YORK REGION

CLASS ENVIRONMENTAL ASSESSMENT STUDY FOR IMPROVEMENTS TO LANGSTAFF ROAD FROM WESTON ROAD TO HIGHWAY 7

PRELIMINARY STRUCTURAL DESIGN REPORT
BOWES BRIDGE (WEST DON RIVER CROSSING)

NOVEMBER 26, 2021

wsp

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BOWES BRIDGE (WEST DON RIVER CROSSING)

YORK REGION

PROJECT NO.: 16M-01457-01

DATE: NOVEMBER 26, 2021

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Prepared by	Reviewed by			
Han Choi, P.Eng.	Steven Huang, P.Eng.			

SIGNATURES

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Senior Project Engineer

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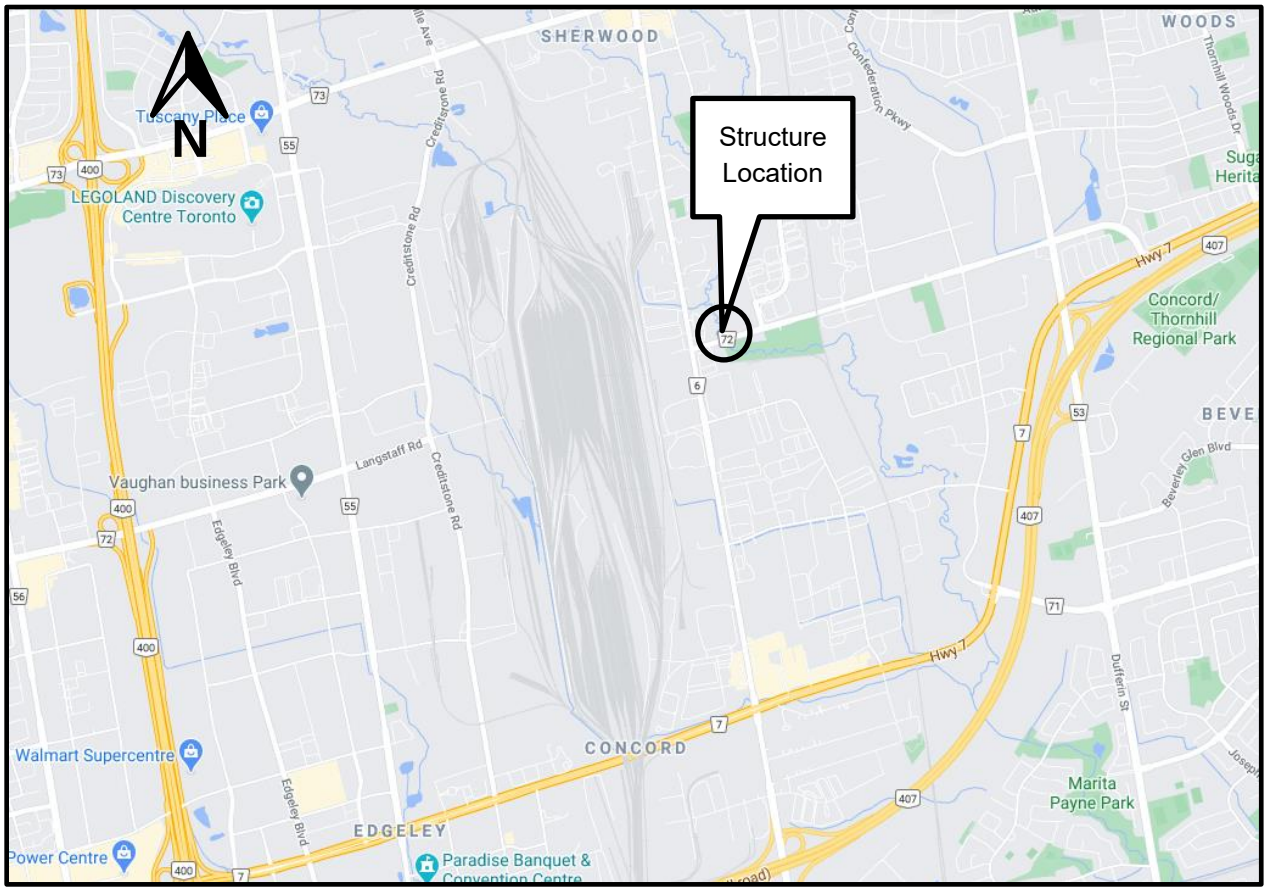
KEY PLAN



Bowes Bridge West Don River Crossing

1 INTRODUCTION

The Regional Municipality of York (York Region) retained WSP Canada Inc. (WSP) to undertake the Municipal Class Environmental Assessment (MCEA) Study of Langstaff Road from Weston Road to Highway 7 in the City of Vaughan.

As part of the study, the proposed improvements on Langstaff Road include:

- Widening of Langstaff Road to six lanes from Weston Road to Dufferin Street;
- A connection across the CN MacMilan Yard from Creditstone Road to Keele Street;
- Replacement of the existing bridge over the West Don River;
- New bridge over at Metrolinx GO Transit Barrie Line;
- Intersection improvements; and
- Improvements of pedestrian and cycling facilities, and provision for transit amenities.

The following Preliminary Structural Design Report (PSDR) presents structural recommendation for the bridge replacement over the West Don River.

2 EXISTING STRUCTURE

2.1 STRUCTURE LOCATION

Bowes Bridge is located on Langstaff going over the West Don River approximately 180 m east of Keele Street. The location of the existing structure is indicated on the Key Plan. For the purpose of this report, Langstaff Road is assumed to run in the east-west direction.

2.2 STRUCTURE DESCRIPTION

Constructed in 1964, the existing structure is a single span side-by-side prestressed precast hollow slab structure over the West Don River with a 15° skew to the roadway. The structure spans over the West Don River with a clear span of 10.67 m perpendicular to the bridge. The deck has a total width of 11.885 m and accommodates a single lane in each direction. The 150 mm thick reinforced concrete deck was placed over 500 mm deep precast hollow girders during the rehabilitation in 1995. There are 6.0 m long (measured along the skew), 250 mm thick approach slabs at the east and west ends of the structure. A total depth of 90 mm layers waterproofing and asphalt are placed on top of the bridge.

The abutments are comprised of cast-in-place reinforced concrete stem walls. The foundation type of the abutment was not identified due to the absence of original drawings. There are retaining walls at each corner of the structure fanning toward the river. The abutments, wingwalls and retaining walls are constructed of reinforced concrete.

Representative photographs can be found in the City's OSIM reports.

2.3 REHABILITATION HISTORY

In 1995, the following rehabilitation works were completed on the structure under Contract No. 15-93-112:

- Removal of existing curb and parapet walls;
- Removal of existing asphalt pavement;
- Removal of existing ballast wall, a portion of wing walls and curtain walls;
- Removal of loose grout in existing shear key between the precast hollow beams;
- Concrete patch repairs on existing deck top surface;
- Concrete patch repairs on existing abutment face, wingwalls and retaining walls;
- New 150 mm thick reinforced normal concrete overlay on top of existing precast hollow beams;
- New 6.0 m approach slabs (250 mm thick);
- New asphalt and waterproofing system (90 mm total) on deck and approach slabs;
- New concrete sidewalk at north side of the bridge;
- New concrete barrier wall with railings;
- Reconstruction of top of wingwalls and deck fascia;

- New expansion joint; and
- New steel beam guide rail end connections at each quadrant of the bridge.

See Figure 1 below for the plan and sections of the structure from the 1993 contract drawings.

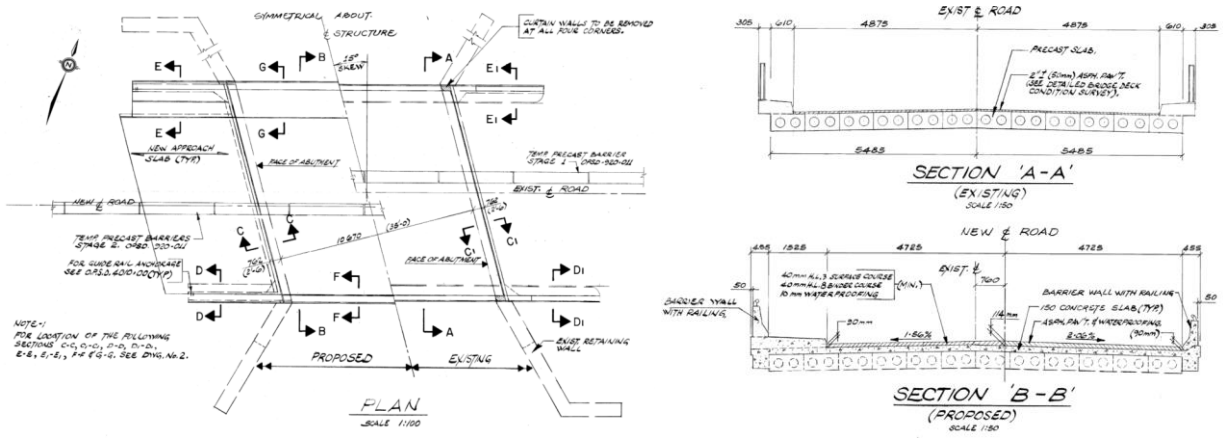


Figure 1: Plan and Sections from 1993 Contract Drawings

2.4 AVAILABLE BACKGROUND INFORMATION

The following background information were made available to the Project Team for review.

- Rehabilitation drawings from 1993 (Contract No. 15-93-112).
- Two OSIM reports (September 15, 2014 and January 6, 2017).

2.5 ROADWAY (LANGSTAFF ROAD)

The existing bridge has one eastbound lane and one westbound lane.

The roadway cross-section comprises of the following from North to South:

- 0.455 m north barrier wall
- 1.525 m north sidewalk
- 4.275 m shoulder and westbound lane
- 4.275 m eastbound lane and shoulder
- 0.455 m south barrier wall

Figure 2 shows a cross-section of the existing bridge from the 1993 contract drawings.

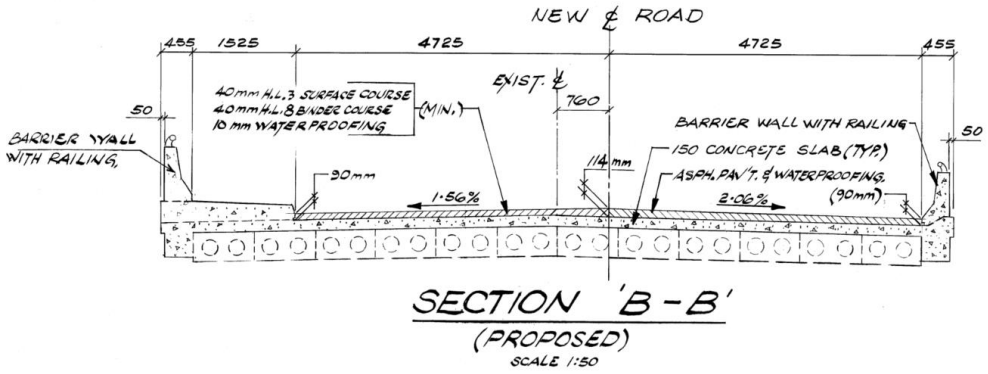


Figure 2: Existing Cross-Section

2.6 TRAFFIC DATA

The posted speed along this section of Langstaff Road is 60 km/h.

The average daily traffic (ADT) volumes were 14, 836 vehicles (November 2014) and 18,125 vehicles (June 2015). The percentages of trucks were 6.6% and 5.6%, respectively.

2.7 POTENTIALLY HAZARDOUS MATERIALS

Based on the review of the existing rehabilitation drawings (1993) and the site visit for annual OSIM inspection carried by WSP on June 2018, there were no potentially hazardous materials. Detailed investigation should be carried out at the detail design stage.

2.8 INSPECTION SUMMARY

2.8.1 GENERAL

The following summarizes the results of the OSIM inspection completed on June 12, 2018. The investigation included a detailed visual inspection and delamination and deterioration survey of all accessible components. The detailed visual inspection included an element-by-element close-up visual assessment of material defects and performance deficiencies of the structures, in accordance with the *Ontario Structure Inspection Manual, May 2018* (OSIM).

The structure was found to be generally in good condition except for some localized areas that are in fair to poor conditions. The findings from the inspection were documented in the OSIM report which is available upon request from the Region.

2.8.2 WEARING SURFACE AND DECK TOP

The structure features an asphalt wearing surface on the deck and approach slabs. The asphalt wearing surface was found to be in fair to poor condition with narrow to wide cracks, narrow map cracking, and minor wheel track rutting. Major settlement was also found on the westbound

lane close to the centre line of road. Previous patching work was also observed near the east expansion joint location.

2.8.3 BARRIER WALLS AND DECK ROADSIDE SAFETY

The barrier walls on the structure were found to be generally in fair condition with narrow vertical cracks, light scaling, wet areas, spalling on north barrier wall at the east expansion joint locations. Staining was also observed around the cracks and wet areas. Minor delamination and spalling were also found at the southwest end.

2.8.4 SOFFIT

The soffit was found to be generally in fair condition with delamination, water staining, rust staining, and medium to wide longitudinal cracks. Concrete spall was also observed on the west end of the soffit exhibiting exposed reinforcing steel bars and rust stains. Wet areas were also found between the precast beams.

2.8.5 ABUTMENTS AND WINGWALLS

The abutment walls were concrete patch repaired during the previous rehabilitation in 1995. The abutment walls and patch repairs were found to be in generally good condition with light scaling and narrow cracks throughout. The condition of the ballast wall could not be investigated as the ballast wall was blocked by the precast beams.

The wingwalls were found to be generally ingood condition. Minor staining and light scaling were identified on wingwalls.

2.8.6 RETAINING WALLS

The retaining walls at four corners of the bridge fanning toward the river were found to be generally in fair to good condition with light to medium scaling and localized delamination. Spalls and vertical cracks were also identified at the southwest retaining wall edge with rust stains.

2.8.7 APPROACHES

The asphalt wearing surface on the approach slabs was found to be generally in fair to poor condition. Medium to wide cracks were identified at the ends of the approaches. Large potholes were observed on the northeast approach at the face of the approach slab. Shoving was also found at the curb at both east and west ends.

The Steel Beam Guide Rail (SBGR) on the approaches was found to be in generally good condition.

3 GEOTECHNICAL INVESTIGATION AND RECOMMENDATIONS

3.1 GENERAL

A geotechnical investigation was carried out by Thurber Engineer Ltd. (Thurber) on behalf of WSP. The findings are provided in the Preliminary Geotechnical Investigation Report dated on February 11, 2021.

The following summarizes the findings of the investigation and recommendations.

3.2 EXISTING CONDITIONS AND FOUNDATION RECOMMENDATIONS

3.2.1 SUB-SURFACE CONDITIONS

The stratigraphy encountered in Borehole 19-11 drilled at the bridge location consisted of a pavement structure and embankment fill extending to a depth of 4.1 m (Elev. 195.7), underlain by loose alluvial sand, loose sand, and compact silt and sand to a depth of 9.5 m (Elev. 190.4), overlying very stiff to hard silty clay till. The upper clay till layer was underlain at 14.8 m depth (Elev. 185.0) by a 2.0 m thick layer of very dense sand, and then hard silty clay till contracted to the exploration depth of 21.7 m. Groundwater was measured in the monitoring well at a depth of 3.6 m (Elev. 196.2). This water level is expected to be near the water lever in the West Don River.

3.2.2 FOUNDATION DESIGN RECOMMENDATIONS

Based on the borehole data, the preferred means of supporting the replacement bridge comprises steel H-piles driven into the very dense sand to hard clay till. For preliminary design purpose, a factored geotechnical resistance at ULS of 1,200 kN and a factored geotechnical resistance at SLS of 1,000 kN are recommended for HP310x110 piles. The piles are expected to achieve the recommended resistance at a pile tip depth in the order of 18 m (Elev. 182.0).

The use of H-piles at the abutment allows for the design of an integral abutment structure. To reduce resistance to lateral movement and provide a relatively flexible pile system, the top of each pile should be installed in a pre-augered hole supported by a CSP and filled with loose sand as per MTO Structural Office Report SO-96-01.

Suitable bearing strata for support of spread footings is not available until a depth of approximately 10.0 m (Elev. 189.8). Excavation for footing construction would need to extend through loose cohesionless construction of footings in the dry. In view of these conditions, spread footings are not considered to be a practical foundation option to support this structure.

Augered caissons extended to the hard clay till below a depth of approximately 18.0 m could be considered at this site. However, installation of caissons may be problematic due to the presence of cohesionless sand deposits and a high groundwater level. Construction will require the use of a steel liner to maintain stability of the caisson sidewalls as well as techniques such as drilling slurry to prevent disturbance of the caisson base. As a result, the use of caissons does not appear to provide an advantage over driven piles, and is not recommended from a geotechnical viewpoint.

4 PROPOSED STRUCTURE

4.1 GENERAL

A hydraulic assessment was undertaken to determine the needs of the bridge replacement and the sizing of the replacement bridge to reduce the potential impacts to the West Don River water levels. Based on the hydrology model updated by using the new PCSWMM hydrological model, the existing bridge meets the freeboard requirement for the 100-year storm event; however, the Regional Storm overtops Langstaff Road by 1.01 m. As such, the existing structure is proposed to be replaced by a single span bridge with a minimum of 30 m clear span perpendicular to the opening. The details on the hydraulic assessment are documented in Drainage and Stormwater Management Report.

A single span side-by-side precast concrete box girder is proposed at this site for a new Langstaff Road 6-lane configuration. Side-by-side precast concrete box girders typically provide shallowest bridge depth and thus well suited to accommodate the Regional Storm event at this site while minimizing the profile changes on the approaches. A span length of 32.0 m between the centre of bearings was determined to provide the 30 m clear span required from the hydraulic assessment as described above. The minimum 150 mm thick concrete deck will be provided on top of the girders with 90 mm asphalt and waterproofing system. An integral abutment configuration is proposed to eliminate the expansion joints at each abutment location and as per the geotechnical recommendations from the Preliminary Geotechnical Investigation Report as described on Section 3.2.

Based on the project correspondence with Navigation Protection Program (NPP), it was confirmed that West Don River would be considered as a navigable waterway. The proposed crossing structure can accommodate a navigational clearance of 4 m (Horizontal) x 2.5 m (Vertical), required for motorized boats up to 8.0 m in length; however, it will not be able to accommodate motorized boats larger than 8.0 m in length. Based on high level observation, the West Don River crossings upstream at Rutherford Road and downstream at Rivermede Road are not considered navigable as they are culvert crossings. Therefore, it is highly unlikely to have motorized boats larger than 8.0 m using this portion of the West Don River. NPP has subsequently confirmed that it is generally acceptable to provide a navigational clearance no less than the structures immediately upstream and downstream from the proposed new structure. An absolute determination can only be provided after the NPP has had an opportunity to review the submission, which is to be confirmed in detail design.

A preliminary General Arrangement drawing of the proposed work is included in Appendix A.

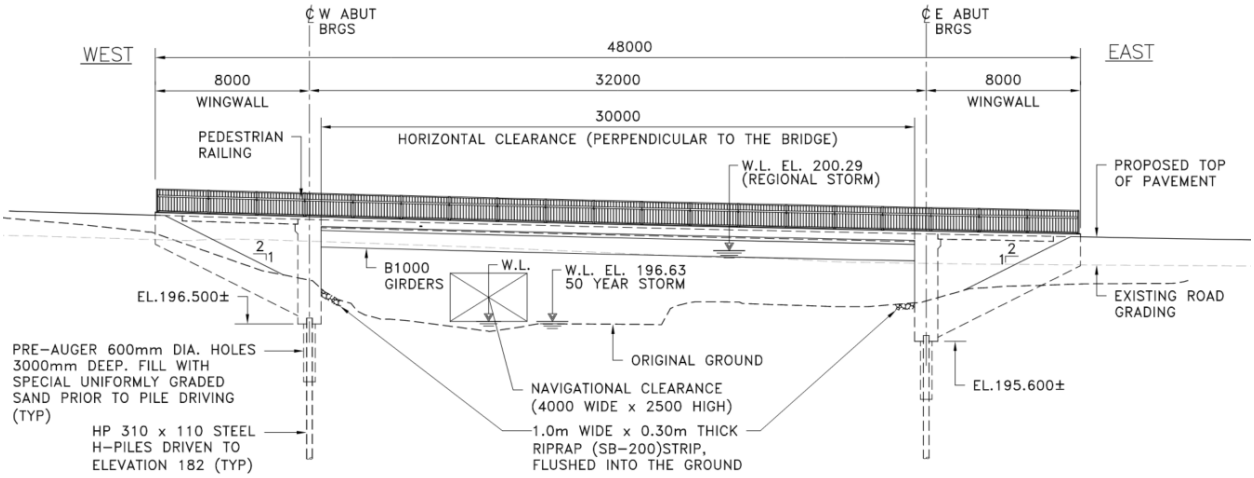


Figure 3: Proposed Elevation

4.2 HORIZONTAL ALIGNMENT AND VERTICAL PROFILE

The proposed structure is located along a horizontal curve with a radius of 2000 m. It is also located near a sag of the vertical alignment with the following parameters:

Sag Vertical Curve LVC = 231.310m
B.V.C. Station = 5+931.150 Elevation = 204.179 (Top of Pavement)
P.V.I. Station = 6+046.810 Elevation = 199.553
E.V.C. Station = 6+162.460 Elevation = 200.590 (Top of Pavement)

4.3 BRIDGE GEOMETRY

Bridge Depth

The overall structural depth from top of asphalt to underside of girder is 1240 mm.

Cross Section

The cross-section comprises the following, from north to south:

- 0.460 m north pedestrian/cyclist railing
- 3.000 m ~ 4.000m north multi-use path
- 0.475 m north concrete barrier wall
- 1.000 m shoulder
- 3.500 m + 3.300 m + 3.300 m westbound lanes
- 1.700 m raised median
- 3.300 m + 3.300 m + 3.500 m eastbound lanes
- 1.000 m shoulder
- 0.475 m south concrete barrier wall

- 3.000 m ~ 4.000m south multi-use path
- 0.460 m south pedestrian/cyclist railing

The proposed roadway cross-section has a normal crown with a 2% cross-fall.. See Figure 4 below for the proposed cross-section.

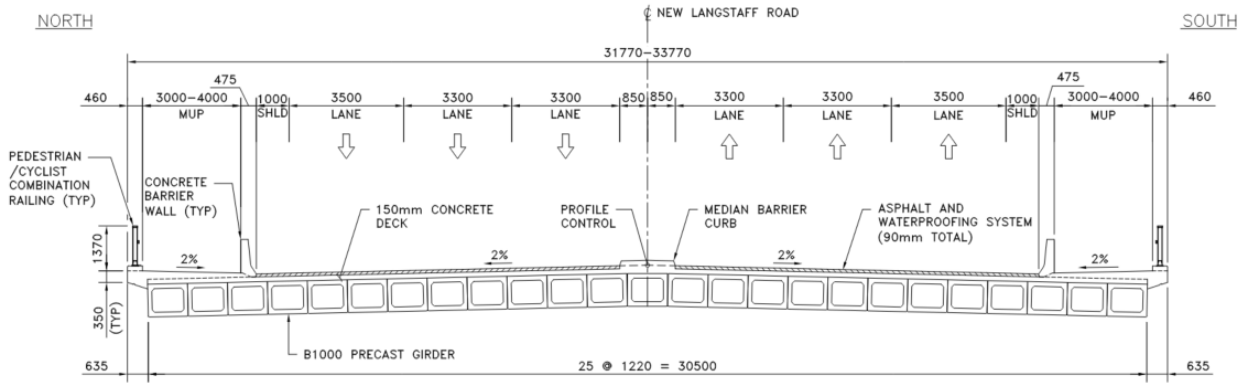


Figure 4: Proposed Cross Section

Skew Angle

The proposed structure will be constructed at a skew of approximately 13.5°.

5 MISCELLANEOUS

5.1 DESIGN STANDARD

The following design codes and references will be used during the detail design stage:

- Canadian Highway Bridge Design Code (CHBDC) CAN/CSA-S6-19;
- MTO Structural Manual, 2016;
- MTO directives and standards; and
- OPSS.

5.2 MATERIALS AND AVAILABILITY

The concrete for precast box girders will be class of 50 MPa. All other cast-in-place concrete will be class of 35 MPa. Precast girders and 35 MPa concrete are available in the area.

5.3 ENVIRONMENTAL ISSUES

This project is subjected to the Ontario Environmental Assessment Act and will be completed in accordance with the Municipal Class Environmental Assessment process Schedule C.

5.4 ACCESS

The site is readily accessible from eastbound and westbound lanes of Langstaff Road.

5.5 CONSTRUCTION STAGING

The site is accessible from the eastbound and westbound lanes of Langstaff Road. Traffic staging and roadway protection will be required for Langstaff Road during construction.

For Stage 1, the northern portion of the proposed new structure will be constructed while maintaining the existing single lane traffic in each direction on the exiting bridge. For stage 2 , the existing single lane traffic in each direction will be diverted onto the new structure, the existing structure will be completely removed, and the remaining portion of the new structure will be constructed.

Two construction seasons will likely be required to complete the construction of the bridge.

5.6 UTILITIES

There were no utility ducts in the deck or barriers identified from the review of the available rehabilitation drawings. A complete utility investigation is will be carried out during detail design.

5.7 DRAINAGE

There will be no deck drains required. Catch basins are provided at the approaches.

5.8 TRAFFIC BARRIERS

In accordance with the CHBDC-S6-19 Clause 12.4.3.2.4, Test Level 4 (TL-4) barriers are required. A standard TL-4 stainless steel reinforced concrete barrier wall with railing (SS 110-54) or GFRP reinforced concrete barrier wall (SS 110-58) will be provided at the edge of the multi-use pathway on both sides of deck to separate pedestrian/cyclist from vehicular traffic. The railing type is to be confirmed during detail design.

This bridge will permit the use of an aesthetically attractive combination railing on the outside of the deck to protect pedestrians and cyclists from falling from the bridge.

5.9 APPROACH SLABS

Approach slabs will be constructed at both ends of the bridge in accordance with the standard MTO drawing SS116-1.

5.10 ILLUMINATION

An illumination plan along Langstaff Road will be confirmed during detail design.

5.11 DURABILITY

Structural durability will be in accordance with the CHBDC (CAN/CSA S6-19) and MTO Structural Manual. Black reinforcing steel will be used in the abutments, deck and approach slabs. Stainless steel will be used in the multi-use pathways and parapet walls.

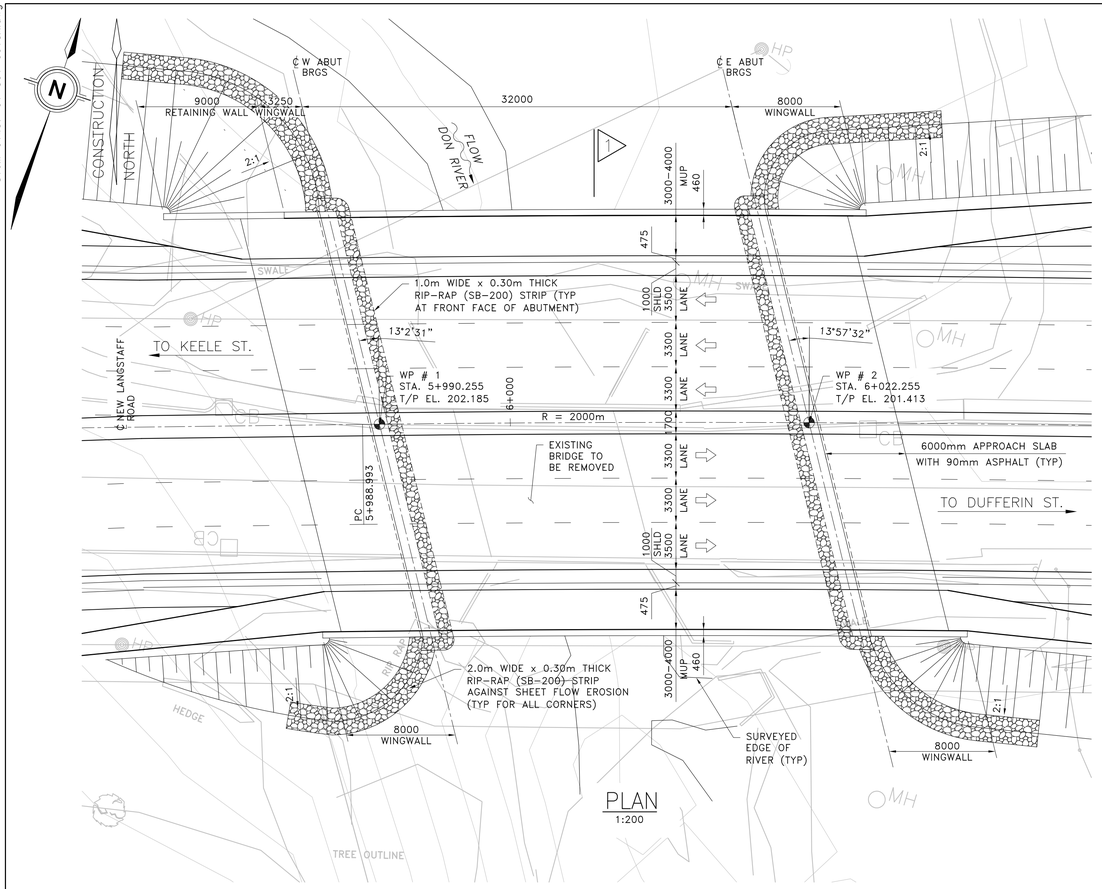
6 PRELIMINARY CAPITAL CONSTRUCTION COST ESTIMATE

The preliminary construction cost for the new bridge and the removal of the existing bridge is estimated to be $5.3M including 20% contingencies. Prices are in 2021 dollars. Details of the cost estimate are included in Appendix B.

Note that the above cost does not include traffic control and roadwork costs.

APPENDIX

A PRELIMINARY GENERAL ARRANGEMENT



PLAN
1:200

LIST OF ABBREVIATIONS

WP	–	DENOTES WORKING POINT
T/P	–	DENOTES TOP OF PAVEMENT
NTS	–	DENOTES NOT TO SCALE
SHLD	–	DENOTES SHOULDER
MUP	–	DENOTES MULTI USE PATH

LIST OF DRAWINGS:

1. GENERAL ARRANGEMENT

APPLICABLE STANDARD DRAWINGS:

3941.2000	FIGURES IN CONCRETE – SITE NUMBER AND DATE LAYOUT
3370.100	DECK, WATERPROOFING, HOT APPLIED ASPHALT MEMBRANE WITH PROTECTION BOARD
3370.101	DECK, WATERPROOFING, HOT APPLIED ASPHALT MEMBRANE AT ACTIVE CRACKS GREATER THAN 2mm WIDE AND CONSTRUCTION JOINTS.
3419.100	BARRIERS AND RAILINGS, STEEL BEAM GUIDE RAIL AND CHANNEL ANCHORAGE

GENERAL NOTES:

METRIC

DESIGN CODE AND LOADING

CHBDC CAN/CSA S6-19 CL-625-ONT

CLASS OF CONCRETE

GIRDER	50MPa
REMAINDER	35MPa

CLEAR COVER TO REINFORCING STEEL

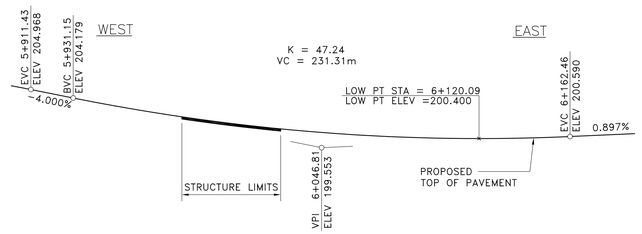
FOOTING	100 ± 20mm
DECK	
TOP	70 ± 20mm
BOTTOM	40 ± 10mm
REMAINDER UNLESS OTHERWISE SPECIFIED	70 ± 20mm

REINFORCING STEEL

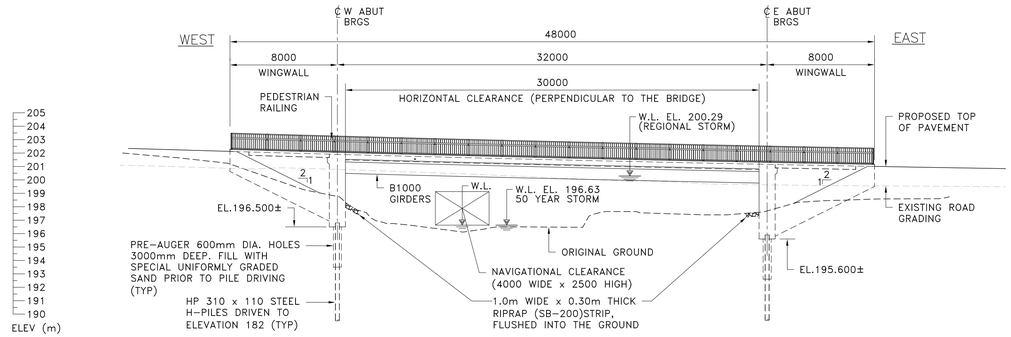
1. REINFORCING STEEL SHALL BE WELDABLE GRADE 400W.
2. UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BARS SHALL BE CLASS B.
3. BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK, DIMENSIONS. ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWING SS12-1 UNLESS INDICATED OTHERWISE.
4. STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX 2205 AND HAVE MINIMUM YIELD STRENGTH OF 500 MPa, UNLESS OTHERWISE SPECIFIED.
5. BAR MARKS WITH THE PREFIX "S" DENOTES STAINLESS STEEL BARS.

CONSTRUCTION NOTES

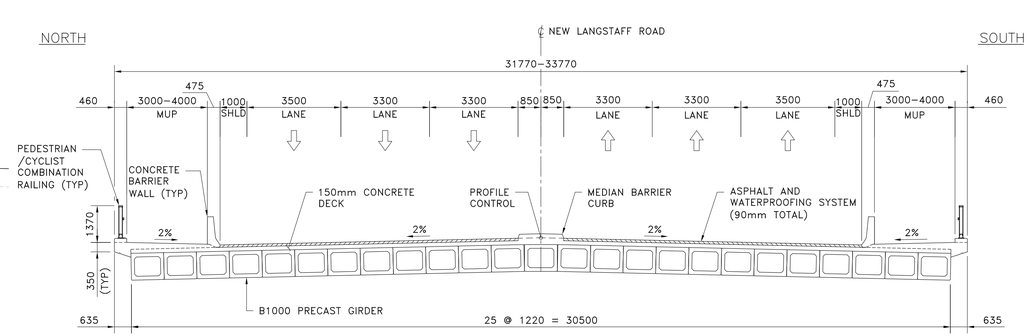
6. ALL ELEVATIONS ARE TO GEODETIC DATUM.
7. THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.
8. BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH ABUTMENTS KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.
9. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND ELEVATIONS SHOWN ON DRAWINGS AGAINST SITE CONDITIONS AND REPORT ANY DISCREPANCIES TO THE CONTRACT ADMINISTRATOR BEFORE PROCEEDING WITH WORK.
10. THE CONTRACTOR IS FULLY RESPONSIBLE FOR THE ADEQUATE PROTECTION OF ALL UTILITIES AS REQUIRED DURING CONSTRUCTION OPERATIONS.
11. THE CONTRACTOR SHALL ADVISE ALL UTILITY COMPANIES IN WRITING OF HIS PROPOSED WORK. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REPAIR AT HIS EXPENSE OF ANY DAMAGE TO UTILITIES CAUSED BY THE CONTRACTOR.



NEW LANGSTAFF ROAD PROFILE
N.T.S.



ELEVATION
1:200



1 FINAL
1:100

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

wsp

NOTE:
THE LOCATION OF UTILITIES IS APPROXIMATE ONLY, AND THE EXACT LOCATION SHOULD BE DETERMINED BY CONSULTING THE MUNICIPAL AUTHORITIES AND UTILITY COMPANIES CONCERNED. THE CONTRACTOR SHALL PROVE THE LOCATION OF UTILITIES AND SHALL BE RESPONSIBLE FOR ADEQUATE PROTECTION FROM DAMAGE DURING CONSTRUCTION.

No.	DATE	REVISIONS	BY

York Region Transportation Services

DESIGN DESIGN	NEW LANGSTAFF ROAD	DWG. NO. DWG_NUM
DRAWN DRAWN	BOWES BRIDGE (WEST DON RIVER CROSSING) PRELIMINARY GENERAL ARRANGEMENT	CONT. NO. CONT_NUM
CHECKED CHECKED		SHEET NO. SHEET_NUM

S16M-01457-01-301-001GA.dwg

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MODIFIED: 12/7/2021 12:20:56 PM BY: TULECKAB
DATE PLOTTED: 12/7/2021 12:02:44 PM BY: TULECKAB

APPENDIX

B PRELIMINARY COST ESTIMATE

Preliminary Cost Estimate

Bridge Replacement - Bowes Bridge West Don River Crossing

Single Span 32.0m
Side-by-side precast concrete box girders B1000
Integral Abutments
Skew 13.5 degree

* Cost Estimate is based on 3m Multi-Use Path.

Description of Item	Unit	Unit Price	Quantity	Total
Protection System	LS	$75,000	1	$75,000
Removal of Existing Bridge Structure	LS	$100,000	1	$100,000
Earth Excavation for Structure	m^3	$35	2020	$70,700
Dewatering Structure Excavation	LS	$50,000	1	$50,000
Supply Equipment for Driving Piles	LS	$75,000	1	$75,000
H-Piles - HP 310x110	m	$350	640	$224,000
Driving Shoes	each	$250	44	$11,000
CSP for Integral Abutment	each	$2,000	44	$88,000
Concrete in Footing	m^3	$800	20	$16,000
Concrete in Substructure	m^3	$1,650	470	$775,500
Concrete in Deck	m^3	$1,500	313	$469,500
Concrete in Sidewalk	m^3	$1,900	100	$190,000
Concrete in Barrier Walls	m^3	$2,500	30	$75,000
Concrete in Apporach Slab	m^3	$750	94	$70,500
B1000 Prestressed Girder Fabrication	m	$1,350	815	$1,100,250
B1000 Prestressed Girder Delivery	m	$150	815	$122,250
B1000 Prestressed Girder Erection	m	$300	815	$244,500
Elastomeric Laminated Bearings	each	$750	50	$37,500
Bicycle Railing with Pickets	m	$500	100	$50,000
Reinforcing Steel Bars	t	$3,000	90	$270,000
Stainless Steel Bars	t	$13,000	15	$195,000
Waterpoofing	m^2	$45	800	$36,000
Form and Fill Grooves	m	$75	52	$3,900
RipRap	m^2	$100	202	$20,200
Granular B Type II Backfill	t	$30	2850	$85,500
			Sub-total	$4,455,300
			Contingency (20%)	$891,060
			Total	**$5,346,360**

Deck Area		1,017	m^2
Cost/m^2 of deck area without contingencies	$	4,381	
Cost/m^2 of deck area with contingencies	$	5,257	