# BRIDGE DESIGN BULLETIN #2/2004 (Updated July 2004)

## Slope Stability during the Installation of Replacement Bridge Size Culverts under High Fills

**Purpose:** To clarify the requirements and responsibility for geotechnical investigation for culvert installations.

**Background:** Over the years a series of standard drawings and specification were developed for the installation of bridge size culverts. Earlier versions of the 'standards' concentrated mostly on details for properly installing a new culvert as part of the construction of a new highway, and design of the excavation for the culvert installation was expected to be the Contractor's responsibility. Presently many culvert installations involve the replacement of an existing culvert under high fill, and the excavation required to remove the old culvert and establish the bed for the new culvert is a major component of the culvert installation. These standards have generally worked well; however, recently there have been a few projects which have not gone as intended. Problems at these sites were related to failures of excavation cut slopes and associated confusion with respect to the project stakeholder's roles and responsibilities. These problems are more frequent on culvert replacement projects where high fill is present. The procedures and methods for execution of the excavation work remain the responsibility of the Contractor; however, an adequate geotechnical investigation undertaken by the Consultant is required in order for the Consultant and the Contractor to properly assess construction risks.

**Current Standards & Practices:** Installation of bridge-size culverts are carried out in accordance with:

a) Sections 1 "Excavation", 2 "Backfill", & 18 "Construction of CSP & SPCSP Structures" of the Specifications for Bridge Construction.
b) Standard Drawing S-1418-03 "Installation of Large Metal Pipes".
c) Site specific Construction (P) Drawings, and any Special Provisions that may be applicable.
d) Standard Drawing S-1418 has recently been revised, and information has been added with respect to the requirements for geotechnical investigation and design of excavation, as follows:
   - Cut slope designs for slopes greater than 6 m high shall be approved by a professional engineer.
   - Flatten and/or bench slopes as required to provide a stable, safe excavation.

Standard Drawing S-1418-03 "Installation of Large Metal Pipes" can be found at:
http://www.trans.gov.ab.ca/Content/doctype30/production/S1418-03-rev1.pdf

## Recommendations:

1. The current practice be continued.

2. The Consultant shall undertake a geotechnical investigation if any of the following conditions apply:
   - The height of the embankment above the existing or proposed culvert bed is greater than 6 metres.
   - The embankment and/or the foundation material is known or suspected to be poor.

The scope of the geotechnical investigation undertaken is at the discretion of the consultant, but would be expected to consist of:

- Review of department files, discussions with department staff
- Airphoto interpretation
- Review of available geologic and soil survey mapping and reports
- Site visit undertaken by the responsible consultant
- Field investigation, consisting of some combination of test pits, borehole drilling, CPT, GPR testing or other appropriate measures
- Lab testing as appropriate
- Engineering analysis and reporting of recommendations

The geotechnical investigation should include recommendations for:

- Design of the excavation cut slope based on a reasonable construction schedule
- Design of the culvert foundation and structural envelope
- Design of final embankment sideslopes
- Discussion of settlement and provision of mitigation options if appropriate
- Identification of geotechnically sensitive areas on the site, such as, but not limited to, slide prone valley walls and crest area above excavation.
- Discussion of construction related issues, such as, but not limited to, rate of excavation, location of spoil stockpiles, location of detours and moisture conditioning of fill soils

This information, including the recommended design of the cut slopes and road sideslopes is to be shown on the site specific drawings. Specific geotechnically related construction directives should be included in the tender document special provisions.

3. Prior to the commencement of construction of a culvert under high fill the Contractor shall submit a detailed workplan to the department's Consultant for review. The workplan shall include but not be limited to the methodology proposed to handle the excavation, backfill and other relevant issues. The workplan should be prepared in accordance with the recommendations provided in the geotechnical report, the tender document special provisions and drawings. The purpose of the Consultant's review of

the workplan review is to confirm that the work method proposed is consistent with the Consultant's recommendations in order to best manage the project risk for all parties. Work shall not proceed until the Contractor has received written acceptance of the proposed workplan. It is accepted that changes to the workplan may occur during construction in response to prevailing site conditions. Changes should be discussed with the consultant prior to implementation, and a written record maintained.

4. All details shown on the site-specific construction 'P' drawing shall be drawn 'To Scale'.

## Implementation of Bulletin:

The recommendations contained in this bulletin are effective immediately.

## Contacts:

Any questions regarding this bulletin should be directed to Technical Standards Branch as follows: for geotechnical concerns Roger Skirrow @ 427-5578, for design Clive Clarke @ 415-1025, and for construction Greg Whyte @ 415-1011.

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