



Geotechnical Engineering Report Highway 93S – Kootenay Parkway

Report Prepared for
Parks Canada Agency

March 2016



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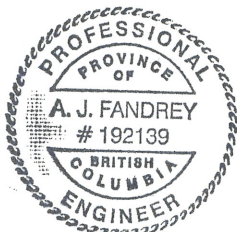
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Certifications

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the Province of British Columbia.



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March 21, 2016

Date

1.0 Introduction

Barr Engineering and Environmental Science Canada Ltd. (Barr) under authorization and contract with Parks Canada Agency (PCA) completed a geotechnical investigation to support the design of Highway 93S (Kootenay Parkway) roadway improvements.

This report describes the geotechnical investigation, summarizes the laboratory analysis of soil samples and provides recommendations for road improvement design and construction.

1.1 Proposed Construction

Highway 93S stationing starts at Trans-Canada Highway and ends at Radium Hot Springs (a total of 104 km). The northerly 10 km are in Alberta and the balance of Highway 93S is in British Columbia. The proposed improvements primarily involve widening the road by adding climbing lanes, passing lanes, and turn lanes. These improvements will likely occur during the next 5 years. The first scheduled improvements are likely to be completed during 2016.

1.2 Information Provided

Barr was provided with the following documents:

- Kootenay Parkway, Highway 93S Large Crack Investigation 10 year Maintenance and Rehabilitation Plan. John Emery Geotechnical Engineering Limited Consulting Engineers for Public Works and Government Services Canada. Preliminary Report, March 10, 2008.
- Pavement Management Update Western National Parks 2009. Dr. D.R. MacLeod, P.Eng. for Parks Canada. 2009.
- West and North National Parks Pavement Management Update 2012. McElhanney Consulting Services Ltd. for Parks Canada. March 27, 2014.
- Inspection of High Priority Rock and Soil Slopes Kootenay National Park Highway 93S. EBA Engineering Consultants for Parks Canada. November 2007.
- Re-Inspection of High Priority Rock Cut and Soil Slopes Highway 93S – Kootenay National Park. EBA Engineering Consultants for Parks Canada. March 2012.
- Prioritization of Rock Slope Remedial Work for 2014 and Five Year On-going Plan. EBA Engineering Consultants for Parks Canada. December 2013.
- Electronic GIS Data (topography and aerial photography) from Parks Canada

1.3 Scope of Services

The Barr scope of services for this investigation was: 1) conduct a field investigation; 2) perform laboratory testing on selected soils samples obtained during the field investigation; and 3) provide geotechnical recommendations for the pavement, base coarse and subgrade design and construction.

1.4 Report Organization

The balance of this report is organized as follows:

Section 2: Field Investigation

Section 3: Sample Laboratory Testing

Section 4: Design Recommendations

Section 5: Construction Recommendations

2.0 Field Investigation

The field investigation consisted of solid-stem auger (SSA) borings at 44 locations (see [Figure 1](#)). The field investigation was completed during December 10 - 17, 2015.

2.1 Regional Geology

Kootenay National Park extends for more than 95 kilometers parallel to the northwest-southeast trending Rocky Mountains, and along its width from the divide leading to the Bow River valley on the northeast and to the Columbia River on the southwest. The bedrock geology consists mainly of sedimentary rocks laid down as sediments by seas that covered this area. The shallow bedrock belonging to Harrogate Formation mainly consists of limestone and quartzite (Baird, 1964), followed by Brisco/Beaverfoot Formation that generally consists of dolomite and limestones.

2.2 Field Work

2.2.1 Soil Boring Locations

The boring locations and depths were defined by the design team (Barr geotechnical engineers in consultation with McElhanney engineers). These locations were selected primarily because they were within or immediately adjacent to the footprint of the road widening.

Initially 49 borings were proposed, but 5 proposed borings were deleted. Four (4) borings were deleted because they were to be located in an avalanche zone. Another boring was deleted because it was too close to underground utility lines. All borings were on or within 10 m of the highway shoulder. The boring locations were staked by Barr personnel on December 2, 2015. The final boring locations are shown in accompanying Figure 1 whereas the GPS coordinates of the borings are provided in Table 1.

2.2.2 Borings

The soil borings were performed between December 10, 2015, and December 17, 2015, by Earth Drilling Co. Ltd (Earth Drilling) of Calgary, AB using solid-stem auger (SSA) drilling techniques. The driller utilized both a track-mounted and a truck-mounted drill rigs. The borings were performed in accordance with ASTM Test Method D 1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils". The borings were advanced to a maximum depth of 5.54 m and were backfilled using bentonite chips and excavated soil.

The borehole locations are present in [Table 1](#). [Figure 1](#) shows the locations of the soil borings. Copies of the soil boring logs are included in [Appendix A](#) of this report.

A total of 44 boreholes were advanced at the identified locations at depths up to 5.54 m to identify existing near-surface soil stratigraphy and geotechnical properties of the area. A total of 23 boreholes were drilled immediately adjacent to the shoulder of the existing highway. The remaining 21 boreholes were within 10 m of the shoulder.

2.2.3 Boring Logs

Barr personnel were present at the site to observe and coordinate the drilling operations. Materials encountered in the borings were visually and manually classified in accordance with ASTM Test Method D 2488. A chart explaining the classification system is included in [Appendix B](#).

Boring logs were prepared to accompany the discussion of subsurface conditions at the site and are included in [Appendix A](#). The logs describe the materials encountered in the soil borings, present the soil classifications, present the results of field and laboratory tests, and present groundwater measurements.

2.2.4 Standard Penetration Testing and Sampling

Standard penetration tests (SPTs) were performed as the soil borings were advanced. SPTs were completed at 0.76 m intervals to a depth of 4.6 m below grade and then at 1.5 m intervals to the termination depths of the borings. Penetration resistances, measured in blows-per-30 cm (blows per foot, bpf), provide an empirical means of estimating the soil relative density, consistency, and strength.

Blow counts necessary to advance the sampler 30 cm (1 foot; N-values) were recorded in the field and are included on the boring logs (available in [Appendix A](#)). Sampler advancement was stopped if 50 blows were achieved for minimal penetration (less than 15 cm), typically indicating the presence of hard material especially large gravel and/or bedrock. Results of the standard penetration tests (SPTs) are summarized in [Table 2](#).

The samples were removed from the sampler, logged and sealed in the field by Barr personnel and transported to the laboratory.

2.3 Site Soils

In general, the soil borings indicated asphalt or topsoil at the surface underlain by fill material underlain by silty and clayey glacial till soils. These materials are described below.

2.3.1 Topsoil

Topsoil was encountered in 8 of the 44 boreholes. The topsoil ranged in thickness from 0.05 m to 0.25 m.

2.3.2 Asphalt

Asphalt was encountered in 25 boreholes. The (shoulder) asphalt ranged in thickness from 0.1 m to 0.3 m at the borehole locations.

2.3.3 Existing Fill

Fill was encountered in 15 of the boreholes, below topsoil or asphalt. The encountered fill was mostly fine-grained sand and gravel. The fill was typically moist and brown in color.

2.3.4 Lean Clay

Lean clay soils were encountered in 27 boreholes. The thickness of lean clay ranged from a minimum of 0.6 m to a maximum of 4.5 m. The samples consisted of light to dark brown to black clay with trace to some sand and gravel.

The SPT N-values for the lean clays ranged from 24 to 92 blows/30 cm, with an average of 36 blows/30 cm indicating stiff to hard clay. Lower SPT values were attributed to variations in moisture content in the shallow soils.

Unconfined compressive strength from the pocket penetrometer values for the lean clay ranged from 24 kPa to 215 kPa, with an average of 120 kPa, indicating stiff to very stiff clay.

2.3.5 Silts

Some low to non-plastic silts and silty clays were encountered in 4 borings (BBH17, BBH18, BBH19, and BBH20). Laboratory testing also identified possible silts and silty clays in an additional 4 borings (BBH23, BBH31, BBH35, and BBH41). The thickness of the silts ranged from a minimum of 1 m to a maximum of 3 m. The samples consisted of olive to light brown silts and silty clays with trace to some sand and gravel.

The SPT N-values for the silts ranged from 7 to 55 blows/30 cm, with an average of 26 blows/30 cm indicating stiff to very stiff silts. Lower SPT values were attributed to variations in moisture content in the shallow soils.

Unconfined compressive strength from the pocket penetrometer values for the silts ranged from 29 kPa to 215 kPa, with an average of 115 kPa indicating stiff to very stiff silts.

2.3.6 Sand

Sand was encountered in 13 of the boreholes. The thickness of ranged from a minimum of 1 m to a maximum of 3 m. The samples consisted of brown to grey silty to clayey sands with trace to some gravel.

The SPT N-values ranged from 7 to >100 blows/30 cm, with an average of 54 blows/30 cm indicating dense to very dense sand.

Unconfined compressive strength from the pocket penetrometer values for the sand ranged from 72 kPa to 215 kPa, with an average of 85 kPa indicating dense to very dense sand.

2.3.7 Gravel

Clayey and silty gravel was encountered in all the boreholes. The thickness ranged from a minimum of 1 m to a maximum of 5 m. The samples consisted of grey to brown silty to clayey gravel with sand.

The SPT N-values ranged from 18 to 105 blows/30 cm, with an average of 48 blows/30 cm indicating dense to very dense material.

Unconfined compressive strength from the pocket penetrometer values for the gravels was 215 kPa or greater.

2.4 Groundwater

Groundwater was observed in some boreholes. The drillers checked for groundwater as the borings were advanced and again after auger withdrawal and before the boreholes were backfilled. Groundwater was observed in 6 of the 44 borings. The groundwater level data are provide in [Table 1](#).

3.0 Sample Laboratory Testing

A program of general laboratory testing, consisting of moisture content, Atterberg limits, grain size analysis, standard Proctor density, pH, chloride content, soluble sulphate content and California Bearing Ratio (CBR) was completed on selected samples collected from the soil borings. All of the laboratory testing was performed by Clifton Associates of Calgary, AB in January 2016. The results of the laboratory tests can be found in [Appendix B](#). Samples were selected for testing by Barr Engineering.

3.1 Soil Testing

The following tests were performed:

- Moisture content tests in accordance with ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass"
- Atterberg limit determinations in accordance with ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
- Sieve and hydrometer particle size analysis in accordance with ASTM D422, "Standard Test Method for Particle-Size Analysis of Soils"
- Standard Proctor density tests in accordance with ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))"
- California Bearing Ratio tests in accordance with ASTM D1883-14, "Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils"
- Soil pH according to ASTM D4972, "Standard Test Method for pH of Soils"
- Soluble chloride and soluble sulphate of soils in accordance with EPA Method 9056 "Determination of Inorganic Anions by Ion Chromatography"
- Organic content test in accordance with ASTM D2974 "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils".

All laboratory test results are provided in [Appendix B](#).

3.2 Laboratory Test Results

Laboratory test results are summarized in [Tables 2-4](#) and included in [Appendix B](#).

3.2.1 Moisture Content Testing

A total of 108 moisture content tests were performed. The soils tested included lean clays, silts, sands, and gravels. The test results indicate moisture contents ranging from 2.3 to 53.2 percent. These results indicate

the soils on site are generally in a moist to wet condition, and are likely highly influenced by weather conditions.

3.2.2 Atterberg Limits Testing

A total of 16 Atterberg limits test were conducted on selected lean clay silt, and silty sand samples. The results of the tests indicate that the samples exhibited liquid limits between 21.0 and 41.0 percent, plastic limits between 14.0 and 28.0 percent, and plasticity indices between -1.0 and 16.0 percent.

3.2.3 Particle Size Analysis

A total of 16 grain size analysis tests were performed on clay, sand, and gravel samples. The average percent fines (percent by weight passing the number 200 sieve) ranged from 10.8 to 98.8 percent. Full gradation test results are included in [Appendix B](#).

3.2.4 Moisture-Density Relationship

Five moisture-density relationship tests, as part of CBR tests, were performed. The average maximum dry density from the standard Proctor test was 1920 kg/m³ with an average optimum moisture content of 15.2 percent.

3.2.5 California Bearing Ratio

California Bearing Ratio tests were conducted on ten samples selected because of their location and soil type. Results ranged from 1.3 to 20.8 at 95% maximum Proctor density with 80 percent of the values being greater than 7.5. The summary of CBR results is presented in [Table 3](#).

3.2.6 Chemical Testing

Two samples were tested for chemical content (chloride and sulphate) and pH and one test was conducted to determine organic content. Soil pH ranged from 7.8 to 8.2, chloride content from 193 to 234 mg/L and sulphate from 46 to 102 mg/L. The organic content of the sample tested was 12 percent. Chemical test results are presented in Table 4.

4.0 Design Recommendations

Results of the field and laboratory investigation have been presented earlier in this report. Based on these results, [Section 4](#) provides the design recommendations for the highway. These recommendations are based on the use of typical roadway construction materials, methods and sequences and assumes that the construction will be observed by geotechnical engineers or technicians.

4.1 Pavement Structure Design

[Figure 2](#) shows the recommended minimum pavement structure for the Highway 93S improvements. This design is based on:

- Recommendations and guidelines in “Pavement Structure Design Guidelines” (Technical Circular T-01/15; British Columbia Ministry of Transportation and Infrastructure; January 2015).
- 2015 traffic data and 2035 traffic projections (from McElhanney)
- The historic road condition surveys, which are identified in Section 1.2 of this report
- This geotechnical investigation
- Barr’s roadway assessment based on our October 2015 – January 2016 field work.

The design 20-year Equivalent Single Axle Load (ESAL) for this project is 6.9 million. This was computed based on the provided traffic data and the BC design guidelines (referenced above).

This design is based on a CBR of 4.1, which was selected based on a review of the soils, CBR test results and the likely frequency of poor soils being under the roadway improvements. A Resilient Modulus of 41.55 MPa was estimated by multiplying the CBR by 10.3, per Association of American State Highway and Transportation (AASHTO) guidelines. The pavement system Structural Number of 129mm (5.06 inches) was computed per BC guidelines (referenced above). The BC minimum pavement section meets this Structural Number design value and is the recommended minimum for the design of new pavements.

For existing pavements, the existing in-place Structural Number with the addition of a minimum overlay (to improve the driving surface) exceeds the BC minimum. For these existing pavements it is recommended that prior to the overlay, the existing pavement be either: 1) repaired by crack sealing and patching; or 2) rehabilitated by pulverizing, re-shaping and compacting. [Figure 2](#) shows the rehabilitation option.

4.2 Subgrade Preparation

4.2.1 Anticipated Subgrade

Based on the results of the soil borings, the subgrade soils will generally be sand and gravel, although there will be lean clay and silty clay in a relatively few areas. Based on historic investigations (see [Section 1.2](#)) and this investigation poor subgrade and/or poor pavement structure should be anticipated at the following stations:

0+050, 2+300, 3+100, 4+400, 7+200, 11+650, 12+750, 13+350, 16+900, 17+650, 24+300, 26+000, 26+500, 26+800, 31+000, 40+700, 41+950, 48+100, 53+700, 75+200, 76+300, 76+350, 80+700, 82+900, 86+200, 86+800, 91+500, 92+550, 93+700, 95+000, 96+100, 98+000, 99+700, 101+450, 102+100 and 103+150

4.2.2 Subgrade

It is recommended that all organic matter (e.g. roots), topsoil and existing non-engineered fill be removed from areas where new road will be constructed or existing road widened. The removal of this material should be oversized a minimum of 1 m beyond the roadway embankment toe.

The resulting exposed subgrade should be scarified and moisture conditioned to within 2 percent of optimum moisture and re-compacted to a minimum of 95 percent of the Standard Proctor maximum dry density (ASTM D698), except the top 300 mm of subgrade should be compacted to a minimum of 100% of Standard Proctor Density.

4.2.3 Proof-roll

It is recommended that at least the first lift of pavement subgrade and base be proof-rolled with a heavy vehicle in the presence of a geotechnical engineer. The proof-roll will help detect areas of loose or soft subgrade materials that require additional compactive effort or removal and replacement with compacted backfill.

4.2.4 Fill Recommendation

Where fill is required to raise subgrade, it is recommended that it consist of a granular soil with no more than 10 percent passing the number 200 sieve. Fill should be compacted to a minimum of 95 percent of the Standard Proctor maximum dry density, except for the upper 300 mm which should be compacted to a minimum of 100 percent of the Standard Proctor maximum dry density.

4.3 Settlement

Based on anticipated fills of 6 m, it is estimated that the total settlement will be no greater than 200 mm. the maximum estimated differential settlement for a maximum compacted fill thickness of 6 m is anticipated to be 100 mm. The degree of settlement is directly dependent on the quality of construction, as well as adherence to the recommendations of this report.

4.4 Groundwater

Groundwater levels of concern were not found during this investigation and are not anticipated. However, if groundwater levels within about 1.5 m of the ground surface are encountered during construction, a geotechnical engineer should be consulted, as groundwater can have a significant impact on road performance and life.

4.5 Utilities

The utilities along the highway will likely be placed in either native soils or fill material. These soils should generally be suitable for support of underground utilities. Within the zone of frost-heave susceptible soils (up to 3 m below the existing ground surface), insulation may be required. Soils from trench excavations may be used as backfill, provided they are free of debris.

Underground utilities installed in the native soils on site may be designed according to conventional utility line design but with a special precaution for frost heave. However, where utilities are to be installed in fill, the geotechnical engineer should be notified to review the utility requirement. In general, for all utilities to be installed in fill, provisions should be made to protect buried utilities from potential damage due to any potential future differential settlement.

4.6 Drainage

Collecting surface runoff and discharging it away from the road foundations and grading to promote positive runoff away from the foundations are two common and recommended methods for reducing groundwater in the roadway. At least 0.3 m of topsoil, clay, or an exterior slope should be sloped away from the building at grade to prevent direct infiltration of water into the soils behind the highway foundation.

It is recommended that the site be graded to promote positive runoff away from the highway. Landscape areas should be sloped away at 20H:1V or steeper. At least 300 mm of topsoil or clay is recommended for use to reduce infiltration into the pavement structure.

4.7 Frost Depth

As per the Canadian Foundation Engineering Manual (CFEM), the frost depth at the site is estimated to be 2.0 m.

4.8 Soil Chemical Content

Soluble sulphate concentrations were measured as less than 0.03%. These results indicate the potential degree of a sulphate attack on the concrete as “negligible” per CSA guidelines, and therefore site soils are compatible with concrete structures.

Imported fill to be placed in contact with concrete, should be tested during project design for water-soluble sulphate content to determine its suitability for use as a backfill or foundation for concrete structures.

5.0 Construction Recommendations

5.1 Subgrade Preparation

5.1.1 Excavations

Based on the results of the borings completed as part of this geotechnical investigation, and the anticipated design, excavation may not be required.

If excavation is required, competent native soils suitable for support of the proposed construction will likely be found between 1 m and 3 m below the ground surface. A geotechnical engineer should be present during excavation to observe and document that all excavations are extended to sufficient depths such that all unsuitable material is removed.

Depending on construction conditions, excavations may have to be extended locally to remove wet, loose, soft or otherwise unstable soils that become disturbed during the excavation process and lose strength.

To provide lateral support to replacement backfill the excavations should be adequately oversized. It is recommended that the excavations be oversized at least 1 m horizontally beyond the roadway perimeter.

5.1.2 Groundwater Control

Groundwater levels in the vicinity of the project site are approximately between 1.8 m and 3.0 m below the existing ground surface. Considering the groundwater levels and soil types encountered across the site, it is not expected that groundwater will be encountered at shallow depths (less than 1.5m). Groundwater levels fluctuate over time, and higher or lower groundwater levels may be experienced during construction and during the life of the road.

If groundwater levels are encountered at shallower depths (less than 1.5m), a geotechnical engineer should be consulted as high groundwater levels can significantly impact road performance.

Dewatering may be required for the construction in some project areas. In low permeability soils (clays and silts), a system of sloped trenches and sump pits likely will be adequate to dewater shallow excavations on the site. Excavations into more permeable soils (sands and gravel) and below the water table, will likely require more comprehensive dewatering methods. However, the project's shallow excavations in sand and gravel will not likely require a greater dewatering effort than described above.

The impermeable nature of the project silty and clay soils will limit water outflow from fills at elevations below these low permeability soils. In this scenario, dewatering can be achieved by the use of drains along the perimeter of these fills. This dewatering maybe required if the fill construction has not yet been compacted to the project minimums.

5.1.3 Subgrade Construction

Following the removal of unsuitable materials (see Section 4.2), the excavation bottom should be proof-rolled with a fully loaded tandem axle dump truck having a minimum gross weight of 25 tons. Proof-

rolling will aid in identifying areas of unstable subgrade. Proof-rolling should be performed in the presence of a geotechnical engineer. Proof-rolling is not an indication that the subgrade strength is adequate or that it meets design requirements, but simply highlights potentially unsuitable subgrade conditions.

If any soft or weak zones are identified during the proof-roll, the material should be sub cut a minimum of 1 m and replaced with suitably compacted engineered fill material.

Backfill and fill placed over wet or submerged excavation bottoms should initially consist of sand with a maximum particle size of 35 mm, having less than 50 percent of the particles by weight passing a number 40 sieve, and less than 5 percent of the particles by weight passing a number 200 sieve. A geotextile should be placed between the sand and the native subgrade as a means of preventing migration of fines into the fill material. This material should be placed to an elevation at least 600 mm above the excavation bottoms or water surfaces prior to compaction and prior to using alternative backfill and fill materials.

5.1.4 Subgrade Stabilization

If large areas of subgrade are unsuitable, then subgrade stabilization is required and one of the following methods can be utilized:

- **Removal and Replacement** – Inadequate materials can be removed and replaced with granular fill (see Section 4.2). This fill shall be compacted as indicated in Section 4.2. The use of a geotextile fabric or geo-grid may potentially reduce removal and replacement requirements
- **Scarification and Re-compaction** – It may be feasible to scarify, dry, and re-compact the exposed soils. The success of this procedure would depend primarily upon favourable weather and sufficient time to dry the soils. Even with adequate time and weather, however, stable subgrades may not be achievable if the thickness of the soft soil is greater than 500 mm.
- **Soil Stabilization** – The use of cement, lime, or fly-ash as a soil stabilizing agent can be considered in lieu of removal and replacement or scarification and re-compaction. The type and quantity of materials used to stabilize the soils will be dependent upon soil type. Typically lime stabilization is used for higher moisture content silty clay to clayey silt soils similar to those encountered at the site. Fat clay soils may be particularly susceptible to softening and disturbance from rain events and construction traffic and soil stabilization may be beneficial if fat clay is encountered below the proposed roadways. Design of a soil stabilization program should be performed by a geotechnical engineer in conjunction with laboratory testing to provide the proper stabilizing agent, application rate, and depth of soils stabilized.

5.1.5 Placement and Compaction of Fill

It is recommended that engineered fill should be placed in 200 -mm maximum compacted lift thickness, provided standard compaction equipment is used (note that small units such as “jumping jacks” are not recommended for compaction). Compaction requirements are presented in Section 4.

5.2 Utilities

It is expected that the native soils encountered on the site will have some potential for sloughing in steep-sided trenches. Utility trenches will either have to be sloped back or entered only when an appropriate safety cage or trench box, used in accordance with the manufacturer's specifications, is utilized.

5.3 Cold Weather Construction

If site grading and construction is anticipated during cold weather, all snow and ice should be removed from cut and fill areas prior to additional grading. No fill should be placed on frozen subgrades. No frozen soils should be used as fill.

The soils on this project site, particularly the clay till of low-medium plasticity, have the potential to exhibit moderate frost effects (heaving upon freezing and softening upon thawing). The soil beneath and/or adjacent to the highway foundation should be protected from freezing during and after construction to prevent the potential of heaving and cracking.

Utility pipes conveying water and buried with less than 3 m of soil cover should be protected with insulation to avoid damage or breakage as a result of frost action.

5.4 Construction Observations and Testing

5.4.1 Observations

It is recommended that a geotechnical engineer observe all excavations related to subgrade preparations

5.4.2 Construction Material Testing

In-place density testing should be performed on the compacted pavement subgrade and on the aggregate base materials. Density tests should be performed where the construction observer is concerned regarding the adequacy of compaction or at a frequency of one test per lift for every 100 square m of fill placed. Material samples should be submitted to a qualified laboratory for Standard Proctor maximum dry density testing in advance of any in-place density testing.

6.0 References

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Tables

Table 1
Summary of Borehole Location, Elevation, Depth and Depth to Water

ID	NAD83-Northing	NAD83-Easting	Elevation (m)	Depth of Boring (m)	Depth to Water (m)
2015-BBH01-S	5679618	574059	4759	3.7	
2015-BBH02-N	5679788	573080	4917	3.7	
2015-BBH03-N	5679288	571770	5182	5.2	1.8
2015-BBH05-SH-N	5678909	570749	5431	4.0	
2015-BBH06-S	5678429	569935	5606	5.2	
2015-BBH07-S	5677938	568173	5674	3.7	
2015-BBH08-SH-N	5677761	567976	5658	3.7	
2015-BBH09-SH-S	5676703	566924	5566	3.7	
2015-BBH10-SH-S	5676503	566763	5501	3.7	
2015-BBH11-SH-S	5676093	566407	5442	3.7	
2015-BBH12-N	5675662	566303	5419	1.7	
2015-BBH16-S	5671662	562551	4956	3.7	
2015-BBH17-N	5670884	561527	4792	3.0	2.0
2015-BBH18-N	5670592	561131	4779	3.7	
2015-BBH19-SH-S	5669974	560578	4792	3.7	
2015-BBH20-S	5668994	559602	4681	3.7	
2015-BBH21-S	5667259	559125	4604	5.4	2.6
2015-BBH22-S	5665051	560597	4556	4.0	2.4
2015-BBH23-SH-S	5662749	563471	4571	5.5	
2015-BBH24-SH-N	5659142	566525	4380	3.9	
2015-BBH25-N	5653125	571442	4152	5.4	
2015-BBH26-SH-S	5651946	571865	4141	5.5	3.0
2015-BBH28-N	5647969	573793	4045	4.0	
2015-BBH29-SH-N	5645660	573084	4012	2.5	
2015-BBH30-SH-N	5644435	571730	4125	3.9	
2015-BBH31-SH-S	5641864	569585	3945	3.8	3.0
2015-BBH32-S	5641489	569307	3938	3.9	
2015-BBH33-S	5640520	567820	4120	5.3	
2015-BBH34-SH-N	5639284	568069	4059	3.2	
2015-BBH35-SH-N	5638506	567418	3938	3.8	
2015-BBH36-S	5637328	566864	3820	5.3	
2015-BBH37-SH-N	5631051	569452	3783	4.0	
2015-BBH38-SH-S	5628122	570513	3720	3.8	
2015-BBH39-SH-S	5626593	572048	3704	3.1	
2015-BBH40-SH-S	5625885	572801	3694	3.8	
2015-BBH41-SH-N	5624438	574320	3688	3.8	
2015-BBH42-SH-S	5623070	575209	3659	4.0	
2015-BBH43-N	5621187	576440	3655	3.8	
2015-BBH44-SH-N	5617699	577687	3911	5.3	
2015-BBH45-SH-N	5613919	576624	4628	5.5	
2015-BBH46-SH-N	5614197	575541	4831	4.0	
2015-BBH47-S	5610388	569886	3621	4.7	
2015-BBH48-N	5609728	568448	3382	4.6	
2015-BBH49-S	5609653	567780	3317	5.4	

Table 2
Summary of General Laboratory Results

Sample Location		USCS Classification	Moisture Content	SPT N	Percent Gravel	Percent Sand	Percent Silt	Percent Clay	Percent Fines	Atterberg Limits			Pocket
Boring No.	Depth (m)		(%)	(blows/30 cm)	(%)	(%)	(%)	(%)	(%)	Liq. Limit	Plast. Limit	Plast. Index	Penetromete (tsf)
	(% moisture content)												
2015-BBH01-S	0.00	TOPSOIL	15	43									
	0.23	GC-GM	4.2										
	0.76	GC-GM		38									
	1.52	GC-GM		35									
	2.29	CL	10.1	25	15.1	37.9	29	18	47	21	14	7	3.50
	3.05	GC-GM		94									
	3.30	GC-GM											
2015-BBH02-N	3.55	GC-GM											4.50
	0.00	GC-GM	5.2	31									
	0.76	SC-SM		26									
	1.52	SC-SM	5.3	105									
	2.29	GC-GM	7.1										
2015-BBH03-N	3.05	SC-SM											
	0.00	PT	53.2	10									2.00
	0.76	CL		11									3.00
	1.52	CL	26.6	49	6.9	49.9	30.6	12.6	43	22	22	0	4.00
	2.29	CL		28									2.00
	3.05	CL	12.8										4.50
	3.81	SC-SM											
2015-BBH05-SH-N	4.57	SC-SM	14.1										
	0.30	FILL											
	1.07	FILL											
	1.83	GC-GM	2.3	59									
	2.59	GC-GM		81									
	3.35	SC-SM	7										
	2015-BBH06-S	0.00	GW-GC	9.2	18								
0.76		GW-GC		49									
1.52		GW-GC		72									
2.29		GW-GC	6.8	105									
3.05		SC-SM											
3.81		SC-SM	7.1	77									1.50
4.57		GC-GM											
2015-BBH07-S	0.00	GC-GM		85									
	0.76	GC-GM	6.1	49	32.3	51.3			16				
	1.52	GC-GM		59									
	2.29	GC-GM	11.5	86									
	3.05	GC-GM	9.9	69									4.50
2015-BBH08-SH-N	0.00	TOPSOIL	13.5	12	19.1	31.2	26.1	23.6	50	26	16	10	2.00
	0.76	CL	12	8									3.00
	1.52	SC-SM											
	2.29	SC-SM											
	3.05	SC-SM	11.5										
2015-BBH09-SH-S	0.00	SC-SM	8.6	37	41.5	47.7			11				
	0.76	SC-SM		32									
	1.52	SC-SM	7.3	71									
	2.13	SC-SM		45									
	3.05	SC-SM		7									
2015-BBH10-SH-S	0.00	TOPSOIL	5.3	31									
	0.76	SC-SM		64									
	1.52	SC-SM	4										
	2.29	SC-SM	6.2	94									
	3.05	SC-SM											
2015-BBH11-SH-S	0.00	SC-SM	5.4	53									
	0.76	SC-SM		41									
	1.52	SC-SM	3.7	54									
	2.29	SC-SM											4.50
	3.05	SC-SM											
2015-BBH12-N	0.00	TOPSOIL	11.7	16	35.5	49.7			15				
	0.76	SC-SM											4.50
	1.52	SC-SM											
2015-BBH16-S	0.00	GC-GM	6.8	24	47.4	39.8			13				
	0.76	CL	8.7	47						21	19	2	4.50
	1.52	GC-GM		42									
	2.29	GC-GM	9.4	22									
	3.05	GC-GM		35									
2015-BBH17-N	0.00	TOPSOIL	18.8	24									
	0.76	CL-ML	22.3	15						21	22	-1	
	1.52	CL-ML		25									
	2.29	GC-GM	5.9	33									
2015-BBH18-N	0.00	TOPSOIL	21.7	46									3.00
	0.76	CL-ML	13.6	55	15.4	23.9	42.7	18	61				
	1.52	CL-ML	19.1	41						31	23	8	4.50
	2.29	GC-GM		66									
	3.05	GC-GM	8.2	43									
2015-BBH19-SH-S	0.00	GC-GM	6.3	25									
	0.76	GC-GM		35									
	1.52	GC-GM	6.1	62						24	22	2	
	2.29	GC-GM		56									
	3.05	CL-ML	14.7	40	11.3	16.6	55.1	17.1	72				4.50

Sample Location		USCS Classification	Moisture Content	SPT N	Percent Gravel	Percent Sand	Percent Silt	Percent Clay	Percent Fines	Atterberg Limits			Pocket Penetromete
Boring No.	Depth									Liq. Limit	Plast. Limit	Plast. Index	
	(m)		(%)	(blows/30 cm)	(%)	(%)	(%)	(%)	(%)	(% moisture content)			(tsf)
2015-BBH20-S	0.00	SC-SM	6.2	29									
	0.76	CL-ML		20									
	1.52	CL-ML	24.4	19		2.7	69	28.3	97				3.50
	2.29	CL		10									0.50
	3.05	CL	27.7	10									0.50
2015-BBH21-S	0.25	GC-GM	7										
	1.01	GC-GM											
	1.78	GC-GM		95									
	2.54	GC-GM	5.3	56	45	43.8			11				
	3.30	GC-GM		48									
	4.06	GC-GM		19									
2015-BBH22-S	4.82	CL	23.3	24									
	0.30	GC-GM											
	1.07	SC-SM	8.7	94									
	1.83	SC-SM		79									
	2.59	GC-GM		61									
2015-BBH23-SH-S	3.35	GC-GM	8.9	42									
	0.34	FILL											
	1.10	FILL	4.7	97									
	1.86	FILL		91									
	2.62	CL	8.4	88									
	3.38	CL		33									2.50
2015-BBH24-SH-N	4.15	CL	24.7	20						29	23	6	1.50
	4.91	GC-GM	6.7	19									
	0.25	FILL											
	1.01	SC-SM	4.5	47									
	1.78	GC-GM		43									
2015-BBH25-N	2.54	GC-GM	2.9										
	3.30	GC-GM		85									
	0.25	FILL											
	1.01	FILL											
	1.78	GC-GM	3.2	81	40.9	43.1			16				
	2.54	GC-GM		74									
2015-BBH26-SH-S	3.30	GC-GM		70									
	4.06	CL	7.5	82						24.0	20.0	4	
	4.82	CL		36									1.25
	0.34	FILL											
	1.10	FILL											
	1.86	CL	5.2	78									
2015-BBH28-N	2.62	GC-GM		61									
	3.38	CL	30.1	25									0.50
	4.15	CL		11									0.00
	4.91	CL	45.4	0		1.2	43.6	55.2	99	41.0	25.0	16	0.00
	0.34	GC-GM											
2015-BBH29-SH-N	1.10	GC-GM											
	1.87	GC-GM	3.5	28	38.9	46.9			14				
	2.63	CL		13									
	3.39	CL	16.6	24						24.0	21.0	3	
	0.35	FILL											
2015-BBH30-SH-N	1.12	FILL											
	1.88	GC-GM		49									
	0.28	FILL											
	1.04	CL	6.4	51									
	1.80	CL		78									
2015-BBH31-SH-S	2.57	CL	8.6	67									
	3.33	CL		89									
	0.15	FILL	4.0	82									
	0.91	GC-GM		36									
	1.68	CL	7.4	49	31.3	38.5			30				
2015-BBH32-S	2.44	CL		54									
	3.20	CL	25.5	21						21.0	21.0	0	0.00
	0.25	CL	7.0	56									
	1.01	CL		28									
	1.78	CL	16.9	13									1.10
2015-BBH33-S	2.54	CL		9									0.80
	3.30	CL	27.9	14									0.00
	0.08	GC-GM	3.9	48									
	0.84	GC-GM		70									
	1.60	GC-GM											
	2.36	CL	7.9	46									
2015-BBH34-SH-N	3.12	CL		39									
	3.89	SC-SM	12.2	12									
	4.65	CL		18									0.75
	0.27	FILL											
2015-BBH35-SH-N	1.03	GC-GM	5.3	54	50.4	35.9			14				
	1.79	GC-GM		26									
	2.55	GC-GM	2.9	29									
	0.13	CL	6.7	53									
2015-BBH35-SH-N	0.89	CL		42									
	1.65	CL		45									
	2.41	CL		86									
	3.18	CL	15.8	27						36.0	28.0	8	

Table 2
Summary of General Laboratory Results

[illegible]

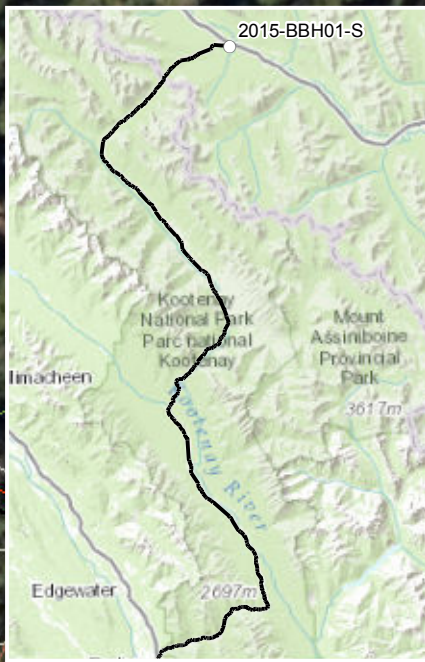
Table 3
Summary of California Bearing Ratio and Standard Proctor Test

Boring	% Compaction	CBR Value	CBR at 95% Compaction	Max Dry Density	Optimum Moisture	Dry Density
2015-BBH03-N	83.1	1	1.34	1239	34.5	1030
	90.2	1.3				1118
	102.7	1.5				1272
2015-BBH06-S	83.4	1	17.68	2174	7.5	
	87.9	3.2				
	100.4	27.3				
2015-BBH11-SH-S	84.8	0.9	12.72	2265	6.5	
	89.1	2				
	100.3	20.6				
2015-BBH17-N	84.7	1.3	2.33	1786	15.7	1513
	91.2	2.1				1629
	100.6	2.8				1797
2015-BBH-24-SH-N	83.4	1.4	11.13	2159	8.9	1801
	89.9	3.1				1941
	100.8	18				2176
2015-BBH28-N	85.2	1.5	10.84	2163	7.8	
	91.2	3.6				
	100.6	18.4				
2015-BBH33-S	79.9	1.2	20.78	2262	6.0	
	86.9	4.9				
	100.6	30.4				
2015-BBH38-SH-S	84.1	1.8	12.08	2194	7.3	1845
	90.6	3.8				1988
	100.7	19.8				2209
2015-BBH39-SH-S	85.8	1.3	9.85	2164	7.8	
	91.4	3.5				
	100.2	16.4				
2015-BBH40-SH-S	80.4	1	7.59	2042	9.6	1642
	91.0	4.4				1858
	98.9	9.54				2020

Table 4
Chemical Test Results on Soil Samples

Boring Number	Depth	pH	Soluble Chloride	Soluble Sulphate
	(ft)		(mg/l)	(mg/l)
2015-BBH01-S	0.0	7.83	193	102
2015-BBH01-S	2.0	8.2	234	45.8
2015-BBH03-N	0.0			
Mean	0.7	8.0	213.5	73.9
Std dev	0.9	0.2	20.5	28.1
Minimum	0.0	7.8	193.0	45.8
Maximum	2.0	8.2	234.0	102.0

Figure



2015-BBH01-S
N: 5679618
E: 574059

0.5 km

17.5 m

1465

1470

1475



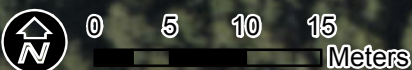
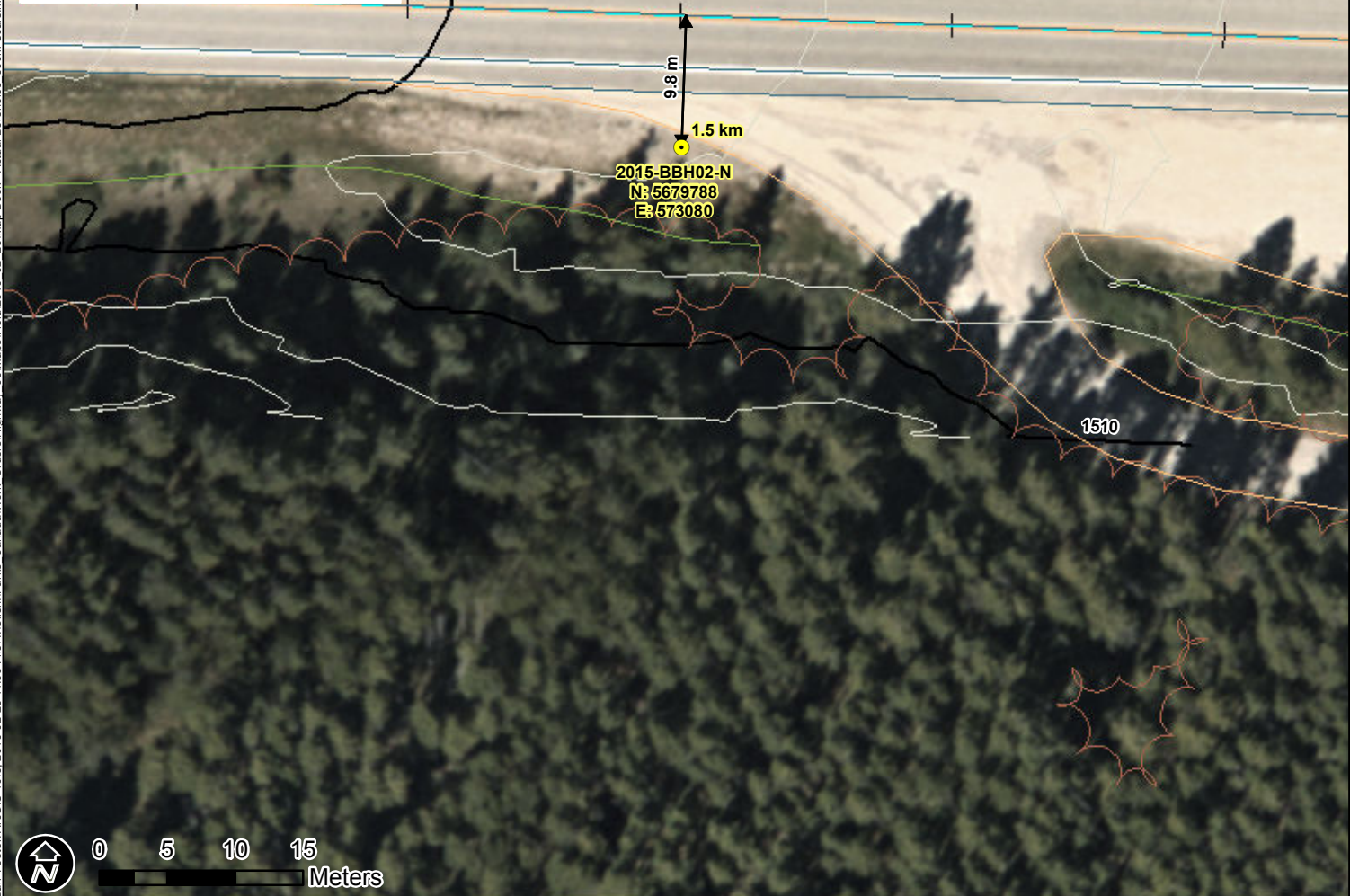
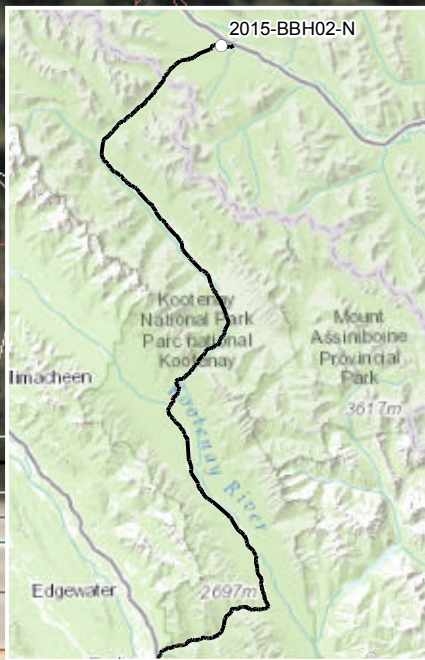
0 5 10 15 Meters

- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH01-S
Highway 93S Kootenay Parkway
Parks Canada

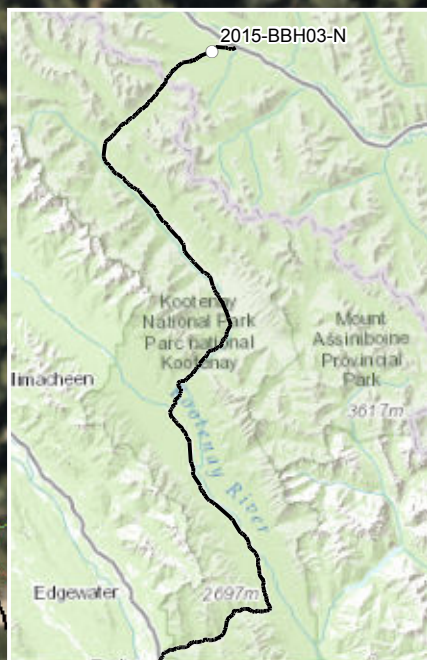


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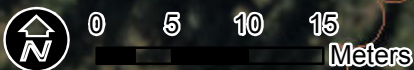
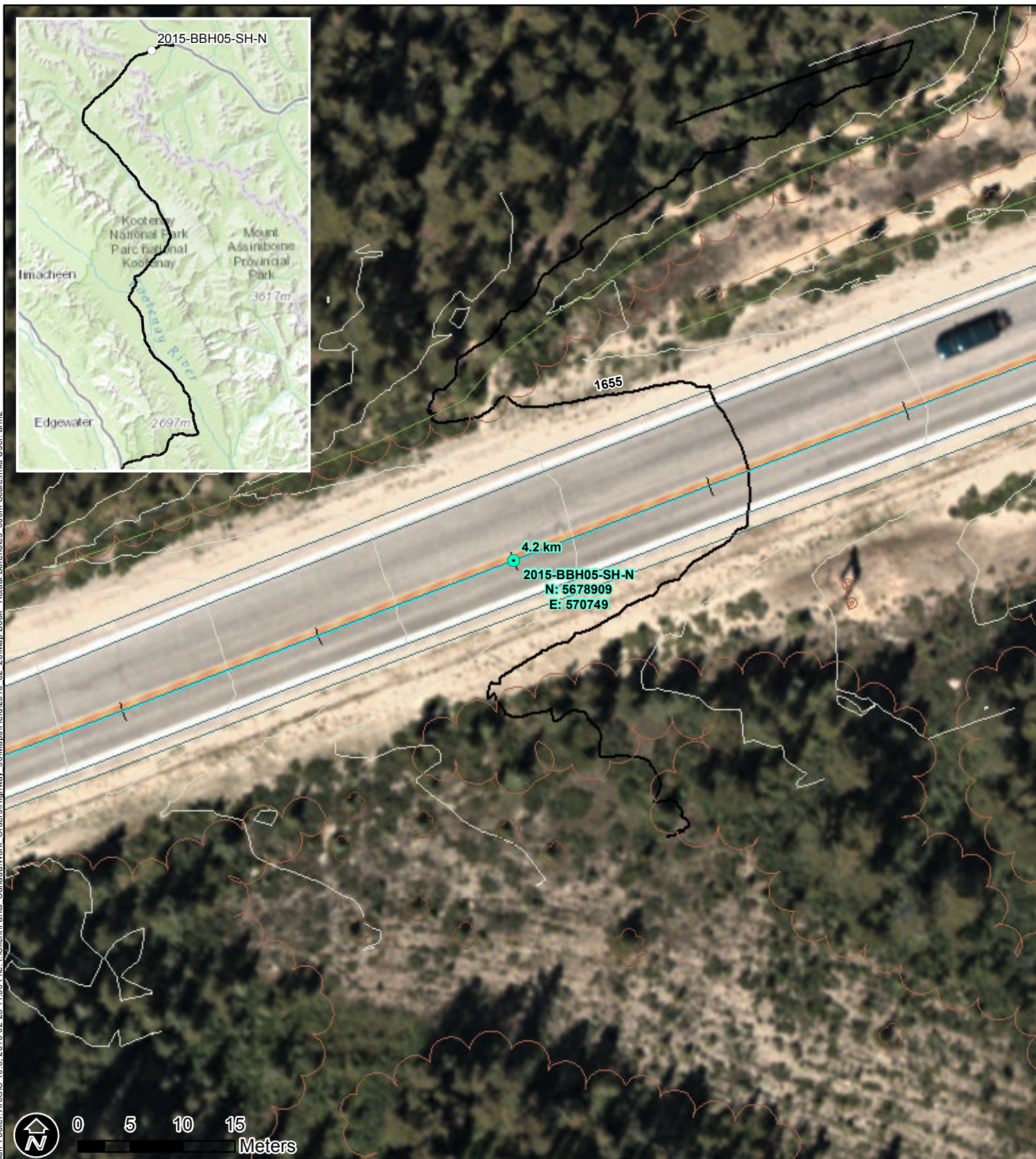
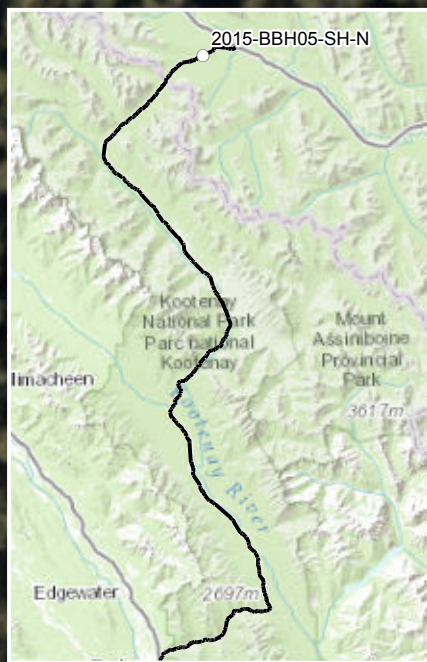
2015-BBH02-N
Highway 93S Kootenay Parkway
Parks Canada



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2015-BBH03-N
Highway 93S Kootenay Parkway
Parks Canada



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2015-BBH05-SH-N
Highway 93S Kootenay Parkway
Parks Canada

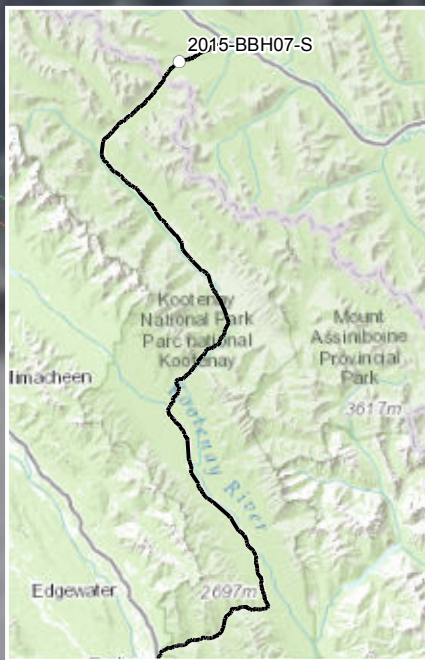


- Proposed Borings
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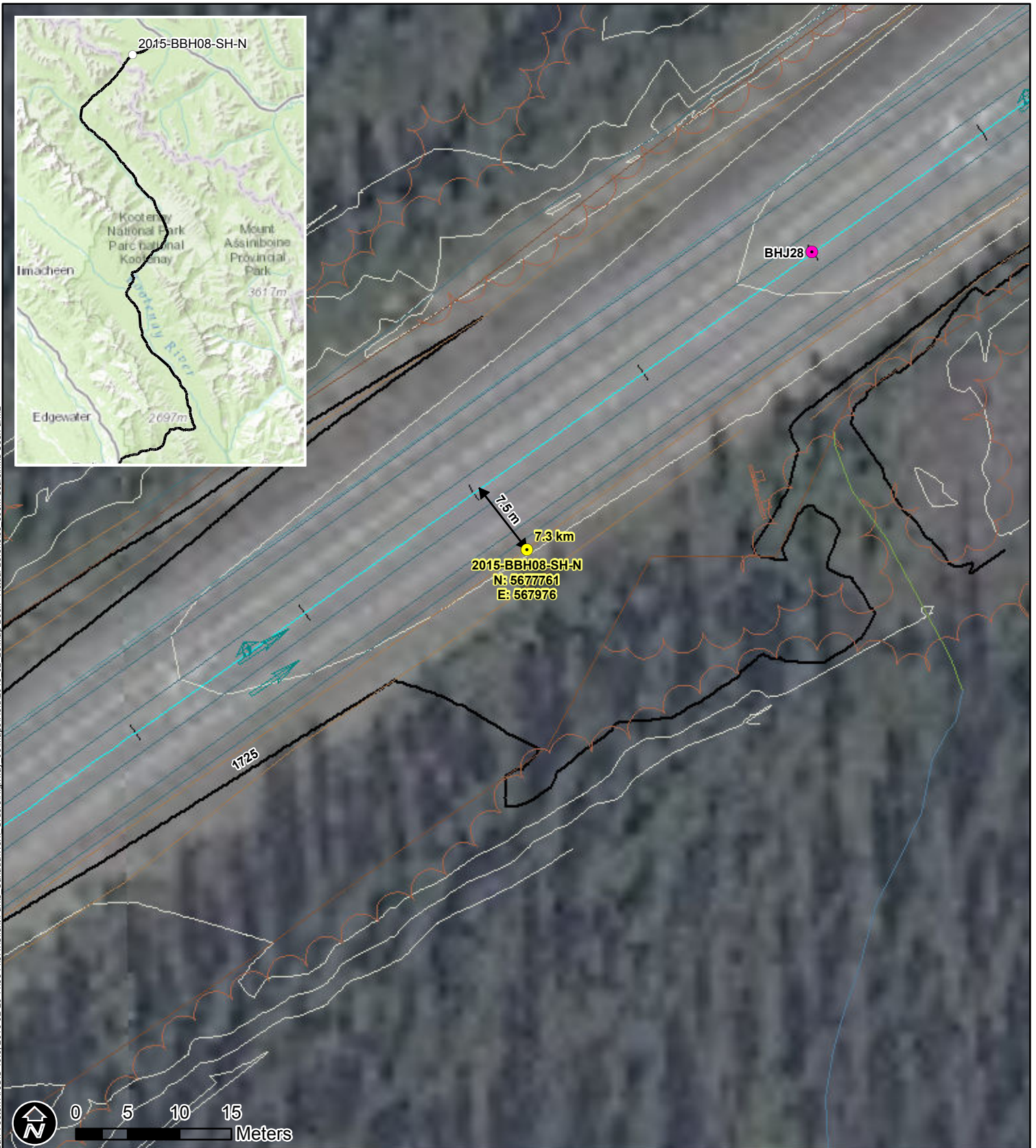
2015-BBH06-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
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2015-BBH07-S
Highway 93S Kootenay Parkway
Parks Canada



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2015-BBH08-SH-N
Highway 93S Kootenay Parkway
Parks Canada



2015-BBH09-SH-S
N: 5676703
E: 566924

8.8 km

15.9 m



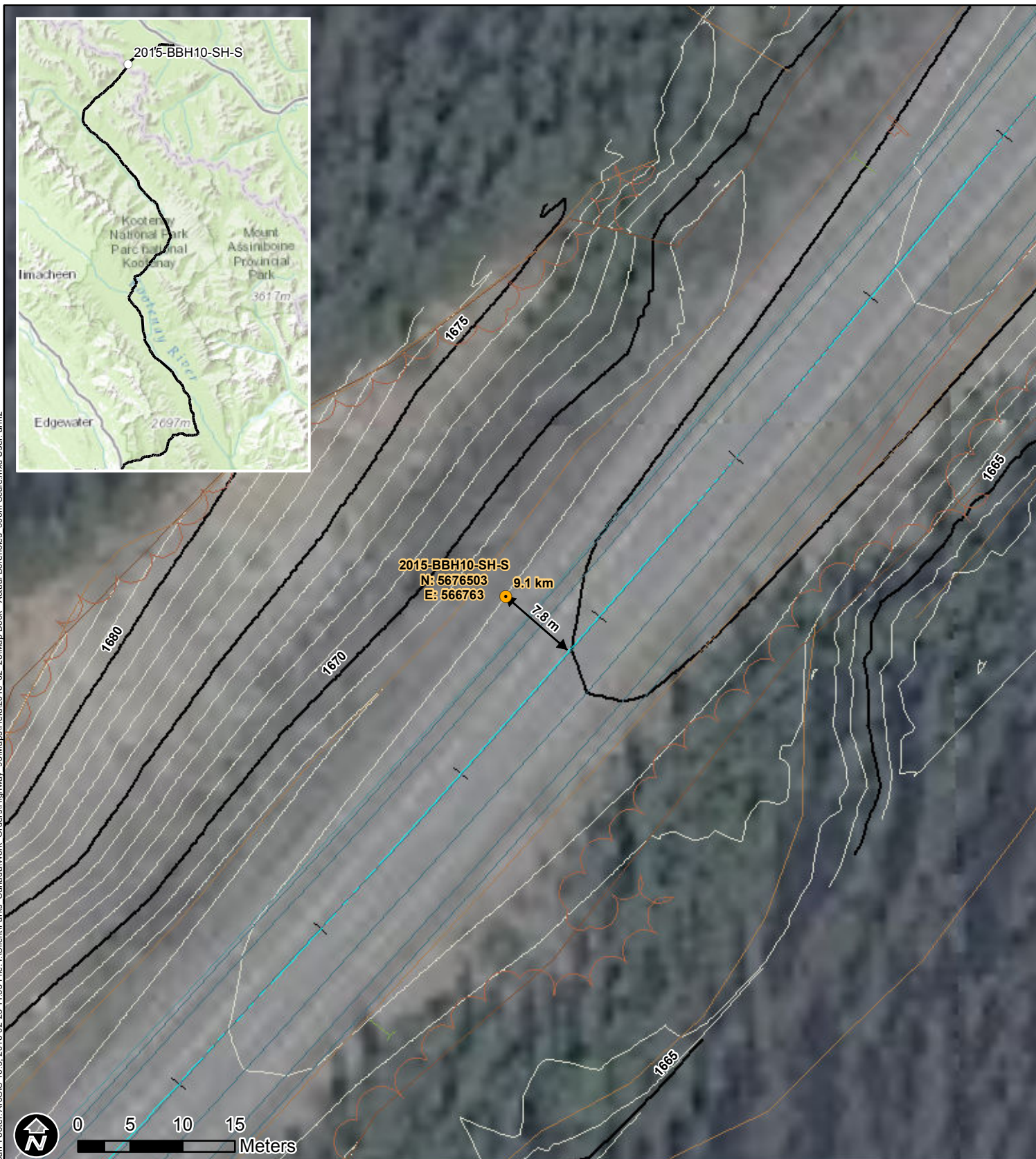
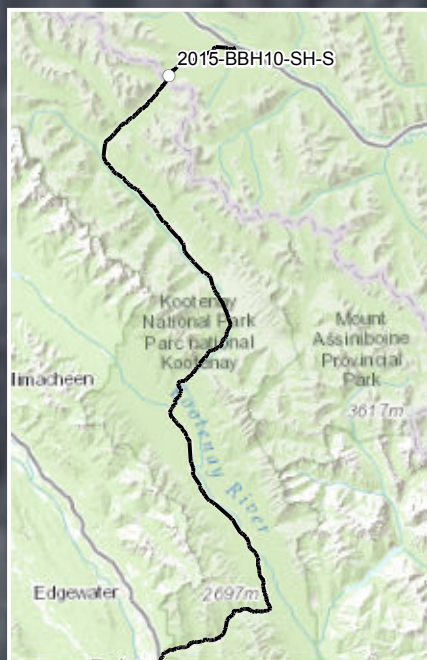
0 5 10 15 Meters

- Proposed Borings
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2015-BBH09-SH-S
Highway 93S Kootenay Parkway
Parks Canada

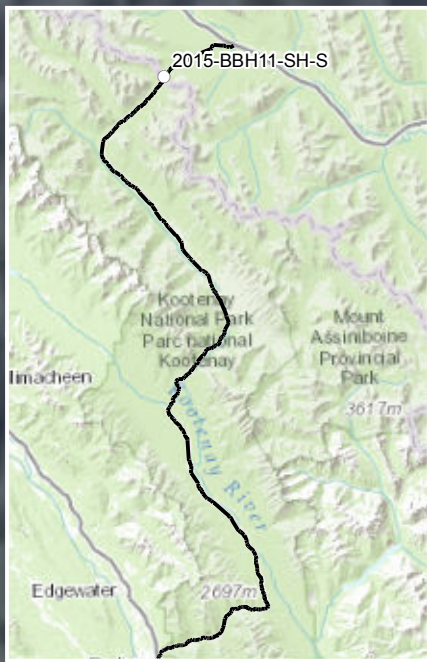


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2015-BBH10-SH-S
Highway 93S Kootenay Parkway
Parks Canada



2015-BBH11-SH-S
N: 5676093
E: 566407

9.6 km

15.1 m



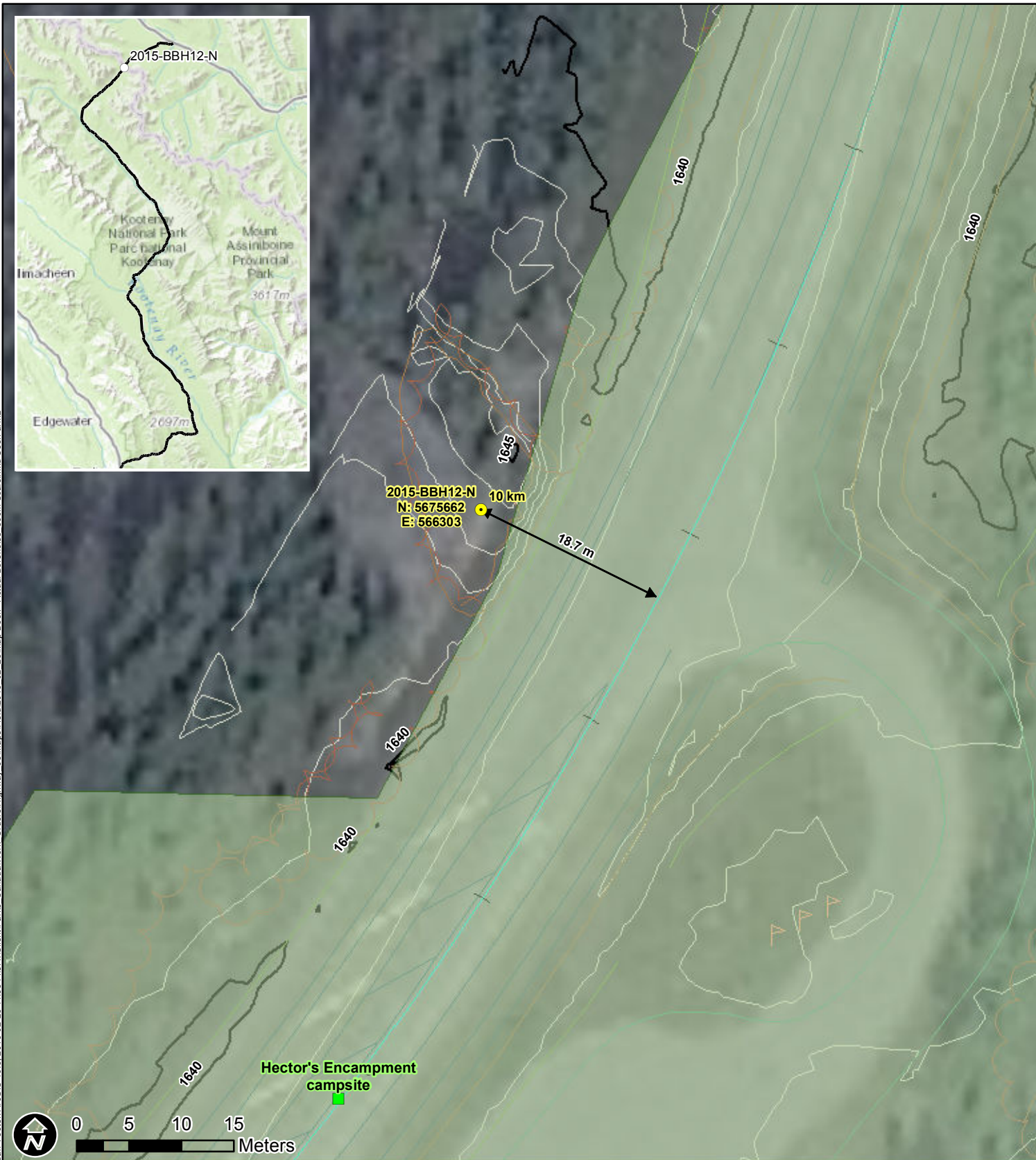
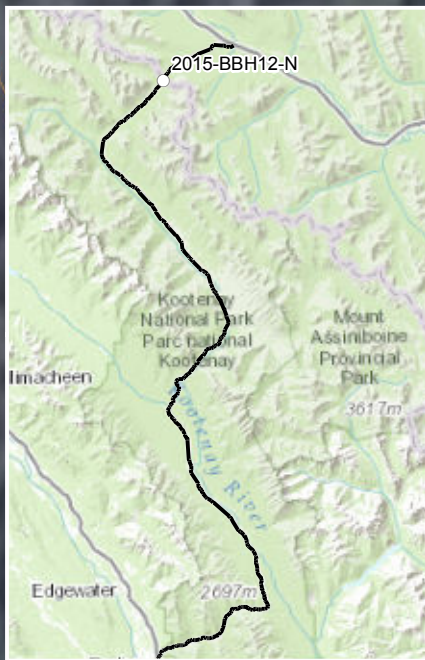
0 5 10 15 Meters

- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH11-SH-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH12-N
Highway 93S Kootenay Parkway
Parks Canada



2015-BBH16-S
N: 5671662
E: 562551

15.6 km

12.0 m



0 5 10 15 Meters

- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

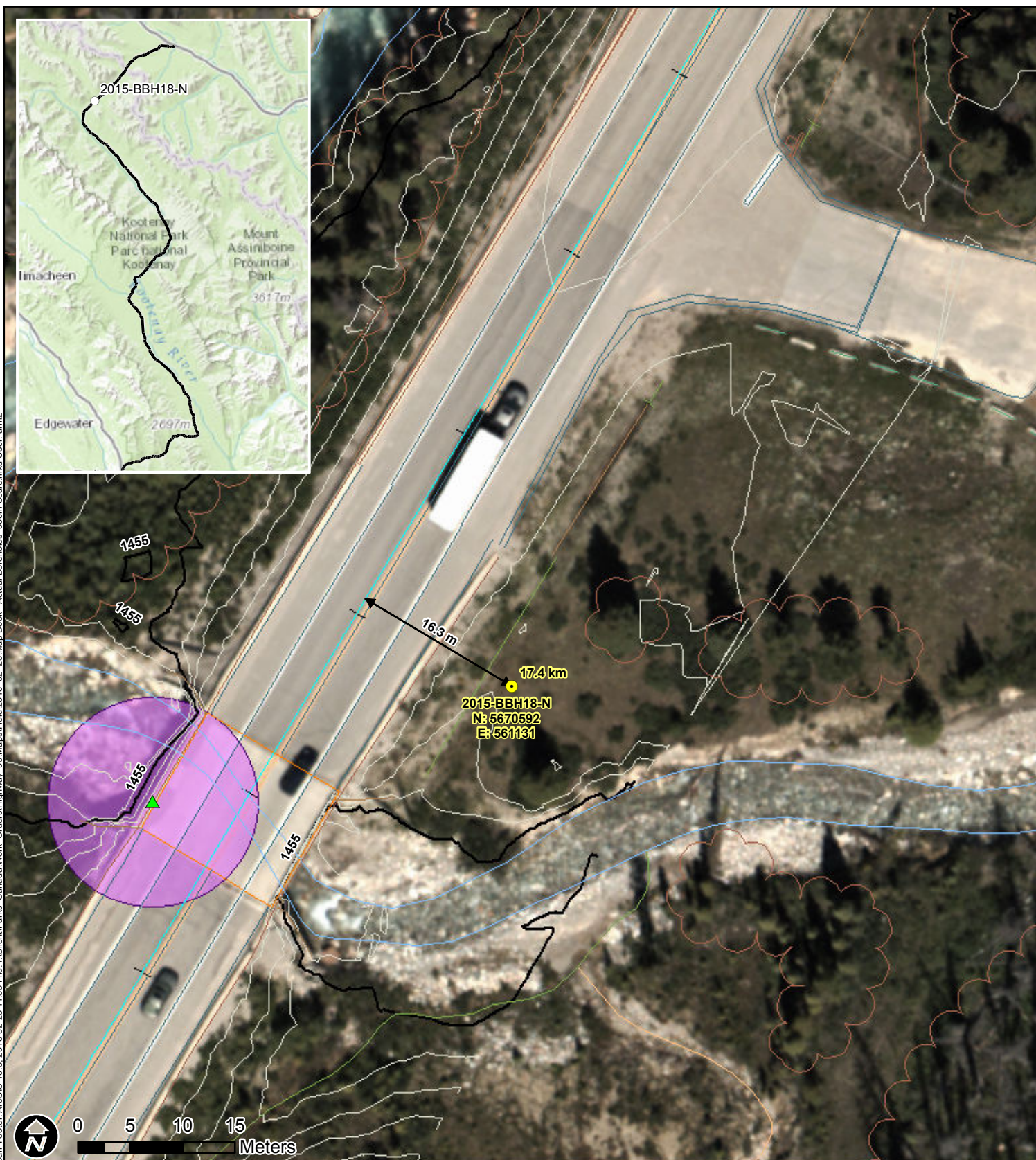
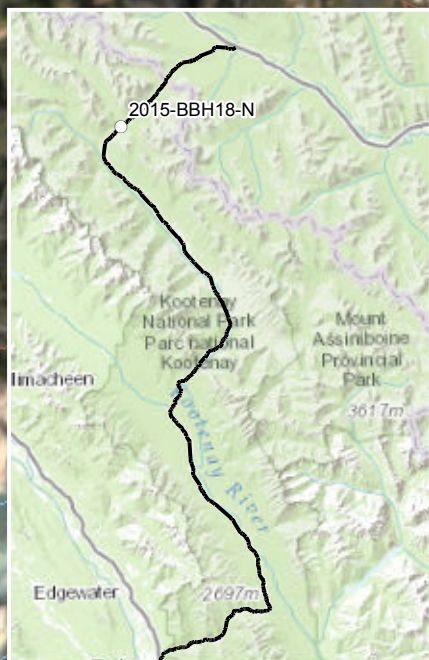
2015-BBH16-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH17-N
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

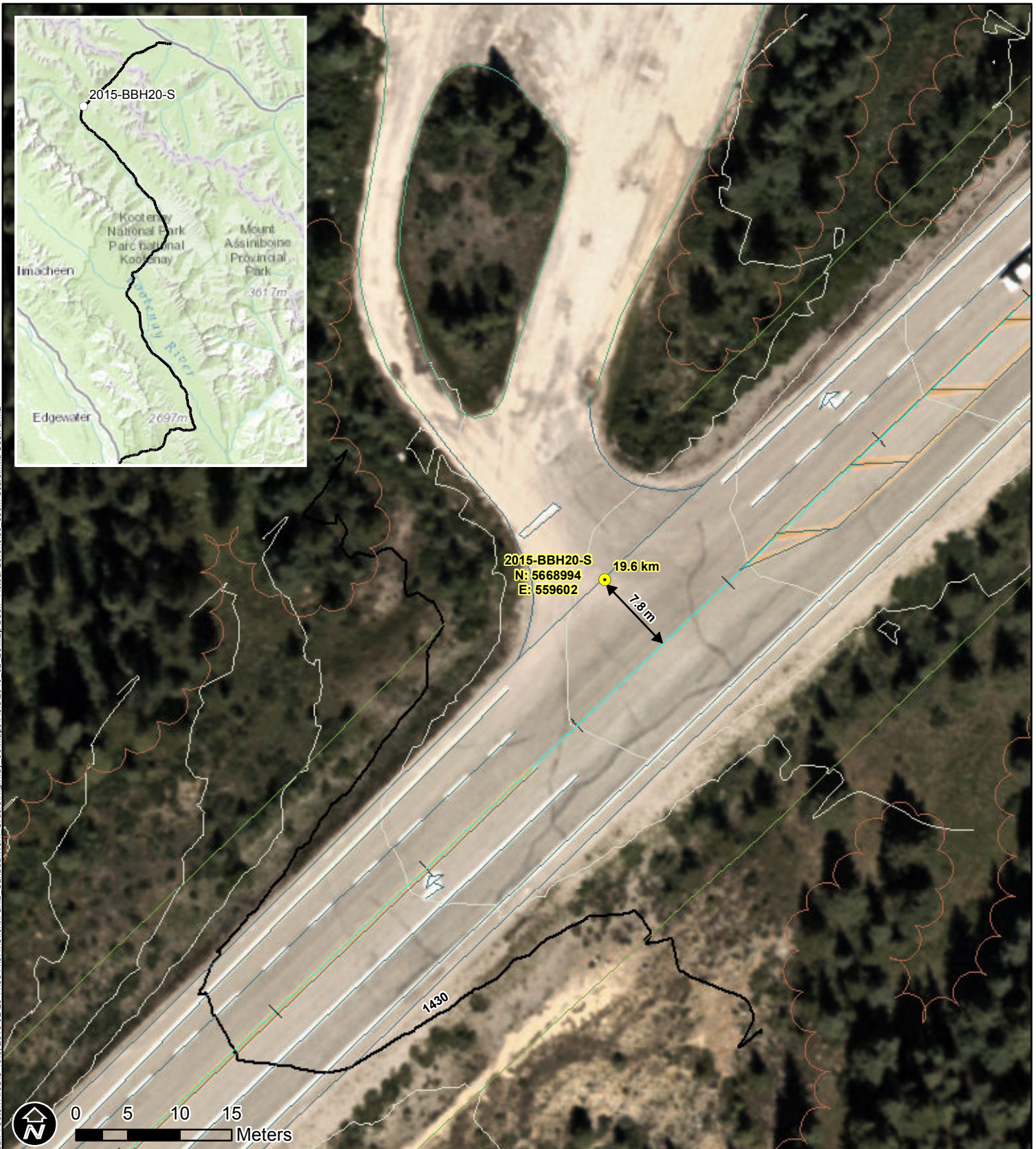
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH18-N
Highway 93S Kootenay Parkway
Parks Canada



- | | |
|--|---|
| <ul style="list-style-type: none"> ● Proposed Borings ● Proposed Shoulder Borings ● Proposed Borings to be Decided Later if Required ● Existing Boreholes ■ Cultural Sites ■ Cultural Site Areas ■ Archaeology Site ■ Archaeology Site Areas | <p>Watercourse Sensitivity Level</p> <ul style="list-style-type: none"> ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. ▲ 4 - No habitat, runoff drainage or no watercourse present. ● Ecological Sites (Aqua) |
|--|---|

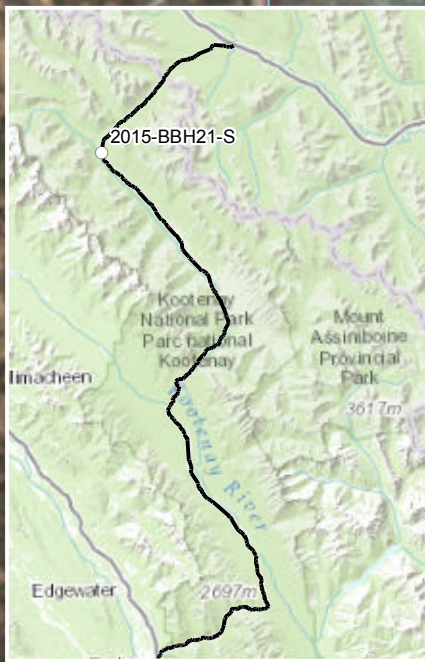
2015-BBH19-SH-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH20-S
Highway 93S Kootenay Parkway
Parks Canada

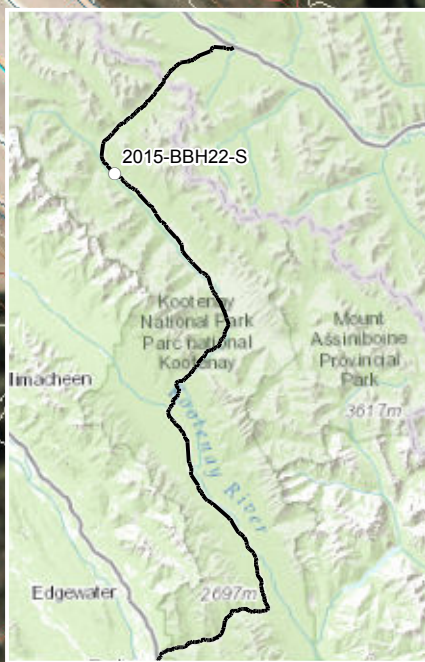


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

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- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

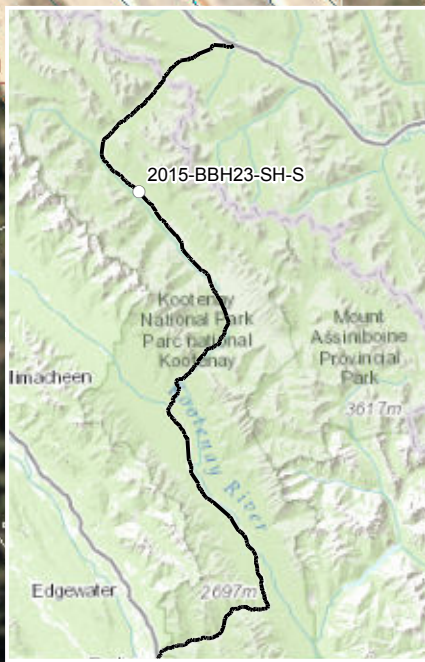
2015-BBH21-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

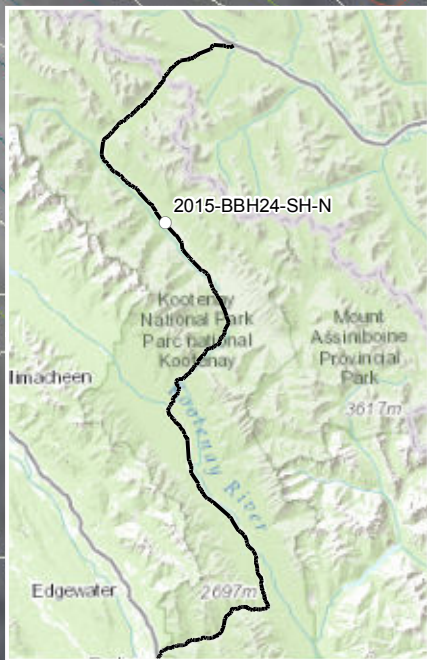
2015-BBH22-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

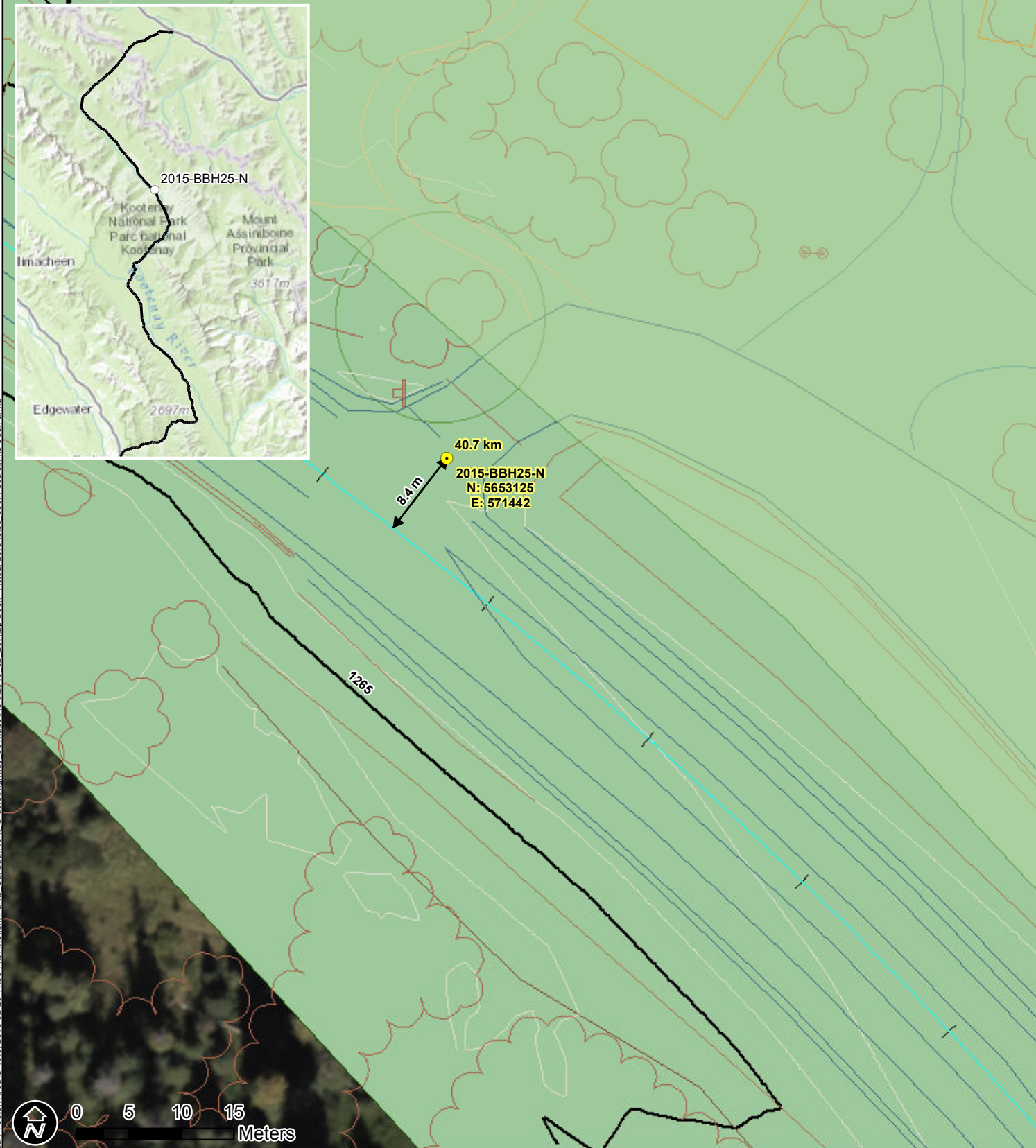
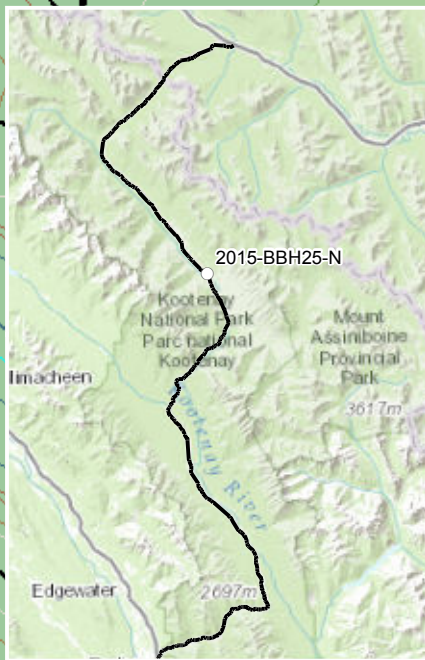
2015-BBH23-SH-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH24-SH-N
Highway 93S Kootenay Parkway
Parks Canada

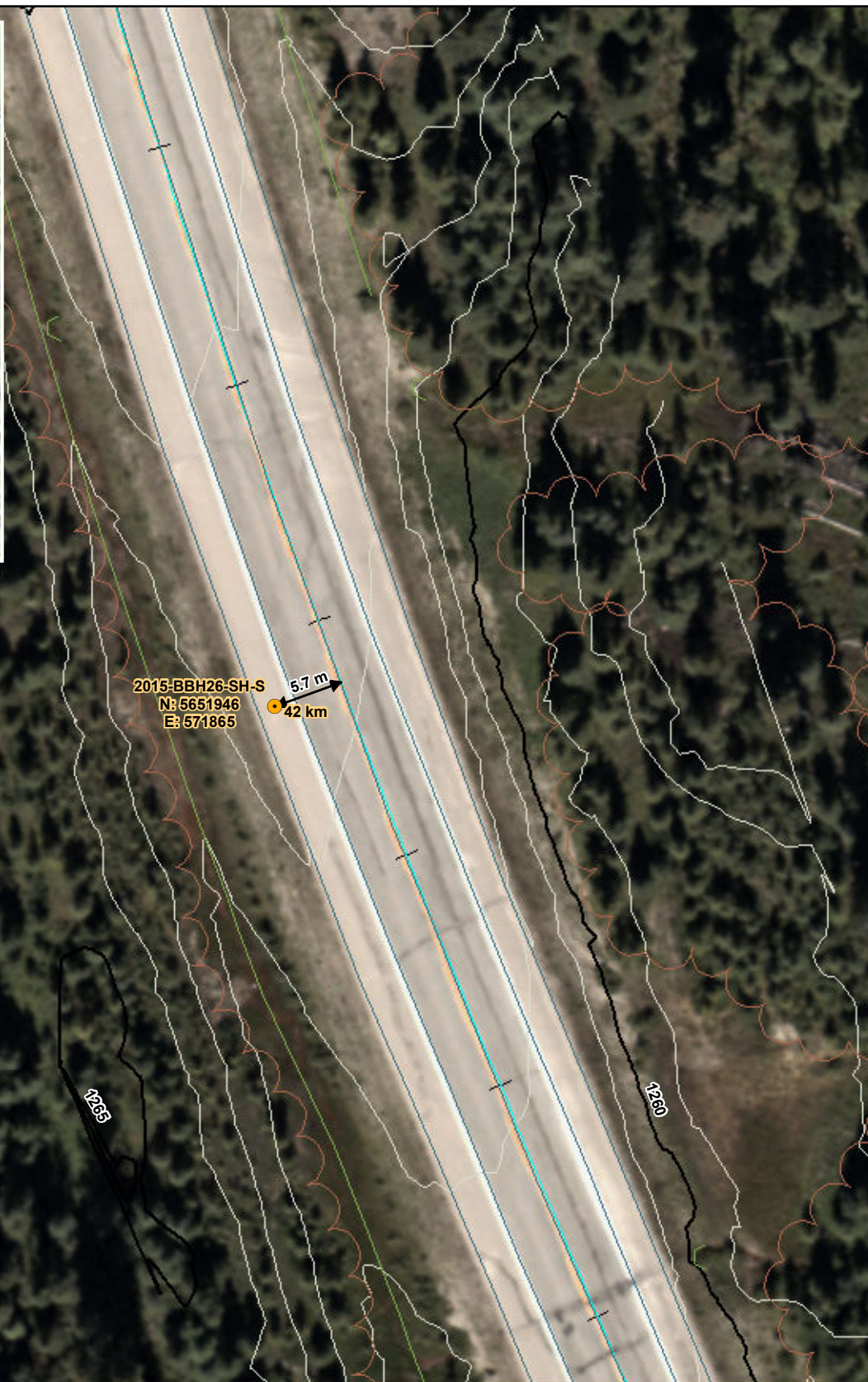
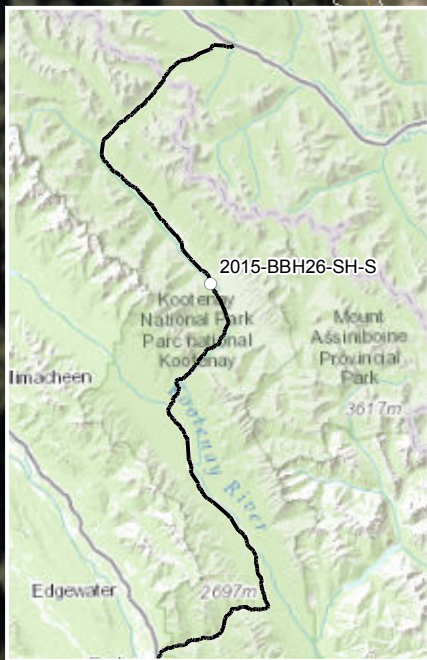


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

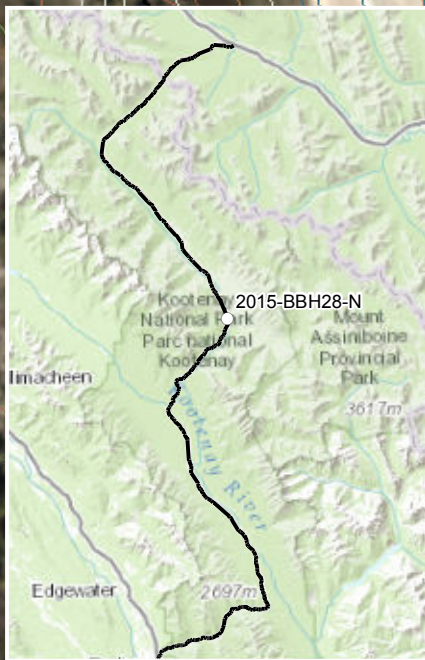
2015-BBH25-N
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH26-SH-S
Highway 93S Kootenay Parkway
Parks Canada

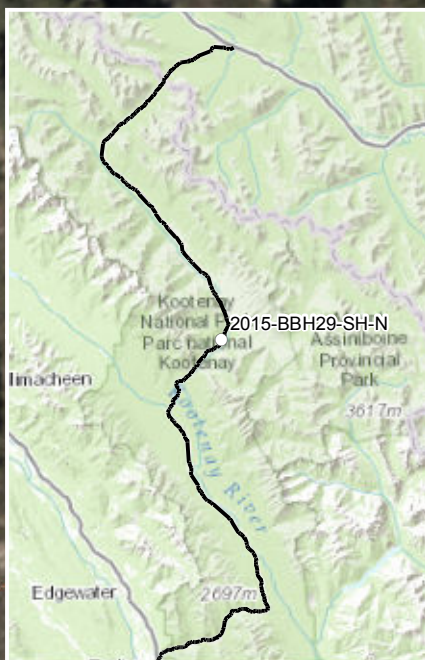


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

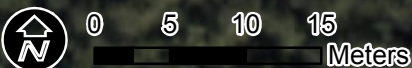
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH28-N
Highway 93S Kootenay Parkway
Parks Canada



- | | |
|--|--|
| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
| ● Proposed Borings to be Decided Later if Required | ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. |
| ● Existing Boreholes | ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. |
| ■ Cultural Sites | ▲ 4 - No habitat, runoff drainage or no watercourse present. |
| ■ Cultural Site Areas | ● Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ■ Archaeology Site Areas | |

2015-BBH29-SH-N
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH30-SH-N
Highway 93S Kootenay Parkway
Parks Canada

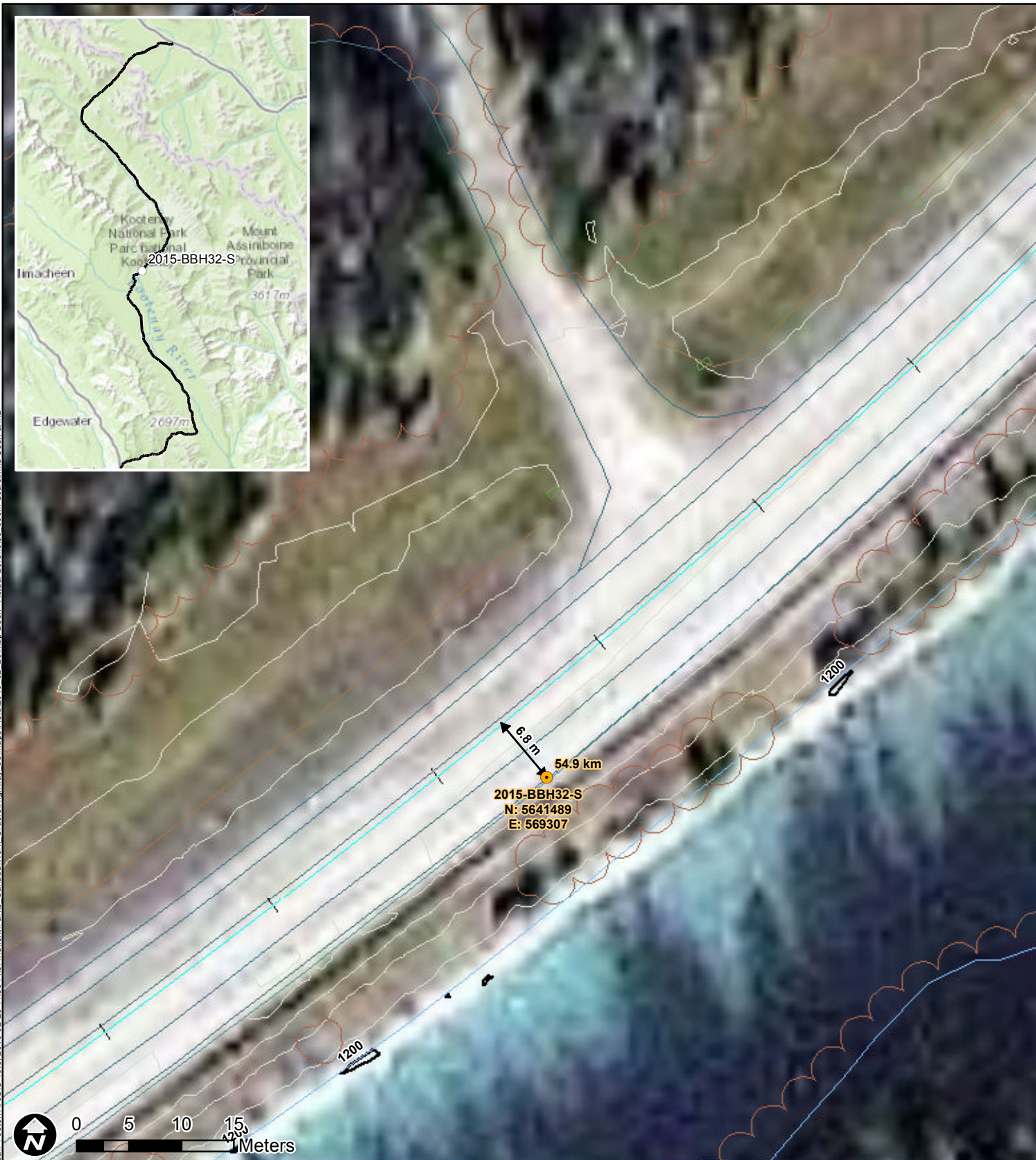


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
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- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH31-SH-S
Highway 93S Kootenay Parkway
Parks Canada



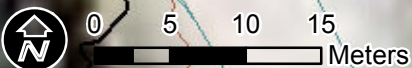
- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH32-S
Highway 93S Kootenay Parkway
Parks Canada



2015-BBH33-S
N: 5640520
E: 567820
56.8 km
7.3 m

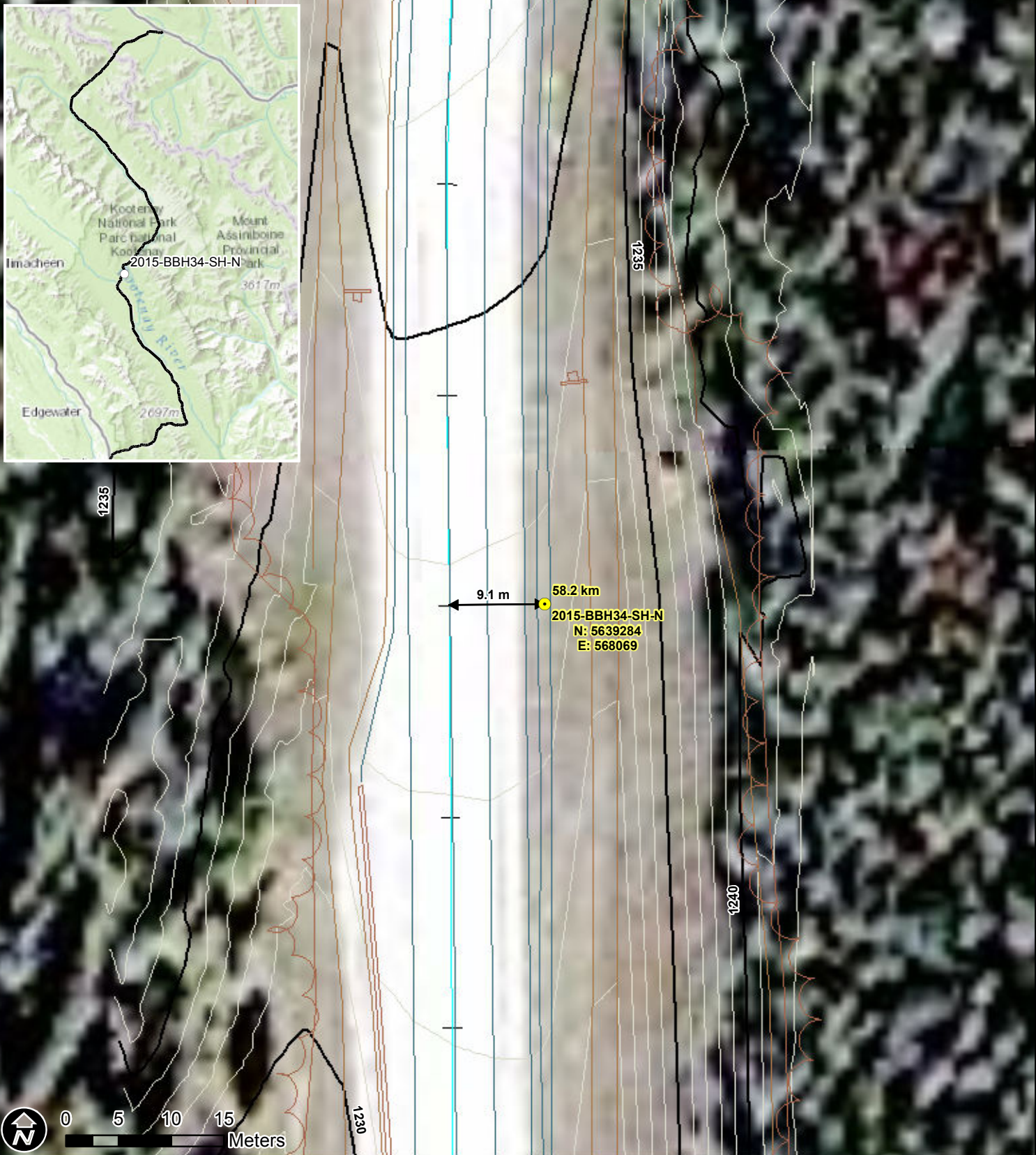
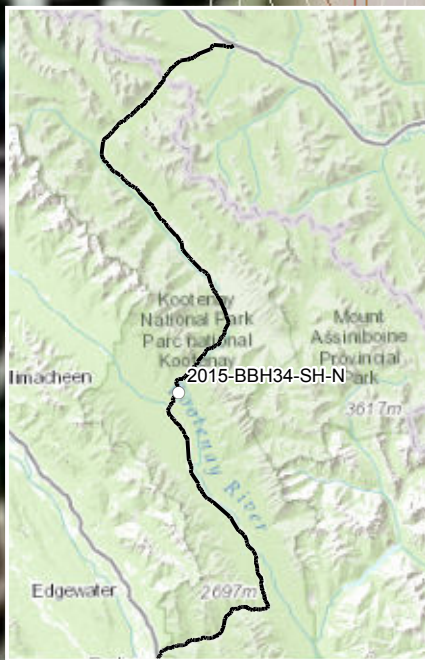


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

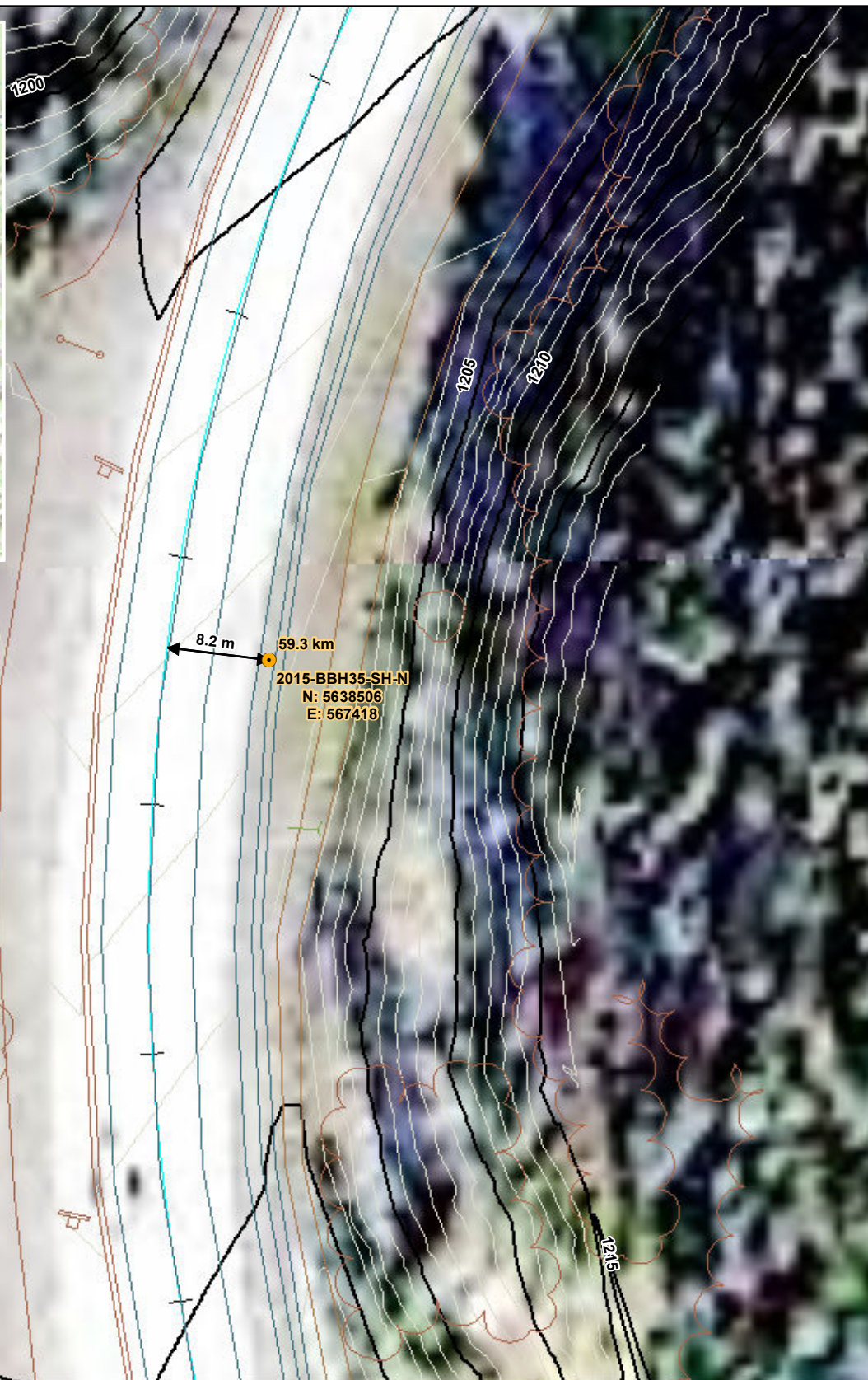
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH33-S
Highway 93S Kootenay Parkway
Parks Canada



- | | |
|--|--|
| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
| ● Proposed Borings to be Decided Later if Required | ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. |
| ● Existing Boreholes | ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. |
| ■ Cultural Sites | ▲ 4 - No habitat, runoff drainage or no watercourse present. |
| ■ Cultural Site Areas | ● Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ■ Archaeology Site Areas | |

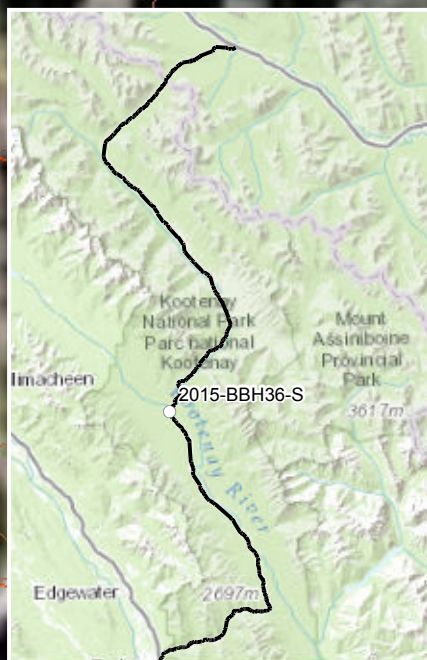
2015-BBH34-SH-N
Highway 93S Kootenay Parkway
Parks Canada



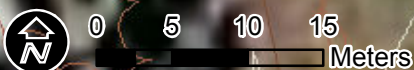
- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH35-SH-N
Highway 93S Kootenay Parkway
Parks Canada



2015-BBH36-S
N: 5637328
E: 566864
60.7 km
17.1 m

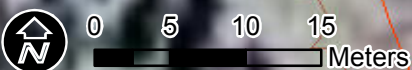
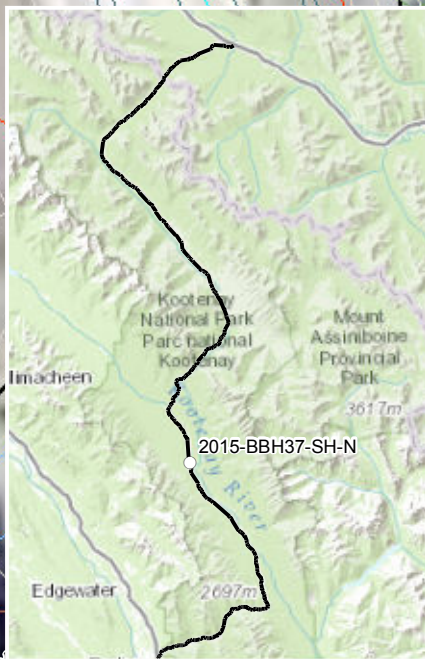


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

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- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
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- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH36-S
Highway 93S Kootenay Parkway
Parks Canada

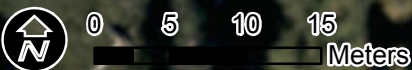
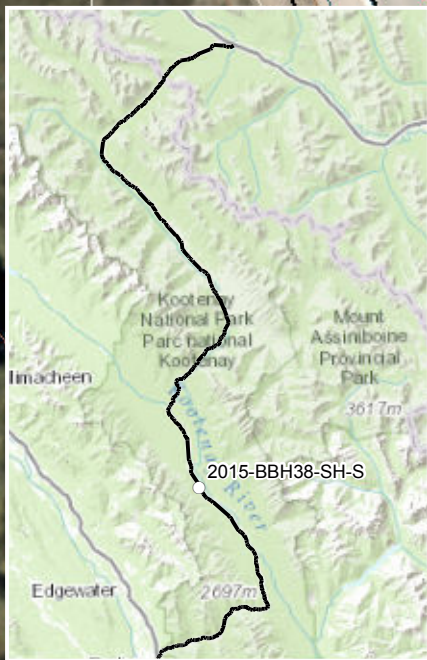


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

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- Ecological Sites (Aqua)

2015-BBH37-SH-N
Highway 93S Kootenay Parkway
Parks Canada

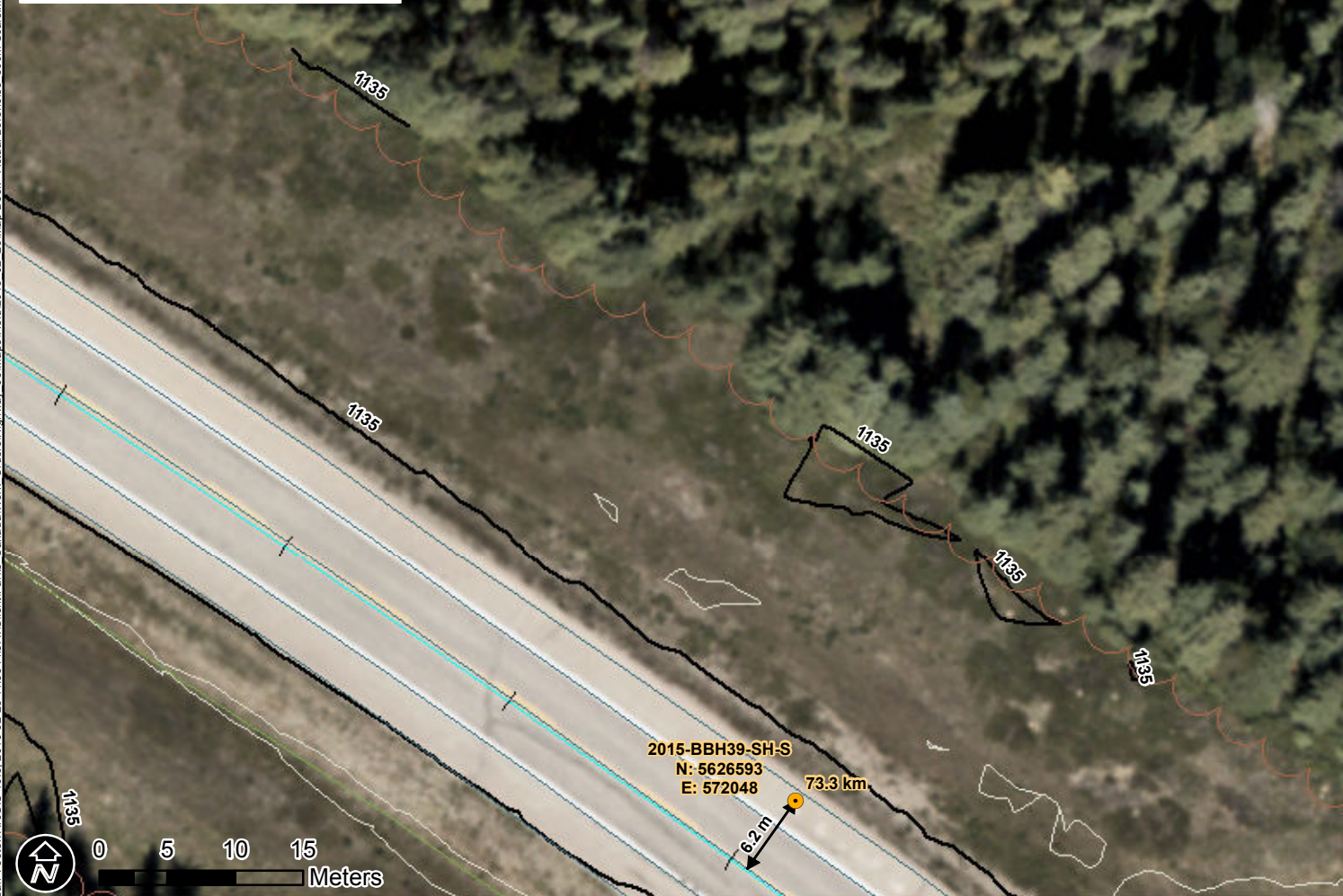


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

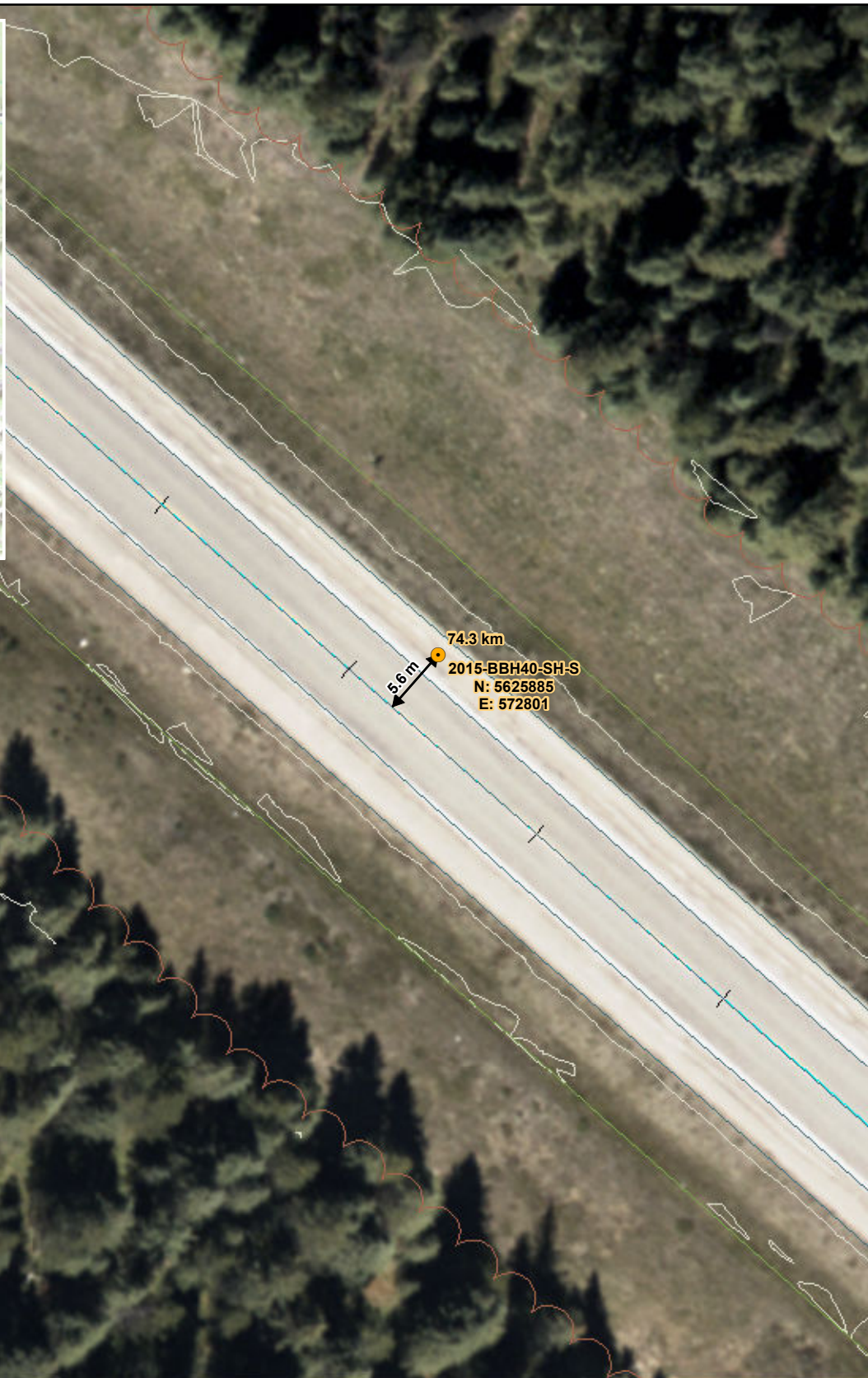
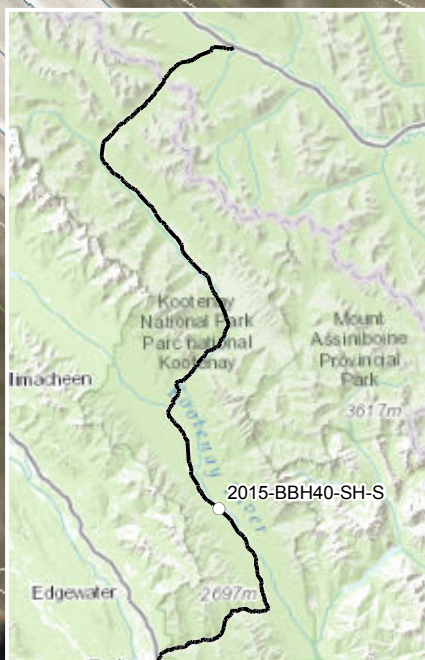
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH38-SH-S
Highway 93S Kootenay Parkway
Parks Canada



- | | |
|--|--|
| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
| ● Proposed Borings to be Decided Later if Required | ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. |
| ● Existing Boreholes | ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. |
| ■ Cultural Sites | ▲ 4 - No habitat, runoff drainage or no watercourse present. |
| ■ Cultural Site Areas | ● Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ■ Archaeology Site Areas | |

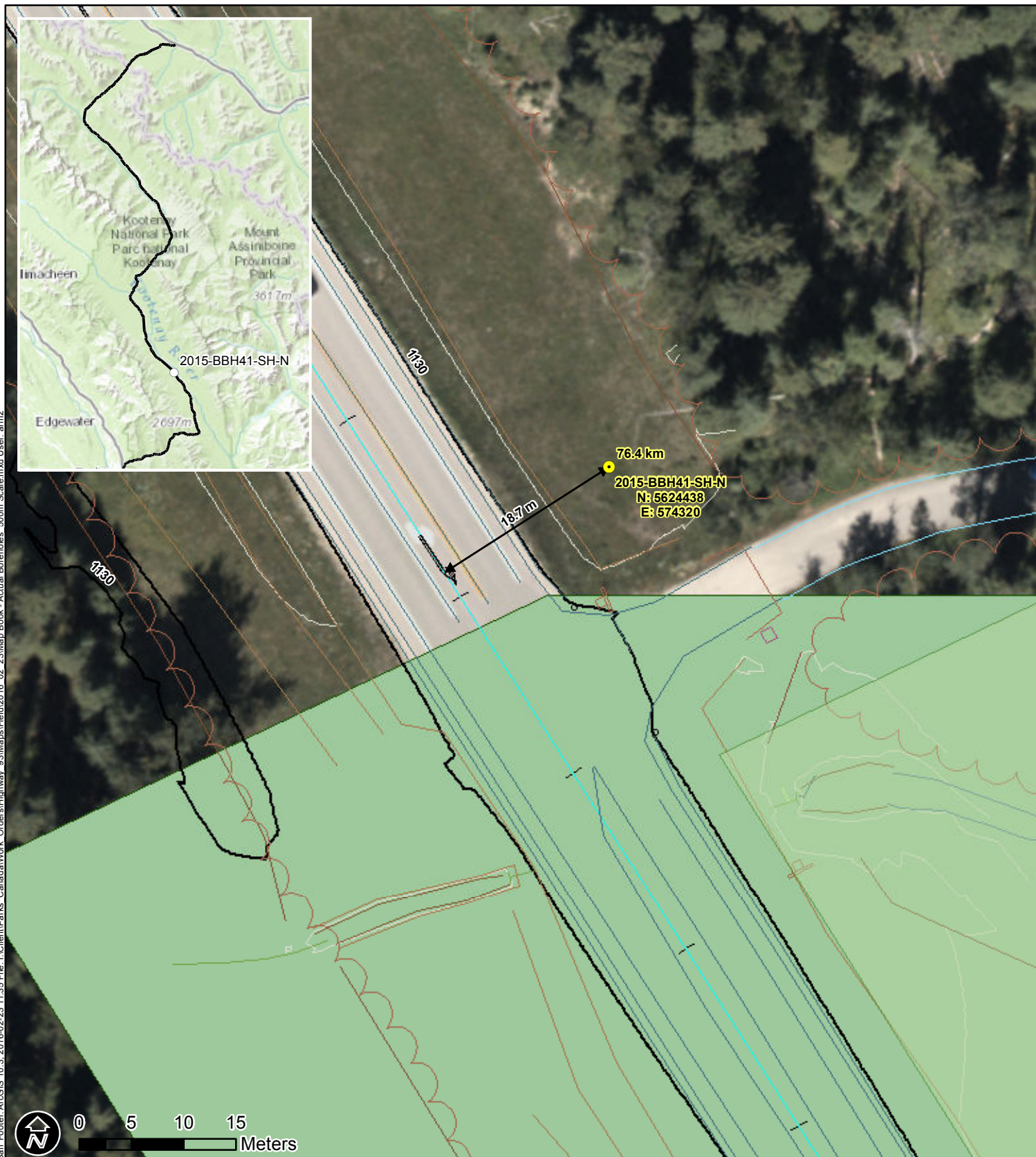
2015-BBH39-SH-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
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 - Ecological Sites (Aqua)

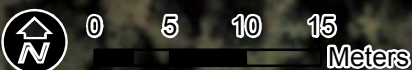
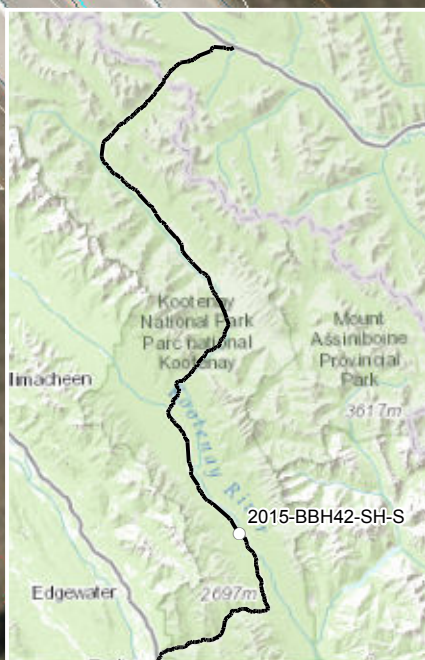
2015-BBH40-SH-S
Highway 93S Kootenay Parkway
Parks Canada



- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

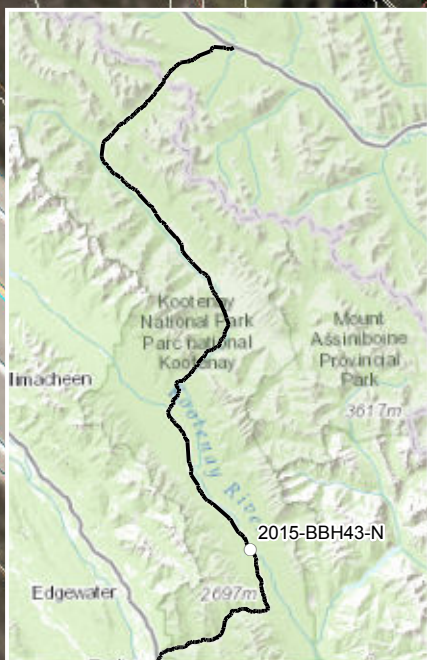
- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH41-SH-N
Highway 93S Kootenay Parkway
Parks Canada



- | | |
|--|--|
| ● Proposed Borings | ▲ Watercourse Sensitivity Level |
| ● Proposed Shoulder Borings | ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. |
| ● Proposed Borings to be Decided Later if Required | ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. |
| ● Existing Boreholes | ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. |
| ■ Cultural Sites | ▲ 4 - No habitat, runoff drainage or no watercourse present. |
| ■ Cultural Site Areas | ● Ecological Sites (Aqua) |
| ■ Archaeology Site | |
| ■ Archaeology Site Areas | |

2015-BBH42-SH-S
Highway 93S Kootenay Parkway
Parks Canada

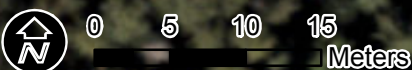


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH43-N
Highway 93S Kootenay Parkway
Parks Canada

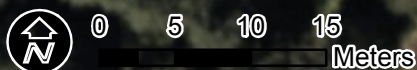


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH44-SH-N
Highway 93S Kootenay Parkway
Parks Canada

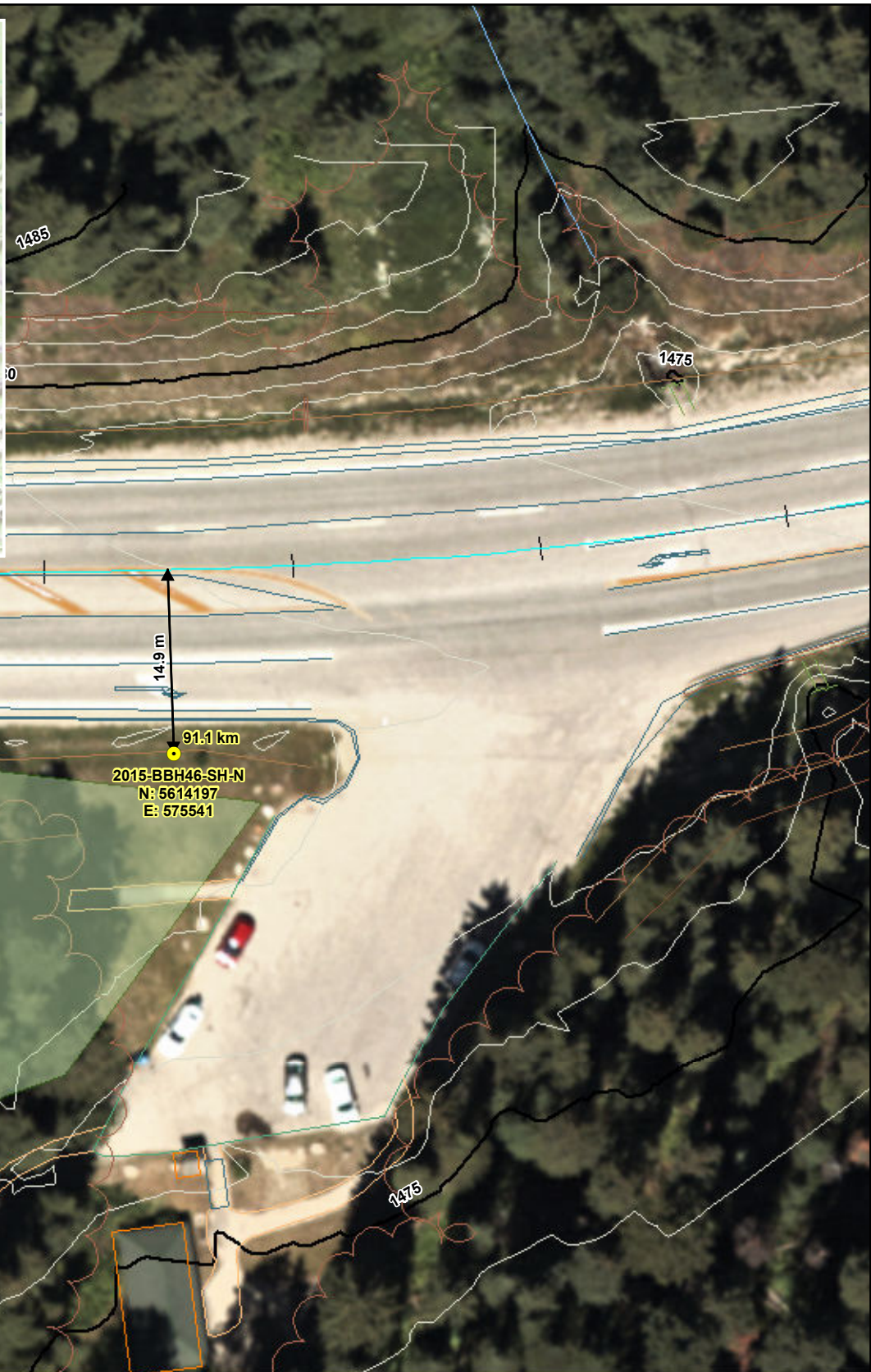


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH45-SH-N
Highway 93S Kootenay Parkway
Parks Canada



- | | |
|--|--|
| <ul style="list-style-type: none"> ● Proposed Borings ● Proposed Shoulder Borings ● Proposed Borings to be Decided Later if Required ● Existing Boreholes ■ Cultural Sites ■ Cultural Site Areas ■ Archaeology Site ■ Archaeology Site Areas | <p>Watercourse Sensitivity Level</p> <ul style="list-style-type: none"> ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable. ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable. ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats. ▲ 4 - No habitat, runoff drainage or no watercourse present. |
|--|--|

Ecological Sites (Aqua)

2015-BBH46-SH-N
Highway 93S Kootenay Parkway
Parks Canada



2015-BBH47-S
N: 5610388
E: 569886

99 km

29.7 m



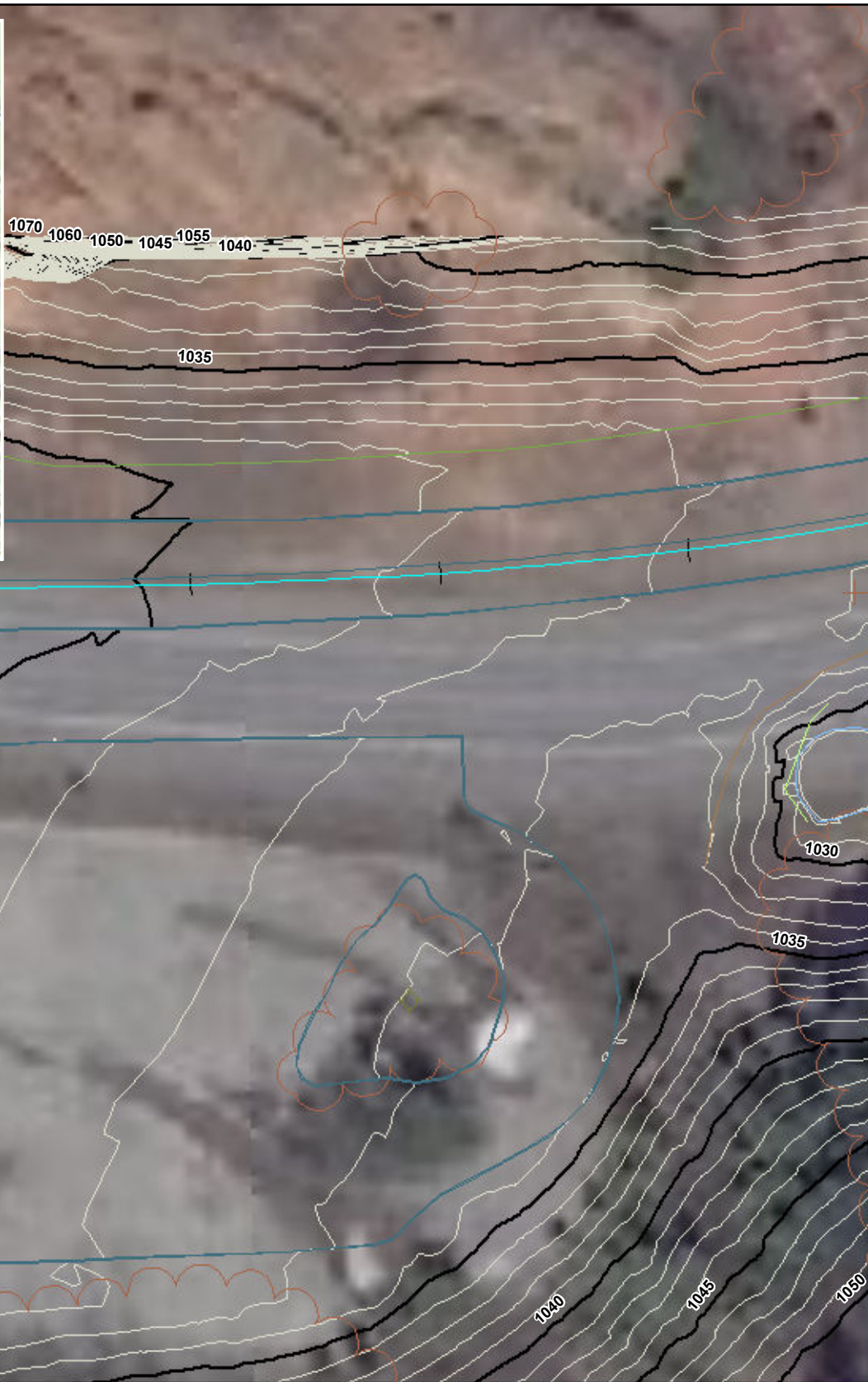
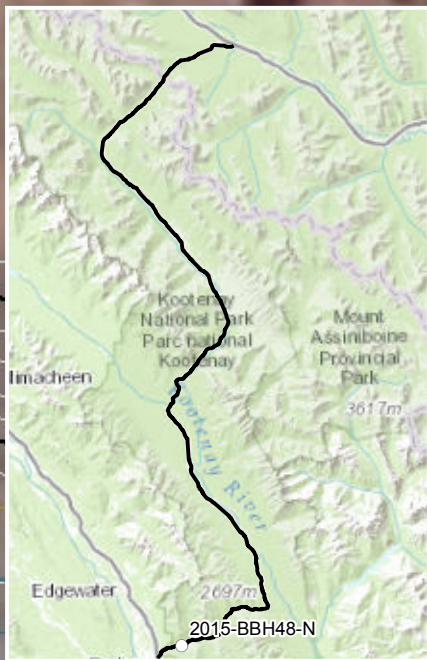
0 5 10 15 Meters

- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH47-S
Highway 93S Kootenay Parkway
Parks Canada

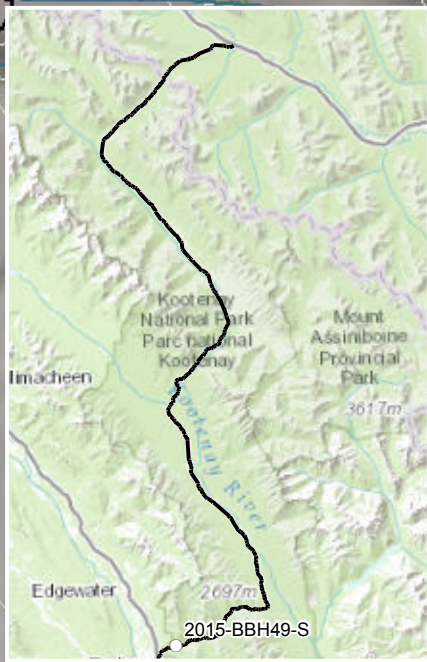


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

Watercourse Sensitivity Level

- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
- ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
- ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
- ▲ 4 - No habitat, runoff drainage or no watercourse present.
- Ecological Sites (Aqua)

2015-BBH48-N
Highway 93S Kootenay Parkway
Parks Canada

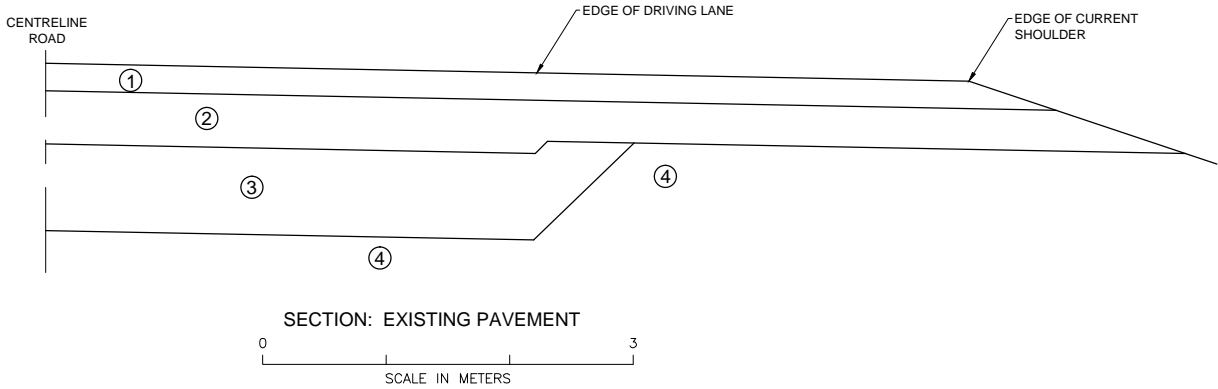


- Proposed Borings
- Proposed Shoulder Borings
- Proposed Borings to be Decided Later if Required
- Existing Boreholes
- Cultural Sites
- Cultural Site Areas
- Archaeology Site
- Archaeology Site Areas

- Watercourse Sensitivity Level**
- ▲ 1 - Fish bearing, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 2 - Fish bearing uncertain, good habitat. Maintain or improve fish passage where applicable.
 - ▲ 3 - Not fish bearing; potentially important for delivery of food and nutrients to downstream habitats.
 - ▲ 4 - No habitat, runoff drainage or no watercourse present.
 - Ecological Sites (Aqua)

2015-BBH49-S
Highway 93S Kootenay Parkway
Parks Canada

February 16, 2016, 07:10:10
Plotted:
Filename: C:\ADPT\WORK\A\Fig01011106_Figure2.dwg;Section



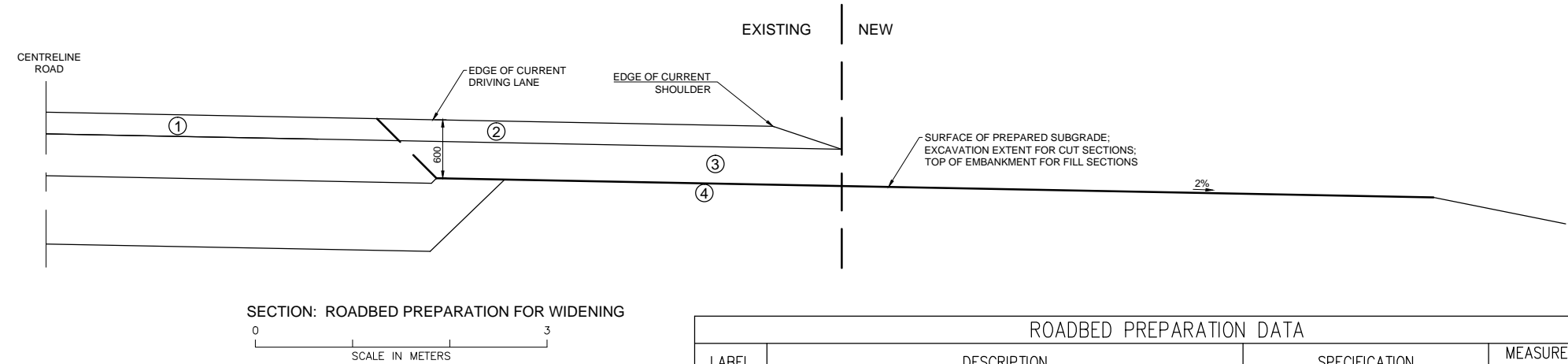
EXISTING SECTION DATA		
LABEL	DESCRIPTION	THICKNESS
1	ASPHALT PAVEMENT	VARIES BETWEEN 90 AND 310; 220 TYPICAL
2	CRUSHED GRAVEL & SAND	VARIES BETWEEN 0 AND 580; 430 TYP; ABOUT 100 THINNER UNDER SHOULDER
3	GENERALLY GRAVEL & SAND	VARIES BETWEEN 200 & 2450; 700 TYP
4	SUBGRADE; TYPICALLY SILTY CLAY; SOMETIMES BEDROCK OR SAND & GRAVEL	

TABLE NOTES:

- THE TABLE DATA IS BASED ON AVAILABLE DATA.
- PRIMARY DATA SOURCE IS: KOOTENAY PARKWAY, HIGHWAY 93S, KOOTENAY NATIONAL PARK, LARGE CRACK INVESTIGATION, 10 YEAR MAINTENANCE PLAN; JOHN EMERY GEOTECHNICAL ENGINEERING LTD; MARCH, 2008

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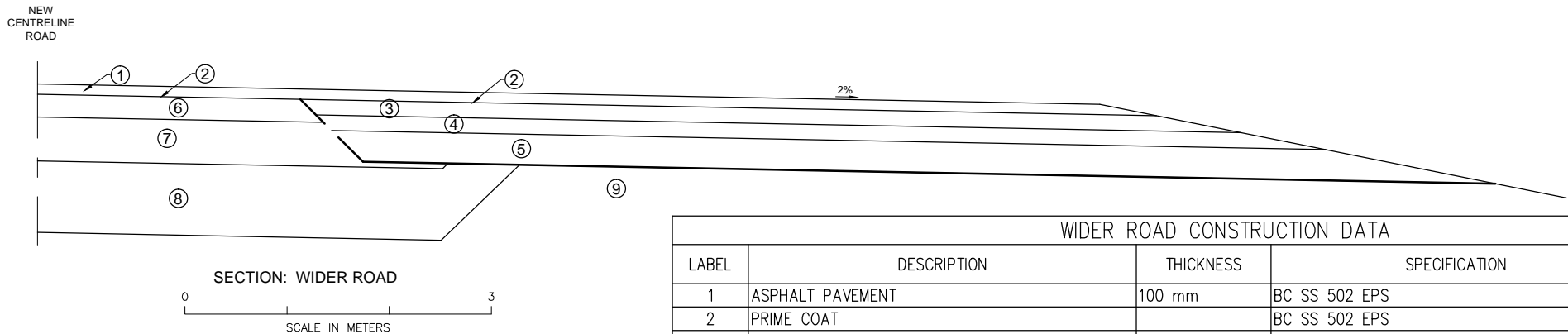
INFORMATION SHOWN ON THESE DRAWINGS REGARDING EXISTING UTILITIES IS COMPILED FROM SOME RECORD DRAWINGS AND SOME SURVEYS, AND MAY NOT BE COMPLETE OR FULLY ACCURATE. PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL EXPOSE AND CONFIRM THE LOCATIONS AND ELEVATIONS OF ALL EXISTING UTILITIES AND ADVISE THE CORPORATION REPRESENTATIVE OF ANY POTENTIAL CONFLICTS.



ROADBED PREPARATION DATA			
LABEL	DESCRIPTION	SPECIFICATION	MEASUREMENT & PAYMENT UNITS
1	PULVERIZE EXISTING ASPHALT PAVEMENT TO DEPTH OF 250; SHAPE & COMPACT TO 100% STD PROCTOR DENISTY (ASTM D698)	BC SS 511(MODIFIED) & BC SS 503	CUBIC METRE
2	PULVERIZE EXISTING SHOULDER ASPHALT & REMOVE; MATERIAL MAY BE USED FOR SUBGRADE FILL	BC SS 511(MODIFIED) & BC SS 201 TYPE D EXCAVATION	CUBIC METRE
3	REMOVE EXISTING SHOULDER MATERIALS; MATERIAL MAY BE USED FOR SUBGRADE FILL	BC SS 201 TYPE D EXCAVATION	CUBIC METRE
4	SUBGRADE	BC SS 201	CUBIC METRE

TABLE NOTES:

- "BC" DENOTES THE BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE.
- "SS" DENOTES STANDARD SPECIFICATION.



WIDER ROAD CONSTRUCTION DATA				
LABEL	DESCRIPTION	THICKNESS	SPECIFICATION	MEASUREMENT & PAYMENT UNITS
1	ASPHALT PAVEMENT	100 mm	BC SS 502 EPS	TONNE
2	PRIME COAT		BC SS 502 EPS	LITRE
3	CRUSHED BASE COARSE	150 mm	BC SS 202; CBC WGB 25 mm	CUBIC METRE
4	CRUSHED BASE COARSE	150 mm	BC SS 202; CBC WGB 75mm, 50 mm OR 25mm	CUBIC METRE
5	SELECT GRANULAR SUB-BASE	300 mm	BC SS 202; SGSB	CUBIC METRE
6	PULVERIZED EXISTING ASPHALT PAVEMENT	ABOUT 250 mm		
7	EXISTING CRUSHED GRAVEL & SAND	VARIES		
8	EXISTING SUB-BASE; GENERALLY GRAVEL & SAND	VARIES		
9	SUBGRADE (EMBANKMENT OR NATIVE MATERIAL)	VARIES	BC SS 201	CUBIC METRE

TABLE NOTES:

- "BC" DENOTES THE BRITISH COLUMBIA MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE.
- "SS" DENOTES STANDARD SPECIFICATION.

Client/client

Parks Canada
Agency
Western and
Northern Region

L'Agence Parcs
Canada
Ouest et Nord
Région

Consultant's Name
Nom de l'expert-conseil



Project title/Titre du projet

**HIGHWAY 93 SOUTH
SAFETY IMPROVEMENTS**

BANFF & KOOTENAY NATIONAL PARKS

Drawing title/Titre du dessin

**CROSS SECTIONS
KOOTENAY PARKWAY
PAVEMENT STRUCTURE RECOMMENDATIONS**

NOT FOR CONSTRUCTION

Surveyed by/Arpenté par -	Drawn by/Dessiné par -	Date/Date 2016.02.16
Designed by/Concepé par -	Reviewed by/Revisé par -	Scale/Echelle AS SHOWN

Parks Canada Project Manager/Administrateur de Projets Parcs Canada

Client Acceptance/Acceptation du client -	Approved by/Approuvé par -
--	-------------------------------

Parks Canada Responsible Officer/Agent Responsable Parcs Canada

Parks Canada Project Manager/Responsable de Projets Parcs Canada

Project No./No. du projet 201536	Asset No./No. du-bien -	Sheet No./ No. de la feuille REV A
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Drawing Reference No./No. de référence du dessin

FIGURE 2

of -

Appendix A

Boring Logs

\\BARR.COM\PROJECTS\CALGARY\61 CANADA\0161011106 PARKS CANADA AGENCY\00 HIGHWAY 93S KOOTENAY PARKWAY GEOTECH SERVICES\WORKFILES\GEOTECHNICAL INVESTIGATION\



Barr Engineering and Environmental Science Canada Ltd.
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Telephone: 403-592-8300

LOG OF BORING 2015-BBH01-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT %	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties						
								WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.: 1450.63 m				PL LL								
1450.5	0.0		LEAN CLAY WITH SAND AND GRAVEL (CL): dark brown; moist to wet; medium stiff; some organics; low plasticity.		26	X		15						
1450.0	0.5		SILTY CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; medium dense.			X		4.2						
1449.5	1.0				21									
1449.0	1.5		Fine grained; increasing amount of clay.											
1448.5	2.0				25									
1448.0	2.5	1448.34	LEAN CLAY WITH GRAVEL (CL): fine to coarse grained; brown; moist; stiff; trace fine sand; low plasticity.		14	14 21	15.1 53 82	10.1				3.5		
1447.5	3.0	1447.58	SILTY CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown and rusty red; moist; very dense.			>> 73								
1447.0	3.5												4.5	
	4.0		Bottom of Boring at 3.66 meters											
	4.5	1446.97												
Completion Depth: 12.0		Remarks: In ditch, close to the utility line, deep snow cover Offset of around 0.5 m												
Date Boring Started: 10/12/15														
Date Boring Completed: 10/12/15														
Logged By: VLW														
Drilling Contractor: Earth Drilling														
Drilling Method: SSA														
Ground Surface Elevation: 4759.3														
Coordinates: UTM NAD83 N:5679618m, E:574059m														
Datum: NAD83														
SAMPLE TYPES					WATER LEVELS (m)			LEGEND						
Split Spoon					At Time of Drilling Dry			MC Moisture Content	Q_u Unconfined Compression					
								γ Dry Unit Weight	Q_p Hand Penetrometer UC					
								ϕ Friction Angle	Gs Specific Gravity					
									RQD Rock Quality Designation					

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH02-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency										
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %		SIEVE ANALYSIS		Physical Properties					
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL ———— X ———— LL		<div><div>GRAVEL</div><div>SAND</div><div>SILT</div><div>CLAY</div><div>FINES</div></div>		WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %	
	0.0	Surface Elev.: 1498.61 m																
1498.5		SILTY CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brownish dark grey; moist; medium dense; few organics.			17								5.2					
1498.0																		
1497.5		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brownish dark grey; moist; medium dense to very dense; gravel sizes less than 1".		1497.85	18													
1497.0																		
1496.5																		
1496.0		SILTY CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; very dense.		1496.32														
1495.5		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brownish grey; moist; very dense; gravel sizes around 1".		1495.56														
1495.0		Bottom of Boring at 3.66 meters		1494.95														
	4.0																	
	4.5																	
Completion Depth:		12.0		Remarks: Offset of around 0.5 m														
Date Boring Started:		10/12/15																
Date Boring Completed:		10/12/15																
Logged By:		VLW																
Drilling Contractor:		Earth Drilling																
Drilling Method:		SSA																
Ground Surface Elevation:		4916.7																
Coordinates:		UTM NAD83 N:5679788m, E:573080m																
Datum:		NAD83																
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND						
				Split Spoon				At Time of Drilling Dry				MC Moisture Content Q_u Unconfined Compression						
												γ Dry Unit Weight Q_p Hand Penetrometer UC						
												ϕ Friction Angle Gs Specific Gravity						
												RQD Rock Quality Designation						

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH03-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency															
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL LL		GRAVEL SAND SILT CLAY FINES				WC	γ	ϕ	Q_u	Q_p	Gs	RQD		
													%	pcf	°	tsf	tsf				
	0	Surface Elev.: 1579.60 m			10	20	30	40	20	40	60	20	40	60	80						
1579		PEAT/TOPSOIL (PT): dark brown; moist; soft; trace roots.		1579.37	7						×					53.2				2	
	1	LEAN CLAY (CL): dark brown to light brown; moist; medium stiff to hard; trace organics; trace fine to coarse gravel; light brown and orange/rust colour from 1.15 m; low plasticity.			7															3	
1578	2	Brown to light brown; moist to wet; sandy lean clay; trace fine to coarse gravel.			24				2222	×		6.9		56.8	87.4	26.6				4	
1577					18															2	
	3																				
1576									78/11"	×						12.8				4.5	
1575	4	SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to medium grained; dark brown to brown; moist to wet; very dense; top of the layer wet from seepage.		1575.79					50/4"	×											
	5								50/4"	×											
	6	Bottom of Boring at 5.18 meters CBR Test conducted - Max Dry Density 1239 kg/m3, optimum water content 34.5%, CBR (95%) 1.34		1574.42												14.1					
Completion Depth:		17.0		Remarks: Offset of around 4m N																	
Date Boring Started:		11/12/15																			
Date Boring Completed:		11/12/15																			
Logged By:		VLW																			
Drilling Contractor:		Earth Drilling																			
Drilling Method:		SSA																			
Ground Surface Elevation:		5182.4																			
Coordinates:		UTM NAD83 N:5679288m, E:571770m																			
Datum:		NAD83																			
SAMPLE TYPES					WATER LEVELS (m)					LEGEND											
Split Spoon					At Time of Drilling 1.83					MC Moisture Content Q_u Unconfined Compression											
										γ Dry Unit Weight Q_p Hand Penetrometer UC											
										ϕ Friction Angle Gs Specific Gravity											
										RQD Rock Quality Designation											

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH05-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency																			
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %		SIEVE ANALYSIS				Physical Properties									
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m				PL LL		GRAVEL SAND SILT CLAY FINES				WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %			
	0.0	Surface Elev.: 1655.37 m																							
	0.5	ASPHALT: 9 inches thick.																							
1655.0		FILL (GC-GM): fine to coarse grained; brown; moist; very dense.		1655.14																					
	1.0																								
1654.0																									
	1.5																								
1653.5		SILTY,CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; brown; moist to wet; dense to very dense; wet from 2.1 m.		1653.54																					
1653.0																									
	2.5																								
1652.5																									
	3.0																								
1652.0		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to medium grained; brown; moist to wet; very dense.		1652.02																					
	3.5																								
1651.5																									
	4.0	Bottom of Boring at 3.96 meters		1651.41																					
	4.5																								
Completion Depth:		13.0		Remarks: wet pockets perched on larger rocks																					
Date Boring Started:		10/12/15		Offset of 2.6 m NNW																					
Date Boring Completed:		10/12/15																							
Logged By:		ETB																							
Drilling Contractor:		Earth Drilling																							
Drilling Method:		SSA																							
Ground Surface Elevation:		5431																							
Coordinates:		UTM NAD83 N:5678909m, E:570749m																							
Datum:		NAD83																							
SAMPLE TYPES				WATER LEVELS (m)				LEGEND																	
Split Spoon				At Time of Drilling Dry				MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation																	

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH06-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency														
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %		SIEVE ANALYSIS				Physical Properties						
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m		PL LL		GRAVEL SAND SILT CLAY FINES				WC	γ	ϕ	Q_u	Q_p	Gs	RQD		
														%	pcf	°	tsf	tsf				
	0	Surface Elev.: 1708.56 m				10	20	30	40	20	40	60	20	40	60	80						
1708		SILTY,CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark brownish grey to brown; moist to wet; loose to very dense; fine to coarse sand.				8				X							9.2					
	1																					
1707		Increasing sand and clay content.																				
	2	Moist to wet.																				
1706																	6.8					
	3	SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brown; moist to wet; very dense.		1705.51																		
1705																						
	4																					
1704		SILTY,CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey and brown; moist to wet; very dense.		1703.99																		
	5	Bottom of Boring at 5.18 meters		1703.38																		
	6																					
Completion Depth:		17.0		Remarks: Offset of around 10 m																		
Date Boring Started:		11/12/15																				
Date Boring Completed:		11/12/15																				
Logged By:		VLW																				
Drilling Contractor:		Earth Drilling																				
Drilling Method:		SSA																				
Ground Surface Elevation:		5605.5																				
Coordinates:		UTM NAD83 N:5678429m, E:569935m																				
Datum:		NAD83																				
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND										
				Split Spoon				At Time of Drilling Dry				MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation										

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH07-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency													
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties						
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL LL		GRAVEL SAND SILT CLAY FINES				WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
		Surface Elev.: 1729.56 m																	
1729.5	0.0	SILTY,CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark grey; moist; dense to very dense; trace organics/roots.																	
1729.0	0.5																		
1728.5	1.0																		
1728.0	1.5	Increasing sand content.																	
1727.5	2.0																		
1727.0	2.5	Wet; with blue-grey weathered shale particles.																	
1726.5	3.0	Wet; with blue-grey weathered shale particles.																	
1726.0	3.5																		
	4.0	Bottom of Boring at 3.66 meters																	
	4.5																		
Completion Depth: 12.0		11/12/15		Remarks: Offset of around 10 m from stake, due to utility line															
Date Boring Started: 11/12/15		11/12/15																	
Date Boring Completed: 11/12/15		VLW																	
Logged By: Earth Drilling		SSA																	
Drilling Contractor: 5674.4		UTM NAD83 N:5677938m, E:568173m																	
Drilling Method: NAD83																			
Ground Surface Elevation:																			
Coordinates:																			
Datum:																			
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND							
				Split Spoon				At Time of Drilling Dry				MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation							

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH08-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties						
								WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
1724.5	0.0	Surface Elev.: 1724.56 m	TOPSOIL/CLAYEY SAND (SC): coarse grained; dark brown; moist to wet.	1724.51	8	16 26	19.1 50.3 76.4	13.5				2		
1724.0	0.5		LEAN CLAY WITH SAND AND GRAVEL (CL): fine to coarse grained; dark brown to brown; moist to wet; medium stiff; low plasticity.											
1723.5	1.0				7			12				3		
1723.0	1.5		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to medium grained; brown; moist to wet; very dense.	1723.04										
1722.5	2.0					61/8"								
1722.0	2.5					50/5.5"								
1721.5	3.0		Blue-grey gravel (around 1").			50/4"								
1721.0	3.5							11.5						
	4.0		Bottom of Boring at 3.66 meters	1720.9										
	4.5													
Completion Depth:		12.0	Remarks: Offset of around 0.5 m											
Date Boring Started:		11/12/15												
Date Boring Completed:		11/12/15												
Logged By:		VLW												
Drilling Contractor:		Earth Drilling												
Drilling Method:		SSA												
Ground Surface Elevation:		5658												
Coordinates:		UTM NAD83 N:5677761m, E:567976m												
Datum:		NAD83												
SAMPLE TYPES			WATER LEVELS (m)			LEGEND								
Split Spoon			At Time of Drilling Dry			MC Moisture Content			Q_u Unconfined Compression					
						γ Dry Unit Weight			Q_p Hand Penetrometer UC					
						ϕ Friction Angle			Gs Specific Gravity					
									RQD Rock Quality Designation					

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH09-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency										
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m 10 20 30 40		WATER CONTENT % PL ——— X ——— LL 20 40 60		SIEVE ANALYSIS GRAVEL SAND SILT CLAY 41.5 89.2		Physical Properties							
		MATERIAL DESCRIPTION (ASTM D2488)									WC	γ	φ	Q _u	Q _p	G _s	RQD	
		Surface Elev.: 1696.58 m			%	pcf	°	tsf	tsf									
		1696.5	0.0		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brown to dark brown, grey; moist; very loose to dense; trace organics.								8.6					
		1696.0	0.5															
		1695.5	1.0															
		1695.0	1.5															
		1694.5	2.0										7.3					
		1694.0	2.5															
		1693.5	3.0		Bottom of Boring at 3.66 meters 1692.92													
1693.0	3.5																	
	4.0																	
	4.5																	
Completion Depth: 12.0		Remarks: Offset: 1.5 m from stake																
Date Boring Started: 12/12/15																		
Date Boring Completed: 12/12/15																		
Logged By: VLW																		
Drilling Contractor: Earth Drilling																		
Drilling Method: SSA																		
Ground Surface Elevation: 5566.2																		
Coordinates: UTM NAD83 N:5676703m, E:566924m																		
Datum: NAD83																		
				SAMPLE TYPES		WATER LEVELS (m)		LEGEND										
				Split Spoon		At Time of Drilling Dry		MC Moisture Content Q _u Unconfined Compression										
								γ Dry Unit Weight Q _p Hand Penetrometer UC										
								φ Friction Angle G _s Specific Gravity										
								RQD Rock Quality Designation										

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LOG OF BORING 2015-BBH10-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency																					
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %				SIEVE ANALYSIS				Physical Properties												
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m				PL LL				GRAVEL SAND SILT CLAY FINES				WC	γ	φ	Q _u	Q _p	G _s	RQD					
		Surface Elev.: 1676.55 m																%	pcf	°	tsf	tsf		%					
1676.5	0.0	TOPSOIL: with organics.		1676.5																									
1676.0	0.5	SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brown to dark brownish grey; moist; medium dense to very dense; trace clay.			16																								
1675.5	1.0																												
1675.0	1.5																												
1674.5	2.0																												
1674.0	2.5																												
1673.5	3.0																												
1673.0	3.5																												
	4.0	Bottom of Boring at 3.66 meters		1672.89																									
	4.5																												
Completion Depth:		12.0		Remarks: Offset: 0.3 m from stake																									
Date Boring Started:		12/12/15																											
Date Boring Completed:		12/12/15																											
Logged By:		VLW																											
Drilling Contractor:		Earth Drilling																											
Drilling Method:		SSA																											
Ground Surface Elevation:		5500.5																											
Coordinates:		UTM NAD83 N:5676503m, E:566763m																											
Datum:		NAD83																											
					SAMPLE TYPES				WATER LEVELS (m)				LEGEND																
					⊗ Split Spoon				▼ At Time of Drilling Dry				MC Moisture Content				Q _u Unconfined Compression												
													γ Dry Unit Weight				Q _p Hand Penetrometer UC												
													φ Friction Angle				G _s Specific Gravity												
																	RQD Rock Quality Designation												

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH11-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency													
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS		Physical Properties									
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m		PL ———— X ———— LL		GRAVEL SAND SILT CLAY FINES		WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %			
						Surface Elev.: 1658.57 m															
						1658.5	0.0	SILTY,CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brown, grey; moist; medium dense to very dense.		17		X				5.4					
						1658.0	0.5														
						1657.5	1.0			26											
						1657.0	1.5														
						1656.5	2.0			37		X				3.7					
						1656.0	2.5					>> 69						4.5			
						1655.5	3.0	Purple rock pieces.													
1655.0	3.5					>> 50/5"															
		Bottom of Boring at 3.66 meters CBR Test conducted - CBR (95%) 12.72		1654.91																	

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH12-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency											
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS		Physical Properties							
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m		PL ———— X ———— LL		GRAVEL SAND SILT CLAY FINES		WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %	
		Surface Elev.: 1651.56 m				10 20 30 40		20 40 60		20 40 60 80									
		TOPSOIL: with organics.								35.5 85.2									
		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; brown; moist; loose to medium dense.				10		X				11.7							
651.50	0.00	1651.51																	
651.25	0.25																		
651.00	0.50																		
650.75	0.75																		
650.50	1.00														4.5				
650.25	1.25																		
650.00	1.50																		
	1.75	Bottom of Boring at 1.65 meters																	
		1649.91																	
Completion Depth: 5.4		12/12/15		Remarks: SPT sampler show broke after sample V51															
Date Boring Started: 12/12/15		12/12/15		Offset: 2m from stake															
Date Boring Completed: 12/12/15		VLW		SAMPLE TYPES				WATER LEVELS (m)				LEGEND							
Logged By: VLW		Earth Drilling		Split Spoon				At Time of Drilling Dry				MC Moisture Content							
Drilling Contractor: Earth Drilling		SSA										γ Dry Unit Weight							
Drilling Method: SSA		5418.5										φ Friction Angle							
Ground Surface Elevation: 5418.5		UTM NAD83 N:5675662m, E:566303m										Q _u Unconfined Compression							
Coordinates: UTM NAD83 N:5675662m, E:566303m		NAD83										Q _p Hand Penetrometer UC							
Datum: NAD83												G _s Specific Gravity							
												RQD Rock Quality Designation							

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH16-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency																		
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m				WATER CONTENT % PL LL				SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES				Physical Properties									
		MATERIAL DESCRIPTION (ASTM D2488)															WC	γ	φ	Q _u	Q _p	G _s	RQD			
		Surface Elev.: 1510.62 m																	%	pcf	°	tsf	tsf		%	
		1510.5	0.0		TOPSOIL: with organics.		1510.57	16				×				47.4 87.2				6.8						
		1510.0	0.5		SILTY,CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark grey and brown; moist; medium dense.																					
		1509.5	1.0		LEAN CLAY WITH GRAVEL (CL): brown; moist; very stiff; trace fine to coarse sand.		1509.86	20				19,21				8.7				4.5						
		1509.0	1.5		Grey/white; 4" cobble.																					
		1508.5	2.0		SILTY,CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; medium dense.		1509.1	32																		
		1508.0	2.5					12				×								9.4						
		1507.5	3.0																							
1507.0	3.5				21																					
	4.0	Bottom of Boring at 3.66 meters		1506.96																						
	4.5																									
Completion Depth:		12.0		Remarks: Offset: 2m from stake																						
Date Boring Started:		14/12/15																								
Date Boring Completed:		14/12/15																								
Logged By:		VLW																								
Drilling Contractor:		Earth Drilling																								
Drilling Method:		SSA																								
Ground Surface Elevation:		4956.1																								
Coordinates:		UTM NAD83 N:5671662m, E:562551m																								
Datum:		NAD83																								
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND														
				Split Spoon				At Time of Drilling Dry				MC Moisture Content Q _u Unconfined Compression γ Dry Unit Weight Q _p Hand Penetrometer UC φ Friction Angle G _s Specific Gravity RQD Rock Quality Designation														

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH17-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %				SIEVE ANALYSIS				Physical Properties																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m				PL LL				GRAVEL SAND SILT CLAY FINES				WC	γ	ϕ	Q_u	Q_p	Gs	RQD																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
		Surface Elev.: 1460.63 m																%	pcf	°	tsf	tsf		%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
1460.5	0.0	TOPSOIL: some wood pieces.		1460.6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

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LOG OF BORING 2015-BBH18-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency													
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m		WATER CONTENT % PL LL		SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES				Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)																			
		Surface Elev.: 1456.64 m																			
		1456.5	0.0		TOPSOIL: brown; with organics.		1456.56	8							21.7					3	
		1456.0	0.5		SILTY LEAN CLAY WITH GRAVEL (CL/ML): dark tannish brown to brown; moist; medium stiff to very stiff; trace coarse sand; low plasticity.																
		1455.5	1.0					43					15.4	39.3	82	13.6					
		1455.0	1.5																		
		1454.5	2.0					29			23	31					19.1			4.5	
		1454.0	2.5		SILTY,CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark brown to brown, grey; moist to wet; medium dense to dense; trace fine to coarse sand.		1454.35														
1453.5	3.0	4 inches thick dark grey shale layer.																			
1453.0	3.5				26									8.2							
	4.0	Bottom of Boring at 3.66 meters		1452.98																	
	4.5																				
Completion Depth:		12.0		Remarks: Offset: 1.5 m from stake																	
Date Boring Started:		14/12/15																			
Date Boring Completed:		14/12/15																			
Logged By:		VLW																			
Drilling Contractor:		Earth Drilling																			
Drilling Method:		SSA																			
Ground Surface Elevation:		4779																			
Coordinates:		UTM NAD83 N:5670592m, E:561131m																			
Datum:		NAD83																			
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND									
				Split Spoon				At Time of Drilling Dry				MC Moisture Content				Qu Unconfined Compression					
												γ Dry Unit Weight				Qp Hand Penetrometer UC					
												φ Friction Angle				Gs Specific Gravity					
																RQD Rock Quality Designation					

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LOG OF BORING 2015-BBH19-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency											
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT %	SIEVE ANALYSIS	Physical Properties									
		MATERIAL DESCRIPTION (ASTM D2488)	WC %					γ pcf	ϕ °	Q_u tsf	Q_p tsf	G_s	RQD %				
	0.0	Surface Elev.: 1460.63 m															
1460.5	0.5	SILTY,CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark brown to brown and grey; moist; medium dense to dense; trace roots and pine needles; gravel size upto 2 inches. Shale fragments in the sample.		16	×												
1460.0	1.0			22													
1459.5	1.5																
1459.0	2.0			32	×	22 24											
1458.5	2.5																
1458.0	3.0			33													
1457.5	3.5	SILTY LEAN CLAY WITH GRAVEL (CL/ML): brown; moist; very stiff; low plasticity.	1457.58	25	×		11.3 27.9 83									4.5	
1457.0	4.0	Bottom of Boring at 3.66 meters	1456.97														
	4.5																
Completion Depth:		12.0		Remarks: Just off the shoulder to minimize traffic disruption													
Date Boring Started:		14/12/14															
Date Boring Completed:		14/12/14															
Logged By:		VLW															
Drilling Contractor:		Earth Drilling															
Drilling Method:		SSA															
Ground Surface Elevation:		4792.1															
Coordinates:		UTM NAD83 N:5669974m, E:560578m															
Datum:		NAD83															
				SAMPLE TYPES		WATER LEVELS (m)			LEGEND								
				Split Spoon		At Time of Drilling Dry			MC Moisture Content								
									γ Dry Unit Weight								
									ϕ Friction Angle								
									Q_u Unconfined Compression								
									Q_p Hand Penetrometer UC								
									G_s Specific Gravity								
									RQD Rock Quality Designation								

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH20-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency															
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %			SIEVE ANALYSIS			Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m				PL LL			GRAVEL SAND SILT CLAY FINES			WC	γ	ϕ	Q_u	Q_p	Gs	RQD		
															%	pcf	°	tsf	tsf		%		
	0.0	Surface Elev.: 1426.65 m			10	20	30	40	20	40	60	20	40	60	80								
1426.5	0.5	TOPSOIL: with organics.		1426.62																			
		SILTY,CLAYEY SAND WITH GRAVEL (SC-SM): fine to coarse grained; dark brown and grey; moist; medium dense; trace fines.																					
1426.0	1.0	SILTY LEAN CLAY WITH SAND (CL/ML): tannish brown; moist; stiff; trace gravel; low plasticity.		1425.89																			
1425.5	1.5																						
1425.0	2.0																						
		LEAN CLAY WITH SAND (CL): tannish brown; moist; stiff; medium plasticity.		1424.36																			
1424.5	2.5																						
1424.0	3.0																						
1423.5	3.5																						
1423.0	4.0	Bottom of Boring at 3.66 meters		1422.99																			
	4.5																						
Completion Depth:		12.0		Remarks: Just south of entrance																			
Date Boring Started:		14/12/15																					
Date Boring Completed:		14/12/15																					
Logged By:		VLW																					
Drilling Contractor:		Earth Drilling																					
Drilling Method:		SSA																					
Ground Surface Elevation:		4680.6																					
Coordinates:		UTM NAD83 N:5668994m, E:559602m																					
Datum:		NAD83																					
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND											
				⊠ Split Spoon				▼ At Time of Drilling Dry				MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation											

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH21-S

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency														
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS		Physical Properties									
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m	PL	LL	GRAVEL SAND SILT CLAY FINES	WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %					
	0	Surface Elev.: 1403.30 m			10	20	30	40												
	1403	ASPHALT: 7 inches thick.		1403.12																
		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey-brown; moist to wet; loose to very dense; few to many large rocks.																		
	1																			
	1402																			
	2																			
	1401																			
	3																			
	1400																			
	4																			
	1399																			
		LEAN CLAY WITH SAND (CL): fine grained; brown/grey; wet; stiff; low plasticity.		1398.88																
	5																			
	1398																			
		Bottom of Boring at 5.43 meters		1397.87																
	6																			
Completion Depth:		17.8		Remarks: Offset of 2.67 m NE																
Date Boring Started:		10/12/15																		
Date Boring Completed:		10/12/15																		
Logged By:		ETB																		
Drilling Contractor:		Earth Drilling																		
Drilling Method:		SSA																		
Ground Surface Elevation:		4604																		
Coordinates:		UTM NAD83 N:5667259m, E:559125m																		
Datum:		NAD83																		
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND								
				Split Spoon				At Time of Drilling 2.59				MC Moisture Content								
												γ Dry Unit Weight								
												φ Friction Angle								
												Q _u Unconfined Compression								
												Q _p Hand Penetrometer UC								
												G _s Specific Gravity								
												RQD Rock Quality Designation								

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH22-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency															
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m 10 20 30 40				WATER CONTENT % PL LL 20 40 60				SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES 20 40 60 80				Physical Properties						
		MATERIAL DESCRIPTION (ASTM D2488)															WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	Gs	RQD %
		Surface Elev.: 1388.67 m																					
		ASPHALT: 12 inches thick.																					
		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): dark grey; moist; very dense.			1388.37																		
		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): brown; moist; dense to very dense.			1387.6																		
		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey; moist to wet.			1386.08																		
Bottom of Boring at 3.96 meters		1384.71																					

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH23-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency																	
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties									
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m		PL ——— X ——— LL		GRAVEL SAND SILT CLAY FINES				WC	γ	φ	Q _u	Q _p	G _s	RQD			
														%	pcf	°	tsf	tsf		%			
	0	Surface Elev.: 1393.24 m				10	20	30	40	20	40	60	20	40	60	80							
1393		ASPHALT: 10.5 inches thick.																					
	1	FILL (GC-GM): fine to coarse grained; grey/brown; moist; very dense; heavily compacted.		1392.97																			
1392																							
	2																						
1391																							
	3	LEAN CLAY WITH SAND (CL): medium grained; olive brown; moist to wet; stiff to very stiff; some gravel.		1390.69																			
1390																							
	4																						
1389																							
	5	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to medium grained; grey; medium dense.		1388.4																			
1388																							
	6	Bottom of Boring at 5.52 meters		1387.72																			
Completion Depth:		18.1		Remarks:																			
Date Boring Started:		11/12/15																					
Date Boring Completed:		11/12/15																					
Logged By:		ETB																					
Drilling Contractor:		Earth Drilling																					
Drilling Method:		SSA		<div><div><div></div></div> Split Spoon</div> <div><div><div></div></div> At Time of Drilling Dry</div> <div><div>MC Moisture Content</div><div>γ Dry Unit Weight</div><div>φ Friction Angle</div></div> <div><div>Q_u Unconfined Compression</div><div>Q_p Hand Penetrometer UC</div><div>G_s Specific Gravity</div><div>RQD Rock Quality Designation</div></div>																			
Ground Surface Elevation:		4571																					
Coordinates:		UTM NAD83 N:5662749m, E:563471m																					
Datum:		NAD83																					

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH24-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Surface Elev.: 1335.02 m	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties						
										WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0.0		ASPHALT: 9 inches thick.													
1334.5	0.5		FILL (GC-GM): medium to coarse grained; grey; moist; very dense; heavily compacted.	1334.79												
1334.0	1.0		SILTY, CLAYEY SAND WITH GRAVEL (SC-SM): medium to coarse grained; brown; moist; medium dense; many large quartz rocks.	1334.01												
1333.5	1.5															
1333.0	2.0		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; light grey to grey; moist; dense to very dense; cobbles.	1333.24												
1332.5	2.5		Grey/white gravel.													
1332.0	3.0															
1331.5	3.5															
	4.0		Bottom of Boring at 3.91 meters CBR Test conducted - Max Dry Density 2159 kg/m ³ , optimum water content 8.9%, CBR (95%) 11.13	1331.11												
	4.5															
Completion Depth: 12.8			Remarks: Golf sized rocks in sand/gravel Offset of 3 m SW													
Date Boring Started: 11/12/15																
Date Boring Completed: 11/12/15																
Logged By: ETB																
Drilling Contractor: Earth Drilling																
Drilling Method: SSA																
Ground Surface Elevation: 4380																
Coordinates: UTM NAD83 N:5659142m, E:566525m																
Datum: NAD83																
SAMPLE TYPES							WATER LEVELS (m)			LEGEND						
Split Spoon							At Time of Drilling Dry			MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation						

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH25-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency																		
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS		Physical Properties													
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL LL		<div><div>GRAVEL</div><div>SAND</div><div>SILT</div><div>CLAY</div><div>FINES</div></div>		WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %							
	0	Surface Elev.: 1265.53 m			10	20	30	40		20	40	60												
		ASPHALT: 7 inches thick.																						
1265		FILL (GC-GM): fine to coarse grained; grey; moist; very dense; Gravel fill.		1265.35																				
	1																							
1264																								
	2	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey/brown; moist; dense to very dense; few to many rocks.		1263.75																				
1263																								
	3																							
1262																								
	4	LEAN CLAY (CL): brown; moist to wet; very stiff; trace gravel.		1261.62																				
1261																								
	5																							
	6	Bottom of Boring at 5.43 meters		1260.1																				
Completion Depth:		17.8		Remarks:																				
Date Boring Started:		11/12/15																						
Date Boring Completed:		11/12/15																						
Logged By:		ETB		SAMPLE TYPES				WATER LEVELS (m)				LEGEND												
Drilling Contractor:		Earth Drilling		<div><div></div> Split Spoon</div>				<div><div></div> At Time of Drilling Dry</div>				MC Moisture Content									Q _u Unconfined Compression			
Drilling Method:		SSA										γ Dry Unit Weight									Q _p Hand Penetrometer UC			
Ground Surface Elevation:		4152										φ Friction Angle									G _s Specific Gravity			
Coordinates:		UTM NAD83 N:5653125m, E:571442m		RQD Rock Quality Designation																				
Datum:		NAD83																						

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LOG OF BORING 2015-BBH26-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency										
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)						WC	γ	φ	Q _u	Q _p	G _s	RQD		
								%	pcf	°	tsf	tsf		%		
Surface Elev.: 1262.18 m																
1262	0	ASPHALT: 11 inches thick.														
		FILL (GC-GM): medium to coarse grained; grey; moist; very dense.		1261.9												
1261	1															
		LEAN CLAY WITH GRAVEL (CL): fine to coarse grained; grey-brown; moist; hard.		1260.32												
1260	2															
		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey-brown; moist; dense.		1259.56												
1259	3															
		LEAN CLAY WITH SAND (CL): fine grained; grey-brown; wet to saturated; very soft to very stiff; medium to high plasticity.		1258.8												
1258	4															
1257	5															
		Bottom of Boring at 5.52 meters		1256.66												
1256	6															
Completion Depth: 18.1			Remarks: Offset of 3.8 m NW													
Date Boring Started: 12/12/15																
Date Boring Completed: 12/12/15																
Logged By: ETB																
Drilling Contractor: Earth Drilling																
Drilling Method: SSA																
Ground Surface Elevation: 4141																
Coordinates: UTM NAD83 N:5651946m, E:571865m																
Datum: NAD83																
SAMPLE TYPES					WATER LEVELS (m)					LEGEND						
Split Spoon					At Time of Drilling 3.05											
										MC Moisture Content						
										γ Dry Unit Weight						
										φ Friction Angle						
										Q _u Unconfined Compression						
										Q _p Hand Penetrometer UC						
										G _s Specific Gravity						
										RQD Rock Quality Designation						

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH28-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency															
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL LL		GRAVEL SAND SILT CLAY FINES				WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %		
	0.0	Surface Elev.: 1232.92 m			10	20	30	40	20	40	60	20	40	60	80						
		ASPHALT: 10 inches thick.																			
1232.5	0.5	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey; moist; very dense; few rocks.		1232.67																	
1232.0	1.0																				
1231.5	1.5																				
1231.0	2.0	Dark grey; moist; medium dense; brittle; weathered shale fragments.																			
1230.5	2.5																				
1230.0	3.0	LEAN CLAY WITH GRAVEL (CL): fine to coarse grained; dark grey/brown; moist to wet; medium stiff to stiff; thin shale layers at 3.47 m and 3.67 m; low plasticity.		1230.29																	
1229.5	3.5																				
1229.0	4.0	Bottom of Boring at 4.00 meters		1228.92																	
	4.5																				
Completion Depth:		13.1		Remarks:																	
Date Boring Started:		12/12/15																			
Date Boring Completed:		12/12/15		SAMPLE TYPES																	
Logged By:		ETB																			
Drilling Contractor:		Earth Drilling		WATER LEVELS (m)																	
Drilling Method:		SSA																			
Ground Surface Elevation:		4045		LEGEND																	
Coordinates:		UTM NAD83 N:5647969m, E:573793m																			
Datum:		NAD83		MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation																	

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH29-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation		Location: Kootenay National Park		Client: Parks Canada Agency								
Elevation, meters	Barr Project Number: 61011106.00	Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m 10 20 30 40	WATER CONTENT % PL ——— X ——— LL 20 40 60	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES 20 40 60 80	Physical Properties						
	WC %					γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %	
Depth, meters	MATERIAL DESCRIPTION (ASTM D2488) Surface Elev.: 1222.86 m ASPHALT: 10 inches thick.											
1222.5	FILL (GC-GM): medium to coarse grained; brown; moist; very dense.	1222.61										
1222.0												
1221.5												
1221.0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; brown; moist; dense; large sandstone fragments.	1220.98										
1220.5												
2.5	Bottom of Boring at 2.49 meters	1220.37										
3.0												
Completion Depth: 8.2		Remarks: Refusal due to cobbles/boulders at 2.5 m										
Date Boring Started: 12/12/15												
Date Boring Completed: 12/12/15												
Logged By: ETB												
Drilling Contractor: Earth Drilling												
Drilling Method: SSA												
Ground Surface Elevation: 4012												
Coordinates: UTM NAD83 N:5645660m, E:573084m												
Datum: NAD83												
			SAMPLE TYPES		WATER LEVELS (m)		LEGEND					
			⊠ Split Spoon		▼ At Time of Drilling Dry		MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation					

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LOG OF BORING 2015-BBH30-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA	WATER CONTENT %	SIEVE ANALYSIS	Physical Properties							
Elevation, meters	Depth, meters						MATERIAL DESCRIPTION (ASTM D2488)	N in blows/0.3m	PL	LL	WC %	γ pcf	ϕ °	Q_u tsf
	0.0	Surface Elev.: 1257.30 m												
	0.5	ASPHALT: 10 inches thick.												
1257.0		FILL (GC-GM): medium to coarse grained; brown; moist; very dense.	1257.05											
	1.0													
1256.5														
	1.5	LEAN CLAY WITH SAND AND GRAVEL (CL): brown/grey; moist; hard.	1256.26											
1256.0														
	2.0													
1255.5														
	2.5													
1255.0														
	3.0													
1254.5														
	3.5	Cobble in spoon.												
1254.0														
	4.0	Bottom of Boring at 3.94 meters	1253.36											
1253.5														
	4.5													
Completion Depth: 12.9		Remarks: Offset of 3.8 m NW												
Date Boring Started: 12/12/15														
Date Boring Completed: 12/12/15														
Logged By: ETB														
Drilling Contractor: Earth Drilling														
Drilling Method: SSA														
Ground Surface Elevation: 4125														
Coordinates: UTM NAD83 N:5644435m, E:571730m														
Datum: NAD83														
SAMPLE TYPES				WATER LEVELS (m)				LEGEND						
Split Spoon				At Time of Drilling Dry				MC Moisture Content Q_u Unconfined Compression						
								γ Dry Unit Weight Q_p Hand Penetrometer UC						
								ϕ Friction Angle Gs Specific Gravity						
								RQD Rock Quality Designation						

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH31-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency										
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)						WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %		
	0.0	Surface Elev.: 1202.44 m														
	0.5	ASPHALT: 5 inches thick. FILL (GC-GM): fine to coarse grained; grown/brown; moist; very dense.		1202.31												
1202.0																
	1.0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; medium dense.		1201.53												
1201.5																
1201.0	1.5															
	2.0	LEAN CLAY WITH SAND AND GRAVEL (CL): brown; wet to saturated; stiff to hard; low plasticity.		1200.76												
1200.5																
	2.5	Coarse gravel.														
1200.0																
1199.5	3.0															
	3.5															
1199.0																
	4.0	Bottom of Boring at 3.81 meters		1198.63												
	4.5															
Completion Depth:		12.5		Remarks: Offset of 3.65 m E												
Date Boring Started:		12/12/15														
Date Boring Completed:		12/12/15														
Logged By:		ETB														
Drilling Contractor:		Earth Drilling														
Drilling Method:		SSA														
Ground Surface Elevation:		3945														
Coordinates:		UTM NAD83 N:5641864m, E:569585m														
Datum:		NAD83														
				SAMPLE TYPES		WATER LEVELS (m)		LEGEND								
				Split Spoon		At Time of Drilling 3.05		MC Moisture Content Q_u Unconfined Compression								
								γ Dry Unit Weight Q_p Hand Penetrometer UC								
								ϕ Friction Angle Gs Specific Gravity								
								RQD Rock Quality Designation								

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LOG OF BORING 2015-BBH32-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency															
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m				WATER CONTENT %				SIEVE ANALYSIS				Physical Properties						
		MATERIAL DESCRIPTION (ASTM D2488)															WC	γ	φ	Q _u	Q _p	G _s	RQD
		Surface Elev.: 1200.30 m							%	pcf	°	tsf	tsf										
		LEAN CLAY WITH SAND AND GRAVEL (CL): brown, grey; moist to wet; medium stiff to hard.																					
1200.0	0.5																						
1199.5	1.0																						
1199.0	1.5																						
1198.5	2.0																						
1198.0	2.5																						
1197.5	3.0																						
1197.0	3.5																						
1196.5	4.0	Bottom of Boring at 3.91 meters																					
	4.5																						
Completion Depth:		12.8		Remarks: Offset: 1.4 m S of stack																			
Date Boring Started:		14/12/15																					
Date Boring Completed:		14/12/15																					
Logged By:		ETB																					
Drilling Contractor:		Earth Drilling																					
Drilling Method:		SSA																					
Ground Surface Elevation:		3938																					
Coordinates:		UTM NAD83 N:5641489m, E:569307m																					
Datum:		NAD83																					
SAMPLE TYPES				WATER LEVELS (m)				LEGEND															
Split Spoon				At Time of Drilling Dry				MC Moisture Content				Q _u Unconfined Compression											
								γ Dry Unit Weight				Q _p Hand Penetrometer UC											
								φ Friction Angle				G _s Specific Gravity											
												RQD Rock Quality Designation											

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH33-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %				SIEVE ANALYSIS				Physical Properties																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m				PL LL				GRAVEL SAND SILT CLAY FINES				WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
		Surface Elev.: 1255.78 m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
	0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; medium dense to very dense.					25																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

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LOG OF BORING 2015-BBH34-SH-N

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency										
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)						WC	γ	φ	Q _u	Q _p	G _s	RQD		
								%	pcf	°	tsf	tsf		%		
Surface Elev.: 1237.18 m																
1237.0	ASPHALT: 7.5 inches thick.		1236.99													
0.5	FILL (GC-GM): fine to coarse grained; brown; moist to wet; very dense.															
1236.5																
1.0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; medium dense to dense.		1236.15													
1236.0	Large cobbles encountered.															
1.5																
1235.5																
2.0																
1235.0																
2.5																
1234.5																
3.0																
	Bottom of Boring at 3.16 meters		1234.02													
3.5																
Completion Depth: 10.4			Remarks: Cave in of cobbles at 1.5 m													
Date Boring Started: 14/12/15																
Date Boring Completed: 14/12/15																
Logged By: ETB																
Drilling Contractor: Earth Drilling																
Drilling Method: SSA																
Ground Surface Elevation: 4059																
Coordinates: UTM NAD83 N:5639284m, E:568069m																
Datum: NAD83																
SAMPLE TYPES					WATER LEVELS (m)					LEGEND						
Split Spoon					At Time of Drilling Dry					MC Moisture Content Q _u Unconfined Compression						
										γ Dry Unit Weight Q _p Hand Penetrometer UC						
										φ Friction Angle G _s Specific Gravity						
										RQD Rock Quality Designation						

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LOG OF BORING 2015-BBH35-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency													
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties						
		MATERIAL DESCRIPTION (ASTM D2488)			WC	γ	φ	Q _u	Q _p	G _s	RQD								
		Surface Elev.: 1200.30 m			%	pcf	°	tsf	tsf		%								
		ASPHALT: 5 inches thick.																	
		LEAN CLAY WITH GRAVEL (CL): brown to light brown, grey; moist; very stiff to hard; fine to coarse gravel; some cobbles.																	

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH36-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency										
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT %	SIEVE ANALYSIS	Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)						WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %		
	0	Surface Elev.: 1164.34 m			10 20 30 40	PL 20 40 60 LL	GRAVEL SAND SILT CLAY FINES									
1164		ASPHALT: 5.5 inches thick.		1164.2												
		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; dark brown to brown; moist; medium dense; trace cobbles.			17	×							6.6			
1163	1	LEAN CLAY WITH GRAVEL (CL): brown; moist; very stiff; black mottling throughout.		1163.44											2.75	
					20											
	2				27											
1162																
		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; brown, grey; moist; medium dense to dense.		1161.91												
1161	3				24											
					17	×							3			
	4															
1160					31											
	5				14											
		Bottom of Boring at 5.32 meters		1159.02												
	6															
Completion Depth:		17.5		Remarks: On the shoulder												
Date Boring Started:		14/12/15														
Date Boring Completed:		14/12/15														
Logged By:		ETB														
Drilling Contractor:		Earth Drilling														
Drilling Method:		SSA														
Ground Surface Elevation:		3820														
Coordinates:		UTM NAD83 N:5637328m, E:566864m														
Datum:		NAD83														
				SAMPLE TYPES		WATER LEVELS (m)				LEGEND						
				Split Spoon		At Time of Drilling Dry				MC Moisture Content Q_u Unconfined Compression γ Dry Unit Weight Q_p Hand Penetrometer UC ϕ Friction Angle Gs Specific Gravity RQD Rock Quality Designation						

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH37-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency																
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %				SIEVE ANALYSIS				Physical Properties							
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m				PL ———— X ———— LL				GRAVEL SAND SILT CLAY FINES				WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %	
1153.0	0.0	Surface Elev.: 1153.06 m			10 20 30 40				20 40 60				20 40 60 80											
		ASPHALT: 11 inches thick.																						
1152.5	0.5	FILL (GC-GM): fine to coarse grained; grey; moist; very dense.		1152.78					50/1.5"															
1152.0	1.0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown, grey; moist; medium dense to very dense.		1151.99																				
1151.5	1.5															4.4								
1151.0	2.0																							
1150.5	2.5																							
1150.0	3.0																							
1149.5	3.5																							
	4.0	Bottom of Boring at 3.96 meters		1149.1																				
	4.5																							
Completion Depth:		13.0		Remarks: Offset: 2.75 m W of stake																				
Date Boring Started:		15/12/15																						
Date Boring Completed:		15/12/15																						
Logged By:		ETB		SAMPLE TYPES				WATER LEVELS (m)				LEGEND												
Drilling Contractor:		Earth Drilling		⊠ Split Spoon				▽ At Time of Drilling Dry				MC Moisture Content			Q _u Unconfined Compression									
Drilling Method:		SSA										γ Dry Unit Weight			Q _p Hand Penetrometer UC									
Ground Surface Elevation:		3783										φ Friction Angle			G _s Specific Gravity									
Coordinates:		UTM NAD83 N:5631051m, E:569452m													RQD Rock Quality Designation									
Datum:		NAD83																						

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH38-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Surface Elev.: 1133.86 m	Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT % PL ——— X ——— LL	SIEVE ANALYSIS GRAVEL SAND SILT CLAY FINES	Physical Properties						
										WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0.0		ASPHALT: 8 inches thick.													
1133.5	0.5		FILL (GC-GM): brown, grey; moist; dense to very dense; heavily compacted.	1133.66												
1133.0	1.0															
1132.5	1.5															
1132.0	2.0															
1131.5	2.5															
1131.0	3.0		LEAN CLAY WITH GRAVEL (CL): brown; moist; hard; some cobbles.	1131.27												
1130.5	3.5															
	4.0		Bottom of Boring at 3.81 meters CBR Test conducted - Max Dry Density 2194 kg/m3, optimum water content 7.3%, CBR (95%) 12.08	1130.05												
	4.5															

Completion Depth: 12.5

Date Boring Started: 15/12/15

Date Boring Completed: 15/12/15

Logged By: ETB

Drilling Contractor: Earth Drilling

Drilling Method: SSA

Ground Surface Elevation: 3720

Coordinates: UTM NAD83 N:5628122m, E:570513m

Datum: NAD83

Remarks: Offset: 7 m E of stake
Refusal of auger at 3.2 m. Used cone to get the number of blows for the last interval

SAMPLE TYPES	WATER LEVELS (m)	LEGEND
Split Spoon	At Time of Drilling Dry	MC Moisture Content γ Dry Unit Weight ϕ Friction Angle
		Q_u Unconfined Compression Q_p Hand Penetrometer UC Gs Specific Gravity RQD Rock Quality Designation

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LOG OF BORING 2015-BBH40-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency															
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %				SIEVE ANALYSIS				Physical Properties						
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m				PL ——— X ——— LL				GRAVEL SAND SILT CLAY FINES				WC	γ	φ	Q _u	Q _p	G _s	RQD
																	%	pcf	°	tsf	tsf		%
	0.0	Surface Elev.: 1125.93 m			10	20	30	40	20	40	60	20	40	60	80								
		ASPHALT: 11.5 inches thick.																					
1125.5	0.5	FILL (GC-GM): medium to coarse grained; grey; moist; very dense.		1125.64																			
1125.0	1.0																						
1124.5	1.5	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; brown; moist; medium dense; some cobbles.		1124.86																			
1124.0	2.0	LEAN CLAY WITH SAND AND GRAVEL (CL): brown; moist to wet; medium stiff to hard. 4 inches thick wood layer.		1124.1																			
1123.5	2.5																						
1123.0	3.0																						
1122.5	3.5																						
	4.0	Bottom of Boring at 3.81 meters CBR Test conducted - Max Dry Density 2042 kg/m3, optimum water content 9.6%, CBR (95%) 7.59		1122.12																			
	4.5																						
Completion Depth:		12.5		Remarks: Offset: 2.1 m NE of stake Shoulder cracks																			
Date Boring Started:		15/12/15																					
Date Boring Completed:		15/12/15		<div>SAMPLE TYPES</div> <div>WATER LEVELS (m)</div> <div>LEGEND</div>																			
Logged By:		ETB																					
Drilling Contractor:		Earth Drilling																					
Drilling Method:		SSA																					
Ground Surface Elevation:		3694																					
Coordinates:		UTM NAD83 N:5625885m, E:572801m																					
Datum:		NAD83																					

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH41-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation

Location: Kootenay National Park

Client: Parks Canada Agency

Elevation, meters	Depth, meters	Barr Project Number: 61011106.00	MATERIAL DESCRIPTION (ASTM D2488)	Surface Elev.: 1124.10 m	Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA N in blows/0.3m	WATER CONTENT %	SIEVE ANALYSIS	Physical Properties						
									WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
1124.0	0.0		ASPHALT: 4 inches thick.		1124										
			LEAN CLAY WITH GRAVEL (CL): brown; moist; hard; fine to coarse gravel.						8.1						
1123.5	0.5														
1123.0	1.0		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; moist; medium dense.		1123.24										
1122.5	1.5														
1122.0	2.0		LEAN CLAY (CL): brown; moist to wet; soft to medium stiff.		1122.48										
1121.5	2.5														
1121.0	3.0		Some gravel.						38.5				0.6		
1120.5	3.5													0.25	
	4.0		Bottom of Boring at 3.76 meters		1120.34										
	4.5														
Completion Depth: 12.3		Remarks:													
Date Boring Started: 15/12/15															
Date Boring Completed: 15/12/15															
Logged By: ETB															
Drilling Contractor: Earth Drilling															
Drilling Method: SSA															
Ground Surface Elevation: 3688															
Coordinates: UTM NAD83 N:5624438m, E:574320m															
Datum: NAD83															
SAMPLE TYPES						WATER LEVELS (m)			LEGEND						
Split Spoon						At Time of Drilling Dry			MC Moisture Content	Q_u Unconfined Compression					
									γ Dry Unit Weight	Q_p Hand Penetrometer UC					
									ϕ Friction Angle	Gs Specific Gravity					
										RQD Rock Quality Designation					

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH42-SH-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency																
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %				SIEVE ANALYSIS				Physical Properties							
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m				PL LL				<div>GRAVEL SAND SILT CLAY</div> <div>FINES</div>				WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %	
	0.0	Surface Elev.: 1115.26 m			10 20 30 40				20 40 60				20 40 60 80											
		ASPHALT: 10.5 inches thick.																						
1115.0	0.5	FILL (GC-GM): fine to coarse grained; light grey; moist; very dense; heavily compacted.		1114.99					>> 50/1.5"															
1114.5	1.0																							
1114.0	1.5								>> 50/3"															
1113.5	2.0	LEAN CLAY WITH SAND (CL): brown; moist; stiff to hard; loose fine sand.		1113.4																				
1113.0	2.5																							
1112.5	3.0																32.2				1.25			
1112.0	3.5	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; brown, grey; moist; dense.		1111.88																				
1111.5	4.0	Bottom of Boring at 3.99 meters		1111.27													14.5							
	4.5																							
Completion Depth:		13.1		Remarks: Pavement cracked																				
Date Boring Started:		15/12/15																						
Date Boring Completed:		15/12/15																						
Logged By:		ETB																						
Drilling Contractor:		Earth Drilling																						
Drilling Method:		SSA																						
Ground Surface Elevation:		3659																						
Coordinates:		UTM NAD83 N:5623070m, E:575209m																						
Datum:		NAD83																						
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND												
				Split Spoon				At Time of Drilling Dry				MC Moisture Content γ Dry Unit Weight φ Friction Angle Q _u Unconfined Compression Q _p Hand Penetrometer UC G _s Specific Gravity RQD Rock Quality Designation												

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH43-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency																																			
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA				WATER CONTENT %				SIEVE ANALYSIS				Physical Properties																									
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m				PL ——— X ——— LL				GRAVEL SAND SILT CLAY FINES				WC	γ	φ	Q _u	Q _p	G _s	RQD																			
																		%	pcf	°	tsf	tsf		%																			
	0.0	Surface Elev.: 1114.04 m				10	20	30	40	20	40	60	20	40	60	80																											
	0.5	ASPHALT: 6 inches thick.															7																										
1113.5		SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown, grey; moist; medium dense.		1113.89							X																																
	1.0																																										
1113.0																																											
	1.5																																										
1112.5		LEAN CLAY WITH GRAVEL (CL): brown; moist; stiff to hard; fine to coarse gravel.		1112.39																																							
1112.0	2.0																																										
	2.5	Some cobbles.																																									
1111.5																																											
	3.0																																										
1111.0																																											
	3.5																																										
1110.5																																											
	4.0	Bottom of Boring at 3.79 meters		1110.25																																							
	4.5																																										
Completion Depth:		12.4		Remarks:																																							
Date Boring Started:		16/12/15																																									
Date Boring Completed:		16/12/15		SAMPLE TYPES																				WATER LEVELS (m)				LEGEND															
Logged By:		ETB																																									
Drilling Contractor:		Earth Drilling		Split Spoon																				At Time of Drilling Dry				MC Moisture Content γ Dry Unit Weight φ Friction Angle								Q _u Unconfined Compression Q _p Hand Penetrometer UC G _s Specific Gravity RQD Rock Quality Designation							
Drilling Method:		SSA																																									
Ground Surface Elevation:		3655		UTM NAD83 N:5621187m, E:576440m																																							
Coordinates:																																											
Datum:		NAD83																																									

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH44-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency														
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties						
		MATERIAL DESCRIPTION (ASTM D2488)				N in blows/0.3m		PL ———— X ———— LL		GRAVEL SAND SILT CLAY FINES				WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %
						Surface Elev.: 1192.07 m														
1192	0	FILL (GC-GM): fine to coarse grained; brown; moist to wet; very dense.																		
1191	1	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): brown; moist; medium dense; with medium to coarse cobbles.		1191.21		16														
1190	2	LEAN CLAY WITH GRAVEL (CL): dark brown to brown; moist to wet; stiff to very stiff.		1190.45		29			X											
1189	3					14														
1188	4	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey, brown; moist; medium dense to dense.		1188.31		9														
1187	5					27														
	6	Bottom of Boring at 5.28 meters		1186.79		45			X											
Completion Depth:		17.3		Remarks:																
Date Boring Started:		16/12/15																		
Date Boring Completed:		16/12/15		SAMPLE TYPES																
Logged By:		ETB																		
Drilling Contractor:		Earth Drilling		WATER LEVELS (m)																
Drilling Method:		SSA																		
Ground Surface Elevation:		3911		LEGEND																
Coordinates:		UTM NAD83 N:5617699m, E:577687m																		
Datum:		NAD83		MC Moisture Content γ Dry Unit Weight φ Friction Angle																
				Q _u Unconfined Compression Q _p Hand Penetrometer UC G _s Specific Gravity RQD Rock Quality Designation																

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH45-SH-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency													
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties						
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL ——— X ——— LL		GRAVEL SAND SILT CLAY FINES				WC %	γ pcf	ϕ °	Q_u tsf	Q_p tsf	Gs	RQD %
	0	Surface Elev.: 1410.61 m				10 20 30 40	20 40 60	20 40 60 80											
1410		ASPHALT: 11 inches thick.																	
		FILL (GC-GM): fine to coarse grained; grey, brown; moist; very dense; compacted.		1410.33				>> 50/1"											
1409	1																		
								>> 59							5.9				
1408	2	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey, brown; moist; medium dense. Thin shale layers.		1408.75															
															8.3				
1407		LEAN CLAY WITH SAND AND GRAVEL (CL): dark brown, black; moist; stiff to very stiff; fine to coarse gravel; fine to medium loose sand. Shale layer.		1407.97															
	3																		
1406	4																		
	5	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): medium to coarse grained; grey; moist; medium dense; some clay.		1405.68															
		Bottom of Boring at 5.54 meters		1405.07															
	6																		
Completion Depth:		18.2		Remarks: High on road (built up more than 5 m)															
Date Boring Started:		16/12/15																	
Date Boring Completed:		16/12/15																	
Logged By:		ETB																	
Drilling Contractor:		Earth Drilling																	
Drilling Method:		SSA																	
Ground Surface Elevation:		4628																	
Coordinates:		UTM NAD83 N:5613919m, E:576624m																	
Datum:		NAD83																	
				SAMPLE TYPES			WATER LEVELS (m)			LEGEND									
				Split Spoon			At Time of Drilling Dry												
										MC Moisture Content				Q_u Unconfined Compression					
										γ Dry Unit Weight				Q_p Hand Penetrometer UC					
										ϕ Friction Angle				Gs Specific Gravity					
										RQD Rock Quality Designation									

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH46-SH-N

Project: Highway 93S Geotechnical Investigation			Location: Kootenay National Park			Client: Parks Canada Agency													
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS		Physical Properties								
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL ——— X ——— LL		<div>GRAVEL SAND SILT CLAY</div> <div>FINES</div>		WC %	γ pcf	ϕ °	Q _u tsf	Q _p tsf	G _s	RQD %		
		Surface Elev.: 1472.49 m			10 20 30 40		20 40 60		20 40 60 80										
	0.0	ASPHALT: 11.5 inches thick.																	
1472.0	0.5	FILL (GC-GM): grey; moist; very dense.		1472.2															
1471.5	1.0																		
1471.0	1.5	LEAN CLAY WITH GRAVEL (CL): dark brown to brown; moist; very stiff to hard.		1471.37															
1470.5	2.0																		
1470.0	2.5																		
1469.5	3.0																		
1469.0	3.5																		
1468.5	4.0	Bottom of Boring at 4.01 meters		1468.48															
	4.5																		
Completion Depth:		13.2		Remarks:															
Date Boring Started:		16/12/15																	
Date Boring Completed:		16/12/15																	
Logged By:		ETB																	
Drilling Contractor:		Earth Drilling																	
Drilling Method:		SSA																	
Ground Surface Elevation:		4831																	
Coordinates:		UTM NAD83 N:5614197m, E:575541m																	
Datum:		NAD83																	
				SAMPLE TYPES				WATER LEVELS (m)				LEGEND							
				Split Spoon				At Time of Drilling Dry				MC Moisture Content				Q _u Unconfined Compression			
												γ Dry Unit Weight				Q _p Hand Penetrometer UC			
												ϕ Friction Angle				G _s Specific Gravity			
																RQD Rock Quality Designation			

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH47-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency										
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS		Physical Properties							
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL ——— LL		<div>GRAVEL SAND SILT CLAY</div> <div>FINES</div>		WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %	
		Surface Elev.: 1103.68 m																
1103.5	0.0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey; moist; very dense.																
1103.0	0.5																	
1102.5	1.0	LEAN CLAY (CL): light brown; moist to wet; medium stiff to stiff; trace sand.		1102.92									20.4				2.5	
1102.0	1.5																	
1101.5	2.0															0.4		
1101.0	2.5																	
1100.5	3.0	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; grey; moist; medium dense to dense.		1100.63									22.1				1	
1100.0	3.5																	
1099.5	4.0																	
1099.0	4.5	LEAN CLAY WITH GRAVEL (CL): brown; moist; hard.		1099.11														
	5.0	Bottom of Boring at 4.69 meters		1099														
Completion Depth:		15.4		Remarks: Offset: 2.6 m N of stake														
Date Boring Started:		16/12/15																
Date Boring Completed:		16/12/15																
Logged By:		ETB																
Drilling Contractor:		Earth Drilling																
Drilling Method:		SSA																
Ground Surface Elevation:		3621																
Coordinates:		UTM NAD83 N:5610388m, E:569886m																
Datum:		NAD83																
SAMPLE TYPES				WATER LEVELS (m)				LEGEND										
Split Spoon				At Time of Drilling Dry				MC Moisture Content Q _u Unconfined Compression γ Dry Unit Weight Q _p Hand Penetrometer UC φ Friction Angle G _s Specific Gravity RQD Rock Quality Designation										

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH48-N

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency															
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties										
		MATERIAL DESCRIPTION (ASTM D2488)			N in blows/0.3m		PL LL		GRAVEL SAND SILT CLAY FINES				WC	γ	ϕ	Q_u	Q_p	G_s	RQD				
													%	pcf	°	tsf	tsf		%				
	0.0	Surface Elev.: 1030.83 m			10	20	30	40	20	40	60	20	40	60	80								
	0.5	ASPHALT: 6.5 inches thick.																					
1030.5		LEAN CLAY WITH SAND AND GRAVEL (CL): light brown to brown; moist to wet; medium stiff to hard; low plasticity.		1030.67																			
	1.0																						
1029.5	1.5																						
	2.0																						
1029.0																							
	2.5																						
1028.5																							
	3.0																						
1028.0	3.5																						
	4.0																						
1027.5																							
	4.5																						
1027.0																							
	5.0																						
		Bottom of Boring at 4.62 meters		1026.21																			
Completion Depth:		15.2		Remarks: Void space between 4.3 m and 5.5 m																			
Date Boring Started:		17/12/15																					
Date Boring Completed:		17/12/15																					
Logged By:		ETB																					
Drilling Contractor:		Earth Drilling																					
Drilling Method:		SSA																					
Ground Surface Elevation:		3382																					
Coordinates:		UTM NAD83 N:5609728m, E:568448m																					
Datum:		NAD83																					
SAMPLE TYPES					WATER LEVELS (m)					LEGEND													
Split Spoon					At Time of Drilling Dry					MC Moisture Content Q_u Unconfined Compression													
										γ Dry Unit Weight Q_p Hand Penetrometer UC													
										ϕ Friction Angle G_s Specific Gravity													
										RQD Rock Quality Designation													

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING 2015-BBH49-S

Sheet 1 of 1

Project: Highway 93S Geotechnical Investigation				Location: Kootenay National Park				Client: Parks Canada Agency																	
Elevation, meters	Depth, meters	Barr Project Number: 61011106.00		Graphic Log	Sample Type & Rec.	STANDARD PENETRATION TEST DATA		WATER CONTENT %		SIEVE ANALYSIS				Physical Properties											
		MATERIAL DESCRIPTION (ASTM D2488)																							
		Surface Elev.: 1011.02 m							N in blows/0.3m		PL LL		GRAVEL SAND SILT CLAY FINES				WC %	γ pcf	φ °	Q _u tsf	Q _p tsf	G _s	RQD %		
		ASPHALT: 6 inches thick.							10 20 30 40		20 40 60														
		FILL (GC-GM): medium to coarse grained; brown; moist; very dense.																							
1010	1																								
1009	2	LEAN CLAY WITH GRAVEL (CL): brown; moist; very stiff to hard; fine to coarse gravel.															6.2								
		1009.28																							
1008	3	Trace peat.																							
1007	4	SILTY, CLAYEY GRAVEL WITH SAND (GC-GM): fine to coarse grained; brown; wet; medium dense.																							
		1007																							
1006	5																6.6								
		Bottom of Boring at 5.39 meters																							
		1005.63																							
	6																								
Completion Depth: 17.7				Remarks:																					
Date Boring Started: 17/12/15																									
Date Boring Completed: 17/12/15																									
Logged By: ETB																									
Drilling Contractor: Earth Drilling																									
Drilling Method: SSA																									
Ground Surface Elevation: 3317																									
Coordinates: UTM NAD83 N:5609653m, E:567780m																									
Datum: NAD83																									
SAMPLE TYPES						WATER LEVELS (m)						LEGEND													
Split Spoon						At Time of Drilling Dry						MC Moisture Content Q _u Unconfined Compression													
												γ Dry Unit Weight Q _p Hand Penetrometer UC													
												φ Friction Angle G _s Specific Gravity													
												RQD Rock Quality Designation													

The stratification lines represent approximate boundaries. The transition may be gradual.

Appendix B

Laboratory Test Results

Water Content Determination

Borehole No.	2015-BBH45-SH-N	2015-BBH45-SH-N	2015-BBH45-SH-N	2015-BBH46-SH-N	2015-BBH46-SH-N	2015-BBH47-S	2015-BBH47-S	2015-BBH47-S
Depth	2.50	5.00	15.00	2.50	7.50	2.50	7.50	12.50
Tare No.	# 869	# 868	# 870	# 860	# 861	# 867	# 926	# 864
Weight of Tare (g)	11.10	11.20	11.10	11.10	11.10	11.10	11.10	11.10
Wet Sample & Tare (g)	370.30	275.90	344.70	298.60	386.50	261.90	356.40	369.30
Dry Sample & Tare (g)	350.20	255.60	323.20	274.20	361.20	219.40	293.80	356.00
Weight of Water (g)	20.10	20.30	21.50	24.40	25.30	42.50	62.60	13.30
Weight of Dry Sample (g)	339.10	244.40	312.10	263.10	350.10	208.30	282.70	344.90
Water Content (%)	5.9	8.3	6.9	9.3	7.2	20.4	22.1	3.9
Borehole No.	2015-BBH49-S	2015-BBH49-S	2015-BBH48-N	2015-BBH48-N				
Depth	5.00	15.00	2.50	7.50				
Tare No.	# 858	# 859	# 830	# 831				
Weight of Tare (g)	11.10	11.10	11.10	11.10				
Wet Sample & Tare (g)	282.20	341.30	237.70	255.40				
Dry Sample & Tare (g)	266.40	320.90	214.70	210.10				
Weight of Water (g)	15.80	20.40	23.00	45.30				
Weight of Dry Sample (g)	255.30	309.80	203.60	199.00				
Water Content (%)	6.2	6.6	11.3	22.8				
Borehole No.								
Depth								
Tare No.								
Weight of Tare (g)								
Wet Sample & Tare (g)								
Dry Sample & Tare (g)								
Weight of Water (g)								
Weight of Dry Sample (g)								
Water Content (%)								

Remarks

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Water Content Determination

Borehole No.	2015-BBH33-S	2015-BBH33-S	2015-BBH34-SH-N	2015-BBH34-SH-N	2015-BBH35-SH-N	2015-BBH35-SH-N	2015-BBH36-S	2015-BBH36-S
Depth	7.50	12.50	2.50	7.50	0.00	10.00	0.00	10.00
Tare No.	# 826	# 825	# 852	# 815	# 813	# 924	# 829	# 828
Weight of Tare (g)	11.00	11.00	11.10	11.00	10.90	11.10	11.10	11.10
Wet Sample & Tare (g)	272.70	223.70	391.40	219.70	251.00	404.00	243.70	232.60
Dry Sample & Tare (g)	253.60	200.60	372.10	213.80	235.90	350.30	229.20	226.20
Weight of Water (g)	19.10	23.10	19.30	5.90	15.10	53.70	14.50	6.40
Weight of Dry Sample (g)	242.60	189.60	361.00	202.80	225.00	339.20	218.10	215.10
Water Content (%)	7.9	12.2	5.3	2.9	6.7	15.8	6.6	3.0
Borehole No.	2015-BBH37-SH-N	2015-BBH37-SH-N	2015-BBH38-SH-S	2015-BBH38-SH-S	2015-BBH39-SH-S	2015-BBH39-SH-S	2015-BBH40-SH-S	2015-BBH40-SH-S
Depth	2.50	10.00	5.00	7.50	2.50	7.50	2.50	7.50
Tare No.	# 822	# 821	# 818	# 925	# 820	# 819	# 886	# 885
Weight of Tare (g)	11.00	11.10	11.10	11.10	11.10	11.00	11.30	11.20
Wet Sample & Tare (g)	286.50	223.00	248.30	376.60	243.80	268.10	369.20	425.90
Dry Sample & Tare (g)	275.00	216.10	241.90	350.70	222.90	260.30	356.20	323.40
Weight of Water (g)	11.50	6.90	6.40	25.90	20.90	7.80	13.00	102.50
Weight of Dry Sample (g)	264.00	205.00	230.80	339.60	211.80	249.30	344.90	312.20
Water Content (%)	4.4	3.4	2.8	7.6	9.9	3.1	3.8	32.8
Borehole No.	2015-BBH41-SH-N	2015-BBH41-SH-N	2015-BBH42-SH-S	2015-BBH42-SH-S	2015-BBH43-N	2015-BBH43-N	2015-BBH44-SH-N	2015-BBH44-SH-N
Depth	0.00	7.50	7.50	10.00	0.00	10.00	5.00	15.00
Tare No.	# 877	# 851	# 875	# 876	# 874	# 876	# 872	# 871
Weight of Tare (g)	11.10	11.00	11.10	11.10	11.10	11.10	11.20	11.20
Wet Sample & Tare (g)	388.80	327.50	273.10	296.30	363.10	357.10	359.00	414.40
Dry Sample & Tare (g)	360.40	239.50	209.30	260.10	340.20	339.20	311.00	394.50
Weight of Water (g)	28.40	88.00	63.80	36.20	22.90	17.90	48.00	19.90
Weight of Dry Sample (g)	349.30	228.50	198.20	249.00	329.10	328.10	299.80	383.30
Water Content (%)	8.1	38.5	32.2	14.5	7.0	5.5	16.0	5.2

Remarks

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Borehole No.	2015-BBH11-SH-S	2015-BBH11-SH-S	2015-BBH12-N	2015-BBH16-S	2015-BBH16-S	2015-BBH16-S	2015-BBH17-N	2015-BBH17-N
Depth	0.00	5.00	0.00	0.00	2.50	7.50	0.00	2.50
Tare No.	# 893	# 894	# 916	# 915	# 914	# 892	# 884	# 913
Weight of Tare (g)	11.20	11.10	11.10	11.10	11.10	11.10	11.30	11.10
Wet Sample & Tare (g)	381.70	308.30	382.40	372.70	373.20	415.10	347.60	318.60
Dry Sample & Tare (g)	362.70	297.60	343.40	349.70	344.30	380.30	294.50	262.50
Weight of Water (g)	19.00	10.70	39.00	23.00	28.90	34.80	53.10	56.10
Weight of Dry Sample (g)	351.50	286.50	332.30	338.60	333.20	369.20	283.20	251.40
Water Content (%)	5.4	3.7	11.7	6.8	8.7	9.4	18.8	22.3
Borehole No.	2015-BBH17-N	2015-BBH18-N	2015-BBH18-N	2015-BBH18-N	2015-BBH18-N	2015-BBH19-SH-S	2015-BBH19-SH-S	2015-BBH19-SH-S
Depth	7.50	0.00	2.50	5.00	10.00	0.00	5.00	10.00
Tare No.	# 883	# 891	# 912	# 911	# 890	# 889	# 910	# 909
Weight of Tare (g)	11.20	11.10	11.10	11.10	11.10	11.30	11.10	11.10
Wet Sample & Tare (g)	303.60	344.60	348.60	295.40	422.60	418.90	363.70	344.50
Dry Sample & Tare (g)	287.30	285.20	308.10	249.80	391.40	394.60	343.50	301.80
Weight of Water (g)	16.30	59.40	40.50	45.60	31.20	24.30	20.20	42.70
Weight of Dry Sample (g)	276.10	274.10	297.00	238.70	380.30	383.30	332.40	290.70
Water Content (%)	5.9	21.7	13.6	19.1	8.2	6.3	6.1	14.7
Borehole No.	2015-BBH20-S	2015-BBH20-S	2015-BBH20-S	2015-BBH21-S	2015-BBH21-S	2015-BBH21-S	2015-BBH22-S	2015-BBH22-S
Depth	0.00	5.00	10.00	0.00	7.50	15.00	2.50	10.00
Tare No.	# 888	# 908	# 887	# 809	# 907	# 810	# 866	# 865
Weight of Tare (g)	11.20	11.00	11.10	11.00	11.00	10.90	11.10	11.10
Wet Sample & Tare (g)	407.70	346.50	366.60	247.80	421.80	226.30	277.40	402.50
Dry Sample & Tare (g)	384.50	280.70	289.50	232.40	401.00	185.60	256.00	370.40
Weight of Water (g)	23.20	65.80	77.10	15.40	20.80	40.70	21.40	32.10
Weight of Dry Sample (g)	373.30	269.70	278.40	221.40	390.00	174.70	244.90	359.30
Water Content (%)	6.2	24.4	27.7	7.0	5.3	23.3	8.7	8.9

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Borehole No.	2015-BBH23-SH-S	2015-BBH23-SH-S	2015-BBH23-SH-S	2015-BBH23-SH-S	2015-BBH25-N	2015-BBH25-N	2015-BBH05-SH-N	2015-BBH05-SH-N
Depth	2.50	7.50	12.50	15.00	5.00	12.50	5.00	10.00
Tare No.	# 880	# 879	# 906	# 878	# 905	# 904	# 812	# 811
Weight of Tare (g)	11.00	11.20	11.10	11.00	11.10	11.10	10.80	11.00
Wet Sample & Tare (g)	372.40	336.60	361.70	297.90	443.60	421.30	231.50	239.20
Dry Sample & Tare (g)	356.20	311.30	292.20	279.80	430.00	392.80	226.60	224.20
Weight of Water (g)	16.20	25.30	69.50	18.10	13.60	28.50	4.90	15.00
Weight of Dry Sample (g)	345.20	300.10	281.10	268.80	418.90	381.70	215.80	213.20
Water Content (%)	4.7	8.4	24.7	6.7	3.2	7.5	2.3	7.0
Borehole No.	2015-BBH26-SH-S	2015-BBH26-SH-S	2015-BBH26-SH-S	2015-BBH24-SH-N	2015-BBH24-SH-N	2015-BBH28-N	2015-BBH28-N	2015-BBH30-SH-N
Depth	5.00	10.00	15.00	2.50	7.50	5.00	10.00	2.50
Tare No.	# 882	# 881	# 903	# 863	# 862	# 902	# 901	# 817
Weight of Tare (g)	10.90	10.80	11.10	11.10	11.00	11.10	11.10	11.10
Wet Sample & Tare (g)	340.50	452.30	353.40	256.20	267.20	395.20	389.30	230.30
Dry Sample & Tare (g)	324.10	350.20	246.60	245.60	260.10	382.20	335.40	217.20
Weight of Water (g)	16.40	102.10	106.80	10.60	7.10	13.00	53.90	13.10
Weight of Dry Sample (g)	313.20	339.40	235.50	234.50	249.10	371.10	324.30	206.10
Water Content (%)	5.2	30.1	45.4	4.5	2.9	3.5	16.6	6.4
Borehole No.	2015-BBH30-SH-N	2015-BBH31-SH-S	2015-BBH31-SH-S	2015-BBH31-SH-S	2015-BBH32-S	2015-BBH32-S	2015-BBH32-S	2015-BBH33-S
Depth	7.50	0.00	5.00	10.00	0.00	5.00	10.00	0.00
Tare No.	# 816	# 814	# 855	# 854	# 853	# 824	# 823	# 827
Weight of Tare (g)	11.00	11.00	11.10	11.10	11.10	11.00	11.10	11.10
Wet Sample & Tare (g)	210.80	227.50	387.00	346.10	420.70	250.10	242.40	245.70
Dry Sample & Tare (g)	194.90	219.10	361.20	278.10	393.90	215.60	191.90	236.80
Weight of Water (g)	15.90	8.40	25.80	68.00	26.80	34.50	50.50	8.90
Weight of Dry Sample (g)	183.90	208.10	350.10	267.00	382.80	204.60	180.80	225.70
Water Content (%)	8.6	4.0	7.4	25.5	7.0	16.9	27.9	3.9

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Borehole No.	2015-BBH01-S	2015-BBH01-S	2015-BBH01-S	2015-BBH02-N	2015-BBH02-N	2015-BBH02-N	2015-BBH03-N	2015-BBH03-N
Depth	0.00	2.00	7.50	0.00	5.00	7.50	0.00	5.00
Tare No.	CG6	CG8	# 922	# 801	# 857	# 856	# 921	# 920
Weight of Tare (g)	507.00	520.60	11.10	10.90	11.00	11.10	11.10	11.10
Wet Sample & Tare (g)	802.40	883.60	399.20	238.40	266.10	223.50	157.10	339.50
Dry Sample & Tare (g)	763.80	869.10	363.50	227.10	253.20	209.40	106.40	270.60
Weight of Water (g)	38.60	14.50	35.70	11.30	12.90	14.10	50.70	68.90
Weight of Dry Sample (g)	256.80	348.50	352.40	216.20	242.20	198.30	95.30	259.50
Water Content (%)	15.0	4.2	10.1	5.2	5.3	7.1	53.2	26.6
Borehole No.	2015-BBH03-N	2015-BBH03-N	2015-BBH06-S	2015-BBH06-S	2015-BBH06-S	2015-BBH07-S	2015-BBH07-S	2015-BBH07-S
Depth	10.00	15.00	0.00	7.50	12.50	2.50	7.50	10.00
Tare No.	# 802	# 803	# 804	# 805	# 806	# 919	# 807	# 808
Weight of Tare (g)	11.00	11.10	10.80	10.90	10.90	11.10	10.90	11.00
Wet Sample & Tare (g)	272.00	235.10	219.10	235.70	238.00	390.00	240.80	272.20
Dry Sample & Tare (g)	242.40	207.40	201.60	221.30	223.00	368.10	217.00	248.70
Weight of Water (g)	29.60	27.70	17.50	14.40	15.00	21.90	23.80	23.50
Weight of Dry Sample (g)	231.40	196.30	190.80	210.40	212.10	357.00	206.10	237.70
Water Content (%)	12.8	14.1	9.2	6.8	7.1	6.1	11.5	9.9
Borehole No.	2015-BBH08-SH-N	2015-BBH08-SH-N	2015-BBH08-SH-N	2015-BBH09-SH-S	2015-BBH09-SH-S	2015-BBH10-SH-S	2015-BBH10-SH-S	2015-BBH10-SH-S
Depth	0.00	2.50	10.00	0.00	5.00	0.00	5.00	7.50
Tare No.	# 918	# 900	# 899	# 917	# 895	# 898	# 897	# 893
Weight of Tare (g)	11.10	11.10	11.20	11.10	11.20	11.30	11.20	11.10
Wet Sample & Tare (g)	328.40	329.10	389.90	350.10	417.80	315.20	464.30	363.80
Dry Sample & Tare (g)	290.70	295.10	350.80	323.20	390.30	299.80	446.70	343.10
Weight of Water (g)	37.70	34.00	39.10	26.90	27.50	15.40	17.60	20.70
Weight of Dry Sample (g)	279.60	284.00	339.60	312.10	379.10	288.50	435.50	332.00
Water Content (%)	13.5	12.0	11.5	8.6	7.3	5.3	4.0	6.2

Remarks

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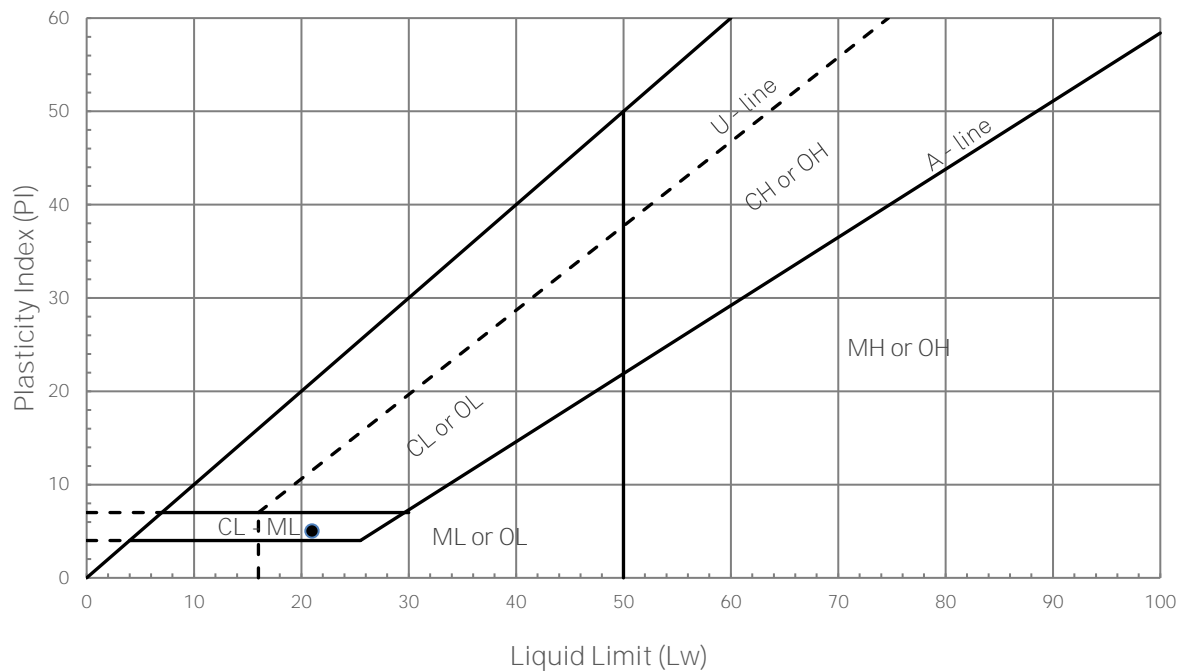
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Sample Date

ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	16-Dec-15	Liquid Limit	21	Soil type	Silty clay
Sample No	2015-BBH47-S @ 7.5'	Plastic Limit	16	Classification	CL-ML
Technician	Client	Plasticity Index	5		



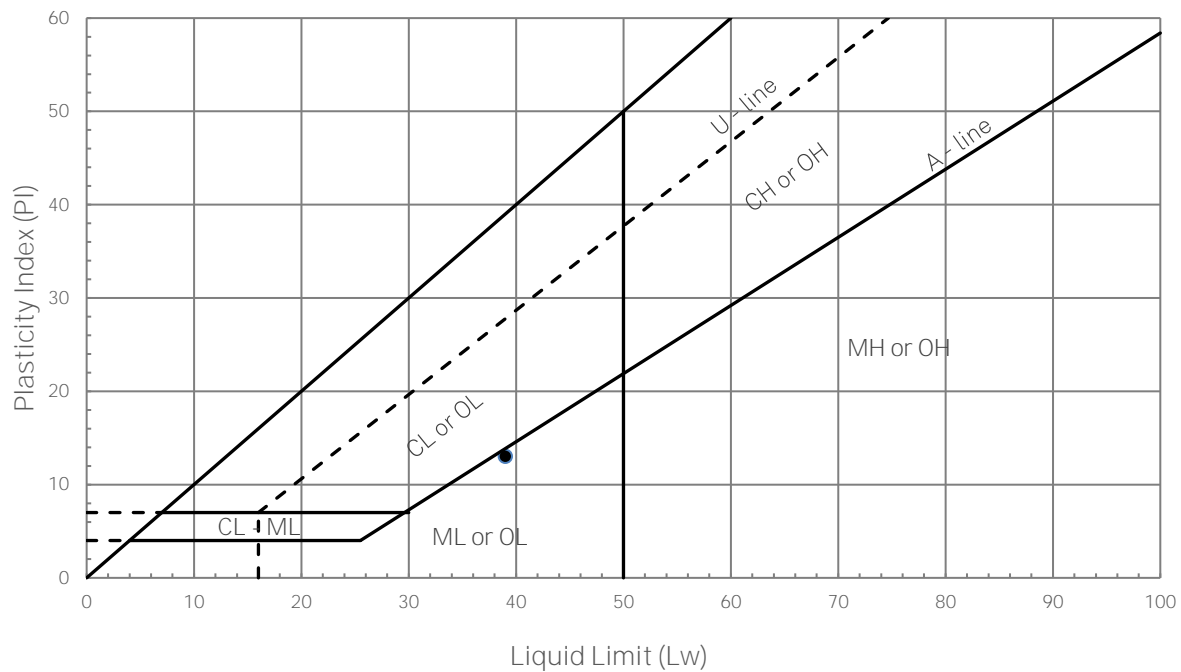
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	15-Dec-15	Liquid Limit	39		
Sample No	2015-BBH41-SH-N @ 7.5'	Plastic Limit	26	Soil type	Silty clay
Technician	Client	Plasticity Index	13	Classification	ML



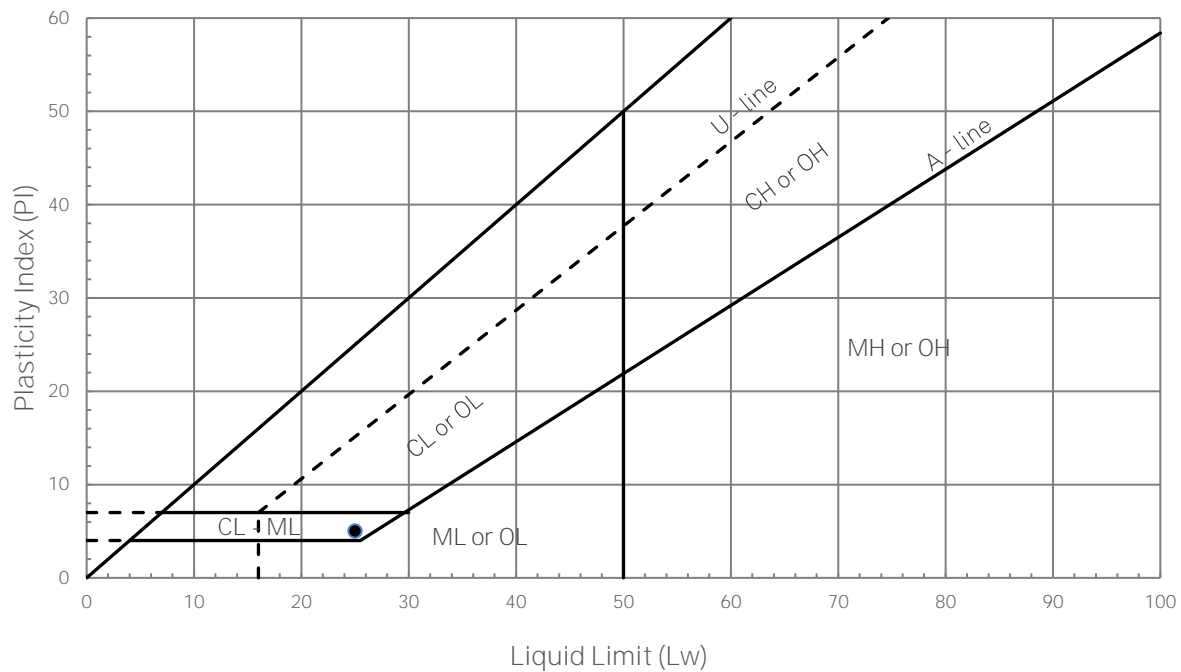
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	15-Dec-15	Liquid Limit	25		
Sample No	2015-BBH38-SH-S @ 7.5'	Plastic Limit	20	Soil type	Silty clay
Technician	Client	Plasticity Index	5	Classification	CL-ML



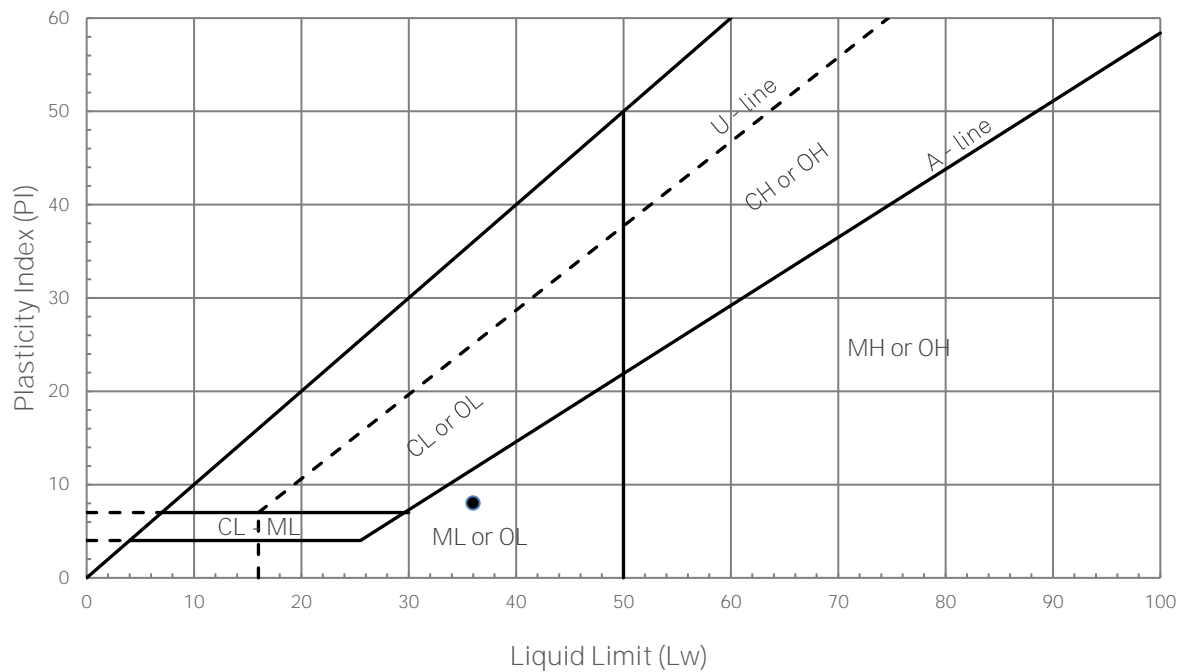
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	36		
Sample No	2015-BBH35-SH-N @ 10.0'	Plastic Limit	28	Soil type	Silty clay
Technician	Client	Plasticity Index	8	Classification	ML



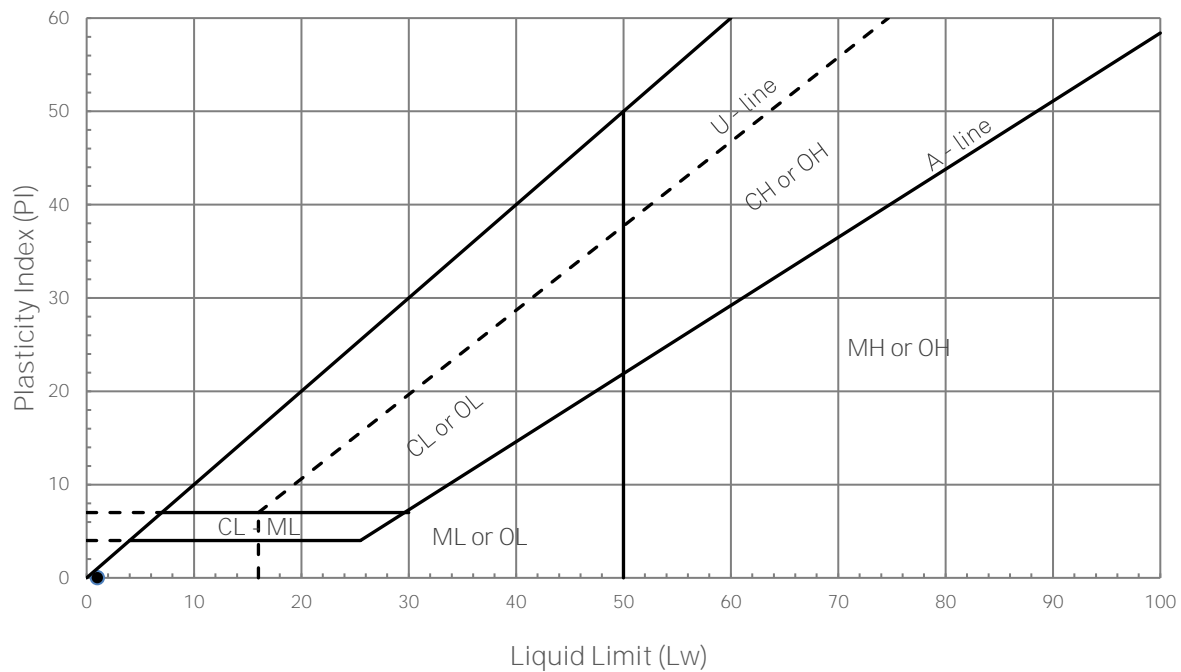
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ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	-	Soil type	Sandy
Sample No	2015-BBH32-S @ 10.0'	Plastic Limit	-	Classification	-
Technician	Client	Plasticity Index	Non plastic		



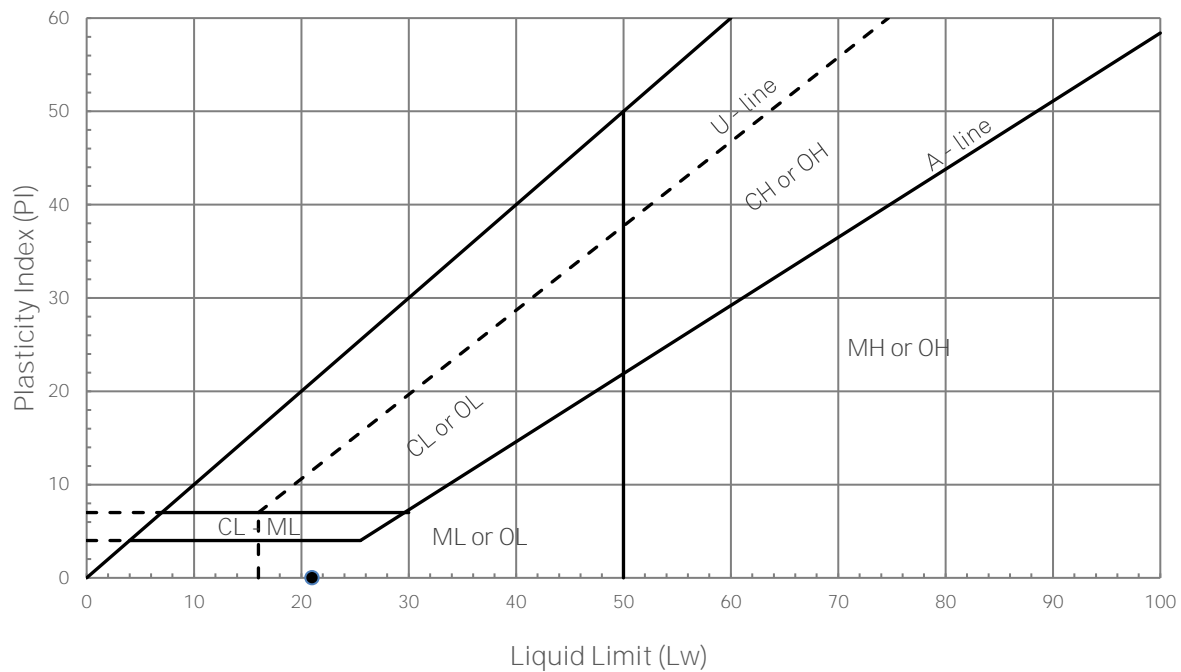
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	12-Dec-15	Liquid Limit	21		
Sample No	2015-BBH31-SH-S @ 10.0'	Plastic Limit	21	Soil type	Sandy silty clay
Technician	Client	Plasticity Index		Classification	ML



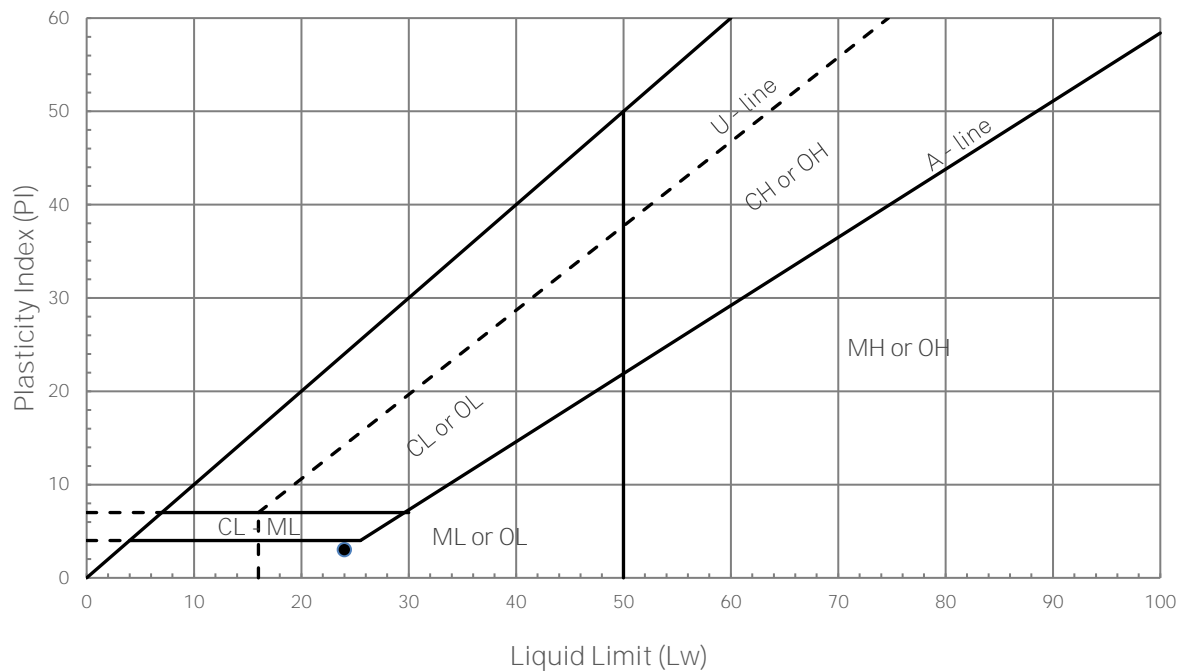
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ASTM D4318

Sample Date	12-Dec-15	Liquid Limit	24	Soil type	Sandy silty clay
Sample No	2015-BBH28-N @ 10.0'	Plastic Limit	21	Classification	CL-ML
Technician	Client	Plasticity Index	3		

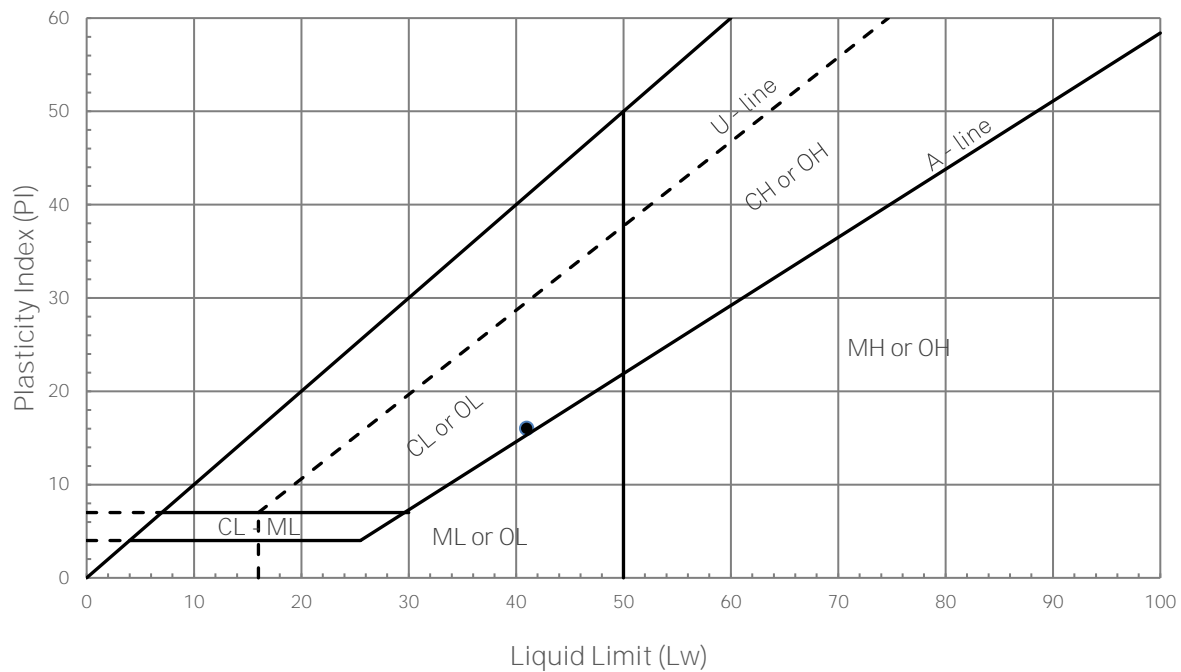


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ASTM D4318

Sample Date	12-Dec-15	Liquid Limit	41		
Sample No	2015-BBH26-SH-S @ 15.0'	Plastic Limit	25	Soil type	Silty clay
Technician	Client	Plasticity Index	16	Classification	CL

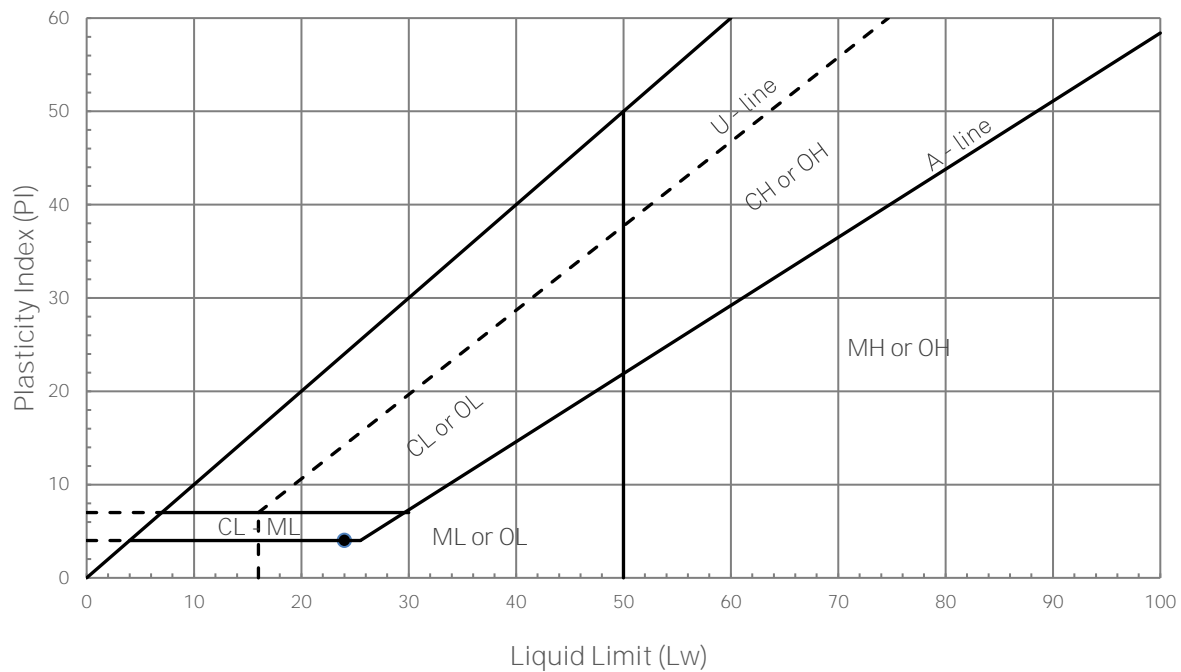


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ASTM D4318

Sample Date	11-Dec-15	Liquid Limit	24	Soil type	Sandy silty clay
Sample No	2015-BBH25-N @ 12.5'	Plastic Limit	20	Classification	CL-ML
Technician	Client	Plasticity Index	4		



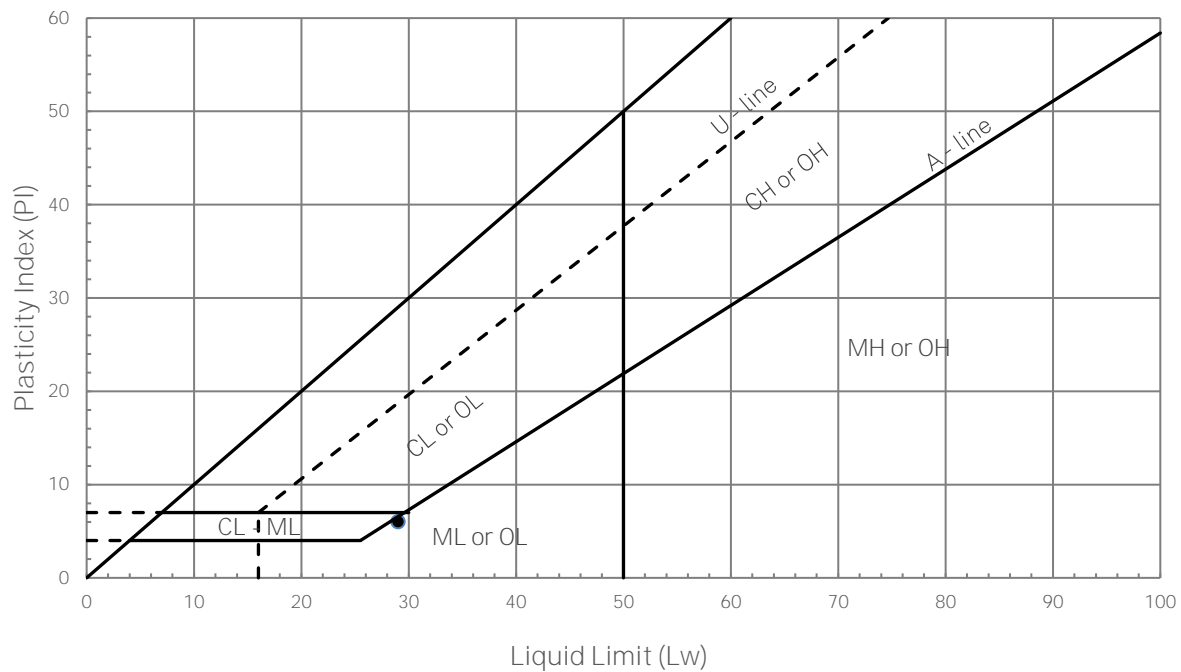
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ASTM D4318

Sample Date	11-Dec-15	Liquid Limit	29		
Sample No	2015-BBH23-SH-S @ 12.5'	Plastic Limit	23	Soil type	Silty clay
Technician	Client	Plasticity Index	6	Classification	ML



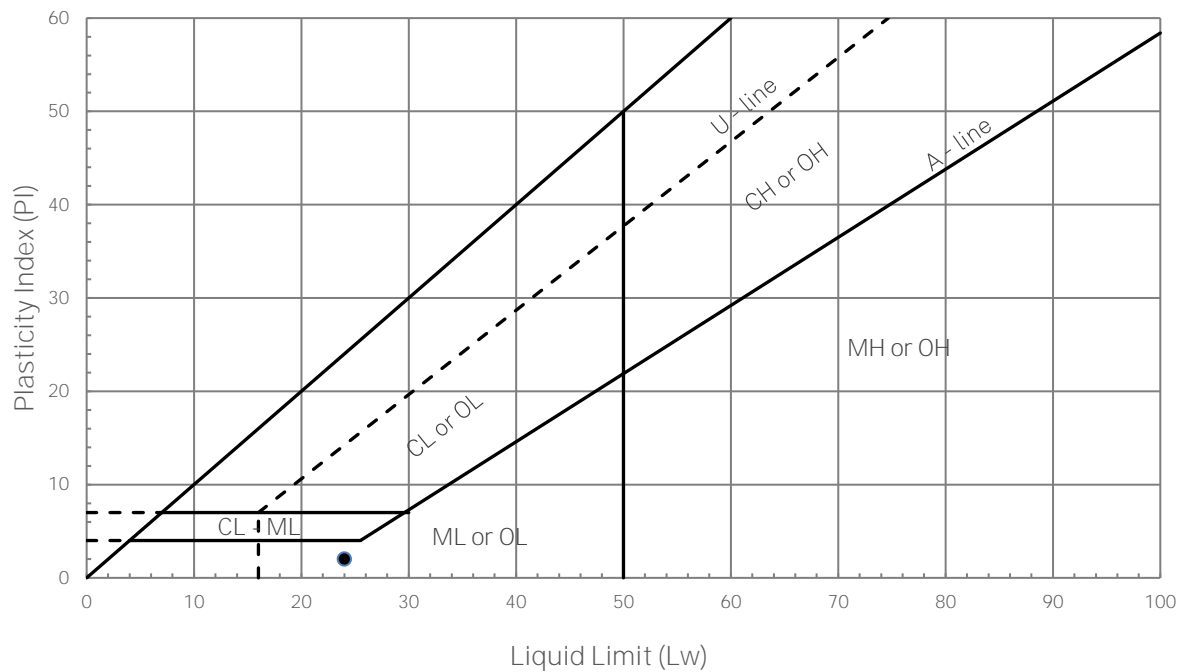
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	24	Soil type	Sandy silty clay
Sample No	2015-BBH19-SH-S @ 5.0'	Plastic Limit	22	Classification	ML
Technician	Client	Plasticity Index	2		



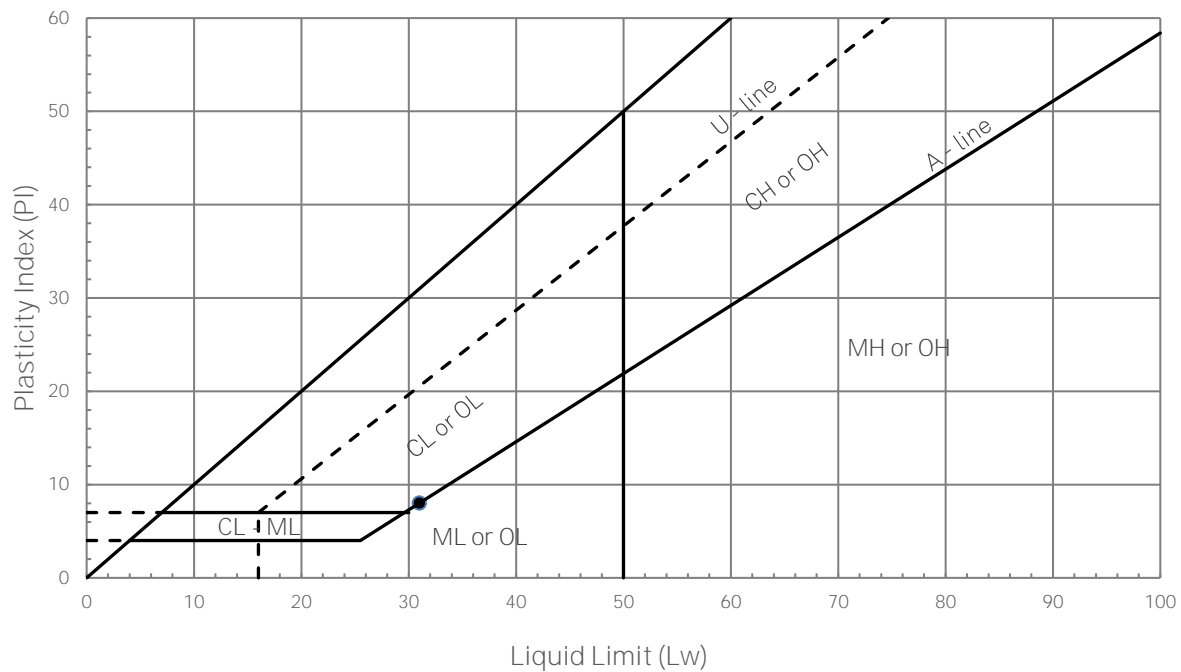
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ASTM D4318

Sample Date	12-Dec-15	Liquid Limit	31		
Sample No	2015-BBH18-N @ 5.0'	Plastic Limit	23	Soil type	Silty clay
Technician	Client	Plasticity Index	8	Classification	ML

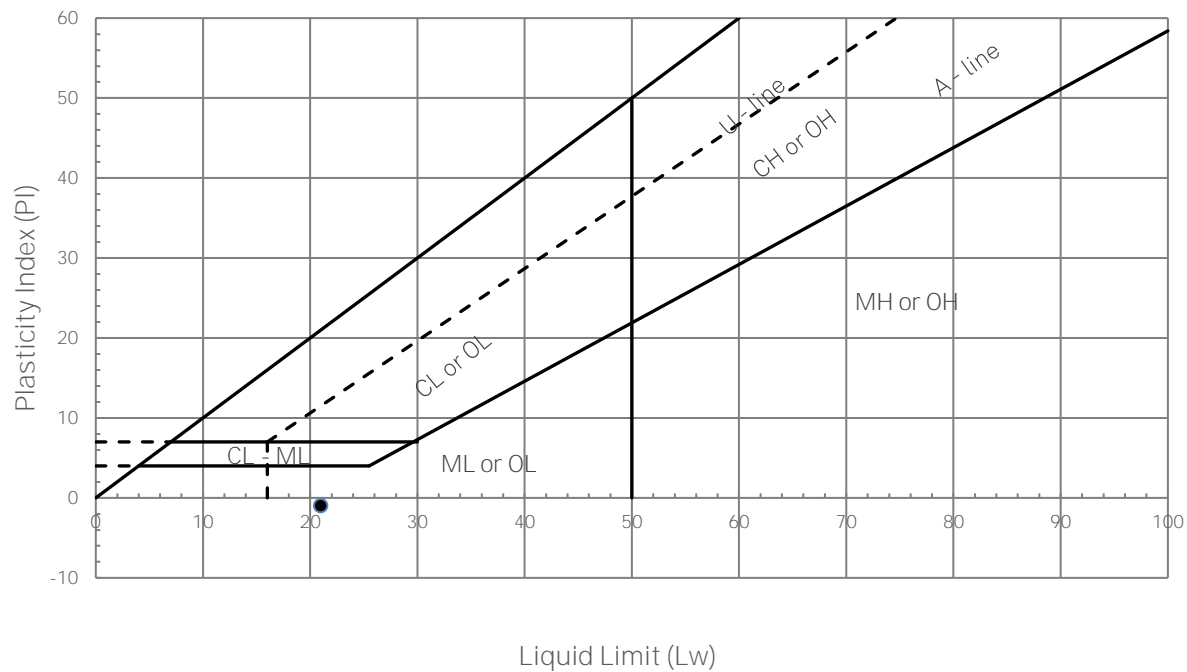


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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	21		
Sample No	2015-BBH17-N @ 2.5'	Plastic Limit	22	Soil type	Sandy silty clay
Technician	Client	Plasticity Index	-1	Classification	ML



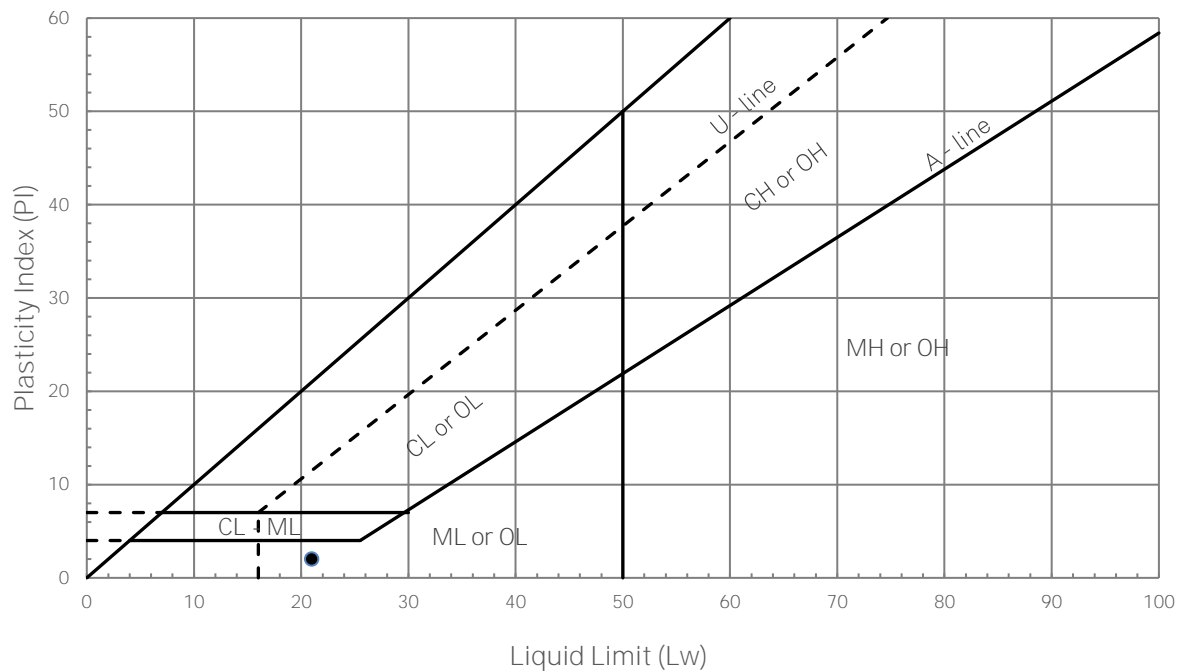
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ASTM D4318

Sample Date	14-Dec-15	Liquid Limit	21		
Sample No	2015-BBH16-S @ 2.5'	Plastic Limit	19	Soil type	Sandy silty clay
Technician	Client	Plasticity Index	2	Classification	CL-ML



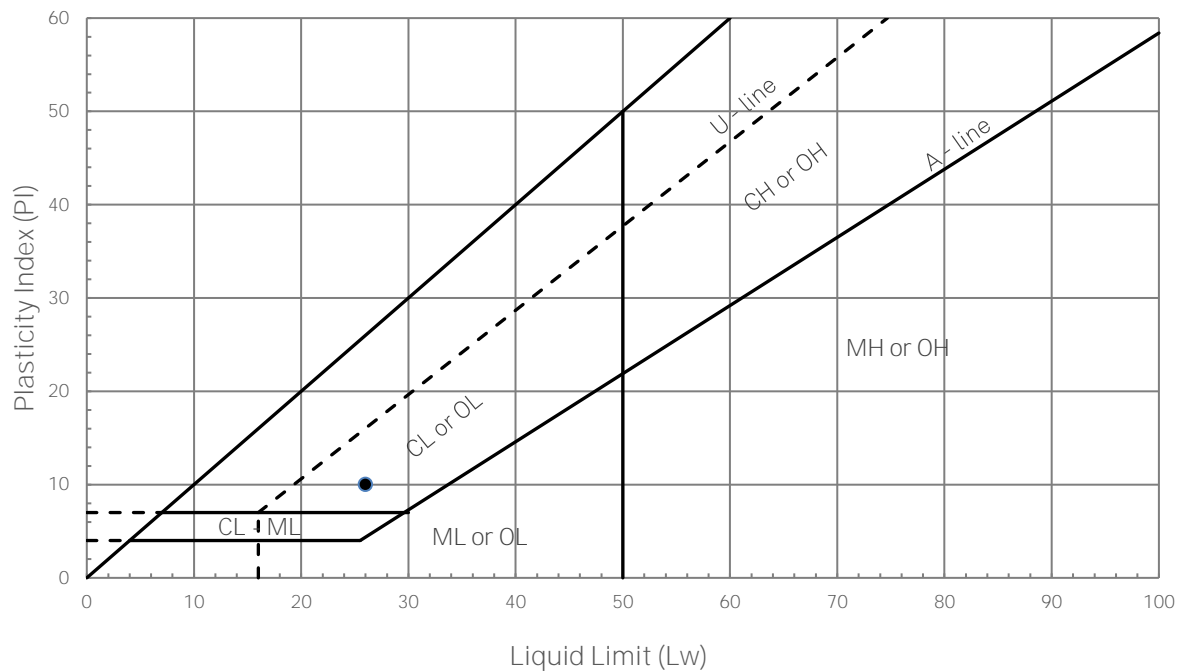
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Project	Barr - Lab Testing
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ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	11-Dec-15	Liquid Limit	26		
Sample No	2015-BBH08-SH-N @ 0.0'	Plastic Limit	16	Soil type	Silty clay
Technician	Client	Plasticity Index	10	Classification	CL

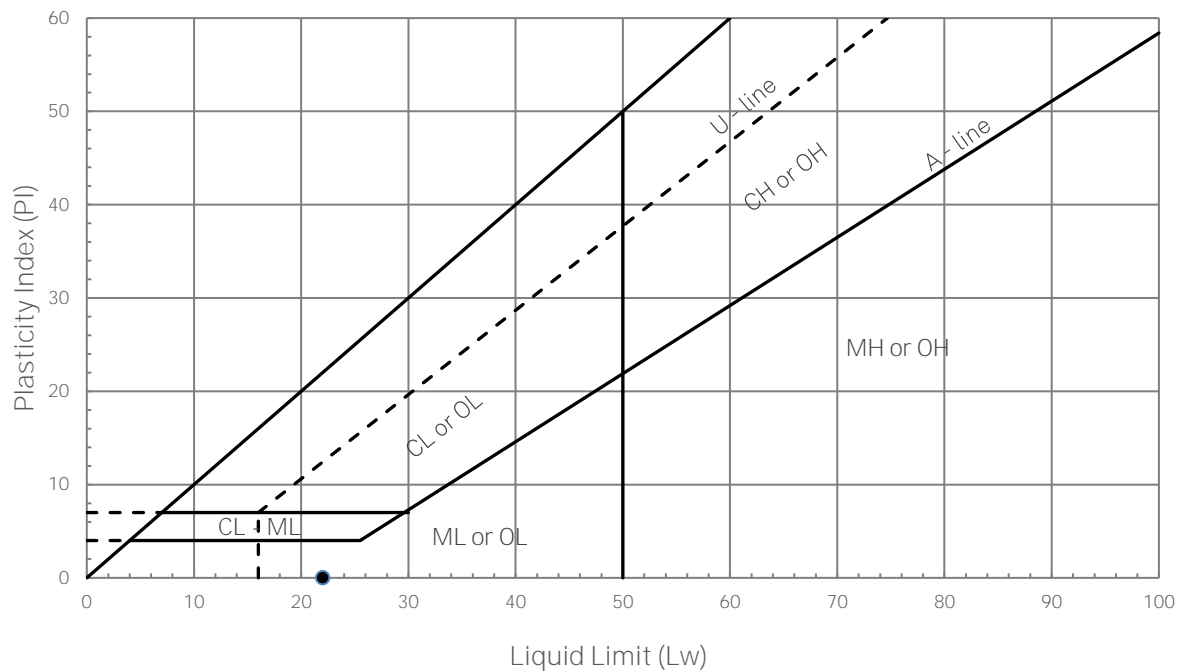


Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	11-Dec-15	Liquid Limit	22		
Sample No	2015-BBH03-N @ 5.0'	Plastic Limit	22	Soil type	Sandy silty clay
Technician	Client	Plasticity Index		Classification	ML



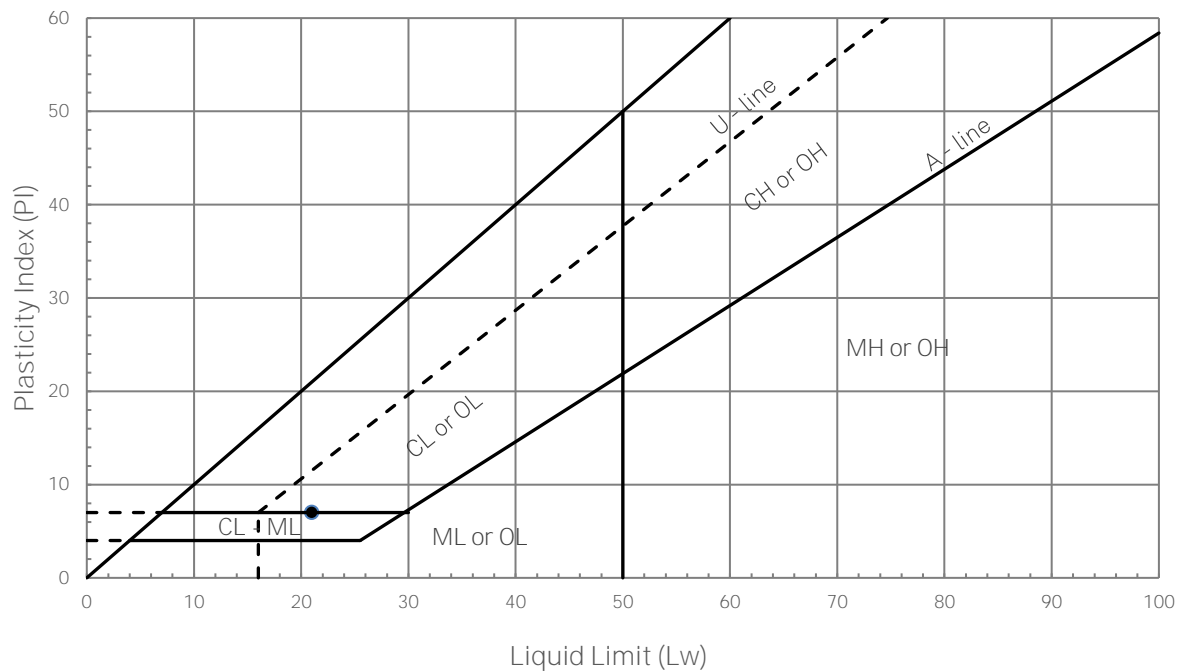
Clifton Associates

Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

ATTERBERG LIMITS PLASTICITY INDEX

ASTM D4318

Sample Date	10-Dec-15	Liquid Limit	21		
Sample No	2015-BBH01-S @ 7.5'	Plastic Limit	14	Soil type	Silty clay
Technician	Client	Plasticity Index	7	Classification	CL-ML



Clifton Associates

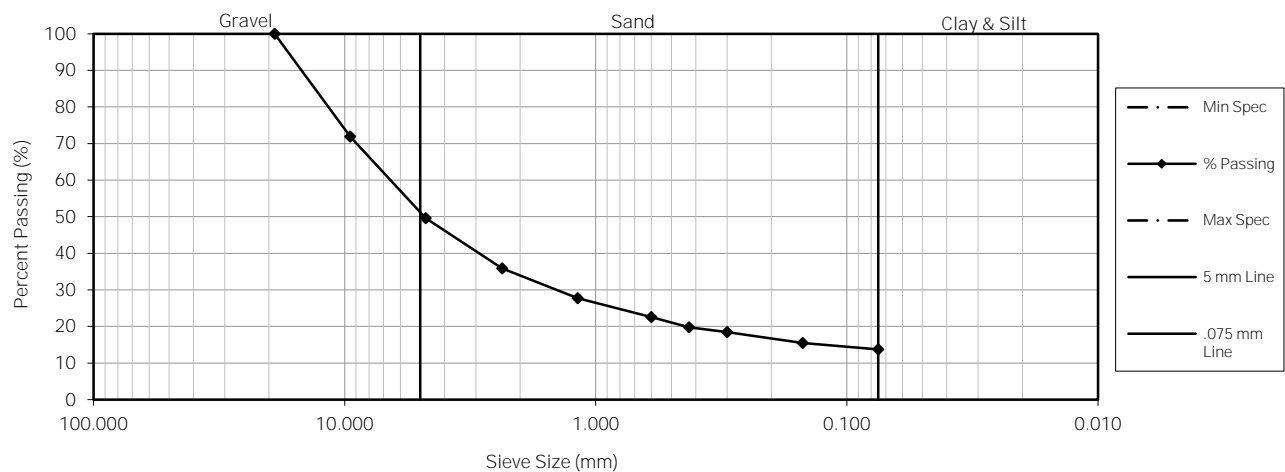
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Mechanical Sieve Analysis

Sample No.	75	Date Received	5 Jan 2016
Date Sampled	14 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH34-SH-N @ 2.5'		

Moisture Content (%)	5.3	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	71.9			
4.750	49.6			
2.360	35.9			
1.180	27.7			
0.600	22.6			
0.425	19.8			
0.300	18.5			
0.150	15.5			
0.075	13.7			



Clifton Associates

Project No. CG2738

Client Barr Engineering Environmental Service Canada

Project Barr - Lab Testing

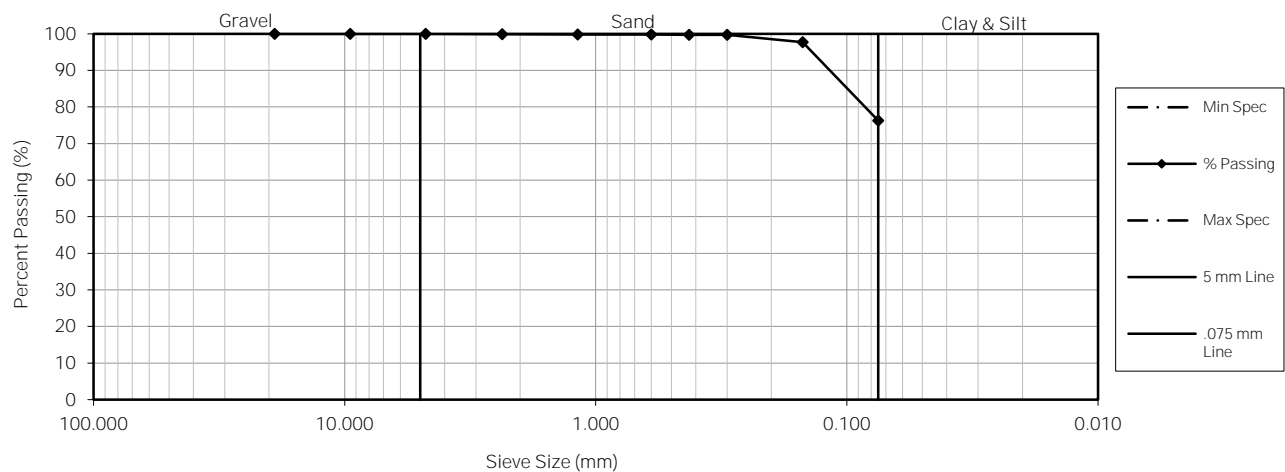
Location

Mechanical Sieve Analysis

Sample No.	68	Date Received	5 Jan 2016
Date Sampled	12 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH31-SH-S @ 10.0'		

Moisture Content (%)	25.5	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	100.0			
4.750	100.0			
2.360	99.9			
1.180	99.8			
0.600	99.8			
0.425	99.7			
0.300	99.7			
0.150	97.7			
0.075	76.3			



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Project No. CG2738

Client Barr Engineering Environmental Service Canada

Project Barr - Lab Testing

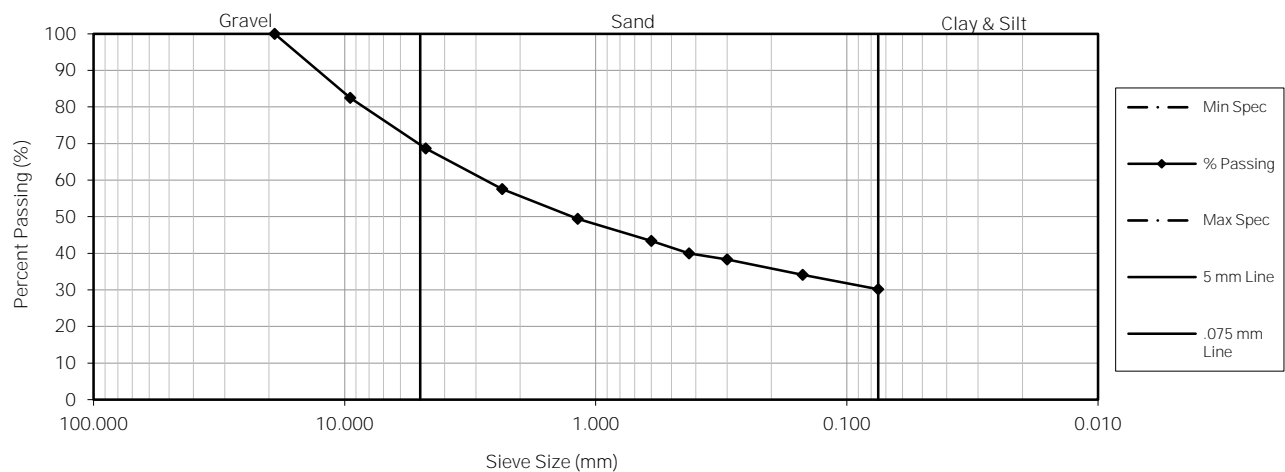
Location

Mechanical Sieve Analysis

Sample No.	67	Date Received	5 Jan 2016
Date Sampled	12 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH31-SH-S @ 5.0'		

Moisture Content (%)	7.4	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	82.4			
4.750	68.7			
2.360	57.6			
1.180	49.4			
0.600	43.4			
0.425	40.0			
0.300	38.3			
0.150	34.1			
0.075	30.2			



Clifton Associates

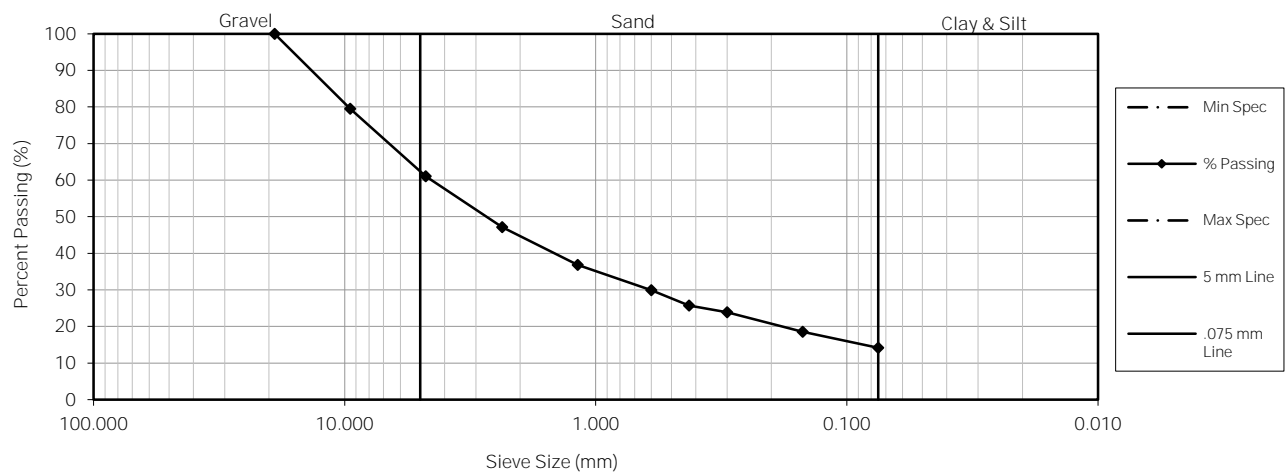
Project No. CG2738
 Client Barr Engineering Environmental Service Canada
 Project Barr - Lab Testing
 Location

Mechanical Sieve Analysis

Sample No.	62	Date Received	5 Jan 2016
Date Sampled	12 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH28-N @ 5.0'		

Moisture Content (%)	3.5	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	79.5			
4.750	61.1			
2.360	47.2			
1.180	36.9			
0.600	29.9			
0.425	25.7			
0.300	23.9			
0.150	18.5			
0.075	14.2			



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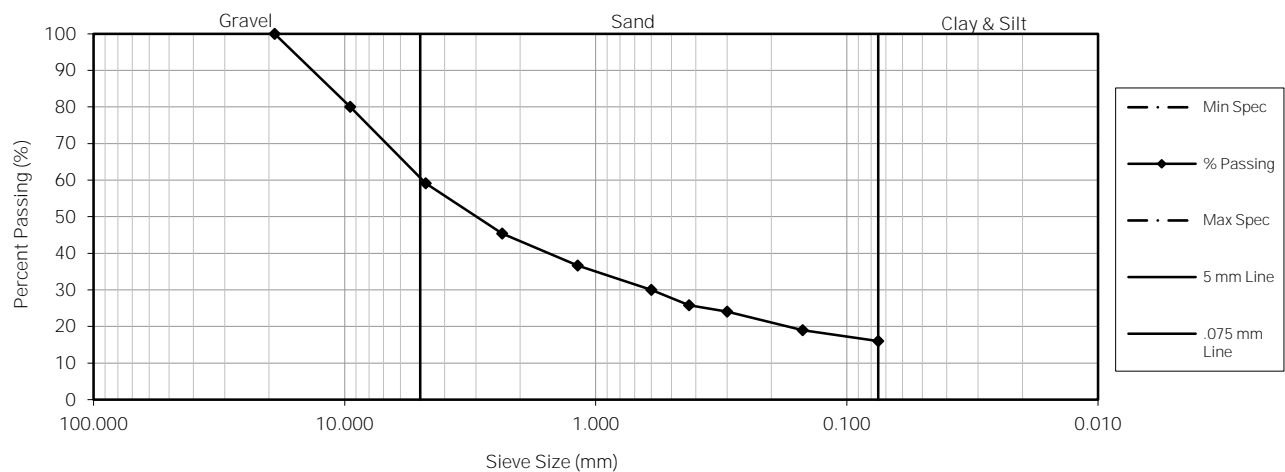
Project No. CG2738
 Client Barr Engineering Environmental Service Canada
 Project Barr - Lab Testing
 Location

Mechanical Sieve Analysis

Sample No.	53	Date Received	5 Jan 2016
Date Sampled	11 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH25-N @ 5.0'		

Moisture Content (%)	3.2	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	80.0			
4.750	59.1			
2.360	45.4			
1.180	36.6			
0.600	30.0			
0.425	25.8			
0.300	24.0			
0.150	19.0			
0.075	16.0			



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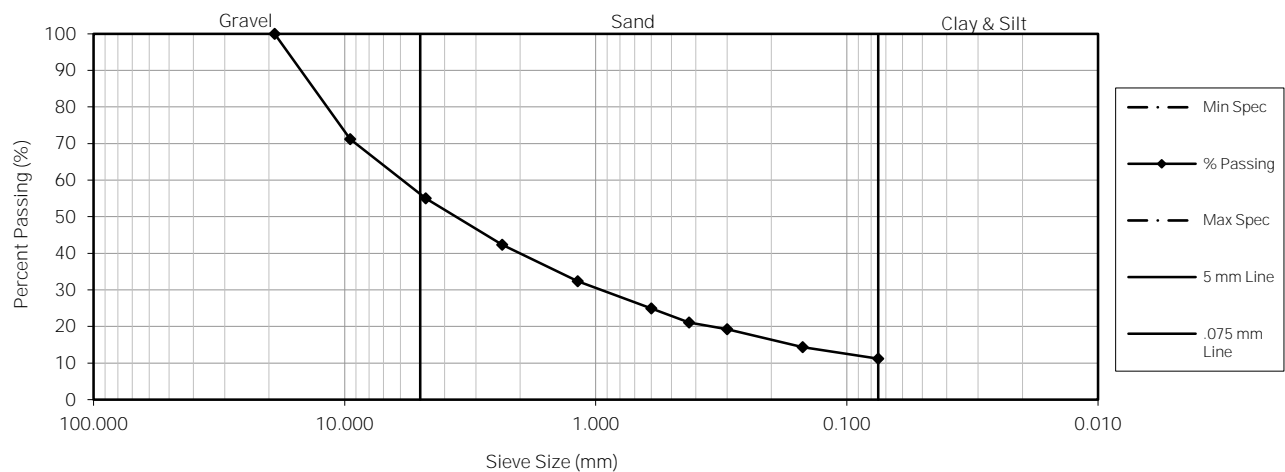
Project No. CG2738
 Client Barr Engineering Environmental Service Canada
 Project Barr - Lab Testing
 Location

Mechanical Sieve Analysis

Sample No.	45	Date Received	5 Jan 2016
Date Sampled	10 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH21-S @ 7.5'		

Moisture Content (%)	5.3	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	71.2			
4.750	55.0			
2.360	42.3			
1.180	32.3			
0.600	24.9			
0.425	21.1			
0.300	19.3			
0.150	14.3			
0.075	11.2			



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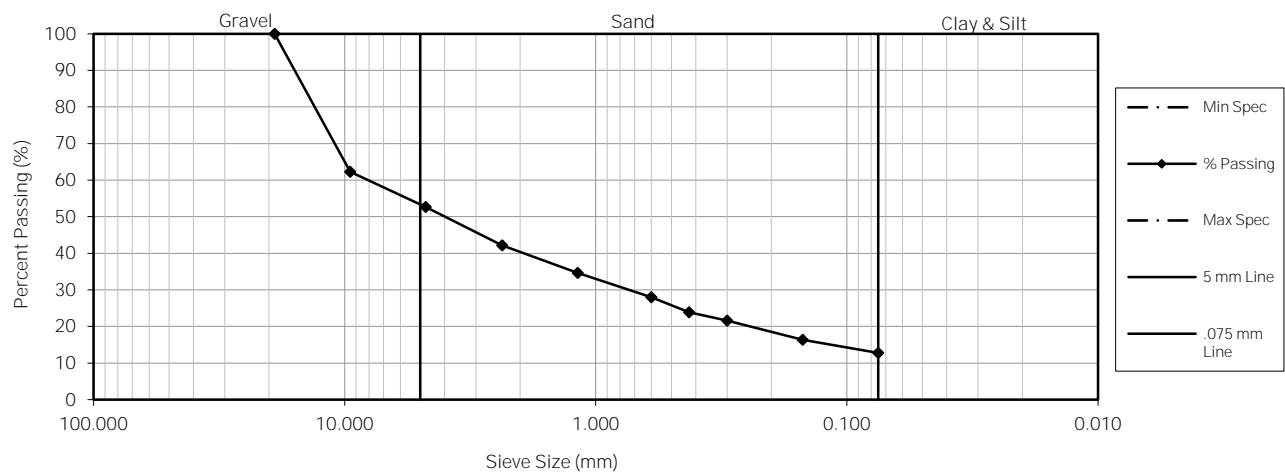
Project No. CG2738
 Client Barr Engineering Environmental Service Canada
 Project Barr - Lab Testing
 Location

Mechanical Sieve Analysis

Sample No.	28	Date Received	5 Jan 2016
Date Sampled	14 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH16-S @ 0.0'		

Moisture Content (%)	6.8	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	62.3			
4.750	52.6			
2.360	42.2			
1.180	34.6			
0.600	28.0			
0.425	23.9			
0.300	21.6			
0.150	16.4			
0.075	12.8			



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Project No. CG2738

Client Barr Engineering Environmental Service Canada

Project Barr - Lab Testing

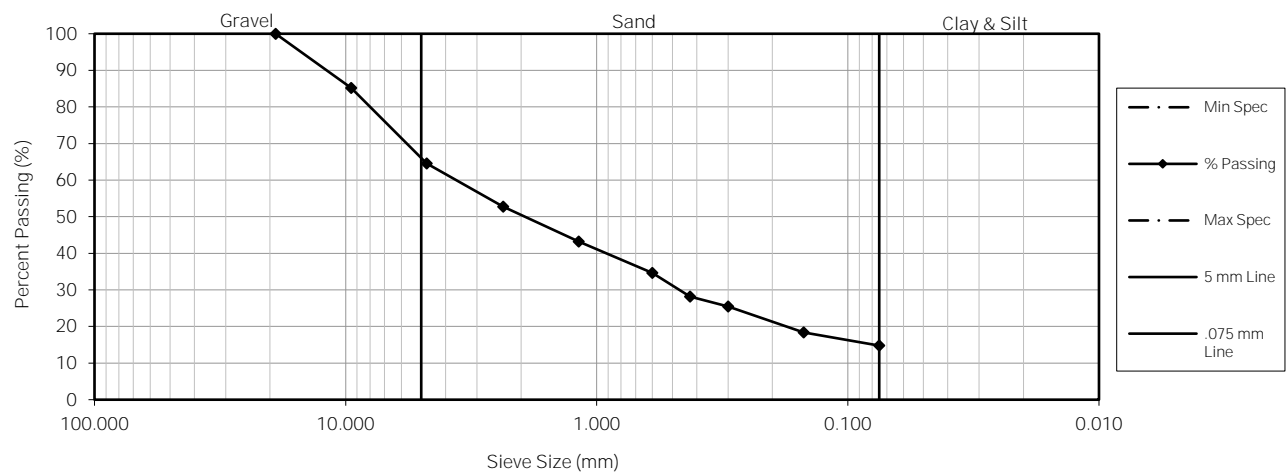
Location

Mechanical Sieve Analysis

Sample No.	27	Date Received	5 Jan 2016
Date Sampled	12 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH12-N @ 0.0'		

Moisture Content (%)	11.7	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	85.2			
4.750	64.5			
2.360	52.7			
1.180	43.2			
0.600	34.6			
0.425	28.2			
0.300	25.4			
0.150	18.4			
0.075	14.8			



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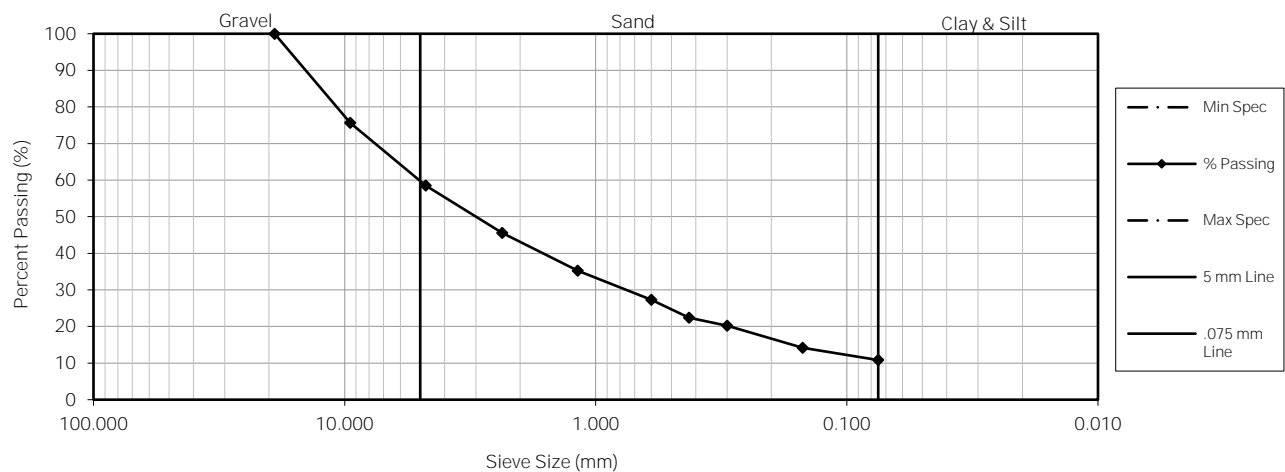
Project No. CG2738
 Client Barr Engineering Environmental Service Canada
 Project Barr - Lab Testing
 Location

Mechanical Sieve Analysis

Sample No.	20	Date Received	5 Jan 2016
Date Sampled	12 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH09-SH-S @ 0.0'		

Moisture Content (%)	8.6	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	75.6			
4.750	58.5			
2.360	45.5			
1.180	35.2			
0.600	27.3			
0.425	22.4			
0.300	20.2			
0.150	14.2			
0.075	10.8			



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Project No. CG2738

Client Barr Engineering Environmental Service Canada

Project Barr - Lab Testing

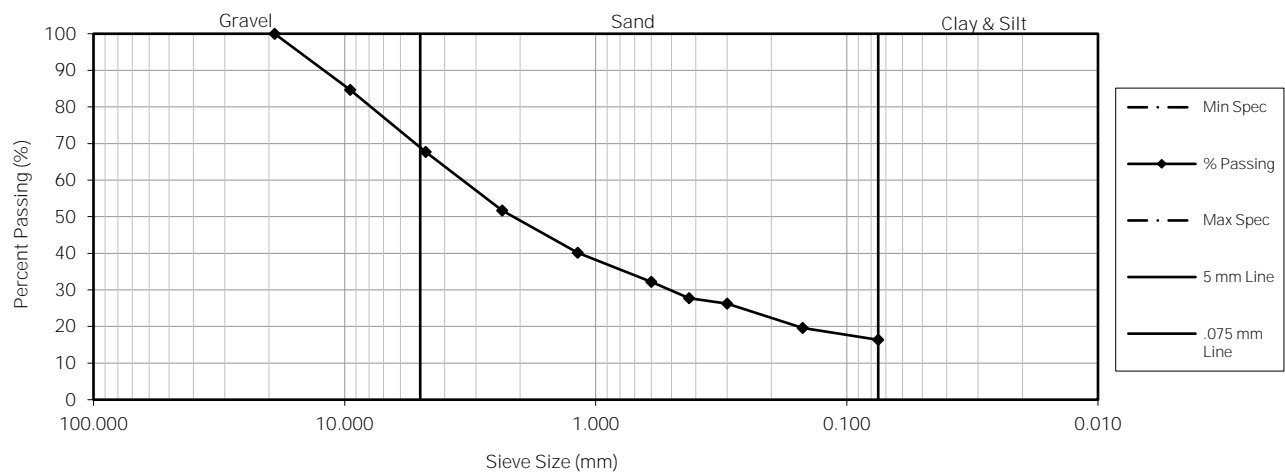
Location

Mechanical Sieve Analysis

Sample No.	14	Date Received	5 Jan 2016
Date Sampled	11 Dec 2015	Date Tested	19 Jan 2016
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	KM
Sample Description			
Sample Location	2015-BBH07-S @ 2.5'		

Moisture Content (%)	6.1	Gravel PI (%)	
Lightweights (%)		Fineness Modulus (%)	
Fracture Aggregate (%)		Sand Equivalent (%)	

Sieve Size (mm)	Percent Passing	Spec. Sieve Size (mm)	Spec. Minimum %	Spec. Maximum %
19.000	100.0			
9.500	84.7			
4.750	67.7			
2.360	51.7			
1.180	40.1			
0.600	32.2			
0.425	27.7			
0.300	26.2			
0.150	19.6			
0.075	16.4			



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Project No. CG2738

Client Barr Engineering Environmental Service Canada

Project Barr - Lab Testing

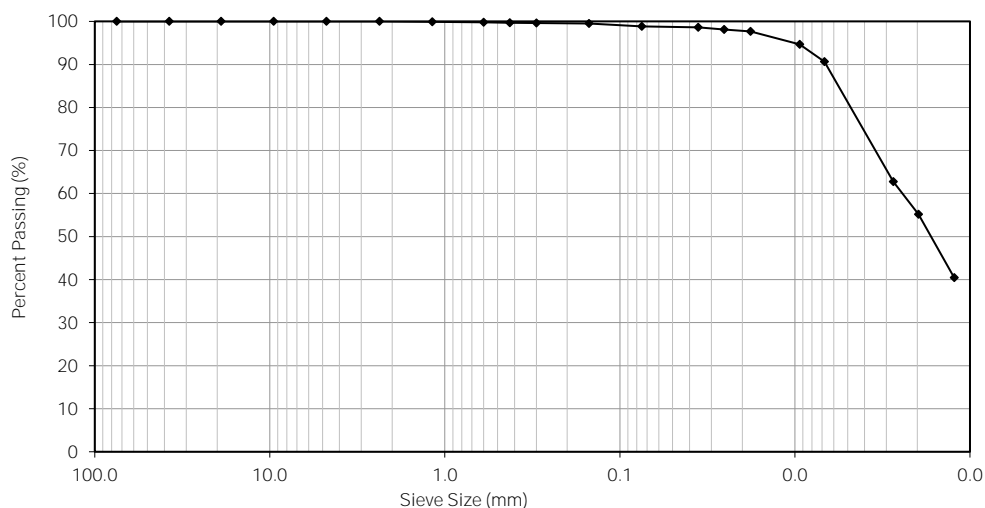
Location

Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	12-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Silty clay		
Sample Location	2015-BBH26-SH-S @ 15.0'		

Moisture Content	45.4	Hygroscopic Moisture Content	
Gravel	%	Silt	43.6 %
Sand	1.2 %	Clay	55.2 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	100.0			
4.750	100.0			
2.360	100.0			
1.180	99.9			
0.600	99.8			
0.425	99.7			
0.300	99.6			
0.150	99.5			
0.075	98.8			
0.036	98.6			
0.025	98.1			
0.018	97.6			
0.009	94.7			
0.007	90.7			
0.003	62.8			
0.002	55.2			
0.001	40.5			



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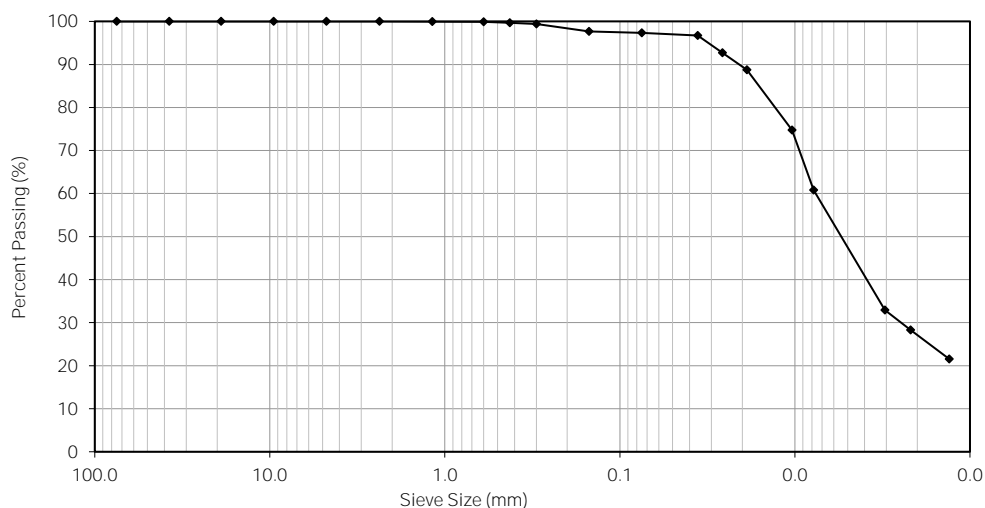
Project No	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	14-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Sandy clayey silt		
Sample Location	2015-BBH20-S @ 5.0'		

Moisture Content	24.4	Hygroscopic Moisture Content	
Gravel	%	Silt	69.0 %
Sand	2.7 %	Clay	28.3 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	100.0			
4.750	100.0			
2.360	100.0			
1.180	100.0			
0.600	99.9			
0.425	99.7			
0.300	99.4			
0.150	97.7			
0.075	97.3			
0.036	96.7			
0.026	92.7			
0.019	88.7			
0.010	74.8			
0.008	60.8			
0.003	32.9			
0.002	28.3			
0.001	21.5			



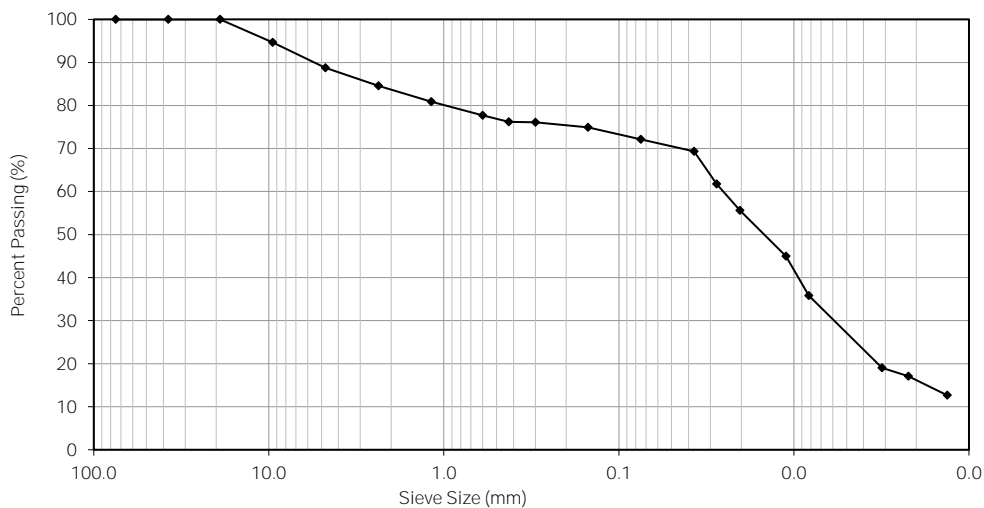
Clifton Associates

Project No	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	14-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Gravelly sandy clayey silt		
Sample Location	2015-BBH19-SH-S @ 10.0'		
Moisture Content	14.7	Hygroscopic Moisture Content	
Gravel	11.3 %	Silt	55.1 %
Sand	16.6 %	Clay	17.1 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	94.6			
4.750	88.7			
2.360	84.5			
1.180	80.9			
0.600	77.7			
0.425	76.2			
0.300	76.1			
0.150	74.9			
0.075	72.1			
0.037	69.4			
0.028	61.7			
0.020	55.6			
0.011	45.0			
0.008	35.8			
0.003	19.1			
0.002	17.1			
0.001	12.7			



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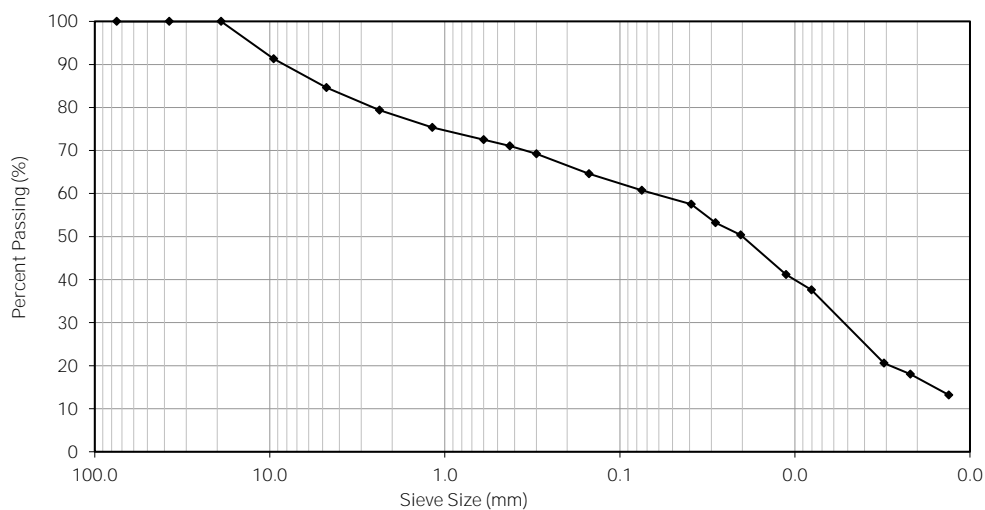
Project No	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	14-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	
Sampled by	Client	Tested by	FG
Sample Description	Gravelly sandy clayey silt		
Sample Location	2015-BBH18-N @ 2.5'		

Moisture Content	13.6	Hygroscopic Moisture Content	
Gravel	15.4 %	Silt	42.7 %
Sand	23.9 %	Clay	18.0 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	91.3			
4.750	84.6			
2.360	79.4			
1.180	75.4			
0.600	72.5			
0.425	71.1			
0.300	69.2			
0.150	64.6			
0.075	60.7			
0.039	57.5			
0.028	53.2			
0.020	50.4			
0.011	41.2			
0.008	37.6			
0.003	20.6			
0.002	18.0			
0.001	13.2			



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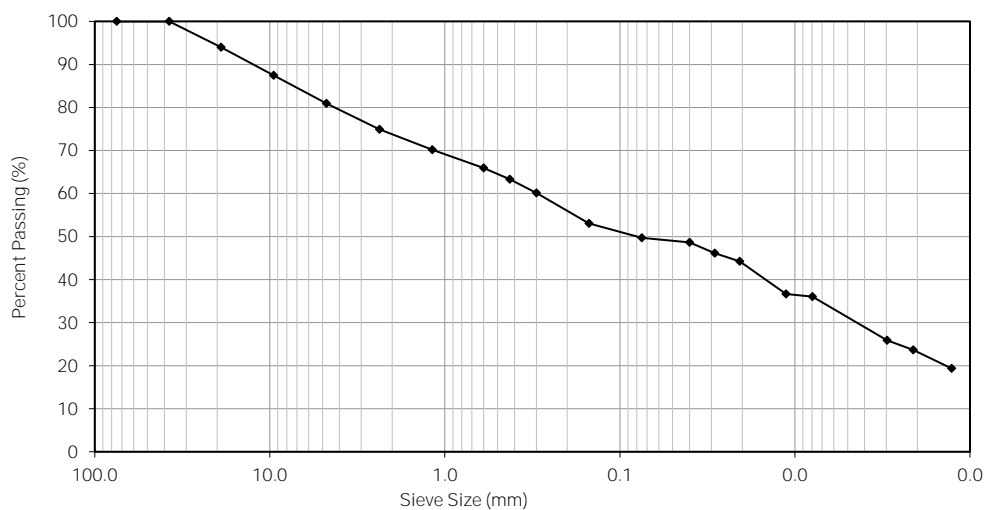
Project No	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	11-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Gravelly sandy clayey silt		
Sample Location	2015-BBH08-SH-N @ 0.0'		

Moisture Content	13.5	Hygroscopic Moisture Content	
Gravel	19.1 %	Silt	26.1 %
Sand	31.2 %	Clay	23.6 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	94.0			
9.500	87.4			
4.750	80.9			
2.360	74.9			
1.180	70.2			
0.600	66.0			
0.425	63.3			
0.300	60.1			
0.150	53.1			
0.075	49.7			
0.040	48.7			
0.029	46.1			
0.021	44.3			
0.011	36.7			
0.008	36.0			
0.003	25.9			
0.002	23.6			
0.001	19.3			



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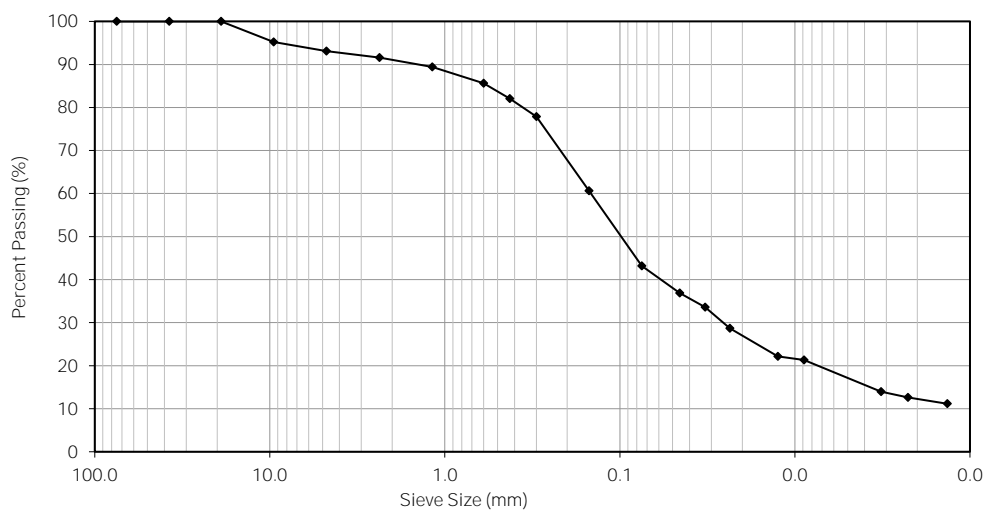
Project No	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	11-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Gravelly silty sand		
Sample Location	2015-BBH03-N @ 5.0'		

Moisture Content	26.6	Hygroscopic Moisture Content	
Gravel	6.9 %	Silt	30.6 %
Sand	49.9 %	Clay	12.6 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	95.2			
4.750	93.1			
2.360	91.6			
1.180	89.4			
0.600	85.6			
0.425	82.1			
0.300	77.9			
0.150	60.6			
0.075	43.2			
0.046	36.9			
0.033	33.6			
0.024	28.7			
0.013	22.1			
0.009	21.3			
0.003	13.9			
0.002	12.6			
0.001	11.2			



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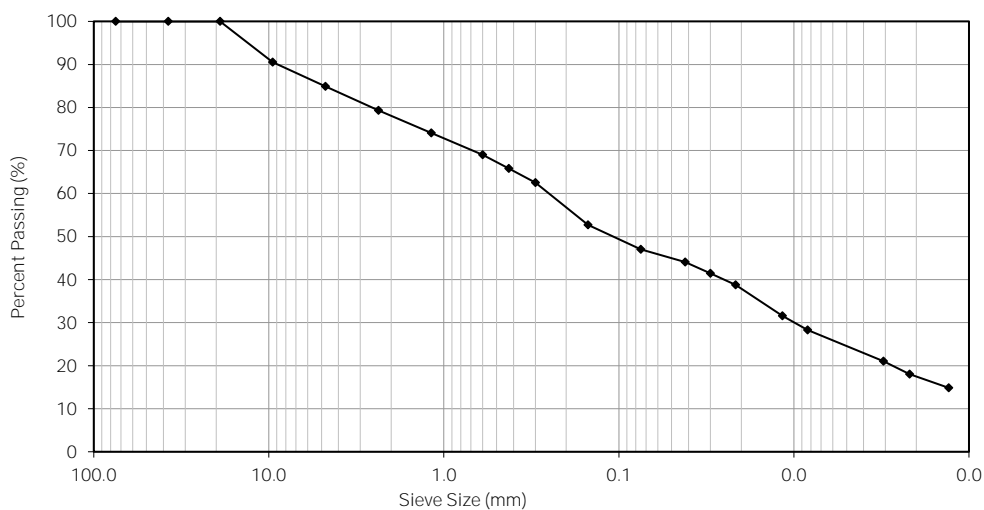
Project No	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Hydrometer Particle Size Analysis

Sample No.		Date Received	5-Jan-16
Date Sampled	10-Dec-15	Date Tested	14-Jan-16
Time Sampled		Supplied by	Client
Sampled by	Client	Tested by	FG
Sample Description	Gravelly sandy clayey silt		
Sample Location	2015-BBH01-S @ 7.5		

Moisture Content	10.1	Hygroscopic Moisture Content	
Gravel	15.1 %	Silt	29.0 %
Sand	37.9 %	Clay	18.0 %

Sieve Size (mm)	Percent Passing	Specification		
		Sieve Size (mm)	Minimum	Maximum
75.000	100.0			
37.500	100.0			
19.000	100.0			
9.500	90.5			
4.750	84.9			
2.360	79.3			
1.180	74.1			
0.600	69.0			
0.425	65.8			
0.300	62.5			
0.150	52.7			
0.075	47.0			
0.042	44.1			
0.030	41.4			
0.022	38.8			
0.012	31.6			
0.008	28.3			
0.003	21.0			
0.002	18.0			
0.001	14.9			



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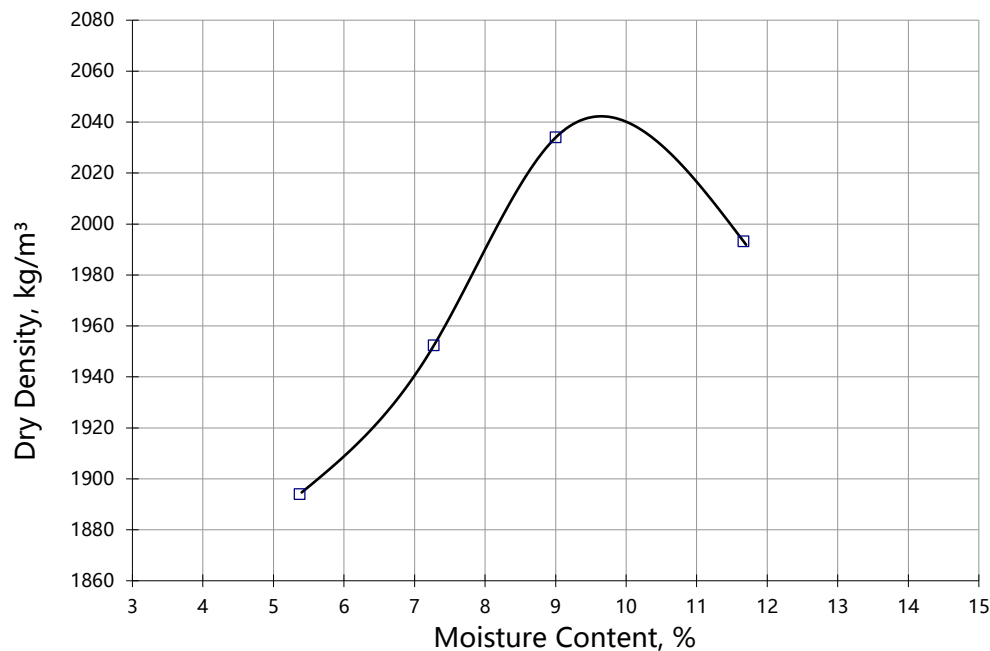
Project No	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method B

Sample No.		Date Received	January 5, 2016
Date Sampled	December 15, 2015	Date Tested	January 6, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH40-SH-S		
Sample Description	Gravelly silty sand		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	2042	kg/m ³	Point 1	1894	@	5.4
Optimum Water Content	9.6	%	Point 2	1952	@	7.3
Rock Corrected Dry Density		kg/m ³	Point 3	2034	@	9.0
Rock Corrected Water Content		%	Point 4	1993	@	11.7
Water Content as Received		%	LL		PL	
Retained on 20mm Sieve		%	PI		USC	



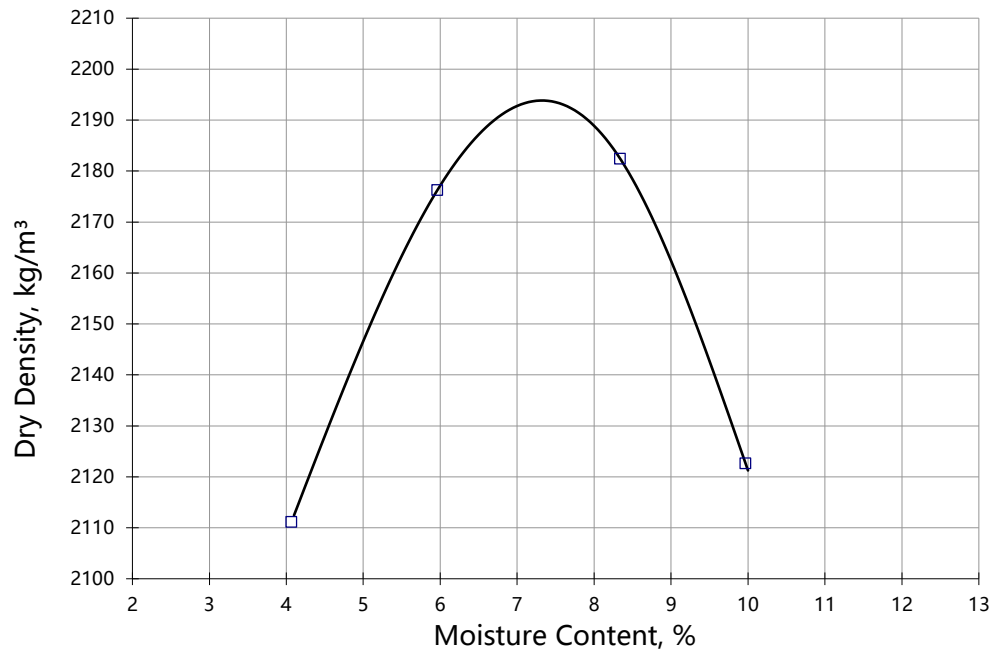
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method B

Sample No.		Date Received	January 5, 2016
Date Sampled	December 15, 2015	Date Tested	January 10, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH38-SH-S		
Sample Description	Gravelly silty sand		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	2194	kg/m ³	Point 1	2111	@	4.1
Optimum Water Content	7.3	%	Point 2	2176	@	6.0
Rock Corrected Dry Density		kg/m ³	Point 3	2182	@	8.3
Rock Corrected Water Content		%	Point 4	2123	@	10.0
Water Content as Received		%	LL		PL	
Retained on 20mm Sieve		%	PI		USC	



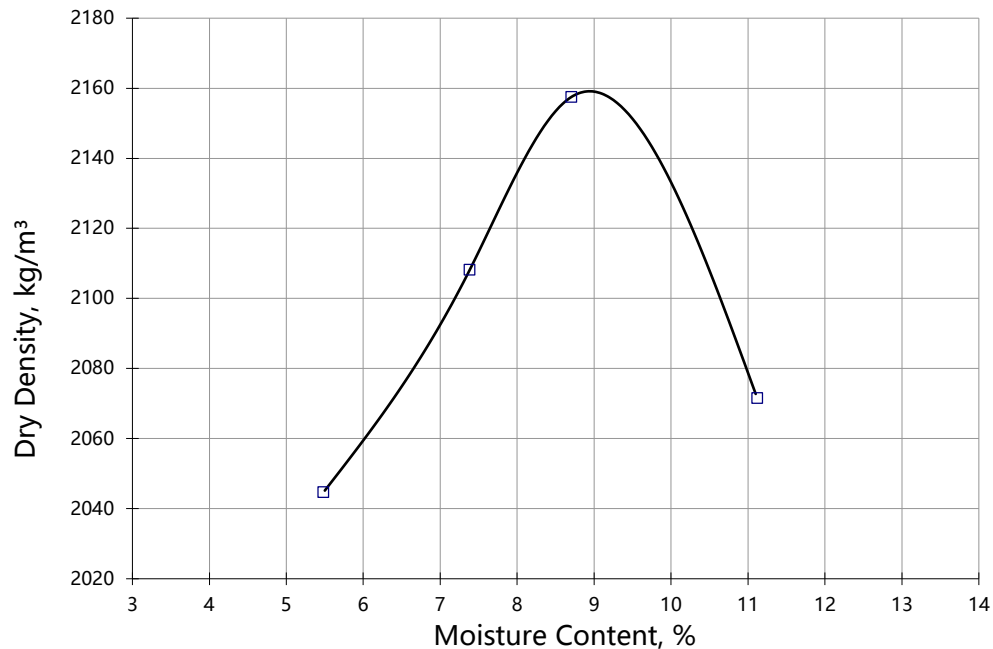
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method B

Sample No.		Date Received	January 5, 2016
Date Sampled	December 11, 2015	Date Tested	January 7, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH24-SH-N		
Sample Description	Gravelly silty sand		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	2159	kg/m ³	Point 1	2045	@	5.5
Optimum Water Content	8.9	%	Point 2	2108	@	7.4
Rock Corrected Dry Density		kg/m ³	Point 3	2158	@	8.7
Rock Corrected Water Content		%	Point 4	2072	@	11.1
Water Content as Received		%	LL		PL	
Retained on 20mm Sieve		%	PI		USC	



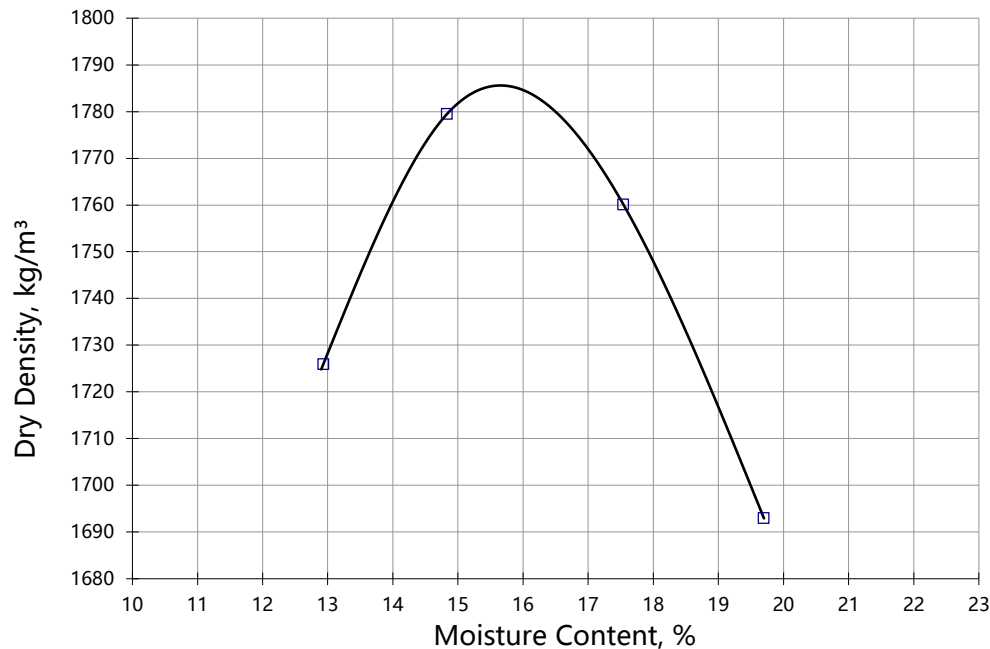
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method A

Sample No.		Date Received	January 5, 2016
Date Sampled	December 14, 2015	Date Tested	January 6, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH17-N		
Sample Description	Clayey silt		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	1786	kg/m ³	Point 1	1726	@	12.9
Optimum Water Content	15.7	%	Point 2	1779	@	14.8
Rock Corrected Dry Density		kg/m ³	Point 3	1760	@	17.5
Rock Corrected Water Content		%	Point 4	1693	@	19.7
Water Content as Received		%	LL		PL	
Retained on 4.75mm Sieve		%	PI		USC	



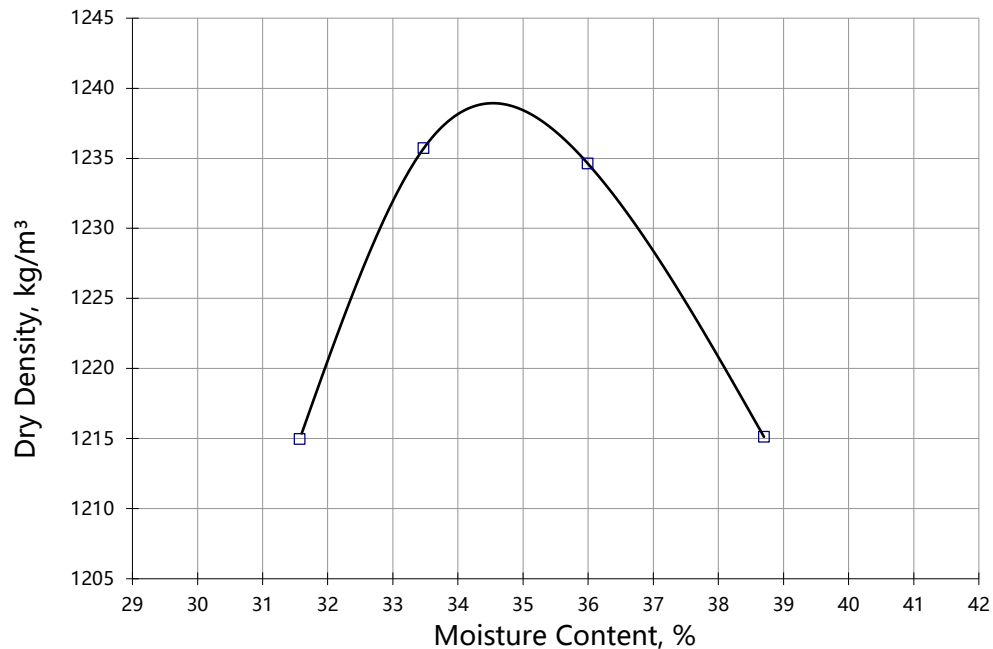
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Standard Effort Laboratory Compaction Test (Proctor Test)

ASTM D698, Method A

Sample No.		Date Received	January 5, 2016
Date Sampled	December 11, 2015	Date Tested	January 6, 2016
Time Sampled		Sampled By	
Supplied By		Tested By	FG
Sample Location	2015-BBH03-N		
Sample Description	Organic loam		
	Gravel	Sand	Clay/Silt

Maximum Dry Density	1239	kg/m ³	Point 1	1215	@	31.6
Optimum Water Content	34.5	%	Point 2	1236	@	33.5
Rock Corrected Dry Density		kg/m ³	Point 3	1235	@	36.0
Rock Corrected Water Content		%	Point 4	1215	@	38.7
Water Content as Received		%	LL		PL	
Retained on 4.75mm Sieve		%	PI		USC	



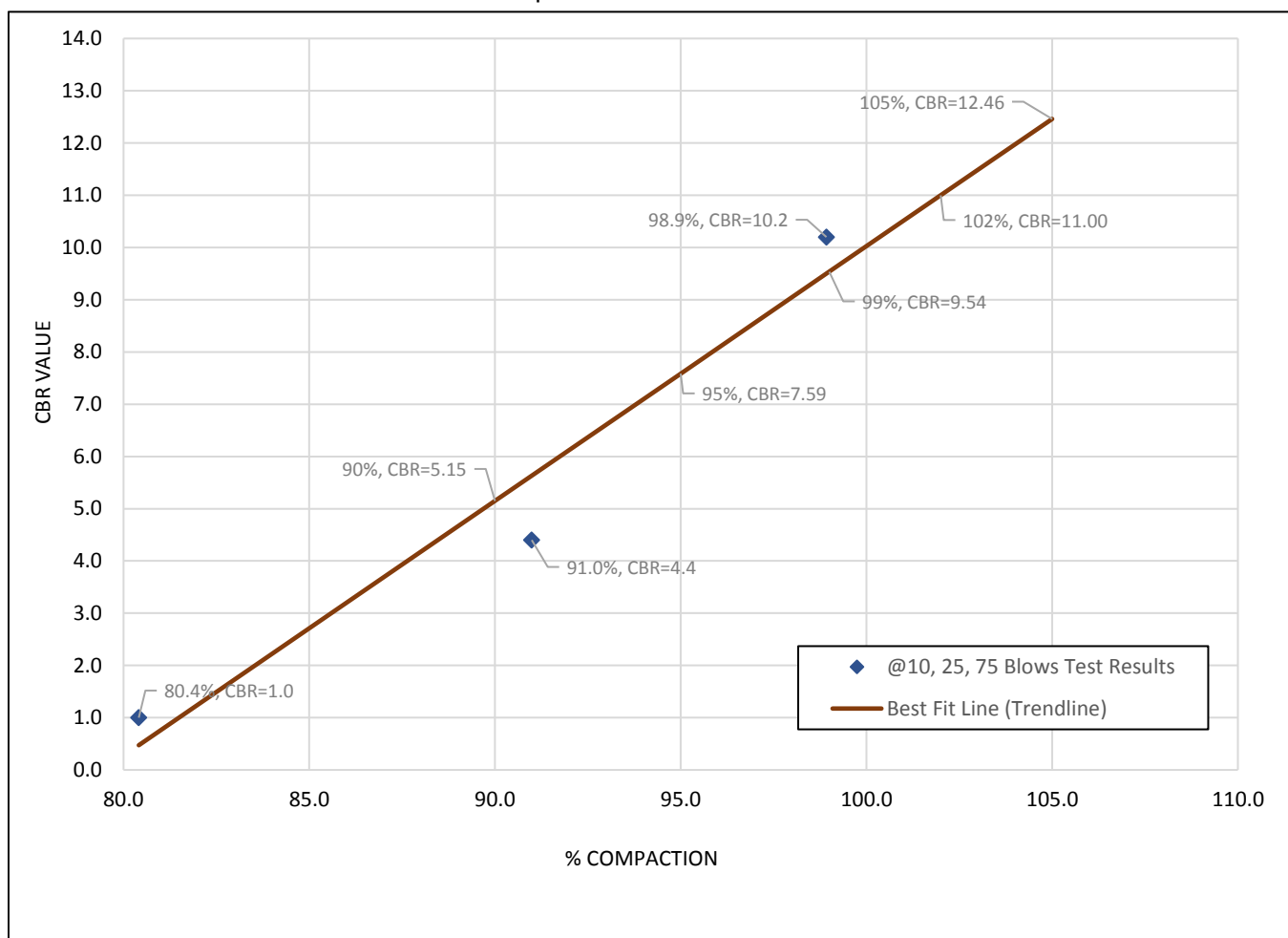
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/15/2015	Date Tested	01/15/2016	Max. Dry Density (kg/m³)	2042
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	9.6
Sample No.	118	Sample ID	2015-BBH40-SH-S		

% Compaction - CBR Value



Approved By



Clifton Associates

Project No. CG2738

Client Barr Engineering Environmental Service Canada

Project Barr - Lab Testing

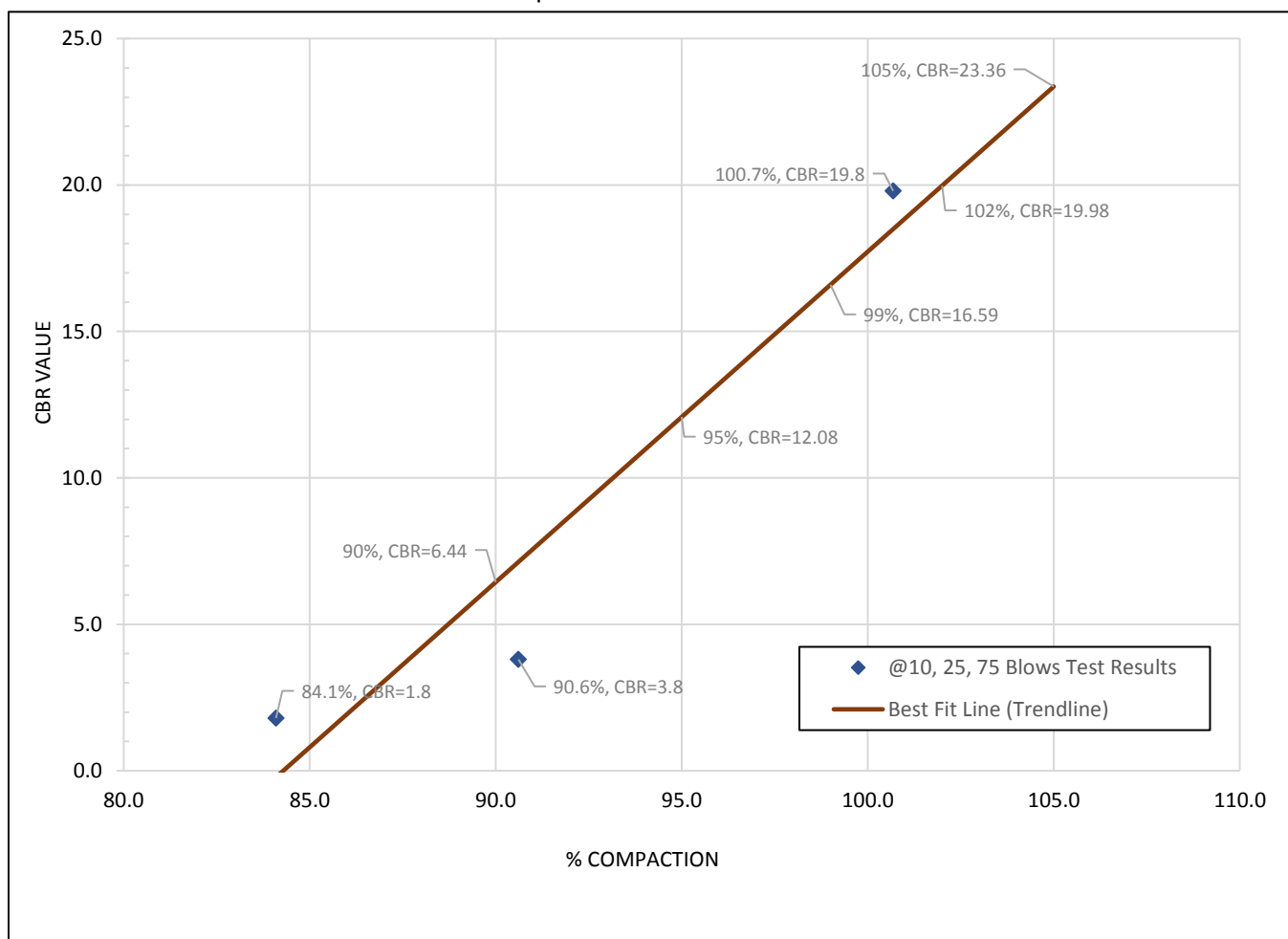
Location

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/15/2015	Date Tested	01/20/2016	Max. Dry Density (kg/m³)	2194
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	7.3
Sample No.	116	Sample ID	2015-BBH38-SH-S		

% Compaction - CBR Value



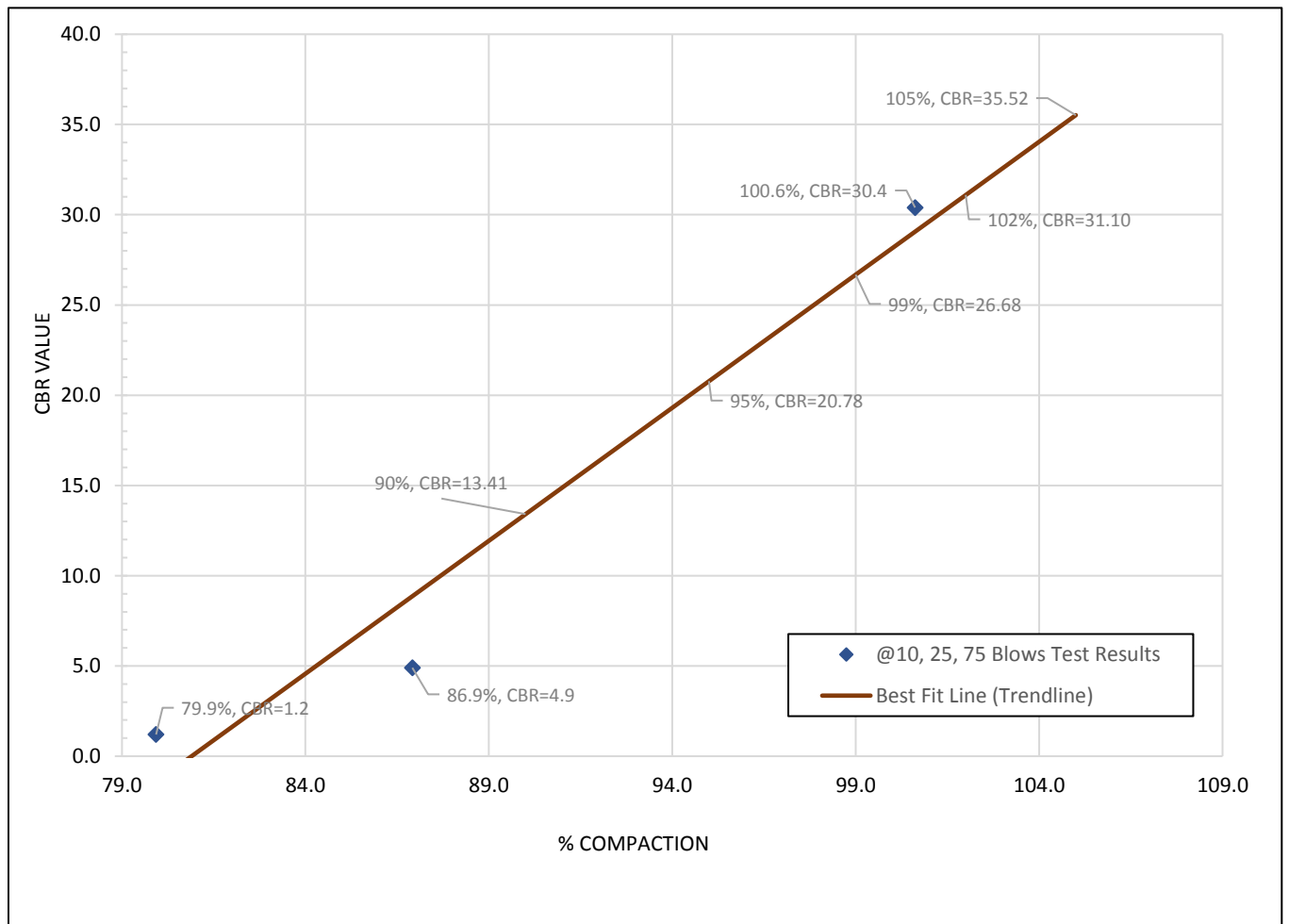
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/14/2015	Date Tested	01/20/2016	Max. Dry Density (kg/m³)	2262
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	6
Sample No.	115	Sample ID	2015-BBH33-S		

% Compaction - CBR Value



Clifton Associates

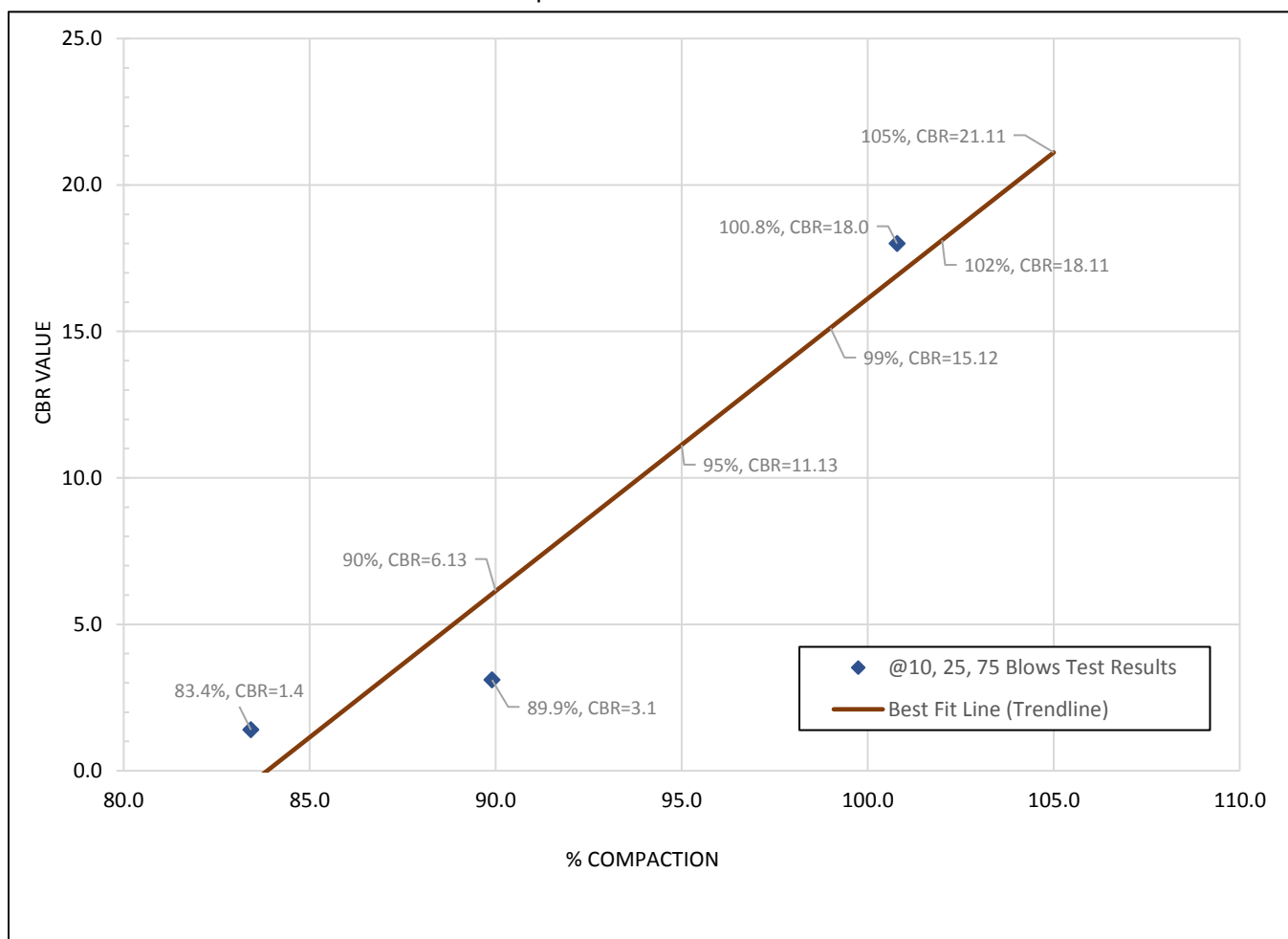
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/11/2015	Date Tested	01/20/2016	Max. Dry Density (kg/m³)	2159
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	8.9
Sample No.	113	Sample ID	2015-BBH24-SH-N		

% Compaction - CBR Value



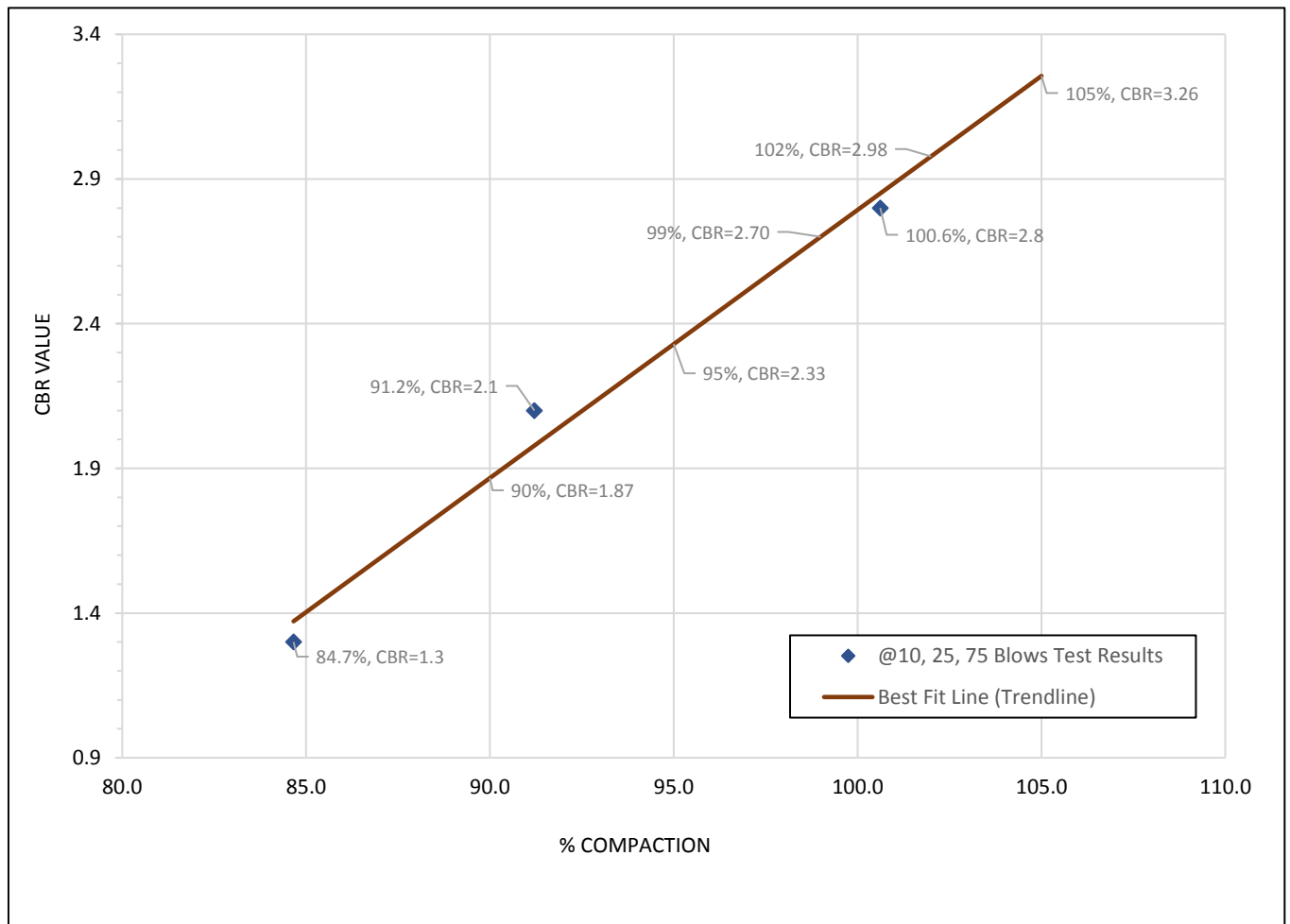
Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/14/2015	Date Tested	01/15/2016	Max. Dry Density (kg/m ³)	1786
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	15.7
Sample No.	112	Sample ID	2015-BBH17-N		

% Compaction - CBR Value



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Clifton Associates

Project No. CG2738

Client Barr Engineering Environmental Service Canada

Project Barr - Lab Testing

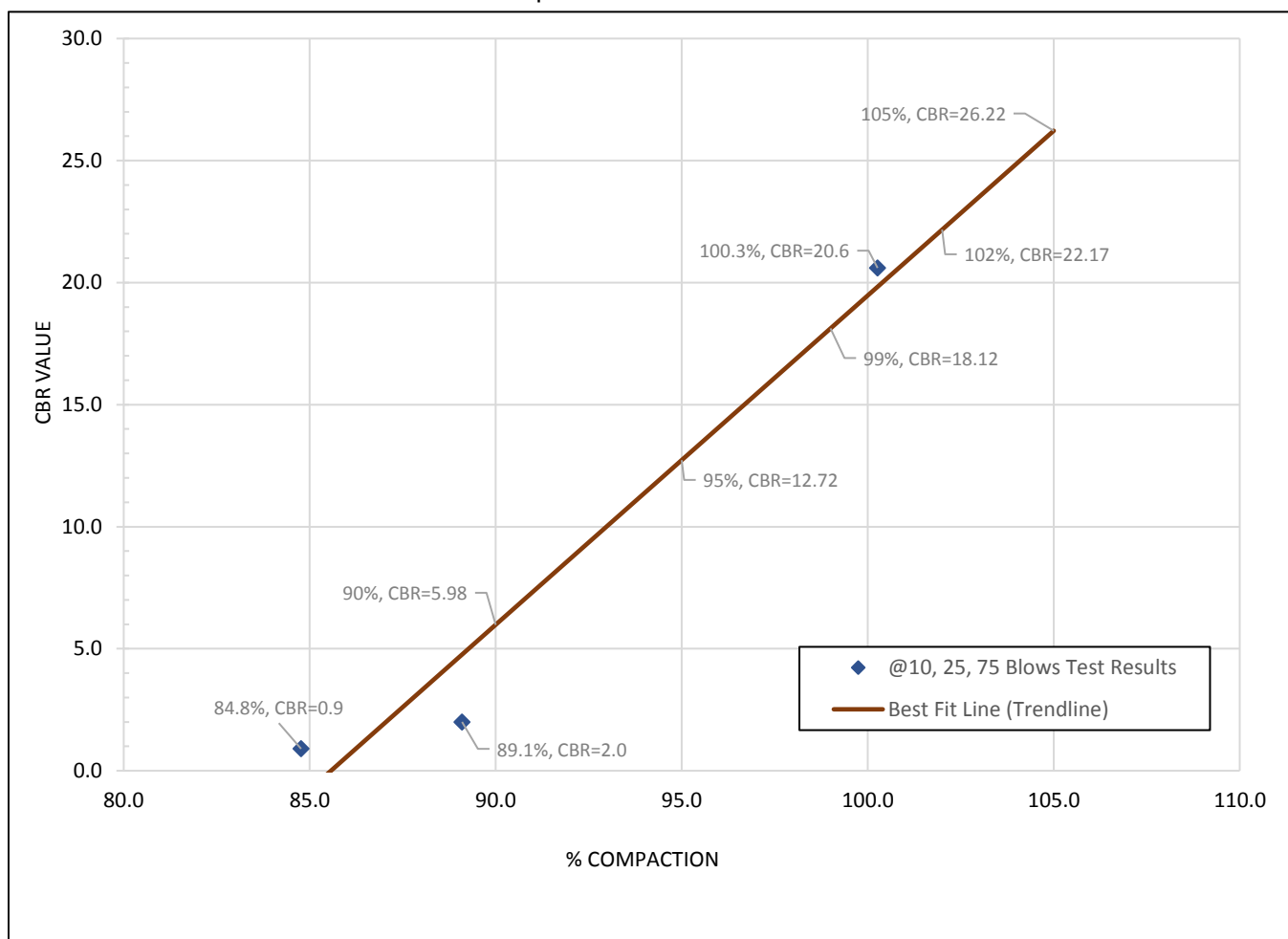
Location

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/12/2015	Date Tested	01/20/2016	Max. Dry Density (kg/m³)	2265
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	6.5
Sample No.	111	Sample ID	2015-BBH11-SH-S		

% Compaction - CBR Value



Project No.	CG2738
Client	Barr Engineering Environmental Service Canada
Project	Barr - Lab Testing
Location	

Organic Content Determination

Borehole No.			2015-BBH03-N		
Depth	ft		0		
Tare No.			# 5		
Weight of Tare (g)			54.02		
Wet Sample & Tare (g)			88.43		
Dry Sample & Tare (g)			84.82		
Weight of organic (g)			3.61		
Weight of Dry Sample (g)			30.80		
Organic Content (%)			11.7		
Borehole No.					
Depth	ft				
Tare No.					
Weight of Tare (g)					
Wet Sample & Tare (g)					
Dry Sample & Tare (g)					
Weight of organic (g)					
Weight of Dry Sample (g)					
Organic Content (%)					
Borehole No.					
Depth	ft				
Tare No.					
Weight of Tare (g)					
Wet Sample & Tare (g)					
Dry Sample & Tare (g)					
Weight of organic (g)					
Weight of Dry Sample (g)					
Organic Content (%)					
Borehole No.					
Depth	ft				
Tare No.					
Weight of Tare (g)					
Wet Sample & Tare (g)					
Dry Sample & Tare (g)					
Weight of organic (g)					
Weight of Dry Sample (g)					
Organic Content (%)					

Remarks



Clifton Associates

Project No CG2738

Client Barr Engineering Environmental
Service Canada

Project Barr - Lab Testing

Location

Tech FG

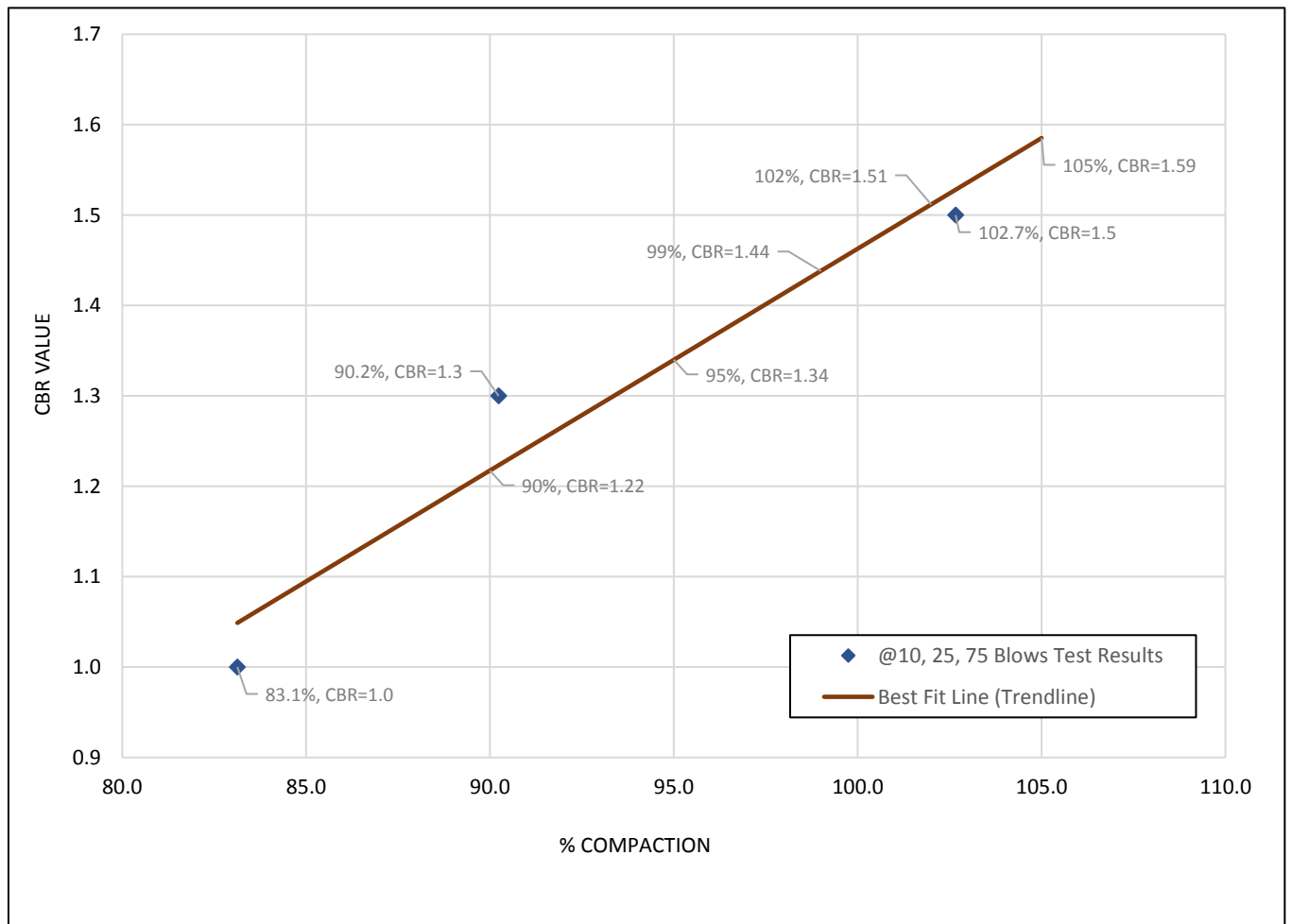
Sample Date 12/11/2015

California Bearing Ratio (CBR)

ASTM D-1883

Date Sampled	12/11/2015	Date Tested	01/15/2016	Max. Dry Density (kg/m³)	1239
Sampled By	Client	Tested By	SF	Optimum Moisture (%)	34.5
Sample No.	109	Sample ID	2015-BBH03-N		

% Compaction - CBR Value



Approved By



Clifton Associates

Project No. CG2738

Client Barr Engineering Environmental Service Canada

Project Barr - Lab Testing

Location



Clifton Associates Ltd.
ATTN: Philip Chong
2222 30 Ave NE
Calgary AB T2E 7K9

Date Received: 08-JAN-16
Report Date: 18-JAN-16 08:12 (MT)
Version: FINAL

Client Phone: 403-263-2556

Certificate of Analysis

Lab Work Order #: L1721708
Project P.O. #: NOT SUBMITTED
Job Reference: CG2738
C of C Numbers:
Legal Site Desc:

Nelson Kwan, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1721708-1 BH1 @ 0.0 Sampled By: CLIENT on 08-JAN-16 Matrix: SOIL Miscellaneous Parameters % Saturation Chloride (Cl) Sulfur (as SO4) pH in Saturated Paste Salinity in mg/kg Chloride (Cl) Sulfur (as SO4)	 44.0 193 102 7.83 84.8 44.7	 	 1.0 20 6.0 0.10 8.8 2.6	 % mg/L mg/L pH mg/kg mg/kg	 	 14-JAN-16 16-JAN-16 14-JAN-16 14-JAN-16 16-JAN-16 16-JAN-16	 R3370313 R3372693 R3371437 R3370313
L1721708-2 BH1 @ 2.0 Sampled By: CLIENT on 08-JAN-16 Matrix: SOIL Miscellaneous Parameters % Saturation Chloride (Cl) Sulfur (as SO4) pH in Saturated Paste Salinity in mg/kg Chloride (Cl) Sulfur (as SO4)	 27.8 234 45.8 8.20 65.0 12.7	 	 1.0 20 6.0 0.10 5.6 1.7	 % mg/L mg/L pH mg/kg mg/kg	 	 14-JAN-16 16-JAN-16 14-JAN-16 14-JAN-16 16-JAN-16 16-JAN-16	 R3370313 R3372693 R3371437 R3370313

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-PASTE-COL-CL	Soil	Chloride in Soil (Paste) by Colorimetry	CSSS, APHA 4500-Cl E
A soil extract produced by the saturated paste extraction procedure is analyzed for Chloride by Colourimetry.			
PH-PASTE-CL	Soil	pH in Saturated Paste	CSSS 16.2
A soil extract produced by the saturated paste extraction procedure is analyzed by pH meter.			
SAL-MG/KG-CALC-CL	Soil	Salinity in mg/kg	Manual Calculation
SAT-PCNT-CL	Soil	% Saturation	CSSS 18.2-Calculation
SO4-PASTE-ICP-CL	Soil	Sulphate (SO4)	CSSS CH15/EPA 6010B
A soil extract produced by the saturated extraction procedure is analyzed for sulfate by ICPOES.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
Chain of Custody Numbers:	

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg ww - milligrams per kilogram based on wet weight of sample

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1721708

Report Date: 18-JAN-16

Page 1 of 2

Client: Clifton Associates Ltd.

2222 30 Ave NE

Calgary AB T2E 7K9

Contact: Philip Chong

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-PASTE-COL-CL	Soil							
Batch	R3372693							
WG2245406-3	IRM	SAL-STD8						
Chloride (Cl)			88.5		%		70-130	16-JAN-16
WG2245406-1	MB							
Chloride (Cl)			<20		mg/L		20	16-JAN-16
PH-PASTE-CL	Soil							
Batch	R3370313							
WG2245406-3	IRM	SAL-STD8						
pH in Saturated Paste			7.39		pH		6.9-7.5	14-JAN-16
SAT-PCNT-CL	Soil							
Batch	R3370313							
WG2245406-3	IRM	SAL-STD8						
% Saturation			98.1		%		80-120	14-JAN-16
SO4-PASTE-ICP-CL	Soil							
Batch	R3371437							
WG2245406-3	IRM	SAL-STD8						
Sulfur (as SO4)			110.8		%		70-130	14-JAN-16
WG2245406-1	MB							
Sulfur (as SO4)			<6.0		mg/L		6	14-JAN-16

Quality Control Report

Workorder: L1721708

Report Date: 18-JAN-16

Page 2 of 2

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



L1721708-COFC

Study / Analytical Request Form

Toll Free: 1 800 668 9878

www.alsglobal.com

COC #

Page 1 of 1

Report To			Distribution			Service Requested (Rush for routine analysis subject to availability)																																																																																																																																																																																																																								
Company: Clifton Associates Ltd. (acct# 10137)			<input checked="" type="checkbox"/> Standard <input type="checkbox"/> Other			<input checked="" type="radio"/> Regular (Standard Turnaround Times - Business Days)																																																																																																																																																																																																																								
Contact: Philip Chong			<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Digital <input type="checkbox"/> Fax			<input type="radio"/> Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT																																																																																																																																																																																																																								
Address: 2222 - 30 Avenue NE			Email 1: philip_chong@clifton.ca			<input type="radio"/> Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT																																																																																																																																																																																																																								
Calgary, AB T2E 7K9			Email 2:			<input type="radio"/> Same Day or Weekend Emergency - Contact ALS to Confirm TAT																																																																																																																																																																																																																								
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Invoice To Same as Report? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			Client / Project Information			Please indicate below Filtered, Preserved or both (F, P, F/P)																																																																																																																																																																																																																								
Hardcopy of Invoice with Report? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			Job #: CG2738																																																																																																																																																																																																																											
Company: Clifton Associates Ltd. (vendor04@clifton.ca)			PO / AFE:																																																																																																																																																																																																																											
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<table border="1"><thead><tr><th>Item No.</th><th>Sample Identification (This description will appear on the report)</th><th>Date (dd-mmm-yy)</th><th>Time (hh:mm)</th><th>Sample Type</th><th>SAL-MG/KG-CALC-CL</th><th>SAT-PCNT-CL</th><th>SO4-PASTE-ICP-CL</th><th>Resistivity</th><th>Hydrometer</th><th>pH</th><th>Chloride</th><th>Organic</th><th></th><th></th><th>Number of Containers</th></tr></thead><tbody><tr><td>1</td><td>BH1 @ 0.0</td><td>08-Jan-16</td><td></td><td>Soil</td><td></td><td></td><td>X</td><td></td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td>BH1 @ 2.0</td><td>08-Jan-16</td><td></td><td>Soil</td><td></td><td></td><td>X</td><td></td><td></td><td>X</td><td>X</td><td></td><td></td><td></td><td></td></tr><tr><td>3</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><td></td></tr><tr><td>4</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><td></td></tr><tr><td>5</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><td></td></tr><tr><td>6</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><td></td></tr><tr><td>7</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><td></td></tr><tr><td>8</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><td></td></tr><tr><td>9</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><td></td></tr><tr><td>10</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><td></td></tr><tr><td>11</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><td></td></tr><tr><td>12</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><td></td></tr></tbody></table>															Item No.	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	SAL-MG/KG-CALC-CL	SAT-PCNT-CL	SO4-PASTE-ICP-CL	Resistivity	Hydrometer	pH	Chloride	Organic			Number of Containers	1	BH1 @ 0.0	08-Jan-16		Soil			X			X	X					2	BH1 @ 2.0	08-Jan-16		Soil			X			X	X					3																4																5																6																7																8																9																10																11																12															
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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.																																																																																																																																																																																																																														
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.																																																																																																																																																																																																																														
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.																																																																																																																																																																																																																														
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