BCMoT Culvert Hydrotechnical Design Criteria Guideline

All culvert hydrotechnical designs will address all/most of the following hydraulic design criteria. In addition, small diameter culverts (span <3.0 meter) must comply with the current BC MoT Supplement to TAC Geometric Design Guide, Chapter 1000 – Hydraulics. These culverts should also include due regard to empirical methods, manufacturer's literature and solutions that have a proven record of success for small diameter culverts. Large diameter culverts (span >3.0 meter) must comply with the CAN/CSA-S6-06 Canadian Highway Bridge Design Code (CHBDC), and the MoT Supplement to the CHBDC.

The designer must include consideration of the following in a concise hydrotechnical design report. If specific items are not considered, the designer must provide rationale as to 'why not'.

- Appropriate design discharge for the Return Period selected from Table 1010.A of the MOT Supplement to the TAC Geometric Design Guide.
- Horizontal culvert alignment site plan that accommodates existing channel morphology.
- Vertical controls including stations and elevations of inlet and outlet inverts and all bed controls (i.e. drop structures, artificial riffle structures, and if applicable, riprap placed in the culvert barrel). This information will be presented on a sufficiently long stream profile (see current MoT General Survey Guide).
- Culvert type, shape, and dimensions (rise and span) sized to convey the design discharge with water levels no higher than the inlet crown for small diameter culverts. However, freeboard requirements must be thoroughly reviewed by the consultant to ensure debris can be safely passed by the culvert, and backwater effects are at acceptable levels. Large diameter culverts (bridge-sized) must meet the freeboard requirements of the CHBDC and the MoT Supplement to the CHBDC.
- Inlet and outlet transitions (i.e. step bevels, flares), scour protection requirements, and recommended riprap details (Class, thickness, slope and filters) including tie-in to the natural channel.
- Structural modifications: cut-off walls, inlet and outlet end treatment (i.e. concrete collars, wingwalls), and trash racks.
- "Bottomless", or open-footing culverts, require a detailed scour assessment to specify footing depth and to ensure stability of the foundations consistent with the CHBDC.
- Identification of unique flow boundary conditions that affect the discharge (i.e. tidal influence, nearby weirs).
- Fish passage design criteria and other environmental constraints – see Hydrotechnical References.

<u>Special Design Considerations</u>

- Geotechnical Assessment: require confirmation of stable highway fill slopes at culvert inlet and outlet, and foundation design for bottomless (spread footing) and closed bottom culverts.
- Debris and sediment control: this is a challenging design problem and MoT recommends specialist advice when this situation is encountered. The FHWA publication HEC 9 - Debris Control Structures, Evaluation and Countermeasures provides guidance on this topic.
- MoT endorses robust hydrotechnical design that accommodates natural channel characteristics. The TAC Guide to Bridge Hydraulics (2001) is a recommended reference for culvert hydraulic design and recommends adopting a first trial culvert width on the basis of typical channel widths in the reach.
- MoT's low volume road design guidelines may allow for the design of approach road surfaces to be over-topped and the road closed during extreme flood events.
- Constructability issues, water management, and operational and maintenance recommendations.