APPENDIX 'D'

OMAND'S CREEK HYDRAULIC REPORT

Quality Engineering | Valued Relationships

Morrison Hershfield Ltd.

Regional Street Reconstruction – Empress Street, Portage Avenue to St. Matthews
Hydrologic and Hydraulic Assessment of Omand's Creek

REPORT

Prepared for:

Mr. Brad Sacher, P.Eng.
Morrison Hershfield Ltd.
Suite 1, 59 Scurfield Blvd.
Winnipeg, MB
R3Y 1V2

Project Number:
0035 037 00

Date:
April 11, 2018

www.trekgeotechnical.ca
1712 St. James Street | Winnipeg, Manitoba R3H 0L3 | Tel 1.204.975.9433 | Fax 1.204.975.9435

April 11, 2018 Our File No. 0035 037 00

Mr. Brad Sacher, P.Eng.
Morrison Hershfield Ltd.
Suite 1, 59 Scurfield Blvd.
Winnipeg, MB
R3Y 1V2

RE: Regional Street Reconstruction – Empress Street, Portage Avenue to St. Matthews Hydrologic and Hydraulic Assessment

TREK Geotechnical Inc. is pleased to submit our report for the hydrologic and hydraulic assessment for the above noted project. This report analyzes changes in channel capacities within the study reach of the Omand's Creek due to roadway realignment along Empress Street from Portage Avenue to St. Matthews Avenue in Winnipeg, Manitoba. Revision 1 examines the hydraulic impact of the riprap blanket proposed for the west bank of Omand's Creek near Jack Blick Avenue.

Please contact the undersigned if you have any questions. Thank you for the opportunity to serve you on this assignment.

Sincerely,

TREK Geotechnical Inc.
Per:

Jim Friesen, P. Eng.
Manager, Water Resources Engineering
Direct: 204.975.9454
Cell: 204.890.7365

Encl.

Revision History

Revision No.	Author	Issue Date	Description
0	MR	February 14, 2018	Report
1	MR	April 11, 2018	Report

Authorization Signatures

Prepared By:

Micha Roemer, M.Sc., EIT
Engineering Intern

Reviewed By:

PROVINCE OF MANITOBA
W.B.J. HARDING
Apr 11, 2018
REGISTERED PROFESSIONAL ENGINEER

Bruce Harding, P. Eng
Senior Water Resources Engineer

ENGINEERS GEOSCIENTISTS MANITOBA
Certificate of Authorization
TREK GEOTECHNICAL INC.
No. 4877 Date: April 11 '18

Table of Contents

List of Tables

List of Appendices

1.0 Introduction

This report summarizes the results of the hydrotechnical analysis completed by TREK Geotechnical Inc. (TREK) for the assessment of channel capacity within the lower reach of Omand's Creek in the City of Winnipeg. Analysis is provided for the existing conditions of Omand's Creek located south of St. Matthews Avenue downstream to Portage Avenue and the Assiniboine River. The hydraulics of the creek channel would be influenced by changes to the road embankments and the resultant encroachment into the creek due to roadway and active transportation path re-alignment along Empress Street within the study area. The location of the site is indicated on Figure 1.

Pertinent features of the site are as follows:

- Jurisdiction - City of Winnipeg
- Watercourse - Omand's Creek
- Flow Direction - East/South
- Designation of Drain Map - No. 26
- Total Drainage Area - 75 km^2
- UTM Coordinates - Downstream end, 629800E, 5527025N (Zone 14)
  - Upstream end, 629600E, 5528065N (Zone 14)

The Department of Fisheries and Oceans Canada[1] has classified the Omand's Creek as fish habitat. As indicated on the appended classification map (Appendix B), the fish habitat is classified as Type A complex habitat with indicator fish species.

2.0 Hydrology

The contributing drainage area of Omand's Creek to the Portage Avenue Bridge is approximately 75 km^2 (WSC gauge Omand's Creek at Metro Route 90 – 05MJ007). Flood estimates for Omand's Creek were developed by Manitoba Water Stewardship from frequency analyses of historical streamflows recorded within Omand's Creek and correlated streamflow's from an adjacent watershed. The flood estimates at the upstream Omand's Creek streamflow gauge (Omand's Creek at Metro Route 90 – WSC 05MJ007), can be assumed to reflect the hydrology at the study reach between St. Matthews Avenue and Portage Avenue due to the proximity and limited increase in drainage area. The flood estimates are summarized in Table 1. As shown on Figure 1, the runoff within the Omand's Creek watershed flows to the southeast. The Omand's Creek continues south from St. Matthews Ave, before discharging into the Assiniboine River.

1 "Fish Habitat Classification for Manitoba Agricultural Watersheds", Maps 062H15, March 2008, Fisheries and Oceans Canada.

Table 1: St. Matthews Avenue at Omand's Creek - Flood Discharge Estimates

Probability	Regional Discharge Coefficient Omand's Creek at Metro Route 90 (05MJ007) *	Flood Discharge Estimate St. Matthews at Omand's Creek (m^3/s)
50% Discharge	0.14	3.8
20% Discharge	0.262	7.1
10% Discharge	0.354	9.6
5% Discharge	0.446	12.1
3% Discharge	0.516	14
2% Discharge	0.575	15.6
1% Discharge	0.674	18.3
3DQ10	0.266	7.2

* - Regional Flood Formulae, Zone 3 – Manitoba Water Stewardship, exponent = 0.765 (updated regional discharge coefficients provided by MWS based on observed and correlated data up to and including 2013)

3.0 Hydraulic Assessment

A steady-state backwater model of Omand's Creek within the study reach was developed to assess the hydraulic conditions of the waterway. The backwater model extends approximately 1000 m upstream from the BNSF railway crossing (near Portage Avenue) to just north of St. Matthews Ave. The backwater model is an extension of the model developed to assess the hydraulics of the Saskatchewan Avenue crossing replacement[2]. The hydraulic analysis for this reach of Omand's Creek was undertaken using the US Army Corps of Engineers River Analysis System HEC-RAS model. The HEC-RAS model is a one-dimensional backwater model, which is considered to be the universal standard for computing steady-state water surface profiles. The backwater model for this reach of the creek was developed using cross sections, channel profiles and details of the crossings surveyed by Dillon Engineering in 2007, 2008 and 2013 as well as data provided by Morrison Hershfield Ltd. (MHL) in 2017.

The backwater model has been developed to the level of detail required to estimate the relative effect of the proposed channel section and material changes. The model has not been calibrated to observed water levels during periods of high flow, and hydraulic parameters such as channel roughness have been selected based on observations, judgement and experience gained from similar projects.

The estimated water surface profiles for Omand's Creek within the study area under existing conditions are shown on Figure 2.

The backwater model of Omand's Creek was modified to incorporate the proposed roadway realignment including bicycle lane upgrades and a pedestrian sidewalk along Empress Street. This new infrastructure will be built in close proximity to Omand's Creek, resulting in minor encroachment on the west bank with resultant changes in channel geometry. In addition, recessed riprap has been proposed to be placed along the west bank of Omand's Creek near Jack Blick Avenue (STA 3+42 to 2+76). The proposed bank stabilization and riprap along the west bank of Omand's Creek has been incorporated into the model by section modifications and roughness coefficient adjustments. The estimated water surface profiles for Omand's Creek with the proposed roadway realignment along Empress Road are shown on Figure 3, while Table 2 summarizes the hydraulic assessment under existing conditions and with the influence of the proposed bank stabilization and riprap. The hydraulic conditions were investigated at key locations associated with cross sections provided by MHL in 2017, as shown on the location plan (Figure 1). The cross sections, as shown on Figures 4 to 13, provide an indication of the proposed works and the resultant encroachment required along the creek as part of the project. The results in Table 2 indicate that the proposed bank stabilization and riprap has little to no significant impact on the hydraulics within the Omand's Creek study reach.

2 "Omands Creek at Saskatchewan, Crossing Replacement, Hydrologic and Hydraulic Assessment", September 2015, prepared for the City of Winnipeg by Bruce Harding Consulting Limited.

Table 2: Omand's Creek – Hydraulic Summary

Station (Section)*	Probability	Discharge (m^3/s)	WSE Existing (m)	WSE Proposed (m)	WSE Difference (m)	Vel. Existing (m/s)	Vel. Proposed (m/s)	Vel. Difference (m)
7+87 (17)	**1%**	18.3	231.15	231.13	-0.02	1.11	1.12	+0.01
	2%	15.6	231.03	231.01	-0.02	1.01	1.02	+0.01
	50%	3.8	230.36	230.35	-0.01	0.36	0.37	+0.01
6+96 (15)	**1%**	18.3	230.97	230.96	-0.01	0.95	1.01	+0.06
	2%	15.6	230.82	230.82	0	0.97	1.03	+0.06
	50%	3.8	230.14	230.14	0	0.82	0.83	+0.01
6+38 (14)	**1%**	18.3	230.90	230.90	0	0.7	0.72	+0.02
	2%	15.6	230.74	230.74	0	0.69	0.71	+0.02
	50%	3.8	229.90	229.90	0	0.51	0.56	+0.05
5+35 (13)	**1%**	18.3	230.78	230.77	-0.01	0.88	0.88	0
	2%	15.6	230.62	230.62	0	0.87	0.87	0
	50%	3.8	229.78	229.78	0	0.62	0.62	0
4+57 (12)	**1%**	18.3	230.49	230.50	+0.01	1.06	1.05	-0.01
	2%	15.6	230.38	230.39	+0.01	0.96	0.96	0
	50%	3.8	229.69	229.70	+0.01	0.39	0.39	0
3+42 (10)	**1%**	18.3	230.46	230.47	+0.01	0.64	0.62	-0.02
	2%	15.6	230.35	230.36	+0.01	0.59	0.58	-0.01
	50%	3.8	229.68	229.69	+0.01	0.26	0.26	0
1+81 (9)	**1%**	18.3	230.39	230.39	0	0.47	0.47	0
	2%	15.6	230.28	230.28	0	0.43	0.43	0
	50%	3.8	229.67	229.67	0	0.18	0.18	0
0+62 (8)	**1%**	18.3	230.30	230.30	0	0.89	0.89	0
	2%	15.6	230.21	230.21	0	0.85	0.85	0
	50%	3.8	229.64	229.64	0	0.47	0.47	0

*Station numbers are associated with key cross sections provided by MHL in 2017
WSE Existing = Water Surface Elevation - Existing Conditions
WSE Proposed = Water Surface Elevation – with Proposed Bank Stabilization and Riprap
WSE Difference = WSE Proposed minus WSE Existing
Vel. Existing = Channel Velocity - Existing Conditions
Vel. Proposed = Channel Velocity – with Proposed Roadway Realignment
Vel. Difference = Vel. Proposed minus Vel. Existing

4.0 Other Considerations

Best Management Practices for working near waterways should be followed including the appropriate implementation of sediment and erosion control measures. Exposed slopes not covered with rock should be revegetated and covered with erosion control blanket. Construction activities within the creek shall not take place between April 1 and June 15 of any given year. An Environmental Management Plan should be prepared which details the specific environmental management requirements and sediment and erosion control.

Water management during construction can be an important aspect of any project and may influence the cost and scheduling for instream works, particularly the installation of the stabilization ribs which require a dewatered site for construction. The largest flows within the creek are expected to occur during the spring runoff period and following a heavy summer rainfall event. Construction should take place in the late fall and winter period when the potential for runoff is reduced thereby minimizing water management requirements. Although minimal, flows often continue throughout the winter, and should be considered as part of the water management plan with appropriate measures taken to manage the flow.

5.0 Closure

The technical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information (field investigation & survey) provided by MHL. Hydrotechnical analysis is based on environmental characteristics assumed to extend uniformly throughout the contributing area and watershed-scale, temporally-discrete hydrologic events.

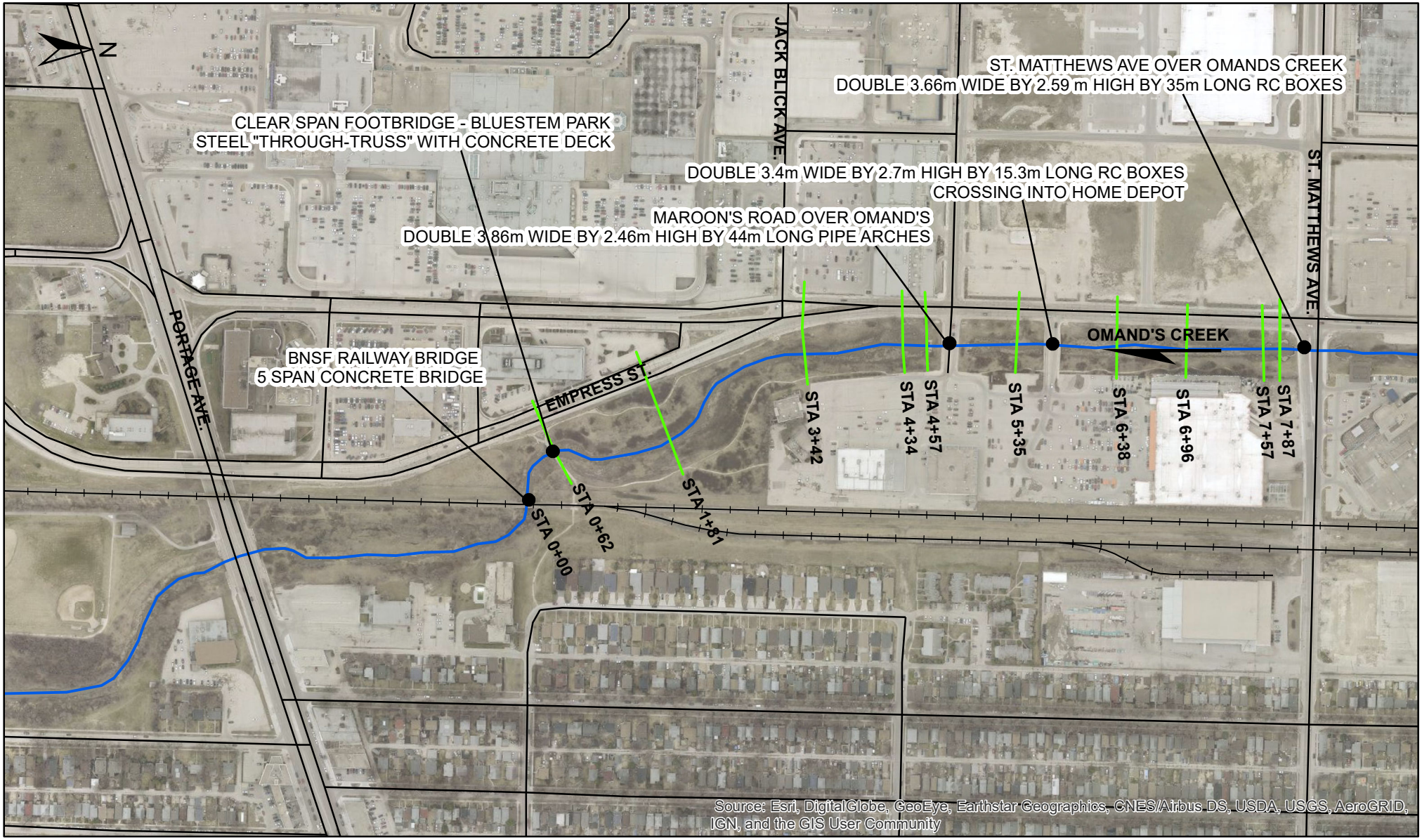
All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work, or a mutually executed standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of the MHL (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Figures

TREK GEOTECHNICAL

0035 037 00
Morrison Hershield Ltd.
Regional Street Reconstruction - Empress Street & Portage Avenue to St. Matthews Avenue

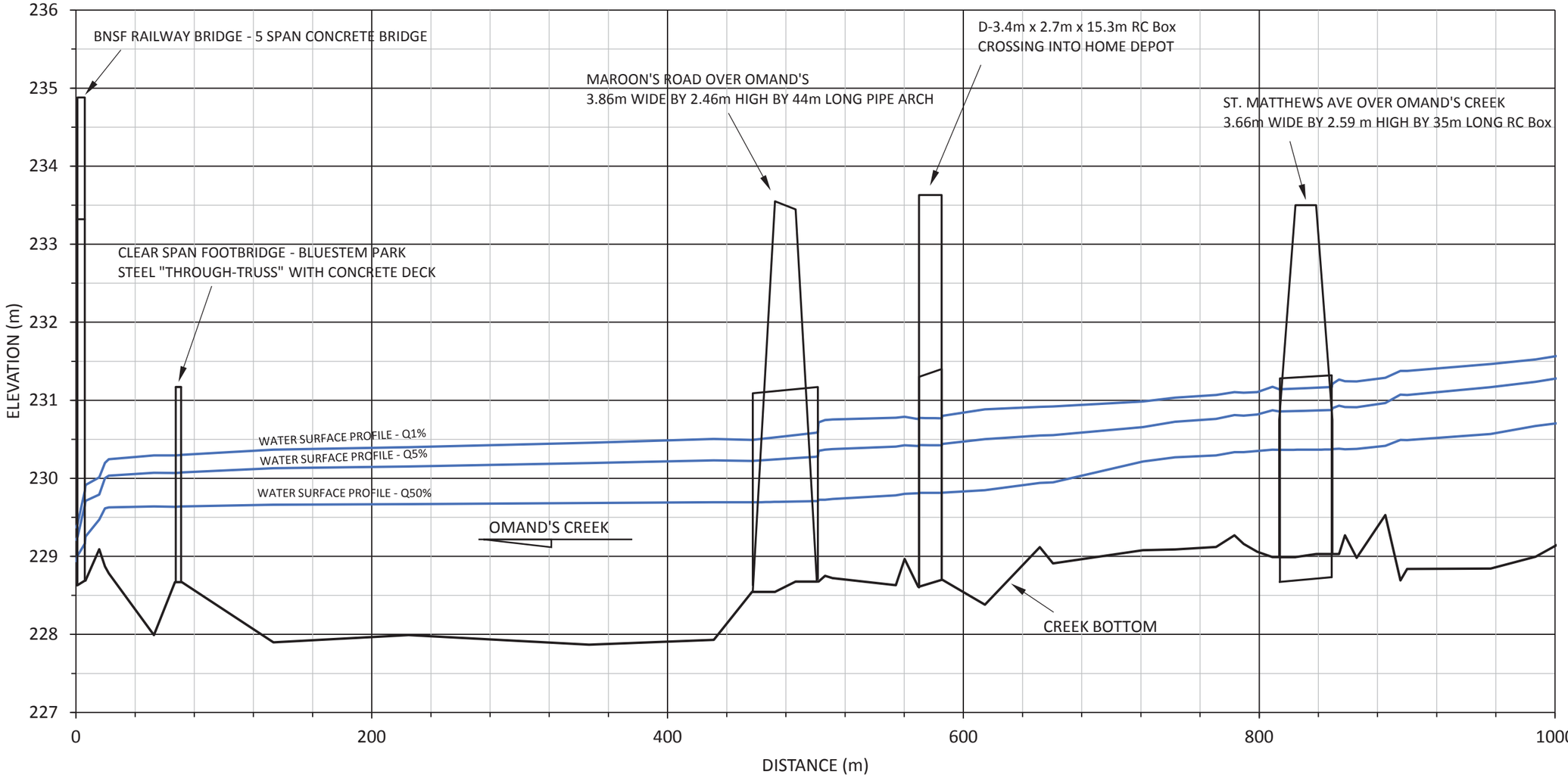


SCALE 1:5,000

Meters

100 50 0 100 200 300 400

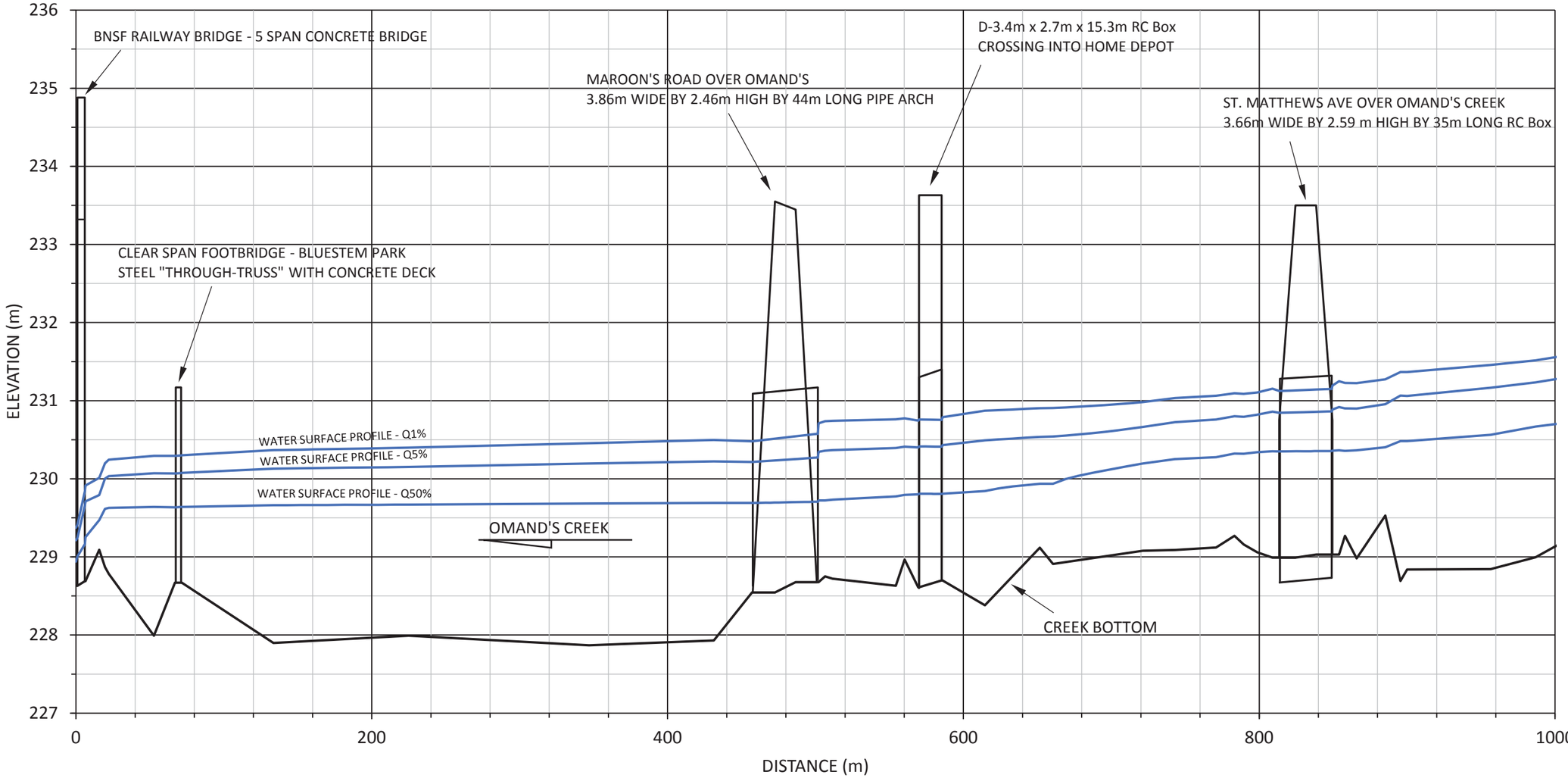
OMAND'S CREEK LOCATION PLAN FIGURE 1



NOTES:
1) HEC-RAS MODEL DEVELOPED USING CROSS SECTIONS, CHANNEL PROFILES AND DETAILS OF THE CROSSINGS SURVEYED BY DILLON ENGINEERING IN 2007, 2008 AND 2013 AS WELL AS DATA PROVIDED BY MORRISON HERSHFIELD LTD. IN 2017
2) WATER SURFACE PROFILES REFLECT HYDRAULIC EXISTING CONDITIONS

REGIONAL STREET RECONSTRUCTION - EMPRESS STREET,
PORTAGE AVENUE TO ST. MATTHEWS
OMAND'S CREEK - WATER SURFACE PROFILES
EXISTING CONDITIONS
FIGURE 2

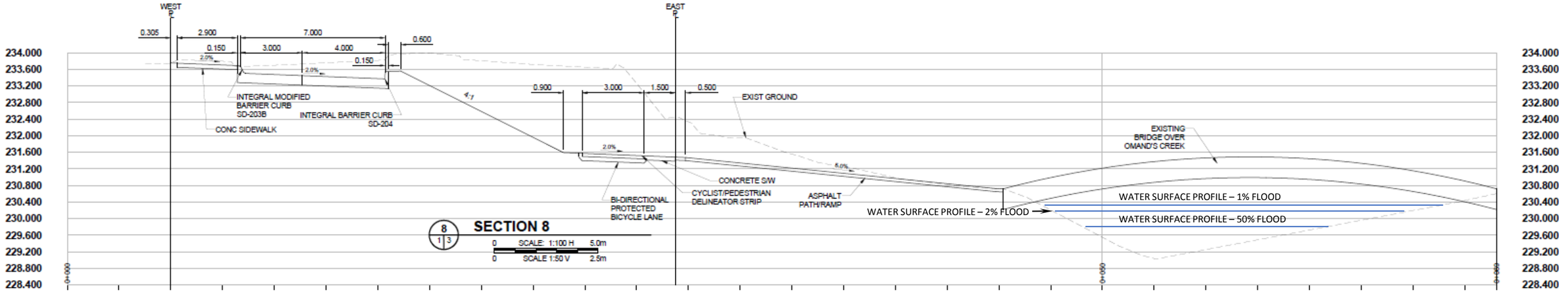
0035 037 00
Morrison Hershfield Ltd.
Regional Street Reconstruction - Empress Street & Portage Avenue to St. Matthews Avenue



REGIONAL STREET RECONSTRUCTION - EMPRESS STREET,
PORTAGE AVENUE TO ST. MATTHEWS
OMAND'S CREEK - WATER SURFACE PROFILES
PROPOSED ROADWAY REALIGNMENT
FIGURE 3

NOTES:
1) HEC-RAS MODEL DEVELOPED USING CROSS SECTIONS, CHANNEL PROFILES AND DETAILS OF THE CROSSINGS SURVEYED BY DILLON ENGINEERING IN 2007, 2008 AND 2013 AS WELL AS DATA PROVIDED BY MORRISON HERSHFIELD LTD. IN 2017
2) WATER SURFACE PROFILES REFLECT HYDRAULIC CONDITIONS INCLUDING MODIFIED CREEK CROSS SECTIONS

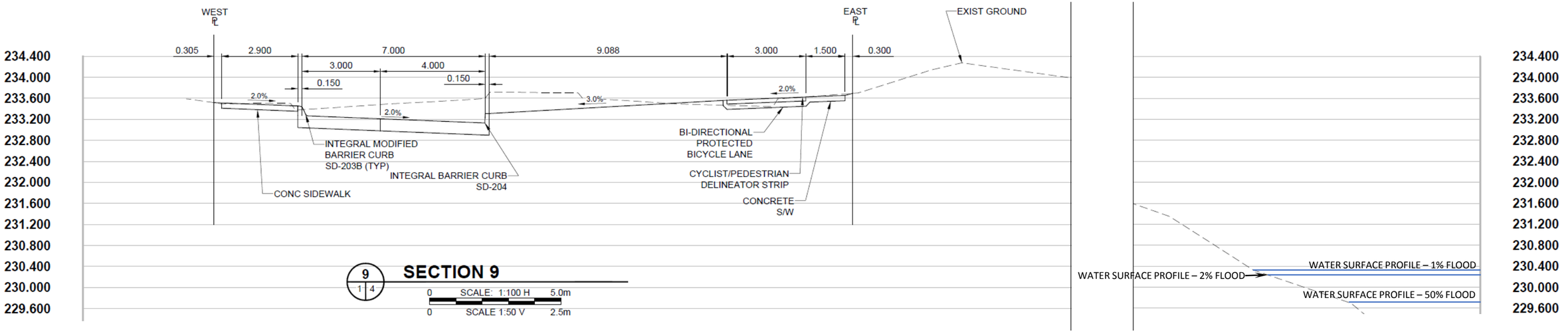
CROSS SECTION STA 0+62



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 4
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

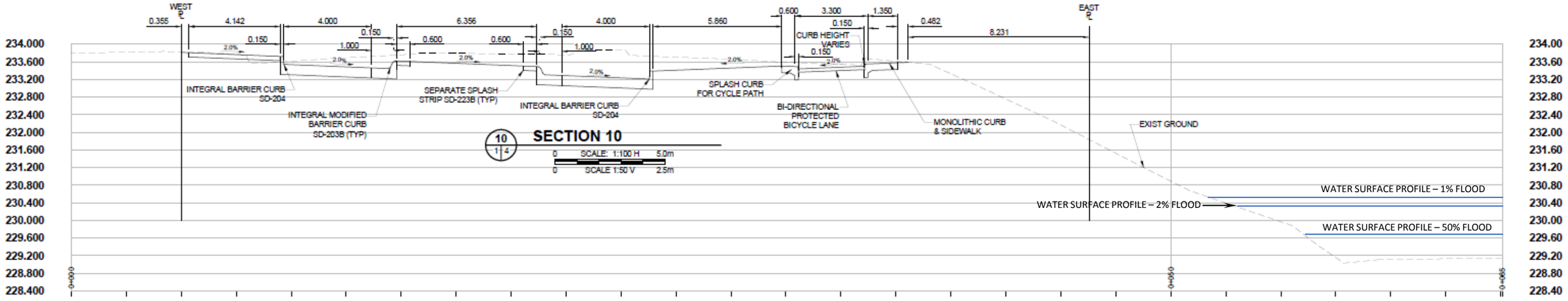
CROSS SECTION STA 1+81



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 5
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

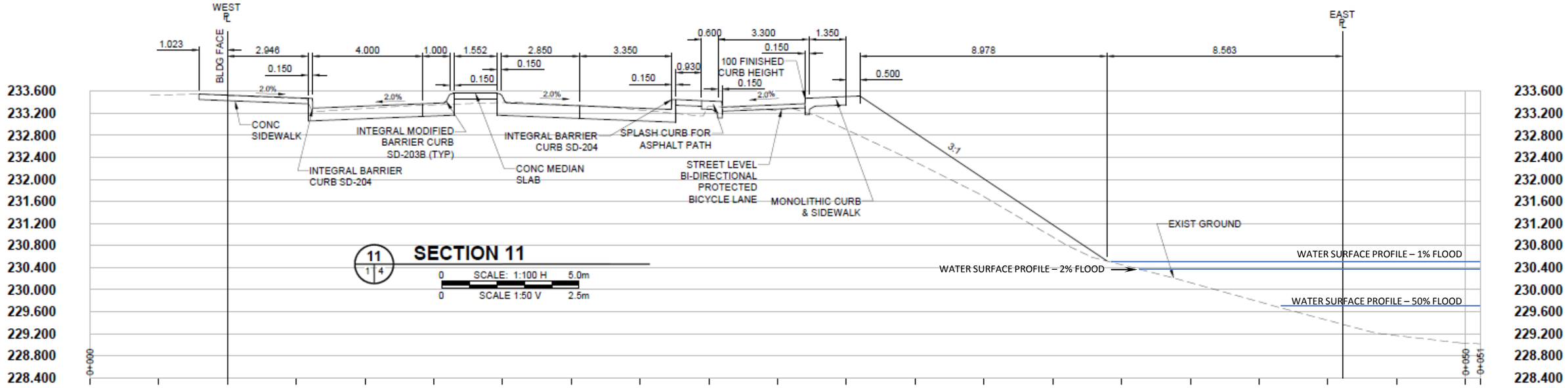
CROSS SECTION STA 3+42



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 6
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

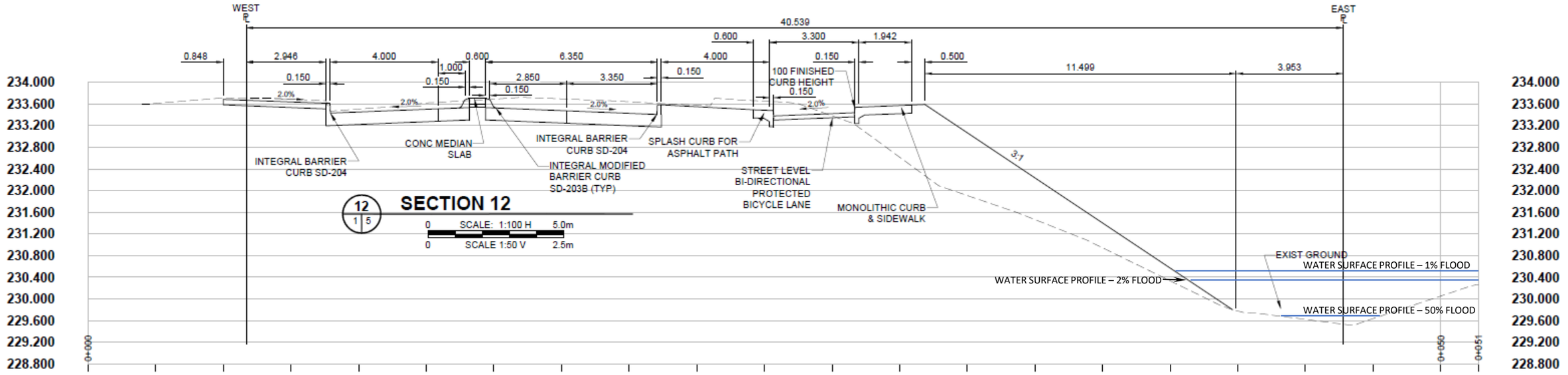
CROSS SECTION STA 4+34



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 7
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

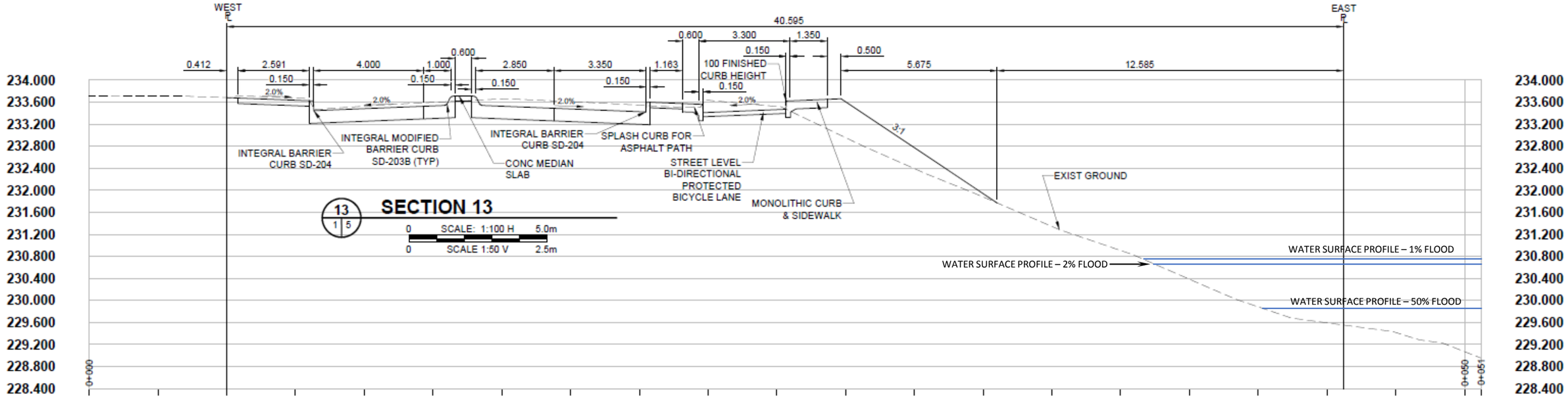
CROSS SECTION STA 4+57



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 8
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

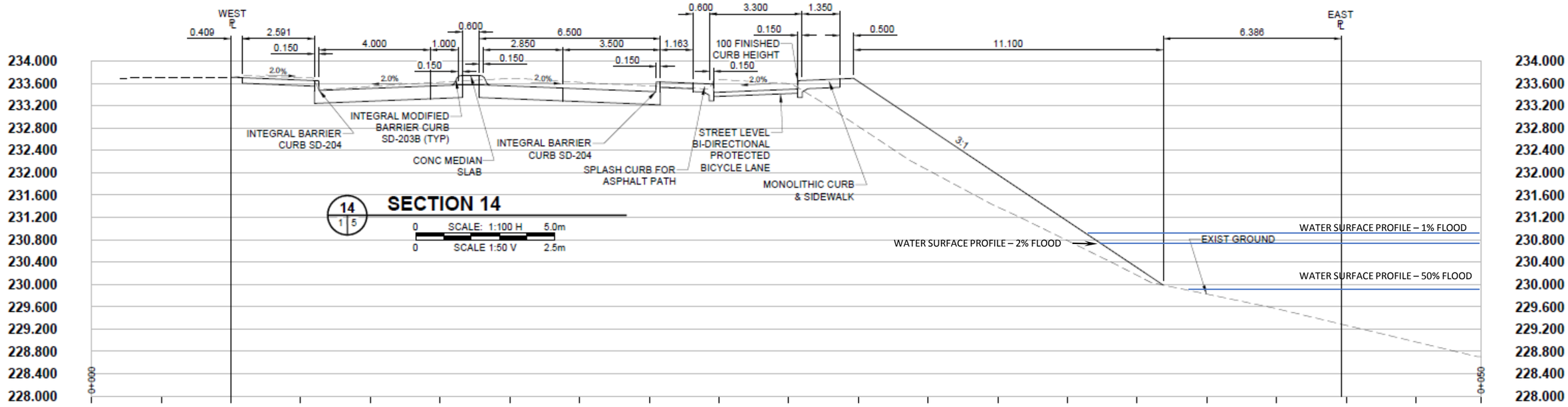
CROSS SECTION STA 5+35



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 9
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

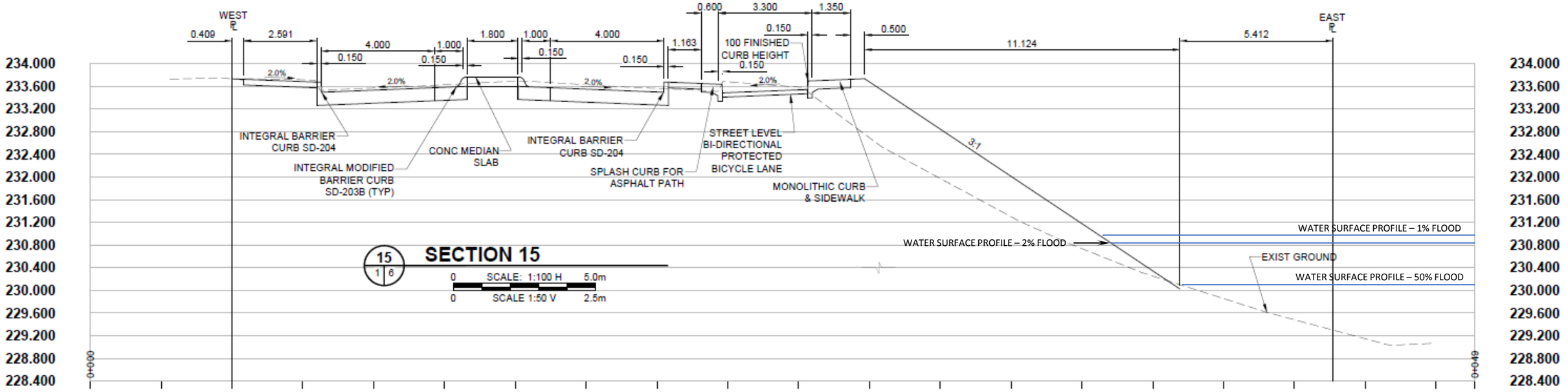
CROSS SECTION STA 6+38



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 10
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

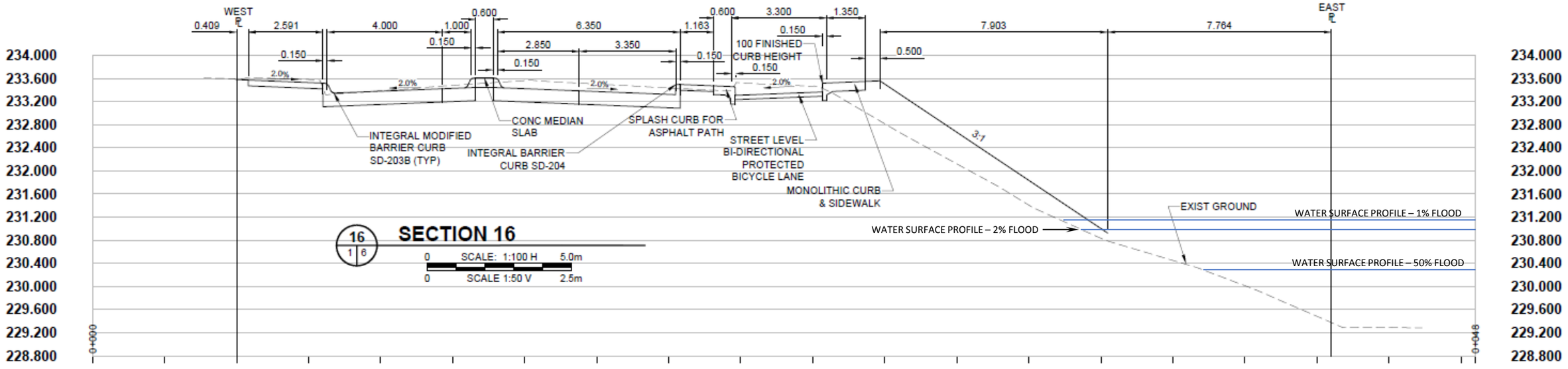
CROSS SECTION STA 6+96



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 11
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

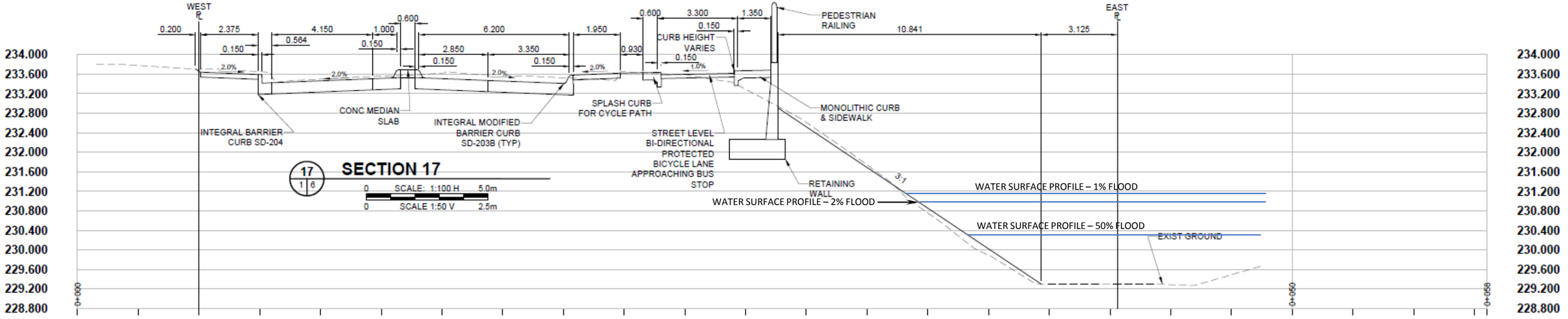
CROSS SECTION STA 7+57



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 12
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

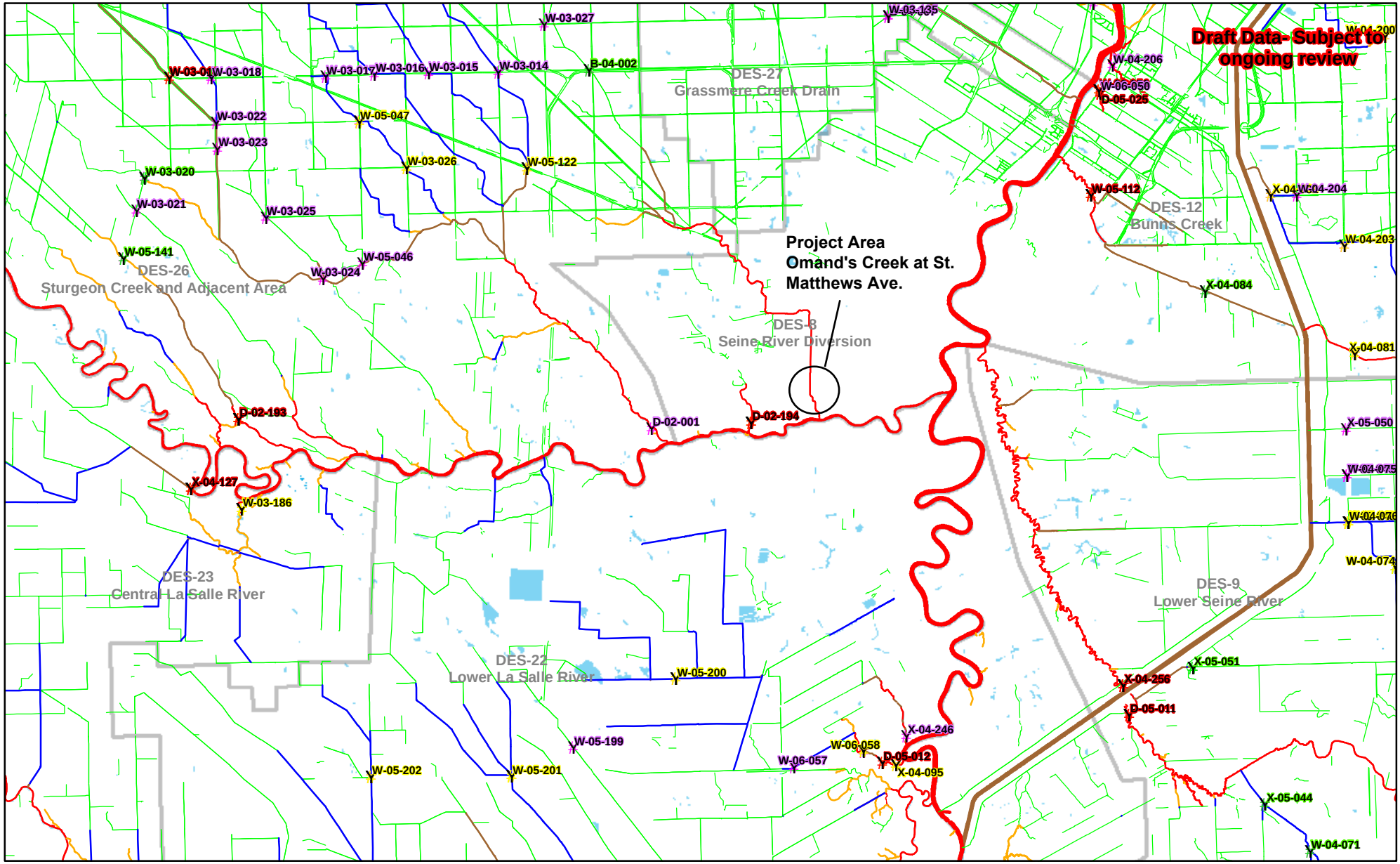
CROSS SECTION STA 7+87



NOTES:
1.) CROSS SECTION REFLECTS SURVEYS AND DESIGN UNDERTAKEN BY MORRISON HERSHFIELD IN 2017.
2.) WATER LEVELS REFLECT CONDITIONS WITH PROPOSED RECONSTRUCTION.
3.) CROSS SECTION LOOKING UPSTREAM.

FIGURE 13
OMAND'S CREEK PROPOSED RECONSTRUCTION
CROSS SECTIONS

Appendix A - Fish Habitat Classification



062I04	062I03	062I02
062H13	062H14	062H15
062H12	062H11	062H10

Habitat Classification

A
B
C
D
E

Fishing Results

Indicator Species ¥
Non-Indicator Species Y
No Catch ¥
No Fishing Effort ¥

Appendix 9
Sampling sites, fish captures and habitat classification of streams and constructed drains throughout agricultural areas of Manitoba (2002 – 2006)

062H14

Produced April 2012