TETRA TECH EBA

OQM | Organizational Quality Management Program

Coral Harbour Airport Road Hydraulic Upgrades: Design Options Report

PRESENTED TO

Government of Nunavut

NOVEMBER 24, 2015
ISSUED FOR REVIEW
FILE: V13203282-01

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CONSULTING ENGINEERS & SCIENTISTS · www.eba.ca

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LIMITATIONS OF REPORT

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1.0 INTRODUCTION

In September of 2015 Tetra Tech EBA Inc. (Tetra Tech) was contracted by the Government of Nunavut (GON) to design, tender, and manage the construction of a series of culvert/bridge crossings in Coral Harbour, Nunavut (Southampton Island). Specifically, the intent of this initial report is to formalize Tetra Tech's recommendations intended to increase the hydraulic capacity of the existing crossings along Airport Road.

The purpose of this report is to build on the options presented by Tetra Tech in the Feasibility Review report completed in January of this year. The original report examined four primary Approaches and recommended one solution presented to the GON for consideration. This report presents the refinement process Tetra Tech has gone through formalising a final concept allowing the design team to proceed through to preliminary design. The same report also summarises the data gaps/deficiencies gathered during the site investigation.

This report presents the following information:

- A brief history of the project to date;
- A summary of the geotechnical and structural field investigations;
- Preliminary/conceptual designs for the proposed crossings including a class 'C' cost estimate;
- An outline of the work needed to secure the required environmental and regulatory approvals for the project; and,
- An assessment of the location, quality of material, and consistency of the materials (aggregates and rock) that is available from the borrow sources required for construction.

1.1 Project History and Details

Tetra Tech was initially retained by the Community and Government Services Department (CGS) of the Government of Nunavut (GON) in November 2012 to prepare a report specifying remediation options for the culvert crossings near the fuel tank farm of Coral Harbour. The impetus behind this project was a road washout which had occurred in June 2012, closing the Airport Road for approximately one week and causing damage to the supports of the fuel line feeding the Hamlet of Coral Harbour (the Hamlet). The failed crossing near the fuel farm facility is one of ten culvert/bridge crossings allowing the Post River to drain across Airport Road.

Figure 1-1. June 2012 Washout

The Hamlet reported that road washouts and flooding had occurred four times over the previous six or seven years and requested assistance to repair the damage and provide a more permanent solution to the problem.

As highlighted in Figure 1-2, Tetra Tech has completed a number of assignments intended to address the flooding issues at the Hamlet including a detailed review of the hydrology and the hydraulics of the Post River in 2013. In 2014, Tetra Tech developed a Feasibility Review examining four primary Approaches to address the problem. For each Approach, several implementation strategies or Alternatives were presented for CGS' consideration. The Feasibility Review included a detailed examination of each solution and a final recommended strategy. To assist the GON in budgeting the project, a class-D cost estimate was also provided.

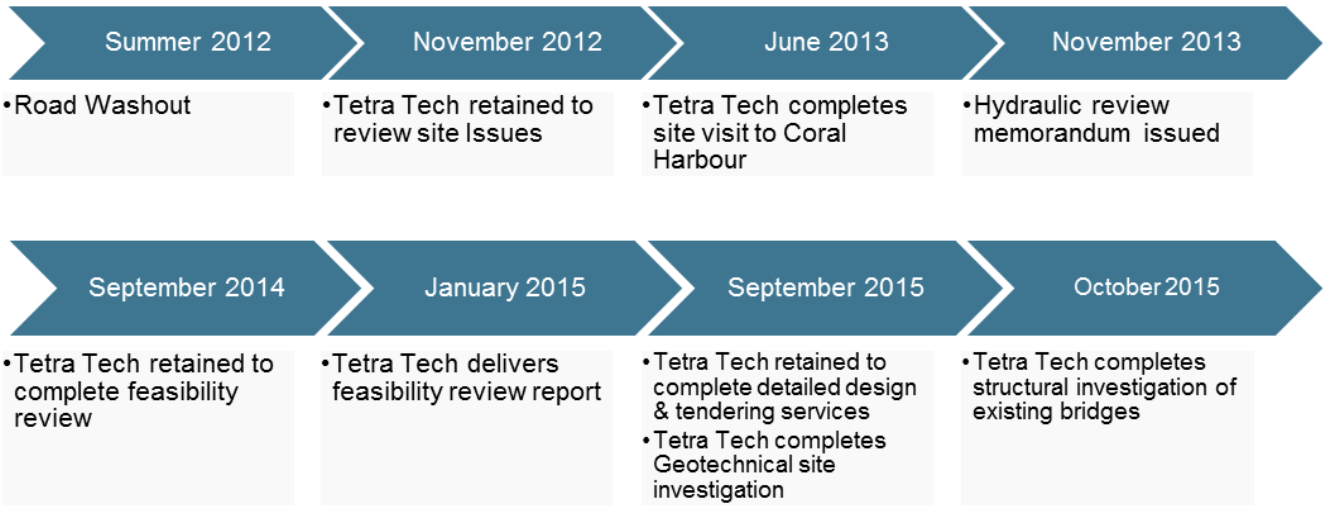
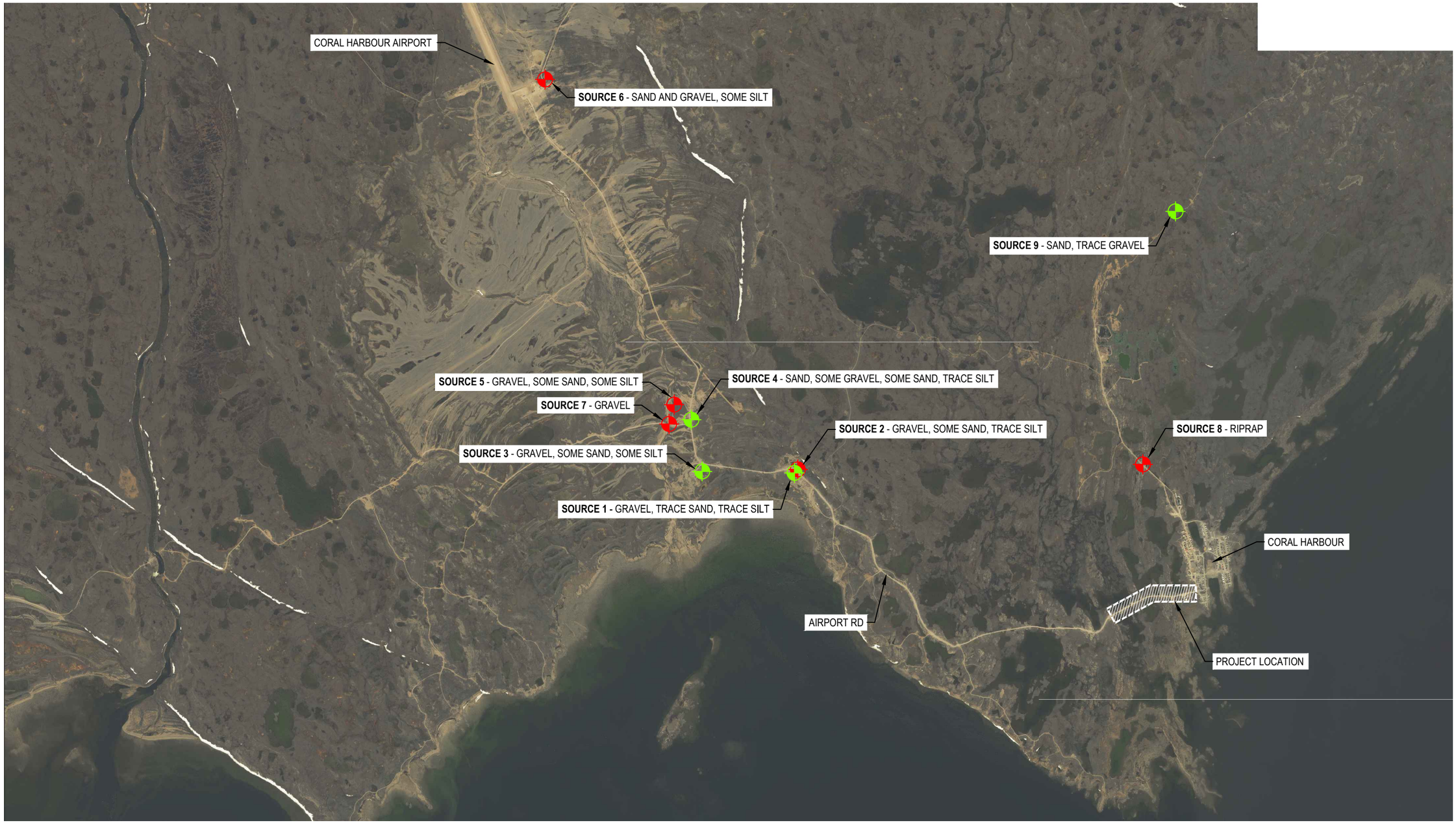


Figure 1-2 – Project History

As mentioned above, the intent of this report is to formalize Tetra Tech's final recommendations allowing the design team to proceed through to preliminary design. This report also summarizes some of the options which were reviewed and summarizes the considerations which have led to the proposed improvements shown in Figures 1-3 – 1-11 of this report. This report also presents the approach followed to develop the conceptual set of drawings and the cost estimate, allowing the CGS to confirm the extent of the funding needed to upgrade the system.



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GRAVEL SOURCE AND SAMPLE LOCATIONS
SITE PLAN

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V13203282	VANC	MAN	DNM	0	Figure 1-3
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KEY PLAN
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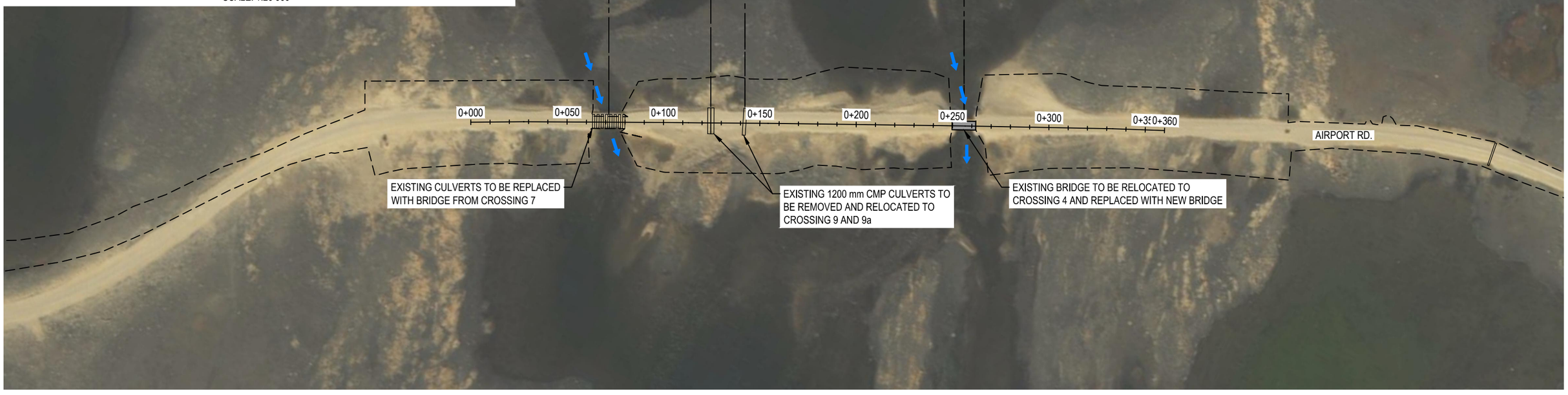

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CROSSING 4 - 7
SITE PLAN

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
V13203282	VANC	MAN	DNM	0	Figure 1-4
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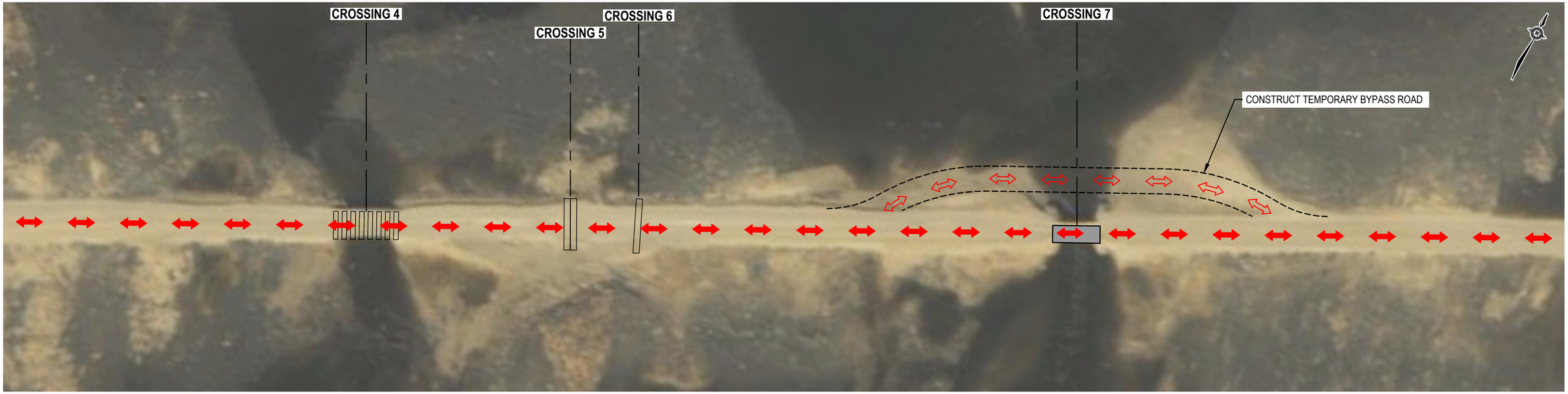
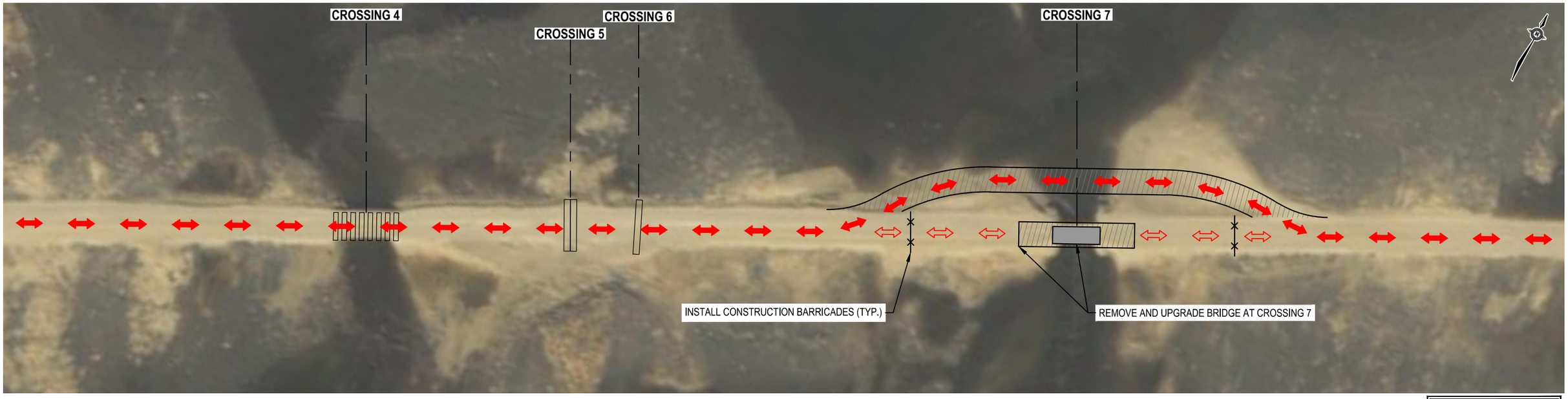


PHASE 1



PHASE 2

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PHASING PLAN

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
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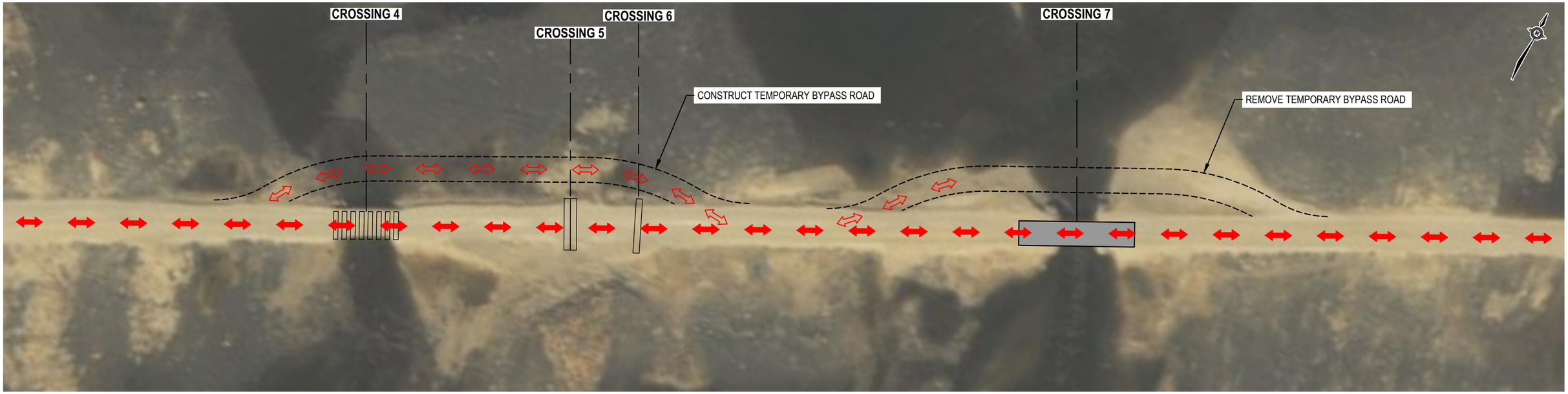

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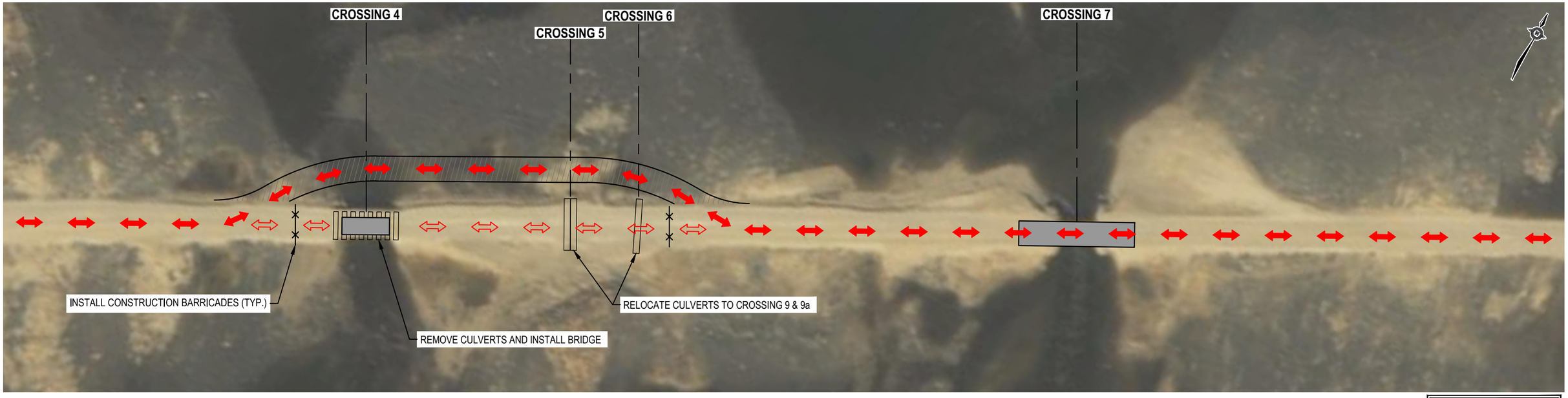

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PHASING PLAN

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
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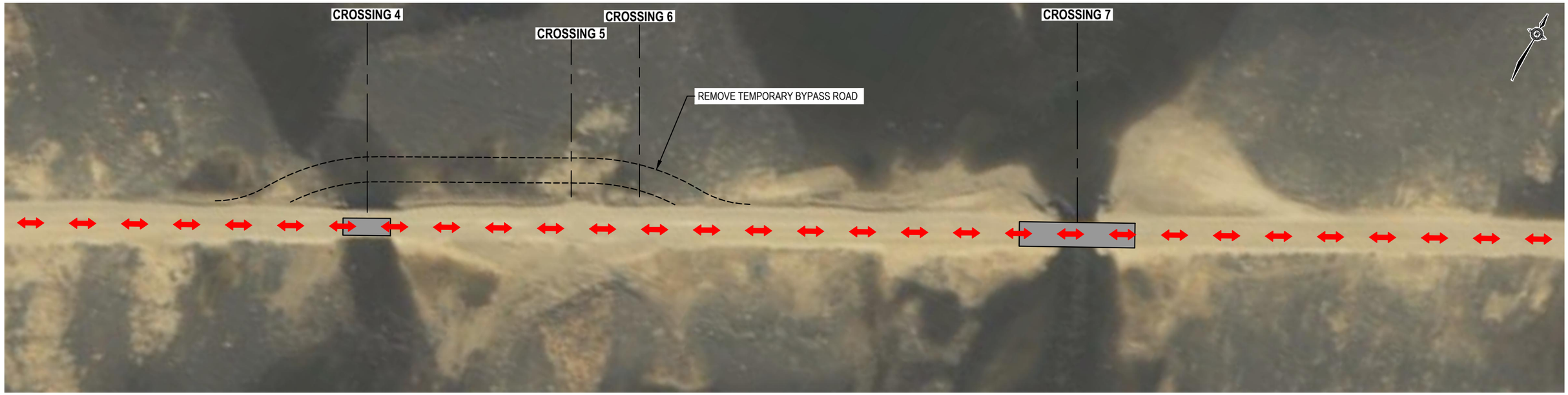
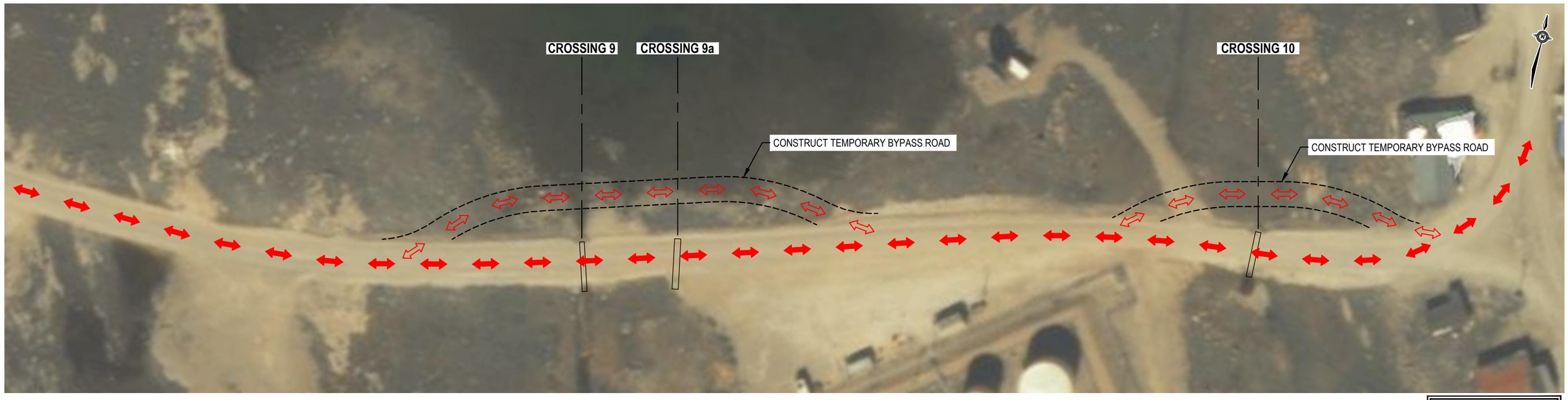


PHASE 5



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PHASING PLAN

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
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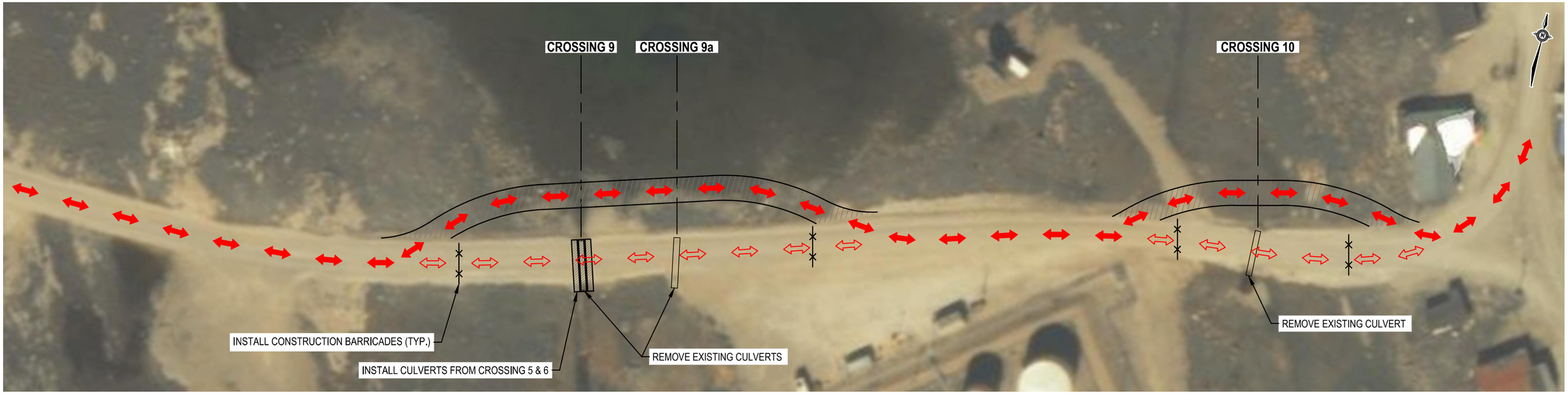

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PHASING PLAN

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
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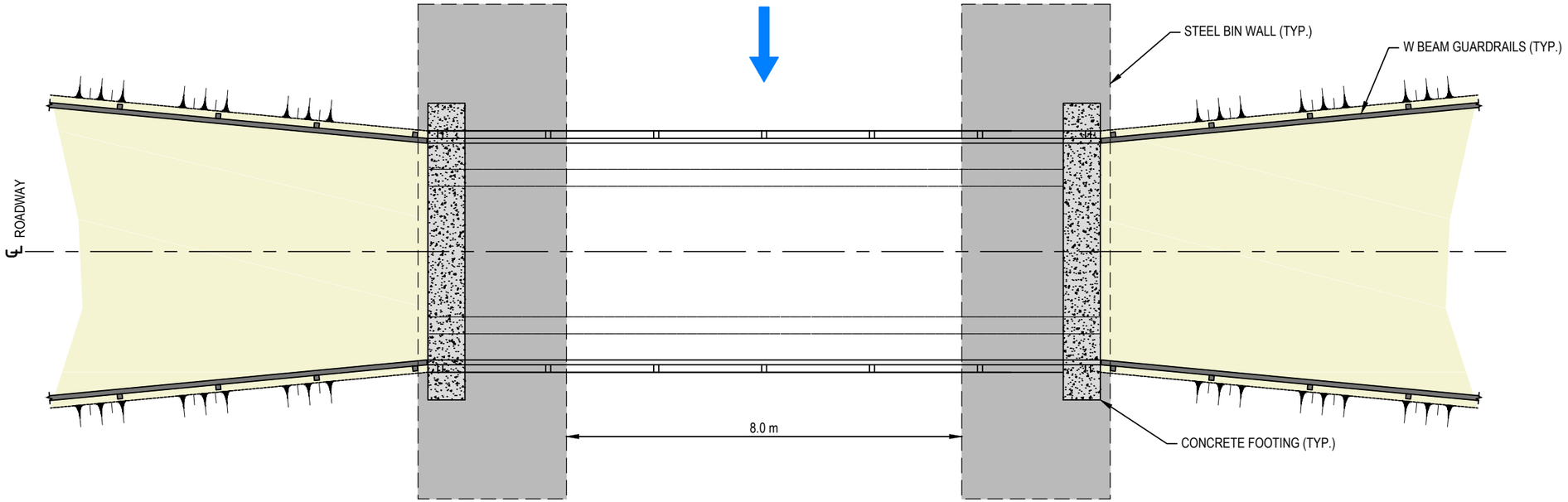

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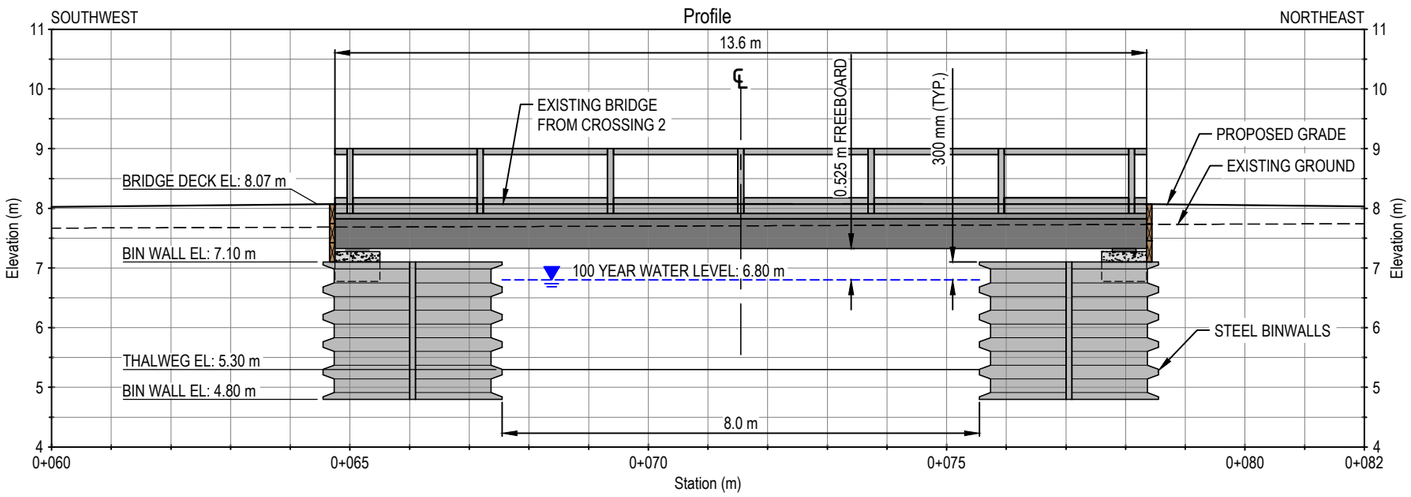

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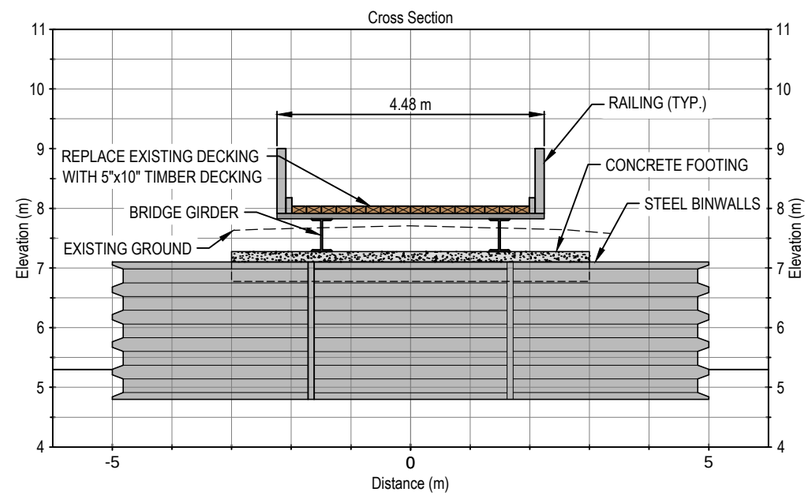

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CROSSING 4

PROJECT NO.	OFFICE	DES	CKD	REV	DRAWING
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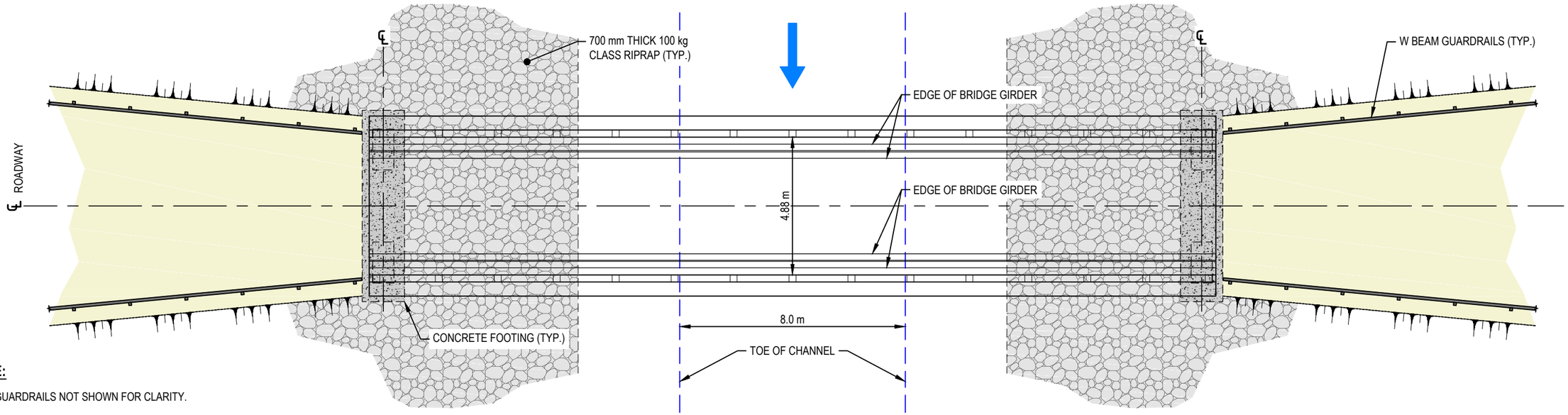

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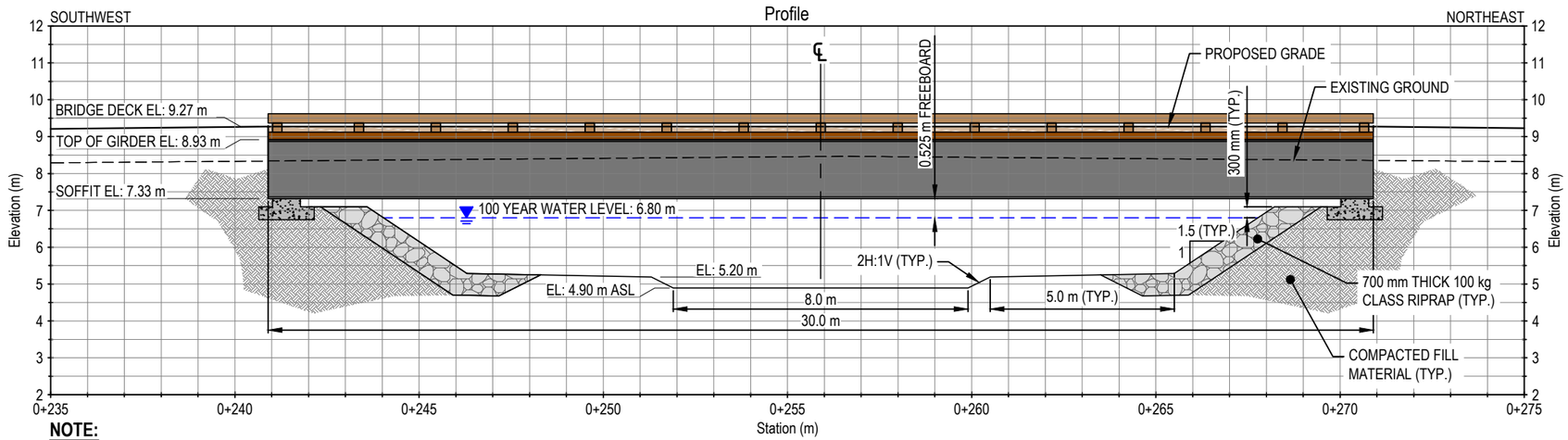

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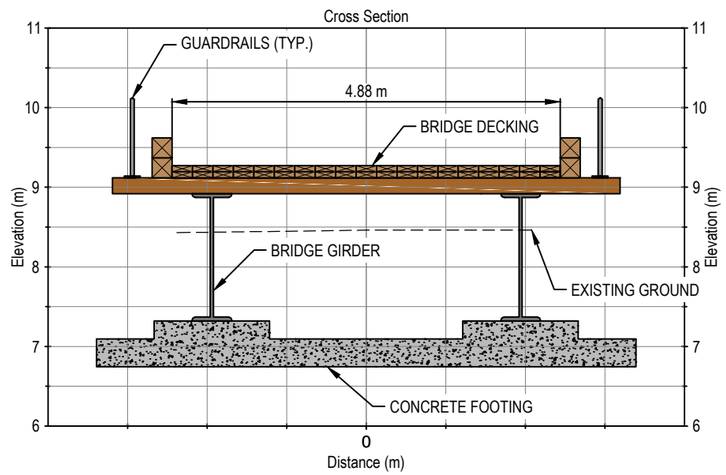

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CROSSING 7

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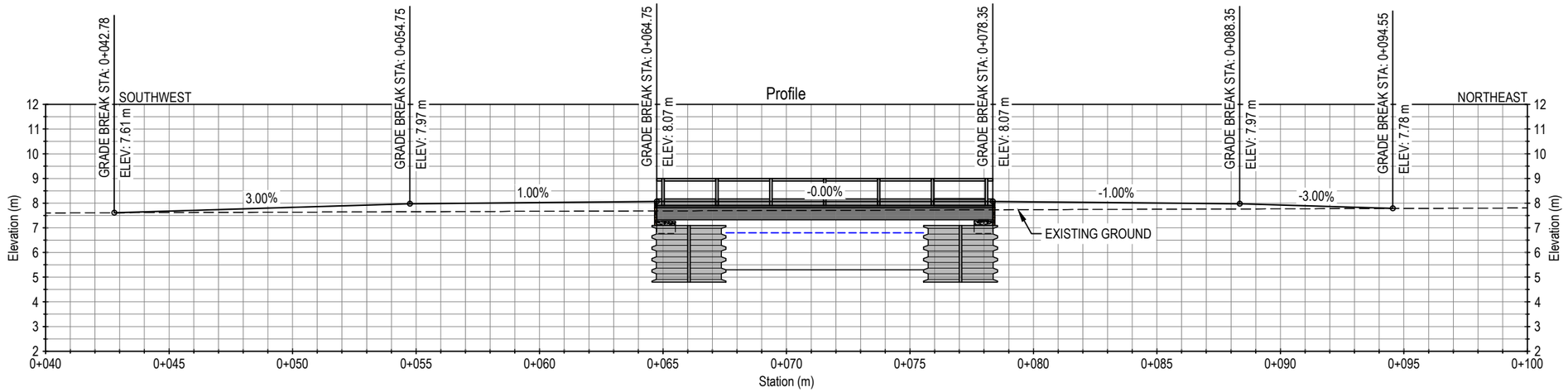

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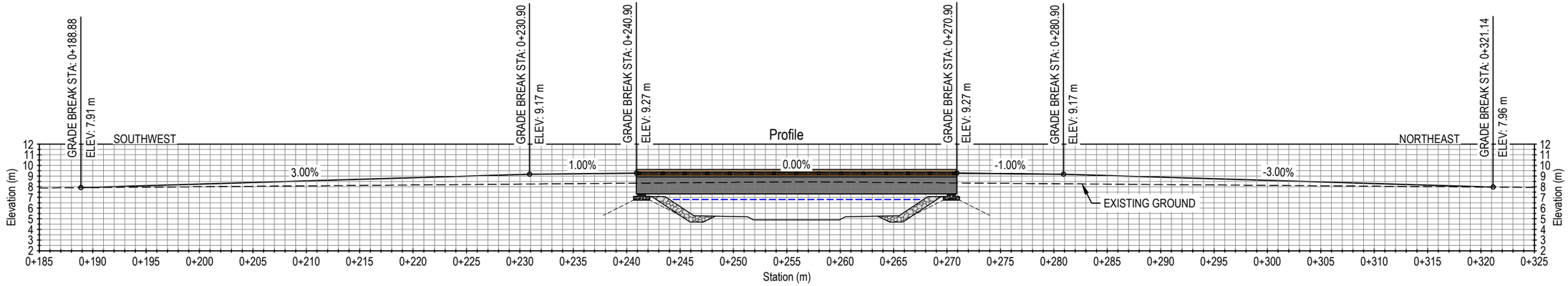

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ROAD PROFILES

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2.0 DESKTOP/FIELD INVESTIGATION

Prior to commencing preliminary design, our team completed two field visits to Coral Harbour. The first visit took place on September 25th through 28th, 2015 by Mr. Ernest Palczewski, Geol.I.T., accompanied by Mr. Ashwani Sharma of the Government of Nunavut. The purpose of this first site visit was to:

- Determine the type, quality, and depth to bedrock at Crossing 4 (eight culverts) (See Figure 2-1);
- Investigate and photograph the conditions of the existing culverts, staff gauges, and fuel pipelines along Airport Community Road as well inspect the design of an existing 80m bridge over the nearby Kirchoffer River (See Figure 2-2);
- Investigate potential gravel sources around the Hamlet. Specifically sourced of gravel, impermeable material, and rip-rap;
- Perform an elevation and photographic survey in the areas surrounding Crossings #4 and #7 (existing bridge);
- Give a presentation to the Hamlet describing the intent of the site visit and the expected construction schedule; and,
- Meet with the local contractor to determine the Hamlet's construction capabilities.

Figure 2-1 – Eight Culverts at Crossing #4 (including test hole location south of crossing).

Figure 2-2 – Existing Bridge over the Kirchoffer River

A second site visit was completed on October 9th by our senior bridge specialist Mr. Darrel Gagnon, P.Eng., M.Sc. of Buckland and Taylor. The purpose of this second visit was to complete a structural inspection of the existing bridge on Airport Road over the Post River (Crossing #7).

Findings of both field investigations have been summarized in the sections below. Copies of the field reports are included in Appendix B and C.

2.1 Geotechnical Investigation

As detailed in the enclosed section, Tetra Tech has completed both a detailed desktop review of the geotechnical nature of the site as well as a field inspection designed to confirm the existing site conditions.

2.1.1 General Geotechnical Site Conditions

The terrain in the vicinity of Coral Harbour is comprised of low, rounded bedrock ridges which trend in a north-south direction (Airphoto Analysis Associates 1971). Relief is very little and the ground surface varies from level to gently undulating. The bedrock, which consists of Precambrian granite and granitic gneiss, is usually massive and not excessively fractured and weathered. Foliation is quite common in these rocks and trending in a north-south direction. Paleozoic sedimentary rock (limestone) has also been reported in and around the community.

As glacial ice retreated from the area about 7,000 years ago, glacial till consisting of fine grained sediments, ranging in texture from sand to clay, was deposited in the troughs or swales between bedrock ridges. A number of eskers and small moraines were also deposited on the Precambrian rocks.

Subsequently, the community and surrounding area was inundated by the sea. Retreating marine waters reworked and modified the exposed bedrock and surficial sediments in some locations leaving extensive beach ridges at many

locations around the community. Cobble, boulder and gravel sized material may therefore be expected between the fine marine sediments and the bedrock surface in many locations

Tetra Tech conducted a background review of the area to characterise the surface and subsurface conditions including information from several geotechnical site investigation reports carried out for various infrastructure in the community. Typical soil and bedrock conditions found in the community are as follows:

Silt (marine):

Most of the previous investigations revealed that troughs between bedrock ridges were generally in-filled with a thin mantle of fine grained sediments (0.5 to 2.0 m thick) which range from fine silty sands, to silts and organic silty clays. The organic sandy silt has been described as low plastic. The majority of silty cores examined exhibited thin ice lensing, with an ice content estimated to be about 20 to 30%. Reticulate ice and segregated ice structures were also noted frequently.

Sand and Gravel:

The overburden at the site is anticipated to be primarily sand and gravel till. Sand with some silt overlying poorly graded gravel was observed in testpits in an area north of the community (EBA 2005). Most of the lakes investigated for the water reservoir had a thin cover of gravelly sand, underlying the silt layer and overlying the bedrock surface (Thurber 1979).

Occasional cobbles and boulders are expected within the sand and gravel layer. Boulders up to 2 m diameter have been encountered within the sand or sandy silt or lying on exposed bedrock.

Bedrock:

When encountered, bedrock has been described to consist of granite or granite gneiss. Bedrock in the area was noted to be massive and not extensively fractured or weathered (Thurber 1985).

Bedrock is exposed in several locations in the community of Coral Harbour and where it is not exposed, it is expected to be shallow. Bedrock outcrops near the proposed bridge locations.

2.1.2 Permafrost

Coral Harbour is within the zone of continuous permafrost. At the location of the sewage dyke, approximately 3 km north of Coral Harbour, and an investigation encountered permafrost in testpits at a depth of approximately 1.0 to 1.2 m in September 2004 (EBA 2005). Visible ground ice, approximately 10 - 20% by volume was observed at the refusal depths.

The depth to permafrost can be affected by several factors including organic cover and the presence of groundwater. However, it was estimated that the maximum thickness of the active layer is likely in the order of 1.0 to 2.0 m (Thurber 1979, Thurber 1985 and EBA 2005). Because the bridges will be located in areas with at least seasonal water flow the depth of the active layer cis expected to be somewhat deeper. For design purposes, an active layer of 2.0 m can be assumed.

Little data on ground temperatures in Coral Harbour exists. A thermistor cable installed at a recent project in Rankin Inlet recorded ground temperatures averaging -6.0°C at depths between 4.0 m to 10.0 m (exp 2013). The mean daily air temperature in Rankin Inlet is -10.5°C, 0.5°C warmer than the mean daily temperature in Coral Harbour. The mean ground temperature for this project in Coral Harbour is thus assumed to be -6.5°C.