 	1.6 1.4 1.2 1.0 0.8 0.4 0.4 0.2 0.0	2.00 10 (BA TEST PR	4.13 95a RSJ	6.9 go Gango Pressue (BA)	EON VALUE	2.06
2,06	TAKE FLC 2.0 CATION: R LEVEL ATION:	Litres	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3 	L.6 L.4 L.4 L.2 L.0 D.0 D.0 D.0 D.4 D.0 D.4 D.0 D.4 D.0 D.4 D.0 D.0 D.4 D.0 D.0 D.0 D.0 D.0 D.0 D.0 D.0 D.0 D.0	2.00 10 (BA TEST PR	4.13 95a RSJ	6.9 go Cango Prosense (BA)	EON VALUE	2.08
2,06	TAKE FLC 2.0 CATION: R LEVEL ATION: CATION	Litres	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3 	L.6 L.4 L.2 L.2 L.2 L.2 L.2 L.2 LU2 LU2 LU2 LU2 LU2 LU2 LU2 LU2 LU2 LU	STA 2.06 10 (BA TEST PR 1.35	4.13 95a RSJ	6.9 go Cango Prosense (BA)	4.13 PERMEABIL MAX k=	2.08
2,06	TAKE FLC FLC 2.0 CATION: R LEVEL ATION: CATION E: CATION	12res	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3 	L.6 L.4 L.2 L.2 L.2 L.2 L.2 L.2 L.2 L.2 L.2 L.2	STA 2.06 10 (BA TEST PR 1.35 0.78	4.13 95a RSJ	6.9 go Cango Prosense (BA)	Alla PERMEABI MAX k= MIN k=	2.08
2,06	TAKE FLC FLC 2.0 CATION: R LEVEL ATION: CATION E: CATION	LAMIN.	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3 3 10.0 2007H (n	L.6 L.4 L.2 L.2 L.2 L.2 L.2 L.2 L.2 L.2 L.2 L.2	STA 2.06 10 (BA TEST PR) 1.35 0.78 1.07	4.13 4.13 Sta RSI ESSURE [E ] ] ion	6.9 go Cango Prosense (BA)	Alla PERMEABI MAX k= MIN k=	2.08
2,06	TAKE FLC FLC 2.0 CATION: R LEVEL ATION: CATION E: CATION	LAMIN.	SUS PRES	SURE PL 3.7 3.5 9 9 9 9 9 9 9 9 9 9 9 9 9	oT 6. 8.0 WATER T	3 3 10.0 2007H (n	L8 L4 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2	STA 2.06 10 (BA TEST PR) 1.35 0.78 1.07	4.13 4.13 Sta RSI ESSURE [E ] ] ion	6.9 go Cango Prosense (BA)	Alla PERMEABI MAX k= MIN k=	2.08
2,06	TAKE FLC FLC 2.0 CATION: R LEVEL ATION: CATION E: CATION	LAMIN, VOID F	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3 3 10.0 2007H (n	L8 L4 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2	STA 2.06 10 (BA TEST PR) 1.35 0.78 1.07	4.13 4.13 Sta RSI ESSURE [E ] ] ion	6.9 go Cango Prosense (BA)	Alla PERMEABI MAX k= MIN k=	2.08
2,06	TAKE FLC FLC 2.0 CATION: R LEVEL ATION: CATION: CATION COW: CATION	LAMIN, VOID F	SUS PRES	SURE PL	oT 6. 8.0 WATER T	3 3 10.0 2007H (n	L8 L4 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2 L2	STA 2.06 10 (BA TEST PR) 1.35 0.78 1.07	4.13 4.13 Sta RSI ESSURE [E ] ] ion	6.9 go Cango Prosense (BA)	Alla PERMEABI MAX k= MIN k=	2.08

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SHEET 2	OF 3	]	LUGI	EON 1	EST I	FIELD	DATA	SHEE	T	Knigh	t Pié	Sold
PROJECT:		Forres	it Kerr P	roject		PRO.	ECT NO:	138 Blank	44/1	DRILLHOLE	GJ	01-Е
AREA:				Tu	nnel Sec	tion		DIBIER		]	TEST NO:	2
DIP:	90	].	DEPTH (	ROUND	WATER:	16.7	] m		top of	TEST INTERVAL:		62.10 m (DOWN HO
	GAUGE HEIGH	IT ABOVE	GROUND:			1.2	m		BOTTON	OF TEST INTERV	AL:	68.30
GAUGE P	· TIME	min	0	1	2	3	4	5			AVERACE FLOW	LUGEON
(BAR)	FLOWMETER	litres	*****	7924	7928	7931	7933.7	7937			litres/min	
2.75	TAKE	liLres		3.40	3.10	3.10	3.10	3.00		÷	3.14	1.12
GAUGE P	TIME	min	0	1	2	3	4	5			AVERACE FLOW	LUCEON
(BAR)	PLOWNETER	litres	7942	7947	7951	7956	7960	7963			litres/min	
5.51	TAKE	litres		4.70	4.50	4.50	4.30	3.30			4.26	0.94
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	7973	7979	7984	7990	7995	8001			litres/min	
7.58	TAKE	litres		5.70	5.30	5.60	5.40	5.50			5.50	0.95
GAUGE P	TIME	edn	0	1	2	3	4	5			WERACE FLOW	LUGEON
(BAR)	FLOWMETER	litres	8005	8009	8013	8016	8019.9	8023			litres/min	
5.51	TAKE	litres		3.90	3.80	3.60	3.60	3.50		and the second second second	3.68	0.81
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	8026	8029	8031	8033	8035.7	8038	ania Sanatan		litres/min	
2.75	TAKE	litres	Too and to	2.50	2.50	2.30	2.40	2.30		e og her som i samt og som	2.40	0.85
4.0			-2.4		1.7 		0.8					
0.0	2.0	4.0 Pres	6.0 sure (BARS)		8.0	10.0	:	2.75	5.51 Staj	7.58 te Gauge Pressure (BAS	5.51 Q	2.75
TERPRET	ATION:	LUGEO	N VALUE		WATER TA		, × ;	10 (BAI TEST PRE	rs) Issure (e	ARS)		
							LUGEONS	1	24		PERMEABIL	ITY, cm/s
	LEVEL	[					MAX Lu= [	1.12			MAX k=	1.1E-05
					-			0.81			MIN k=	0.10.00
ETERMINA		L					MIN Lu=	0.01			MILLY A-	8.1E-06
ETERMINA	ATION						AVG Lu=	0.93			AVG k=	9.3E-06
ETERMINA ITERPRET/ EFERENCE ITERPRET/	ATION :: ATION	LAMINA TURBUI DILATIO WASH-O VOID FI	LENT 1 DN 1 DUT 1	VES NO NO NO NO	4			0.93			ſ	
	ATION :: ATION	TURBUI DILATIC WASH-C VOID FI	LENT I DN I DUT I ILLING N	NO NO NO	4		AVG Lu= [	0.93			ſ	
ETERMINA ITERPRETA EFERENCE ITERPRETA ITERPRETA ITERPRETA ITERPRETA ITERPRETA ITERPRETA ITERPRETA ITERPRETA	ATION ATION DW: TEST RESU	TURBUI DILATIC WASH-C VOID FI	LENT I DN I DUT I ILLING N	NO NO NO	•	deper	AVG Lu= [	0.93			ſ	

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		Forres	t Kerr P	roject		PRO	JECT NO:		44/1	DRILLHOLE:	GT	01-Е
AREA:				Tu	nnel Sec	tion		Blank		1	TEST NO:	<b>.</b>
DIP:	90	].	DEPTH (	ROUNDY	VATER:	16.8	] m		TOP OF	TEST INTERVAL:		68.30 m (DOWN HOI
	GAUGE HEIGE		GROUND:			1.2	m		BOTTON	OF TEST INTERV	AL:	74.40 m (DOWN HOI
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	*****	8166	8169	8172	8175.6	8179.			litres/min	
2.75	TAKE	litres		3.50	3.40	3.40	3.30	3.00			3.32	1.19
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	8186	8192	8196	8200	8204.5	8209			litres/min	CONTRACTOR OF STAT
5.51	TAKE	litres		6.00	4.40	4.00	4.10	4.10			4.52	1,01
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litrea	8219	8229	8239	8249	8259	8269			litres/min	-
8.61	TAKE	litres		9.90	9.90	10.20	10.00	10.00			10.00	1.67
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	8276	8281	8287	8292	8296.8	8302			litres/min	
5.51	TAKE	litres		5.30	5.20	5.20	5.10	5.10			5.18	1.16
GAUGE P	TIME	min	0	1	2	3	4	5			AVERAGE FLOW	LUGEON
(BAR)	FLOWMETER	litres	8305	8307	8310	8312	8314.3	8317			litres/min	
2.75	TAKE	litres		2.40	2.30	2.40	2.40	2.40			2.38	0.86
10.0					/"	0.0	1.6					
10.0 - (utjue/j) 6.0 - 4.0 - 2.0 - 0.0 -	2.0	40	8.0	\$2 4.5	10.0	12.0	1.4 1.2 1.0 0.8 0.8 0.4 0.2 0.0	2.75	5.51	. 821	5.51	2.75
8.0 - (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)		Pres	8.0 BRURE (BAR9	8.0 }	10.0	12.0	1.4 1.2 1.0 0.0 0.4 0.2 0.0	2.75	Sta	. 8.61 ge Gango Pressure DAR	5.31	2.75
8.0 - (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)		Pres	8.0	8.0	10.0 WATER TJ	12.0 AKE ()/mi	1.4 1.2 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0	10 (BAJ	Sta	e Gauge Pressure (BAR IARS)	0	
8.0 - (9) (1) (2) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	ATION:	Pres	8.0 BRURE (BAR9	8.0	10.0 WATER TJ	12.0 AKE ()/mi	1.4 1.2 1.0 0.8 0.4 0.2 0.0 0.0 0.0	10 (BAJ TEST PRE	Sta RS)	(e Gauge Pressure (BAR IARS)	PERMEABILI	TY, cm/s
8.0 - (urput/y) 6.0 - 4.0 - 2.0 - 0.0 -	ATION:	Pres	8.0 BRURE (BAR9	8.0	10.0 WATER TJ	12.0 AKE ()/mi	1.4 1.2 1.0 3.0.8 0.4 0.2 0.0 X 1.0 0.4 0.2 0.0 X 1.0 0.4 0.2 0.0 X 1.0 0.4 0.2 0.0 X 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	10 (BAJ TEST PRE	Sta RS)	(e Gaago Prossure (BAR	PERMEABILI MAX k= [	TY, cm/s 1.6E-05
8.0 (1) (2) (4) (4) (4) (4) (4) (4) (4) (4	ATION: R LEVEL TION:	Pres	8.0 BRURE (BAR9	8.0	10.0 WATER TJ	12.0 AKE ()/mi	1.4 1.2 1.0 0.8 0.4 0.2 0.0 0.0 0.0	10 (BAJ TEST PRE	Sta RS)	(e Gaago Prossure (BAR	PERMEABILI	TY, cm/s
8.0	ATION: R LEVEL ATION:	Pres	8.0 BRURE (BAR9	8.0	10.0 WATER TJ	12.0 AKE ()/mi	1.4 1.2 1.0 3.0.8 0.4 0.2 0.0 X 1.0 0.4 0.2 0.0 X 1.0 0.4 0.2 0.0 X 1.0 0.4 0.2 0.0 X 1.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	10 (BAJ TEST PRE	Sta RS)	(e Gange Pressure (RAR	PERMEABILI MAX k= [	TY, cm/s 1.6E-05
4.0 - 2.0 - 0.0 0.0 - TATIC WTF ETERMINA VTERPRET/	ATION: R LEVEL TION: ATION 5: ATION	LUGEO	A B.O BARS NVALUE	8.0	10.0 WATER TJ	12.0 AKE (//ml ENOTH (m	1.4 1.2 1.0 5.8 0.9 0.4 0.2 0.0 X UQEONS MAX Lu= [ MIN Lu= [	10 (BAJ TEST PRE 1.57 0.86 1.14	5424 25) 25SURE (E	(e Gange Pressure (RAR	9 PERMEABILI MAX k= [ MIN k= [	TY, cm/s 1.6E-05 8.6E-06

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Knight Piésold

### APPENDIX C

DRILL CORE PHOTOGRAPHS





PHOTO 1 - GT01-A Box 1 to 3



PHOTO 2 - GT01-A Box 4 to 6

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

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PHOTO 3 - GT01-B Box 1 to 3



PHOTO 4 - GT01-B Box 4 to 6

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PHOTO 5 - GT01-B Box 7 to 8

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT



PHOTO 6 - GT01-C Box 1 to 3



PHOTO 7 - GT01-C Box 4 to 6

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

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PHOTO 8 - GT01-C Box 7 to 9

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT



PHOTO 9 - GT01-D Box 1 to 3

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

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PHOTO 10 - GT01-E Box 1 to 3



PHOTO 11 - GT01-E Box 4 to 6

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PHOTO 13 - GT01-E Box 10 to 12

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

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Knight Piésold



PHOTO 14 - GT01-E Box 13 to 15



PHOTO 15 - GT01-E Box 15 to 17

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

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### APPENDIX D

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### FALLING HEAD PERMEABILITY TEST RESULTS



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Screen Length 3.1 m Screen Inner Diameter 0.095 m









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Knight Piésold

## <u>APPENDIX E</u>

### CONSTRUCTION DETAILS OF PIEZOMETERS



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Knight Piésold

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# APPENDIX F

# LABORATORY ROCK STRENGTH TEST RESULTS AND PHOTOGRAPHS

Knight Piésold PROJECT # 012-1323 BOREHOLE DH-B-1 DEPTH 54 - 55.5 ft PHOTO 1 - GT01-B-1 Photo before testing. PROJECT # 012-1323 BOREHOLE DH-B-1 DEPTH 54 - 55.5 ft PHOTO 2 - GT01-B-1 Photo after testing. COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

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ght Piésold				
		PROJECT # 012-1323 BOREHOLE DH-C-1 DEPTH 72 - 72.7 ft		
		100 - 4000 100 2 - 5 - 6 2 - 7		
РНОТО 5 –	GT01-C-1	Photo before testing.		
	· •	PROJECT # 012-1323 BOREHOLE DH-C-1 DEPTH 72 - 72.7 ft	-	

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

 Knight Piésold

 Consulting

 PROJECT # 012-1323

 BOREHOLE DH-C-2

 DEPTH

 82-83 ft



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 PROJECT #
 012-1323

 BOREHOLE
 DH-C-2

 DEPTH
 82 - 83 ft

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PHOTO 8 - GT01-C-2 - Photo after testing.

COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

M:\13844\1\Photos\UCS photos\AppF photos\_r0.doc Rev'd : 10/17/00 Print : 10/18/01 3:43 PM Knight Piésold PROJECT # 012-1323 BOREHOLE DH-E DEPTH 218 - 219 ft PHOTO 9 - GT01-E-1 Photo before testing. PROJECT # 012-1323 BOREHOLE DH-E DEPTH 218 - 219 ft 1. PHOTO 10 - GT01-E-1 Photo after testing. COAST MOUNTAIN HYDRO CORPORATION FORREST KERR HYDROELECTRIC PROJECT

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	]	Unco	onfined	t Comp	ressive	Streng	th of Ir	itact Ro	ck C	ore Sp	ecim	ens .	ASTM	D-2938-95		
Project #	012-1323	<u>;</u>	· · ··	Comores	sion Frame	A Calibratic	i	<u>+</u> ∼-~-	┢━━	┝─	<u> </u>				<u>!</u>	!
Project :	File# 1384	4/1.03	╋ <b>╌</b> ┈╼┈╼	Compression Frame Calibration : Ram - A 25 Ton Ram Area = 32.26 c				╞───-	┨	·	Туре	Failure Mode	<u> </u>	1		
Client:	Knight Pies	sold Lid.	·   · · ·	Ram - B 150 Ton Ram Area = 217.36 jcr			{	∮	<b> </b>	<u> </u>	(1)	Single diagonal shear plan	<u>ie</u>	<u> </u>		
Location:	Bumaby	1	!	╉╵╧╼═				<u></u> -	<u> </u>	<u> </u>	<u> </u>	(2)	Multi-vertical fracture		÷	
Tech:	88	r	†	Nole	(៧ទច) កាម	asured from	COTP AVIS	┿───	·	<u>}</u>	{		(3)	Vertical splitting		
Sch#	222		1	+	1	1	1	· [ ·]	{	┠		<u> </u>	(4)	Shear along Ioliation or joi	<u>nl</u>	Ļ
	1		i	Ţ	- <u></u>	+	÷	<u>}</u>	<u> </u>	ł			(5)	Conicat	┢	· .
			· · · ·				l	Wet	<u> </u>	Dry	[	Gauge	Stress	·	┿╍╍╼	<u></u>
Borehale	Sample	Deplh	Dia	Hi	A	V	Mass	Density	W	Density i	Ram	Reading	C	Rock Type	Failure i	
		(/i)	(c/n)	(cm)	(cm²)	(cm <sup>3</sup> )	(g)	(Kg/M <sup>3</sup> )	(%)	(Kg/M <sup>2</sup> )		(MPa)	(MPa)	HOLK TYPE	Type	(deg
								1	( (	1.1.1.1			(111) 43		1 1905	1 1069
OH B 1	1	54 - 55.5	6.09	12.88	29,13	375.3	1055.9	2814	0.3	i 2806	B	16.26	121.3	Basall	2	╂╼──
0H-8-2	i			<u> </u>	ļ.,			Γ	┥╼ <u>──</u> ──			↓			<u> </u>	<u>+</u> −
UH-B-2	2	87 - 68	6.09	12 72	29.15	370.9	1057.0	2850	0.2	2845	ß	18.00	140.2	Basall	5	
DH-C-I	3	72 - 72 7	6.08	13.49	28.99		ļ		<u> </u>			}			<u></u>	<b> </b>
		12 121	0.00	13.49	20.99	391.0	1109.4	2837	0,5	2823	8	20.43	153,2	Basall	5	
OH-C-2	_4	82 - 83	6.08	12.35	28.99	357,9	1000.5	2795	0.7	2776	B	16.02	120.1		l	<u>[</u>
					<u>†</u> <sup>-</sup>					- 6//0		10.02	120.1	Basell	5	<b>↓</b>
DH-E	5	218.219	6.35	12.85	31.62	406 3	1124.2	2767	02	2762	B	7.37	50.7	Greenstone	2.4	<u>}</u>
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	Coast Mountain I #8 - 3471 Regina Richmond, B.C. V6X 2K8					
	INVOICE # 296 Drill "E"	Re: isku B-15				10/15/01
	Date	ltem	Mater	rials	Services-NOFC	Services-OFC
	20-Sep	0.5 Day Pad Building	? platforms?			150.00
	21-Sep	3 Days Pad Building	Shine and a second s			900.00
		12.5 hrs Moving @ \$45/	nr			562,50
		4 hrs Hiab Rental @	\$80/hr		320,00	
	22-Sep	49.5 hrs Moving @ \$45/				2,227.50
		800 litres Fuel		0.00		
	23-Sep	1 3-Ring HW Casing		0.00		
•		6 hrs OFC - Waterlin				900.00
		3 hrs Moving @ \$45/	רר			135.00
		1 Day Pad Building				300.00
		480 litres Fuel		0,00		
	24-Sep	2 hrs OFC - Waterlin				300.00
		3 hrs Moving @ \$45/	Jr			135.00
•		1 Day Pad Building				300.00
	25-Sep	1 hr OFC - Waterline				150.00
		1 Day Pad Building				300.00
•		2 hrs OFC - Reaming	and Washing			300.00
		3 hrs Packer Testing				450.00
		1 hr Standby			100.00	
	26-Sep	1 hr OFC - Waterline				150.00
		3.5 hrs OFC - Set Up a	nd Moving			525.00
		1 Day Pad Building				300.00
		1 hr Reaming				150.00
		1.5 hrs Packer Testing			500.00	225.00

5 hrs Standby

0.5 hr OFC - Waterline

1 Day Pad Building

3.5 hrs Packer Testing

1 hr Standby

2 hrs OFC - Reaming and Lost Circ.

27-Sep

75.00 300.00

300.00

525.00

500.00

100.00

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Date	ltem	Materials	Services-NOFC	Services-OFC
	38.5 Man Days R & B @ \$50/day		1925.00	
	<ol> <li>Drill Move 58 KM to 33 KM by Bandstra</li> </ol>		183.18	
	1 Hiab Truck Rental to Move Equip Split Charges with Hy-Tech		942.81	
	1 Bandstra Shipping Charge Knight Piesold - 1 Skid / 2 Tubes		170.33	
	1 Air Canada Charge for Shipping Water Samples to ASL		51.45	
25-Sep	74.37 m Hole DHE @ \$90.00		6693.30	7 15 12 0
27-Sep 28-Sep	24.08 m Hole DHA @ \$90.00 37.19 m Hole C @ \$90.00		2167.20 3347.10	4 115 10
20-0ep 29-Sep	31.09 m Hole B @ \$90.00		. 195.10	• •
29-Sep	17.07 m Hole A @ \$90.00		136 30	
	SUBTOTAL MATERIALS PLUS 15%	<b>8,407.93</b> 1,261.19		
	SUBTOTAL SERVICES-OFC	18,545.00	<b>•</b> ••	
	PLUS 15%	2,481.75		
	SUBTOTAL SERVICES-NOFC CHARGE FOR HOLES	4,292.77 16,542.00		
	SUBTOTAL GST	49,53 <u>0.64</u> 3,467.14	>	
<del></del>		N	<u> </u>	
	TOTAL OF INVOICE	\$52,997.78		(A)
	Less Payment ( Inv. 286 ) Less 2nd Advance	25,000.00 20,000.00	,	
	Balance O/S	\$7,897.78	3)	
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Knight Piésold

INVOICE 9192A ( REVISED)

Coast Mountain Hydro Corp. #8 - 3471 Regina Avenue Richmond, BC V6X 2K8

# Knight Piésold Ltd.

Suite 1400 750 West Pender Street Vancouver, British Columbia Canada V6C 278

Telephone: (604) 685-0543 Facsimile: (604) 685-0147 E-mail: kpl@knightpiesold.com

Our Reference: Number:

> K13844/1 .19 September 30, 2001

Attn:Mr. Neil BrazierCopy :Accounts Payable

Re: Coast Mountain Hydro Corp.

For Professional Services provided for the period

September 1, 2001 to September 30, 2001

### A. TIME CHARGES

R. Kostaschuk	5.25	Hrs @ \$ 105.00	551.25	
I. Manning	17.50	Hrs @ \$ 88.00	1,540.00	
J. Kinch	3.00	Hrs @ \$ 88.00	264.00	
R. Dale	156.00	Hrs @ \$ 88.00	13,728.00	
D. Ma	62,25	Hrs @ \$ 75.00	4,668.75	
	244.00	-	20,752.00	20,752.00



Detailed Time Sheets and Back up for Reimbursable expenses available on request Payment due within 30 days of invoice date. Interest will be charged on overdue accounts at 1 5% per mon

Knight Piésold

- 2 -

Brought forward

20,752.00

2,826.10

1,650.47

25,228.57

\$ 26,472.35

978.84

#### В. **REIMBURSABLE EXPENSES**

CIBC Aerogold (Travel)	1,652.00
Fax	6.00
Long Distance - Telephone & Fax	5.93
Xerox and Lazer Printing	15.40

1,679.33 +10%167.93

Site Staff Expenses

GST (Registration #R102864493)

# TOTAL AMOUNT (Canadian \$)

America Nul Ba X 12 43. 78 oudi I have asked them to deduc over payment from final musice (see Dem Brux's En armit)

Knight Piésold

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Brought Forward		20,752.00
B. REIMBURSABLE EXPENSES		
CIBC Aerogold Fax Knight Piesold Long Distance - Telephone & Fax Xerox and Laser Printing	1,652.00 6.00 1,946.58 5.93 15.40	
+10%	3,625.91 362.59	3,988.51
GST (Registration# R102864493)	· · ·	24,740.51 1,731.84
TOTAL AMOUNT (Canadian \$)		\$26,472.35
Cheque 01 Oct 25/0 Dulling/ Fwa	03 1 1 6 1 7	

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Detailed Time Sheets and Back up for Reimbursable expenses available on request Payment due within 30 days of invoice date. Interest will be charged on overdue accounts at 1.5% per mon

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Knight Piésold

Brought Forward

## **B. REIMBURSABLE EXPENSES**

CIBC Acrogold	1,652.00	
Fax	6.00	
Knight Piesold	1,946.58	
Long Distance - Telephone & Fax	5.93 🖌	
Xerox and Laser Printing	15.40 🗸	
	3,625.91	
+10%	362.59	3,988.51

GST (Registration# R102864493)

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24,740.51 1,731.84



Detailed Time Sheets and Back up for Reimbursable expenses available on request Payment due within 30 days of invoice date. Interest will be charged on overdue accounts at 1.5% per mon-