Appendix C

Existing Bridges - Circa 1950
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Appendix C
Existing Bridges - Circa 1950

C1 Introduction

This Appendix provides details on the bridges that were modeled in HEC-RAS. As identified in the main report the backwater modeling is to duplicate hydraulic conditions on the river from the 1950 timeframe (Section 1). The bridges that existed on the river in 1950 are shown in Figure C-1.

Plans for all the bridges modeled were provided by Manitoba Water Stewardship and coded into HEC-RAS format by Acres. This Appendix provides:

- a brief hydraulic assessment of each bridge;
- a cross-section of the bridge and how it is depicted in HEC-RAS. Location refers to chainage shown in Table B1 (Appendix B);
- simulated water levels from both the 1950 and 1966 floods; and,
- photos of the particular bridge.

More specific details on the bridge coding can be found in the actual model setup in HEC-RAS.

Table C1 provides a summary of simulated versus observed bridge losses. As discussed in Section 4.1.4.3, it is concluded that the modeling does not support the observed high bridge losses for both the CNR and Provencher Bridge in 1950 and the Elm Park Bridge in 1966. It is believed that the higher losses through these bridges could be as a result of a number of other factors such as benchmark errors, debris, back eddies, gauging location, etc. Typically these types of errors (differences) can only be resolved during or just after collection and not 35-50 years after the event.

Bridge losses computed for each bridge over a range of discharges are summarized in Table C2 in this appendix. For some of the bridges (e.g. CPR Keewatin) bridge losses increase dramatically when the water levels are just above the underside of girder, but below deck level. However, when water levels exceed deck level, the headloss decreases significantly.
### TABLE C-1

**Modelled Versus Observed Bridge Losses**

**1950 and 1966**

<table>
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<td>757.64</td>
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**Notes:**

1. Location of bridges shown in Figure 2-1 and Figure 4-1
2. Distance calculated from HEC-RAS
3. Stage data from Clark (1950)
4. Stage data from Long (1971)
5. Downstream #2 gauge
6. Based on 1 water level reading per day
7. Interpolated dated for May 29th, 1950 for upstream gauge
8. All elevations refer to GSC 1929 Datum

File: Table C_1.xls

Table C-1
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<td>300,000</td>
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<td>0.21</td>
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Notes: 1 - Discharge is given D/S of the Assiniboine River junction. 2 - Assiniboine River contribution is assumed to be 10% of the total flow. 3 - HEC-RAS simulations were run with the “natural” geometry file.
C2 Elm Park Bridge

**Location** - 64426 metres (HEC-RAS).

**Description** - Multi-span open truss type structure with minor approaches and minimal constriction on flow.

**Status** - As of 2004, there have been no significant changes to the structure as it existed in 1950.

**Hydraulic Modeling Approach** - Modeled using HEC-RAS energy method (standard-step) as bridge structure follows natural cross section without constrictive abutments or a deep bridge structure. Truss structure not considered a blockage to flow, and was therefore not accounted for in model HEC-RAS deck feature. Bridge profile reflects the underside of the bridge to the top of the horizontal traffic guardrails (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

Elm Park Bridge – Bridge Profile as modeled In HEC-RAS – Upstream Side.
Elm Park Bridge – Upstream Side.

Elm Park Bridge – Downstream Side.
Elm Park Bridge – Centre Pier.

Elm Park Bridge – 1950 Flood.
Elm Park Bridge – 1950 Flood.
C3 Norwood Bridge

Location - 58204 metres (HEC-RAS).
Description - Multi-span plate girder structure with lift section for boat traffic. Minor approaches and minimal constriction on flow.
Status – Structure as modeled was replaced in 1997.
Hydraulic Modeling Approach - Modeled using HEC-RAS energy method (standard-step) as bridge structure follows natural cross section without constrictive abutments. Low underside of girder elevation restricts flows for conditions equivalent to 1966 flood (90,000cfs+) or higher until water levels exceed deck elevation. Bridge profile reflects the underside of the bridge to the top of the traffic guard rails adjacent to roadway (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

Norwood Bridge – Bridge Profile as modeled In HEC-RAS – Upstream Side.
Norwood Bridge – Upstream Side.

Norwood Bridge – Downstream Side.
Norwood Bridge – 1950 Flood.
C4  Provencher Bridge

**Location** - 57134 metres (HEC-RAS).

**Description** - Multi-span plate girder structure with centre lift section for boat traffic

**Status** – Structure as modeled was replaced in 2003/04.

**Hydraulic Modeling Approach** - Modeled using HEC-RAS energy method (standard-step) as bridge structure follows natural cross section without constrictive abutments. Low underside of girder elevation restricts flows for conditions equivalent to 1950 flood (108,000cfs+) or higher until water levels exceed deck elevation. Bridge profile reflects the underside of the bridge to the top of the through girders adjacent to roadway (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

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Provencher Bridge – Bridge Profile as modeled In HEC-RAS – Upstream Side.
Upstream Side of Provencher Bridge.

Centre Pier (typical) - Provencher Bridge.
Aerial View of Provencher Bridge (looking West).

Road Deck - Provencher Bridge (Note girders adjacent to roadway).
Provencher Bridge (looking West) – 1950 Flood.
C5 Canadian National Railways – Redditt Subdivision Bridge

**Location** - 56597 metres (HEC-RAS).

**Description** - Multi-span open truss type structure.

**Status** - As of 2004, there have been no significant changes to the structure as it existed in 1950.

**Hydraulic Modeling Approach** - Modeled using HEC-RAS energy method (standard-step) as underside of truss structure elevated well above flood levels. Truss structure not considered a blockage to flow, and was therefore not accounted for in model HEC-RAS deck feature. Bridge profile reflects the underside of the bridge to the top of the rails. The eastern railway embankment is elevated well above prairie level however drops to prairie level near Lagomodier Boulevard which permits overflow east of the bridge for flows greater than 250,000 cfs. Embankment opening for Seine River and Archibald Avenue accounted for and appropriate flow line and blocks used to reflect flow patterns. The western railway embankment, although high at the bridge, slopes down to prairie level and turns parallel the river permitting overland flow to pass west of the bridge through downtown Winnipeg during larger flood events. (Photographs of bridge not available as of January 29, 2004). (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

CNR – Redditt Subdivision - Bridge Profile as modeled In HEC-RAS – Upstream Side.
Upstream Side of Canadian National Railways – Redditt Sub Bridge – West End.

Upstream Side of Canadian National Railways – Redditt Sub Bridge.

Downstream Side of Canadian National Railways – Redditt Sub Bridge.
C6 Canadian Pacific Railways – Keewatin Subdivision Bridge

Location 54537 metres (HEC-RAS).

Description - Multi-span open truss type structure.

Status - As of 2004, there have been no significant changes to the structure as it existed in 1950.

Hydraulic Modeling Approach - Modeled using HEC-RAS energy method (standard-step) up to the underside of truss structure (120,000 cfs +). Truss structure not considered a blockage to flow, and was therefore not accounted for in model HEC-RAS deck feature. Bridge profile reflects the underside of the bridge to the top of the rails. For water levels greater than the underside of girders, the bridge was modeled using the Pressure method until the water exceeded the deck (railbed) elevation (200,000 cfs +). The railway embankments are elevated and constrict discharge through the bridge opening. The railway embankment is overtopped during large flood events. (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

CPR Keewatin Subdivision Bridge – Bridge Profile as modeled In HEC-RAS – Upstream Side.
Downstream Side of CPR Keewatin Subdivision Bridge.
C7 Louise Bridge

Location - 54051 metres (HEC-RAS).
Description - Multi-span open truss type structure with minor approaches and minimal constriction on flow.
Status - As of 2004, there have been no significant changes to the structure as it existed in 1950.
Hydraulic Modeling Approach - Modeled using HEC-RAS energy method (standard-step) as bridge structure follows natural cross section without constrictive abutments or a deep bridge structure. Truss structure not considered a blockage to flow, and was therefore not accounted for in model HEC-RAS deck feature. Bridge profile reflects the underside of the bridge to the top of the horizontal traffic guardrails (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

Louise Bridge – Bridge Profile as modeled In HEC-RAS – Upstream Side.
Louise Bridge - Upstream Side – Looking West.
Louise Bridge – Bridge Deck.
C8  Redwood Bridge

**Location** - 52448 metres (HEC-RAS).

**Description** - Multi-span open truss type structure with minor approaches and minimal constriction on flow.

**Status** - As of 2004, there have been no significant changes to the structure as it existed in 1950.

**Hydraulic Modeling Approach** - Modeled using HEC-RAS energy method (standard-step) as bridge structure follows natural cross section without constrictive abutments or a deep bridge structure. Truss structure not considered a blockage to flow, and was therefore not accounted for in model HEC-RAS deck feature. Bridge profile reflects the underside of the bridge to the top of the horizontal traffic guardrails (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

Redwood Bridge – Bridge Profile as modeled In HEC-RAS – Upstream Side.
Redwood Bridge - Upstream Side.

Redwood Bridge - Downstream Side - Looking East.
Redwood Bridge - Upstream Side - Looking East.

Redwood Bridge – Centre Section Pivoted.
C9 Canadian Pacific Railways – Bergen Cutoff Bridge

**Location** - 47798 metres (HEC-RAS).

**Description** - Multi-span open truss type structure with elevated railway approaches and centre pivot span.

**Status** - As of 2004, there have been no significant changes to the structure as it existed in 1950.

**Hydraulic Modeling Approach** - Modeled using HEC-RAS energy method (standard-step) as underside of truss structure elevated well above flood levels. Truss structure not considered a blockage to flow, and was therefore not accounted for in model HEC-RAS deck feature. The railway embankments are elevated and constrict discharge through the bridge opening up to flood events of approximately 140,000 cfs before overland flow can occur beyond the eastern and western limits of the railway approach embankments. The hydraulic influence of the railway embankments has been considered and was modeled using the block feature. (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

CPR Bergen Cutoff Bridge – Bridge Profile as modeled In HEC-RAS – Upstream Side.
Downstream Side of CPR Bergen Cutoff Bridge – Note Centre Span Pivoted.
Upstream Side of CPR Bergen Cutoff Bridge – Note Centre Span Pivoted.
C10 St. Andrews Lock and Dam

Location - 25746 metres (HEC-RAS).

Description - a unique water control structure comprised of multiple spillway bays controlled by removable wooden “curtains”.

Status - As of 2004, there have been no significant changes to the structure as it existed in 1950.

Hydraulic Modeling Approach – Structure modeled as a bridge with an elevated cross section, to simulate the spillway, using the energy method (standard-step). The wooden curtains in the spillway bays are used only during low flow open water periods to control water levels upstream through the City of Winnipeg. The curtains are removed during the passage of a flood. The overhead structure is truss bridge, with the underside of the girders elevated well above flood levels. The flow is contained within the structure opening for flows up to 300,000 cfs+ (Refer to photographs). Four cross sections used to model bridge.

St. Andrews Lock and Dam – Bridge/Structure Profile as modeled In HEC-RAS – Upstream Side.
St. Andrews Lock and Dam – Upstream Side – Looking West.

St. Andrews Lock and Dam – Downstream Side – Looking West.
St. Andrews Lock and Dam – Downstream Side – Looking West.
C11 PR 204 Bridge - Selkirk

Location - 14573 metres (HEC-RAS).
Description - Multi-span open truss structure with lift section for boat traffic.
Status - As of 2004, there have been no significant changes to the structure as it existed in 1950.
Hydraulic Modeling Approach - Modeled using HEC-RAS energy method (standard-step) as bridge structure follows natural cross section without constrictive abutments or a deep bridge structure. Under flood events >100,000 cfs, flood flows can pass overland to the east of the bridge. Truss structure not considered a blockage to flow, and was therefore not accounted for in model HEC-RAS deck feature however water levels up to 300,000 cfs to do reach the underside of girder at this location. Bridge profile reflects the underside of the bridge to the top of the horizontal traffic guardrails (Refer to photographs). Four cross sections used to model bridge. Refer to Table C-2 for computed bridge losses.

PR 204 Bridge - Selkirk – Bridge Profile as modeled In HEC-RAS – Upstream Side.
Downstream Side of PR 204 Bridge (Selkirk) – Note Centre Lift Span.

Downstream Side of PR 204 Bridge (Selkirk) – Note Centre Lift Span.
Upstream Side of PR 204 Bridge (Selkirk).