CITY OF TORONTO

Hydraulic Report

Rouge Park Bridges Transportation Master Plan

November 2020 - 19-1924

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1.0 Introduction

Dillon Consulting Limited (Dillon) has been retained by the City of Toronto (the City) to complete a Transportation Master Plan Environmental Assessment (TMPEA) for the following five bridges located within the Rouge National Urban Park (RNUP), Ontario (the Project):

- Sewell's Road Bridge;
- Milne's Bridge;
- Hillside Bridge;
- Maxwell's Bridge; and
- Stott's Bridge.

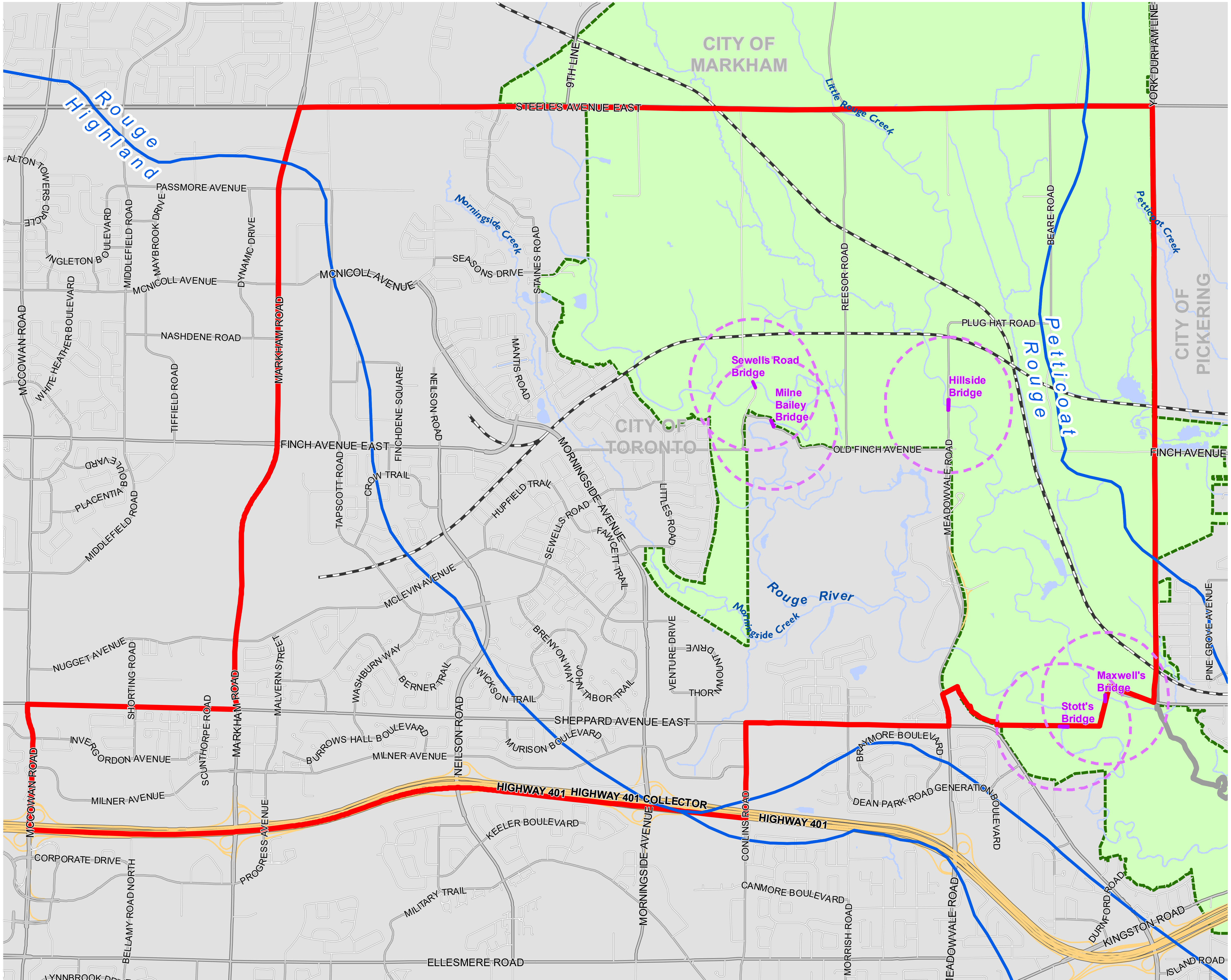
As part of the EA, Dillon completed a hydraulic assessment of the existing bridges. The hydraulic assessment was completed based on available regulatory modelling and design flow data, no new analysis or field work was performed to gather additional data or verify the existing hydrologic or hydraulic models. The purpose of this report is to characterize the existing hydraulic conditions at each crossing and provide hydraulic design guidance if changes to the existing structures are proposed.

1.1 Study Area

The western and southwestern portions of the Project Study Area are located within the Highland Creek watershed, while the remainder of the Project Study Area is located within the Rouge River watershed. The Highland Creek watershed drains an area of approximately 102 km^2 (TRCA, 2020a) and is highly urbanized, with 89% urban land cover and 11% natural cover (TRCA, 2018a). Key issues in the Highland Creek watershed include urban stormwater runoff, habitat loss and fragmentation, and invasive species (TRCA, 2018a).

The Rouge River watershed area is approximately 336 km^2 and includes all of the lands which drain to the Rouge River and its tributaries, including Little Rouge River (TRCA, 2020b). Land cover in the watershed is approximately 40% rural, 35% urban, 24% forest/wetland/meadow, and 1% watercourses/water bodies (TRCA, 2020b). Key issues in this watershed include increased urbanization, stormwater runoff, and habitat protection, including a fish Species at Risk (SAR), Redside Dace (*Clinostomus elongatus*) (TRCA, 2018b).

The five watercourse crossings within the study area are located in the Rouge River Watershed. TRCA divides the Rouge River watershed into five subwatersheds – Little Rouge, Middle Tributaries, Upper Rouge/Beaver Creek, Morningside Creek, and Lower Rouge. Sewell's Road Bridge, Milne's Bridge and Stott's Bridge are located in the Lower Rouge River subwatershed, while Hillside Bridge and Maxwell's Bridge are located in the Little Rouge River sub-watershed. The locations of the five crossing are presented on **Figure 1**.



ROUGE PARK BRIDGES TMP

FIGURE 1
PROJECT LOCATION

- Project Study Area
- Watershed Boundary
- Rouge National Urban Park Boundary
- Bridge Location
- Project Focus Area
- Railway
- Municipal Boundary
- Water Body

SCALE 1:30,000

0 250 500 1,000 1,500 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNRF, CITY OF TORONTO

MAP CREATED BY: ATC
MAP CHECKED BY: NE
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 191924

DATE: 2020-11-11

FILE LOCATION: C:\Users\31atc\Documents\00_Projects\19-1924 - Rouge River EA\191924 - Rouge Park TMP EA_USE E DRIVE\191924 - Rouge Park TMP EA_USE E DRIVE\mxd\Natural Heritage Existing Conditions Memo\Figure 1 Project Location.mxd

1.2 Background Information

The following background information was reviewed to assist with preparation of the hydraulic assessment:

- The following drawings for the five crossings:
  - Gregg and Edens Limited (July 1987). Drawing Set – Repairs to Sewells Road Bridge
  - Sandwell Swan Wooster (June 1988). Drawing Set – Finch Ave Bailey Bridge Replacement
  - Totten Sims Hubick Associates (May 1997). Drawing Set - Structural Rehabilitation of the Maxwell's Bridge on Twyn Rivers Drive
  - Totten Sims Hubicki Associates (May 1997). Drawing Set - Structural Rehabilitation of the Stott's Bridge on Twyn Rivers Drive
  - Wyllie & Ufnal (August 1986). Drawing Set – Rehabilitation of Hillside Bridge
- TRCA provided the following models:
  - PCSWMM hydrologic model for the Rouge River Watershed, including relevant background reports
  - Hydrologic Engineering Centers River Analysis System (HEC-RAS) modelling of the Rouge River and its tributaries
- Bridge Inspection Reports:
  - Associates Engineering (2013a). Multiple Bridge Inspection and Rehabilitation in North-East Scarborough – Sewells Road Bridge Over Rouge River (Bridge No.812). City of Toronto Contract 12SE-10S.
  - Associates Engineering (2013b). Multiple Bridge Inspection and Rehabilitation in North-East Scarborough – Old Finch Avenue Over Rouge River (Bridge No.813). City of Toronto Contract 12SE-10S
  - Associates Engineering (2013c). Multiple Bridge Inspection and Rehabilitation in North-East Scarborough – Twyn Rivers Drive Over Little Rouge River (Bridge No.802). City of Toronto Contract 12SE-10S
  - Associates Engineering (2013d). Multiple Bridge Inspection and Rehabilitation in North-East Scarborough – Twyn Rivers Drive Over Rouge River (Bridge No.803). City of Toronto Contract 12SE-10S
  - MMM Group (2017). Meadowvale Road Bridge - Bridge No. 806 – Structural Steel Inspection and Fatigue Analysis Report
- Site visits and existing condition stream assessments were completed as part of this EA process. The following memo was used as a reference for the existing site conditions:
  - Dillon Consulting Limits (2020). DRAFT Natural Heritage Existing Conditions Memo – Rouge Park Bridges Transportation Master Plan Environmental Assessment.

2.0 Existing Bridges

A brief description of the study area bridges is presented below.

2.1 Sewell's Road Bridge

The Sewell's Road Bridge is located on Sewell's Road between Steele's Avenue East and Old Finch Avenue and spans the Rouge River. The Sewell's Road Bridge, constructed in 1912, is a three span "stiffened" suspension bridge with pinned tower bases and an exposed concrete deck that carries one lane of Sewell's Road over the Rouge River (Associates Engineering, 2013a). The existing structure is shown on Error! Reference source not found..

Figure 2 - Sewell's Road Bridge (November, 2019)

The 2020 Natural Heritage Existing Conditions Memo notes that the bankfull width of the Rouge River at the crossing is approximately 25 m, with a bankfull depth of approximately 3 m. In addition, the information presented in the inspection report suggest that sediment deposition is occurring on the southern bank, while the northern bank downstream of the bridge was observed to be heavily eroded.

2.2 Milne's Bridge

Milne's Bridge is located on Old Finch Avenue between Sewell's Road and Reesor Road, over the Rouge River. Milne's Bridge, constructed in 1988, is a two span Bailey truss bridge with re-enforced concrete abutments and a timber bent pier supported by timber piles. The steel grated deck carries one narrow lane of traffic from Old Finch Avenue Drive over the Rouge River, the one lane is controlled by traffic lights on either end of the crossing (Associates Engineering, 2013b). The existing structure is shown on **Figure 3**.

Figure 3 – Milne's Bridge (November, 2019)

The 2020 Natural Heritage Existing Conditions Memo notes that the bankfull width of the Rouge River at the crossing is approximately 15 m, with a bankfull depth of approximately 2 m. In addition, both banks appeared to be protected from erosion.

2.3 Hillside Bridge

The Hillside Bridge is located on Meadowvale Road Drive between Plug Hat Road and Old Finch Ave, over the Little Rouge River. The Hillside Bridge, constructed between 1905 and 1932 and rehabilitated in 1985 , is a single span steel-beam pony truss bridge with a steel grated deck that carries one lane of traffic over the Little Rouge River (MMM Group, 2017). The existing structure is shown on **Figure 4**.

Figure 4 – Hillside Bridge (October, 2020)

The 2020 Natural Heritage Existing Conditions Memo notes that the bankfull width of the Rouge River at the crossing is approximately 30 m, with a bankfull depth of approximately 5 m. In addition, erosion of both banks was observed both upstream and downstream of the existing structure.

2.4 Maxwell's Bridge

Maxwell's Bridge is located on Twyn Rivers Drive northeast of Shepperd Avenue East, over the Little Rouge River. The Maxwell's Bridge, constructed in 1927, and is a single span concrete bowstring through arch bridge with a concrete deck carrying two narrow lanes of Twyn Rivers Drive over the Little Rouge River (Associates Engineering, 2013c). The existing structure is shown on **Figure 5**.

Figure 5 - Maxwell's Bridge (October, 2020)

The 2020 Natural Heritage Existing Conditions Memo notes that the bankfull width of the Little Rouge River at the crossing is approximately 15 m, with a bankfull depth of approximately 1.5 m. In addition, undercutting of the south bank was observed, while sediment deposition was observed on the north bank.

2.5 Stott's Bridge

Stott's Bridge is on Twyn Rivers Drive north-east of Sheppard Avenue East, over the Rouge River. The Stott's Bridge, constructed in 1997, is a single span steel Warren pony truss bridge with a steel grated deck that carries one lane of traffic over the Rouge River (Associates Engineering, 2013d). The existing structure is shown on **Figure 6**.

Figure 6 - Stott's Bridge (November, 2019)

The 2020 Natural Heritage Existing Conditions Memo notes that the bankfull width of the Rouge River at the crossing is approximately 20 m, with a bankfull depth of approximately 2 m. The banks underneath the existing structure are armoured, however upstream of the crossing the eastern bank is heavily eroded with a steep exposed sandy sections.

3.0 Hydraulic Model Review

Hydraulic and hydrologic modelling of the study river reaches that include the subject bridges was obtained from TRCA. The hydraulic model was prepared using the Hydrologic Engineering Center's River Analysis System (HEC-RAS). The design flows used in the hydraulic model were calculated using a PCSWMM hydrologic model that has been calibrated to represent existing conditions within the watershed (Wood, 2018). Dillon did not review the hydrologic model inputs or results, as this was beyond the scope of the current assignment.

A summary of the existing bridge locations in the HEC-RAS model is presented in Error! Reference source not found..

Table 1: HEC-RAS Bridge Location Summary

Parameter	Sewell's Road Bridge	Milne's Bridge	Hillside Bridge	Maxwell's Bridge	Stott's Bridge
River (model ID)	Lower Rouge	Lower Rouge	Little Rouge	Little Rouge	Lower Rouge
Reach (model ID)	Reach 3	Reach 3	Reach 2	Reach 1	Reach 2
Station	4687.265	3030.782	1268.599	2504.845	4391.447

Dillon completed a review of the available hydraulic model and compared the input values with the available site data to evaluate whether they are representative of the existing site conditions near the study area bridges. A summary of the review results and corresponding recommendations is presented below.

3.1 Cross Sections

- The main channel portion of the cross sections within the study reaches have flat bottoms. This suggests that the modelled bathymetry may not accurately represent the actual river bed. No terrain source information was provided with the model documentation.
- Manning's roughness coefficients of 0.035 are assigned to the channels and values of 0.08 are assigned to the overbanks at all of the reviewed cross sections. Based on the guidance presented in the Hydraulic Reference Manual (USACE, 2016), the channel Manning's roughness coefficient may not be representative of existing conditions within the reach based on available site photos. A higher Manning's roughness coefficient between 0.04 and 0.05 may more accurately represent hydraulic losses, but this should be confirmed on a reach by reach basis. Additionally, the Hydraulic Reference Manual suggests that a Manning's roughness coefficient of 0.08 is representative of floodplains with medium to dense brush, in the summer; this is fairly representative of the observed site conditions. However this should be confirmed on a reach by reach basis.
- Split flow occurs at several cross sections within the study reaches. Dillon recommends that these sections are reviewed to verify whether split flow is an accurate representation of high flow

conditions. If not, levees or ineffective flow calculations options should be considered to accurately represent the cross section conveyance.

- Bank station locations do not appear to be accurately set at the top of bank of each cross section, based on the guidance presented in the Hydraulic Reference Manual (USACE, 2016) and Computation of Water-Surface Profiles in Open Channels (USGS, 1984). This may affect the accuracy of the hydraulic model results within the study reach.
- Several cross sections do not include sufficient ground elevation points to fully contain the flows for higher return period events. These cross sections should be extended to contain the entirety of the flow for all evaluated design events.
- Blocked obstructions are used to represent buildings within the floodplain.
- Expansion and contraction coefficients at open reach cross sections are 0.1 and 0.3, respectively. Expansion coefficients of 0.3 and contraction coefficients of 0.5 are assigned at hydraulic structures in accordance with the guidance presented in the Hydraulic Reference Manual (USACE, 2016).

3.2 Structures

- A comparison of the geometry used to represent the bridges in the HEC-RAS model with the actual bridge information from the as-built drawings and inspection reports is presented in **Table 2**. The data show there are differences between the bridge geometry data used in the HEC-RAS model and the available background documentation. The geometry of each structure should be field surveyed to confirm the actual bridge dimensions and the HEC-RAS model should be updated if necessary.
- Under low flow conditions, energy losses through the subject bridges are calculated using the highest energy answer of the energy and momentum equations. Energy losses under high flow conditions are calculated using the pressure and/or weir equations with the exception of the Hillside Bridge, which uses the energy only equation during high flow conditions. This approach is reasonable for the Hillside Bridge since the model results suggest that the calculated water surface is well below the bridge low chord elevation for all of the modelled design events.
- Ineffective flow areas are input at watercourse crossings in accordance with the guidance presented in the Hydraulic Reference Manual (USACE, 2016), with the exception of the Milne’s Bridge which has the left bank ineffective flow area extending into the hydraulic opening of the structure.

Table 2: Comparison of Bridge Geometry from HEC-RAS and As-Built Drawings/Inspection Reports

Bridge	Source	Opening Span (m)	Deck Width (m)	Low Cord Elevation (mASL)	High Cord Elevation (mASL)	Edge of Pavement Elevation (mASL)	Number of Piers	Pier Width (m)
Sewell's	Modelled	47	4	129.63	129.89	-	2	1.7
	Actual	48.77	5.79	130.1	131.8	130.46	2	1.14
Milne	Modelled	60	4	122.23	123.23	-	1	4
	Actual	57.95	6.4	122.37	-	123.3	1	2.4
Hillside	Modelled	24.44	6	131.03	131.7	-	0	-
	Actual	24.68	5.14	130.85	-	-	0	-
Maxwell's	Modelled	18	10.5	88.15	89.15	-	0	-
	Actual	19.03 18.26	7.51	-	-	88.67	0	-
Stott's	Modelled	21.5	5	88.09	89.07	-	0	-
	Actual	22.01	4.7	-	-	-	0	-

3.3 Model Results

- Critical depth was assumed at several locations within the study reaches to calculate the corresponding water surface profile for several of the evaluated design events. This may suggest that there are regions of supercritical flow within the study reaches, which may affect the accuracy of the computed water surface profiles at the subject bridges. This should be further investigated to evaluate whether a mixed flow model may be necessary to accurately evaluate the reach hydraulics.
- High changes in velocity head and conveyance ratios were observed at some cross sections within the study reaches, which could indicate the need for additional cross sections.

3.4 Model Accuracy

The hydraulic model appears to provide a reasonable representation of the river reaches that include the subject bridges. Consequently, the corresponding results are likely sufficiently accurate to evaluate the bridge hydraulics for the purposes of the Rouge Park Bridges Transportation Master Plan EA. However, prior to detailed design, the following items identified through the model review should be addressed:

- The modelled channel geometry should be compared with surveyed channel sections to verify that the channel bathymetry is accurately represented;
- Model cross sections should be extended to verify that they contain all evaluated design flows;
- The bridge dimensions and elevations should be surveyed and the corresponding HEC-RAS model inputs should be updated, if necessary;
- Ineffective flow locations at the Milne's Bridge should be verified;

- The channel reach profile should be reviewed to evaluate whether mixed flow conditions likely occur, and corresponding boundary conditions should be developed; and
- If sufficient appropriate data are available, the hydraulic model should be calibrated.

4.0 MTO Hydraulic Design Criteria

Dillon reviewed the MTO's Highway Drainage Design Standards (HDDS) (2008) to identify the corresponding hydraulic design criteria at the existing bridges, as summarized in **Table 3**.

Table 3: MTO Design Criteria

Design Criteria	Sewell's	Milne	Hillside	Maxwell's	Stott's
Road Name	Sewell's Road	Old Finch Avenue	Meadowvale Road	Twyn Rivers Drive	Twyn Rivers Drive
Road Classification	Local Road	Collector	Collector	Collector	Collector
Design Flow [1]	1:25 Year	1:50 Year	1:50 Year	1:50 Year	1:50 Year
Check Flow[2]	100 Year	115% of 100 Year	115% of 100 Year	115% of 100 Year	115% of 100 Year
Freeboard[3]	≥ 0.3 m	≥ 1.0 m	≥ 1.0 m	≥ 1.0 m	≥ 1.0 m
Clearance[4]	≥ 0.3 m	≥ 1.0 m	≥ 1.0 m	≥ 1.0 m	≥ 1.0 m

[1] MTO HDDS 2008, WC-1 Section 1.1.1– Total Span > 6 m.

[2] MTO HDDS 2008, WC-1 Section 1.1.1 – Check flow shall not overtop structure.

[3]MTO HDDS 2008, WC-2 Section 3.2.1 – Calculated distance between the design flow WSE and edge of travel lane elevation.

[4] MTO HDDS 2008, WC-2 Section 3.2.2, calculated based on the design flow WSE and the minimum soffit elevation.

5.0 Existing Bridge Hydraulics

A summary of the hydraulic model results at the existing bridges is provided below.

5.1 Sewell's Road Bridge

The calculated maximum water surface elevations (WSE) for the 2 to 350 year, and the Regional Storm events at Sewell's Road Bridge are summarized in **Table 4**. The hydraulic model results suggest that the existing structure meets the MTO design criteria for clearance, freeboard and check flow rate. In addition, the existing structure is only overtopped during the Regional Storm Event.

Table 4: Sewell's Road Bridge Existing Conditions

Flood Event	Flow (m^3/s)	Calculated Upstream WSE[1] (mASL)	Calculated Downstream WSE[2] (mASL)	Freeboard [3] (m)	Clearance [4] (m)
2-Year	22.23	125.34	125.23	5.12	3.34
5-Year	44.14	125.83	125.70	4.63	2.85
10-Year	61.42	126.09	125.91	4.37	2.59
25-Year[5]	92.73	126.51	126.20	3.95	2.17
50-Year	122.96	126.88	126.44	3.58	1.80
100-Year	155.00	127.24	126.55	3.22	1.44
350-Year	286.89	128.56	127.94	1.90	0.12
Regional	665.78	130.52	129.11	-	-

[1] Calculated values at HEC-RAS cross section 4695.849.

[2] Calculated values at HEC-RAS cross section 4678.375.

[3] Calculated based on edge of travel lane elevation of 130.46 m.

[4] Calculated based on minimum soffit elevation.

[5] Design event as per MTO design Criteria.

5.2 Milne's Bridge

The calculated WSE for the 2 to 350 year, and the Regional Storm events at the Milne's Bridge are summarized in **Table 5**. The hydraulic model results suggest that the existing structure meets the MTO design criteria for clearance and freeboard. Hydraulic calculations were not performed to evaluate the check flow (115% of the 100 year return period), but the results show that the structure is not overtopped during the 350 year event, which is more than check flow. Therefore, the existing structure meets the check flow design criteria as well.

Table 5: Milne's Bridge Existing Conditions

Flood Event	Flow (m^3/s)	Calculated Upstream WSE[1] (mASL)	Calculated Downstream WSE[2] (mASL)	Freeboard [3] (m)	Clearance [4] (m)
2-Year	22.23	117.77	117.38	5.53	4.46
5-Year	44.14	118.38	117.95	4.92	3.85
10-Year	61.42	118.68	118.27	4.62	3.55
25-Year	92.73	119.19	118.53	4.11	3.04
50-Year[5]	122.96	119.55	118.70	3.75	2.68
100-Year	155.00	119.88	118.84	3.42	2.35
350-Year	286.89	120.52	119.74	2.78	1.71
Regional	665.78	123.45	121.73	-	-

[1] Calculated values at HEC-RAS cross section 3039.615.

[2] Calculated values at HEC-RAS cross section 3020.872.

[3] Calculated based on edge of travel lane elevation of 123.30 m.

[4] Calculated based on minimum soffit elevation.

[5] Design event as per MTO design Criteria.

5.3 Hillside Bridge

The calculated WSE for the 2 to 350 year, and the Regional Storm events at the Hillside Bridge are summarized in **Table 6**. Hydraulic calculations were not performed to evaluate the check flow (115% of the 100 year return period), but the results show that the structure is not overtopped during the 350 year event, which is more than check flow. Therefore, the existing structure meets the check flow design criteria as well.

Table 6: Hillside Bridge Existing Conditions

Flood Event	Flow (m^3/s)	Calculated Upstream WSE[1] (mASL)	Calculated Downstream WSE[2] (mASL)	Freeboard [3] (m)	Clearance [4] (m)
2-Year	18.03	124.86	124.31	6.84	6.17
5-Year	27.16	125.12	124.58	6.58	5.91
10-Year	36.66	125.34	124.81	6.36	5.69
25-Year	51.55	125.64	125.13	6.06	5.39
50-Year[5]	61.68	125.82	125.31	5.88	5.21
100-Year	71.00	125.96	125.45	5.74	5.07
350-Year	126.65	126.70	126.19	5.00	4.33
Regional	279.44	128.43	127.94	3.27	2.60

[1] Calculated values at HEC-RAS cross section 1280.451.

[2] Calculated values at HEC-RAS cross section 1254.999.

[3] Calculated based on edge of travel lane elevation of 123.30 m.

[4] Calculated based on minimum soffit elevation.

[5] Design event as per MTO design Criteria.

5.4 Maxwell's Bridge

The calculated WSE for the 2 to 350 year, and the Regional Storm events at Maxell's Bridge are summarized in **Table 7**. The existing structure meets the MTO design criteria for freeboard but not for clearance. Hydraulic calculations were not performed to evaluate the check flow (115% of the 100 year return period), but the results show that the structure is not overtopped during the 350 year event, which is more than check flow. Therefore, the existing structure meets the check flow design criteria as well.

Table 7: Maxwell's Bridge Existing Conditions

Flood Event	Flow (m^3/s)	Calculated Upstream WSE[1] (mASL)	Calculated Downstream WSE[2] (mASL)	Freeboard [3] (m)	Clearance [4] (m)
2-Year	19.19	86.49	86.09	2.18	1.66
5-Year	29.72	86.78	86.34	1.89	1.37
10-Year	39.70	86.98	86.51	1.69	1.17
25-Year	54.45	87.11	86.72	1.56	1.04
50-Year[5]	65.76	87.33	86.87	1.34	0.82
100-Year	76.73	87.53	86.99	1.14	0.62
350-Year	137.08	88.56	87.56	0.11	-
Regional	294.57	89.45	88.44	-	-

[1] Calculated values at HEC-RAS cross section 2519.924.

[2] Calculated values at HEC-RAS cross section 2488.285.

[3] Calculated based on edge of travel lane elevation of 123.30 m.

[4] Calculated based on minimum soffit elevation.

[5] Design event as per MTO design Criteria.

5.5 Stott's Bridge

The calculated maximum water surface elevations (WSE) for the 2 to 350 year, and the Regional Storm events at Stott's Bridge are summarized in **Table 7**. The existing structure meets the MTO design criteria for freeboard but not for clearance. The check storm (115% of the 100 year return period) was not assessed, since the structure is overtopped during the 350 year event (approximately 183% of the 100 year event) it is unknown whether the structure meets the check flow design criteria. Additional analysis is required to evaluate whether the existing structure meets this design criteria

Table 8: Stott's Bridge Existing Conditions

Flood Event	Flow (m^3/s)	Calculated Upstream WSE[1] (mASL)	Calculated Downstream WSE[2] (mASL)	Freeboard [3] (m)	Clearance [4] (m)
2-Year	23.72	85.87	85.59	3.20	2.22
5-Year	46.86	86.39	86.14	2.68	1.70
10-Year	65.16	86.72	86.48	2.35	1.37
25-Year	96.54	87.15	86.85	1.92	0.94
50-Year[5]	127.4	87.58	87.09	1.49	0.51
100-Year	160.06	88.47	87.32	0.60	-
350-Year	292.42	89.19	87.95	-	-
Regional	733.36	90.08	90.40	-	-

[1] Calculated values at HEC-RAS cross section 4407.875.

[2] Calculated values at HEC-RAS cross section 4377.297.

[3] Calculated based on edge of travel lane elevation of 123.30 m.

[4] Calculated based on minimum soffit elevation.

[5] Design event as per MTO design Criteria.

5.6 Bridge Hydraulics Summary

The results of the preliminary hydraulic assessment suggest that the Sewell's Road Bridge, Milne's Bridge and Hillside Bridge meet the current MTO hydraulic design criteria. Maxwell Bridge and Stott's Bridge do not meet the current MTO hydraulic design criteria. A summary of the applicable MTO criteria is summarized in Error! Reference source not found..

Table 9: Design Criteria Summary

Design Criteria	Sewell's	Milne Bailey	Hillside	Maxwell's	Stott's
Freeboard	Yes	Yes	Yes	Yes	Yes
Clearance	Yes	Yes	Yes[1]	**No**	**No**[1]
Check Flow	Yes	Yes[2]	Yes[2]	Yes[2]	**No**[2]

[1] Calculated based on High Cord because edge of travel lane information is unavailable.

[2] Based on 350 year design storm which is larger than the check storm.

6.0 Conclusions and Recommendations

The hydraulic assessment results suggest that the existing Sewell's Road Bridge, Milne's Bridge and Hillside Bridge meet the current MTO hydraulic design criteria but Maxwell Bridge and Stott's Bridge do not. The following minimum design criteria should be applied to any proposed replacement structures at the existing bridge locations.

Table 10: Minimum Bridge Design elevations

Minimum Elevation	Sewell's	Milne Bailey	Hillside	Maxwell's	Stott's
Low Cord	126.81	120.88	126.96	88.53	89.47
High Cord	127.24	120.52[1]	126.70[1]	88.56[1]	89.19[1]
Edge of Pavement	126.81	120.88	126.96	88.53	89.47

[1]Based off of 1:350-year WSE which is higher than the Check Flow.

References

Associates Engineering (2013a). Multiple Bridge Inspection and Rehabilitation in North-East Scarborough – Sewells Road Bridge Over Rouge River (Bridge No.812). City of Toronto Contract 12SE-10S.

Associates Engineering (2013b). Multiple Bridge Inspection and Rehabilitation in North-East Scarborough – Old Finch Avenue Over Rouge River (Bridge No.813). City of Toronto Contract 12SE-10S

Associates Engineering (2013c). Multiple Bridge Inspection and Rehabilitation in North-East Scarborough – Twyn Rivers Drive Over Little Rouge River (Bridge No.802). City of Toronto Contract 12SE-10S

Associates Engineering (2013d). Multiple Bridge Inspection and Rehabilitation in North-East Scarborough – Twyn Rivers Drive Over Rouge River (Bridge No.803). City of Toronto Contract 12SE-10S

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