



THURBER ENGINEERING LTD.

MEMORANDUM

To: Dale Wiersema, P.Eng.
Hatch Corporation

Date: January 18, 2019

From: Stephen Dunlop, M.A.Sc., P.Eng.

File: 19773

**ADDENDUM #1 TO
FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGHWAY 527 POSHKOKAGAN RIVER CULVERT
94.1 KM NORTH OF HIGHWAY 11/17, THUNDER BAY UNORGANIZED
SITE NO. 48C-223/C
ASSIGNMENT 6017-E-0013
G.W.P. 6827-14-00**

GEOCRES NO.: 52H-44

This memorandum presents an addendum to the above captioned Foundation Investigation and Design Report (FIDR) for the Poshkokagan River Culvert (formerly known as the Rinker Lake Culvert) on Highway 527. The original FIDR was prepared by Thurber Engineering Ltd. and was dated December 2018. The following addendum must be read in conjunction with the original FIDR.

1. Proposed Grade Raise and Temporary Embankment Widening

It is understood that the new culvert will consist of twin 4.61 m diameter corrugated steel pipes (CSPs) with invert elevations of 422.75 and 422.50 m at the inlet and outlet, respectively.

The original FIDR assumed that no grade raise was required at the site. However, it is now understood that a future grade raise of up to about 1.4 m will be required, and the current contract requires the culverts to be lengthened to accommodate this future grade raise. In addition, it is understood that temporary embankment widening will be required during construction for staging purposes. During Stage 2, the east side of the embankment will be widened by about 3.1 m, with a maximum vertical grade raise of about 1.4 m on the side slope. During Stage 3, the west side of the embankment will be widened by about 3.6 m, with a maximum vertical grade raise of about 1.1 m.

As a result of the proposed grade raise and temporary widening, a foundation assessment is required to evaluate foundation settlement and global slope stability of the embankment slopes. This memorandum presents the results of this assessment.



This memorandum assumes that the grade raise will be constructed as described in Section 10.5.1 'Embankment Construction' of the 2018 FIDR. The following discussion replaces Section 10.5.2 'Embankment Settlement and Stability' of the original FIDR; the remaining portions of the original FIDR are unchanged.

2. Foundation Settlement

The proposed 1.1 and 1.4 m grade raises (whether temporary or permanent) are estimated to result in approximately 10 to 15 mm of total foundation settlement, respectively. This estimated settlement is a result of elastic deformation only and will occur relatively quickly (during construction); long-term consolidation settlement is not anticipated. As such, the foundation will rebound by an approximately equal amount once the temporary widening is removed (assuming the final grade is equal to the existing grade). These movements should be taken into account where the new CSPs will be overlain by a temporary widened embankment.

For the future permanent 1.4 m grade raise, it should be noted that the 15 mm settlement would occur after the new CSPs are installed; therefore, the CSPs will need to be able to accommodate this amount of settlement. The settlement will also be differential, with the greatest settlement occurring near the centreline of the road and the least amount of settlement (if any) occurring at the ends of the culverts, which will have a lesser load from overlying soil.

2.1 Global Slope Stability

Stability analyses were carried out for the maximum proposed embankment (a 1.4 m grade raise with 2H:1V side slopes) under both static and seismic loading conditions. Stability analyses were carried out utilizing the commercially available slope stability program Slope/W (Version 8) of the GeoStudio software package developed by Geo-Slope International with the option for Morgenstern-Price method of slices for limit equilibrium analyses.

Based on the above assessment, the proposed embankment has a factor of safety greater than 1.5 against deep seated instability under static drained loading and a factor of safety of greater than 1.1 against deep-seated slope failure under seismic loading. These factors of safety are considered acceptable and therefore the proposed embankment is considered stable from the perspective of global slope stability.



3. CLOSURE

We trust that this memorandum satisfies your current requirements. Please do not hesitate to contact us if you have any questions.

Yours truly,

Thurber Engineering Ltd.



Stephen Dunlop, M.A.Sc., P.Eng.
Senior Geotechnical Engineer



Fred Griffiths, Ph.D., P.Eng.
Senior Associate, Senior Geotechnical Engineer