



Kiggavik Project Environmental Impact Statement

Tier 3 Technical Appendix 2L

All-Season Roads Report

December 2011



AREVA RESOURCES CANADA LTD.

**KIGGAVIK PROJECT
NORTHERN & SOUTHERN ALL-SEASON ROADS REPORT**

V33101016

October 2010



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APPENDICES

- Appendix A Reference Drawings and Supporting Documentation
- Appendix B Northern Road Plan Profiles



1.0 INTRODUCTION

The Northern and Southern All Season Road Report is one of a group of studies performed by EBA of various aspects related to access and infrastructure for the proposed Kiggavik Mine Project. The other studies include:

- Haul Road Report
- Physical Environment Within the DEIS Report
- Andrew Lake Dyke Report
- Port Facility Report
- Mine Site airstrip Report
- Winter Road Report
- Mine Site Building Foundations Report

Figure 1.0-1 below shows the general location of the Kiggavik Project.

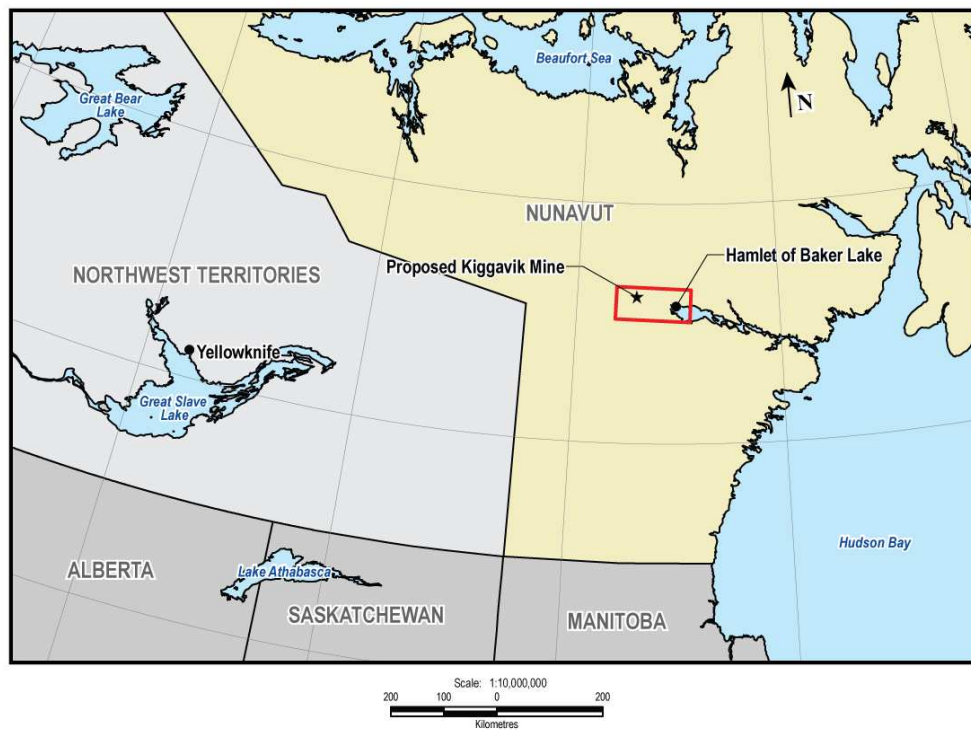
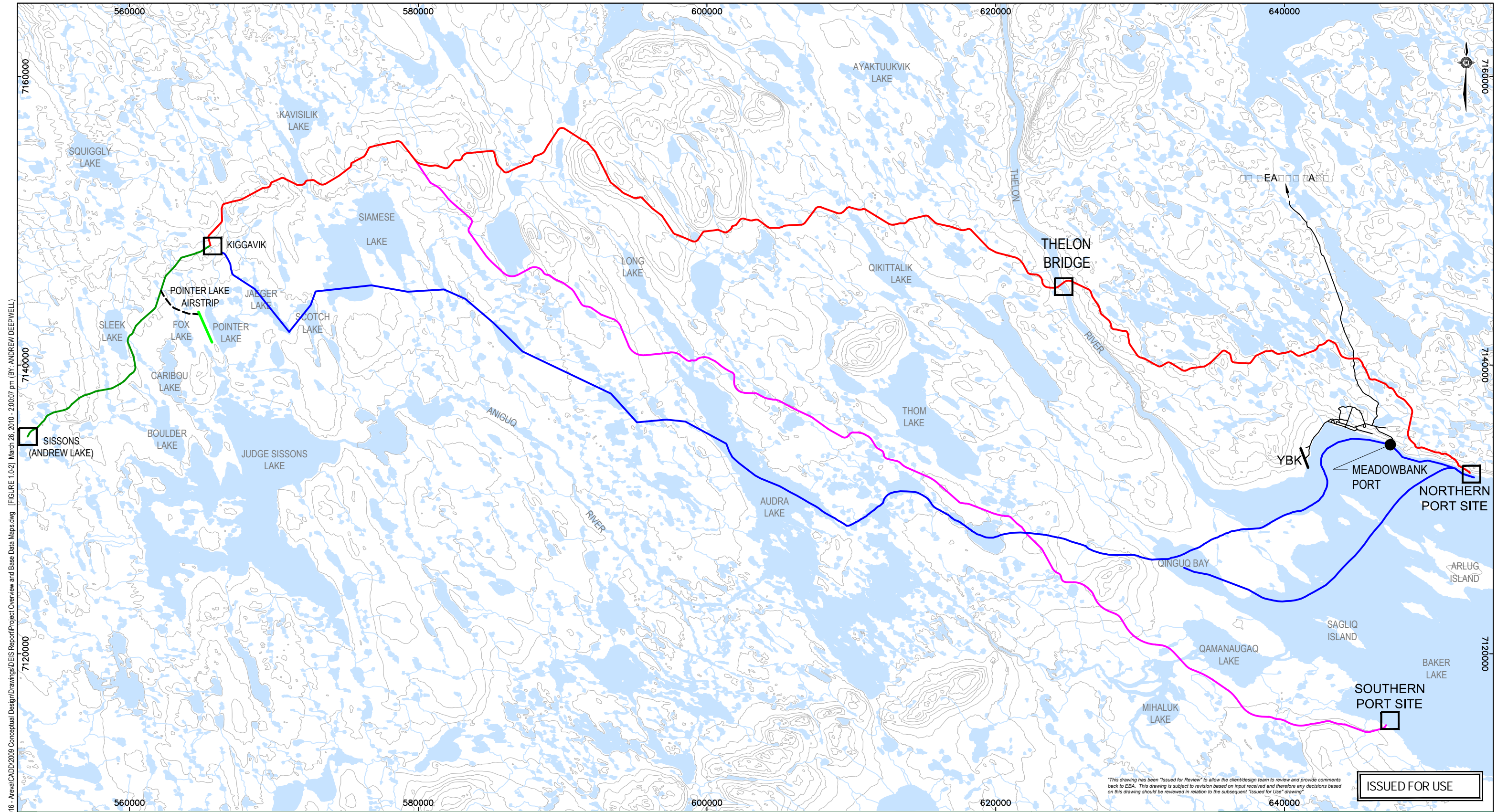


Figure 1.0-1 Key Plan

Figure 1.0-2 on the following page shows the various project elements discussed within this Report and the other Reports listed above.

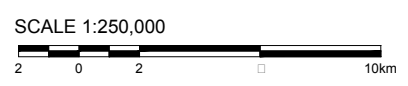


Q:\Vancouver\Transportation\V3310\Projects\V33101016 - Areva\CADD\2009 Conceptual Design\Drawings\DEIS Report\Project Overview and Base Data Maps.dwg [FIGURE 1.0-2] March 26, 2010 - 2:00:07 pm (BY: ANDREW DEERWELL)

*This drawing has been "Issued for Review" to allow the client/design team to review and provide comments back to EBA. This drawing is subject to revision based on input received and therefore any decisions based on this drawing should be reviewed in relation to the subsequent "Issued for Use" drawing.

ISSUED FOR USE

- | | |
|---|---|
| PROPOSED | EXISTING |
| — Northern All Season Road | — Roads |
| — Southern All Season Road | — 20m Contour - NTS Base Data |
| — Haul Road | — YBK Airport |
| — Winter Road | |
| — Pointer Lake Airstrip | |



PROJECTION: UTM Zone 14
DATUM: NAD 83

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|---|------------------------|------------|----------|---------------------|
| KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT | | | | |
| PROJECT OVERVIEW MAP | | | | |
| PROJECT NO. V33101016 | DWN AJD | CHK DCD | REV - | Figure 1.0-2 |
| OFFICE VANC | DATE March 26, 2010 | | | |

2.0 ACCESS ROAD OPTIONS

2.1 INTRODUCTION

In 2007, EBA completed a Pre-feasibility Study which examined and evaluated ten distinct transportation options, with some variations in each. (See Figure 2.1-1) This high-level desktop study outlined the advantages and disadvantages of each option based on estimated construction costs, maintenance costs, reliability, operational logistics, and construction logistics. Areva then consulted with various environmental consultants involved in the Kiggavik project as well as the local community. From this process three options were selected for further study. These three options are shown previously in Figure 1.0-2, and are described in detail as follows:

1. Northern All Season Road
2. Southern All Season Road
3. Winter Road

2.2 AREVA'S FUNCTIONAL REQUIREMENTS FOR THE ACCESS ROAD

- The Kiggavik Project requires that the majority of fuel, reagents and supplies required for yearly operations be transported from a port facility on Baker Lake each year that the mine is in operation. In addition to this annual re-supply, the building materials and construction/mining equipment required to construct and operate the site will also need to be transported in the same manner.

Based on the current estimate of annual supplies (Areva, 2008) the required road-based transportation requirements will be 81,000 tonnes of supplies and equipment, and 57,000 tonnes (70 million litres) of fuel. For purposes of design, the assumed primary hauling unit is a Super B-Train, which could have a configuration similar to that show in Figure 2.2-1 as follows:

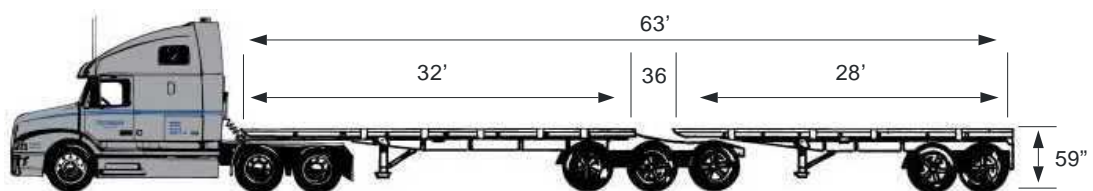
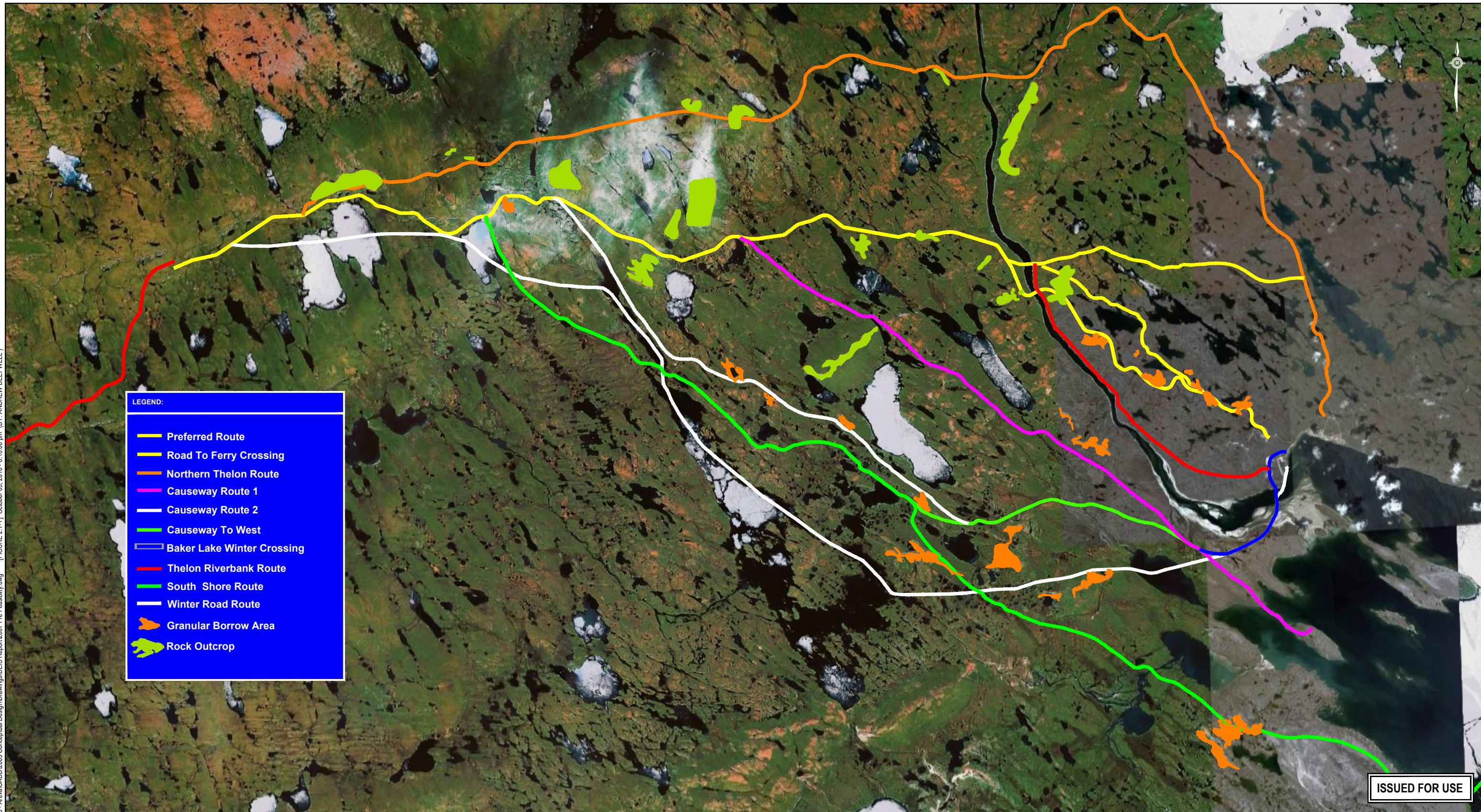


Figure 2.2-1: Super B -Train

The Kiggavik Project - Project Proposal, November 2008, states that 1,375 truck loads of fuel and 2250 truck loads of supplies and equipment will be required annually for these transportation requirements. It should be noted that the design vehicles will be hauling slightly less on average than the maximum allowable truck haul loads which are in the order of 40-45 tonnes. Additional traffic on the road should be expected due to maintenance

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KIGGAVIK PROJECT
 CIVIL INFRASTRUCTURE REPORT

2007 PRE-FEASIBILITY STUDY
 OPTIONS EVALUATION

| | | | |
|--------------------------|------------------------|-----------|----------|
| PROJECT NO. V33101016 | DWN MM | CKD KJ | REV - |
| OFFICE VANC | DATE March 26, 2010 | | |

Figure 2.1-1

vehicles, employee vehicles, and public vehicles from Baker Lake. The life of the road should be designed at least for the life of the operating mine.

2.3 NORTHERN ALL SEASON ROAD

2.3.1 General

The proposed Northern All Season Road extends from the proposed Kiggavik Mine/Mill site to a proposed port site on the north shore of Baker Lake, east of the community, as shown on Figure 2.3-1 (a and b). There are a number of variations to the alignment around the Hamlet that have yet to be fixed. These are discussed in later sections.

The proposed Northern All Season Road is 114 km in length from Kiggavik to the proposed port site.

There are 13 bridges (less than 50 meters in length) proposed along the route, with one major bridge (approximately 450 meters in length) crossing the Thelon River. The remainder of the water crossings have been accommodated with culverts. Additional bridges may be required if fisheries issues dictate the need for a bridge rather than a culvert.

The road will be 10 meter wide, built with Run-of-Quarry (ROQ) rock embankment (fill). There will be no earth cuts along the alignment, and the only cut sections will be through rock, which will service as quarry material.

Material for the rock embankment and road surfacing will be derived from rock quarries developed along the road.

2.3.2 Design Principles & Criteria

The design principles developed for this project are based on:

- Producing a design that is cost-effective with respect to construction costs;
- A design that produces good operating characteristics for the design vehicles;
- Minimal maintenance requirements, both on an annual and life-cycle basis;
- Respecting the environmental and archaeological constraints.

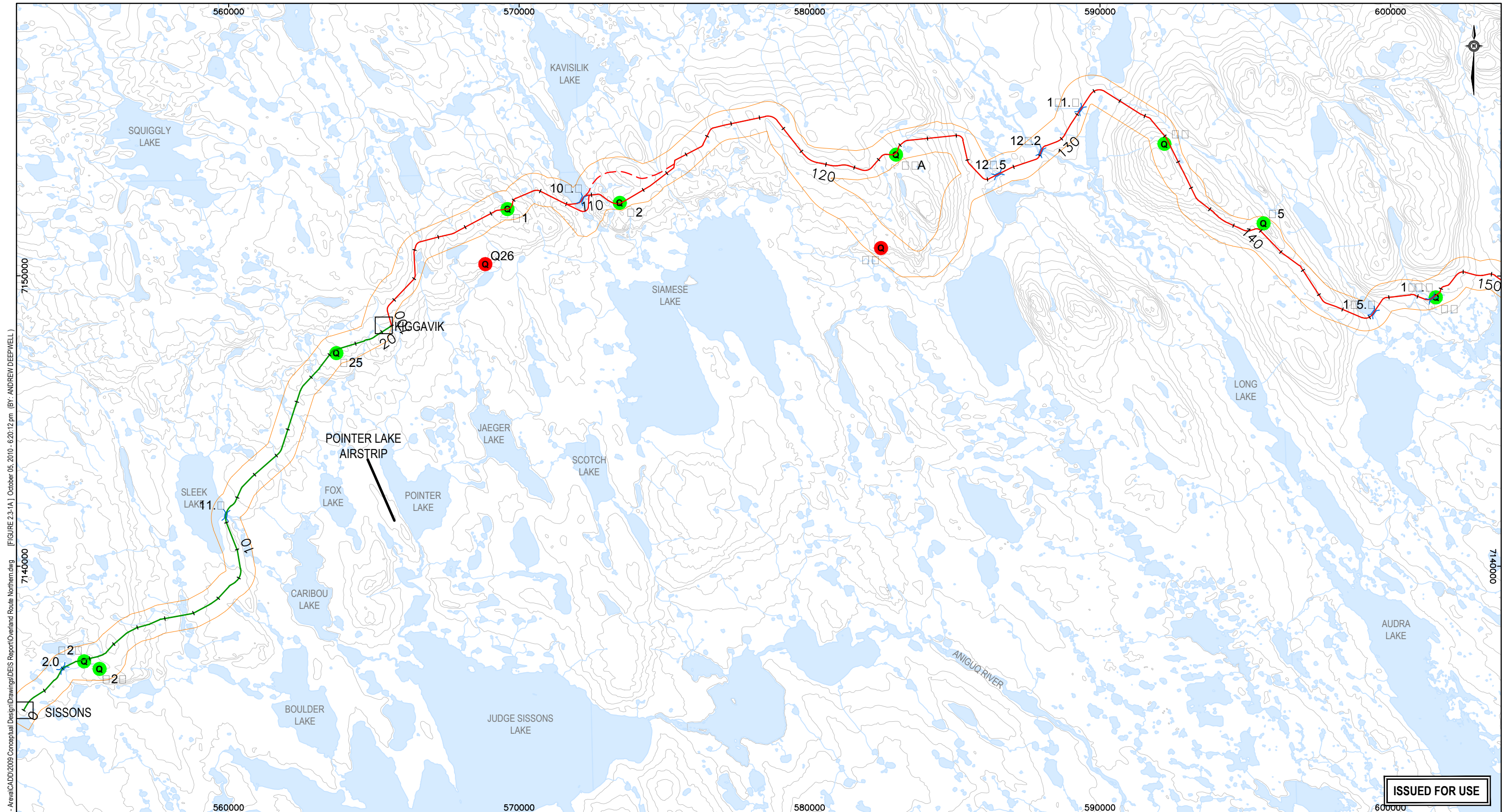
The following sections outline these principles and detail the road design criteria.

2.3.2.1 Routing Selection

Numerous options and variations have been developed and evaluated to arrive at the preferred option presented in this report.

The route has been located generally on higher ground. The reasons for this are as follows:

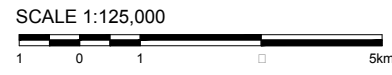
- Higher areas tend to be less ice-rich, which presents fewer geotechnical issues for constructing the road;



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- | | |
|--|---|
| <p>PROPOSED</p> <ul style="list-style-type: none"> — Northern All Season Road - - - Alternate Alignment — Haul Road ● Probable Quarry Sites ● Quarry Site (Eliminated) + km Marker X Bridge | <p>EXISTING</p> <ul style="list-style-type: none"> ● Quarry — 10m Contour - NTS Base Data — Extents of Road LiDAR Survey (2009) |
|--|---|



PROJECTION: UTM Zone 14
DATUM: NAD 83

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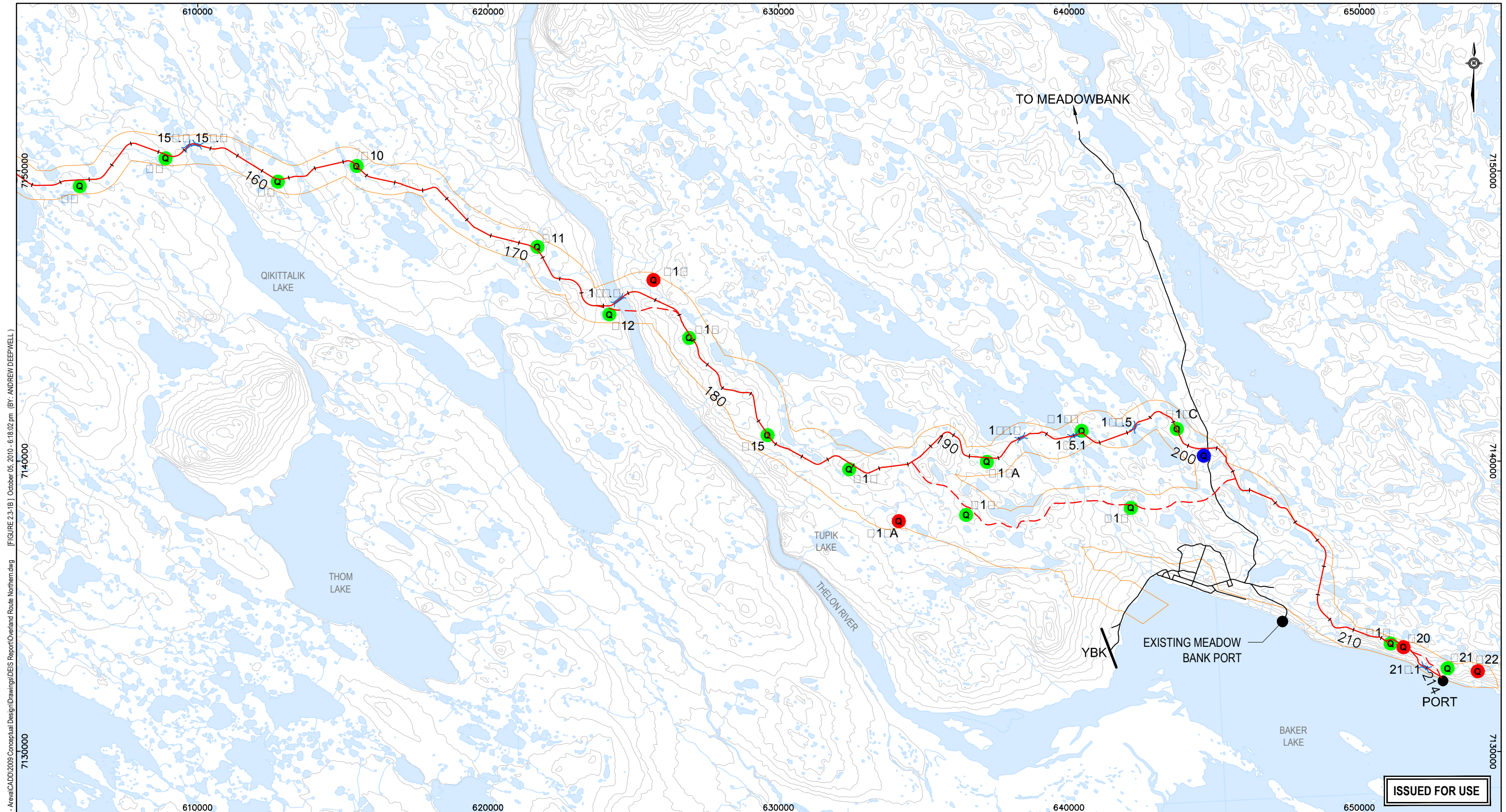
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| KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT | | | |
| NORTHERN ALL SEASON ROAD KM 100-150 | | | |
| PROJECT NO. V33101016 | DWN AJD | CKD DCD | REV - |
| OFFICE VANC | DATE March 26, 2010 | | |

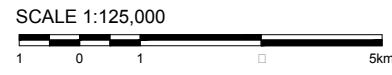
Figure 2.3-1A



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ISSUED FOR USE

- | | |
|--------------------------|-------------------------------------|
| PROPOSED | EXISTING |
| Northern All Season Road | Quarry |
| Alternate Alignment | 10m Contour - NTS Base Data |
| Haul Road | Extents of Road LiDAR Survey (2009) |
| Probable Quarry Sites | |
| Quarry Site (Eliminated) | |
| km Marker | |
| Bridge | |



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**KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT**

**NORTHER ALL SEASON ROAD
KM 150 TO POTENTIAL PORTS**

| | | | |
|--------------------------|------------------------|------------|----------|
| PROJECT NO. V33101016 | DWN AJD | CKD DCD | REV A |
| OFFICE VANC | DATE March 26, 2010 | | |

Figure 2.3-1B

- Higher areas tend to have fewer areas of diffuse drainage patterns, which are hard to accommodate in construction;
- Higher areas have fewer cross-drainage surface flow;
- Higher areas are less prone to snow drifts, which can become a major maintenance issue;
- Higher areas tend to have more areas of bedrock which improves the bearing capacity of the road and reduces the embankment fill requirement;
- Suitable quarries are located in higher areas.

Areas of geotechnical instability, environmental and archeological constraints also guided the route selection.

The location of the major bridge crossing across the Thelon River and the proximity of the Hamlet of Baker Lake also factored in the selection of the preferred location for the road.

2.3.2.2 Geometric Design Criteria

The criteria for the design of the Northern All Season Road are listed in Table 2.3-1 below. These criteria are based on the findings and recommendations of previous design work completed on similar projects in the Canadian north, and reflect information gathered from experienced haulers and northern road construction contractors. Since very few roads of the proposed type currently exist in Nunavut, reference has been made to the Government of Northwest Territories (GNWT) Department of Transportation where territorial highways exist in conditions similar to the Kiggavik project area.

| TABLE 2.3-1: SUGGESTED DESIGN CRITERIA SUMMARY | | |
|--|---------------------------------|--|
| Design Element | Criteria | Comments |
| Road Surface width | 10 m | Width based on the design vehicle in winter conditions. Conforms to Transportation Association of Canada (TAC) table 2.2.13.4 and typical GNWT Department of Transportation Practices. |
| Design Speed | 70 km/h minimum with exceptions | Exceptions are based on topographical considerations and in areas in the vicinity of the Mine site and Baker Lake. Where conflicts with other traffic is more common. |
| Design Vehicle | Super B-Train | This is the typical haul unit currently used supply mines in NWT. |
| Min. Horizontal Radius | 190 m | This radius was selected to maintain a 10 meter road surface width for adequate width for Super B-train to pass a WB-20. Also conforms to minimum radius for design speed of 70 km/h - TAC table 2.1.2.6. |

| TABLE 2.3-1: SUGGESTED DESIGN CRITERIA SUMMARY | | |
|--|---|---|
| Design Element | Criteria | Comments |
| | | No spirals have been used in the development of the alignment. This is in keeping with ambient design conditions of similar roads in NWT and typical GNWT Department of Transportation Practices. |
| Min. Crest /Sag Vertical K Value | 20 crest 22 sag | Headlight Control assumed. Minimum curve length of 70m. TAC tables 2.3.3.2 and 2.3.3.4. Midrange of curves to be used for design. |
| Maximum Grade | 6% | Based on rural collector maximum grades TAC table 2.3.3.1. |
| Cross Fall | 3% | Follows typical GNWT Department of Transportation Practices for gravel roads. |
| Maximum Super-elevation | 6% | Follows typical GNWT Department of Transportation Practices. |
| Side Slopes | 3:1 in fill 0.25: 1 in rock cut | Fill Sideslopes conform to TAC table 2.3.13.4. |
| Barriers | none | Not considered appropriate for the typical operating conditions of the design vehicle. |
| Bridges | Canadian Highway Bridge Design Code. S6-2000 | |
| Road Structure | 19 mm gravel over rock fill | Variable, depending on subsurface conditions. |
| Traffic | 20 year design life (assumed mine life and construction/decommissioning) | Must be capable of handling 3,625 loaded Super B-Trains and an equal number of return vehicles each year. |

2.3.2.3 Geotechnical Design Cross Sections for Varying Subsurface Conditions

In non-permafrost areas, it is common for road designs to incorporate both cuts and fills to establish the final grade along the alignment. However, in permafrost areas, disturbing sensitive overburden soils and surface vegetation can result in thaw degradation and the creation of unstable ground. Consequently, the design for this project calls for fill-construction only, wherever the road passes over overburden soils. Minimum depth of embankment fill is specified for various “terrain types”, and is designed to be sufficient to construct a stable road embankment and to protect the underlying permafrost. In this design, cuts have only been incorporated in bedrock.

The following generalized “terrain types” have been considered in the design of the road:

Terrain Type 1:

Terrain Type 1 is relatively dry, stable, till and outwash deposits, on level terrain overlain by a thin organic cover. There is little surface expression of ice-rich permafrost conditions. Figure 2.3-2 shows the typical road cross-section associated with traversing this type of terrain.

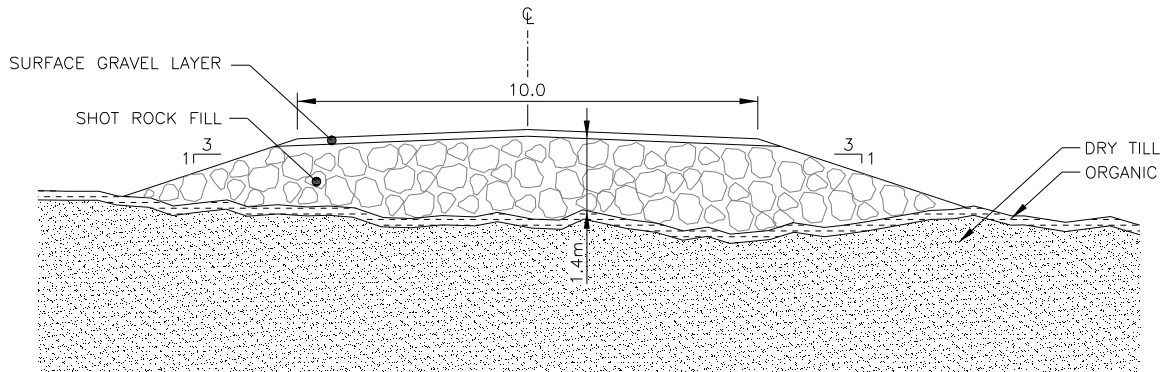


Figure 2.3-2: Typical Road Cross Section on Relatively Dry, Stable, Till (Terrain Type 1)

Terrain Type 2:

Terrain Type 2 includes wet till and till with ice-rich permafrost features indicative of thermally sensitive terrain. The terrain is relatively wet, with some expression of ice-rich permafrost conditions, overlain by a thin to moderate organic cover. Figure 2.3-3 shows the typical road cross section associated with crossing this type of terrain.

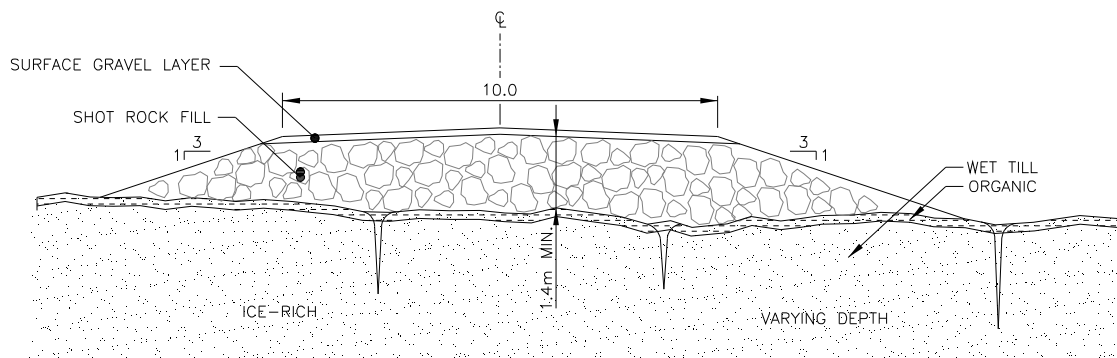


Figure 2.3-3: Typical Road Cross Section on Wet Till or Till with Ice-Rich Patterned Ground (Terrain Type 2)

Terrain Type 3:

Terrain Type 3 includes alluvial silts & sands and/or organic peatlands & ice-rich permafrost. This generalized terrain usually consists of thick organics and poorly drained, fine grained, deposits with moderate to thick organic cover and distinct expressions of ice-rich permafrost conditions. In general, this terrain is unfavourable and was avoided wherever possible. Figure 2.3-4 shows the typical road cross section associated with traversing this type of terrain.

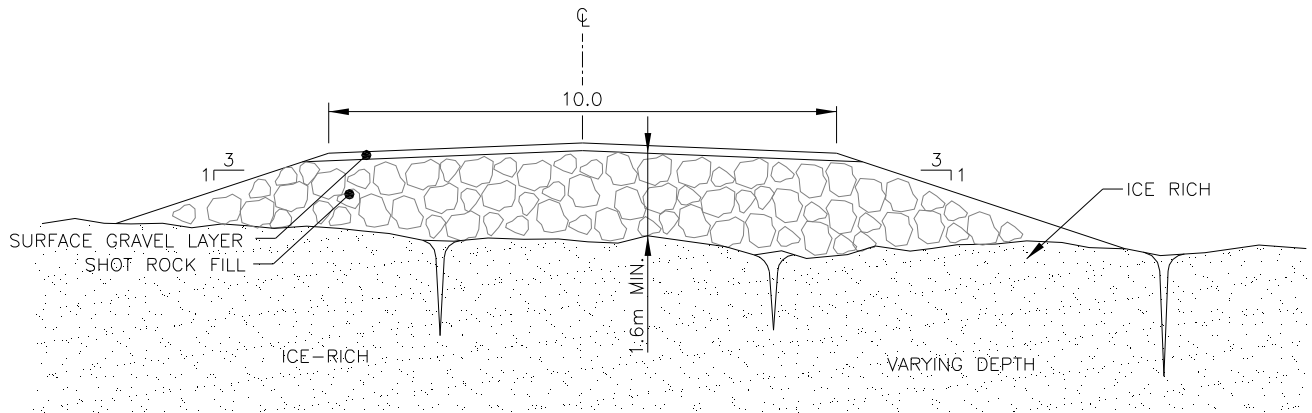


Figure 2.3-4 Typical Road Section on Organic and Wet Fine Grained Deposits (Terrain Type 3)

Terrain Type 4:

Terrain Type 4 comprises frost shattered and boulder covered terrain. The terrain has rugged micro-relief and sometimes depressions are infilled with sediment and/or organics. The fill height required on this terrain is controlled by the micro-relief and geometric constraints to provide a reliable road surface.

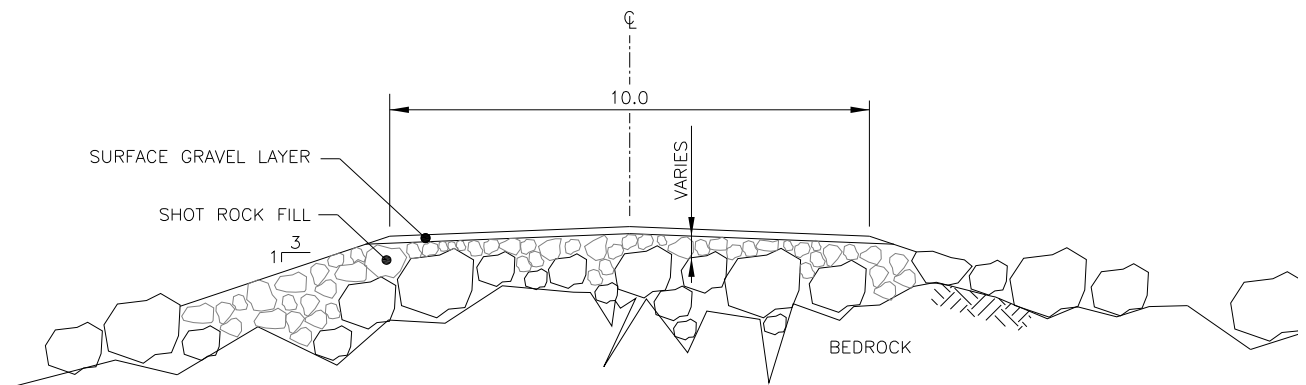


Figure 2.3-5 Typical Road Section on Frost Shattered and Boulder Covered Terrain (Terrain Type 4)

Terrain Type 5:

Terrain Type 5 comprises all bedrock terrain, including exposed/shallow undulating bedrock. This terrain unit is typically irregular and non or sparsely vegetated. This terrain unit is present at the quarry sites and at other areas where exposed bedrock was found. Figure 2.3-6 shows the typical road cross section associated with traversing this type of terrain.

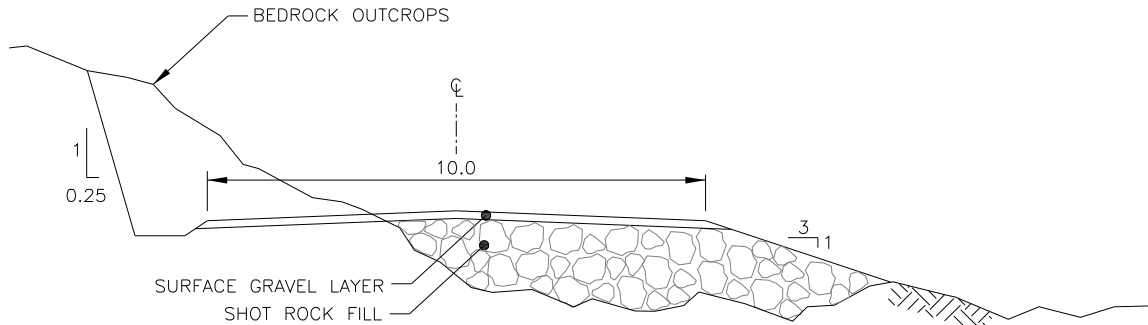


Figure 2.3-6: Typical Road Cross Section on Bedrock (Terrain Type 5)

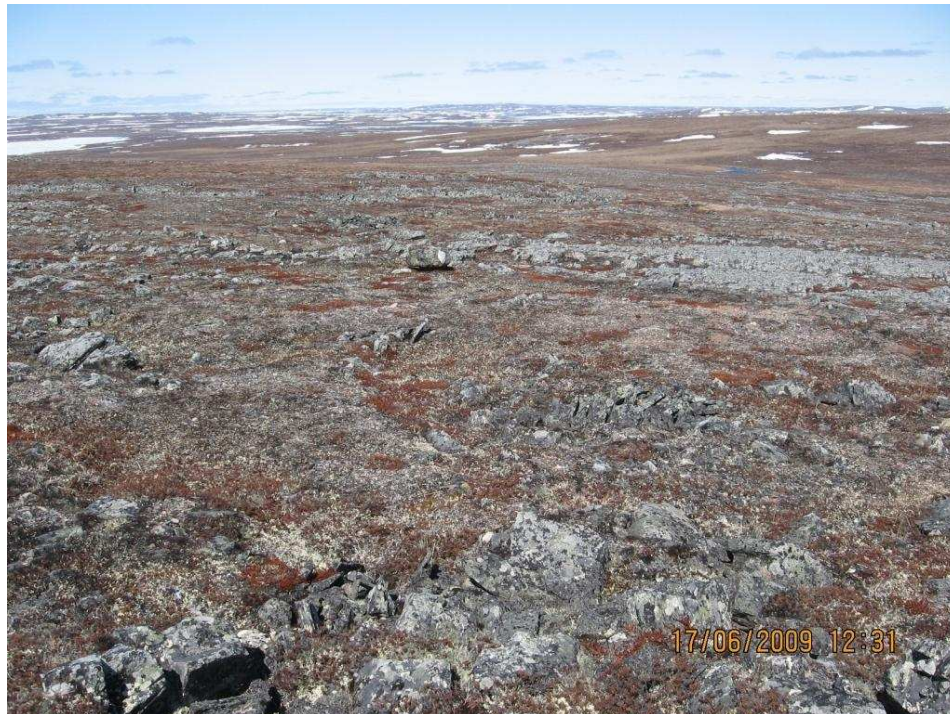
Table 2.3-2 provides the design parameters for minimum depth of embankment fill by Terrain Type.

| TABLE 2.3-2: DESIGN PARAMETERS FOR MINIMUM DEPTH OF EMBANKMENT FILL | | |
|---|---|--|
| Terrain Type | Terrain Description | Depth of Embankment Fill |
| 1 | Dry (Ice-poor) Till (relatively dry, stable, upland till and outwash deposits, on level terrain overlain by a thin organic cover) | 1.4 m |
| 2 | Wet (Ice-medium to Ice-rich) Till (relatively wet, with some expression of ice-rich permafrost conditions, overlain by a thin to moderate organic cover) | 1.4 m - 1.6 m |
| 3 | Alluvial Silts & Sands (Ice-rich) or Thick Organic Peatlands & Ice-Rich Permafrost (wet, fine grained, deposits with distinct expressions of ice-rich permafrost conditions, moderate organic cover) | 1.6 m - 1.8 m |
| 4 | Frost shattered and boulder covered terrain - rugged micro-relief, with depressions infilled with sediment and/or thin organics) | 0.5 m to 1.0 m - Varies based on size of rock (smooth over) |
| 5 | Exposed Bedrock - rock (irregular to relatively smooth outcrops, rock cuts) | <0.5m |

As indicated in Table 2.3-2, a minimum depth of quarried rock embankment of about 1.4 m is recommended over glacial till terrain for construction, operational and maintenance considerations. Construction with less fill often results in greater maintenance effort and cost, and ultimately additional fill materials will be required. Increased depths of embankment will be required across low-lying, wet areas and areas of ice-rich ground that cannot be avoided, as shown in the photo below, and will most likely be 1.8 m thick or greater.



Construction across wet, undefined drainage channels containing thick organics will also require a greater depth of embankment fill to bridge-over and protect the underlying terrain and allow for a competent road surface. The required depth of embankment over bedrock-exposed terrain will be controlled by the micro-topography of the area, as shown in the photo below, but in general will be 0.3 m to 0.5 m thick.



2.3.3 Detailed Route Description

2.3.3.1 Road Geometry

Horizontal alignments and vertical profiles have been developed using digital terrain models created from the LiDAR survey. The alignment and profiles have been developed in 5km sections using Autodesk Civil 3d 2010. All of the alignments and profiles meet the design criteria specified in Section 2.3.2.2. These plans and profiles are included in Appendix B, and include quarry and water crossing locations.

In general, the grades are gentle, in the order of 1 to 3%. There are some sections that reach the maximum end of the design criteria range of 5-6%. The longest section of this steep gradient (500 meters) is around Km 133.5. The gradient, however, is favourable for loaded vehicles travelling towards the mine.

There are two potential routes around the Hamlet of Baker Lake. The more northerly route is approximately 2 km north of the southerly route which skirts the hamlet by approximately 1-2 km. Both routes are feasible from a geometric and geotechnical perspective. The routes cross the existing Meadowbank Road which connects to an existing port facility. EBA understands that Areva will choose the final route based on discussions with the Hamlet and Agnico-Eagle the Owner/Operator of the Meadowbank mine.

2.3.3.2 Geotechnical Route Description

The surficial landforms along the Northern All Season Road between the Sissons and Kiggavik mine/mill sites and the north shore of Baker Lake comprise mainly glacial till overlying precambrian intrusive igneous and metamorphic bedrock. The periglacial geomorphic processes in the area are characteristic of permafrost conditions associated with excess ground ice.

The eastern portion of the proposed alignment near Baker Lake is below the most recent glacial marine transgression; consequently the elevations near Baker Lake are covered by marine reworked sediments, and the till deposits appear reworked by nearshore marine processes, forming flights of raised strandlines (McMartin, I., Dredge, L.A., and Aylsworth, J.M. 2008). Widespread areas of marine reworked sands are present near Baker Lake and along its shoreline.

Further inland, the glacially deposited overburden soils are interrupted by bedrock outcrops that are more prevalent inland (west). Widespread areas of thin till veneer are present and bedrock boulder fields frequent the route. – also called block fields (or felsenmeer) – as a surface layer of angular shattered rocks formed in either a modern or Pleistocene periglacial environment. More recent alluvial sediments occur as thin deposits of fine-grained sand and silt and present themselves locally in topographic depressions (low-lying areas) and along recent stream channels. The project area in general is devoid of glaciofluvial sediments, although there are areas north of Judge Sissons Lake that show evidence of proglacial and subglacial meltwater erosion and deposition (McMartin, I., Dredge, L.A., and Aylsworth, J.M. 2008).

The general surficial geology of the project area is described by the Geologic Survey of Canada, Schultz Lake south, Nunavut, Map 2120A at scale 1:100,000 (McMartin, I., et al., 2008; Aylsworth, J.M., 1990); and Aylsworth, J.M. et al., 1990, 1989, 1985).

Generalized terrain and topographic conditions observed along the proposed Northern All Season Road beginning at the proposed Kiggavik Mine/Mill site at the west end of the route (Km 100) and traveling east towards a proposed port location east of the Hamlet of Baker Lake along the shoreline of Baker Lake (Km 214) are described in Table 4.3-3 below. Generalized Design cross sections for the varying subsurface conditions (Terrain types referenced in table 2-3.3) are shown in the table. These design cross sections will be revised and refined during the next stages of design as more information becomes available.

TABLE 2.3-3: GENERALIZED TERRAIN CONDITIONS ALONG PREFERRED ALIGNMENT

| Kilometre | | Description of Terrain Conditions |
|-----------|-------|---|
| 100 | 106.5 | 1 The proposed North All Season road alignment departs the Kiggavik site at an elevation of about 215m and travels along rolling till moraine terrain gradually climbing in elevation to a pronounced rock outcrop at Km 106.5, an elevation of 260 m. This is the location of the first of many proposed rock quarries along the route. |
| 106.5 | 109.7 | 1 The alignment then descends at grades of 2 to 5 % for about 3 km to the south end (outflow) of Kavisilik Lake (about elevation 170 m). The terrain grades towards Siamese Lake to the southeast. |
| 109.7 | | Between Km 109 and Km 110, the road traverses a topographic low along the south end of Kavisilik Lake, separating Kavisilik Lake from Siamese Lake. An open channel water crossing requiring a bridge structure is located at about Km 109.7. |
| 110 | 111 | 1 At Km 110, the road climbs in elevation at grades of 3 to 5 % to a topographic high. A route along lower elevations near Siamese Lake was initially investigated, but was judged to be a more difficult alignment because it crossed very wet terrain with many drainage channels that originated from the higher ground. It was decided that a better route would traverse along the higher terrain that avoided the less favorable wet, sensitive ground and significant cross-drainage flow. |
| 111 | 121.5 | 4 At Km 111, the road travels along a topographic high ridge top for about 11 km, varying in elevation from 205 m to 230 m. The section of road from Km 116 to Km 121.5 is particularly smooth |
| 121.5 | 125.0 | 4 From Km 121.5 to Km 122.5, the terrain becomes more irregular and then begins a long descent from Km 212.5 to Km 125.0 along grades of 2 to 6 % to an elevation of about 125 m at Km 125.0. The alignment crosses a prospect quarry site at Km 122.6 km. |
| 125.0 | 132.5 | 1 From Km 125 to Km 132.5, the route further descends in elevation from about 125 m to 90 m at Km 132.5, and crosses two significant stream crossings and several smaller drainage channels that will require culverts or other cross-drainage measures. |
| 127.4 | | Alignment crosses an open water channel requiring a bridge structure. |
| 129.1 | | Alignment crosses an open water channel requiring a bridge structure. |
| 132.5 | 135.0 | 1 At Km 132.5, the route begins a 3 to 6 % climb from elevation 90 m to 180 m over a distance of about 2.5 km. |
| 135.0 | 138.0 | 4 From Km 135.0 to Km 136.5, the route traverses a ridge top and then descends along the southeast side of the ridge at a grade of about 2% to Km 138. The alignment passes by another quarry prospect at about Km 135. |
| 138.0 | 143.5 | 1 From Km 138 to Km 143.5, the route traverses relatively smooth ground with a cross slope from an area of topographic high to the lowlands at Km 143.5. |
| 143.5 | 149.0 | 1 From Km 143.5 to 144.6, the route descends in elevation and crosses a stream crossing at approx Km 145.1 at an elevation of about 100 m, and then climbs away from the topographic low to about an elevation of 130 m at Km 164 and continues along rolling terrain to about Km 149. |
| 145.1 | | Stream crossing will require a bridge structure. |
| 147.5 | | Stream crossing will require a bridge structure. |
| 149.0 | 157.2 | 1 The route decreases along relatively smooth terrain for 1 km and then travels along level to gradually rolling terrain weaving around several lakes to the next major crossing at Km 157.2. At 156.2 the route travels by another quarry. |
| 157.2 | | Stream crossing will require a bridge structure. |

| Kilometre | | | Description of Terrain Conditions |
|-----------|-------|---|--|
| 157.2 | 170.0 | 1 | The route continues along relatively favorable, rolling terrain varying in elevation from 90 m to 110 m. At Km 160.5 and Km 163.5 the route passes by two quarry prospects. |
| 170.0 | 174.4 | 1 | At Km 170.0, the route begins a general decent towards the Thelon River (Km 174). Another prospect quarry site exists at Km 170.5. |
| 174.4 | 174.8 | 1 | The Thelon River is the most significant crossing along route with a river channel width of about 400 m |
| 174.8 | 177.0 | 4 | After crossing the Thelon River, the route ascends gradual slopes to rolling terrain. The route connects to a network of existing ATV trails that follow dry ridge tops and generally favorable terrain from the Thelon River towards Baker Lake. The proposed all- season road follows acceptable horizontal and vertical grades along the general direction of the ATV trails. |
| 177.0 | 182.5 | 4 | From Km 177 to Km 182.5, elevations vary from 90 m to 110 m. Quarry prospects are located at about Km 177.8 and Km 182.5. |
| 182.5 | 185.0 | 2 | The route passes by two lakes and wet low-lying areas. |
| 185.0 | 192.0 | 1 | The route ascends in elevation onto more favorable, dry, stable terrain. The route follows the topography of the terrain through this section. From Km 185 to Km 192.0 the route follows relatively dry stable terrain with few lakes. The route crosses low-lying sections from Km 187.4 to Km 187.9, and cross-drainage depressions at Km 189.6, Km 190.4 and Km 191.4 km. Quarry prospects are located at about Km 186.3 m and near Km 191.6. |
| 192.0 | 195.0 | 2 | At Km 192.0, the route begins descending to a dispersed drainage crossing at Km 193 and continues along low-lying terrain to another stream crossing at Km 195. |
| 193.0 | | | Stream crossing will require a bridge structure. |
| 195.0 | | | Stream crossing will require a bridge structure. |
| 195.0 | 200.5 | 1 | Beyond about Km 195, the frequency of water bodies increases and the route is forced to navigate around them. The elevation of the terrain from Km 195 to Km 200.5 varies from 70 to 90 m. A Quarry prospect exists at Km 199.2. |
| 197.3 | | | Stream crossing will require a bridge structure. |
| 200.5 | 213.5 | 2 | The route initially climbs in elevation and then decends over a distance of 1 km before coming to a section of wet terrain from Km 202.5 to Km 203.5, Between Km 207 and Km 208 the route crosses a lowland section that connects a series of lakes that is wet with no defined flow. The route continues along progressively decending terrain to a proposed port site at about Km 213.5 and passes by a rock quarry site at Km 211.3.. |

Bedrock outcrops along the route are the best available sources of fill material (Rock-of-Quarry) for constructing the road. Quarry sites are available inland along the route, and possible locations have been identified along the entire route.

Morainal/till materials generally provide suitable foundation conditions on which a road can be constructed. These materials are typically moderately well drained comprising of fractions of sand, gravel and cobbles within a fine-grained matrix. They present few limitations to road construction except in areas with steep slopes or where drainage is poor and ice-rich.

Alluvial and organic deposits comprise a small percentage of the materials that will be encountered along the route. Alluvial materials are transported and deposited by streams

and gravity and are found along water courses. From a geologic perspective, alluvial deposits could represent potential borrow sources, however, these materials are often fine grained, and ice-rich, and are located in sensitive areas, in close proximity to water bodies. These deposits are of small volume and relatively unmapped, so should not be relied upon as material sources.

2.3.3.3 Water Crossings and Drainage

The route crosses many minor diffuse drainage paths, and many are many of these are ephemeral (dry for most of the year). Defined, but still minor stream crossings will be accommodated using culverts. Larger streams (> 2 meters in width) will be spanned with bridges.

The concept for culvert installation is similar to that commonly used in northern Canada. Culverts of appropriate size are laid in place with little disturbance to the existing ground, at locations where drainage paths have been identified in the detailed design. Fill material is placed and compacted around and over the culverts. In some cases, multiple smaller diameter culverts may be used instead of a single large diameter culvert to avoid having to cut the foundation of the large culvert into the existing ground to maintain the vertical road profile, or to avoid having to create a crest curve or “hump” in the roadway profile where the embankment is constructed over the culvert. Appropriate culvert sizing and location will be confirmed in the detailed design stages of the work.

The route crosses numerous water courses along its length. During the route selection process the alignment was often moved to higher ground where it could run along local drainage divides. This eliminated many of the smaller crossings, and limited the size and flow that would be encountered in others. The water crossings are shown in Appendix B on the Plan/Profile Drawings.

Hydrology work on the Kiggavik project has been undertaken by Golder Associates (Golder). This information has been used to aid in the initial assessment of the stream crossing requirements for the road design. During detailed design, the hydrology information collected by Golder will be used to help determine the type and size of structures to be used. EBA has assumed more culverts and bridges than Golder based on the need for short term drainage and construction issues during freshet where ponding water could compromise the integrity of the road. EBA anticipates the following typical structure types will be used:

- 1 Multi-span bridge at the Thelon River;
- 14 Single-span bridges;
- 13 Culverts;
- 69 Coarse rock fills.

The following table 2.3.3.3 summarizes the water crossings and proposed crossing methods.

| TABLE 2.3.3.3: WATER CROSSINGS NORTHERN ALL SEASON ROAD | | | |
|--|-----------------------------|----------------------|----------------------|
| Crossing # | Plan/Profile Sheet # | Crossing Type | Bridge Length |
| 100.2 | 101 | culvert | |
| 102.8 | 101 | rockfill | |
| 103.1 | 101 | rockfill | |
| 103.4 | 101 | rockfill | |
| 104.2 | 102 | rockfill | |
| 104.7 | 102 | rockfill | |
| 104.7 | 102 | rockfill | |
| 107.0 | 102 | culvert | |
| 107.2 | 102 | culvert | |
| 107.8 | 102 | rockfill | |
| 108.8 | 103 | rockfill | |
| 109.0 | 103 | rockfill | |
| 109.2 | 103 | rockfill | |
| 109.4 | 103 | rockfill | |
| 109.8 | 103 | bridge | 20-50m |
| 110.5 | 103 | rockfill | |
| 111.0 | 103 | culvert | |
| 112.9 | 104 | rockfill | |
| 115.3 | 104 | rockfill | |
| 115.4 | 104 | rockfill | |
| 120.2 | 106 | rockfill | |
| 121.2 | 106 | rockfill | |
| 121.4 | 106 | rockfill | |
| 122.4 | 106 | rockfill | |
| 123.8 | 106 | rockfill | |
| 126.1 | 107 | rockfill | |
| 127.5 | 107 | bridge | 50m |
| 129.2 | 108 | bridge | 50m |
| 129.7 | 108 | rockfill | |
| 130.1 | 108 | rockfill | |
| 131.3 | 108 | bridge | 5-10m |
| 132.7 | 109 | rockfill | |
| 134.7 | 109 | rockfill | |
| 134.9 | 109 | culvert | |
| 135.6 | 109 | rockfill | |
| 136.0 | 110 | culvert | |
| 136.8 | 110 | rockfill | |
| 137.2 | 110 | rockfill | |
| 138.0 | 110 | multiple culverts | |

| Crossing # | Plan/Profile Sheet # | Crossing Type | Bridge Length |
|------------|----------------------|-------------------|---------------|
| 138.7 | 110 | rockfill | |
| 139.8 | 110 | rockfill | |
| 140.0 | 111 | rockfill | |
| 140.1 | 111 | rockfill | |
| 140.3 | 111 | rockfill | |
| 140.4 | 111 | rockfill | |
| 140.8 | 111 | rockfill | |
| 143.0 | 111 | rockfill | |
| 145.3 | 112 | bridge | 35m |
| 146.1 | 112 | rockfill | |
| 147.1 | 112 | rockfill | |
| 147.6 | 112 | bridge | 20m |
| 148.0 | 112 | rockfill | |
| 149.0 | 113 | rockfill | |
| 149.4 | 113 | rockfill | |
| 151.4 | 113 | rockfill | |
| 152.3 | 114 | rockfill | |
| 154.8 | 114 | rockfill | |
| 157.3 | 115 | bridge | 50m |
| 157.7 | 115 | bridge | 15m |
| 159.5 | 115 | culvert | |
| 161.5 | 116 | rockfill | |
| 163.2 | 116 | rockfill | |
| 163.9 | 116 | rockfill | |
| 168.0 | 117 | rockfill | |
| 169.4 | 118 | rockfill | |
| 172.2 | 119 | rockfill | |
| 174.3 | 119 | rockfill | |
| 174.8 | 119 | bridge | 470m |
| 179.8 | 120 | rockfill | |
| 184.6 | 122 | culvert | |
| 185.0 | 122 | multiple culverts | |
| 187.2 | 122 | rockfill | |
| 187.8 | 122 | rockfill | |
| 190.6 | 123 | rockfill | |
| 191.2 | 123 | rockfill | |
| 193.3 | 124 | bridge | 20m |
| 195.1 | 124 | bridges | 20m and 15m |
| 196.1 | 125 | rockfill | |
| 196.9 | 125 | rockfill | |
| 197.5 | 125 | bridge | 40m |
| 197.9 | 125 | rockfill | |
| 198.3 | 125 | rockfill | |

| Crossing # | Plan/Profile Sheet # | Crossing Type | Bridge Length |
|------------|----------------------|---------------|---------------|
| 199.9 | 125 | rockfill | |
| 202.0 | 126 | culvert | |
| 203.0 | 126 | culvert | |
| 205.2 | 127 | rockfill | |
| 205.6 | 127 | rockfill | |
| 206.6 | 127 | rockfill | |
| 207.6 | 127 | rockfill | |
| 209.4 | 128 | rockfill | |
| 210.9 | 128 | rockfill | |
| 211.7 | 128 | rockfill | |
| 212.2 | 129 | culvert | |
| 212.8 | 129 | rockfill | |
| 212.9 | 129 | culvert | |
| 213.1 | 129 | bridge | 20m |

Culverts have been used throughout the Canadian north with varying degrees of success. When installed in areas with permafrost, they tend to require more maintenance and fail more often than culverts installed in more temperate climates, especially in areas with thick organic layers and ice-rich ground conditions. For this reason EBA suggests using permeable rock fills to allow passage of water in wet lowland areas with seasonal channelized flows. Specifically selected coarse single graded rock is placed to above the waterline to facilitate the cross drainage in this concept.

2.3.3.4 Borrow Sources and Quarry Locations

Material to be used for constructing road embankments should be either rock or granular material. However, there is minimal granular material of sufficient quality available along the route to consider using it as a source of fill. Most of the route has exposed bedrock of appropriate quality and quantity close to the alignment. The bedrock outcrops can be developed into suitable quarries for embankment fill material.

Sources of granular material found along the route include till and alluvial deposits and Glaciofluvial outwash deposits are uncommon. Granular materials found in alluvial areas are often finer grained, ice-rich, and located in sensitive areas, in close proximity to water bodies, and are of small volume and relatively unmapped, so have not been considered as significant material sources. Glaciofluvial outwash deposits occur in the region, but are relatively infrequent and of minimal depth, so they also have not been considered as significant material sources.

The basic road building material used throughout the length of the road will be rock excavated from bedrock quarries situated at various locations along the route. The surface

gravel will likely be 19-25 mm crushed gravel produced from the quarried rock, and will be placed in a layer approximately 300 mm thick.

The potential quarry locations are shown previously in Figures 2.3-1a and 2.3-1b. The quarry selection was based upon a combination of factors.

- Accessibility (proximity to alignment);
- Most economical haul distances (approx. 5 km max. based on past experience);
- Potential quarry size (enough volume);
- Ease of excavation (relief and potential face);
- Amount of overburden;
- ARD and ML potential.

The size and final locations of quarries will be developed during detailed design. A typical potential rock quarry site is shown below



2.3.3.5 ARD and ML Potential

A desktop screening assessment of the potential for acid rock drainage (ARD) and metal leaching (ML) within the identified quarries has been undertaken.

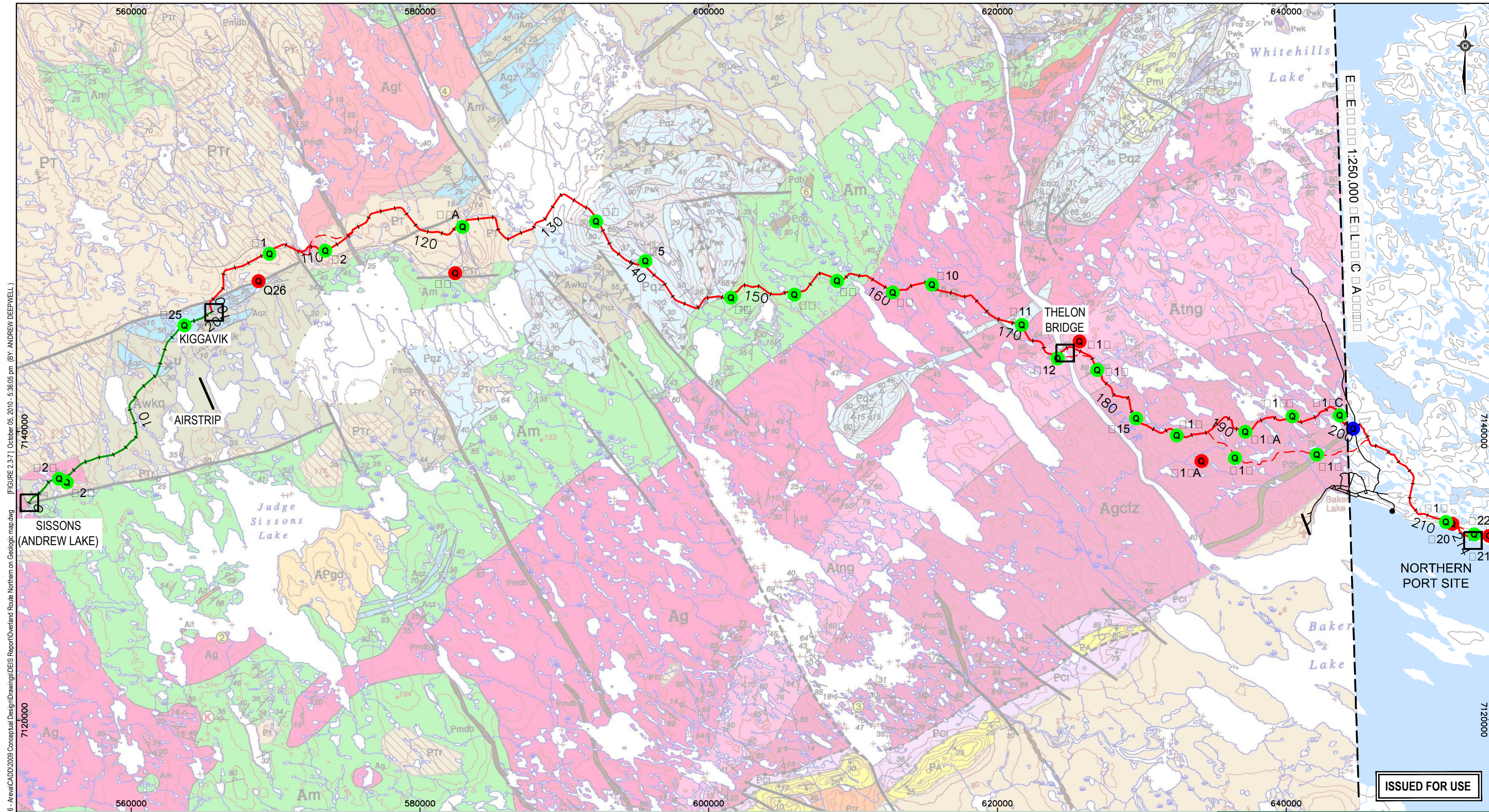
The screening level assessment involved a desktop review of available geological information on the study area, and an analysis of rock chip samples gathered along the alignment in 2009. In addition, information on ARD and ML from other projects in, or

near to, the study area was also reviewed in order to identify any common specific geologic rock types or units that have already been found to be of concern.

The proposed access road traverses a number of different lithologies as shown on Figure 2.3-7. The scale of the regional geologic mapping for the route to Baker Lake is at 1:125,000 which means that some local variation in the geology may occur without being shown on the map. The regional geologic mapping for the area of the proposed port facilities is only available at a scale of 1:1,000,000. The broad spatial extent of each unit means that there may be some geochemical variability associated with similar rock types within the same rock unit.

Table 2.3-4 contains a summary of the individual regional geologic units occupied by the proposed quarries. The table also contains a range of the anticipated ARD and ML potential based on the available geologic information for the rock units. From this table it can be seen that the majority of the rock that would be excavated from quarries along the proposed route are not anticipated to have a significant ARD or ML potential.

| TABLE 2.3-4 REGIONAL GEOLOGIC MAPPING OF PROPOSED QUARRY LOCATIONS | | | |
|--|---|--|--|
| Geologic Unit | Proposed Quarries within Unit | Anticipated Acid Rock Drainage Potential | Anticipated Metal Leaching Potential |
| PT: Thelon Formation; quartz arenite; cross-stratified fluvial and eolian sandstones. | Q1, Q2, Q3, Q3A, Q24 | None to Low | None to Low |
| Pwk: KetYet Group metawacke, flaggy to schistose, pervasive carbonate | Q4 | None to Low | None to Low |
| Pqz: quartzite, locally crossbedded and rippled; white but locally hematitic | Q5, Q11 | Low to High | None to Moderate. |
| Am: meta volcanic rocks; minor intermediate to felsic volcanic and volcanoclastic rocks, also undifferentiated meta sedimentary rocks; locally schistose. | Q6, Q7, Q8 | Volcanic rock: Low to Moderate Sedimentary rock: None to Low | Volcanic rock: Low to Moderate Sedimentary rock: None to Low |
| Ag/Agcfz: un-subdivided granitoid rocks: granite, granodiorite, tonalite, minor diorite and gabbro: biotite + hornblende; medium to coarse grained; foliated to gneissic. | Q9, Q10, Q15, Q16, Q16A, Q17, Q17A, Q17B, Q17C, Q23 | None to Low | None to Low |
| Atng: porphyritic to inequigranular granodiorite, tonalite and amphibolite; gneissic to layered. | Q12, Q13, Q14 | Low to Moderate | Low to Moderate |
| Pbd: undifferentiated diabase or metagabbro dykes | Q18 | None to Low | None to Low |
| Aqz: quartzite; massive to schistose. | Q25 | Moderate to High | Low |
| Agn: gneiss (undifferentiated) | Q19, Q20, Q21, Q22 | Low to Moderate | Low to Moderate |



Q:\Vancouver\Transportation\33101016 - Areva\CADD\2009 Conceptual Design\Drawings\DEIS Report\Overland Route Northern on Geologic map.dwg [FIGURE 2.3-7] October 05, 2010 - 5:36:05 pm (BY: ANDREW DEERWELL)

- PROPOSED**
- Northern All Season Road
 - - - Alternate Alignment
 - Haul Road
 - | km Marker
 - Proposed Quarry Site
 - Quarry Site (Eliminated)
 - Existing Quarry



PROJECTION: UTM Zone 14
 DATUM: NAD 83

| | | | | |
|--|---|------------|------------|---------------------|
| AREVA EBA Engineering Consultants Ltd. | KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT | | | Figure 2.3-7 |
| | NORTHERN ALL SEASON ROAD GEOLOGIC MAPPING | | | |
| | PROJECT NO. V33101016 | DWN AJD | CKD DCD | |
| OFFICE VANC | DATE March 26, 2010 | | | |

ISSUED FOR USE

The highest ARD potential is expected to be associated with the quartzite and hematitic rock types with some ARD potential also expected to exist within the volcanic rock units that may be excavated along the proposed alignment. The ARD and ML potential may be elevated in rock located near to geologic structural features, such as fault zones, where metamorphic alteration may be higher.

The results of the desktop screening assessment and the analysis of the rock chip samples gathered in the field in 2009 are inconclusive with respect to accurate prediction of the ARD/ML potential of the rock contained in each of the proposed quarry sites. Further testing done by EcoMetrix however, confirms that the aggregate samples are non-acid generating, with paste pH values ranging from 6.1 to 8.4. The preliminary results of the leach tests suggest that the potential aggregate rock materials are not likely to represent an issue with respect to leaching of constituents of potential concern.

Because of this anticipated low potential for ARD/ML, it is not unreasonable to consider proceeding with construction and dealing with the issue at that time. Construction procedures will need to be established that call for only clean rock (ARD/ML free) to be placed in areas where roadway drainage has the potential to enter fish bearing streams. Further testing of the rock being excavated from each quarry should be done at time of construction, and decisions made regarding its suitability for placement in these specific areas of critical environmental concern. In general, the roadway fills placed along the majority of the proposed alignment are in areas that are not subject to generation of drainage that will directly enter fish bearing streams, and as such are not of particular concern.

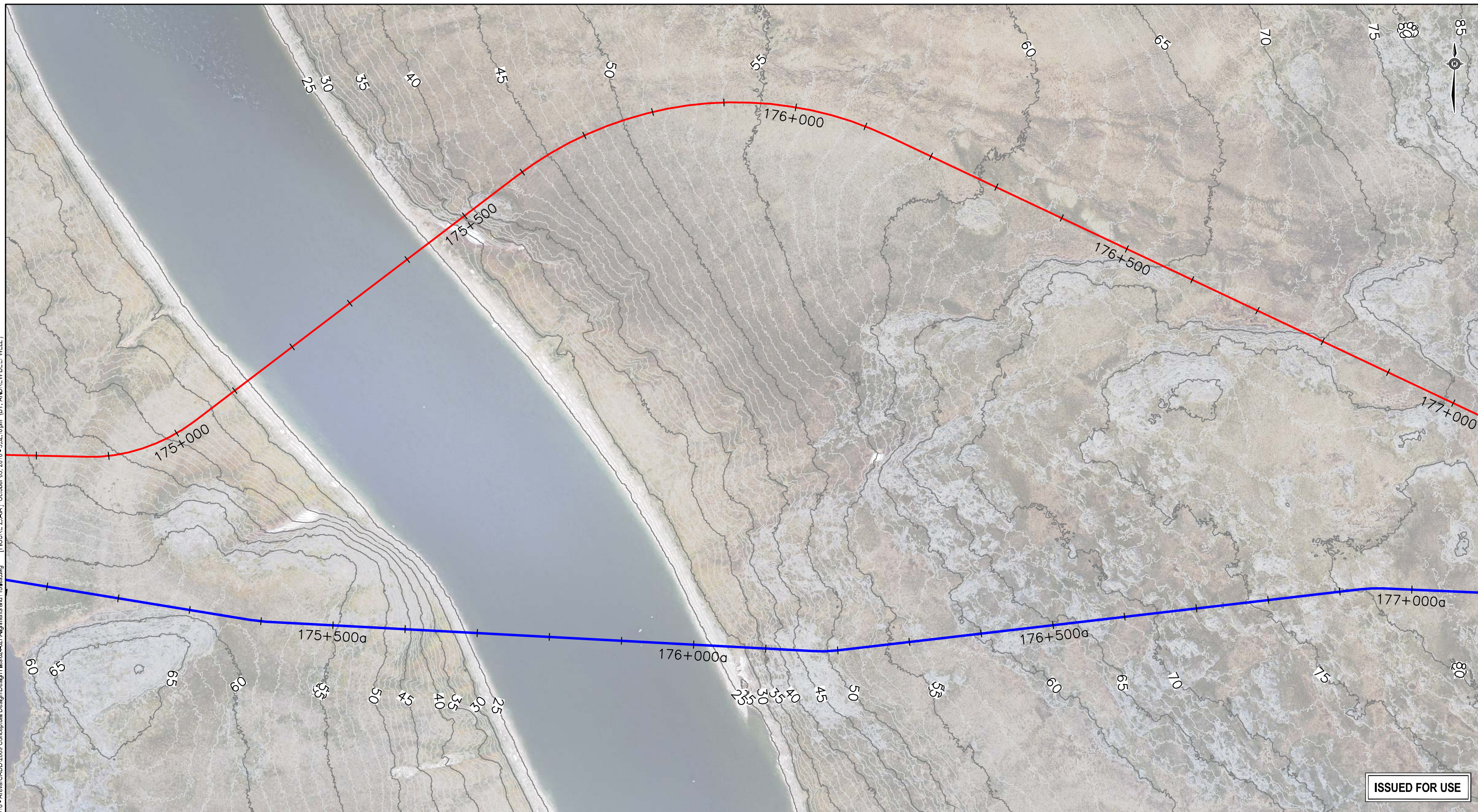
Proceeding with construction in this manner will, however, result in some minor risk that a designated source of rock excavation could turn out to have a higher level of ARD/ML potential than originally anticipated, and the changes made during construction could have a financial implication.

2.3.4 Thelon River Crossing

2.3.4.1 Design Approach

Mr. Darrel Gagnon, P.Eng. of Buckland and Taylor Ltd. reviewed the potential crossing locations of the Thelon River for the proposed access road and the conceptual bridge design previously prepared by EarthTech (See Figures 2.3-8A and 2.3-8B). In general, the preferred alignment appears to provide several desirable attributes for a bridge compared to the alternate alignment. This preferred alignment provides for shorter or fewer bridge spans, more user friendly approach roadway profiles, and would be more suitable for a launching erection method for the superstructure girders. However, good quality rock at a reasonable depth would be required at either location for the river piers. Initial GPR information provided some preliminary information regarding the depth to bedrock at the preferred location. Bedrock was observed near or at surface on the east bank of the crossing and appeared near the riverbed through the river. On the west bank the GPR did

Q:\Vancouver\Transportation\33101016 - Areva\CADD\2009 Conceptual Design\Design Files\624-627 Alignments and Profiles.dwg [FIGURE 2.3-8A] October 05, 2010 - 5:52:16 pm (BY: ANDREW DEEPWELL)



ISSUED FOR USE

LEGEND

- Northern All Season Road
- Northern All Season Road Alternate
- 1m Contour
- + | 100m Marker

SCALE 1:5000



CLIENT



EBA Engineering
Consultants Ltd.



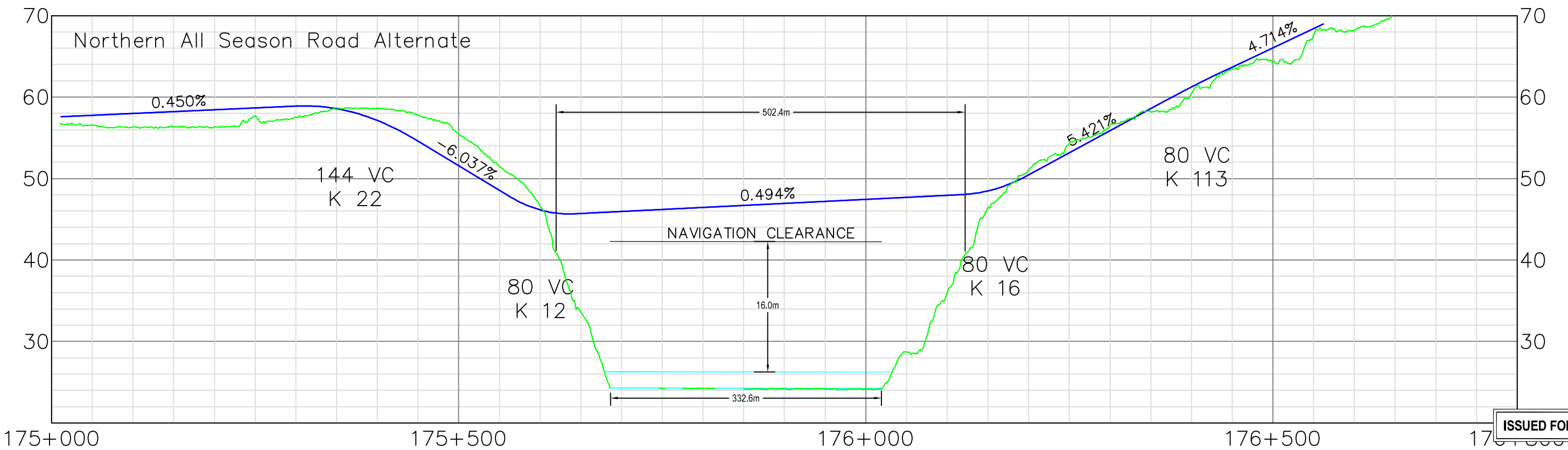
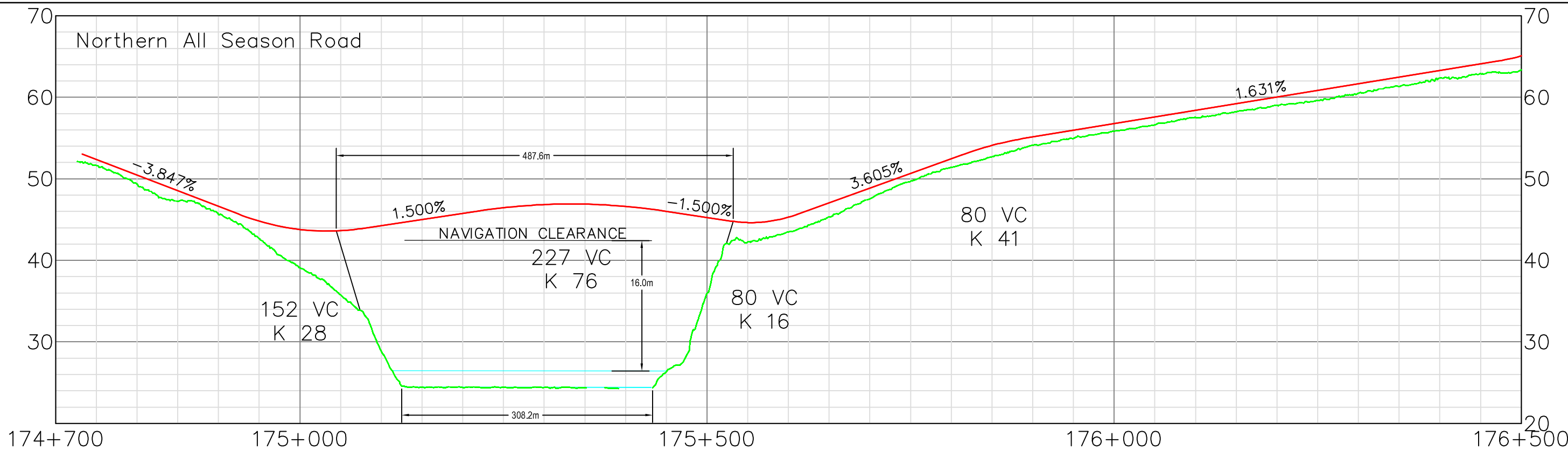
**KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT**

**THELON RIVER BRIDGE
OPTION DEVELOPMENT**

| | | | |
|--------------------------|------------------------|------------|----------|
| PROJECT NO. V33101016 | DWN AJD | CKD DCD | REV - |
| OFFICE VANC | DATE March 26, 2010 | | |

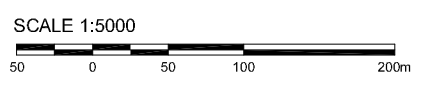
Figure 2.3-8A

Q:\Vancouver\Transportation\33101016 - Areva\CADD\2009 Conceptual Design\Design Files\24-677 Alignments and Profiles.dwg [FIGURE 2.3-8B] October 05, 2010 - 5:03:14 pm (BY: ANDREW DEEPWELL)



ISSUED FOR USE

LEGEND
 — Northern All Season Road
 — Northern All Season Road Alternate
 10:1 Vertical Exaggeration



| | | | | |
|----------------|---|------------|------------|---|
| CLIENT | KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT | | | THELON RIVER BRIDGE OPTION DEVELOPMENT PROFILE |
| | PROJECT NO. V33101016 | DWN AJD | OKD DCD | |
| OFFICE VANC | DATE March 26, 2010 | | | Figure 2.3-8B |

not provide usable data on the depth to bedrock. This could be due to particular soil conditions interfering with the unit, such as clay which cannot be penetrated by the radar signal or indicates that the bedrock was deeper than the radar was capable of penetrating.

The remote location of the bridge site, short summer season and severity of winter conditions will have a significant impact on the construction of the bridge. Extensive use of prefabricated bridge components that can be readily transported to the site will be important to reduce construction costs, duration of construction, and the risk of construction delays.

For the preferred alignment, a five-span bridge with a total bridge span between 409 m to 475 m is expected depending on how close fill materials can be placed to the river. This results in individual spans of 86 m to 100 m. This arrangement would minimize the number of piers required in the river while maintaining a cost efficient superstructure design. Constant depth welded plate girders would likely be used for the superstructure as they typically provide good cost efficiency, can be transported long distances by truck and can be erected using a number of different techniques. Although bridge spans exceeding 100 m can be achieved with constant depth girders, the economics and constructability decline considerably. The five-span arrangement is also desirable as it centers the piers on the river which avoids having a pier located near the center of the river. This minimizes the protrusion of berms into the river, if berms are required/permitted for pier construction. The BLUE alignment is less desirable structurally, as six spans are required to maintain individual spans below 100 m. This results in an additional river pier that is centered in the river.

Access to install the piles/piers and the superstructure steel may be an issue. It is understood that ice forms all the way across the Thelon River at this location during the winter. The GPR survey carried out from the ice surface in April 2009 indicated consistent ice thickness across the entire river at this location. This may provide a window of opportunity where some heavy equipment can be operated on the ice. This can be ideal for installation of the piles and pier construction, as well as for the erection of the superstructure steel. However, doing all of these tasks on a bridge this size is a lot to expect during one winter season. Piles and piers could also be installed from barge mounted rigs or from berms placed in the river but this is subject to environmental approvals and can be vulnerable to high water events. Superstructure steel could be installed from berms, barges or launching the steel pier to pier from one side of the river. Launching can be accomplished during open water times with little relative impact on the river.

2.3.4.2 Construction Staging and Costs

Construction Staging

Access to the proposed bridge site could be staged out of Baker Lake by either barge transportation or via an overland route if available. The base equipment required for pier construction generally consists of a large crane outfitted with a drill attachment capable of creating rock sockets of the required diameter, a vibro hammer and a mobile concrete batch

plant. General construction materials would consist of large diameter pipe piles, reinforcement cages and concrete materials. All these materials and equipment could be delivered by barges or via trucks depending on what type of access route is available. Note that numerous additional but smaller types of equipment and the appropriate personnel would also be required.

Bridge construction could commence in either summer or winter depending on the type of access selected for pier construction. While it is likely that pier construction can be completed during one summer or winter construction season, it should be possible to change the type of construction access should the work extend beyond the end of the season.

Depending on construction timing and environmental approvals, two different construction sequences can be envisioned:

Option A: Mobilize all equipment and materials to the crossing site in time to start construction of the river piles when the ice (ice bridge) has sufficient thickness to support the rigs/cranes. Note that construction of an appropriate ice bridge will have to be accelerated by flooding the ice. This has a good probability of allowing the completion of the river piles and piers (hoarding and heating required for pier construction). A contingency plan would be to leave the pier closest to shore for last, as this could be completed from an access berm in open water with the least impact on the river environment. Construction of the far shore abutment and approach embankment would also need to be completed using the ice bridge as access. Construction of the near shore abutment could occur following breakup of the river, but needs to be ready for launching of the steel girders. Launching of steel girders is now a fairly common construction technique, and is expected to be feasible during the spring and summer months. Once the steel girders are in place, precast deck panels can be progressively placed across the spans using the previously installed panels for access. Final grouting of the panels will require relatively warm conditions but could be conducted with hoarding and heating if necessary.

Option B: If environment permits allow, construction of the piles and piers could be conducted using berms and work bridges. This method tends to be more expensive since effective access and supply may only be available from one side of the open river thus requiring a work bridge. However, if the piles and piers are installed during the open water season, erection of the structural steel and deck panels could be more economically conducted in the winter from the ice. Final grouting of the deck panels would likely need to be conducted during warmer conditions in the spring.

Option A will probably be the most economical approach but both options contain significant potential for delays due to unexpected weather conditions and equipment breakdown. It appears from the 2009 GPR survey that ice develops at this location with generally consistent thickness at the crossing location. However, there is potential for thinner ice to develop in areas where currents are stronger and this must be further evaluated before a decision is made to utilize an ice bridge for construction.

If operations are well planned and supported, it may be possible to complete the structure within one year, but two years should be allowed for in the schedule.

Protection of the environment and the remoteness of the site will have a substantial influence on the design and construction of the proposed Thelon River bridge crossing.

Access for River Pier Construction

Construction access to the individual pier locations can be accomplished by a number of means, each with pros and cons as discussed in the following.

Berms constructed from the riverbank to the pier locations using fill materials have often been used to provide access for river pier construction. In addition to access, the berms provide a stable work platform from which to install the piers. However, the installation and removal of the berm material can have a significant impact on the environment and once installed the berms also constrict the flow of the river. From a construction risk point of view, the berms can be vulnerable to high water events and provide access from only one side of the river at a time. Although the bridge superstructure could be installed from berms, it is unlikely that the summer work season would be long enough to complete both pier construction and superstructure erection.

Using barges to provide equipment access for pier construction has proven successful for other northern bridge sites and could be used for the Thelon Bridge if sufficient depth of water, at least 2.0 m, is present at all pier locations. In addition to the barges, substantial additional equipment/materials will be required such as tugs, service boats and temporary barge landings. Since rock socket drilling operations occur over open water, some of the drill spoil would likely enter the watercourse. However, the overall impact is expected to be much less than that of berm construction and removal.

Construction of a temporary work bridge across the river parallel to the permanent bridge would also provide construction access to all pier locations. A work bridge could be constructed from one shore by driving piles and placing superstructure progressively from the end of the already completed bridge. However, it is unlikely that a work bridge could be practically designed to resist the higher ice forces expected on the Thelon. Therefore, the work bridge would need to be constructed and removed in one summer construction season which may not provide sufficient time to complete the work.

As noted the long, cold winter conditions at the site should permit the construction of an ice bridge from which pier construction could be accomplished. An ice bridge would provide flexible access for equipment and materials to all pier locations simultaneously. This approach would probably minimize the construction impact on the environment as there is little or no contact with open water. The primary risks using an ice bridge are the accidental damage to the bridge during construction or insufficient time to complete all piers due to either construction delays or a short ice bridge season due to warmer than expected climatic conditions. Erection of the bridge superstructure can be readily accomplished from an ice

bridge, but it would be very aggressive to try to complete both the piers and superstructure in one ice bridge season.

While all of the above methods of access for pier construction should be investigated further, at this time it appears that use of an ice bridge may be the best option for this bridge site.

Superstructure Erection

A bridge superstructure consisting of steel plate girders can be erected by launching the girders from one side of the river or erected using cranes located on an ice bridge or work bridge. Launching of the steel can be conducted in any season but carries some premium for additional equipment required for the launch. Cranes located on an ice bridge can also erect the bridge girders. Similarly, cranes could erect the steel from a temporary work bridge but this would only be economical if the same work bridge was used for pier construction which may not be possible with the relatively short summer construction season.

Precast deck panels can be erected progressively across the bridge using a small crane starting at one end of the bridge using previously installed deck panels to provide access. Alternatively, if an ice bridge or work bridge is still available, the deck panels could be erected along the length of the bridge using a larger crane.

Material Quantities

Further advancement of the bridge design is required to provide reasonably accurate material quantities. However, the following quantities are being provided based on similar previous designs.

- Large diameter steel piles (2.0 to 2.4 m) with 19 mm wall – 120 m or approximately 45 tonnes.
- Cast-in-place reinforced concrete for pier piles – 1300 m³.
- Steel girders – approximately 700 tonnes of steel.
- Precast concrete deck panels – approximately 135 panels at about 12 tonnes each (7.0 m X 3.0 m X 0.25 m).
- Steel railings.

Cost Estimate

Northern bridge construction projects in remote locations are typically dominated by costs to mobilize equipment and to deploy and maintain personnel on site. As part of our initial investigation we contacted personnel in the NWT Ministry of Transportation for more recent tender costs for remote bridges. The following approximate unit prices for somewhat similar remote bridges were obtained.

- Bear River Bridge – This 500 m bridge requiring barge access for construction was tendered circa 2007. Tender prices in the range of \$15,000 to \$19,000 per m² of bridge deck were received near the peak of the construction market. The tender was not awarded.
- Blackwater Bridge – This 300 m long single lane bridge was recently completed using barge access and winter roads. The construction costs were reported to be \$10,800 per m² of bridge deck. This project would have been tendered shortly after the peak in construction prices.

Although construction prices have generally reduced in the past 12 to 18 months, it is recommended that bridge construction costs (direct and indirect) in the range of \$11,000 to \$15,000 per m² of bridge deck be budgeted for at this time. This corresponds to bridge construction costs between \$30,000,000 to \$43,000,000 for a 7.0 m wide bridge with a total length of 410 m.

2.3.4.3 Bridge Configuration

The proposed bridge configuration can be seen on Figure 2.3-9.

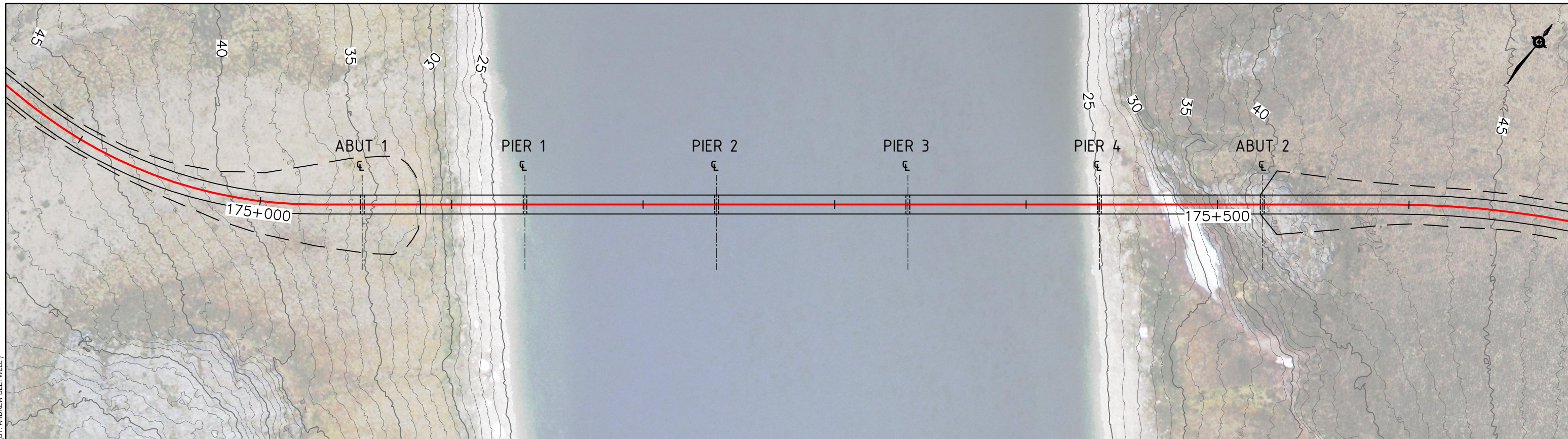
2.3.4.4 Foundation Types

Surficial geology mapping by the GSC of the general area denotes an irregular blanket of glacial till overlying bedrock.

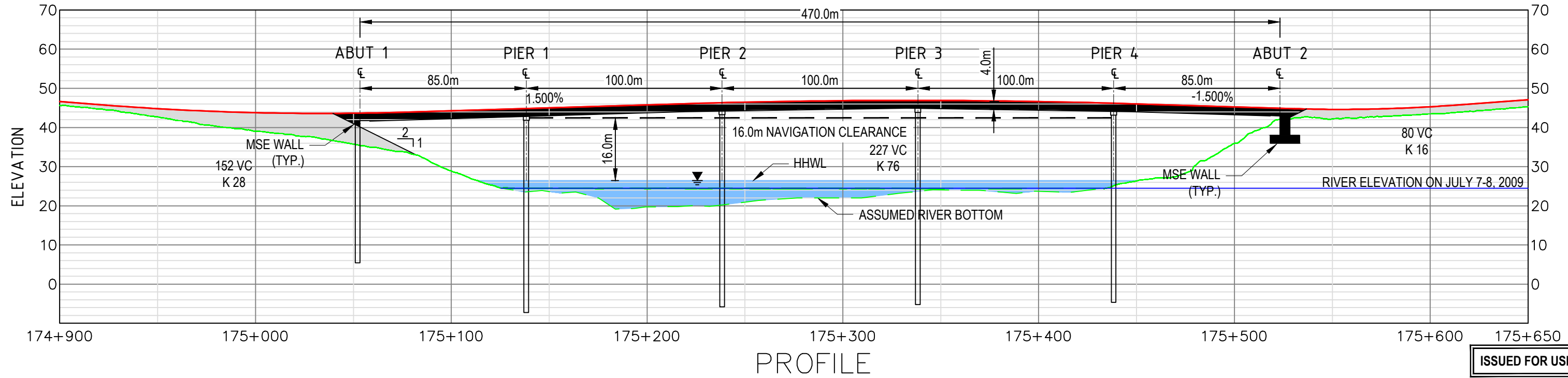
The geophysical survey (GPR and OhmMapper) in the area of the proposed crossing provides an indication of the stratigraphy, refer to Appendix A. In general, bedrock appears to be at relatively shallow depth on the east abutment and across the bottom of the river. It would appear that the depth to bedrock is on the order of 3.0 m or less in these portions of the crossing. Unfortunately, the survey was inconclusive with respect to the depth to bedrock on the east abutment, perhaps due to a higher percentage of clay in the overlying till or potentially a thicker till blanket in this area through which the GPR signal could not penetrate. The three GPR profiles across the river clearly show that the river bed topography is highly variable in this area.

Currently no subsurface borehole data exists for the proposed crossing location. At minimum, boreholes should be advanced at both abutment locations and at each pier location.

Large diameter piles, as indicated in the concept drawings, have proven successful in terms of economics and reducing environmental impacts for other northern river crossings (Suncor Bridge near Ft. McMurray is an example). However, the use of such piles will depend on the existence of appropriate geotechnical conditions at the selected crossing location. Decent rock at a reasonable depth is typically required to develop the necessary end bearing capacities and to provide sufficient lateral resistance against ice forces. However, using steel caissons allows the piles to be installed without dewatering through significant thicknesses of softer overburden materials. At Suncor the piles extended



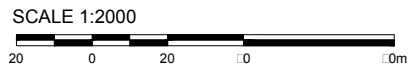
PLAN



PROFILE

ISSUED FOR USE

- LEGEND**
- Northern All Season Road
 - 1m Contours
 - 2:1 Vertical Exaggeration
 - Elevations measured above sea level



CLIENT

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| KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT | | | |
| THELON RIVER BRIDGE GENERAL ARRANGMENT | | | |
| PROJECT NO. V33101016 | DWN AJD | CKD DCD | REV - |
| OFFICE VANC | DATE March 26, 2010 | | Figure 2.3-9 |

Q:\Vancouver\Transportation\33101016 - Areva\CADD\2009 Conceptual Design\Drawings\DEIS Report\Thelon River Bridge GA.dwg [FIGURE 2.3-9] October 05, 2010 - 5:25:36 pm (BY: ANDREW DEEPWELL)

through up to 17.0 m of sand prior to being rock socketed into the underlying limestone layers. Other types of river piers are possible, but will likely require coffer dams or dewatering within containment berms to construct. This would increase the duration of construction and the exposure of the project to the higher risks associated with dewatered construction or high water events and unseasonable weather.

Although a variety of designs and construction methodologies could be used for the river piers, the use of large diameter pile type piers would be desirable at this location. Each river pier would consist of two large diameter piles (2.0 to 2.4 m in diameter) that are likely interconnected near water level and by a pier cap. In the last 10 to 15 years, the construction of such river piers has proven to be rather economical with lower impacts on the environment.

The primary advantage of large diameter pile type pier is that they can be constructed from the surface of the river without the need for dewatering. This avoids many of the construction risks and environmental impacts inherent in more traditional cofferdam construction techniques. The construction process for these piers starts with large diameter steel pipe piles being vibro-hammered through the riverbed materials down to the top of bedrock. A large diameter auger drill is then advanced through the pipe pile into the bedrock to form a socket into the bedrock. A reinforcement cage is placed into the pipe pile and rock socket, and tremie concrete is then placed to complete the pile. The steel pipe acts as formwork, environmental containment and protection against abrasion from future ice floes.

Typically, competent bedrock at depths not greater than 20 m below water level is required to make this type of pier viable. The preliminary data from the GPR survey would indicate that this type of foundation would therefore be appropriate.

2.3.5 Examples of Alternatives Considered

The route selected to be carried through to design was developed in accordance with the design principles and routing selection criteria stated in Section 2.3.2.

The following examples are indicative of the process used to reach the current level of design.

2.3.5.1 Geotechnical Stability Issue at Km 135-140

The prefeasibility report had a gentle grade following the base of the valley slope that stayed as far away as possible from the ice-rich terrain and water courses. Examination in the field revealed that this ground was unstable and should be avoided. There are numerous locations along this corridor that show evidence of previous landslides. These landslides occur only in ice-rich soils in permafrost regions. Retrogressive thaw flows develop in ice-rich, fine-grained sediments and result from the thawing and subsequent flow of water-saturated ground. These failures can occur on very gentle slopes and hundreds of these features line the river banks and tundra lakes in the project area. These landslides are

typically relatively small, but over time can retreat some distance back from the rim and from the escarpment.

The photo on the following page shows a typical slide in this area. These slides could have a significant impact on a road if one were to occur.



As a result of this geotechnically unstable area, the road was re-routed to the top of the ridge to avoid any potential landslides. This was also beneficial from an embankment perspective as it allowed us to use less fill material. From a maintenance perspective, it avoided areas of snowdrifts that would have occurred at the base of the slope.

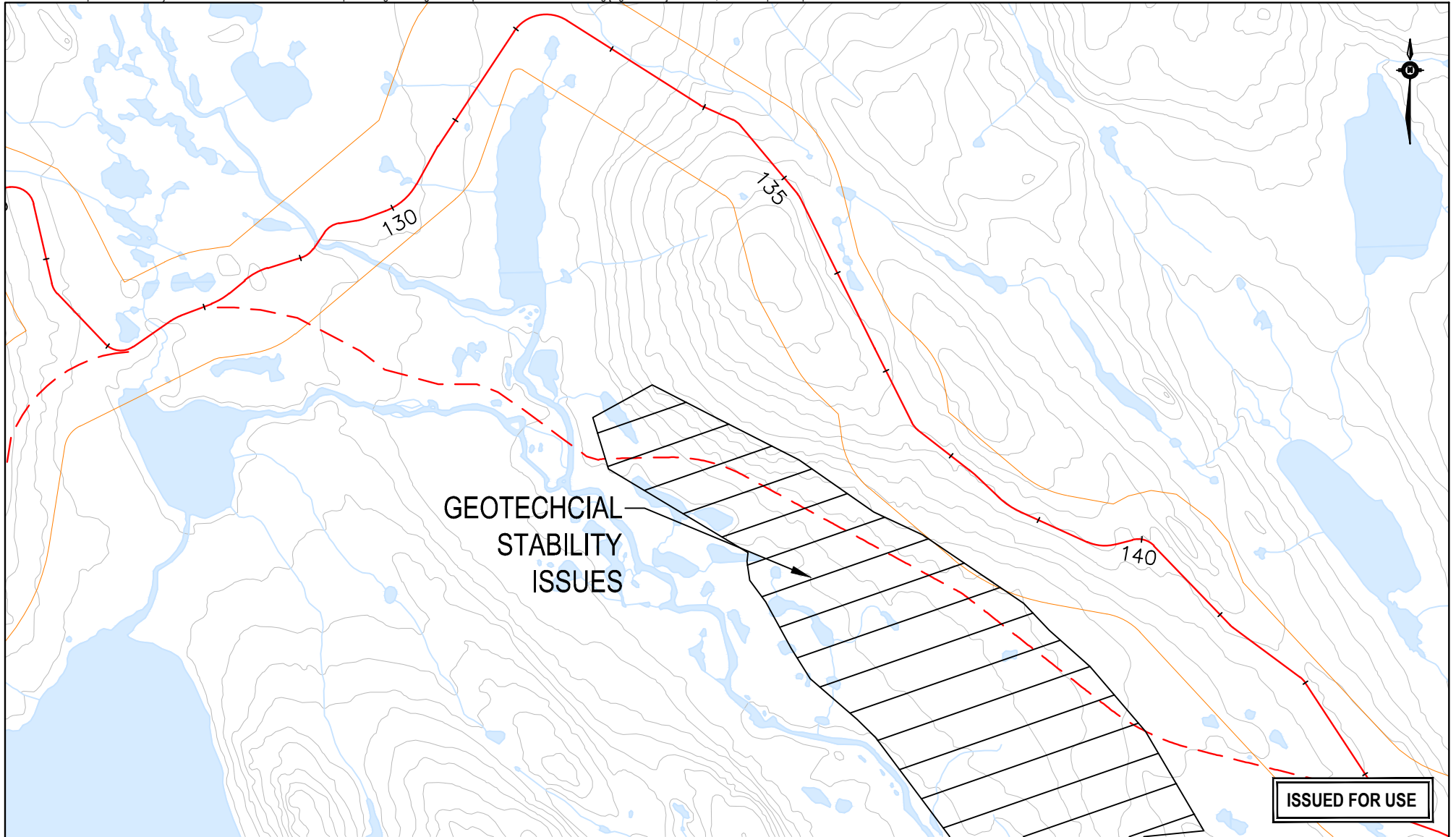
Further details of this area of geotechnical instability, including the alignments considered are illustrated in Figure 2.3-10.

2.3.5.2 Raptor and Maintenance Issues at Km 120-125

The initial field visit located an acceptable route in the lowlands with minimal gradient changes. It was determined later that this route was close to a raptor nest. An alternative route was then developed to avoid the raptor nest. This alternative route was examined in the field during early spring, at which time was evidence was observed of more snow drifts along the original route than the alternative.

The original alignment would have resulted in significant maintenance issues if it had been chosen. Although the alternate route has a steeper gradient, the combination of avoiding snowdrifts and raptor nests makes it the preferable route.

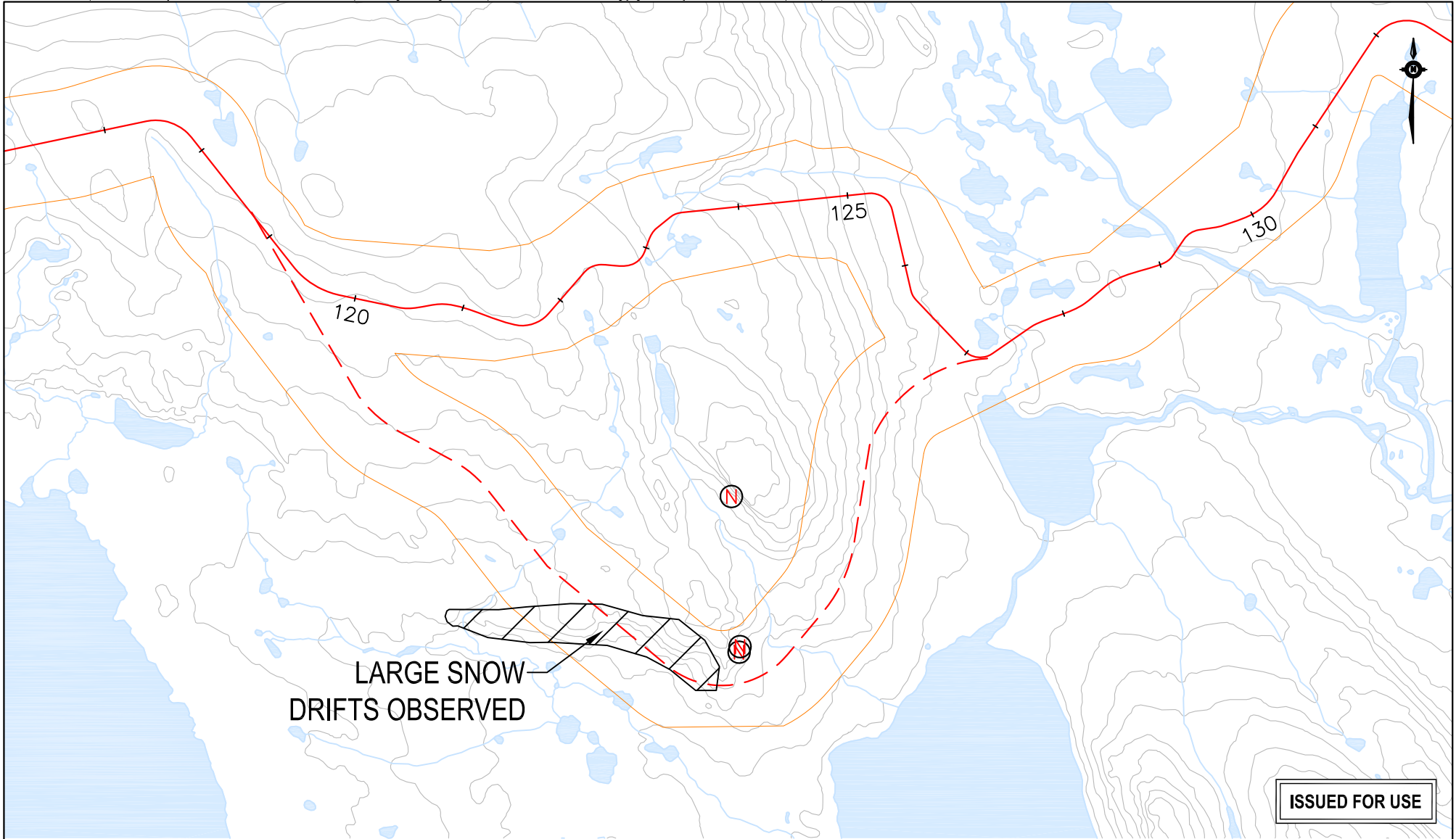
Figure 2.3-11 is a plan of this area, including the alignments considered to avoid the raptor nest and the large snow drift area.



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| <p>PROPOSED</p> <ul style="list-style-type: none"> — Northern All Season Road - - - Previous Alignment — Haul Road + km Marker | | <p>EXISTING</p> <ul style="list-style-type: none"> Quarry 10m Contour - NTS Base Data Extents of Road LiDAR Survey (2009) Raptor Nest | | <p>CLIENT</p> | | <p>KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT</p> | |
| <p>SCALE 1:50,000</p> | | <p>PROJECTION: UTM Zone 14 DATUM: NAD 83</p> | | <p>AREVA</p> | | <p>NORTHERN ALL SEASON ROAD GEOTECHNICAL STABILITY ISSUES 135-140km</p> | |
| <p>PROJECT NO. V33101016</p> | | <p>DWN DCD</p> | | <p>CKD GEW</p> | | <p>REV -</p> | |
| <p>OFFICE EBA-VANC</p> | | <p>DATE March 26, 2010</p> | | <p>Figure 2.3-10</p> | | | |

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| | |
|---|--|
| <p>PROPOSED</p> <ul style="list-style-type: none"> — Northern All Season Road - - - Previous Alignment — Haul Road km Marker | <p>EXISTING</p> <ul style="list-style-type: none"> Quarry 10m Contour - NTS Base Data Extents of Road LiDAR Survey (2009) Raptor Nest |
|---|--|

SCALE 1:50,000

PROJECTION: UTM Zone 14
DATUM: NAD 83

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AREVA

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**KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT**

**NORTHERN ALL SEASON ROAD
RAPTOR NEST AND MAINTENANCE ISSUES**

| | | | | |
|--------------------------|------------------------|------------|----------|----------------------|
| PROJECT NO. V33101016 | DWN DCD | CKD GEW | REV - | Figure 2.3-11 |
| OFFICE EBA-VANC | DATE March 26, 2010 | | | |

The following photo shows one of the many large snow drifts along the original route.



2.3.5.3 Terrain Types and Drainage Issues at Km 100-109

The prefeasibility route was designed on having gentle gradients. More detailed terrain typing and field investigation has revealed that the prefeasibility route was prone to ice-rich areas and was located in areas of diffuse drainage. The road was then re-routed to a dryer, higher area with minimal or no cover over the bedrock. The following photo illustrates an area of ice-rich terrain and diffuse drainage.



The following photo illustrates a preferable location for the road, as it is a dryer, higher area with minimal or no cover over the bedrock.



This shift in routing allowed for an embankment design that required less material, fewer culverts, and fewer drainage solutions.

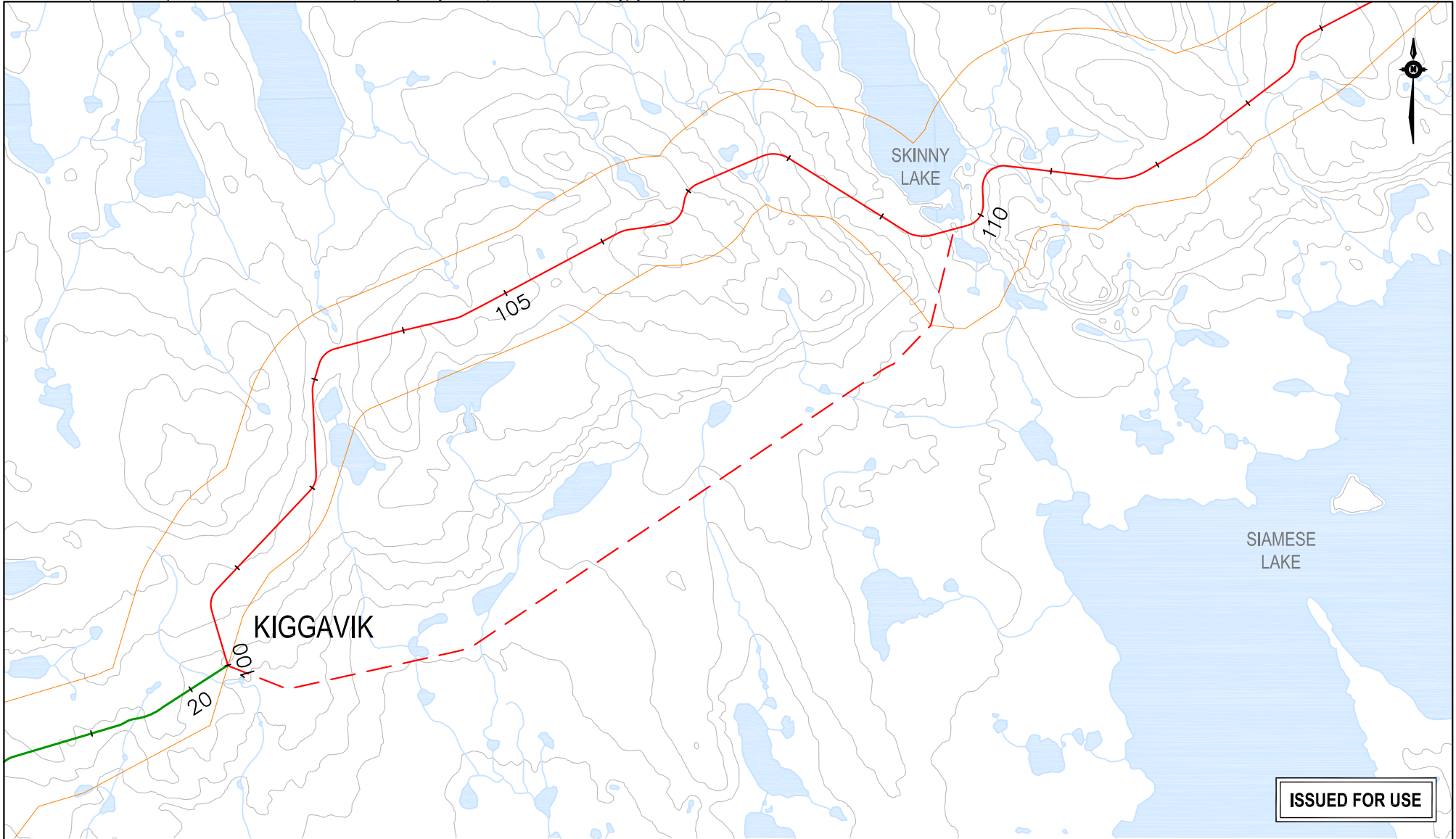
Figure 2.3-12 is a plan showing the relocation of the alignment to the higher, dryer area.

2.3.5.4 Archeological and Caribou at Km 109-110

Multiple routes in this area were developed as information on the location of Archeological and Caribou crossings became available. Routes included crossing further south in the valley as well as to the north on the edge of Skinny Lake as shown on Figure 2.3-13.

All of these routes are acceptable from a geometric and geotechnical perspective, however, the final route will be determined based on further guidance from the Archeological and Caribou team members.

The following photos show the valley crossing south of Skinny Lake, and the spit at the end of Skinny Lake.



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| | | | |
|-----------------|--------------------------|-----------------|-------------------------------------|
| PROPOSED | | EXISTING | |
| | Northern All Season Road | | Quarry |
| | Previous Alignment | | 10m Contour - NTS Base Data |
| | Haul Road | | Extents of Road LiDAR Survey (2009) |
| | km Marker | | Raptor Nest |

SCALE 1:50,000

 PROJECTION: UTM Zone 14
 DATUM: NAD 83

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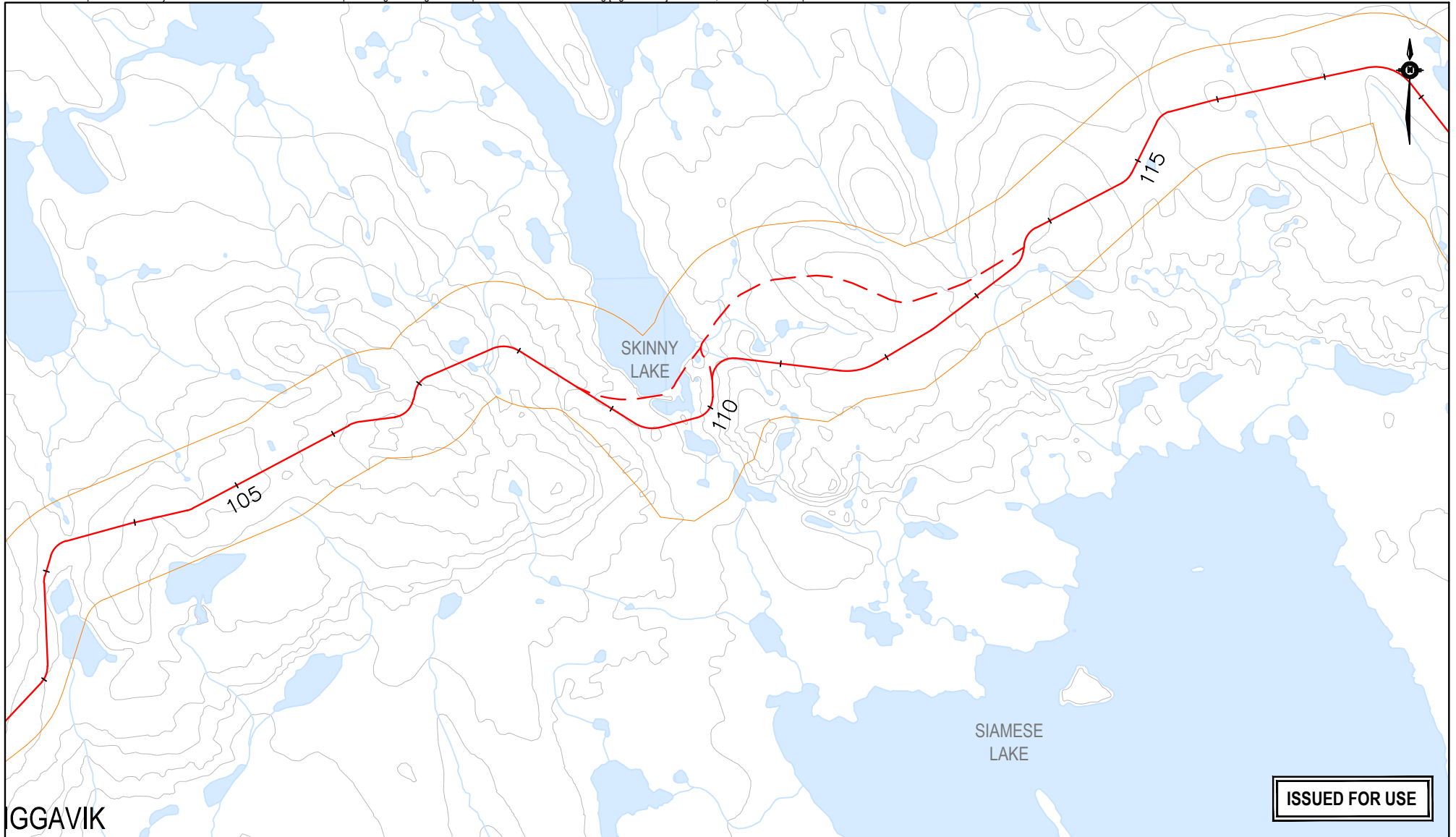
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KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

NORTHERN ALL SEASON ROAD
ALIGNMENT RELOCATIONS

| | | | |
|--------------------------|------------------------|------------|----------|
| PROJECT NO. V33101016 | DWN DCD | CKD GEW | REV - |
| OFFICE EBA-VANC | DATE March 26, 2010 | | |

Figure 2.3-12



ISSUED FOR USE

| | |
|---|--|
| <p>PROPOSED</p> <ul style="list-style-type: none"> — Northern All Season Road - - - Previous Alignment — Haul Road km Marker | <p>EXISTING</p> <ul style="list-style-type: none"> — Quarry — 10m Contour - NTS Base Data — Extents of Road LiDAR Survey (2009) N Raptor Nest |
|---|--|

SCALE 1:50,000

PROJECTION: UTM Zone 14
DATUM: NAD 83

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**KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT**

**NORTHERN ALL SEASON ROAD
ARCHEOLOGICAL AND CARIBOU CONCERNS**

| | | | |
|--------------------------|------------------------|------------|----------|
| PROJECT NO. V33101016 | DWN DCD | CKD GEW | REV - |
| OFFICE EBA-VANC | DATE March 26, 2010 | | |

Figure 2.3-13



2.3.6 Construction Staging

For purposes of estimating the probable approach that a contractor would take in constructing the northern all season road, and to estimate the time that it would take to construct, we have divided the project up into distinct sections as shown on the following key plan:

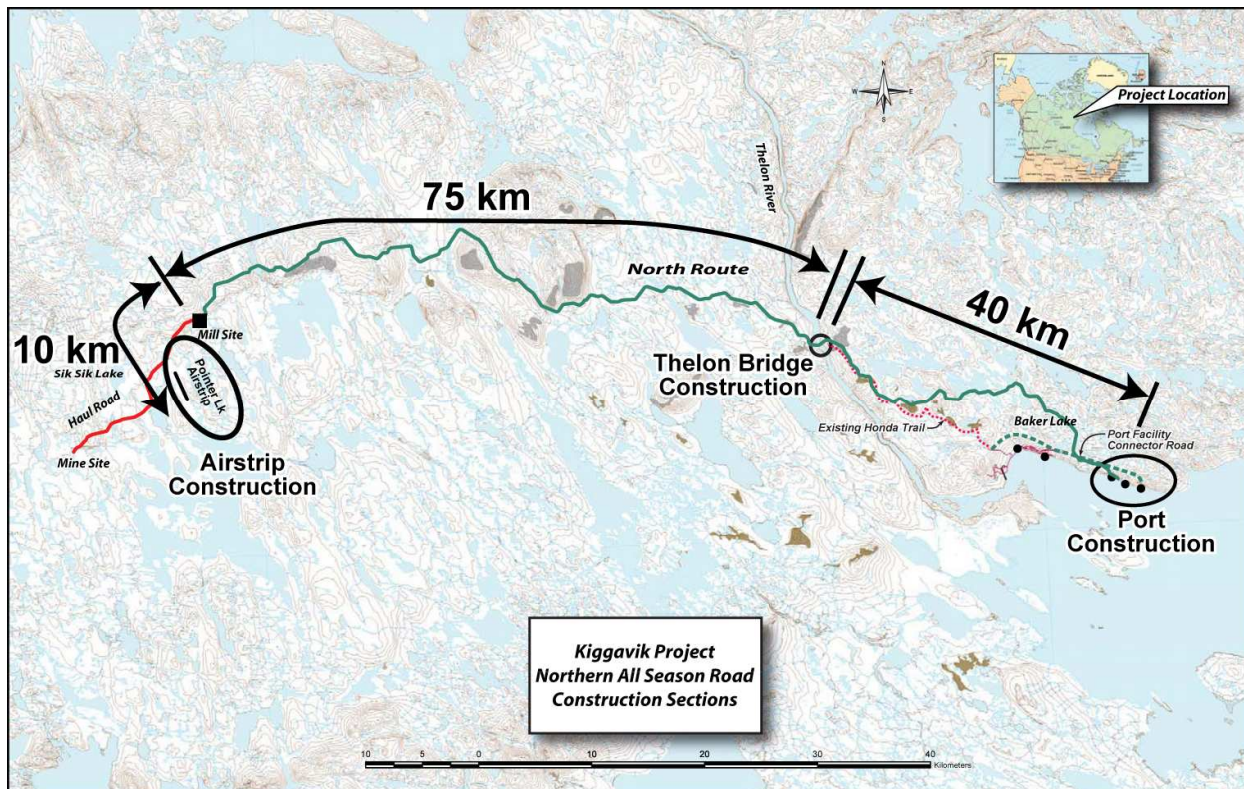


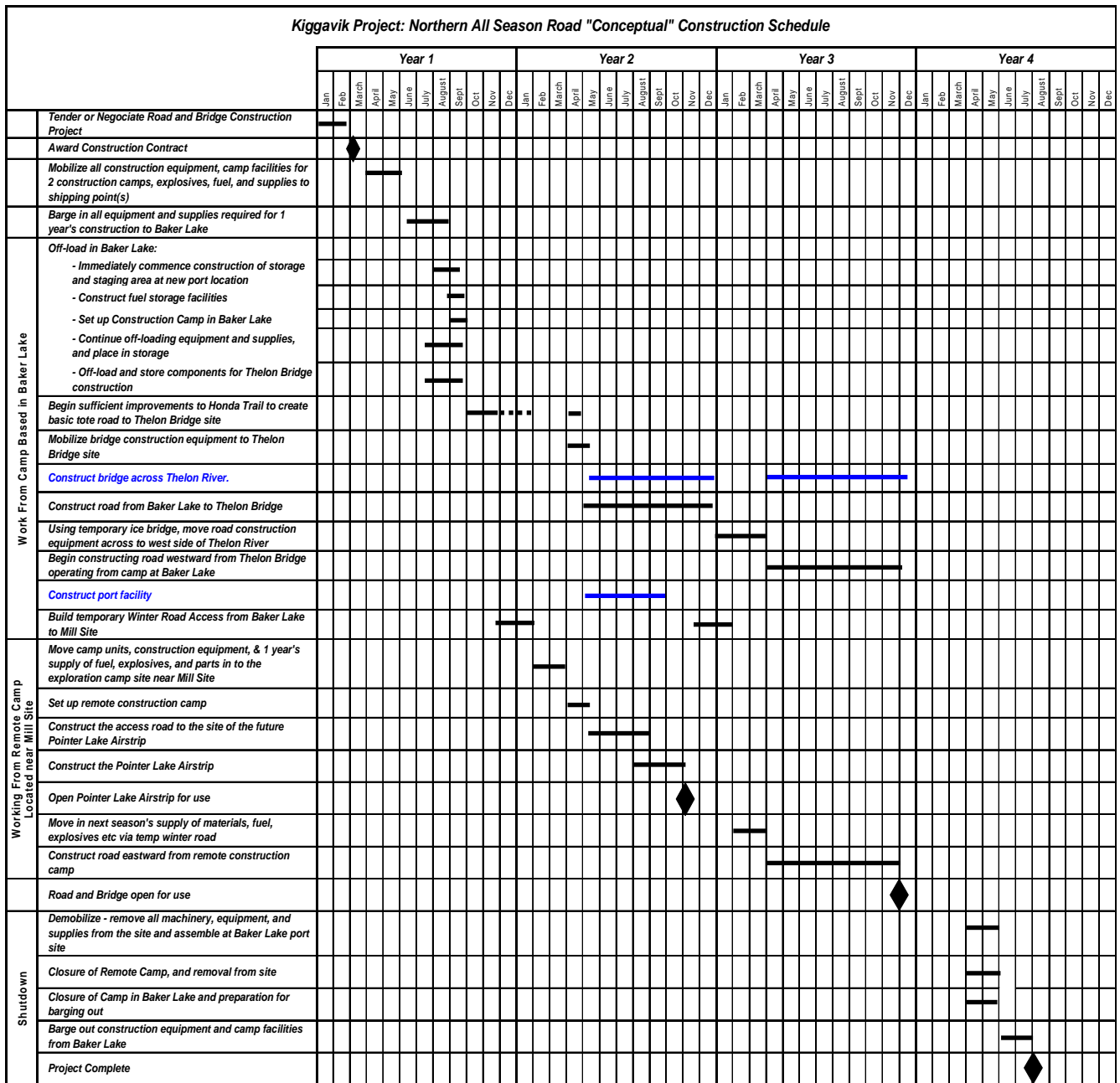
Figure 2.3-14: Construction Sections Map

In summary, the distinct sections of construction work will include:

- Construction of the port facilities. This could also be a suitable location for the Baker Lake temporary construction camp;
- Construction of approx. 40 km of road from the port facility to the Thelon River Bridge site. A portion of this alignment already crosses and parallels portions of the Honda Trail. Detailed design would determine the exact location of the road in with respect to the Honda Trail. If the Honda Trail was incorporated into the road, it would need to be reconstructed and upgraded to the full all season road standard;
- Construction of the Thelon River Bridge;
- Construction of approx. 10 km of road from the mill site to the site of the proposed Pointer Lake Airstrip. This work would be based out of a temporary construction camp to be located in the vicinity of the existing exploration camp;

- Construction of the Pointer Lake Airstrip;
- Construction of approx. 75 km of road from the Thelon River Bridge to the mill site.

Since the design of the road and bridge is presently at an early preliminary stage, precise quantities and details of items of construction are still unknown. However, sufficient work has been done to estimate a possible schedule of work. The following chart outlines a scenario where construction is based out of two (2) separate construction camps, one located in Baker Lake, and the other near the mill site.



As outlined on the previous chart, the construction work would take place over a three (3) year period, with the final demobilization and removal of construction equipment occurring in the shipping season of the fourth year.

The phasing of construction work is illustrated further as follows:

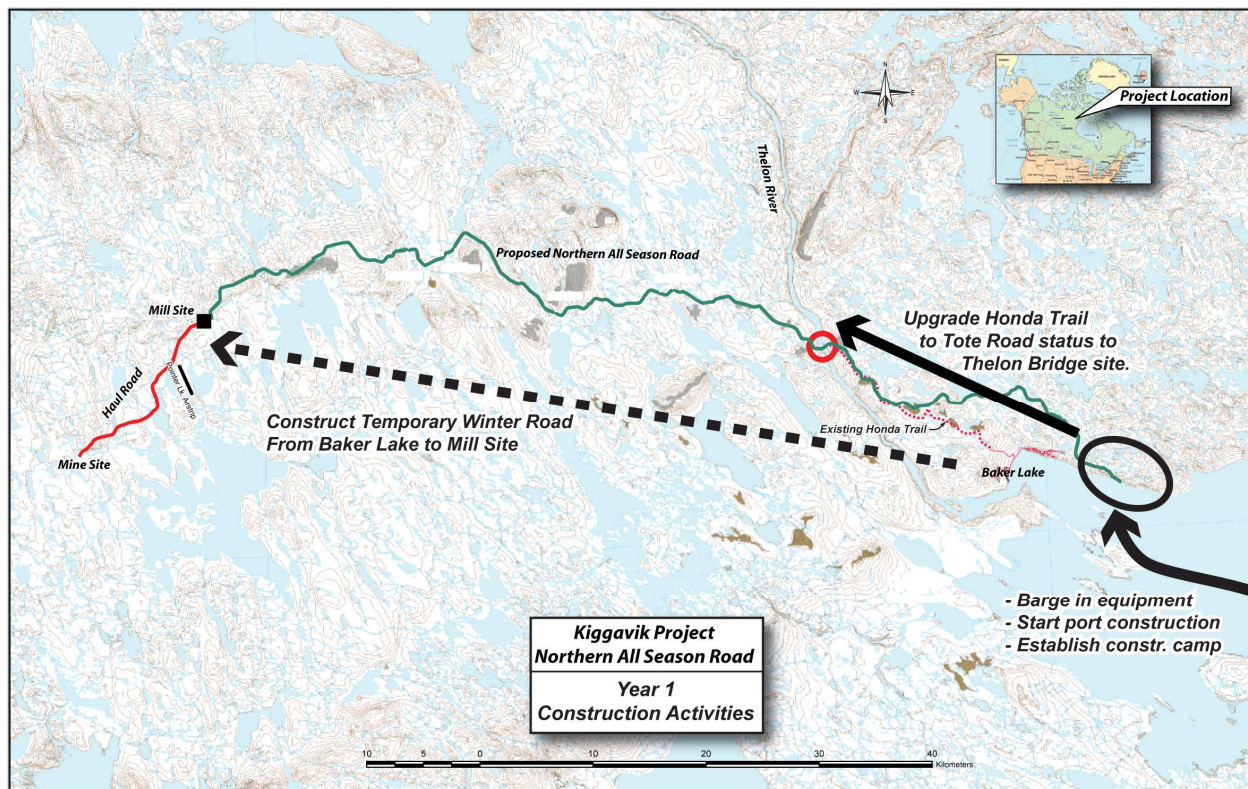


Figure 2.3-15: Year 1 Construction Activities

The extent of construction during Year 1 is somewhat limited by the earliest date that equipment and supplies can be barged into Baker Lake. It is assumed that shipping channels will become open sometime in July or August.

The immediate construction activity will be to prepare a storage area at the future port site suitable to receive all the construction equipment, supplies, and camp facilities that will be arriving by barge. Construction will then commence on upgrading the existing Honda Trail to a tote road status adequate for moving the Thelon Bridge construction equipment up to the site. A construction camp will be established at a suitable location near Baker Lake, or possibly at the site of the new port facility.

During the winter months, a temporary winter road will be established connecting Baker Lake to the Mill Site for purposes of mobilizing the second campsite and construction spread.

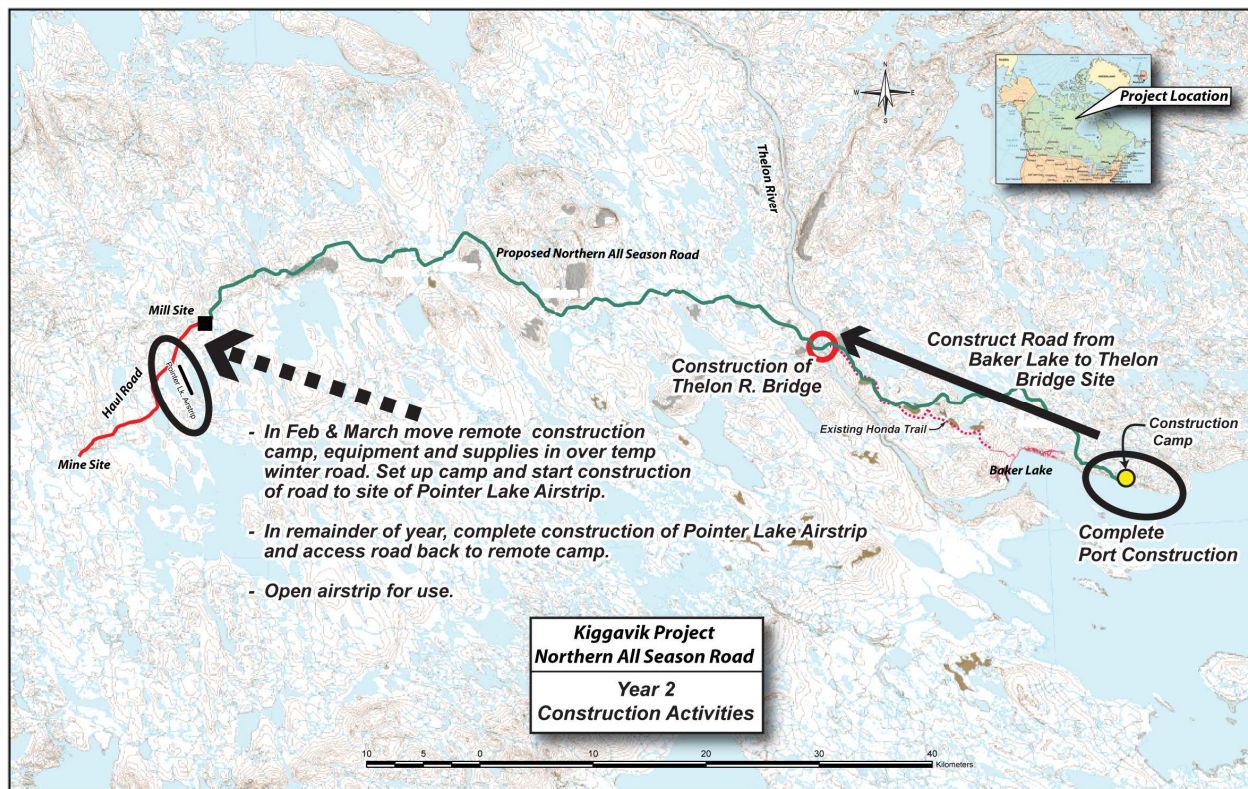


Figure 2.3-16: Year 2 Construction Activities

It is assumed that the temporary winter road will be suitable for use in February and March of the 2nd Year. At this time the remote camp will be moved into place somewhere near the existing exploration camp, and construction of the access road to the site of the future airstrip will commence. Work will continue all season finishing the airstrip and access road.

Meanwhile, construction of the road from Baker Lake to the Thelon River Bridge will be underway, as well as construction of the port facility, and initial construction of the Thelon Bridge.

At the end of Year 2, a temporary winter road will once again be put into place to facilitate the hauling into the remote campsite of all the supplies, fuel, explosives, parts, etc that will be required for Year 3.

As illustrated on the following graphic, construction in the 3rd Year will consist of building the Northern All Season Road from the east and west simultaneously. In addition, construction of the Thelon Bridge will be completed, allowing the road to be put into service late in the year.

Final demobilization of equipment will have to wait until the following year, as barging services out of Baker Lake will not be available until approximately June or July.

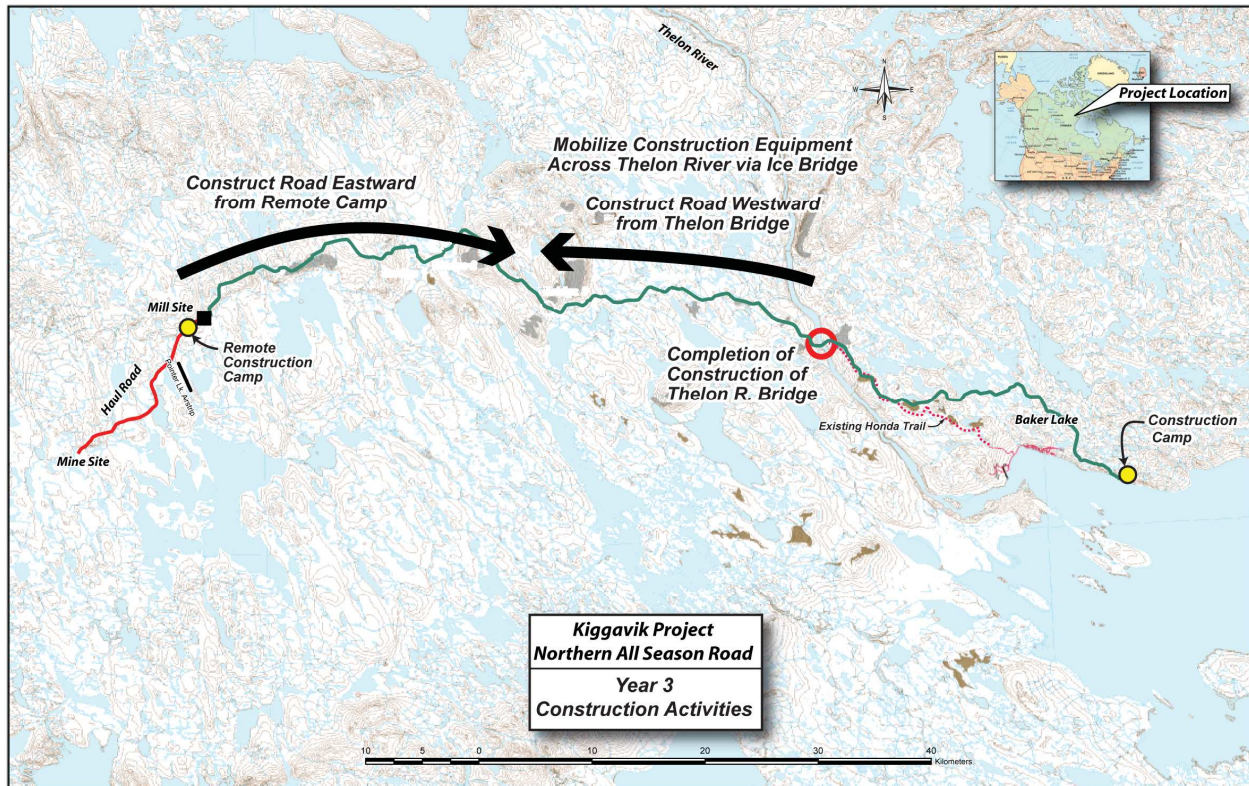


Figure 2.3-17: Year 3 Construction Activities

2.3.7 Quantities and Cost Estimate

2.3.7.1 Quantity Estimates

Approximate preliminary material quantities were developed using the Lidar information along the road. The quantities were calculated applying the typical sections outlined in Section 2.3.2.3. and modeling the finished road surface in Civil3D. Results are summarized below and have been extrapolated from representative sections that were carefully designed along the alignment.

The volume of embankment is in the range of 2.5 Million cubic meters.

The volume of road surfacing has been estimated to be 375 Thousand cubic meters.

The following table shows estimated volumes based the level of design completed to date.

TABLE 2.3.7.1 NORTHERN ROUTE QUANTITIES

| Start Station (km) | End Station (km) | Design Terrain Type | Embankment Fill (m ³) | Surfacing Material (m ³) |
|--------------------|------------------|---------------------|-----------------------------------|--------------------------------------|
| 100 | 106.5 | 1 | 143,000 | 22,000 |
| 106.5 | 110 | 1 | 77,000 | 12,000 |
| 110 | 111 | 1 | 22,000 | 3,000 |
| 111 | 121.5 | 4 | 210,000 | 35,000 |
| 121.5 | 125 | 4 | 70,000 | 12,000 |
| 125 | 132.5 | 1 | 165,000 | 25,000 |
| 132.5 | 135 | 1 | 55,000 | 8,000 |
| 135 | 138 | 4 | 60,000 | 10,000 |
| 138 | 143.5 | 1 | 121,000 | 18,000 |
| 143.5 | 149 | 1 | 121,000 | 18,000 |
| 149 | 157.2 | 1 | 180,000 | 27,000 |
| 157.2 | 170 | 1 | 280,000 | 42,000 |
| 170 | 174.4 | 1 | 96,000 | 15,000 |
| 174.4 | 174.8 | 1 | 9,000 | 1,000 |
| 174.8 | 177 | 4 | 44,000 | 7,000 |
| 177 | 182.5 | 4 | 110,000 | 18,000 |
| 182.5 | 185 | 2 | 62,000 | 8,000 |
| 185 | 192 | 1 | 154,000 | 23,000 |
| 192 | 195 | 2 | 75,000 | 10,000 |
| 195 | 200.5 | 1 | 121,000 | 18,000 |
| 200.5 | 213.5 | 2 | 325,000 | 43,000 |
| Total | | | 2,500,000 | 375,000 |

2.3.7.2 Cost Estimate

In estimating the construction costs of a remote northern project such as this, one needs to consider the following variables that can all have an influence on costs:

- The state of the heavy construction industry at the time of tendering or negotiating the contract: When construction work is generally abundant, prices tend to rise. In times of scarcity of construction activity, competition intensifies, and prices tend to fall.
- Time allowed for construction: When very tight time frames are imposed on the construction contractor, prices will correspondingly rise. For example, on a project such as this one, shortening the allowable time for construction could result in the necessity of mobilizing and operating from multiple headings, all of which results in a price premium.

The preliminary estimate of the “order of magnitude” construction costs of the Northern All Season Road based on the staging scenario described above, not including the Thelon River Bridge, is in the range of \$1.1 to \$1.4M/km. For a length of 125km, this equates to a

range of from \$125,000,000 to \$160,000,000. This has been based on EBA's knowledge of construction costs and in the Arctic and discussions with Contractors. EBA recommends the employment of a road construction contractor to determine a more accurate construction cost estimate.

A cost breakdown into specific items (both direct and indirect) will not render this estimate any more accurate at this point. While we have reasonable estimates of the overall major quantities as shown in 2.3.7.1, EBA does not have a strong feel for the associated unit prices associated with the quantities. There are limited historical unit costs that are relevant to this project as there are few roads of this magnitude constructed in this remote part of the Arctic.

The following Table 2.3.7.2 outlines a breakdown into its main constituents.

| TABLE 2.3.7.2: NORTHERN ROUTE COST ESTIMATE | | | | |
|--|-------------------|----------------|----------------------|-----------------------|
| Item | Unit Price | Unit | Est. Quantity | Cost |
| Mob/Demob | 10% | LS | | \$ 12,911,000 |
| Rock Excavation & Embankment Placement | 35 | m ³ | 2,500,000 | \$ 87,500,000 |
| Granular Base | 55 | m ³ | 375,000 | \$ 20,625,000 |
| Bridges | 4000 | m ² | 2,765 | \$ 11,060,000 |
| Culverts | 1000 | l.m. | 325 | \$ 325,000 |
| Camps | 1 | Each | 9,600,000 | \$ 9,600,000 |
| Other Indirect & Contingency | 15% | LS | | \$ 19,366,500 |
| Total | | | | \$ 161,387,500 |

*Bridges do not include Thelon River bridge

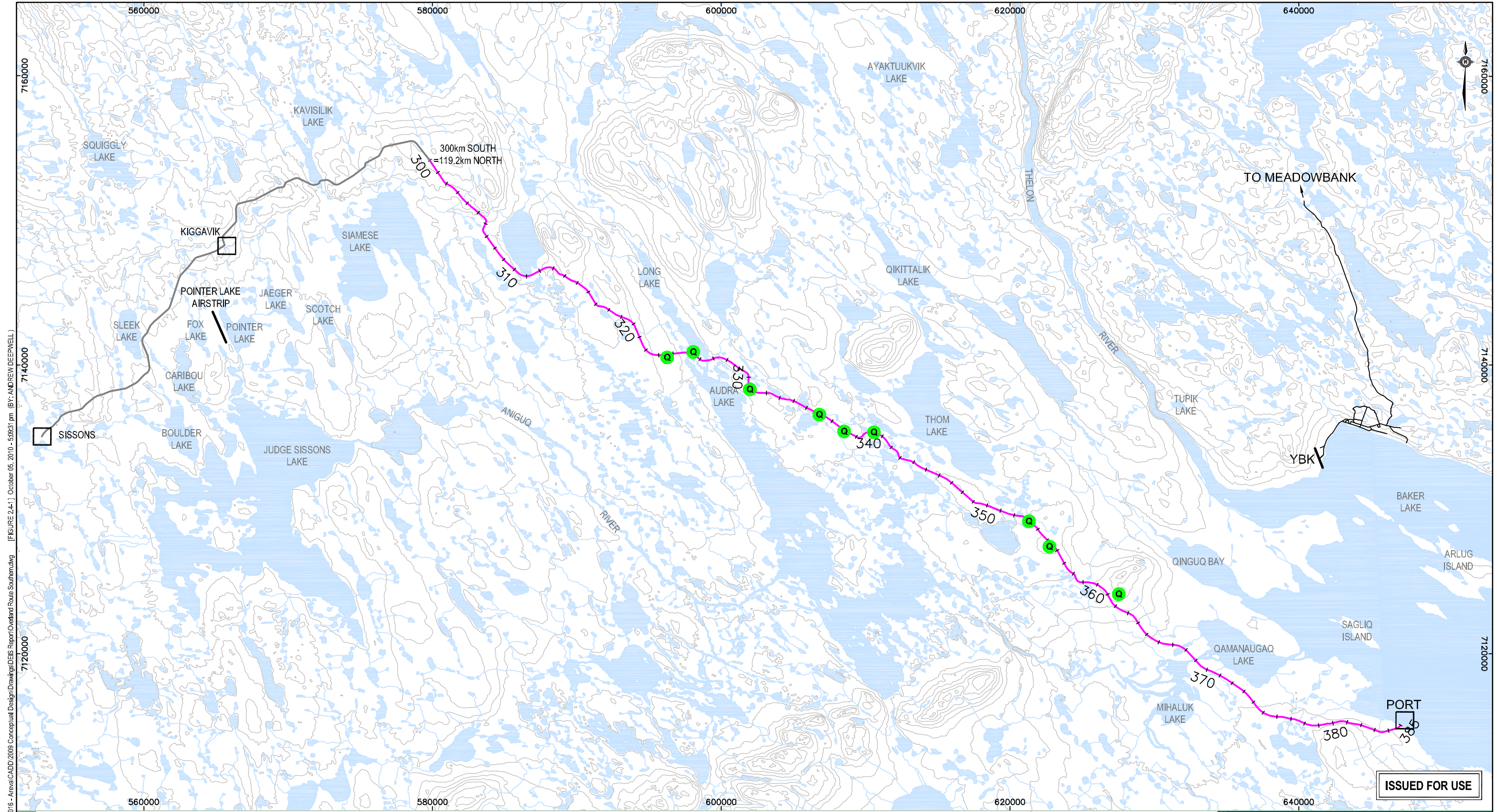
2.4 SOUTHERN ALL SEASON ROAD

2.4.1 General

The proposed Southern All Season Road extends from the proposed Kiggavik Mine/Mill site to a proposed port site on the south shore of Baker Lake, southeast of the Thelon River., as shown on Figure 2.4.1. The northern 20 kilometers of the route is the same route as the Northern All Season Road. The proposed Southern All Season Road is 104 km long from Kiggavik to the proposed port site.

The location of the port site was based on a combination of the shortest causeway length and a navigable shipping approach. This allowed EBA to shorten the overall road length by 10 kilometers from previous work.

Five bridges (less than 50 meters in length) and two longer bridges (one at approximately 60 meters and one at about 120 meters in length) are planned along the route. The remainder





Q:\Vancouver\Transportation\33101016 - Areva\CADD\2009 Conceptual Design\Drawings\DEIS Report\Overhead Roads Southern.dwg [FIGURE 2.4-1] October 05, 2010 - 5:09:31 pm (BY: ANDREW DEEPMELL)

- LEGEND**
- Northern All Season Road
 - Southern All Season Road
 - 20m Contour - NTS Base Data
 - km Marker
 - Existing Roads
 - Potential Quarry

SCALE 1:250,000

 PROJECTION: UTM Zone 14
 DATUM: NAD 83

ISSUED FOR USE

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|--|--|---|------------------------|--------------|
|  | | KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT | | |
| EBA Engineering Consultants Ltd.  | | SOUTHERN ALL SEASON ROAD | | |
| CLIENT | | PROJECT NO. V33101016 | DWN AJD | CKD DCD |
| | | OFFICE VANC | DATE March 26, 2010 | REV - |
| | | | | Figure 2.4-1 |

of the water crossings can be accommodated with culverts. Additional bridges may be required if fisheries issues dictate the need for a bridge rather than a culvert.

The road will be a 10 meter wide gravel road, built with rock embankment (fill). There will be no earth cuts along the alignment, and the only cut sections will be through rock. The same approach as discussed for the Northern All Season Road.

Material for the road embankment and road surfacing material will be derived from rock quarries developed along the road and granular deposits at the southern end of the route.

It should be noted that this route has not been investigated and designed to the same level Lidar data and detailed orthophotography are not available for the southern route.

2.4.2 Geotechnical Route Description

Generalized terrain and topographic conditions observed along the proposed Southern All Season Road beginning at the northwest end of the route (Km 300) and traveling east-southeast towards a proposed port location along the shoreline of Baker Lake (Km 385) are described in Table 2.4-2 below. Generalized Design cross sections for the varying subsurface conditions were not developed for this road.

| TABLE 2.4-2: GENERALIZED TERRAIN CONDITIONS ALONG SOUTHERN ALL SEASON ROAD ALIGNMENT | | |
|--|-------|--|
| Kilometre | | Description of Terrain Conditions |
| 300 | 313 | The route travels along the west and south side of a large unnamed lake, crossing two stream channels along the way, which would both require bridge structures (Km 307 and Km 313). |
| 313 | 315 | The route parallels along the base of a bedrock controlled slope, which has potential to be developed into a quarry for constructing the road. |
| 315 | 320 | The route crosses onto a morainal (till) blanket that slopes to the northeast and is generally wet with many small lakes. The route crosses an area of undefined flow at Km 317.5 and ribbed moraine terrain at Km 320. A suitable quarry may be developed at a rock outcrop at Km 318. |
| 320 | 326.5 | From about Km 320 to Km 326.5, the route travels along relatively level till blanket and veneer terrain with surface boulders. |
| 326.5 | | This crossing will require a bridge structure. At 326.5, the route crosses a major stream crossing with a wetted perimeter of about 50 m and a 15 m wide open channel. The stream separates the north end of Long Lake from a chain of unnamed lakes that extend further north (effectively an extension of Long Lake). |
| 326.5 | 332 | The route travels along a blanket and veneer of till skirting between bedrock outcrops. A potential quarry site was identified at Km 332. |
| 332 | 347 | The alignment continues along relatively level, wet till terrain with areas of alluvial deposits. The entire area between Long Lake and Thom Lake is relatively low-lying and irregular with several bedrock outcrops. A prospect quarry site exists to the northeast of the alignment at Km 335. The terrain appeared especially wet at Km 339 and Km 342 and ribbed terrain was observed at Km 346. There are numerous water bodies and signs of thermokarst activity between Km 341 and Km 345. |

| TABLE 2.4-2: GENERALIZED TERRAIN CONDITIONS ALONG SOUTHERN ALL SEASON ROAD ALIGNMENT | | |
|--|-----|---|
| Kilometre | | Description of Terrain Conditions |
| 347 | 354 | The alignment parallels a bedrock outcrop and a deposit of sand between Km 347 and Km 349, and crosses both ribbed till and relatively smooth terrain between Km 349 and Km 354. This bedrock out crop would provide a suitable quarry site; however, may provide limited supply. Surficial mapping also shows a small bedrock outcrop at Km 353. |
| 354 | 364 | The route leaves the till terrain and crosses a widespread area of marine reworked sediments derived from the reworking of glacial deposits by wave and current action during marine regression (refer to surficial geology mapping). The route descends in elevation from Km 355 to Km 360 and descends further from Km 360 to Km 365 as it crosses linear strandlines of marine reworked beach ridges. Surficial mapping shows a small bedrock outcrop at Km 361. Beyond this location to Km 385, there were no bedrock exposures identified, which supports the surficial geology mapping of the area. Rock quarry material from this location to the proposed port location is in short supply. Road embankment material would need to be hauled long distances from rock quarries further west or more likely be sourced from the marine reworked sands (littoral sediments) |
| 364 | 368 | The route travels along till terrain to Km 368 where it approaches the largest stream crossing along the route and extensive deposits of alluvial outwash sands and gravels mapped along its south bank. The open channel width varies from 75 m to 110 m depending on the location of the crossing. An intermediate pier structure would be required for the bridge crossing. |
| 368 | 373 | The route traverses aeolian and modified/reworked till terrain, which is likely ice-rich and sensitive to disturbance.. The terrain is relatively smooth and level as it approaches Baker Lake. |
| 373 | 385 | The route transitions back onto another widespread area of marine reworked sediments derived from reworking of glacial deposits during marine regression. The route follows beach ridges on its way to the proposed port location. Along the alignment the route crosses several small, ephemeral drainage channels that will require cross-drainage structures(culverts). Between Km 374 and Km 376, the terrain becomes wet with signs of thermokarst activity. A bridge structure will be required to cross the stream channel at Km 375. |

2.4.2.1 Geometrics

Horizontal and vertical alignments have not been developed for this route other than general field routing. Lidar and orthophography is not available for this route.

In the field, the grades have been noted to be fairly gentle.

General field observations indicate that this route will provide acceptable operating characteristics for the chosen design vehicle.

2.4.2.2 Water Crossings and Drainage

There are 5 bridges (less than 50 meters in length) along the route, one bridge at approximately 60 meters and one bridge at about 120 meters in length. The remainder of

the water crossings can be accommodated with culverts. Additional bridges may be required if fisheries issues dictate the need for a bridge rather than a culvert.

The following table 2.4.2.2 summarizes the water crossings and proposed crossing methods.

| TABLE 2.4.2.2: WATER CROSSINGS SOUTHERN ALL SEASON ROAD | | | | |
|--|-----------------|----------------|----------------------|----------------------|
| Crossing # | Northing | Easting | Crossing Type | Bridge Length |
| S1 | 7149397 | 583541 | Bridge | 21.0 |
| S2 | 7146514.351 | 587357.867 | Bridge | 11.0 |
| S3 | 7144050.278 | 591653.59 | rockfill | |
| S4 | 7142484.971 | 594106.311 | culvert | |
| S5 | 7142127.326 | 594251.434 | culvert | |
| S6 | 7140853.184 | 597522.042 | rockfill | |
| S7 | 7140290.462 | 598854.119 | Bridge | 18.0 |
| S8 | 7140318.775 | 599073.193 | Bridge | 55.0 |
| S9 | 7139195.776 | 601888.895 | multiple culverts | |
| S10 | 7137330.97 | 605337.031 | culvert | |
| S11 | 7135209.5 | 609893.264 | rockfill | |
| S12 | 7134450.696 | 611635.326 | rockfill | |
| S13 | 7133483.128 | 612571.235 | culvert | |
| S14 | 7132647.364 | 614328.108 | rockfill | |
| S15 | 7129799.929 | 619634.207 | rockfill | |
| S16 | 7129546.139 | 620658.976 | culvert | |
| S17 | 7124982.761 | 624728.203 | culvert | |
| S18 | 7120465.308 | 631900.135 | culvert | |
| S19 | 7119625.407 | 632773.057 | Bridge | 112.0 |
| S20 | 7118690.602 | 634140.535 | culvert | - |
| S21 | 7115508.357 | 639323.843 | Bridge | 5.0 |
| S22 | 7115341.366 | 640083.733 | culvert | |
| S23 | 7115041.523 | 641419.614 | culvert | |
| S24 | 7115241.439 | 642494.146 | culvert | |
| S25 | 7115259.577 | 642552.268 | culvert | |
| S26 | 7115284.066 | 642716.672 | culvert | |
| S27 | 7115187.518 | 643603.767 | culvert | |
| S28 | 7115072.253 | 644280.019 | culvert | |
| S29 | 7114883.772 | 644861.155 | culvert | |
| S30 | 7114646.177 | 645475.113 | multiple culverts | |
| S31 | 7114619.021 | 645530.391 | culvert | |

The photo below shows the long 120 meter crossing at km 369.



2.4.2.3 Borrow Sources and Quarry Locations

Bedrock outcrops (possible quarry locations) available along the route present the best available materials for construction of the road. Quarry sites are available inland along the route and prospect locations have been identified between km 300 and km 360; however, the final 25 km of road and the proposed port causeway do not have nearby quarry sites. This poses the primary limitation/disadvantage of the Southern All Season Road. Potential Quarry locations have been previously shown on Figure 2.4-1.

Marine deposits near Baker Lake consist of materials deposited in a postglacial sea, which have been mainly derived from reworking of glacial deposits by wave and current action during marine regression. The deposits are dominantly comprised of well-sorted sands with a percentage of gravel and cobbles. These materials could be used for embankment construction, but risk erosion and road rutting issues which will need to be addressed during design. The following photos show the quality, quantity and surficial appearance of these deposits.



Marine Deposits near Baker Lake- (well-sorted sands with a percentage of gravel and cobbles)



Representative photo showing well sorted sands

2.4.2.4 ARD and ML Potential

ARD and ML potential has not been evaluated for the Southern All Season Road.

2.4.3 Alternatives Considered

Alternatives were not considered to the same level of detail for the Southern All Season Road as the Northern Road. Issues related to the environment, maintenance, construction staging and cost estimates were not developed for this route.

2.5 COMPARISON OF NORTHERN AND SOUTHERN ALL SEASON ROADS

A direct comparison of the Northern and Southern All Season Roads in terms of quantities and overall geometric design can not be made because the two routes were not developed to the same level of investigation and design. Only the Northern Alignment had a preliminary alignment designed meeting specific horizontal and vertical geometrics.. The field investigation for the Northern Alignment looked in greater detail at the specific stream/river crossings and potential rock quarries. This detail of data was not collected for the Southern All Season Road. However, having explained the above, there are several differences between the two routes including some obvious and less obvious advantages

and disadvantages. Table 2.5 summarizes the physical components and compares the two roads.

| TABLE 2.5: COMPARISON BETWEEN NORTHERN AND SOUTHERN ROADS | | | |
|--|----------------------|--|--|
| Item | | Northern | Southern |
| 1 | length of road | 114 km | 104 km |
| 2 | # of bridges | 14, not including the 400 meter long Thelon River Crossing | 6 |
| 3 | # of culverts | 13 | 19 |
| 3 | Quarries | good rock quarries spaced evenly throughout alignment | no rock quarries for final 25 km of alignment. Only potential for borrow is well sorted sands. Will require either a very long haul if rock is to be used or sand can be used for embankment but rutting and erosion issues must be addressed. |
| 4 | Construction Staging | favourable construction staging. Can be built out of the Baker Lake community. Multiple headings possible. | Difficult construction staging. None of the route can be directly connected to the community of Baker Lake. Port Facility would have to be constructed to allow for heading to start from the southern end of the project. |
| 5 | Terrain | Terrain is generally dry, located on higher areas where possible. | Terrain is not as favourable as the northern road as a significant portion of the road is in lower, wetter areas. Will result in a greater degree of maintenance. |
| 6 | Geometrics | some gradients in the order of 5 to 6 % | gradients relatively gentle- in the order of 2-3 % |

3.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Yours truly,
EBA Engineering Consultants Ltd.



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| PERMIT TO PRACTICE EBA ENGINEERING CONSULTANTS LTD. | |
| Signature | |
| Date | |
| PERMIT NUMBER: P 018 NWT/NU Association of Professional Engineers and Geoscientists | |

APPENDIX

APPENDIX A REFERENCE DRAWINGS AND SUPPORTING DOCUMENTATION

List of Data in Appendix A:

- A1 – LiDAR Survey Report
- A2 – Baker Lake Sonar Report
- A3 – Mill Site and Sik Sik Lake Geophysics Survey
- A4 – Andrew Lake Dyke Geophysics Survey
- A5 – Thelon Crossing – Geophysics Survey
- A6 – Winter Road Geophysics Survey
- A7 – North Port Site Bathymetric Data
- A8 – 2009 Mill Site Borehole Logs
- A9 – Summary of Activities Thelon ice Observations
- A10 – Project Photo Log

Note:

Appendix A is a large compilation of reference drawings and documents that contains information common to all of the other Reports as well. To avoid unnecessary duplication, it has not been attached to each Report, but has been submitted as a separate document.

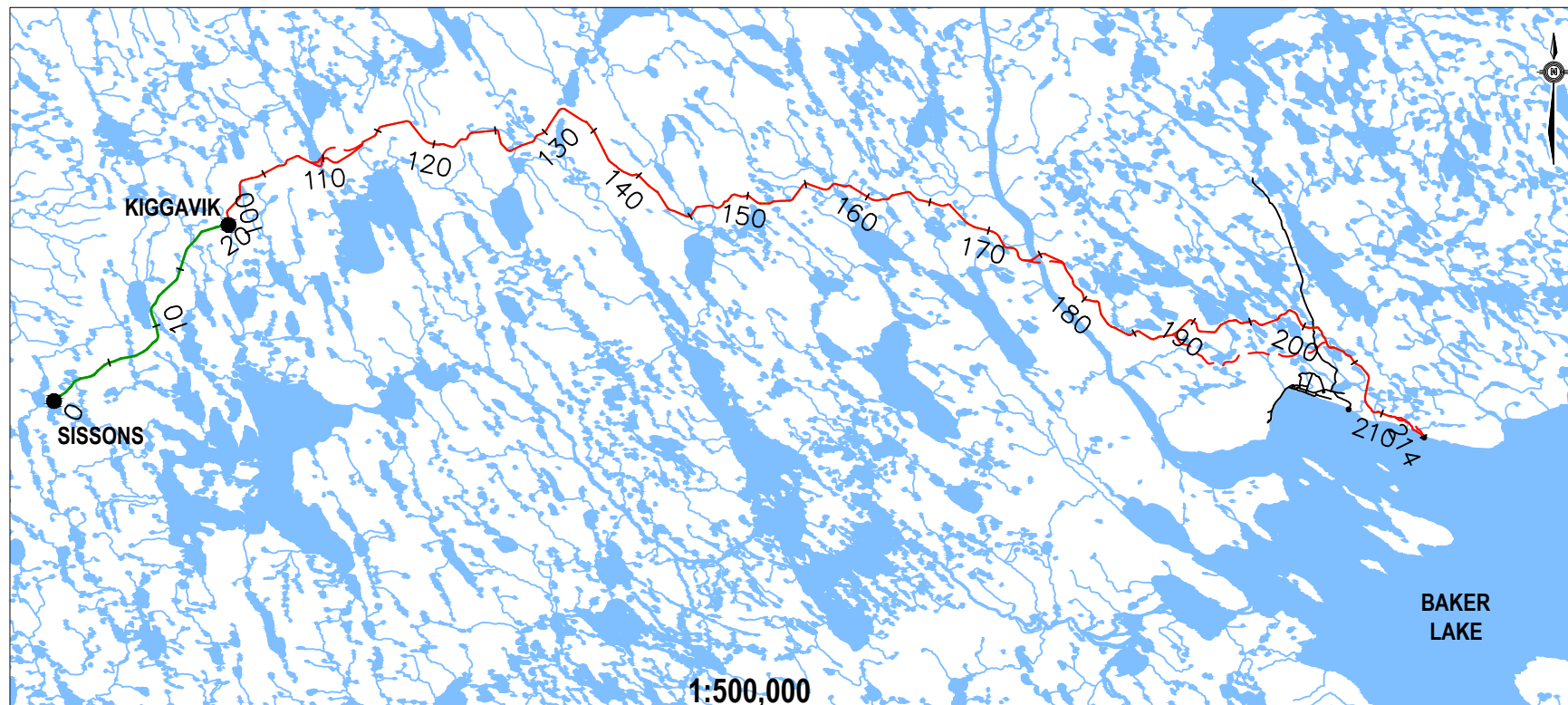


APPENDIX

APPENDIX B NORTHERN ROAD PLAN PROFILES

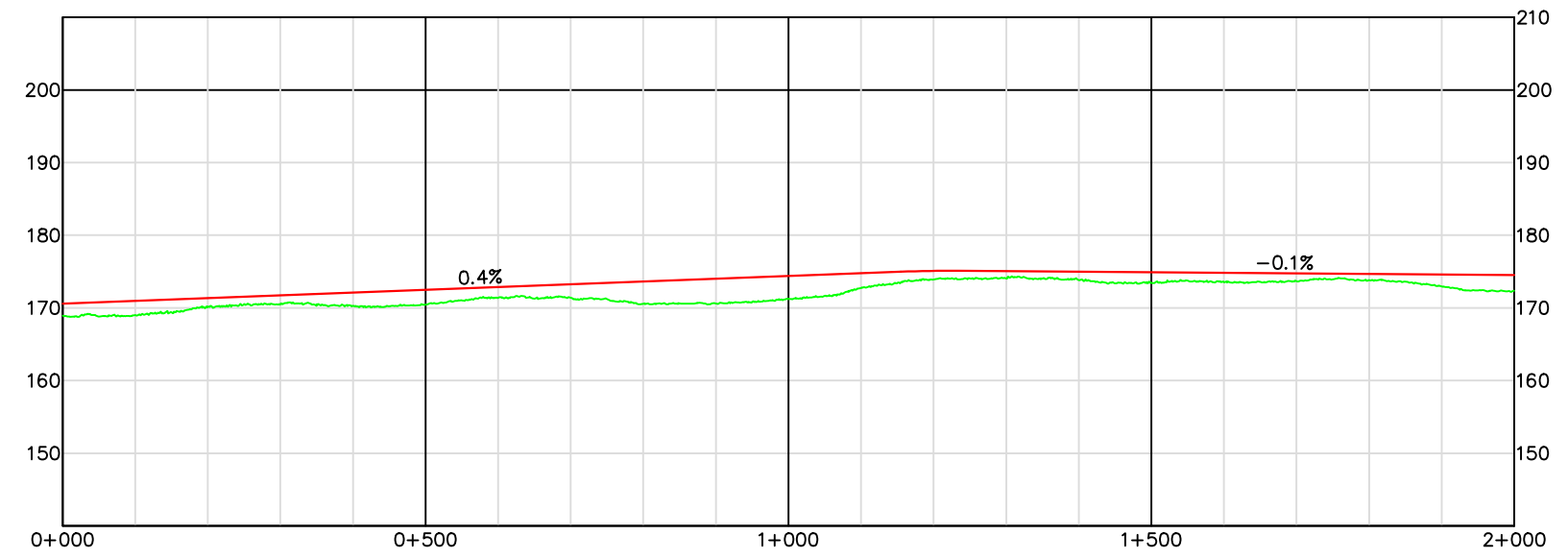


**NORTHERN ALL SEASON ROAD
DEIS PLAN / PROFILE
KIGGAVIK PROJECT**



V33101016

March 2010



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

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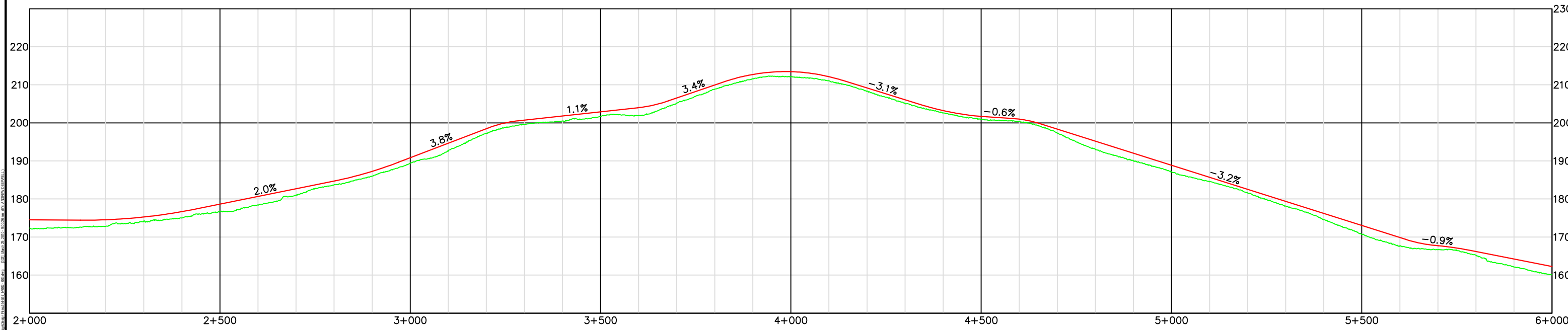
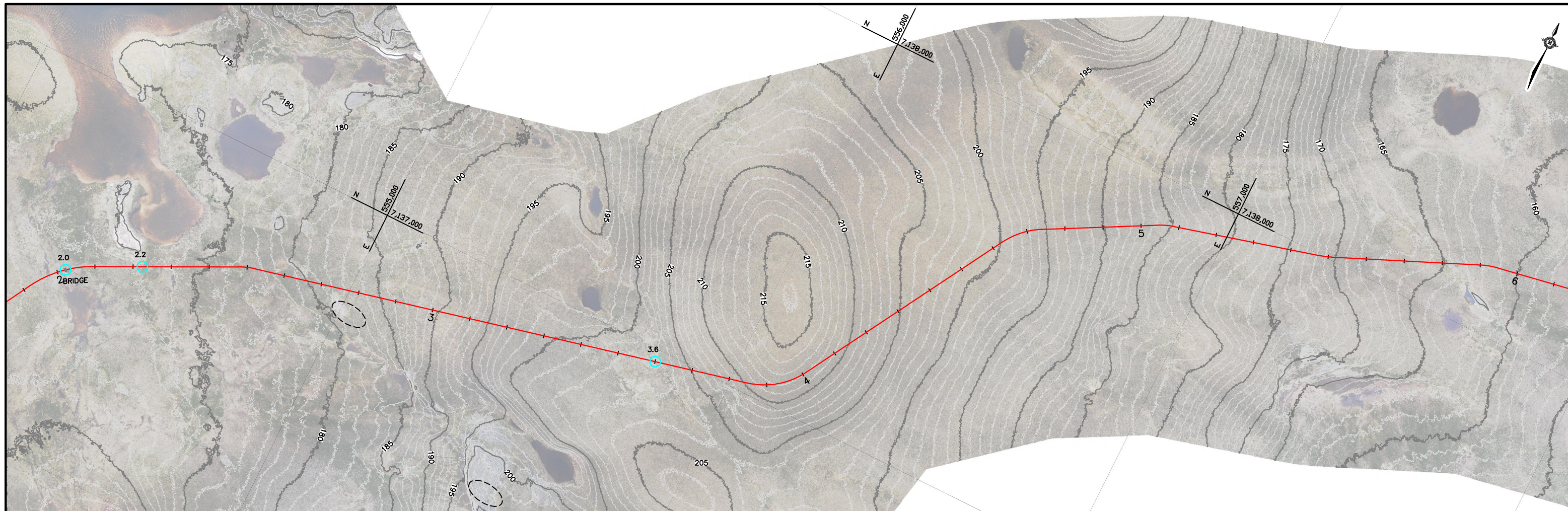
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- Stream Crossing
- Bridge
- Quarry

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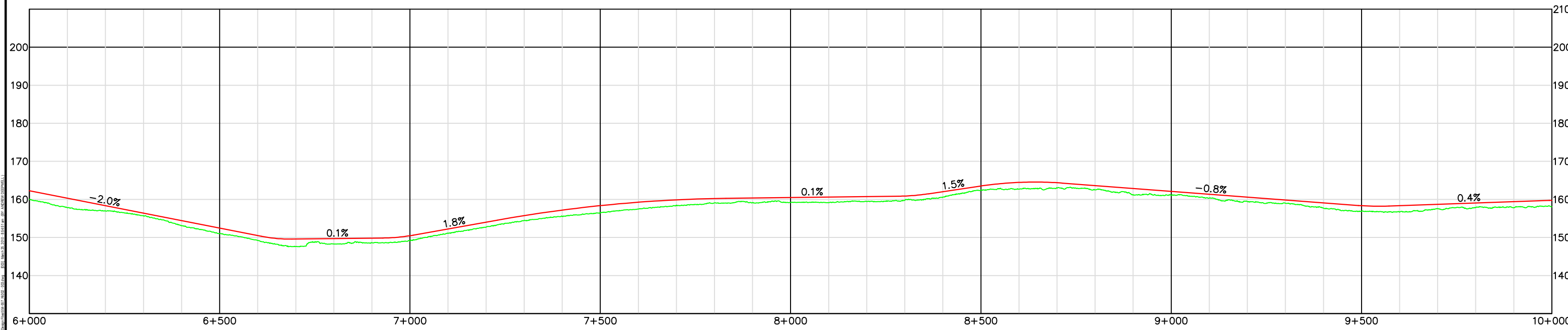
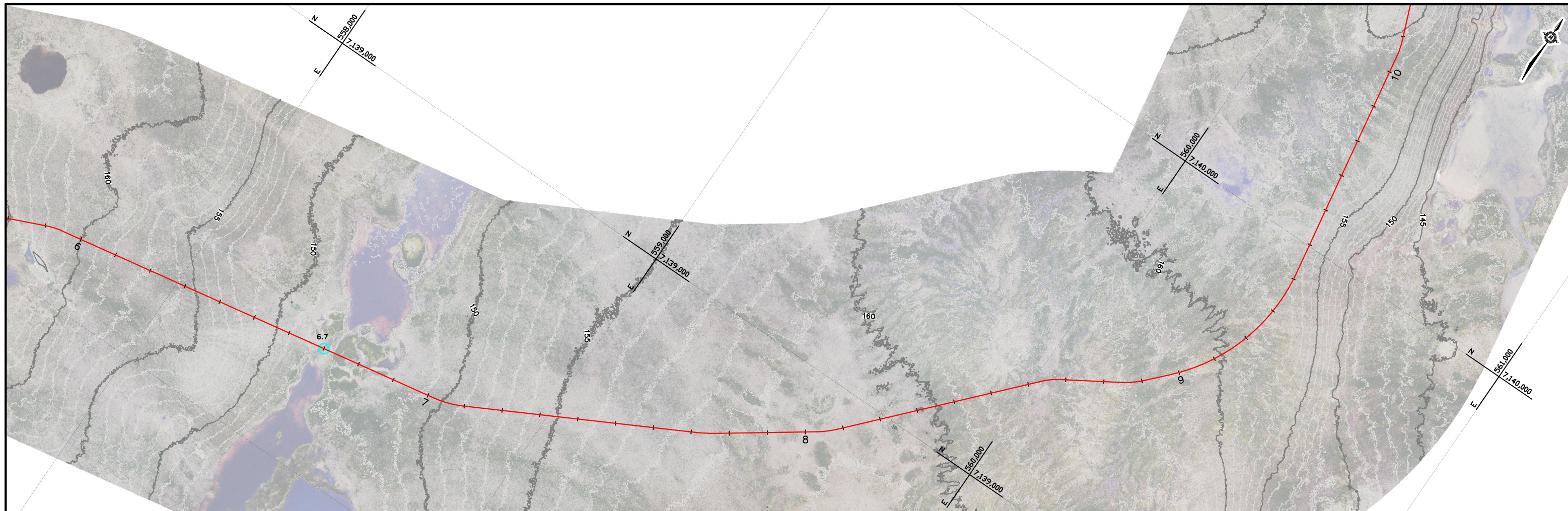
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LEGEND

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- Stream Crossing
- Bridge
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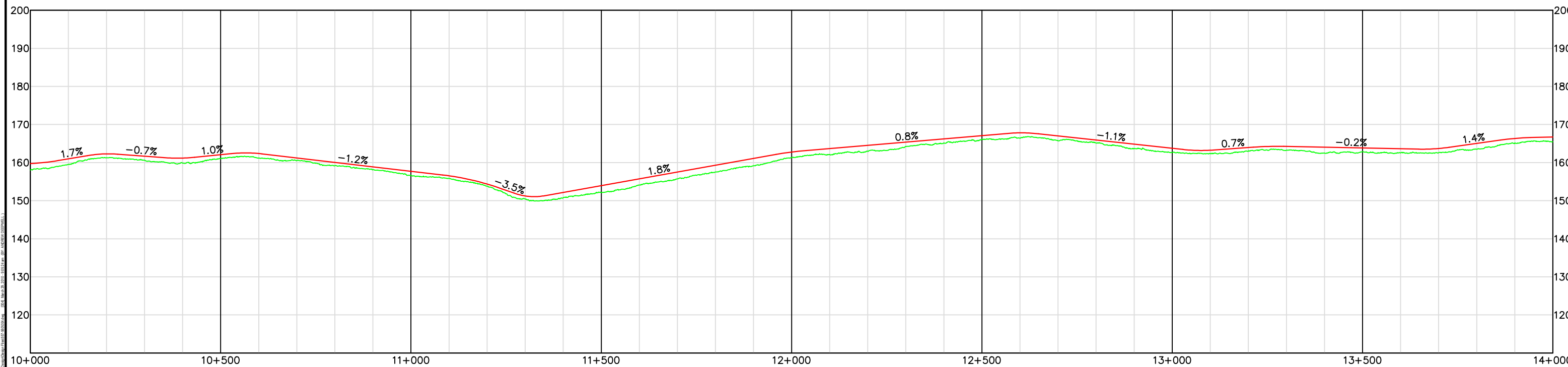
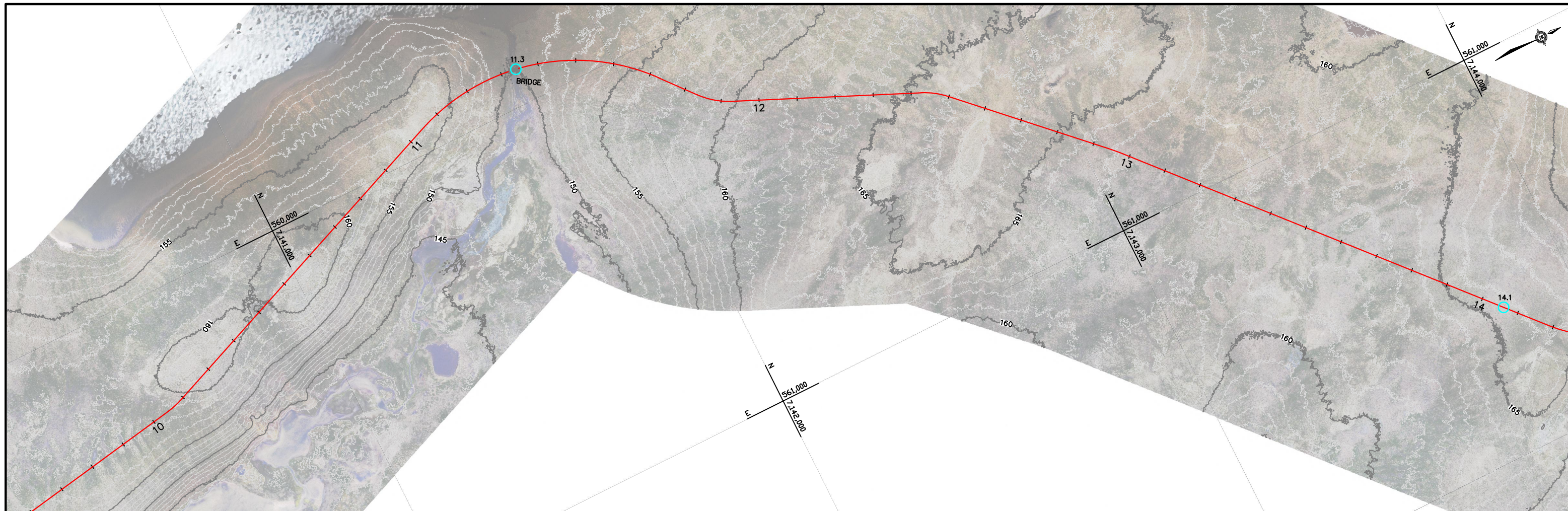
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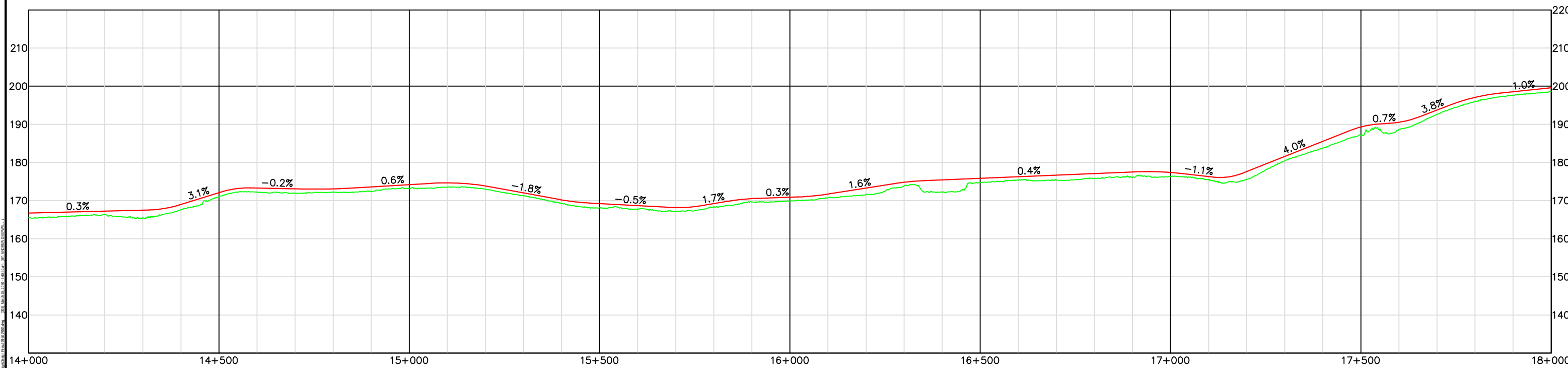
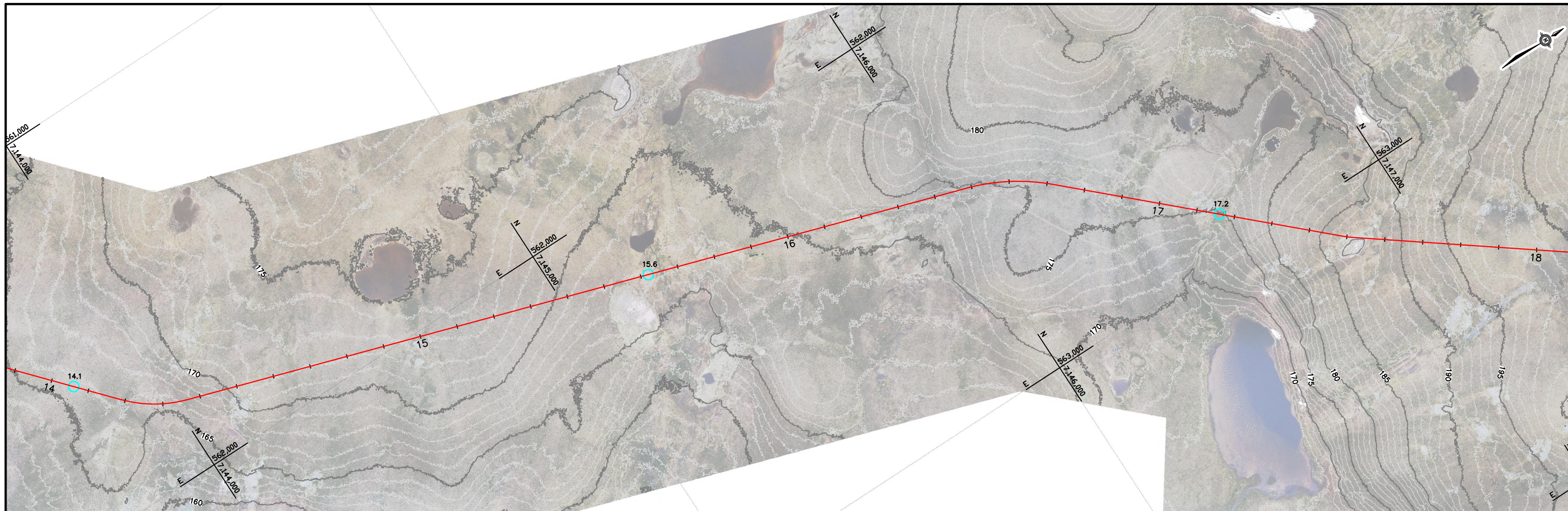
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- Existing Ground
- Stream Crossing
- Bridge
- Quarry

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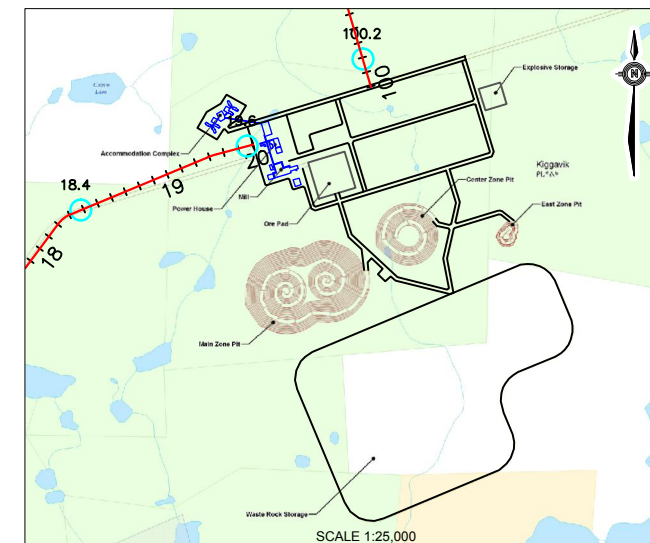
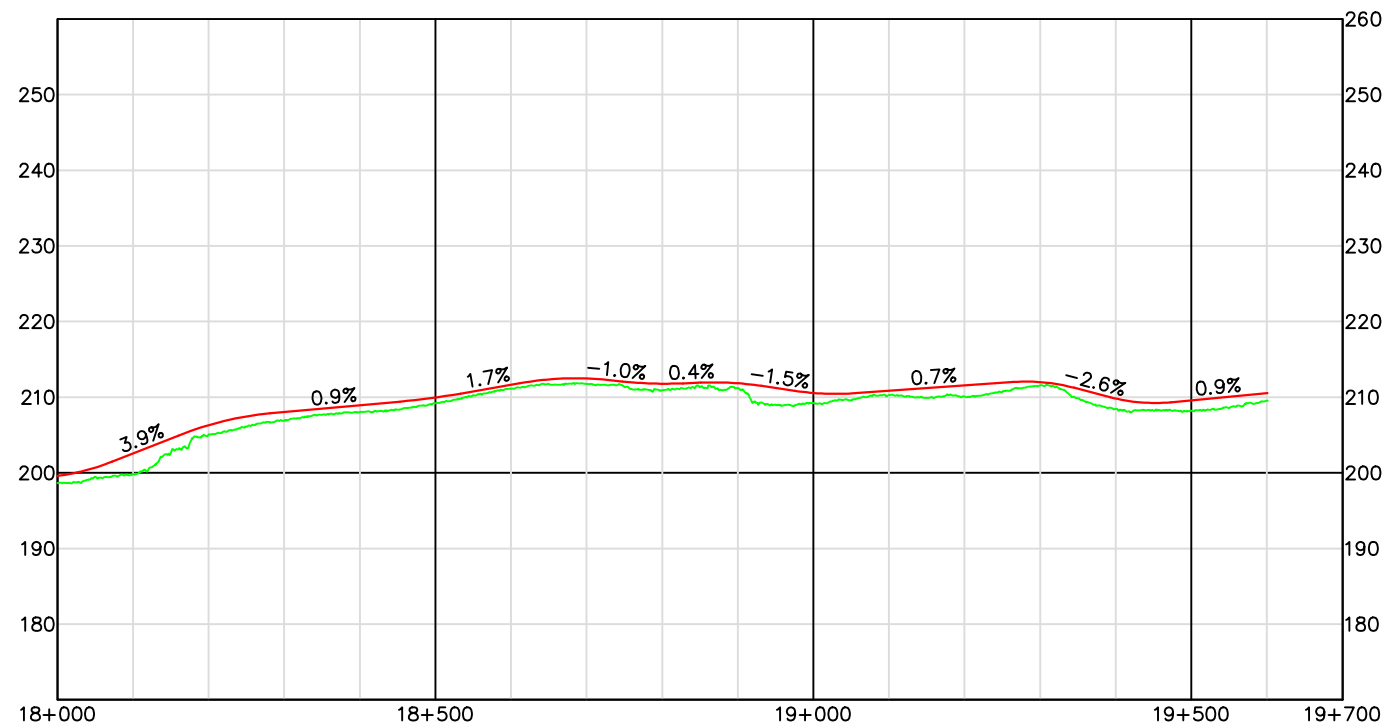
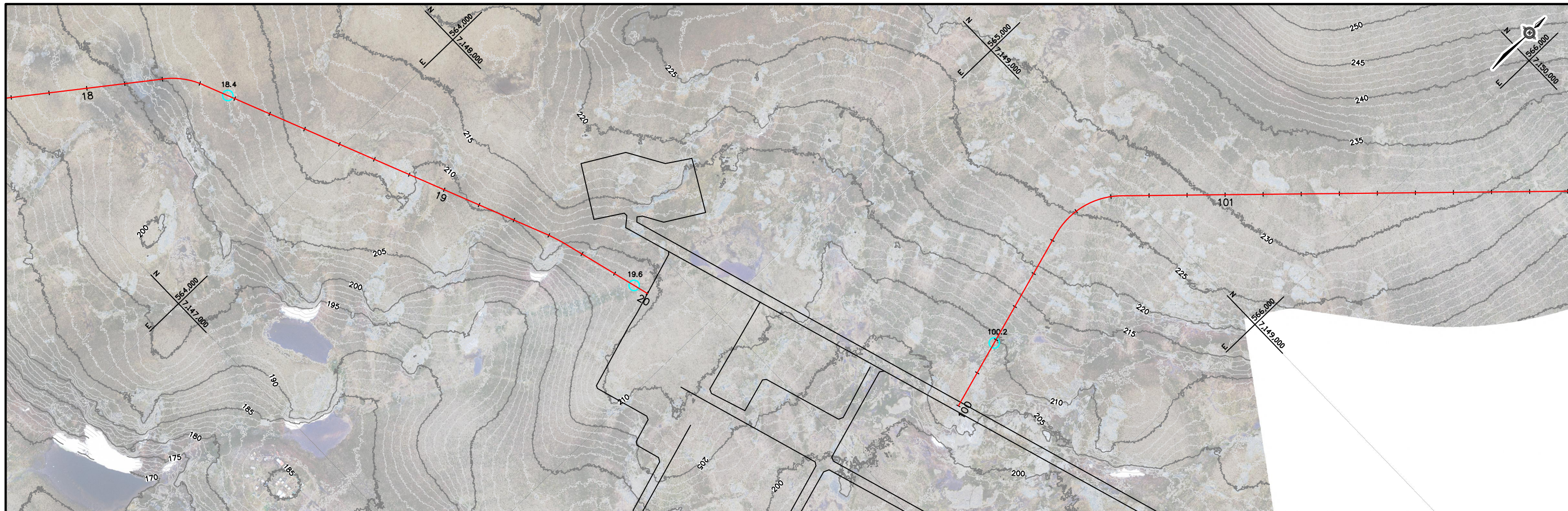
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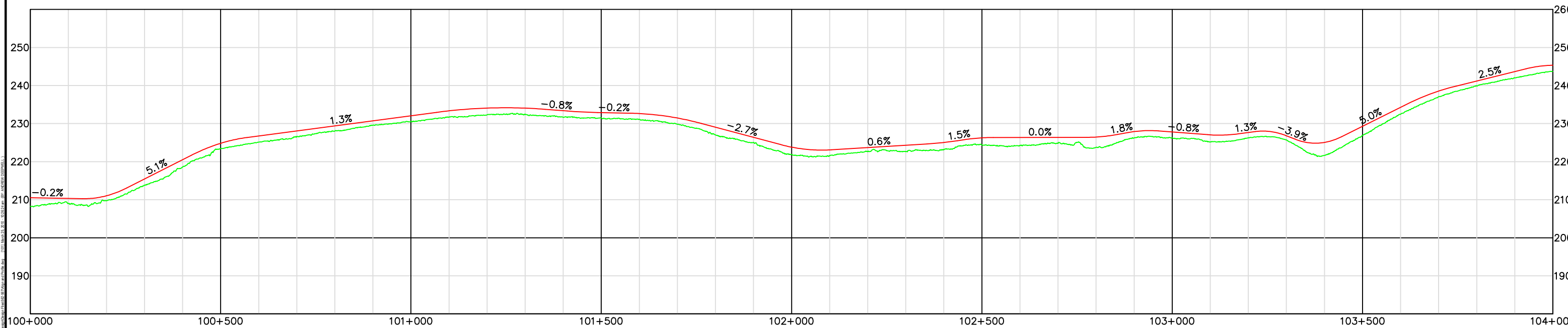
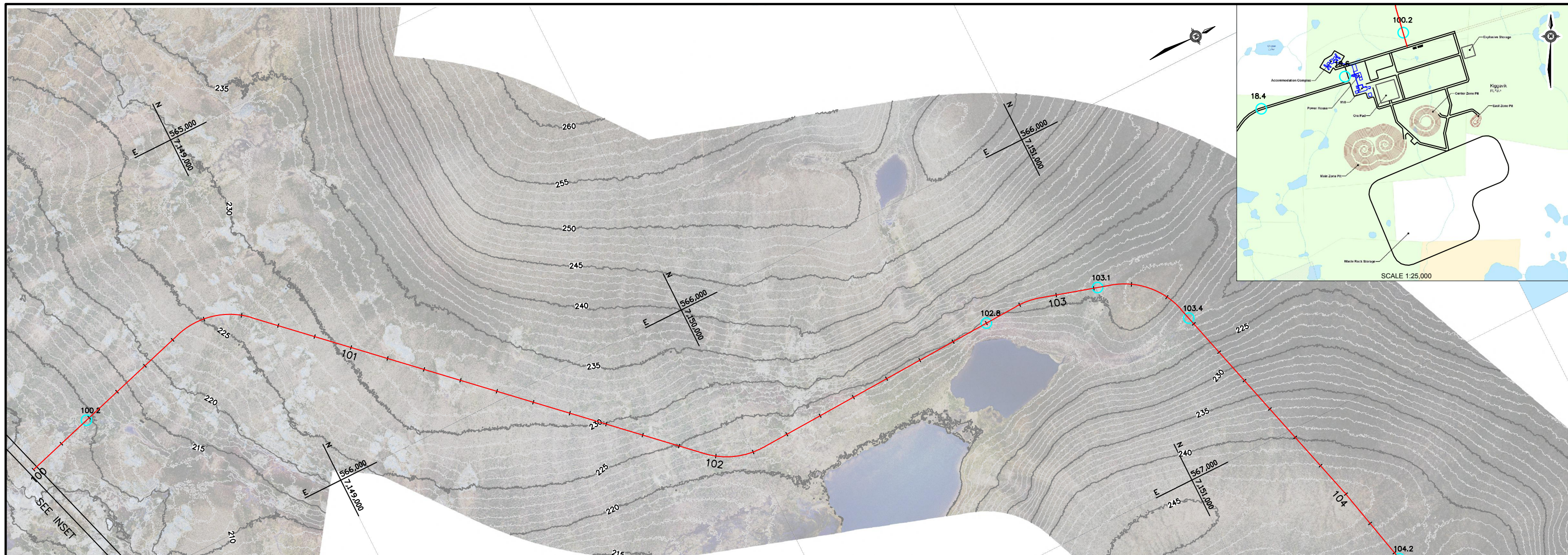
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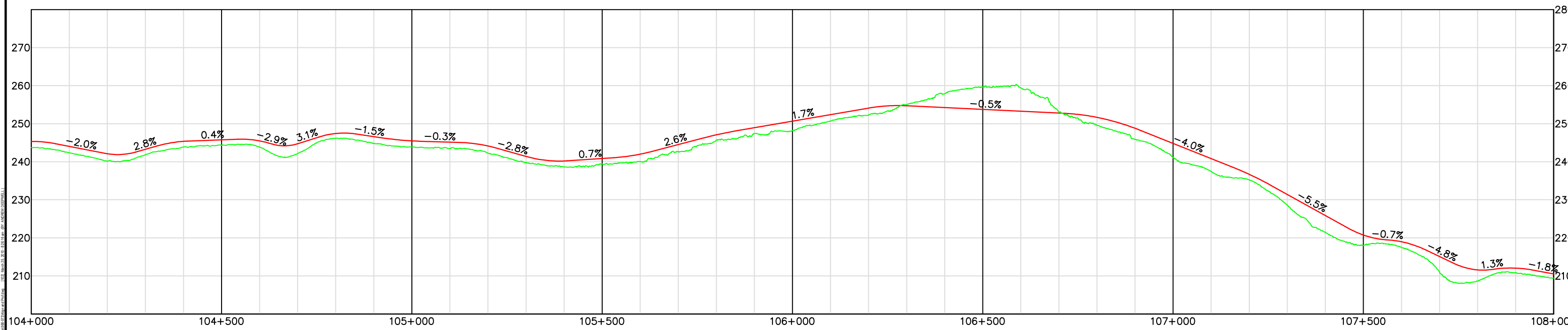
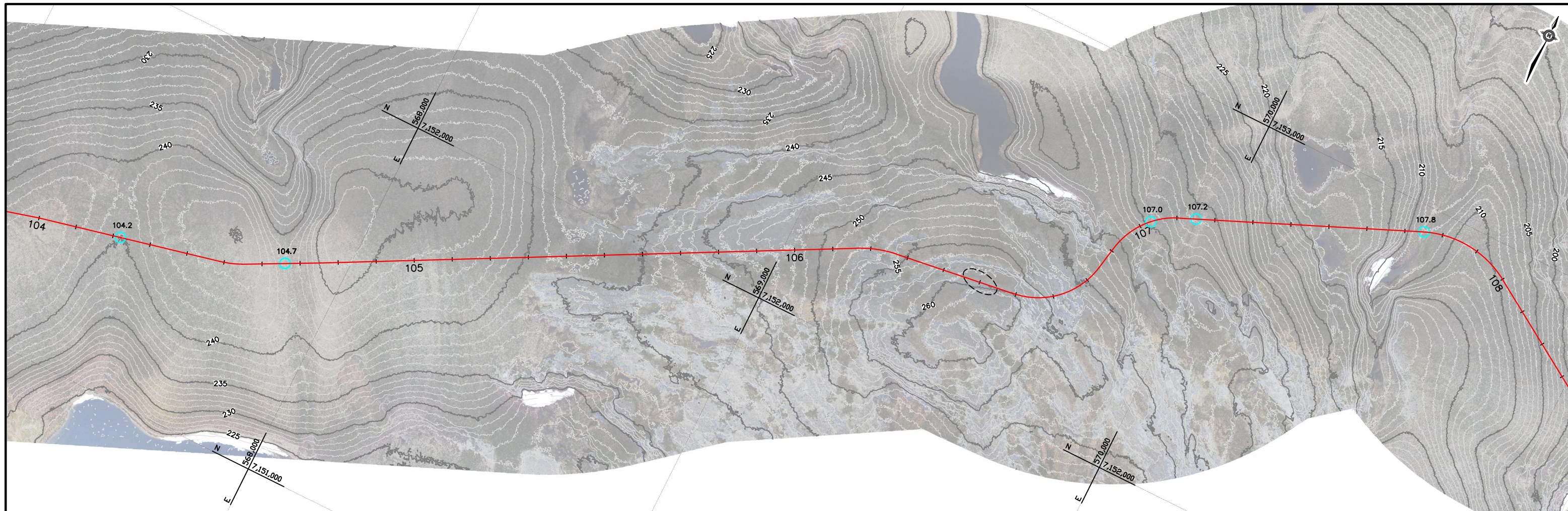
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LEGEND

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- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

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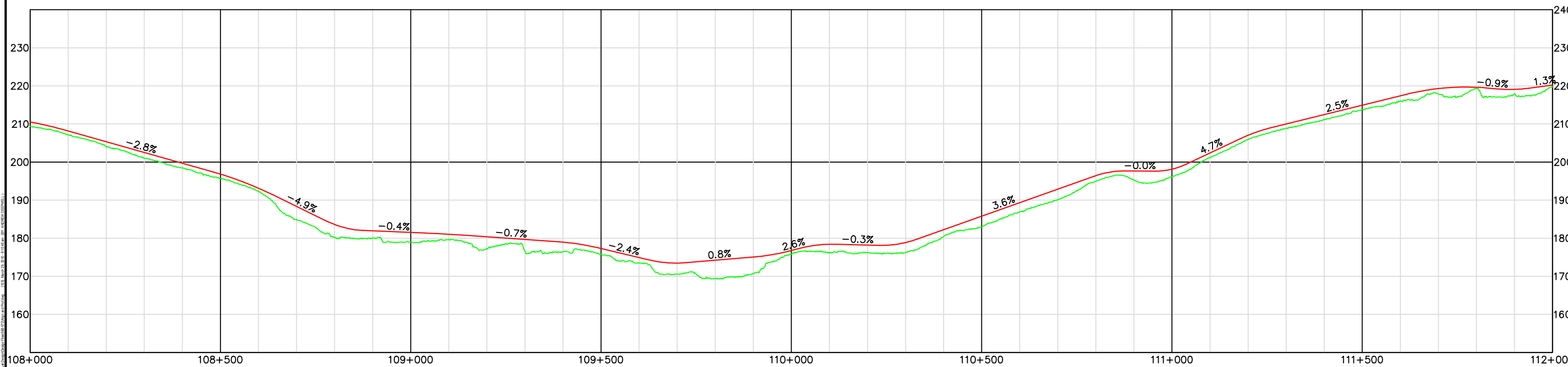
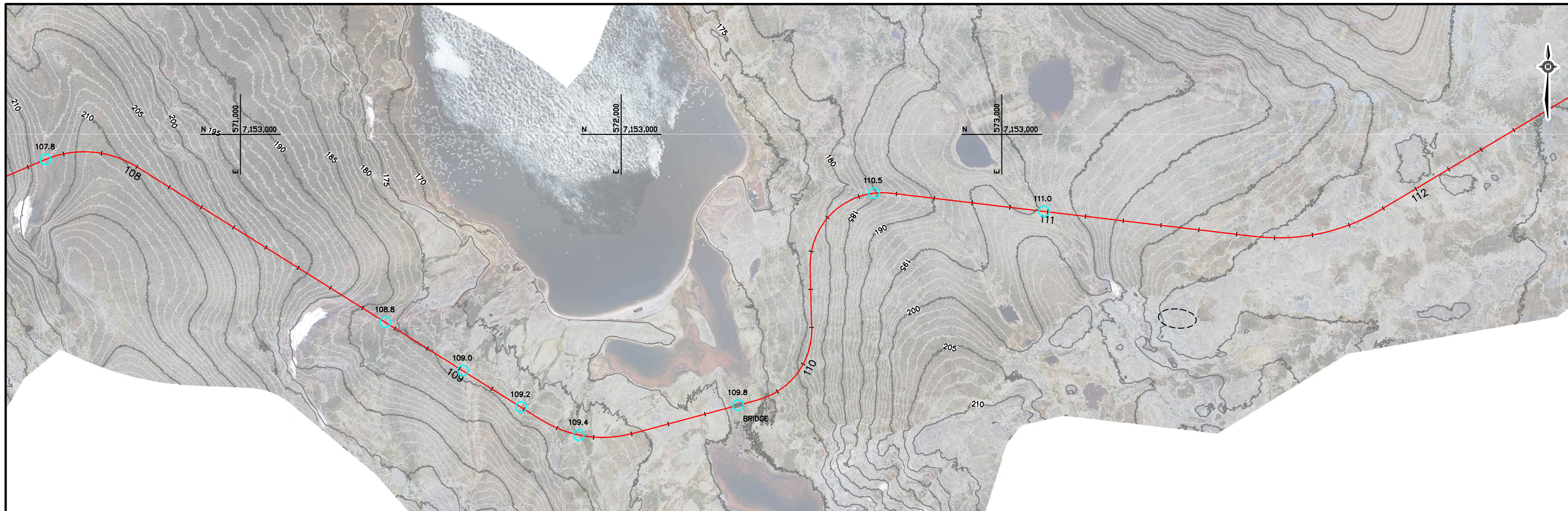
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STA. 104+000 TO STA. 108+000

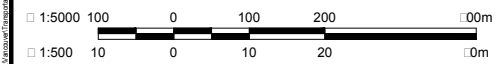
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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING - |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | 102 |

PROFESSIONAL SEAL



LEGEND
 — Alignment/Profile
 — Existing Ground
 ○ Stream Crossing
 □ Bridge
 ○ Quarry
 Ortho photo & Contour data provided by LSI, Summer 2009

HALF SIZE



| REVISIONS | | | | DRAWING STATUS | | | | | |
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| NUM | DATE | DWN | CKD | APR | DESCRIPTION | NUM | DATE | APR | DESCRIPTION |
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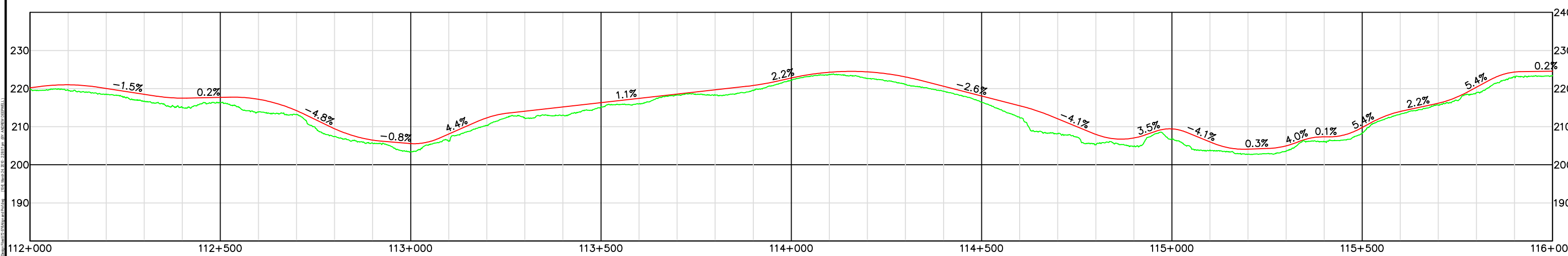
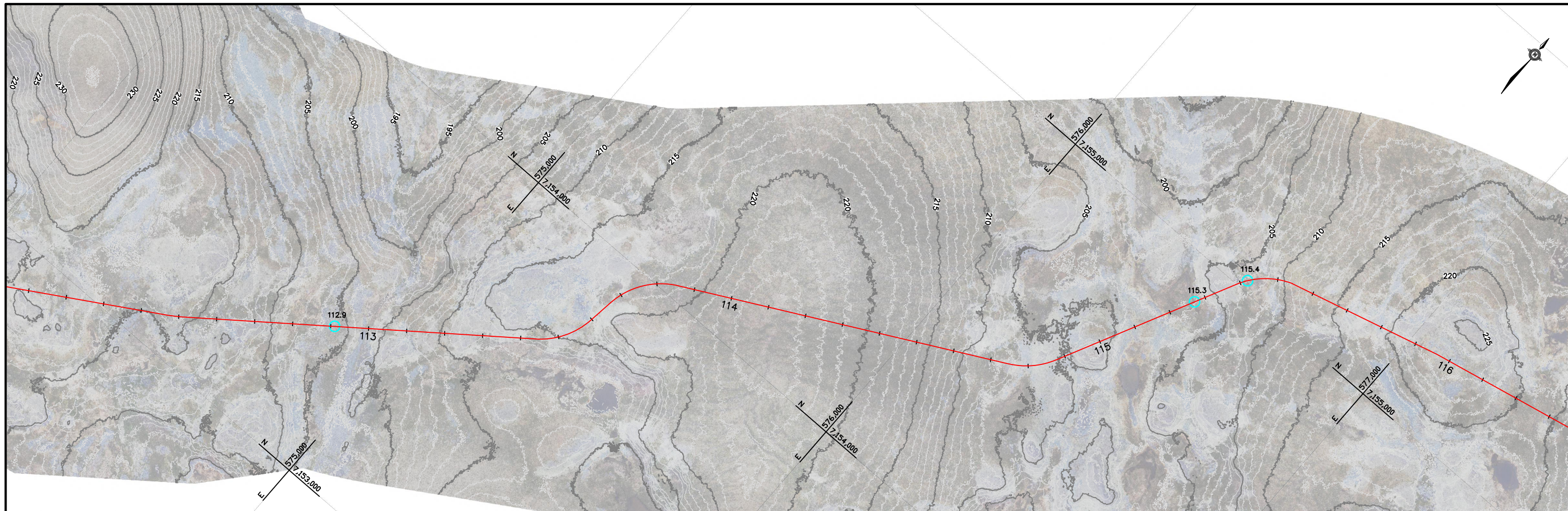
CLIENT

KIGGAVIK PROJECT
 CIVIL INFRASTRUCTURE REPORT

DEIS
 PLAN / PROFILE
 STA. 108+000 TO STA. 112+000

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|--------------------------|-----------------|------------|------------|-------------|----------------|
| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 103 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

EBA Engineering Consultants Ltd.



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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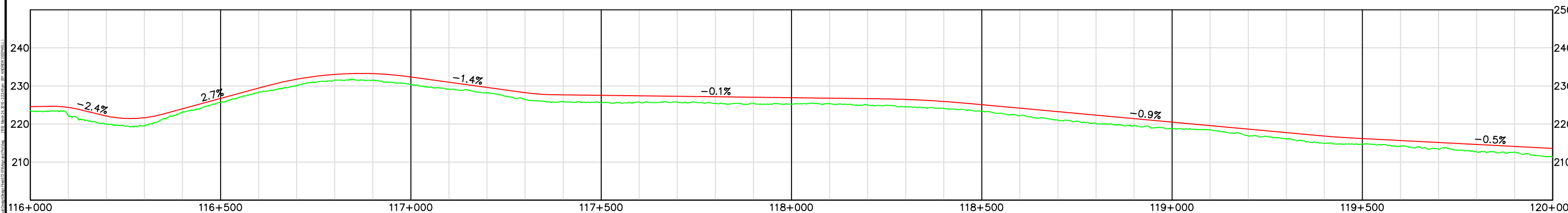
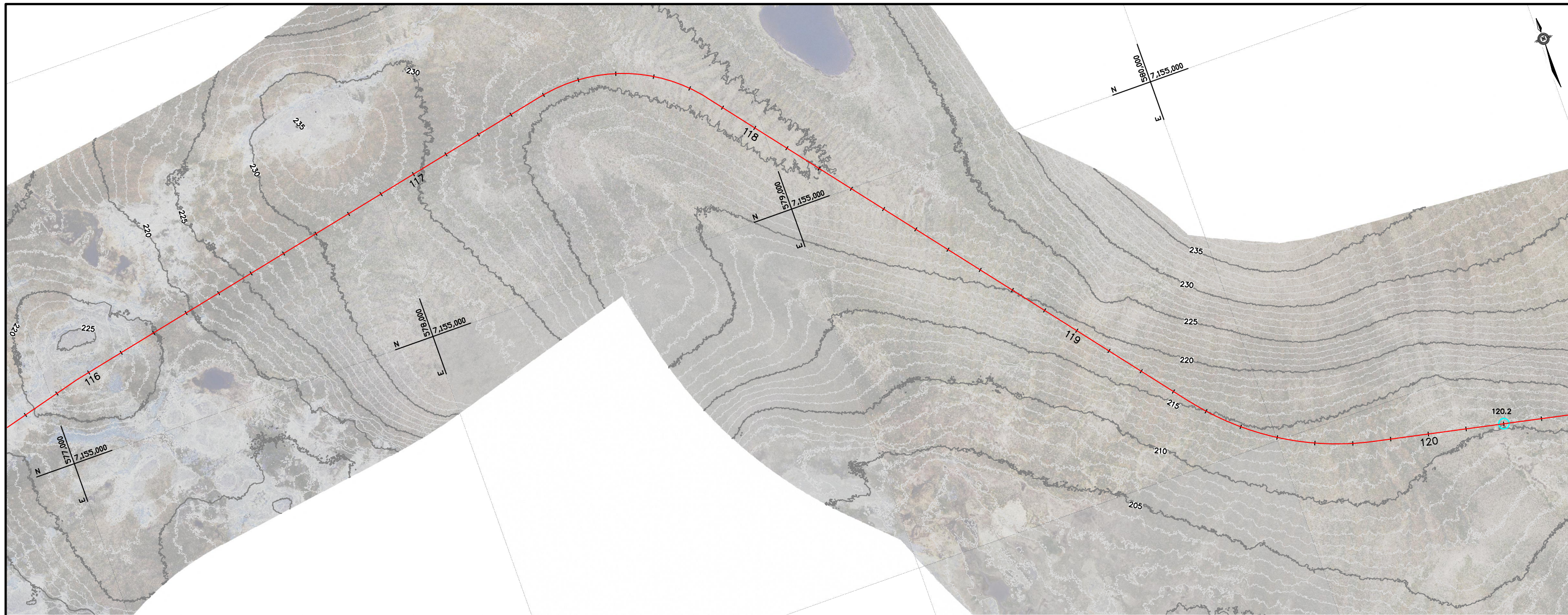
AREVA

EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 112+000 TO STA. 116+000

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| PROJECT No. | OFFICE | DES | CKD | REV | DRAWING |
| V33101016 | VANC | DCD | GEW | - | 104 |
| DATE: | SHEET No. | DWN | APP | STATUS | |
| March 2010 | of | AJD | GEW | A | |



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

Scale: 1:5000 (0, 100, 200, 00m) and 1:500 (0, 10, 20, 0m)

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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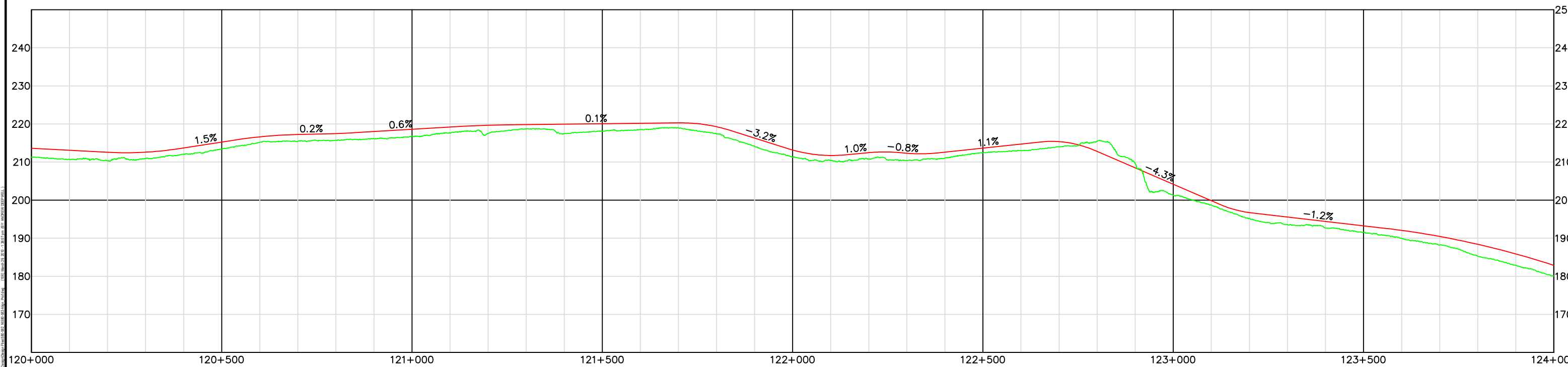
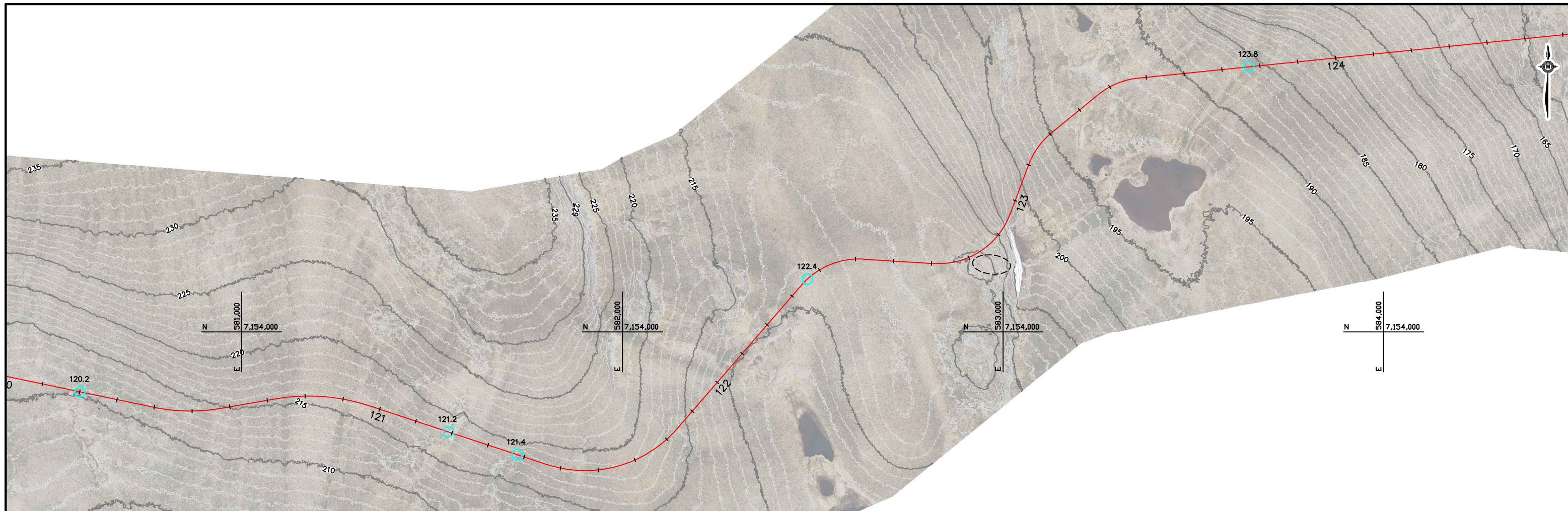
CLIENT

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 116+000 TO STA. 120+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 105 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

EBA Engineering Consultants Ltd.



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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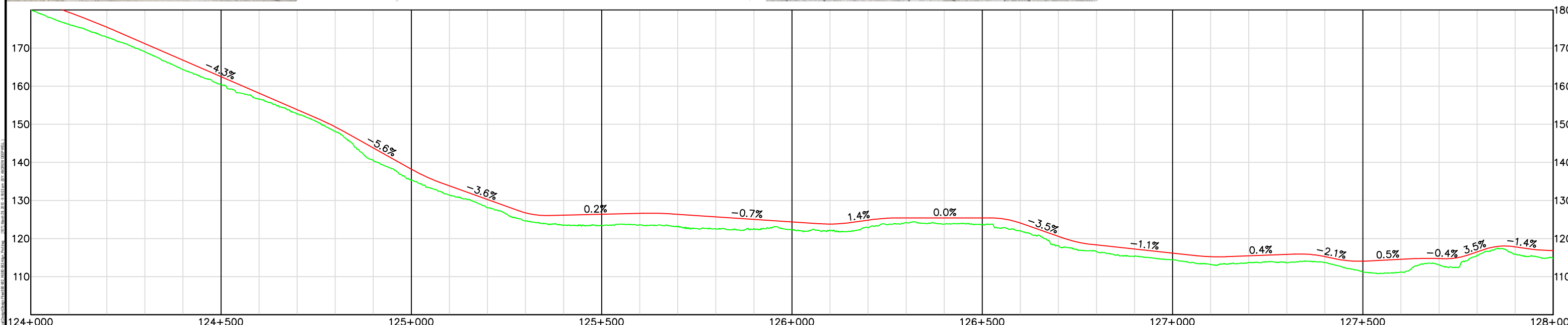
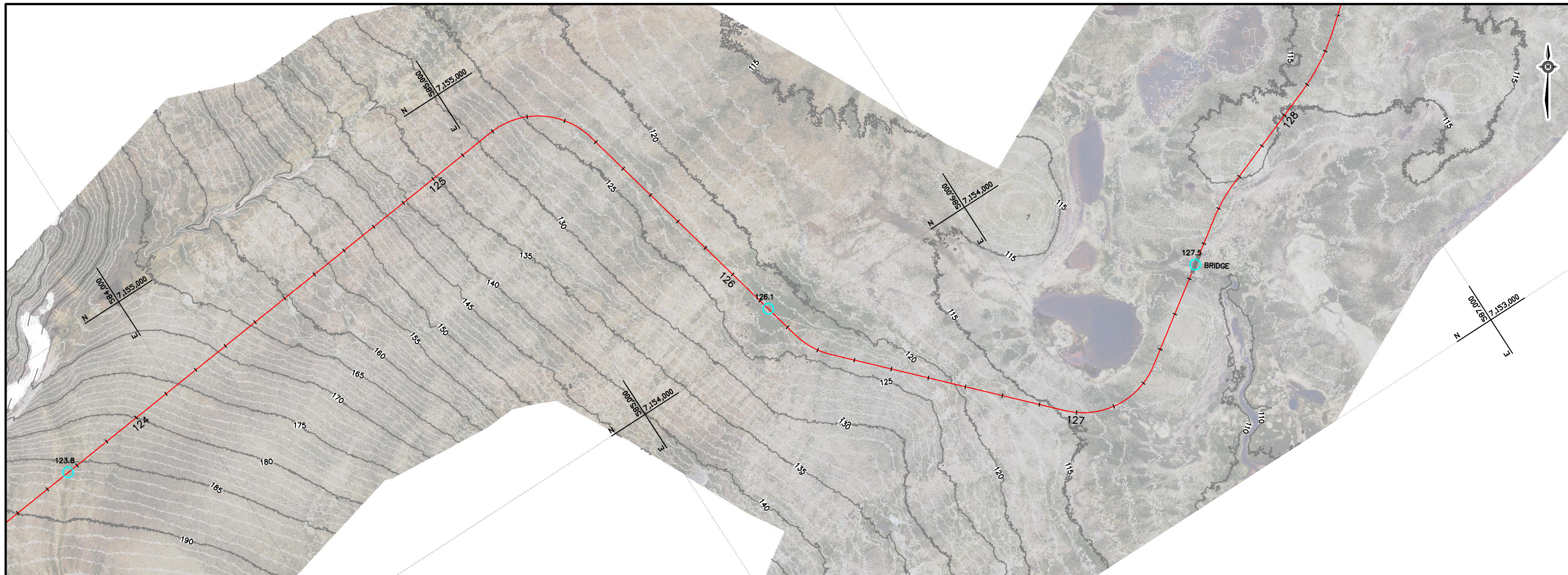
CLIENT

EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 120+000 TO STA. 124+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 106 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | |
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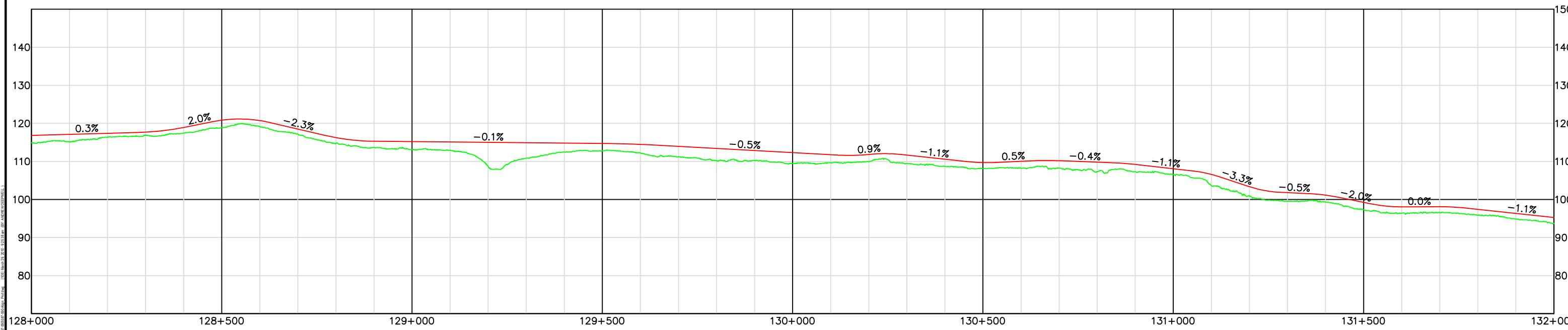
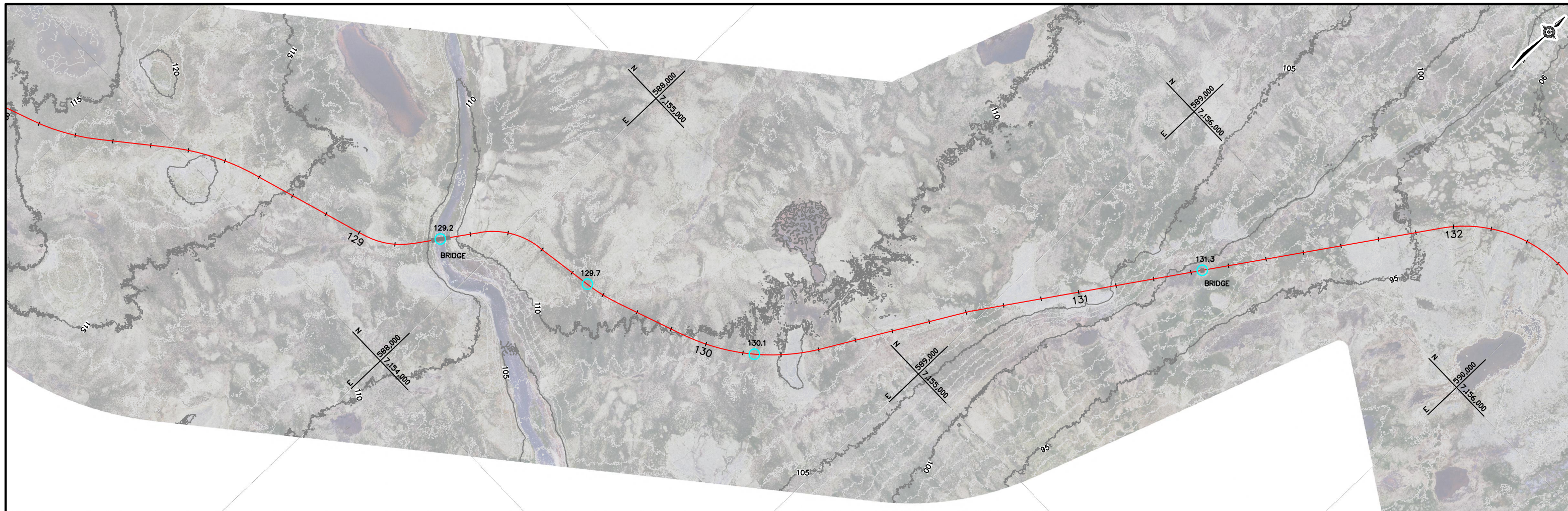
CLIENT

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 124+000 TO STA. 128+000

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|--------------------------|-----------------|------------|------------|-------------|----------------|
| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 107 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

EBA Engineering Consultants Ltd.



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| NUM | DATE | DWN | CKD | APR | DESCRIPTION | NUM | DATE | APR | DESCRIPTION |
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REVISIONS DRAWING STATUS

PROFESSIONAL SEAL

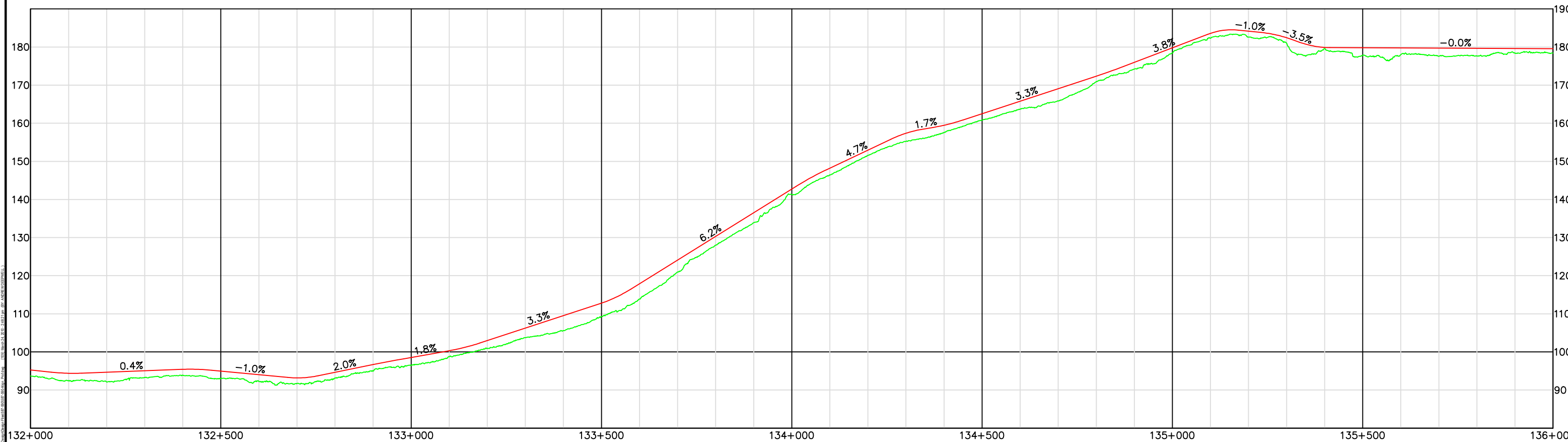
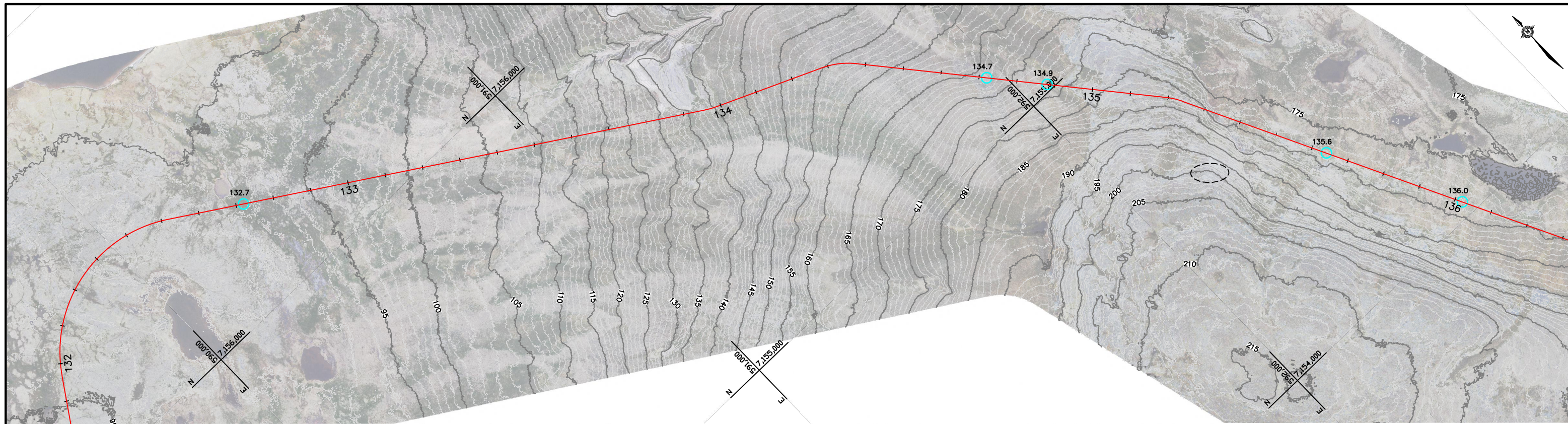
CLIENT

EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 128+000 TO STA. 132+000

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| PROJECT No. | OFFICE | DES | CKD | REV | DRAWING |
| V33101016 | VANC | DCD | GEW | - | |
| DATE: | SHEET No. | DWN | APP | STATUS | |
| March 2010 | of | AJD | GEW | A | 108 |



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:50000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | |
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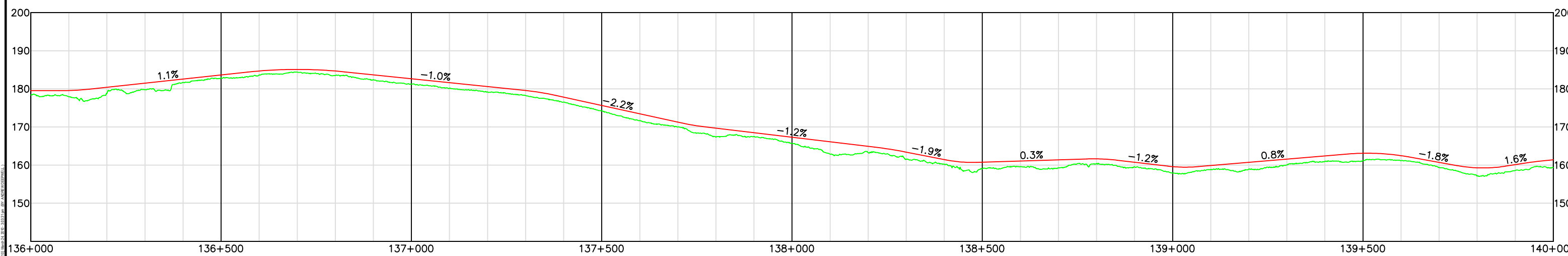
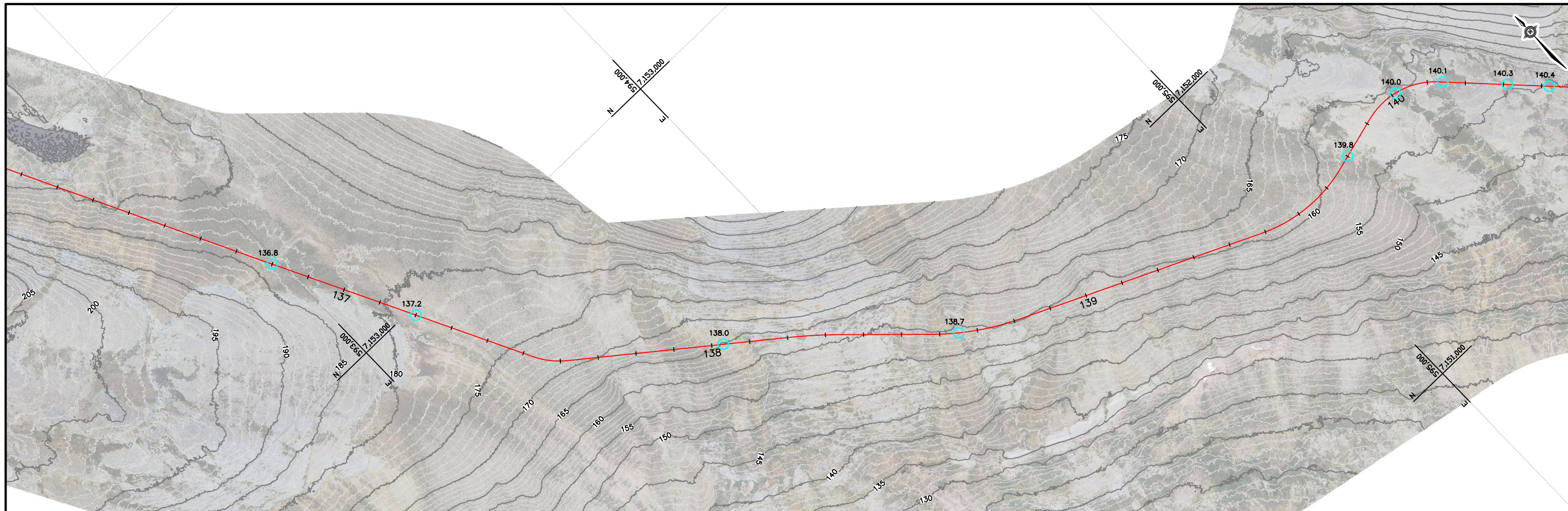
KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 132+000 TO STA. 136+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING - |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | DRAWING 109 |

EBA Engineering Consultants Ltd.

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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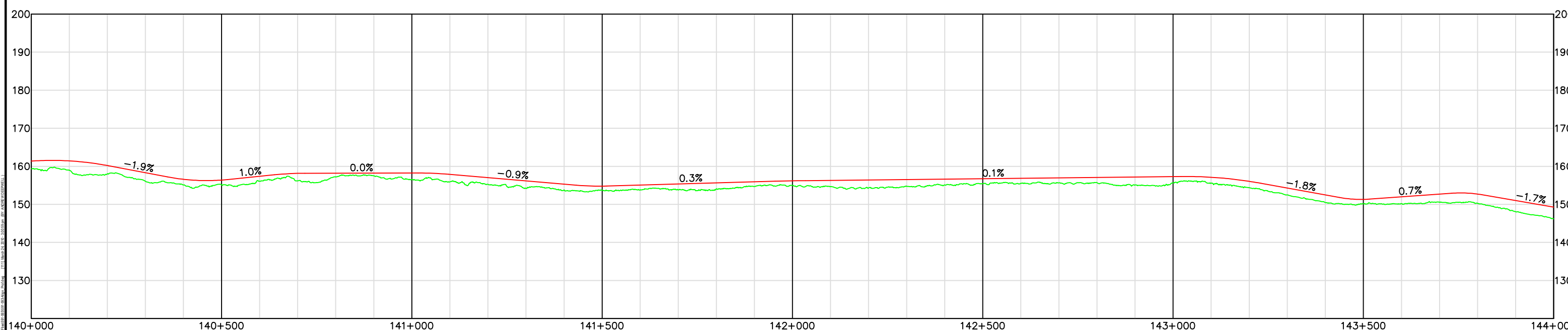
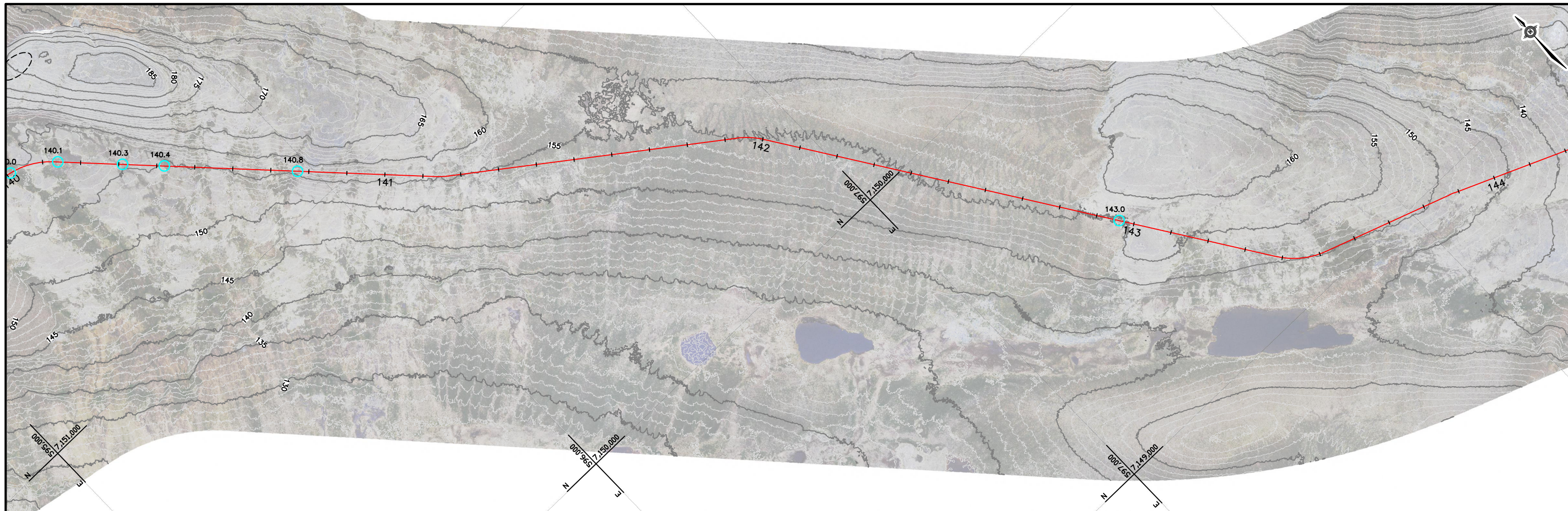
AREVA

EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 136+000 TO STA. 140+000

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| PROJECT No. | OFFICE | DES | CKD | REV | DRAWING |
| V33101016 | VANC | DCD | GEW | - | |
| DATE: | SHEET No. | DWN | APP | STATUS | |
| March 2010 | of | AJD | GEW | A | 110 |



LEGEND

- Alignment Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | |
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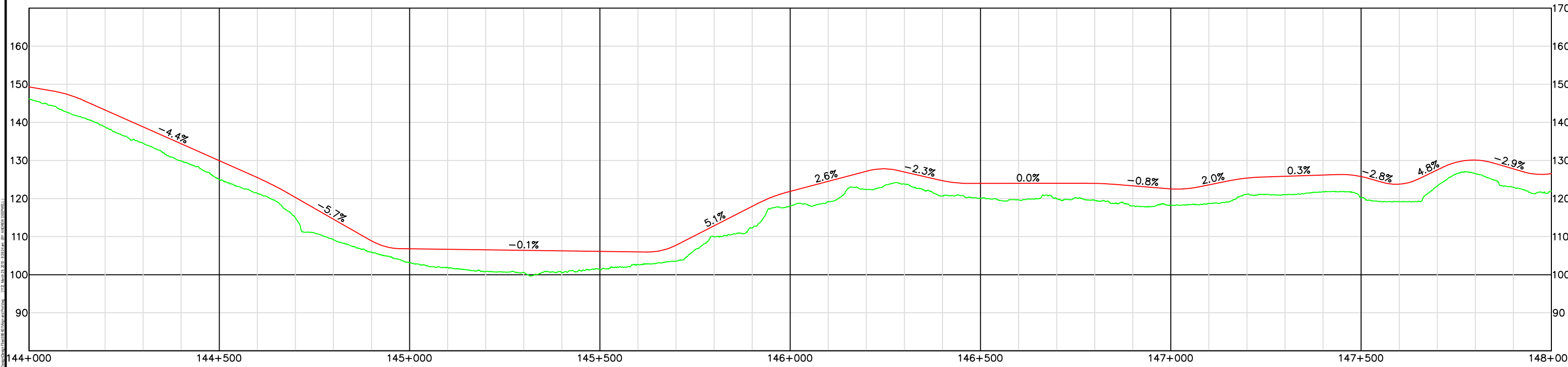
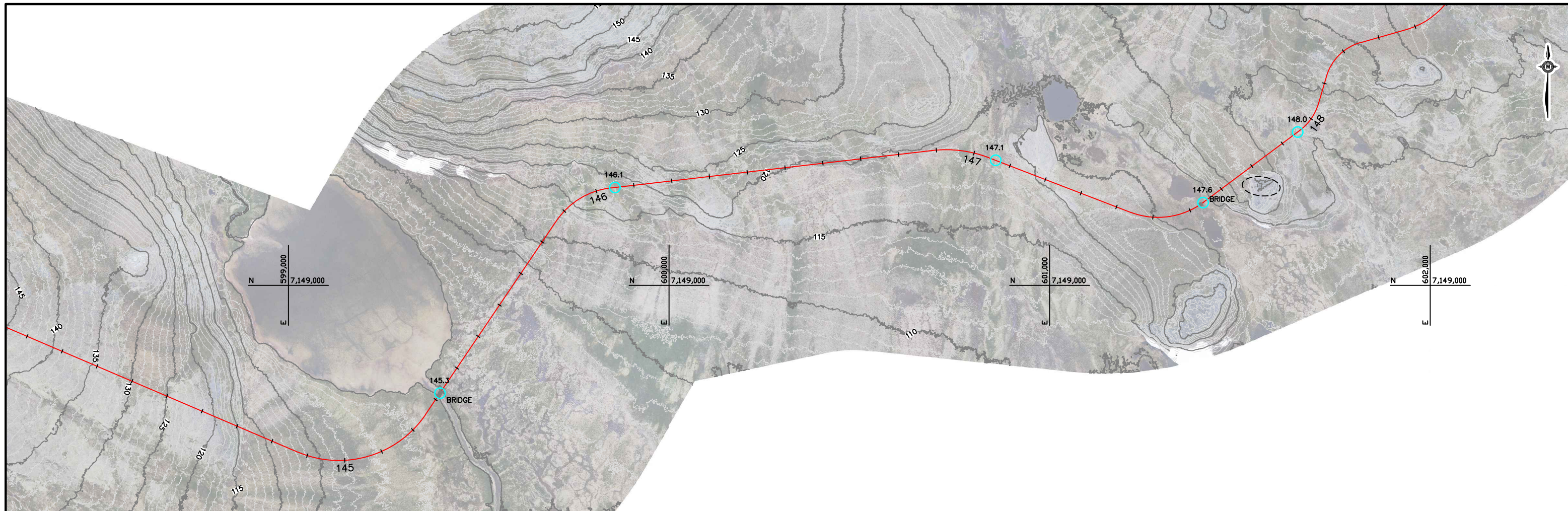
EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 140+000 TO STA. 144+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 111 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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| NUM | DATE | DWN | CKD | APR | DESCRIPTION | NUM | DATE | APR | DESCRIPTION |
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CLIENT

AREVA

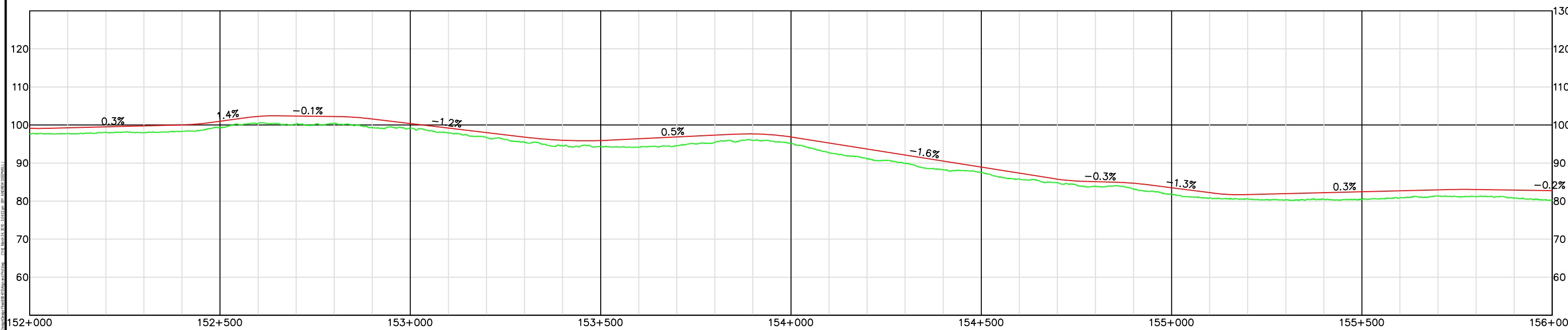
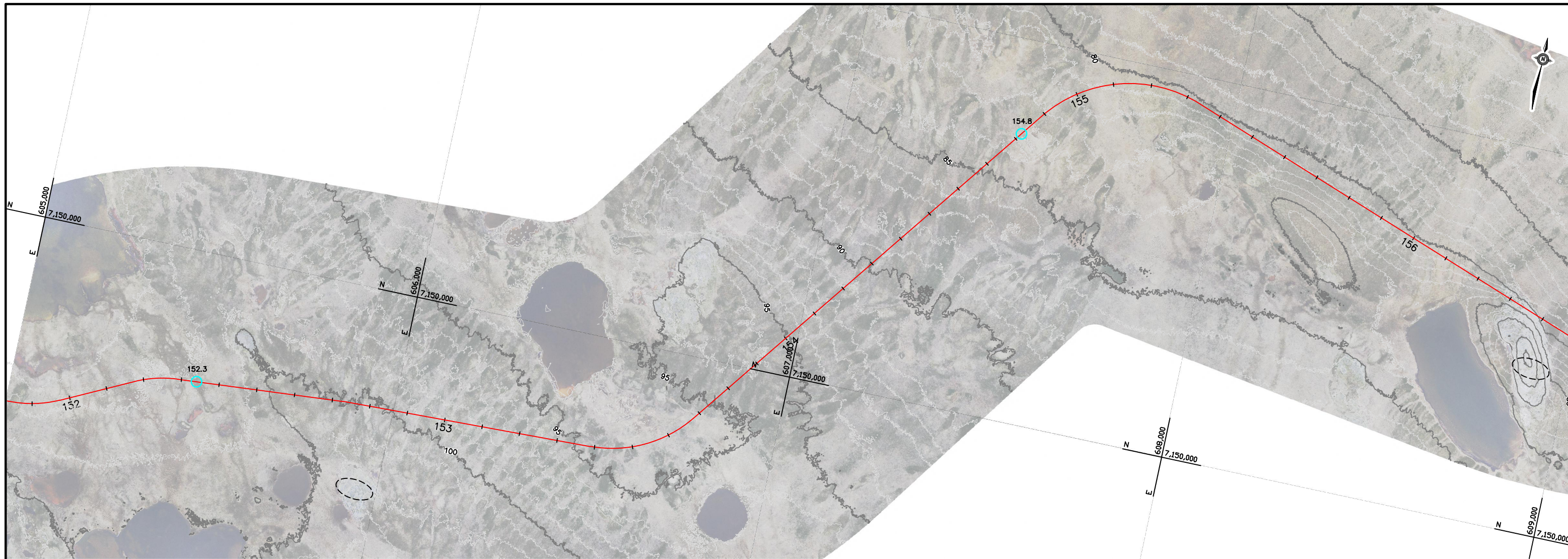
EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT

DEIS PLAN / PROFILE STA. 144+000 TO STA. 148+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING |
| DATE: March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | 112 |

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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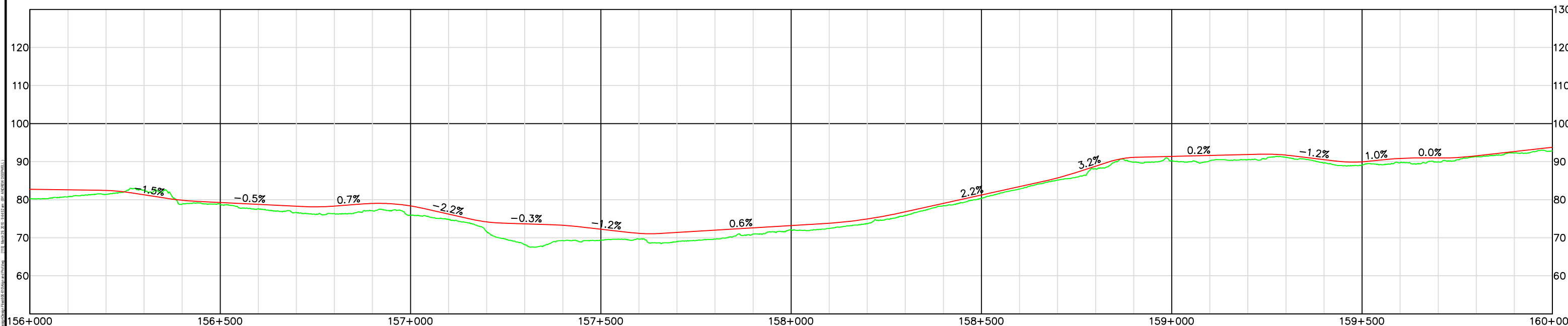
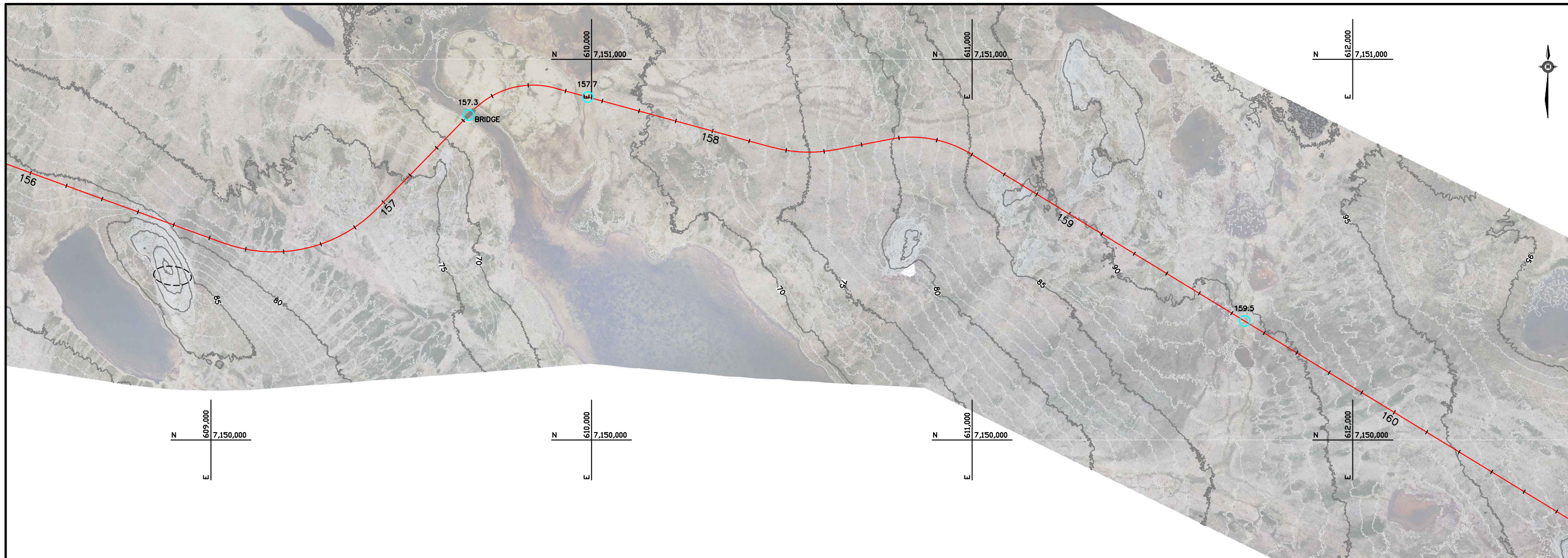
KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 152+000 TO STA. 156+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING - |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | 114 |

EBA Engineering Consultants Ltd.

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

Scale: 1:5000 (0, 100, 200, 00m) and 1:500 (0, 10, 20, 0m)

HALF SIZE

| NUM | DATE | DWN | CKD | APR | DESCRIPTION | NUM | DATE | APR | DESCRIPTION |
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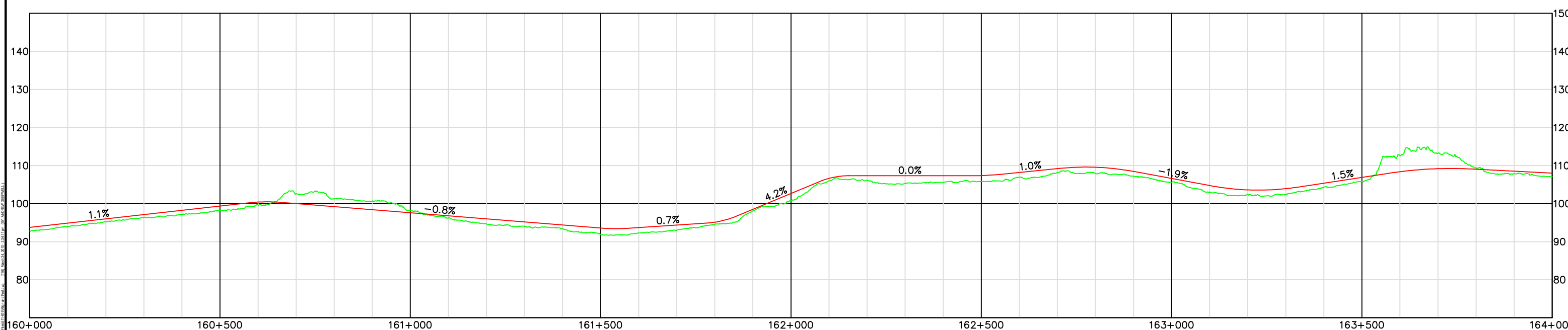
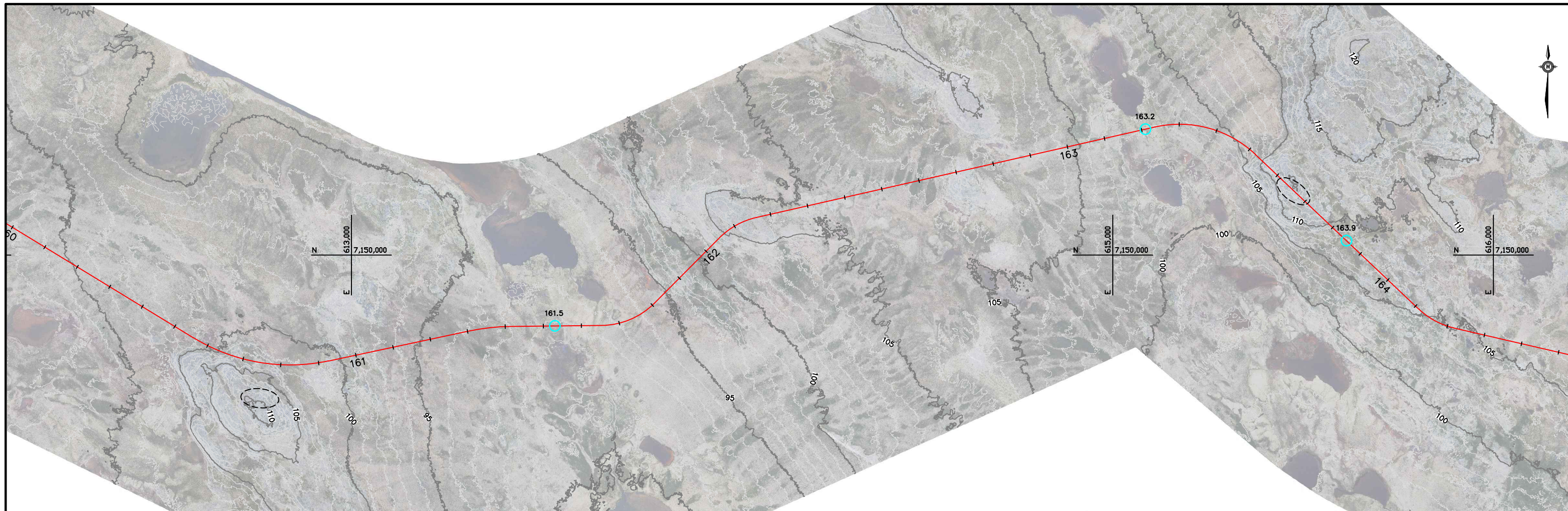
CLIENT

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 156+000 TO STA. 160+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 115 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

EBA Engineering Consultants Ltd.



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| NUM | DATE | DWN | CKD | APR | DESCRIPTION | NUM | DATE | APR | DESCRIPTION |
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CLIENT

AREVA

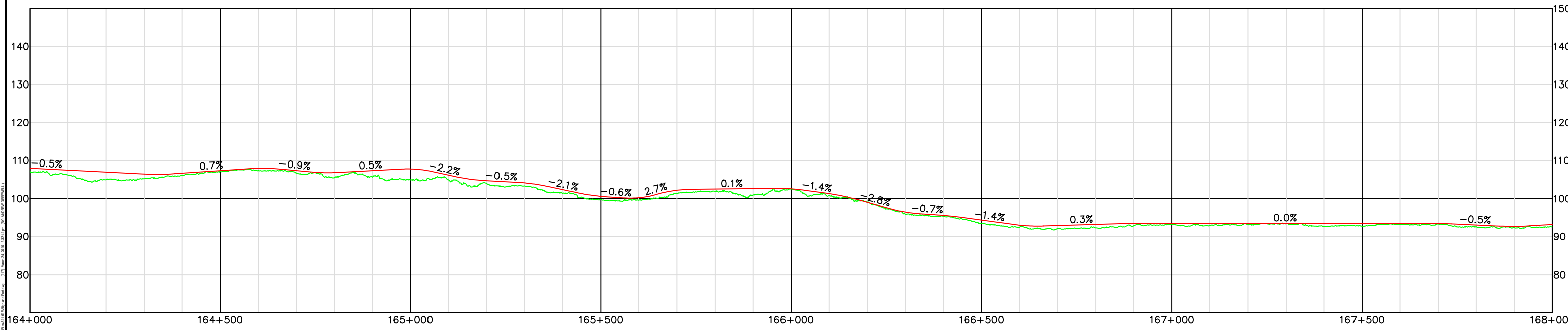
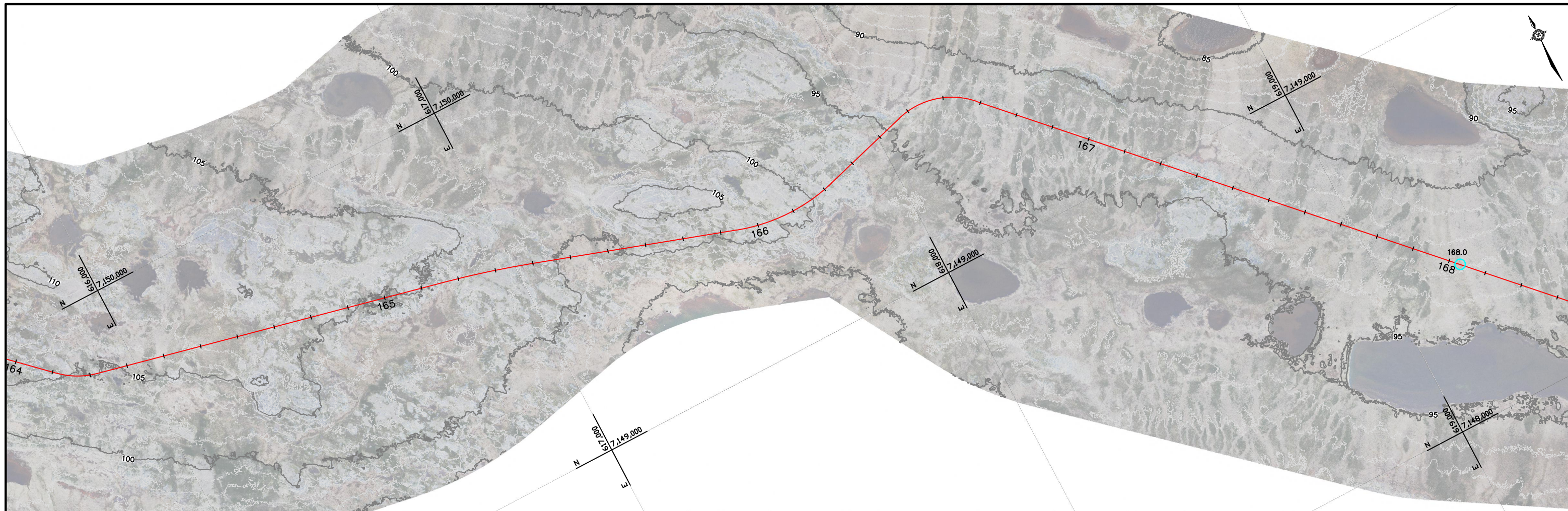
EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 160+000 TO STA. 164+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 116 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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CLIENT

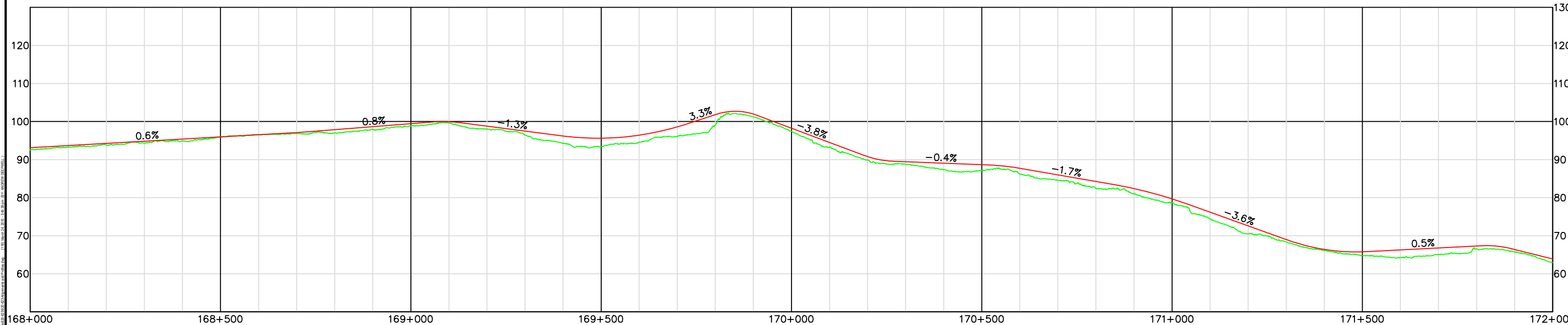
KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 164+000 TO STA. 168+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING - |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | 117 |

EBA Engineering Consultants Ltd.

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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| NUM | DATE | DWN | CKD | APR | DESCRIPTION | NUM | DATE | APR | DESCRIPTION |
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CLIENT

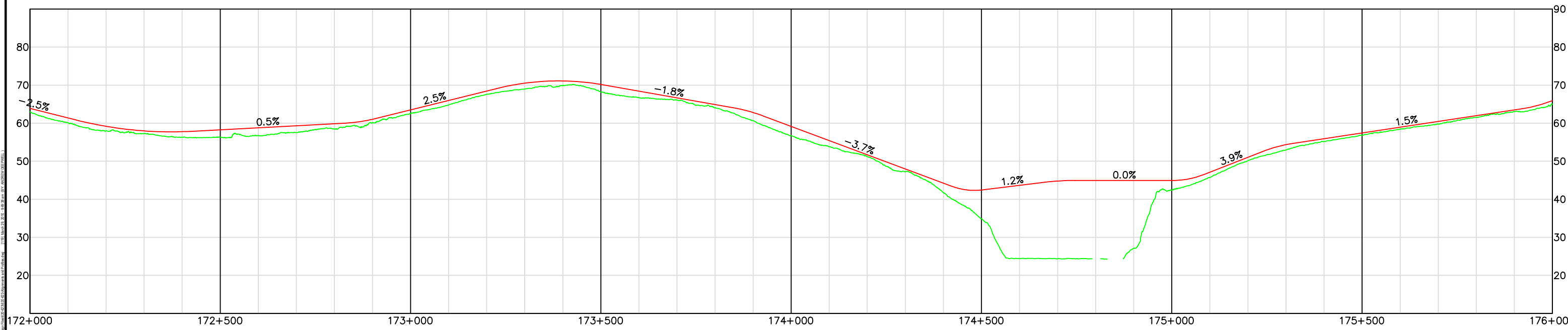
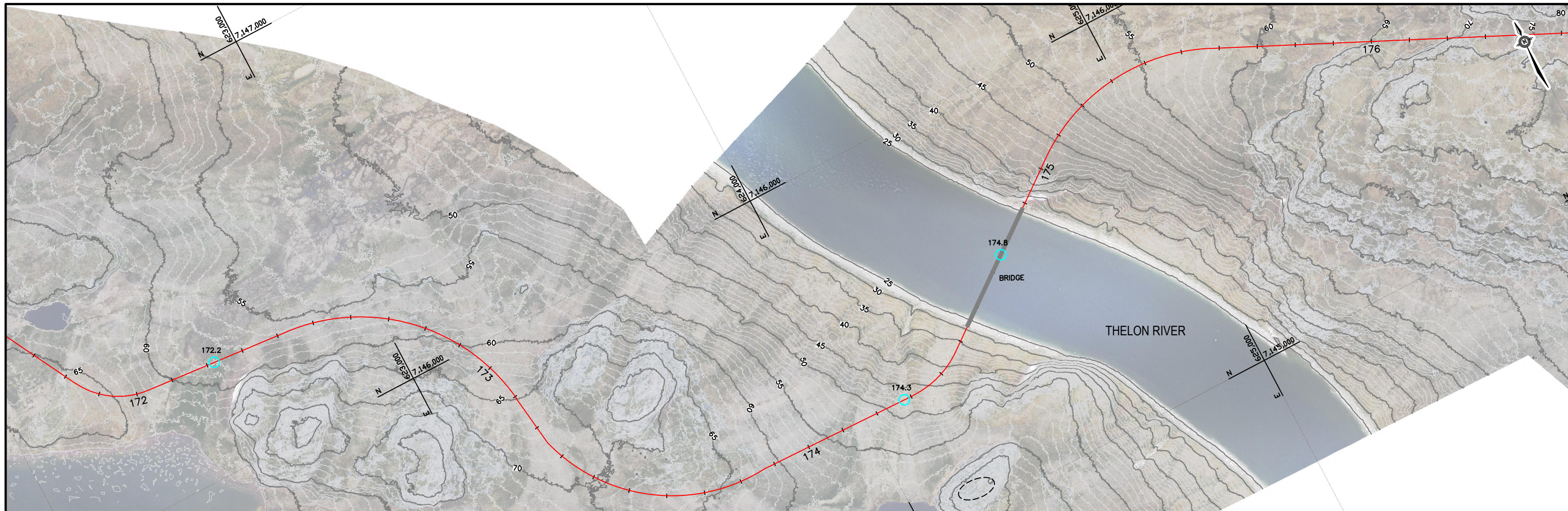
EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 168+000 TO STA. 172+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING - |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | 118 |

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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CLIENT

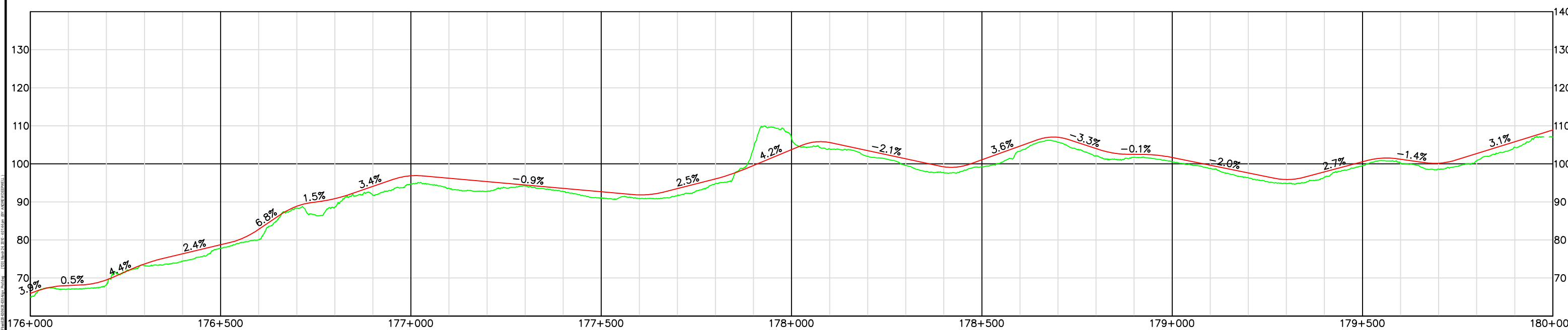
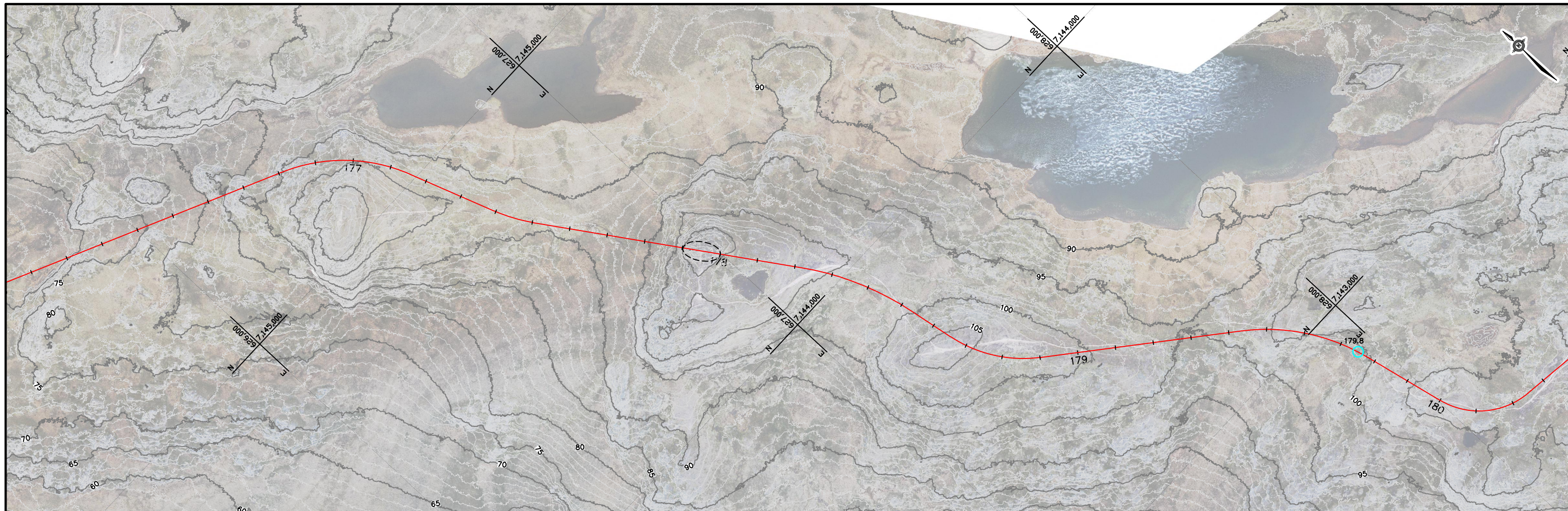
KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 172+000 TO STA. 176+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 119 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

EBA Engineering Consultants Ltd.

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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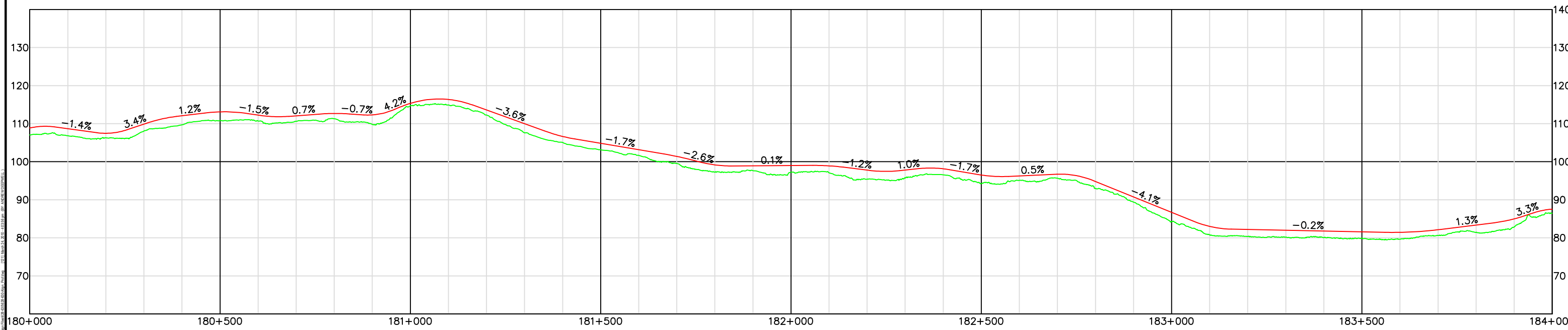
EBA Engineering Consultants Ltd.

**KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT**

**DEIS
PLAN / PROFILE
STA. 176+000 TO STA. 180+000**

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 120 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| NUM | DATE | DWN | CKD | APR | DESCRIPTION | NUM | DATE | APR | DESCRIPTION |
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REVISIONS DRAWING STATUS

CLIENT

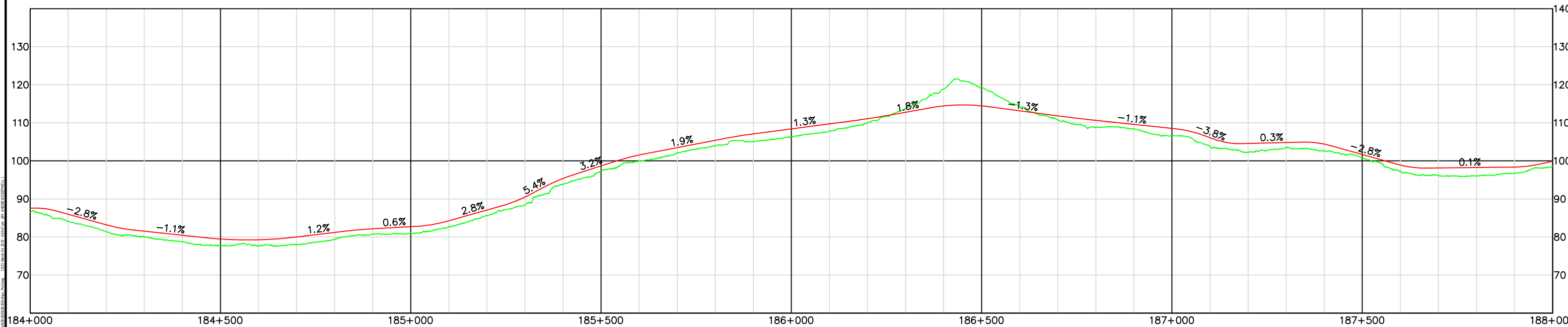
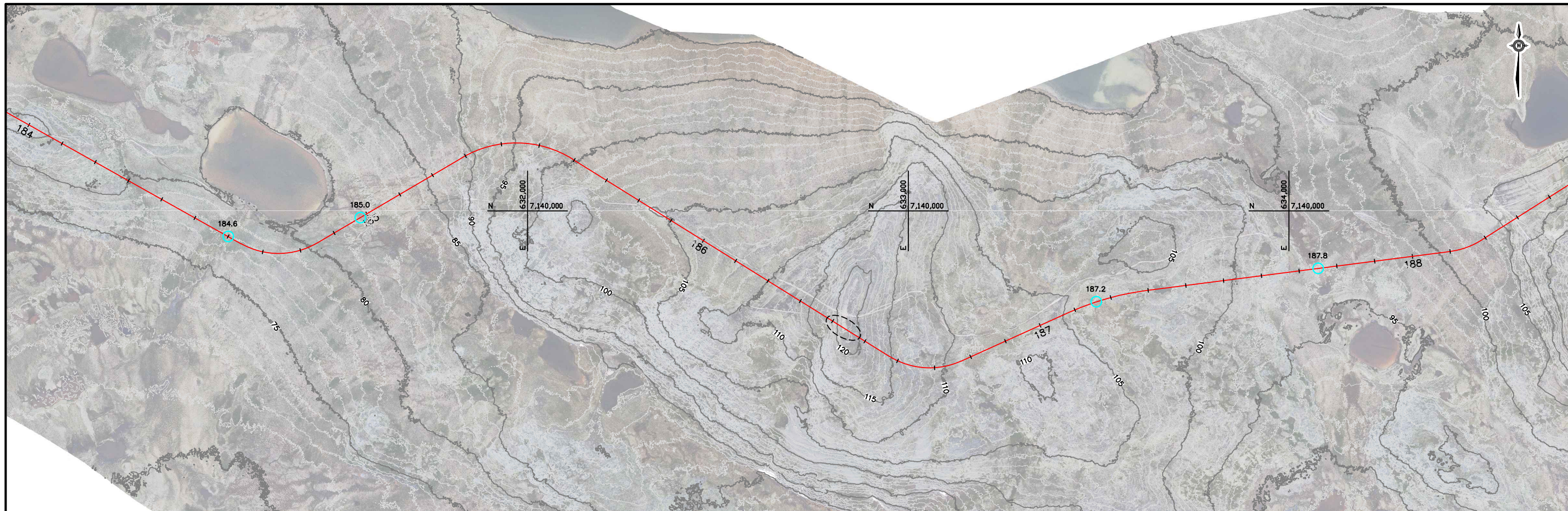
EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT CIVIL INFRASTRUCTURE REPORT

DEIS PLAN / PROFILE STA. 180+000 TO STA. 184+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 121 |
| DATE: March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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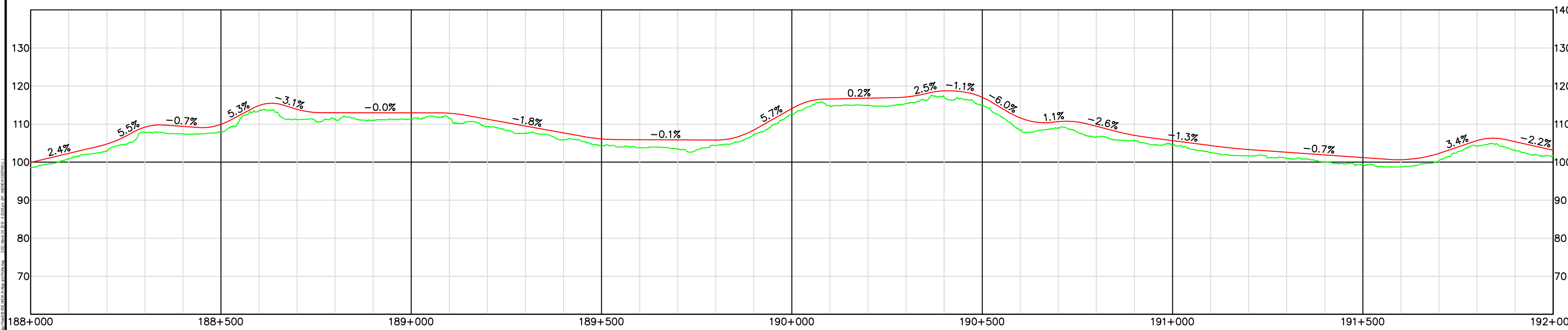
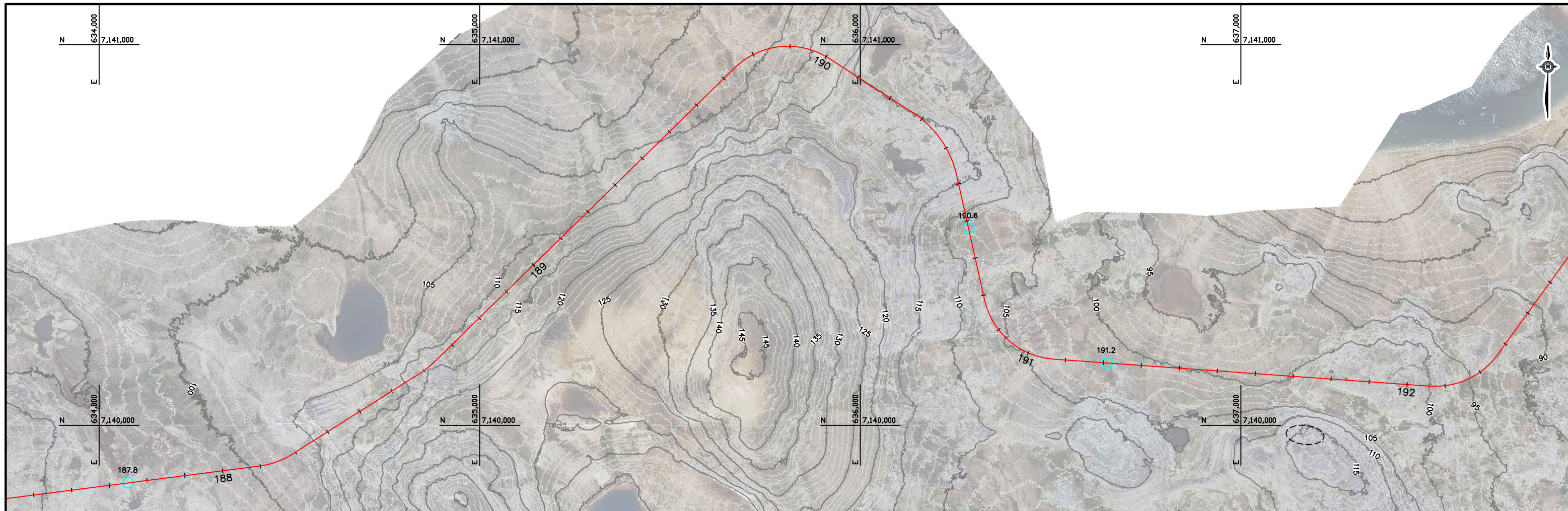
KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 184+000 TO STA. 188+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 122 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

EBA Engineering Consultants Ltd.

PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

| NUM | DATE | DWN | CKD | APR | DESCRIPTION | NUM | DATE | APR | DESCRIPTION |
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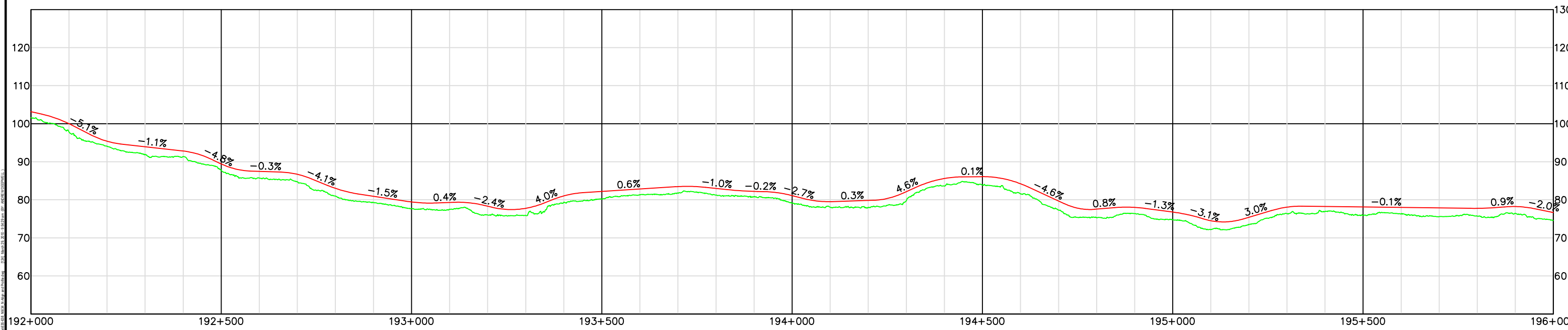
CLIENT

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 188+000 TO STA. 192+000

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| PROJECT No. | OFFICE | DES | CKD | REV | DRAWING |
| V33101016 | VANC | DCD | GEW | - | 123 |
| DATE | SHEET No. | DWN | APP | STATUS | |
| March 2010 | of | DWN | AJD | GEW | |

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LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

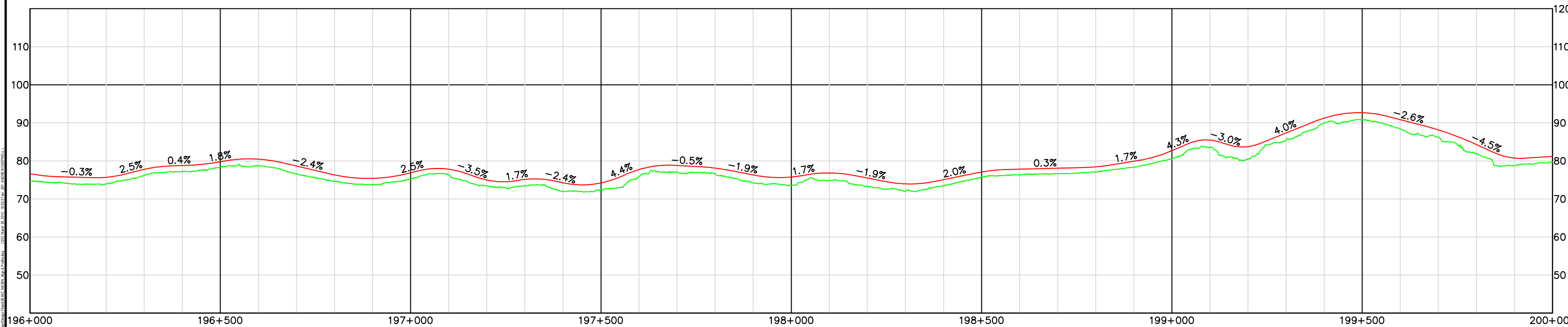
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KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 192+000 TO STA. 196+000

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| PROJECT No. | OFFICE | DES | CKD | REV | DRAWING |
| V33101016 | VANC | DCD | GEW | - | |
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| March 2010 | of | AJD | GEW | A | 124 |



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- BRIDGE Bridge
- QUARRY Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
 1:500 10 0 10 20 0m

HALF SIZE

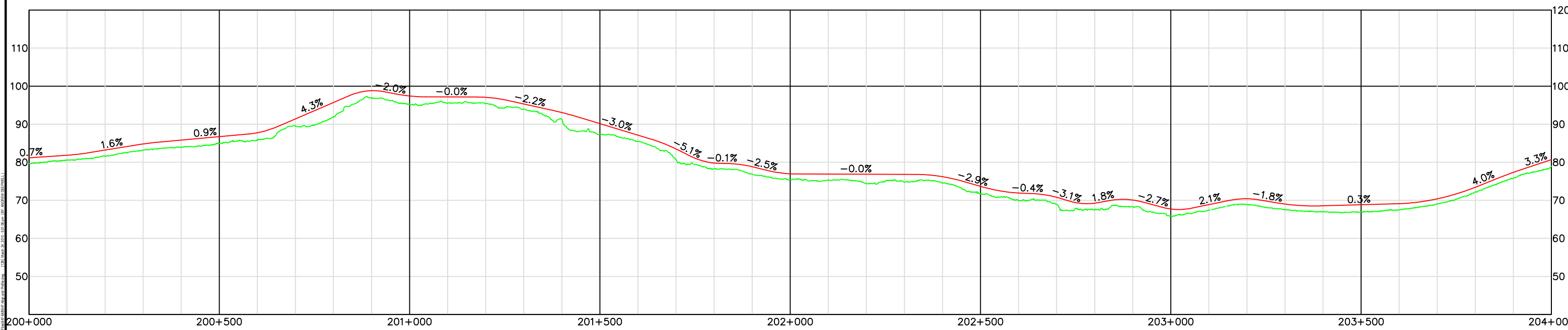
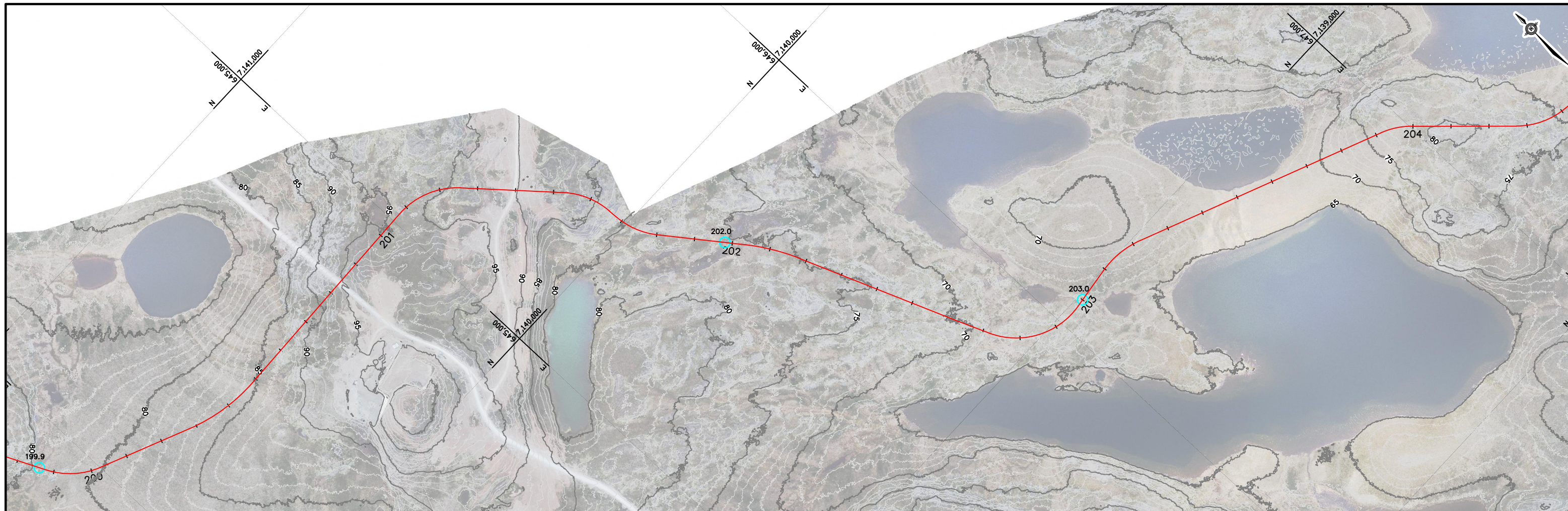
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KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 196+000 TO STA. 200+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 125 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |



LEGEND
 Alignment Profile
 Existing Ground
 Stream Crossing
 Bridge
 Quarry
 Ortho photo & Contour data provided by LSI, Summer 2009

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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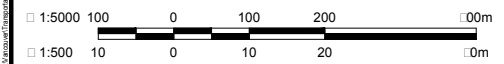
CLIENT

**KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT**

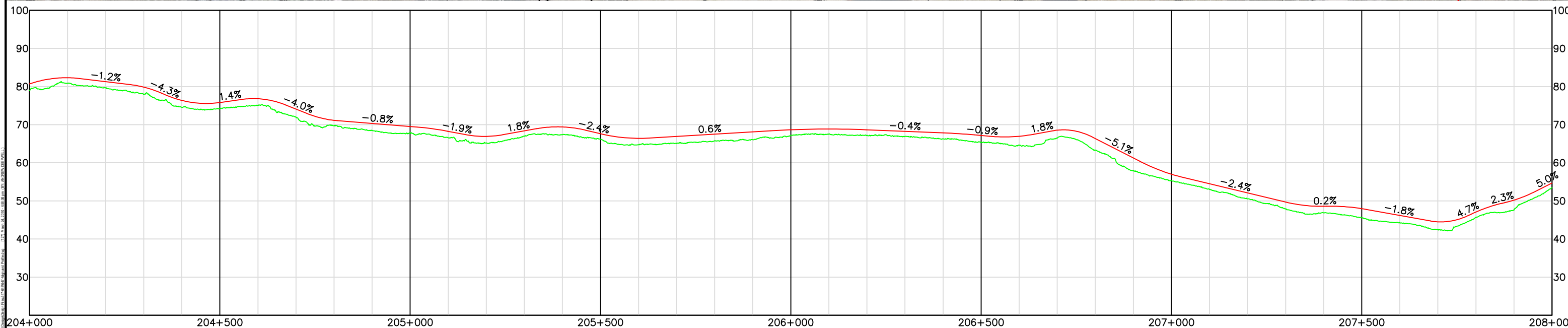
**DEIS
PLAN / PROFILE
STA. 200+000 TO STA. 204+000**

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 126 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

EBA Engineering Consultants Ltd.



PROFESSIONAL SEAL



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m
1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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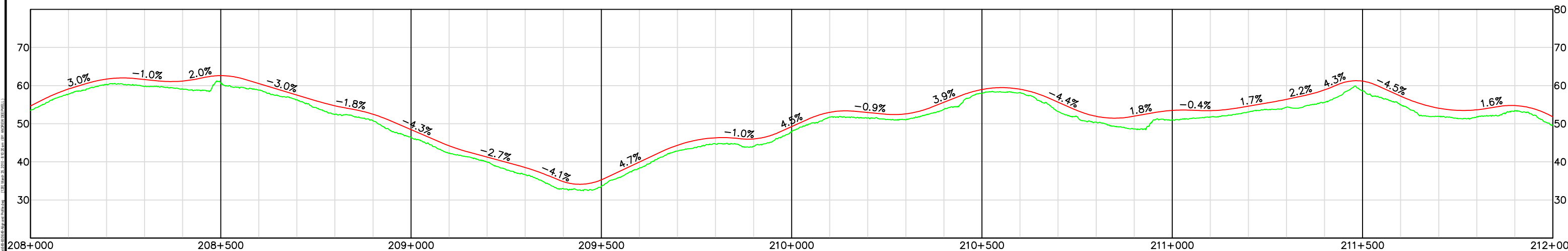
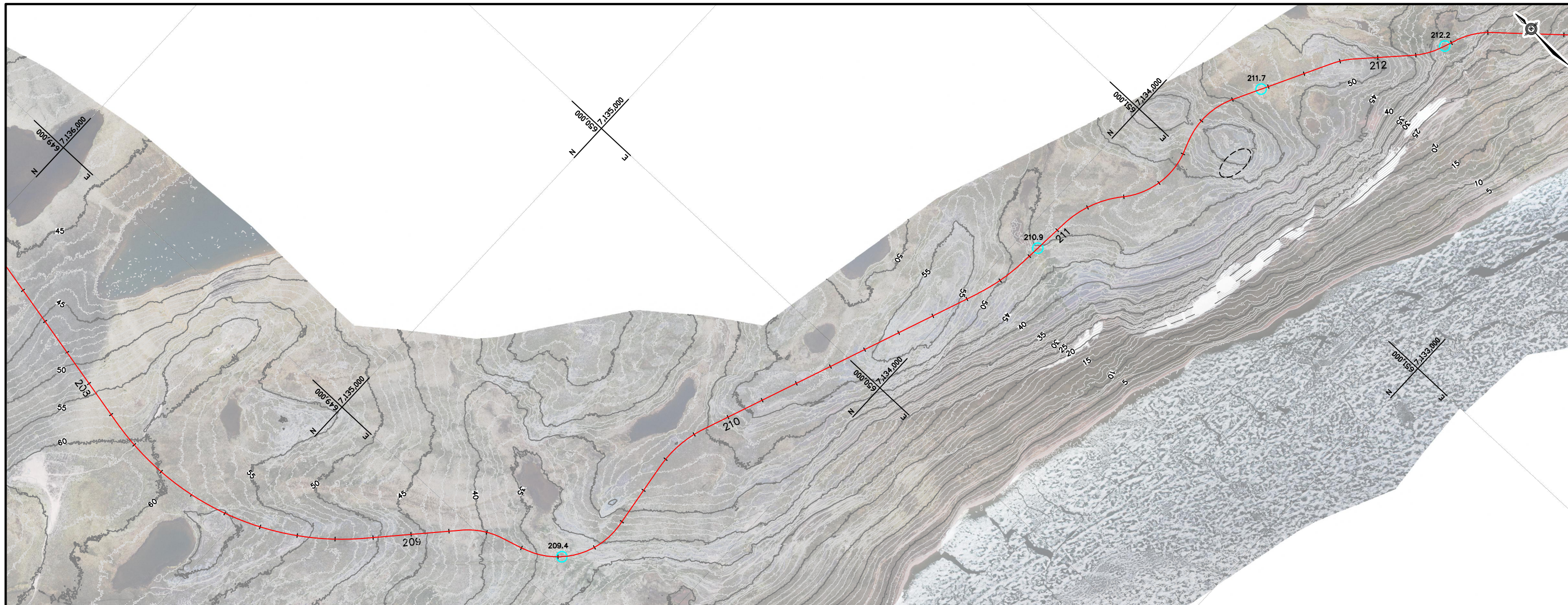
CLIENT

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 204+000 TO STA. 208+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 127 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |

EBA Engineering Consultants Ltd.



LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

HALF SIZE

| REVISIONS | | | | DRAWING STATUS | | | | | |
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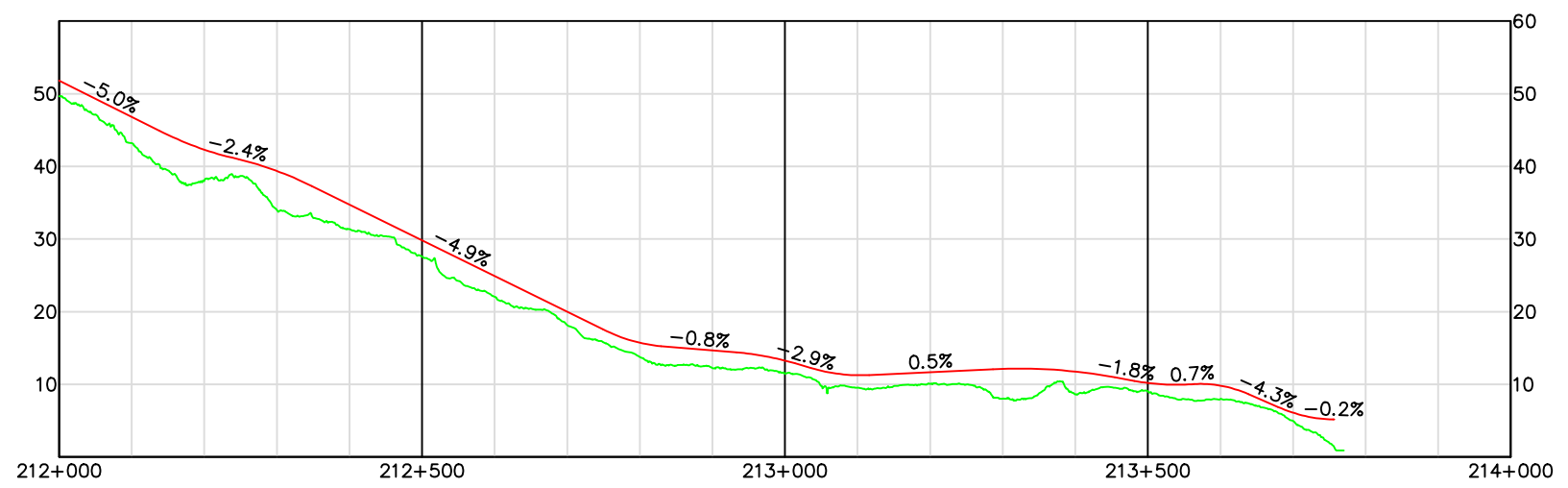
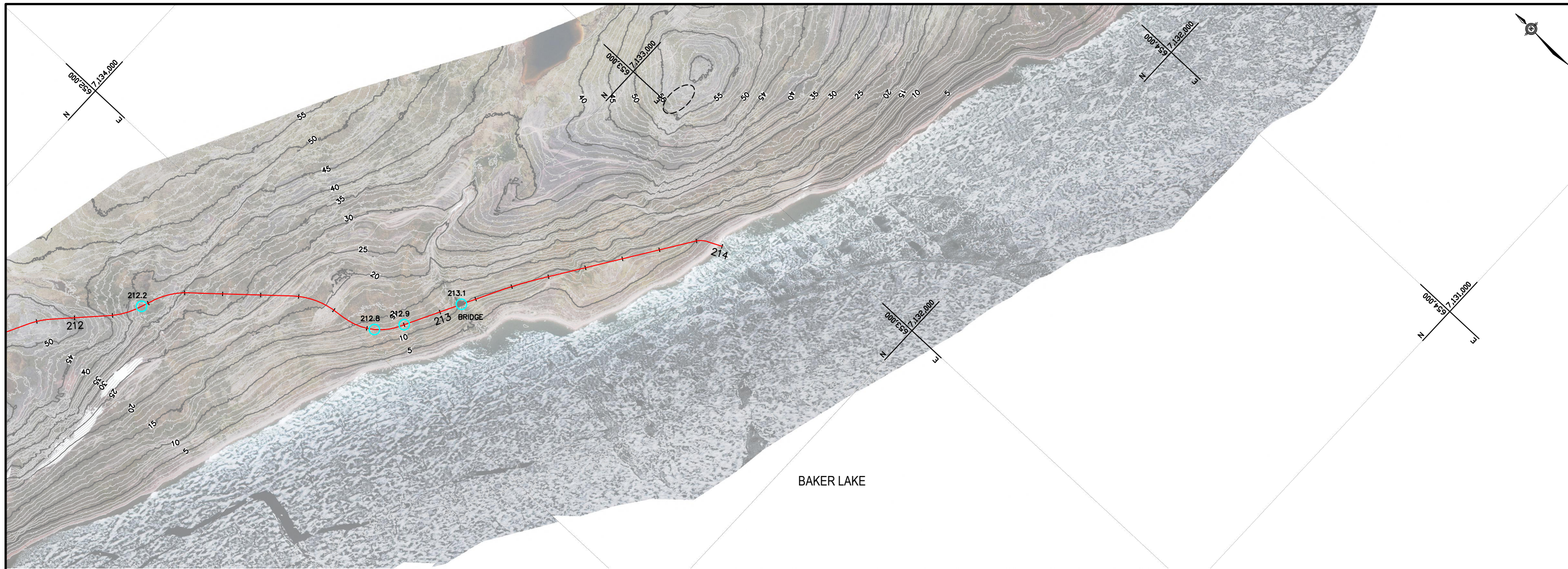
AREVA

EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 208+000 TO STA. 212+000

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| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING 128 |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | |



HALF SIZE

LEGEND

- Alignment/Profile
- Existing Ground
- Stream Crossing
- Bridge
- Quarry

Ortho photo & Contour data provided by LSI, Summer 2009

1:5000 100 0 100 200 00m

1:500 10 0 10 20 0m

| REVISIONS | | | | DRAWING STATUS | | | | | |
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CLIENT

AREVA

EBA Engineering Consultants Ltd.

KIGGAVIK PROJECT
CIVIL INFRASTRUCTURE REPORT

DEIS
PLAN / PROFILE
STA. 212+000 TO STA. 213+600

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|--------------------------|-----------------|------------|------------|-------------|--------------|
| PROJECT No. V33101016 | OFFICE VANC | DES DCD | CKD GEW | REV - | DRAWING - |
| DATE March 2010 | SHEET No. of | DWN AJD | APP GEW | STATUS A | 129 |