GENERAL GUIDELINES

Hydrologic/Hydraulic Design Report

submitted in support of *Dike Maintenance Act* approval applications

1.0 Introduction

To ensure that the proposed works meet provincial standards a Hydrologic/Hydraulic Design Report may be required as part of an application for *Dike Maintenance Act* approval.

In general, significant changes to the configuration of a dike and channel adjacent to a dike, upgrades made to achieve a new design flood elevation for a dike, and the construction of a new dike will require a Hydrologic/Hydraulic Design Report prepared by a Professional Engineer with appropriate experience in river engineering.

This document is intended to provide guidance on the type and extent of Hydrologic/Hydraulic Design Report for significant works above noted.

The regional Deputy Inspector of Dikes office should be contacted for further guidance on requirements.

2.0 Design Flood Event

The minimum design flood[1] for flood protection works in BC is a flood with a magnitude that is equal to an event having a 200-year annual recurrence interval, based on a frequency analysis of unregulated historic flood records or by regional analysis where there is inadequate streamflow data available. An exception to this is the Lower Fraser River where the design flood is the 1894 flood of record.

Similarly coastal protection works are required to be designed to protect against tidal floods with a 200-year annual recurrence period within the Strait of Georgia.

Any computation method using a statistical frequency analysis to determine the design flood magnitude for fluvial systems must take in consideration that the underlying

[1] Flood Hazard Area Land Use Guidelines available at http://www.env.gov.bc.ca/wsd/public_safety/flood/landuse_mgmt.html

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historical streamflow data may not be applicable due to changes in the watershed or climate change.

In some circumstances critical flood levels may result from ice-related flooding not a specified discharge frequency, and the level of flood protection to be provided must be accepted by the Inspector of Dikes (IOD).

Flood protection works on alluvial fans and/or colluvial fan require special consideration and the regional Deputy Inspector of Dikes (DIOD) office should be consulted.

Protection works for other hazards such as debris flows and debris floods require special consideration, and the DIOD's office should be consulted for requirements.

The Inspector of Dikes must approve the specific design flow and other design criteria for the proposed flood protection project.

3.0 Design Flood Profile

Once a design flood event is determined, a design flood profile (water levels) must be computed.

1. **Fluvial Protection Projects**
   Various factors that affect this profile derived from a design flood include any or all of the following that must be considered in rivers, and streams:

   - Sediment aggradation: An allowance may be required for fluvial systems that are subject to high sediment bedloads, and often a sediment management plan is required as a condition of *Dike Maintenance Act* (DMA) approval. The sediment plan would have to be acceptable to the fishery agencies and would be incorporated into an Operations and Maintenance (O&M) Manual.
   - Flow constrictions (i.e. bridges, encroachments in the flood corridor, debris jams, etc): in fluvial systems that are prone to floating debris and/or ice the constrictions may cause blockages that have to be accounted for in a design flood profile.
   - Impacts to 3rd parties – refer to the section below on No Transfer of Risk.

2. **Coastal Protection Projects**
   These works are subject to elevated water levels caused by a complex combination of factors that include:

   - Tidal fluctuations
   - Storm surges
   - Wave set-up and wave run-up
   - Geological processes (tectonic uplift/subsidence, tsunami) and
   - Sea level rise

Determination of appropriate design water levels for coastal developments requires an assessment of each component of elevated water level at the subject site and the

combining of these components in a realistic and statistically meaningful way. Simple addition of the values for each element may not be necessarily appropriate.

The design water levels for coastal flood protection projects are often specific due to local offshore bathometry, exposure to wind and the length of fetch.

4.0 Freeboard

A freeboard allowance is applied to flood profile to determine the construction of crest elevation of the flood protection works. Freeboard may be different for local conditions, however, the province historically has applied the following minimum freeboard allowance for open water conditions:

The higher of:

- 600 mm vertical allowance above the calculated 1 in 200 year peak mean daily flow profile, which normally applies to large river systems or
- 300 mm vertical allowance above the calculated 1 in 200 year peak instantaneous flow profile.

Where the channel is potentially subject to sediment aggradation and/or debris jamming additional freeboard may be required.

5.0 Approved and Existing Design Flood Profiles

A number of design flood profiles have been accepted by the Inspector of Dikes (IOD) as meeting provincial standards. A major one of general interest is the Lower Fraser River which starts at Laidlaw, near the Township of from Hope to the sea. This design flood profile, and the supporting technical study report are available at the ministry website[2].

Other design flood profiles: On many rivers, throughout the province, floodplain maps complete with computed 200-year flood level isolines – Flood Construction Levels (FCL's) – were produced under the 1987 Canada/British Columbia Agreement Respecting Floodplain Mapping and an earlier provincial mapping program commenced in 1974. These floodplain maps are available online at the ministry website[3] It is important to note, however, that, because of subsequent flood events or changes/development on the floodplain and/or other factors, many of the published floodplain maps and flood profiles are now out of date.

The regional Deputy Inspector of Dikes (DIOD) office should be consulted for further information on the acceptability of an existing published FCL's for use in a particular flood protection project.

[2] The Fraser River Hydraulic Model Update Report, March 2008 refer to Item 8: http://www.env.gov.bc.ca/wsd/public_safety/flood/structural.html
[3] The Floodplain Maps are Associated Design Briefs are available at the ministry website: http://www.env.gov.bc.ca/wsd/data_searches/fpm/reports/index.html#about

6.0 Erosion Hazards

The hydrologic/hydraulic analysis shall evaluate the need for erosion control features for the flood protection works, which may be threatened by wind, and water generated waves, stream or surface flows.

7.0 No Transfer of Risk

The design flood profile for a proposed flood protection system (either for new works or for upgrades to existing works) must not transfer additional flood risk to third parties. The hydraulic analysis shall be undertaken to ensure no such risk-transfer would occur.

8.0 Climate Change

Due consideration shall be given to allowing for future climate change where appropriate for all new flood protection schemes. As a minimum measure, new works should be designed to be capable of further raising or enhancement and it should be ensured that legal access for the dike enhancements exist or can be acquired. The regional DIOD's office should be consulted for requirements.

9.0 Hydrologic Design Acceptability

The Inspector of Dikes must approve the specific design flow and design profile for a proposed flood protection works.

10.0 Other Requirements

Once the specific details of the application are known the regional Deputy Inspector of Dikes office can provide further guidance on the requirements of a hydrologic/hydraulic report.

11.0 Reference Documents

Ministry of Water, Land and Air Protection, Dike Design and Construction Guide. Best Management Practices for British Columbia dated July 2003[4]

US Army Corps of Engineers (USACE), Hydraulic Design for Local Flood Protection Projects, ER 1110-2-1405, dated September 30, 1982[5]

US Army Corp of Engineers (USACE), Hydrologic Engineering Studies Design, EP 1110-2-9, dated July 31, 1994[6]

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[4] Available at the following link to the Ministry of Environment Website
http://www.env.gov.bc.ca/wsd/public_safety/flood/pdfs_word/aug03_dike_des_cons_guide.pdf

[5] Available at the following link
http://www.usace.army.mil/publications/eng-regs/er1110-2-1405/entire.pdf

[6] Available at the following link
http://www.tpub.com/content/USACEengineeringpamplets2/EP-1110-2-9/index.htm
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