
HYDRAULICS TECHNICAL MEMORANDUM

To: Dennis Callan & Mike Bricks **File:** 6300
MRC - Mississauga

From: Karen Hofbauer **Date:** July 2009

RE: Metrolinx – Georgetown South Link
Hydraulic Assessment of Black Creek Bridge

1.0 INTRODUCTION

1.1 Study Purpose

Metrolinx proposes to widen the bridges on the CN Railway along the proposed Georgetown South Link from Pearson Airport to Union Station to accommodate three additional rail tracks. McCormick Rankin Corporation was retained to complete a hydraulic assessment of the proposed bridge at Black Creek.

This Hydraulics Technical Memorandum outlines the required performance standards for the structure, documents the design flows, and details the development of the hydraulic model used to evaluate the hydraulic performance of the existing and proposed structure.

1.2 Existing and Proposed Structures

This Black Creek Bridge is situated just north of the intersection of Black Creek Drive and Weston Road (see Exhibit 1). The following outlines the existing and the proposed structures which are shown on Exhibit 2.

The existing bridge is a 70.16 metre three span structure over the creek. The soffit elevation is 119.0 metres. The low point of the rail tracks is 122.72 metres. The piers are 6 metres long with square nose and tail.

It is proposed to widen the existing structure to accommodate three additional tracks. In conjunction with the widening, fill has been proposed behind the west pier. The proposed structure is in line with the existing structure with a proposed total pier length of 24 metres.

1.3 Study Scope

This Hydraulics Technical Memo includes the following:

- Identification of design flows during 50-year, 100-year and Regional rainfall events;
- Development of hydraulic models for calculating surface elevations;

- A review of the impacts of the proposed bridges on water surface elevations;
- A presentation of design requirements for new structures based on standard hydraulic performance standards;

2.0 PERFORMANCE STANDARDS

Performance standards include:

- the design storm used to calculate flood elevations;
- the top of road freeboard;
- the soffit clearance;
- and the allowable increase in the flood elevation upstream of the structure.

Performance standards are based on the *Canadian Highway Bridge Design Code (CHBDC)*.

2.1 Design Storms

In accordance with the requirements of the CHBDC, a new structure should be designed to convey the 50-year design storm. In addition the structure should convey 100-year design storm without endangering the integrity of the structure or embankments and should convey the Regulatory Flow without causing flooding of upstream property outside of the established floodplain.

2.2 Top of Road Freeboard

The CHBDC recommends a minimum freeboard of 1.0 metre from the high water level for the design flow (50-year storm) to the edge of through traffic lanes. This freeboard is a recommended value although it is recognized that, due to site-specific considerations, it is not always feasible to meet this objective.

2.3 Soffit Clearance

The CHBDC recommends a minimum clearance of 1.0 metre from the high water level for the design flow (50-year storm) to the soffit. This freeboard is a recommended value although it is recognized that, due to site-specific considerations, it is not always feasible to meet this objective. The CHBDC also states that the clearance for structures with arched soffits shall be based on site-specific conditions.

2.4 Changes in Upstream Water Levels

The CHBDC does not quantify a maximum increase in flood elevations. However, the Toronto and Region Conservation Authority (TRCA) requires that proposed structures ensure there is no significant increase in upstream and downstream flooding.

3.0 DESIGN FLOWS

3.1 Design Storms

Peak flows for the 50-year, 100-year, and Regional rainfall events were extracted from the TRCA's existing conditions HEC-RAS model. Table 1 summarizes the peak flows at the structures.

Table 1 - Summary of Peak Flows

Crossing	Peak Flow (m ³ /s) – Provided by TRCA		
	50-year	100-year	Regional
Black Creek	206.9	240.0	510.8

4.0 HYDRAULIC MODELLING

4.1 Overview

The Hydraulic Engineering Centre's River Analysis System modeling software package (HEC-RAS) was used in this study to generate flood elevations and to determine the impact of the proposed bridge alternatives.

4.2 Model Setup

An existing conditions hydraulic model was provided by the TRCA for Black Creek. This model was used as a base for the future conditions model. Exhibit 1 illustrates the location of the HEC-RAS cross-sections included in the model near the Black Creek crossing.

4.3 Modelling Results

Table 2.1 summarizes the existing and future flood elevations for the Black Creek crossing.

Table 2.1 – Black Creek Crossing – Flood Elevation Comparison

Section Number	50-Year Storm			100-Year Storm			Regional Storm		
	Existing (m)	Future (m)	Diff. (m)	Existing (m)	Future (m)	Diff. (m)	Existing (m)	Future (m)	Diff. (m)
48.231	105.35	105.35	0.00	105.86	105.86	0.00	108.23	108.23	0.00
48.2315	WESTON ROAD BRIDGE								
48.235	107.08	107.08	0.00	107.18	107.18	0.00	109.77	109.77	0.00
48.237	107.02	107.01	-0.01	107.09	107.09	0.00	109.47	109.47	0.00
48.2375	CN RAILWAY BRIDGE								
48.243	107.02	107.06	0.04	107.10	107.15	0.05	109.62	109.68	0.06
48.245	107.14	107.12	-0.02	107.27	107.24	-0.03	109.93	109.92	-0.01
48.2455	CP RAILWAY BRIDGE								
48.246	107.25	107.23	-0.02	107.43	107.40	-0.03	110.20	110.19	-0.01
48.25	107.53	107.51	-0.02	107.83	107.80	-0.03	110.89	110.88	-0.01
48.26	107.93	107.92	-0.01	108.24	108.23	-0.01	110.98	110.97	-0.01
48.27	108.16	108.15	-0.01	108.44	108.43	-0.01	111.05	111.05	0.00

Table 2.2 summarizes the top of road and soffit clearance summary for the existing bridge.

Table 2.2 - Existing Bridge - Top of Rail and Soffit Clearance Summary

Structure (Upstream Face)	50-Year	100-Year	Regional
Description	Existing	Existing	Existing
Span	70.16	70.16	70.16
Water Surface Elevation	107.02	107.10	109.62
Top of Rail (Low Point)	122.72	122.72	122.72
Top of Rail Freeboard	15.70	15.63	13.10
Soffit Elevation	119.00	119.00	119.00
Soffit Clearance	11.98	11.91	9.38

Note: Water surface elevations are upstream of the existing bridge.

Table 2.3 summarizes the top of road and soffit clearance summary for the proposed bridge.

Table 2.3 - Proposed Bridge - Top of Rail and Soffit Clearance Summary

Structure (Upstream Face)	50-Year	100-Year	Regional
Description	Future	Future	Future
Span	51.78	51.78	51.78
Water Surface Elevation	107.06	107.15	109.68
Top of Rail (Low Point)	122.72	122.72	122.72
Top of Rail Freeboard	15.72	15.57	13.04
Soffit Elevation	118.82	118.82	118.82
Soffit Clearance	11.76	11.67	9.14
Maximum Increase Upstream of Structure	0.04	0.05	0.06

Note: Water surface elevations are upstream of the proposed bridge.

5.0 SUMMARY OF FINDINGS

Key findings are as follows.

- i) In accordance with the requirements of the CHBDC, a new structure should be designed to convey a minimum of the 50-year design storm. The 50-year design storm should be used to check whether the future bridge meets top of road freeboard and soffit clearance standards.
- ii) The Regional Storm was used to check for any potential flood elevation increases.
- iii) The 100-year storm was used to check for railway overtopping.
- iv) The existing bridge meets all performance standards.
- v) The proposed Black Creek Bridge meets all performance standards.

All of which is respectfully submitted,
McCormick Rankin Corporation

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