

133

SEE SHEET NO. 131

SEE SHEET NO. 134

133

102 AVE. (LATE ATHABASCA AVE.)

EDMONTON ALTA VOLK - JUNE 1913

(FORMERLY SHEET 111)

SITE WEST OF 124 ST

SEE SHEET NO. 132 124 ST. (LATE 24th ST.)

532

530

531

SEE SHEET NO. 134

123 ST. (LATE 23rd ST.)

122 ST. (LATE 22nd ST.)

101 AVE. (LATE JASPER AVE.)

121 ST. (LATE 21st ST.)

533

534

HILLSIDE AVE.

536

SCALE 50 FT - 1 INCH



Canadian Northern Ry. (C.P. MAIN LINE) (E. YARD) VERY STEEP HILL (30)

DEMOLISHED GARAGE

NORTH SIDE

WEST SIDE

EAST SIDE

SOUTH SIDE

132

SEE SHEET NO. 130
102 AVE (LATE ATHABASCA AVE)

SEE SHEET NO. 131

132

588

528

587

126 St ?

125 ST (LATE 20th ST)

124 ST (LATE 24th ST)

SEE SHEET NO. 133

SITE SOUTH OF 100 AVE

SEE SHEET NO. 136

535

299

298

SITE B/W 124 & 126 STs

118 ST (LATE 18th ST)

117 ST (LATE 17th ST)

116 ST (LATE 16th ST)
SEE SHEET NO. 7 VOL I

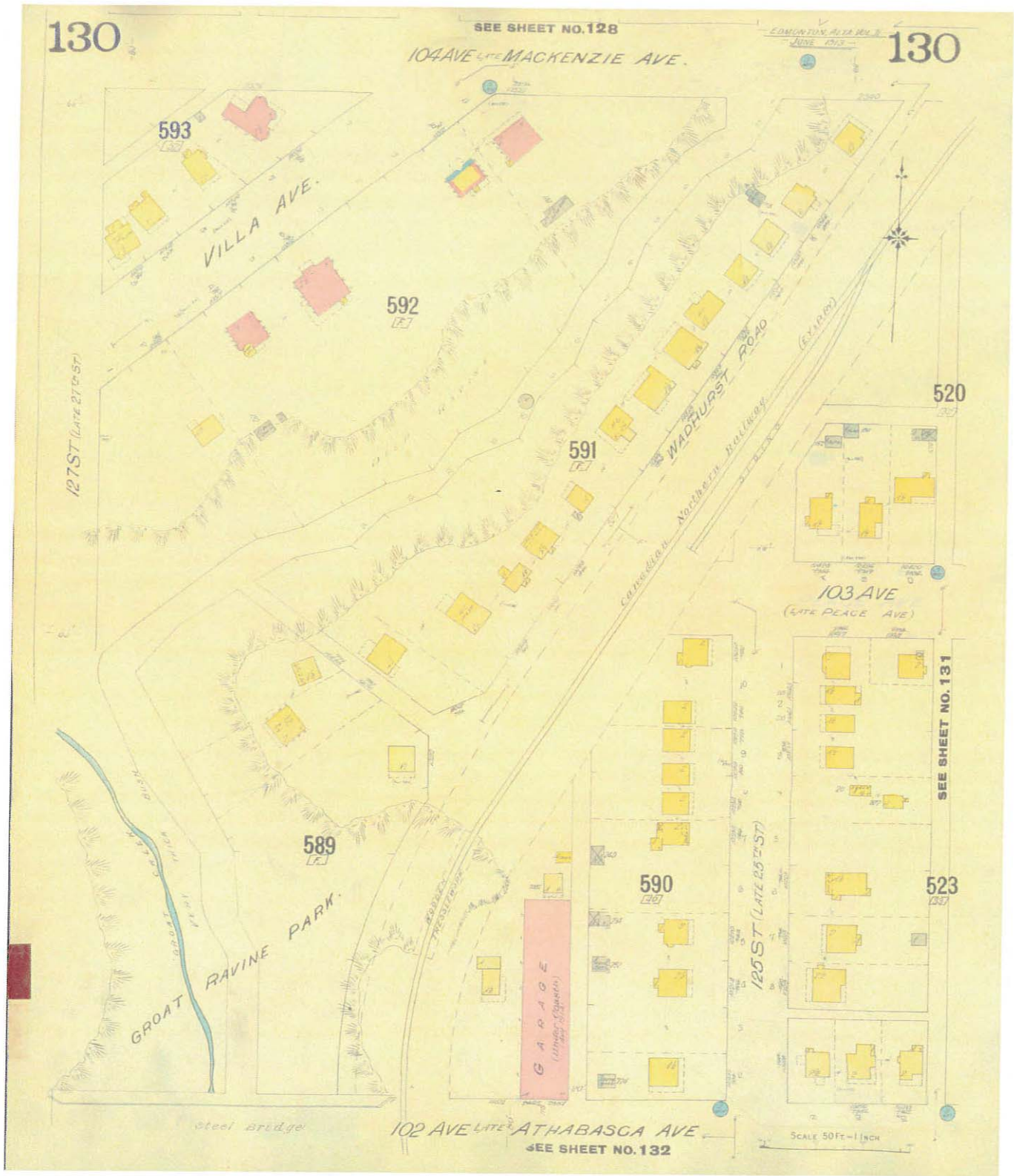
100 AVE (LATE VICTORIA AVE)

537



SCALE 50 FT = 1 INCH





↓
Site is south of 100 Avenue.



APPENDIX E

Alberta Land Titles



LAND TITLE CERTIFICATE

S
LINC SHORT LEGAL TITLE NUMBER
0015 416 472 RN22C;35;4-11 249W155

LEGAL DESCRIPTION

PLAN RN22C (XXIIC)
BLOCK THIRTY FIVE (35)
LOTS FOUR (4) TO ELEVEN (11) INCLUSIVE
EXCEPTING THEREOUT : PART, OUT OF EACH OF LOTS SIX (6)
TO TEN (10) INCLUSIVE, AS SHOWN ON ROAD PLAN 8321286
EXCEPTING THEREOUT ALL MINES AND MINERALS

ATS REFERENCE: 4;24;53;2;RL
ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF EDMONTON

REGISTERED OWNER(S)
REGISTRATION DATE (DMY) DOCUMENT TYPE VALUE CONSIDERATION

249W155 28/09/1955 \$4,205

OWNERS

THE CITY OF EDMONTON.
OF CITY HALL, #1 SIR WINSTON CHURCHILL SQUARE,
EDMONTON
ALBERTA

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION
NUMBER DATE (D/M/Y) PARTICULARS

NO REGISTRATIONS

TOTAL INSTRUMENTS: 000

(CONTINUED)

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN
ACCURATE REPRODUCTION OF THE CERTIFICATE OF
TITLE REPRESENTED HEREIN THIS 17 DAY OF MARCH,
2016 AT 11:52 A.M.

ORDER NUMBER: 30302777

CUSTOMER FILE NUMBER:



END OF CERTIFICATE

THIS ELECTRONICALLY TRANSMITTED LAND TITLES PRODUCT IS INTENDED
FOR THE SOLE USE OF THE ORIGINAL PURCHASER, AND NONE OTHER,
SUBJECT TO WHAT IS SET OUT IN THE PARAGRAPH BELOW.

THE ABOVE PROVISIONS DO NOT PROHIBIT THE ORIGINAL PURCHASER FROM
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OR TECHNICAL EXPERTISE FOR THE BENEFIT OF CLIENT(S).



LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0017 246 570	EDMONTON;;2	127M94

LEGAL DESCRIPTION

FIRST

EDMONTON SETTLEMENT

ALL THAT PORTION OF RIVER LOT 2

DESCRIBED AS FOLLOWS: BOUNDED ON THE EAST BY THE EASTERN LIMIT OF EDWARD STREET, THE WESTERLY LIMIT OF LOT 25 IN BLOCK F AND THE PRODUCTION NORTHERLY TO THE NORTHERN LIMIT OF RIVER SIDE AVENUE OF THE SAID WESTERLY LIMIT OF LOT 25; ON THE NORTH BY THE SOUTHERLY LIMIT OF HILLSIDE AVENUE PRODUCED ACROSS EDWARD AND ST. CATHERINE STREETS; ON THE WEST BY THE EASTERN LIMIT OF GROAT STREET, THE WESTERN LIMIT OF LOT 5 IN BLOCK F AND A STRAIGHT LINE DRAWN FROM THE NORTH WEST CORNER OF SAID LOT 5 BLOCK F TO THE POINT OF INTERSECTION OF THE SAID EASTERN LIMIT OF GROAT STREET WITH THE NORTHERN LIMIT OF RIVERSIDE AVENUE AND ON THE SOUTH BY THE SASKATCHEWAN RIVER

EXCEPTING THEREOUT:	HECTARES	(ACRES) MORE OR LESS
A) PLAN 8321286 - ROAD	5.17	12.77

EXCEPTING THEREOUT ALL MINES AND MINERALS

SECOND

EDMONTON SETTLEMENT

THOSE PORTIONS OF RIVER LOT 2

FORMERLY SHOWN AS LOT 5 IN BLOCK 13 AND ALL OF LOT 7 IN BLOCK 18 ALL AS SHOWN OUTLINED IN RED ON PLAN RN22C (XXII-C)

EXCEPTING THEREOUT ALL MINES AND MINERALS

ATS REFERENCE: 4;24;52;2;RL

ATS REFERENCE: 4;24;53;2;RL

ATS REFERENCE: 4;25;52;2;RL

ATS REFERENCE: 4;25;53;2;RL

ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF EDMONTON

REGISTERED OWNER(S)				
REGISTRATION	DATE (DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
127M94	26/01/1942			SEE INSTRUMENT

(CONTINUED)

OWNERS

THE CITY OF EDMONTON.
OF OFFICE OF THE CITY CLERK
1 SIR WINSTON CHURCHILL SQUARE
EDMONTON
ALBERTA T5J 2R7

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION
NUMBER DATE (D/M/Y) PARTICULARS

NO REGISTRATIONS

TOTAL INSTRUMENTS: 000

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN
ACCURATE REPRODUCTION OF THE CERTIFICATE OF
TITLE REPRESENTED HEREIN THIS 17 DAY OF MARCH,
2016 AT 11:52 A.M.

ORDER NUMBER: 30302777

CUSTOMER FILE NUMBER:



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LAND TITLE CERTIFICATE

S

LINC SHORT LEGAL
0015 416 464 RN22C;38;1-7

TITLE NUMBER
207V70

LEGAL DESCRIPTION

PLAN RN22C (XXIIC)
BLOCK THIRTY EIGHT (38)
LOTS ONE (1) TO SEVEN (7) INCLUSIVE
EXCEPTING THEREOUT : PART, OUT OF EACH OF LOTS ONE (1)
TO SEVEN (7) INCLUSIVE, AS SHOWN ON ROAD PLAN 8321286
EXCEPTING THEREOUT ALL MINES AND MINERALS

ATS REFERENCE: 4;23;52;2;RL
ESTATE: FEE SIMPLE

MUNICIPALITY: CITY OF EDMONTON

REGISTERED OWNER(S)				
REGISTRATION	DATE (DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
207V70	03/04/1929		\$700	

OWNERS

THE CITY OF EDMONTON.
OF CITY HALL, #1 SIR WINSTON CHURCHILL SQUARE,
EDMONTON
ALBERTA

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION	DATE (D/M/Y)	PARTICULARS
NUMBER		

NO REGISTRATIONS

TOTAL INSTRUMENTS: 000

(CONTINUED)

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN
ACCURATE REPRODUCTION OF THE CERTIFICATE OF
TITLE REPRESENTED HEREIN THIS 17 DAY OF MARCH,
2016 AT 11:52 A.M.

ORDER NUMBER: 30302777

CUSTOMER FILE NUMBER:



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OR TECHNICAL EXPERTISE FOR THE BENEFIT OF CLIENT(S).



THURBER ENGINEERING LTD.

December 6, 2016

File: 10298

Dialog
100, 10237 – 104 Street
Edmonton, AB, T5J 1B1

Attention: Mr. Neil Robson, P.Eng.

**PHASE I ENVIRONMENTAL SITE ASSESSMENT ADDENDUM
GROAT ROAD RIVER BRIDGE REHABILITATION
EDMONTON, ALBERTA**

Dear Mr. Robson:

At the request of Dialog, Thurber Engineering Ltd. (Thurber) has prepared the following Addendum to our 2016 Phase I Environmental Site Assessment¹ (ESA) for the Groat Road River Bridge Rehabilitation project in relation to proposed changes to the original project footprint. This Addendum should be read in conjunction with Thurber's 2016 Phase I ESA report.

Use of this letter is subject to the Statement of Limitations and Conditions that is included at the end of the text of this report.

1. TEMPORARY ACCESS ROAD AND LAYDOWN AREA

Thurber understands that the methodology for the rehabilitation project has changed, and that the project will now require access at both the north and south ends of the existing Groat Road Bridge. The proposed footprint revisions include a temporary access road on the north bank and a temporary laydown area on the south bank, as shown on Drawing 10298-1B-R1, attached. The original Phase I ESA footprint area is also shown on this drawing.

Based on our review of the historical aerial photographs for the proposed temporary access road and laydown area, and the historical records identified during the Phase I ESA, the proposed project footprint expansion does not alter the findings of the Phase I ESA. Additional areas of potential environmental concern have not been identified for these two proposed temporary construction areas.


The review historical aerial photographs for the proposed footprint revisions identified a former drainage channel, which has subsequently been backfilled, further to the west of the proposed temporary access road on the north bank. While it is not expected that excavation will be required at the west end of the proposed access road, it is possible that fill materials of unknown origin may be present in this area.

¹ Thurber Engineering Ltd. 2016. Phase I Environmental Site Assessment, Groat Road Bridges Rehabilitation Project, Edmonton, Alberta. Report dated May 25, 2016.



2. CLOSURE

We trust that this letter provides you with the information you require at present. Should you have any questions, please contact the undersigned at your convenience.

Yours very truly,
Thurber Engineering Ltd.
Neal Fernuik, M.Sc., P.Biol., P. Eng. 
Review Principal



Craig Campbell, M.Eng., P. Eng.
Senior Environmental Engineer
/lg

Attachments:

- Statement of Limitations and Conditions
- Drawing 10298-1B



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

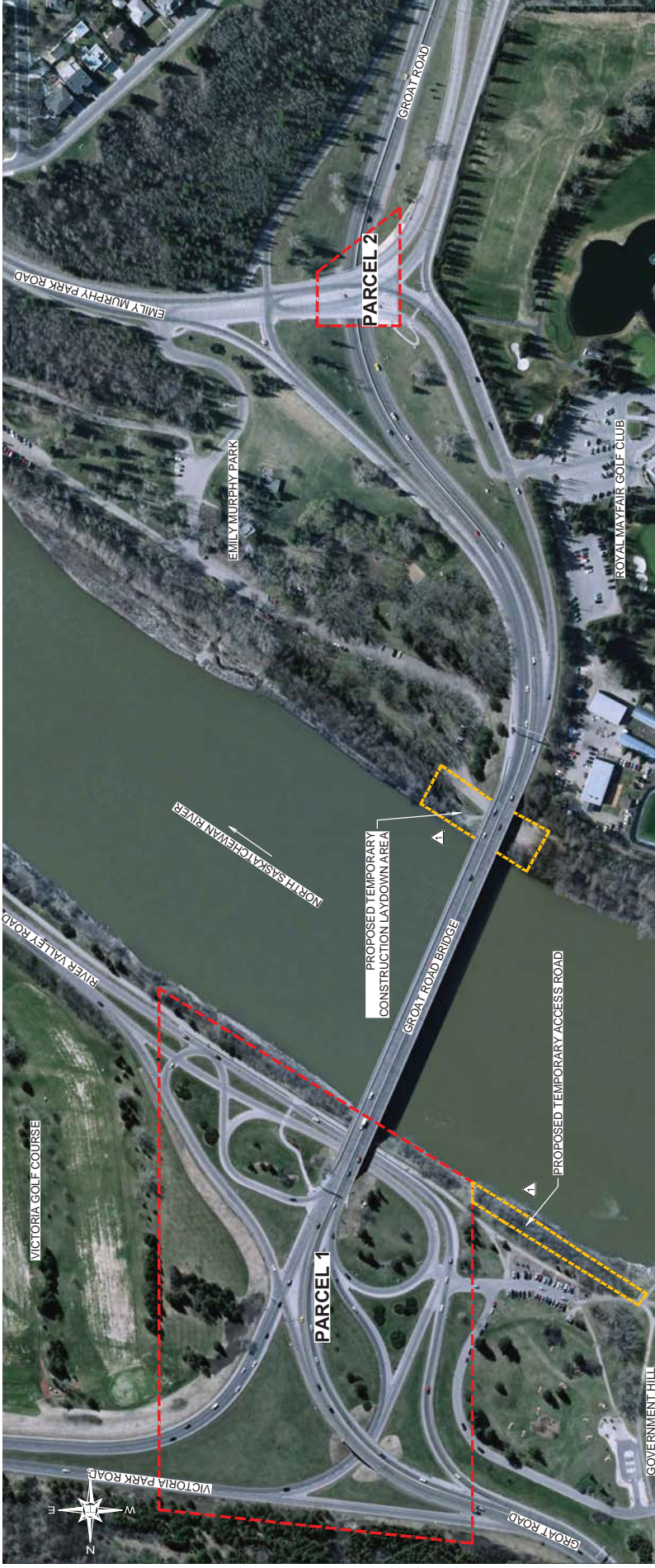
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



BASE PLAN PROVIDED BY CITY OF EDMONTON TRANSPORTATION DEPARTMENT

△	2016-12-06	ADDITIONAL PROJECT FOOTPRINT	CAC
REV	DATE	REVISION	BY

DIALOG

**GROAT ROAD BRIDGE REHABILITATION
PHASE I ENVIRONMENTAL SITE ASSESSMENT
PROJECT LOCATION PLAN SHOWING
ADDITIONAL PROJECT FOOTPRINT**

DWG No. 10298-1B

DRAWN BY	KLW
DESIGNED BY	JLM
APPROVED BY	CAC
SCALE	1:3000
DATE	DECEMBER 2016
FILE NO.	10298



THURBER ENGINEERING LTD.

- LEGEND**
- APPROXIMATE SITE BOUNDARIES
 - ADDITIONAL PROJECT FOOTPRINT BOUNDARIES
 - △



**Appendix E. Groat Road Bridge Rehabilitation Hydrotechnical
Assessment of Berms – 2D Modeling (Northwest Hydraulic
Consultants Ltd. 2017)**

NHC Ref. No. 1002602

14 March 2017

Dialog Design
100, 10237 – 104 Street
Edmonton, AB
T5J 1B1

Attention: Neil Robson, M.Eng., P.Eng.
Principal, Structural Engineering

Re: Groat Road Bridge Rehabilitation
Hydrotechnical Assessment of Berms – 2D Modeling

1 INTRODUCTION

Northwest Hydraulic Consultants Ltd. (NHC) are pleased to provide the following report to establish design flood and hydraulic conditions for the two proposed berm arrangement plans associated with rehabilitation of the existing Groat Road Bridge on the North Saskatchewan River in Edmonton, Alberta (**Appendix A**). The proposed construction process will be staged over two seven month periods, with each period beginning in August and ending late-February. In Period One, the downstream half of the bridge will be replaced. This will commence by first constructing a berm to isolate the south half of the bridge in August and keeping that in place until the end of October. Between the end of October and end of November, the berm will be moved from the south to the north half of the bridge. It is expected that work along the north half will take place starting late November and the berm be removed by late February. Period Two would be the mirror image of Period One with the berms being placed to work on the upstream half of the bridge, commencing from the north side and then moving to the south. Each of the berm arrangements for both Periods will constrict the flow to approximately 40% of the average channel width through the bridge section. It is assumed that the berms will be constructed from the existing berm material from the Walterdale Bridge replacement and will consist of a combination of Class I and Class II rock riprap.

The North Saskatchewan River at this site is a Class C stream with a fisheries Restricted Activity Period (RAP) between September 16 and July 31 (ie: the typical in-stream construction window is August 1 to September 15 of each year). It is understood that construction activity will commence on or after 1 August 2017 and be completed by 19 February 2018, before the start of ice breakup in the spring. The hydrotechnical assessment for this time frame, which includes a review of available hydrologic and hydraulic information, as well as an evaluation of the local hydraulic characteristics and ice conditions using a combination of 1D and 2D modeling results, is presented below.

2 SITE DESCRIPTION

Originating on the eastern slopes of the Rocky Mountains, the North Saskatchewan River in Edmonton has a drainage basin area of 28,000 km². The majority of flood events occur in June and July, arising out of a combination of snowmelt and precipitation in the mountains and the surrounding Foothills. Flow is regulated by two hydroelectric dams: the Brazeau dam completed in 1963 and the Bighorn dam completed in 1972. These dams tend to reduce the magnitude of the median sized flood events, but do not tend to have a significant impact on the highest open water flood events.

The North Saskatchewan River in Edmonton has a stream-cut valley with moderately forested valley walls¹. The channel is entrenched and exhibits irregular meanders with point bars along the insides of bends and side bars in the straight reaches. The Groat Road Bridge is located along a relatively straight reach of the river, several hundred meters downstream of a large meander bend (**Figure 1**). The channel width through the bridge crossing reach is approximately 250 m. The channel bed is comprised of gravel (D₅₀ = 30 mm) overlying shale and/or sandstone bedrock at shallow depth. Channel banks are typically comprised of sand/gravels that are experiencing only minor erosion.

3 OPEN WATER HYDROLOGY

Water Survey of Canada (WSC) has operated a hydrometric gauge at the Low Level Bridge in Edmonton (05DF001) since 1911. The Groat Road Bridge crosses the North Saskatchewan River at a location approximately 4.6 km upstream of the Low Level Bridge (**Figure 1**). A flood frequency analysis was conducted on peak flows using data from the beginning of August to freeze-up from 1972 to present (**Table 1**). A 2-year open water flow event corresponds to an open water flow event with 50% probability occurring in each given year.

Table 1 Maximum August 1st to Freeze-Up Flood Peak Frequencies at Groat Road Bridge (1972-2014)

Return Period (years)	Annual Exceedance Probability (percent)	Discharge (m ³ /s)
2	50	343
5	20	539
10	10	678
25	4	856
50	2	989
100	1	1123

Note that Dialog Design has selected the 2-year flood for the assessment.

¹ Kellerhals et al. *Research Council of Alberta River Engineering and Surface Hydrology Report 72-1 "Hydraulic and Geomorphic Characteristics of Rivers in Alberta"* (1972).

For reference, a summary of the widely adopted open water flood discharges for the City of Edmonton² as per the Alberta Environment and Parks 1990 flood designations is included in **Table 2**.

Table 2 Maximum Open Water Flood Peak Frequencies at Groat Road Bridge (1899-1990)

Return Period (years)	Annual Exceedance Probability (percent)	Discharge (m ³ /s)
2	50	1270
5	20	2230
10	10	2940
25	4	3870
50	2	4570
100	1	5270
200	0.5	5960

4 OPEN WATER HYDRAULIC ANALYSIS

4.1 1D Model of August 1st to Freeze-Up Flood

4.1.1 Model Construction

A HEC-RAS 1D hydraulic model was previously generated using cross sections at locations shown in **Figure 1**. The following three scenarios were modeled to represent the open water conditions during Periods One and Two of the construction program:

- 1) Base Case, or unobstructed and without any berms in place;
- 2) Right Berm (First Half of Period One), or berm extending from the right bank (when looking downstream) in place; and
- 3) Left Berm (First Half of Period Two), or berm extending from the left bank (when looking downstream) in place.

² Onyshko, P. "North Saskatchewan River Flood Risk Mapping Study – Devon to Fort Saskatchewan – Hydrology Report" (2007) Report submitted to AEP.

4.1.2 Results

Tables 3, 4 and 5 present the section average velocities, maximum flow depths and water levels determined for the 2-year August 1st to freeze-up flood peak discharge ($Q = 343 \text{ m}^3/\text{s}$) for the three scenarios described above.

Table 3 Velocity, Flow Depth and Flood Levels at 2-year August 1st to Freeze-Up Flood Peak Base Case

Cross Section	Mean Velocity (m/s)	Max Flow Depth (m)	Water Level (m)
90	0.6	3.1	616.1
89.2 (Upstream of Bridge)	1.0	2.3	616.0
89.15 (Bridge Centreline)	1.0	2.7	616.0
89.1 (Downstream of Bridge)	0.9	3.1	616.0
88	2.1	1.8	615.4
87	1.2	2.2	614.6
86	1.1	2.1	614.4
85.2	0.9	2.7	614.3
85.1	0.8	3.4	614.3
84	1.3	2.7	614.2
83.2	0.9	3.6	614.1
83.1	1.1	3.6	614.1
82	0.7	4.3	614.0

Table 4 Velocity, Flow Depth and Flood Levels at 2-year August 1st to Freeze-Up Flood Peak Right Berm

Cross Section	Mean Velocity (m/s)	Max Flow Depth (m)	Water Level (m)
90	0.6	3.4	616.4
89.2 (Upstream of Bridge)	1.6	2.4	616.2
89.15 (Bridge Centreline)	1.7	2.8	616.2
89.1 (Downstream of Bridge)	1.5	3.2	616.2
88	2.1	1.8	615.4
87	1.2	2.2	614.6
86	1.1	2.1	614.4
85.2	0.9	2.7	614.3
85.1	0.8	3.4	614.3
84	1.3	2.7	614.2
83.2	0.9	3.6	614.1
83.1	1.1	3.6	614.1
82	0.7	4.3	614.0

Table 5 Velocity, Flow Depth and Flood Levels at 2-year August 1st to Freeze-Up Flood Peak Left Berm

Cross Section	Mean Velocity (m/s)	Max Flow Depth (m)	Water Level (m)
90	0.5	3.8	616.8
89.2 (Upstream of Bridge)	2.0	2.7	616.5
89.15 (Bridge Centreline)	2.3	2.4	616.5
89.1 (Downstream of Bridge)	1.9	3.5	616.5
88	2.1	1.8	615.4
87	1.2	2.2	614.6
86	1.1	2.1	614.4
85.2	0.9	2.7	614.3
85.1	0.8	3.4	614.3
84	1.3	2.7	614.2
83.2	0.9	3.6	614.1
83.1	1.1	3.6	614.1
82	0.7	4.3	614.0

The model shows that the greatest impacts to velocity and water level are experienced under the third scenario: Left Berm, or when the berm extends from the left bank (when looking downstream). This is due to the geometry of the channel cross section at the bridge. The left half of the channel has lower bed elevations than the right half. Thus, when the left berm is in place and the left side of the channel is obstructed, the right half has a further reduced capacity to carry flow and a greater backwater effect results under this scenario.

In order to refine the cross section averaged results of the 1D model, the same three scenarios (as described in **Section 4.1.1**) were modeled in 2D to represent the open water conditions during Periods One and Two of the construction program.

4.2 2D Model of August 1st to Freeze-Up Flood

4.2.1 Available Data

EBA, a Tetra Tech Company, collected bathymetric data along a 250 m long reach around the Groat Road Bridge in 2013. These data were provided as contours (**Appendix B**). These bathymetric data were combined with Canadian Surface Digital Model elevation data to create a single digital terrain model representing the river bed and banks.

4.2.2 Model Construction

A 2D depth-averaged hydrodynamic model was constructed using the TELEMAC-MASCARET suite of software. Available bathymetric and LiDAR data were used to create the model geometry with upstream and downstream extensions added to minimize boundary effects. The 2D model has a total length of

approximately 850 m and includes the area bounded by Cross Sections 88 and 90 of the 1D model (**Figure 1**). Bridge piers were modeled as vertical frictionless walls, represented as internal boundaries. The computational mesh consisted of approximately 55,500 nodes in a Triangulated Irregular Network (TIN) spaced between 1 m and 10 m, with a higher spatial density of nodes in areas of interest and locations of complex flow behavior. The water surface elevation from the 1D model was used as the downstream boundary condition. Bed roughness was adjusted so that the resulting water surface profile matched that of the 1D model.

4.2.3 Results

Figures 2 through 4 show the modeled water surface elevation and backwater effect for the two berm configurations. The differences in water surface elevation from the upstream to downstream portion of the berm for the Right Berm and Left Berm scenarios are 0.4 m and 0.5 m, respectively. As compared with the Base Case scenario, this shows a water level increase of 0.3 m and 0.4 m for the Right Berm and Left Berm scenarios, respectively.

Figures 5 through 7 show the modeled velocity magnitudes for all three scenarios. **Figure 5** shows the Base Case depth-averaged velocities are between 0.8 m/s and 1.0 m/s through the majority of the channel. **Figures 6 and 7** show that the depth-averaged velocities for the Right Berm and Left Berm scenarios reach a maximum of 2.3 m/s and 2.5 m/s, respectively, near the nose of the berm under each berm scenario. Lower depth-averaged velocities of 1.0 m/s are experienced close to the banks under each berm scenario. Large recirculating eddies exist in the downstream lee of each berm.

5 ICE CONDITIONS

5.1 Freeze-up

Local ice conditions were assessed from the information recorded at the WSC gauge (05DF001) located downstream. Upon interpretation of water levels for the post-1972 record, the average date of first ice appearance is November 14, with a range from October 16 to December 16. The discharge at freeze-up averages 138 m³/s, and ranges from 76.7 m³/s to 202 m³/s. Water levels at freeze-up typically increase by between 1 and 2 m due to the thickness of the ice accumulation and its additional flow resistance.³ A frequency analysis was conducted of the freeze-up elevations at Groat Road Bridge (**Table 6**) by using the freeze-up elevation record available from the WSC gauge and transferring it to the bridge site.

³ Northwest Hydraulic Consultants. "Valley Line LRT – Tawatina Bridge Design on the North Saskatchewan River: Hydrotechnical Report" (2016).

Table 6 Frequency Analysis of Freeze-Up Elevations at Groat Road Bridge (1972-2013)

Return Period (years)	Annual Exceedance Probability (percent)	Elevation (m)
2	50	616.3
5	20	616.6
10	10	617.2
25	4	617.9
50	2	618.4
100	1	618.9

5.2 Ice Covered Conditions

To model ice covered conditions, an average winter monthly discharge of 70 m³/s was used. In addition, an ice cover with thickness of 0.67 m and a Manning’s roughness of 0.02 was assumed⁴.

The following three scenarios were modeled using the HEC-RAS 1D hydraulic model to represent the ice covered conditions during Periods One and Two of the construction program:

- 1) Base Case, or unobstructed and without any berms in place;
- 2) Left Berm (Second Half of Period One), or berm extending from the left bank (when looking downstream) in place; and
- 3) Right Berm (Second Half of Period Two), or berm extending from the right bank (when looking downstream) in place.

Tables 7, 8 and 9 present the section average velocities, maximum flow depths and water levels determined for ice covered conditions ($Q = 70 \text{ m}^3/\text{s}$) for the three scenarios described above.

⁴ Northwest Hydraulic Consultants. “Hydrotechnical Assessment for a Footbridge over the North Saskatchewan River near Fort Edmonton Park” (2007).

**Table 7 Velocity, Flow Depth and Flood Levels for Ice Covered Conditions
Base Case**

Cross Section	Mean Velocity (m/s)	Max Flow Depth (m)	Water Level (m)
90	0.2	2.9	615.8
89.2 (Upstream of Bridge)	0.4	2.1	615.8
89.15 (Bridge Centreline)	0.2	2.4	615.8
89.1 (Downstream of Bridge)	0.4	2.8	615.8
88	1.7	1.7	615.3
87	0.5	2.0	614.4
86	0.7	1.8	614.0
85.2	0.4	2.3	614.0
85.1	0.3	3.0	613.9
84	0.6	2.4	613.9
83.2	0.3	3.3	613.8
83.1	0.4	3.4	613.8
82	0.2	4.1	613.8

**Table 8 Velocity, Flow Depth and Flood Levels for Ice Covered Conditions
Left Berm**

Cross Section	Mean Velocity (m/s)	Max Flow Depth (m)	Water Level (m)
90	0.2	3.4	616.3
89.2 (Upstream of Bridge)	0.8	2.5	616.3
89.15 (Bridge Centreline)	0.5	2.2	616.3
89.1 (Downstream of Bridge)	0.7	3.3	616.3
88	1.7	1.7	615.3
87	0.5	2.0	614.4
86	0.7	1.8	614.0
85.2	0.4	2.3	614.0
85.1	0.3	3.0	613.9
84	0.6	2.4	613.9
83.2	0.3	3.3	613.8
83.1	0.4	3.4	613.8
82	0.2	4.1	613.8

**Table 9 Velocity, Flow Depth and Flood Levels for Ice Covered Conditions
Right Berm**

Cross Section	Mean Velocity (m/s)	Max Flow Depth (m)	Water Level (m)
90	0.2	3.0	615.9
89.2 (Upstream of Bridge)	0.6	2.2	615.9
89.15 (Bridge Centreline)	0.4	2.5	615.9
89.1 (Downstream of Bridge)	0.5	2.9	615.9
88	1.7	1.7	615.3
87	0.5	2.0	614.4
86	0.7	1.8	614.0
85.2	0.4	2.3	614.0
85.1	0.3	3.0	613.9
84	0.6	2.4	613.9
83.2	0.3	3.3	613.8
83.1	0.4	3.4	613.8
82	0.2	4.1	613.8

Once again, the greatest impacts to velocity and water level are experienced under the Left Berm scenario, or when the berm extends from the left bank (when looking downstream). However, due to the lower flow and the increased resistance due to an ice cover, cross section average velocities for all ice covered scenarios are lower than during open water conditions. As the open water scenarios present the highest section average velocities, 2D modeling of ice conditions was not considered at this time.

5.3 Breakup

WSC gauge (05DF001) records can be used to identify the date of breakup. The last remnants of an ice cover are typically seen in April, but ice effects can persist into May. The average date of last ice is April 16, but ice effects can disappear as early as April 3 or persist as late as May 5, based on interpretation of water levels for the period between 1973 and 2013.³

6 SUMMARY

The objective of this report was to establish design flood and hydraulic conditions for the proposed berm arrangements associated with rehabilitation of Groat Road Bridge on the North Saskatchewan River in Edmonton. The hydrologic assessment consisted of carrying out a flood frequency analysis on peak flows using data from the beginning of August to freeze-up from 1972 to present (**Table 1**). For reference, the widely adopted open water flood frequency analysis as based on data from 1899 to 1990 was presented (**Table 2**). A 1D hydraulic model was used to determine section average velocities, maximum flow depths and water levels for the 2-year August 1st to freeze-up flood peak discharges for each of the modeled scenarios (**Tables 3 through 5**). A 2D model was constructed and used to refine the cross section averaged results of the 1D model for the same three scenarios (**Figures 2 through 7**). 2D model results showed that under both berm scenarios, there are areas near the banks where depth averaged velocities are similar to those under the base case scenario.

In addition, analyses of ice conditions were conducted to determine freeze-up elevations at Groat Road Bridge (**Table 6**) as well as determine that freeze-up can occur between October 16 and December 16, while breakup can occur between April 3 and May 5. **Tables 7 through 9** show the 1D section average velocities, maximum flow depths and water levels of the three scenarios under ice covered conditions. 2D modeling was not carried out as modeled section average velocities were all lower than for open water conditions.

In summary, the August 1st to freeze-up flood peak level and freeze-up levels for the 2-year return periods are contained in **Table 10**. The 2-year August 1st to freeze-up flood peak level is 0.5 m higher than the 2-year freeze-up level. It should be noted that the open water and freeze-up conditions do not influence each other and that probabilities of the open water event and freeze-up event occurring are independent.

Table 10 Summary of Maximum Open Water (August 1st to Freeze-up) Flood Peak Elevations and Freeze-Up Elevations at Groat Road Bridge (1972-2013)

Return Period (years)	Annual Exceedance Probability (percent)	Discharge (m ³ /s)	Max Open Water Elevation (m)	Max Freeze-up Elevation (m)
2	50	343	616.8	616.3

7 CLOSURE

DISCLAIMER

This document has been prepared by Northwest Hydraulic Consultants Ltd. in accordance with generally accepted engineering practices and is intended for the exclusive use and benefit of Dialog Design and their authorized representatives for specific application to the Groat Road Bridge Rehabilitation on the North Saskatchewan River in Edmonton, Alberta, Canada. The contents of this document are not to be relied upon or used, in whole or in part, by or for the benefit of others without specific written authorization from Northwest Hydraulic Consultants Ltd. No other warranty, expressed or implied, is made. Northwest Hydraulic Consultants Ltd. and its officers, directors, employees, and agents assume no responsibility for the reliance upon this document or any of its contents by any parties other than Dialog Design.

Sincerely,

Northwest Hydraulic Consultants Ltd.

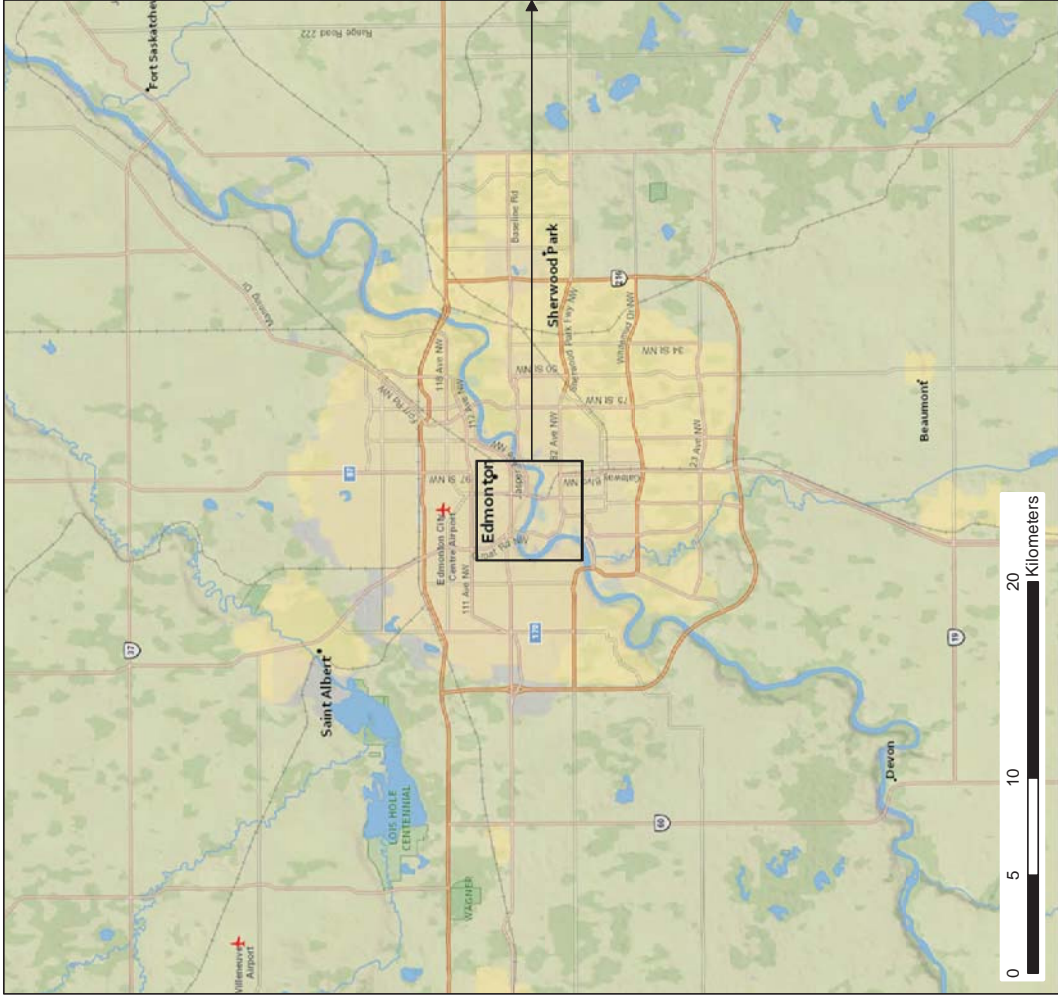
Prepared by:


Reviewed by:

Agata Hall, M.Sc., P.Eng.
Project Engineer

Eugene Yaremko, M.Sc., P.Eng.
Principal

ENCLOSURE



		DIALOG DESIGN	
		GROAT ROAD BRIDGE BERM DESIGN	
LOCATION PLAN		1002602	31 JAN 2017
Figure 1			

Legend/Notes:
 Coordinate System: NAD 1983 CSRS 3TM 114

Service Layer Credits:
 Esri, DigitalGlobe, GeoEye, Earthstar Geographics,
 CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP,
 swisstopo, National Geographic, DeLorme, HERE, UNEP-WCMC, NASA,
 ESA, METI, GEBCO, NOAA, Increment P Corp. and the GIS User Community.

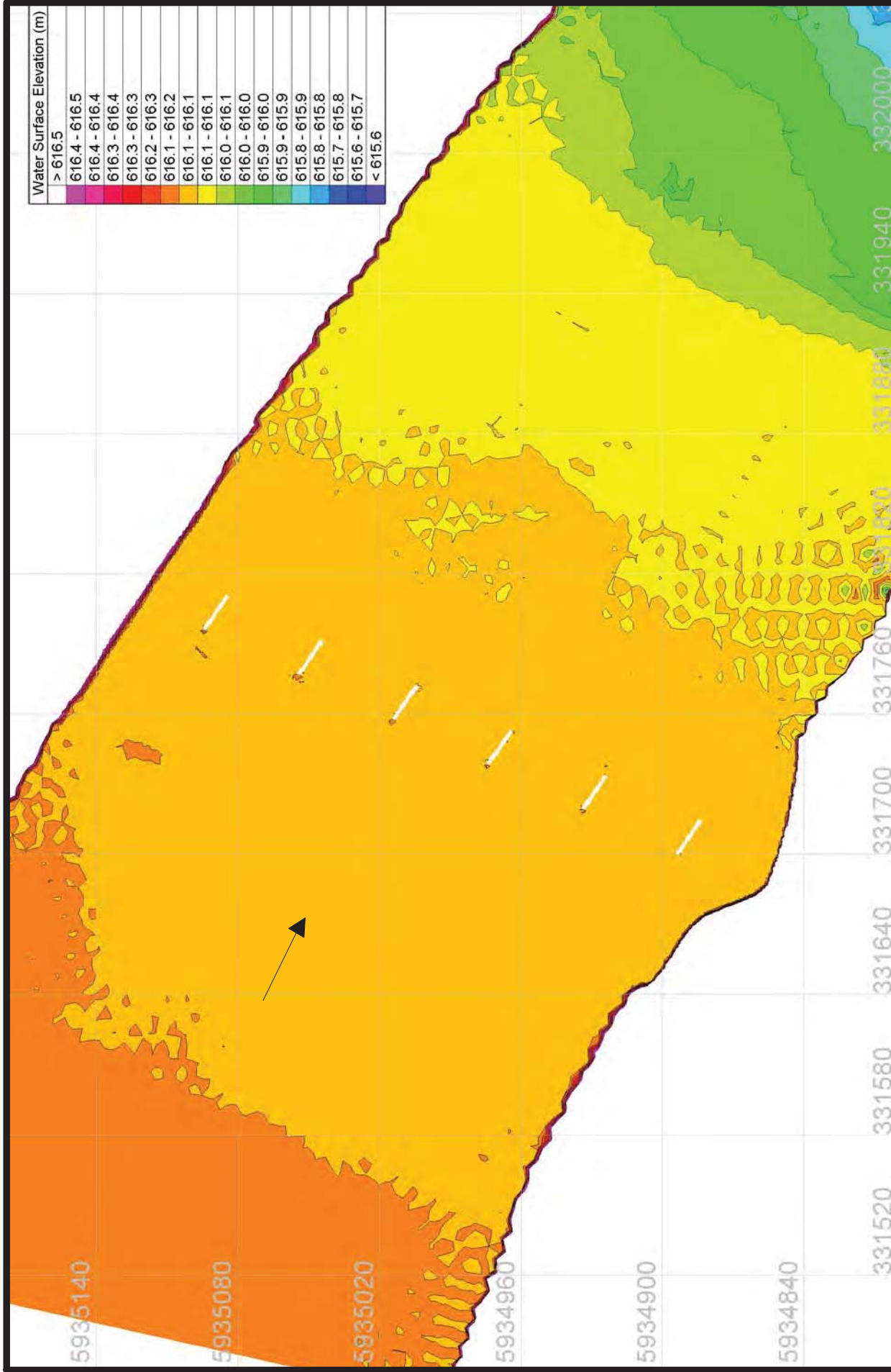


Figure 2 - Water Surface Elevation - Base Case

Mar 13 2017 14:50

Q = 343 cms

BlueKenue64 V3.3 CHC/NRC (c) 1998-2012

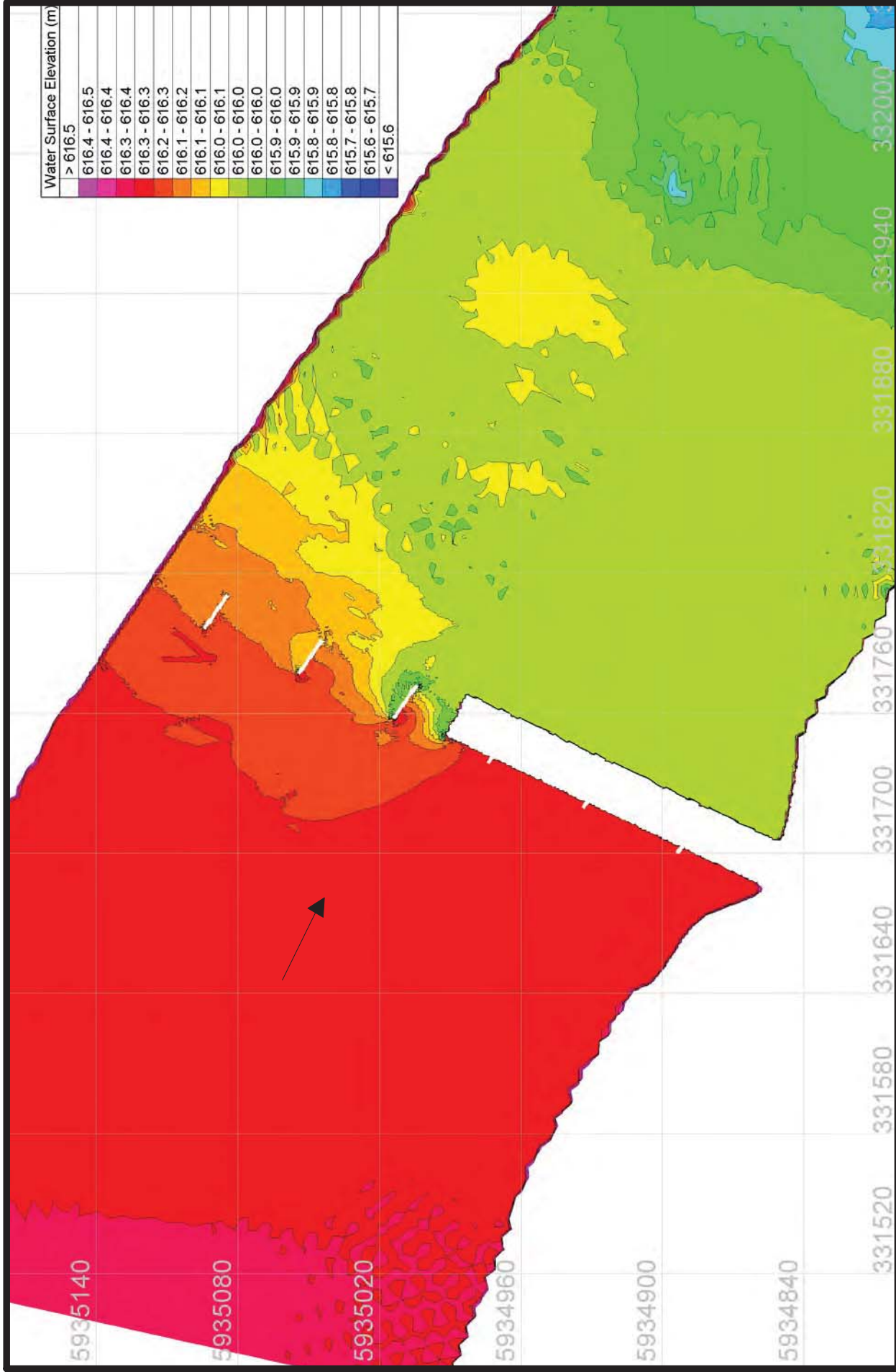
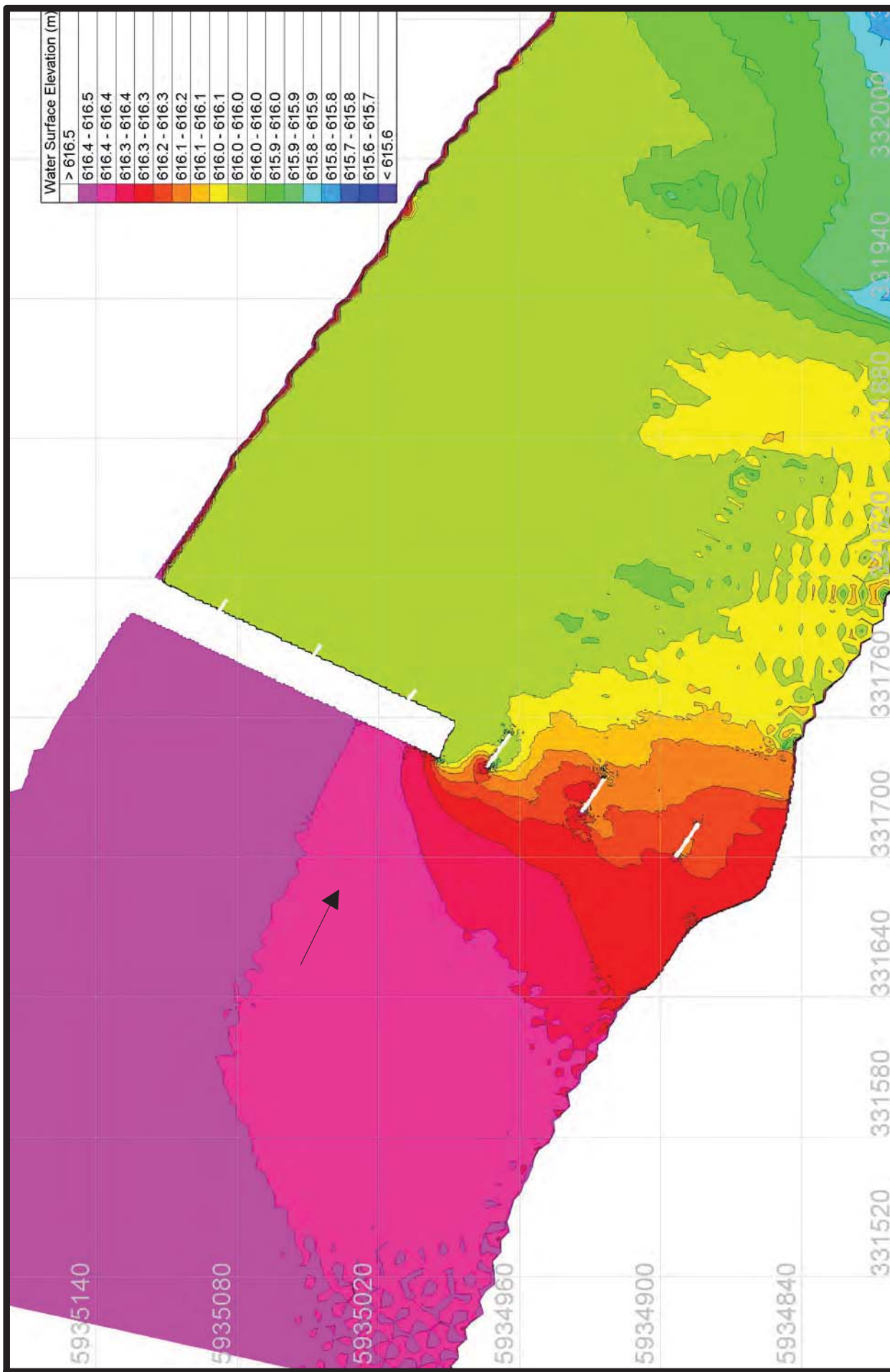


Figure 3 - Water Surface Elevation - Right Berm

Mar 13 2017 14:51

Q = 343 cms

BlueKenue64 V3.3 CHC/NRC (c) 1998-2012



Water Surface Elevation (m)	
> 616.5	
616.4 - 616.5	
616.4 - 616.4	
616.3 - 616.4	
616.3 - 616.3	
616.2 - 616.3	
616.1 - 616.2	
616.1 - 616.1	
616.0 - 616.1	
616.0 - 616.0	
616.0 - 616.0	
615.9 - 616.0	
615.9 - 615.9	
615.8 - 615.9	
615.8 - 615.8	
615.7 - 615.8	
615.6 - 615.7	
< 615.6	

Figure 4 - Water Surface Elevation - Left Berm

Mar 13 2017 14:51

Q = 343 cms

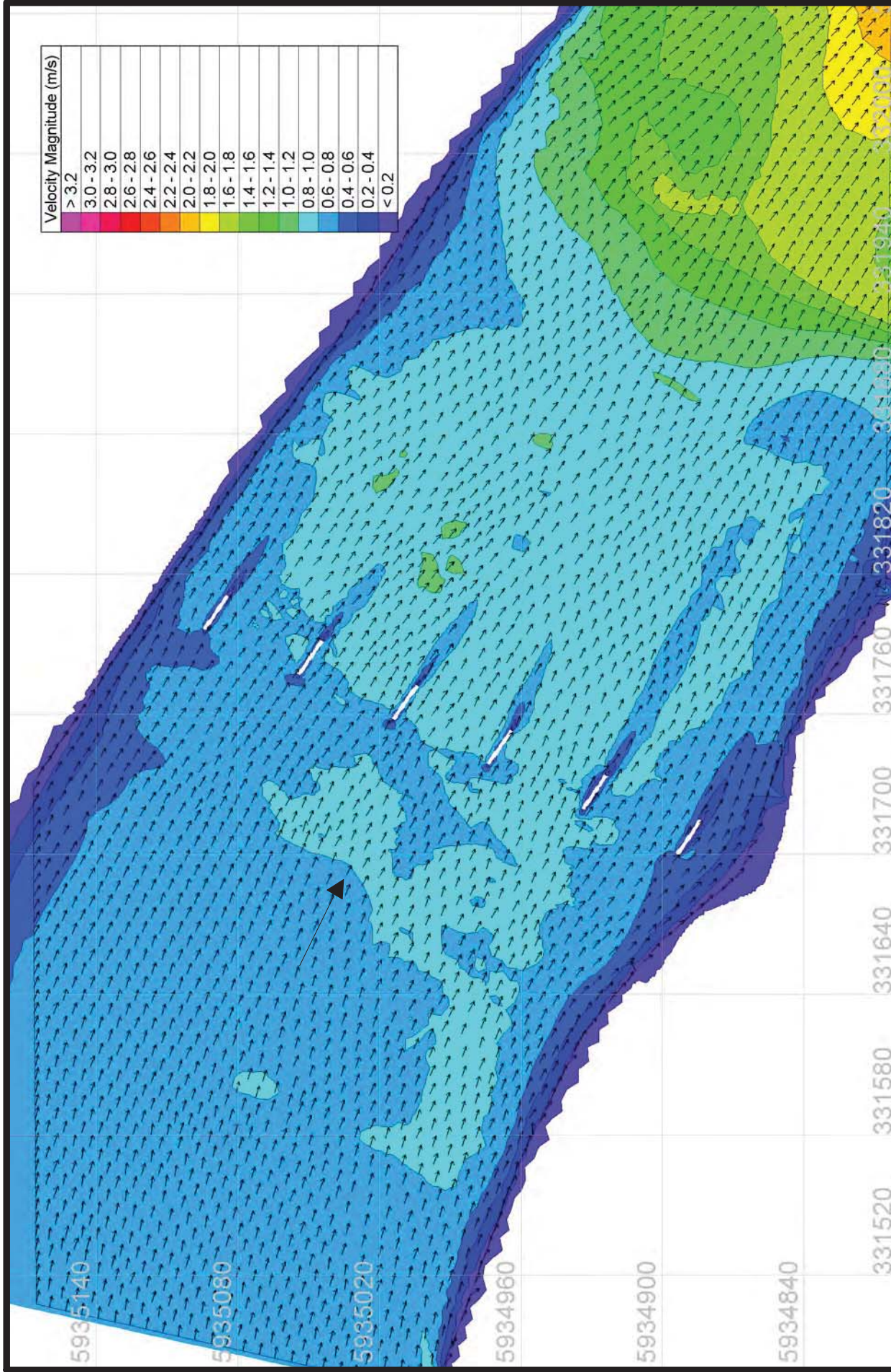


Figure 5 - Velocity Magnitude - Base Case

Mar 13 2017 14:51

BlueKenue64 V3.3 CHC/NRC (c) 1998-2012

Q = 343 cms

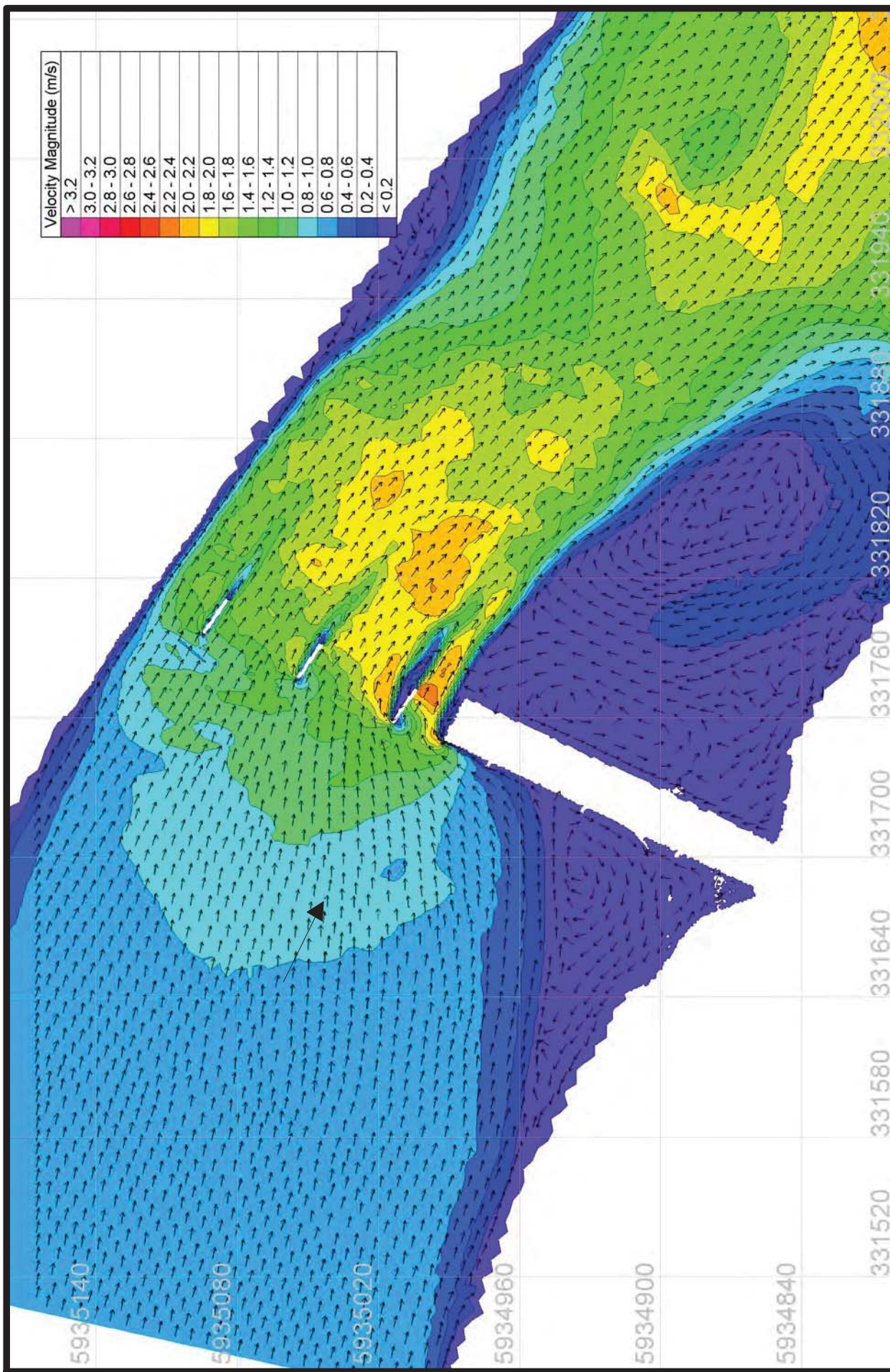
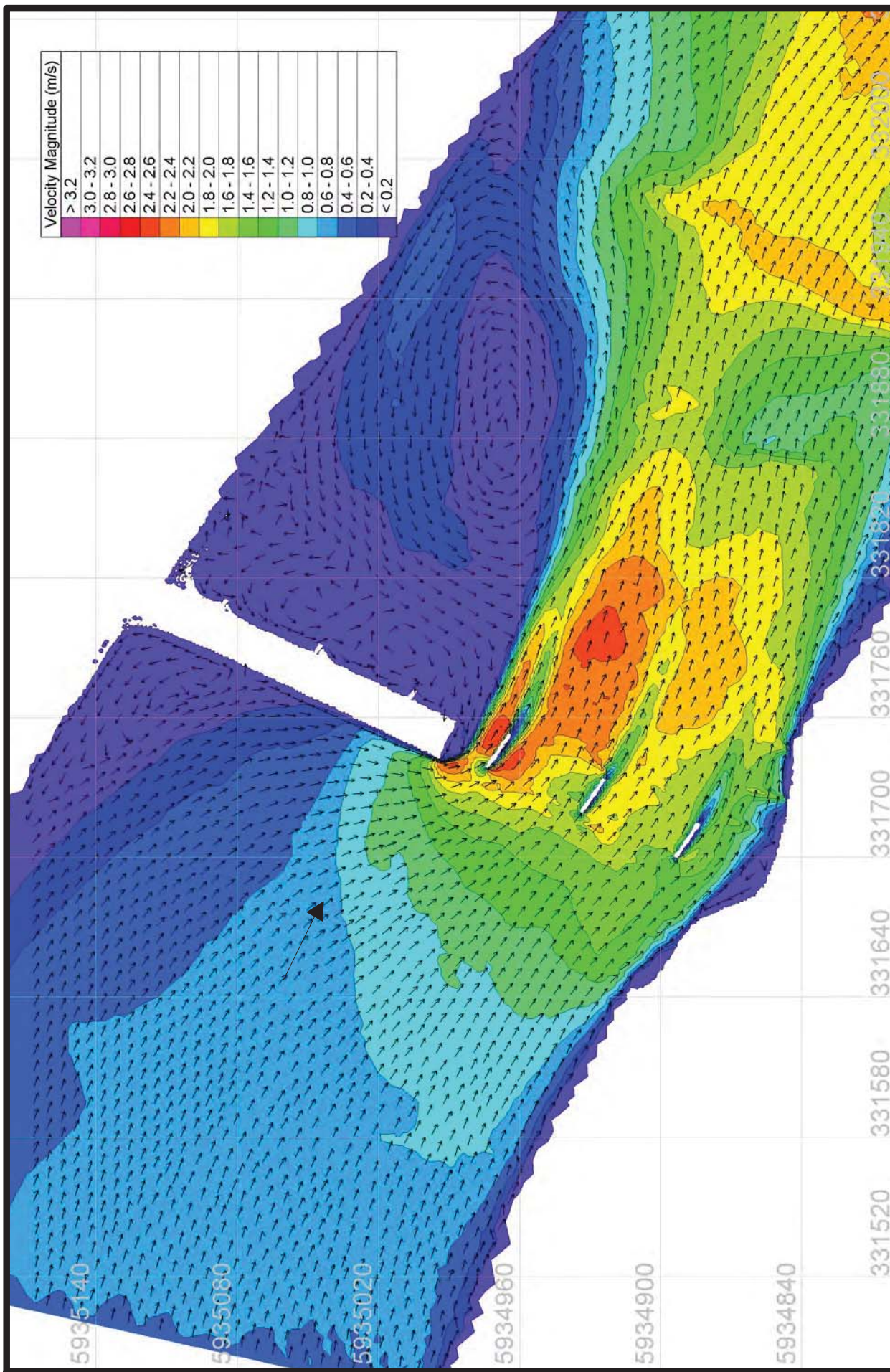


Figure 6 - Velocity Magnitude - Right Berm

Mar 13 2017 14:51

Q = 343 cms



Velocity Magnitude (m/s)
> 3.2
3.0 - 3.2
2.8 - 3.0
2.6 - 2.8
2.4 - 2.6
2.2 - 2.4
2.0 - 2.2
1.8 - 2.0
1.6 - 1.8
1.4 - 1.6
1.2 - 1.4
1.0 - 1.2
0.8 - 1.0
0.6 - 0.8
0.4 - 0.6
0.2 - 0.4
< 0.2

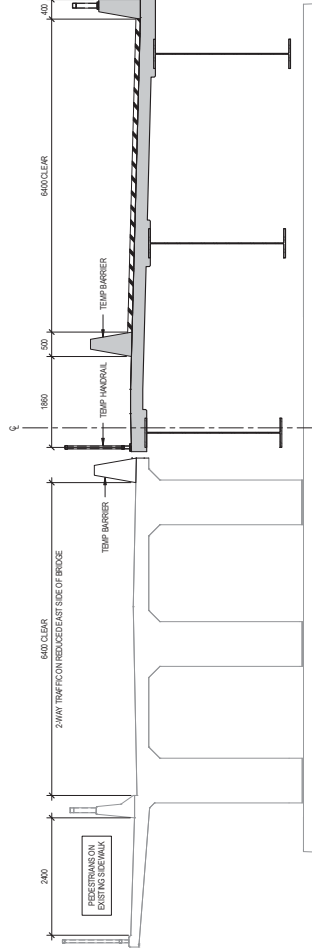
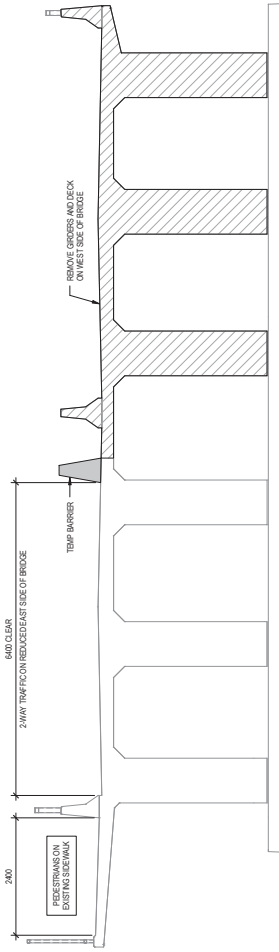
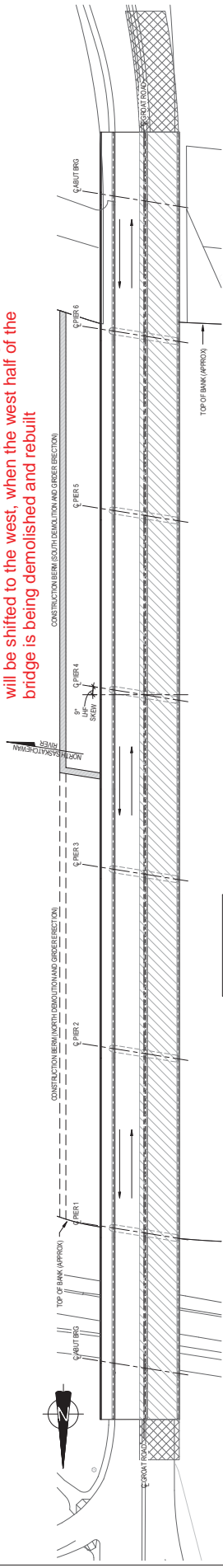
Figure 7 - Velocity Magnitude - Left Berm

Mar 13 2017 14:51

Q = 343 cms

APPENDIX A

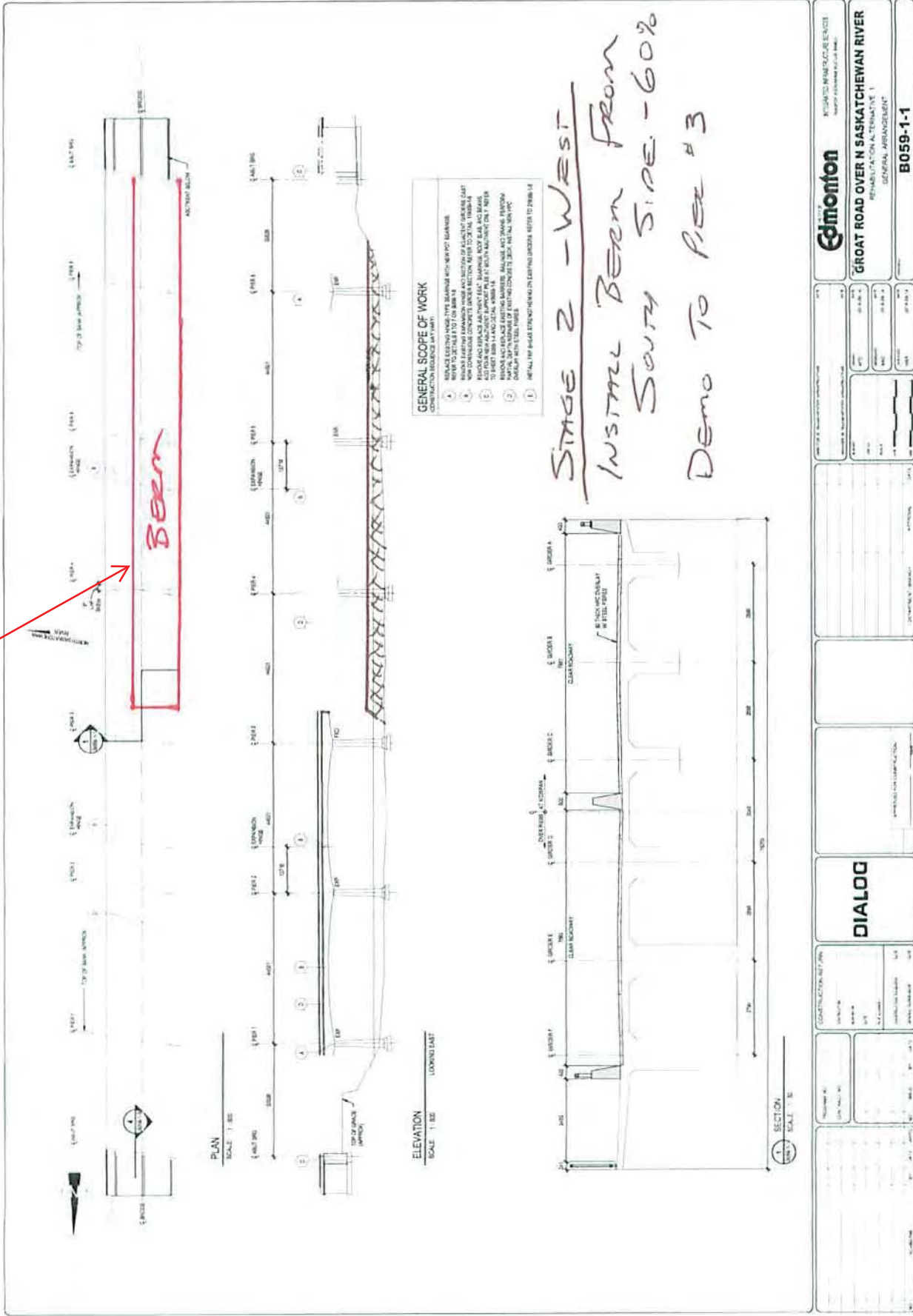
Note - Berms are drawn on wrong side of bridge. Berms will be shifted to the west, when the west half of the bridge is being demolished and rebuilt



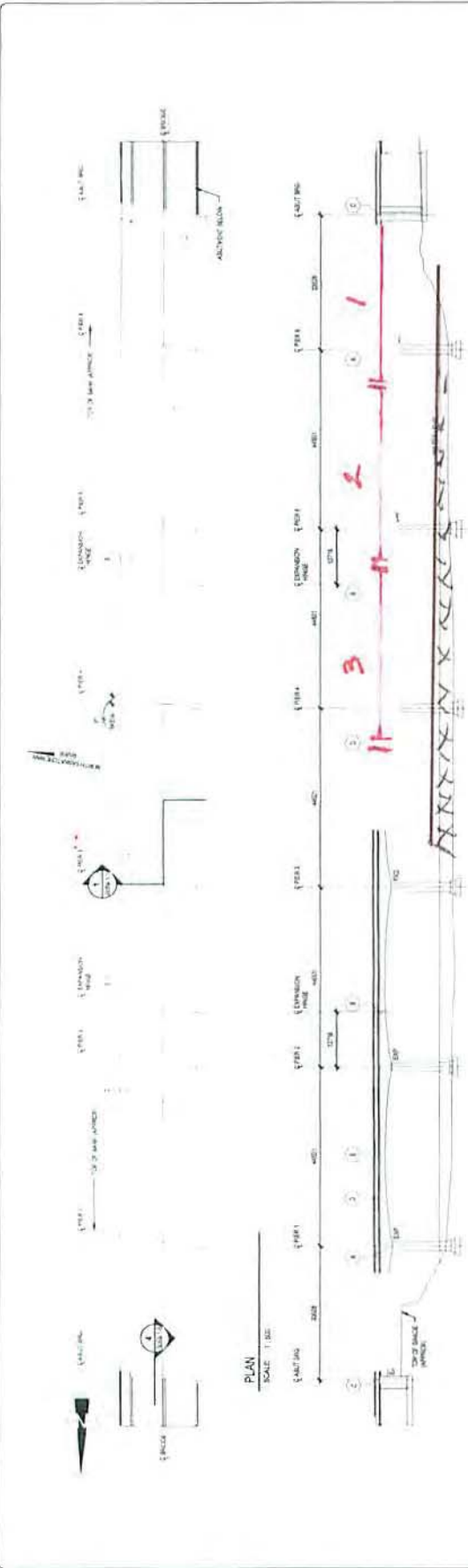
		INTEGRATED INFRASTRUCTURE SERVICES INFRASTRUCTURE PROJECTS DIVISION	
G/GRAND ROAD OVER N SASKATCHEWAN RIVER REHABILITATION ALTERNATIVE 4 STAGING PLAN - PHASE 1		B059-4-2	
DATE	DATE	DATE	DATE
2016/08-14	2016/08-14	2016/08-14	2016/08-14
DESIGN	DTC	DESIGNED	SAO
2016/08-14	2016/08-14	2016/08-14	2016/08-14
ISSUED	SAO	ISSUED	NSR
2016/08-14	2016/08-14	2016/08-14	2016/08-14
DATE	DATE	DATE	DATE
2016/08-14	2016/08-14	2016/08-14	2016/08-14
APPROVED FOR CONSTRUCTION	APPROVAL	APPROVAL	APPROVAL
DATE	DATE	DATE	DATE
2016/08-14	2016/08-14	2016/08-14	2016/08-14
DEPARTMENT / BRANCH	DEPARTMENT / BRANCH	DEPARTMENT / BRANCH	DEPARTMENT / BRANCH
DIALOG			
PROGRAM NO.	CONSTRUCTION RE TURN	CONSTRUCTION RE TURN	CONSTRUCTION RE TURN
CONTRACT NO.	CONTRACTOR	CONTRACTOR	CONTRACTOR
DATE	DATE	DATE	DATE
2016/08-14	2016/08-14	2016/08-14	2016/08-14
ISSUE	ISSUE	ISSUE	ISSUE
NO	NO	NO	NO
1	1	1	1
DATE	DATE	DATE	DATE
2016/08-14	2016/08-14	2016/08-14	2016/08-14
BY	BY	BY	BY
REVISIONS	REVISIONS	REVISIONS	REVISIONS

Approx dimensions of Class 2
rock riprap berm:

- 16m wide at top
- 20m wide at base
- 3.8 to 4.0m high



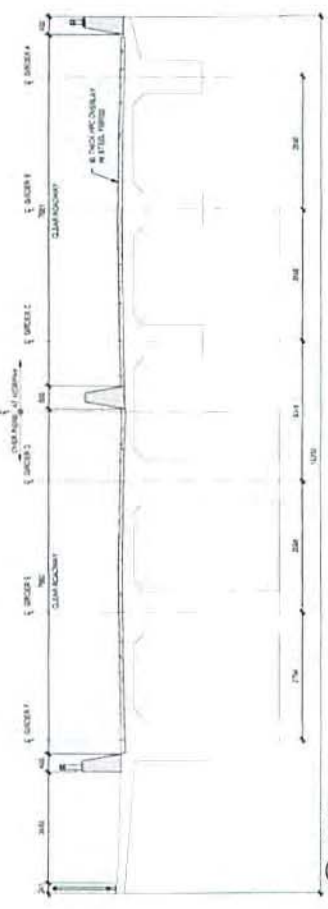
Estimated Construction Schedule:
Install Berm in Late August 2018
Demolition occurs in September 2018



GENERAL SCOPE OF WORK

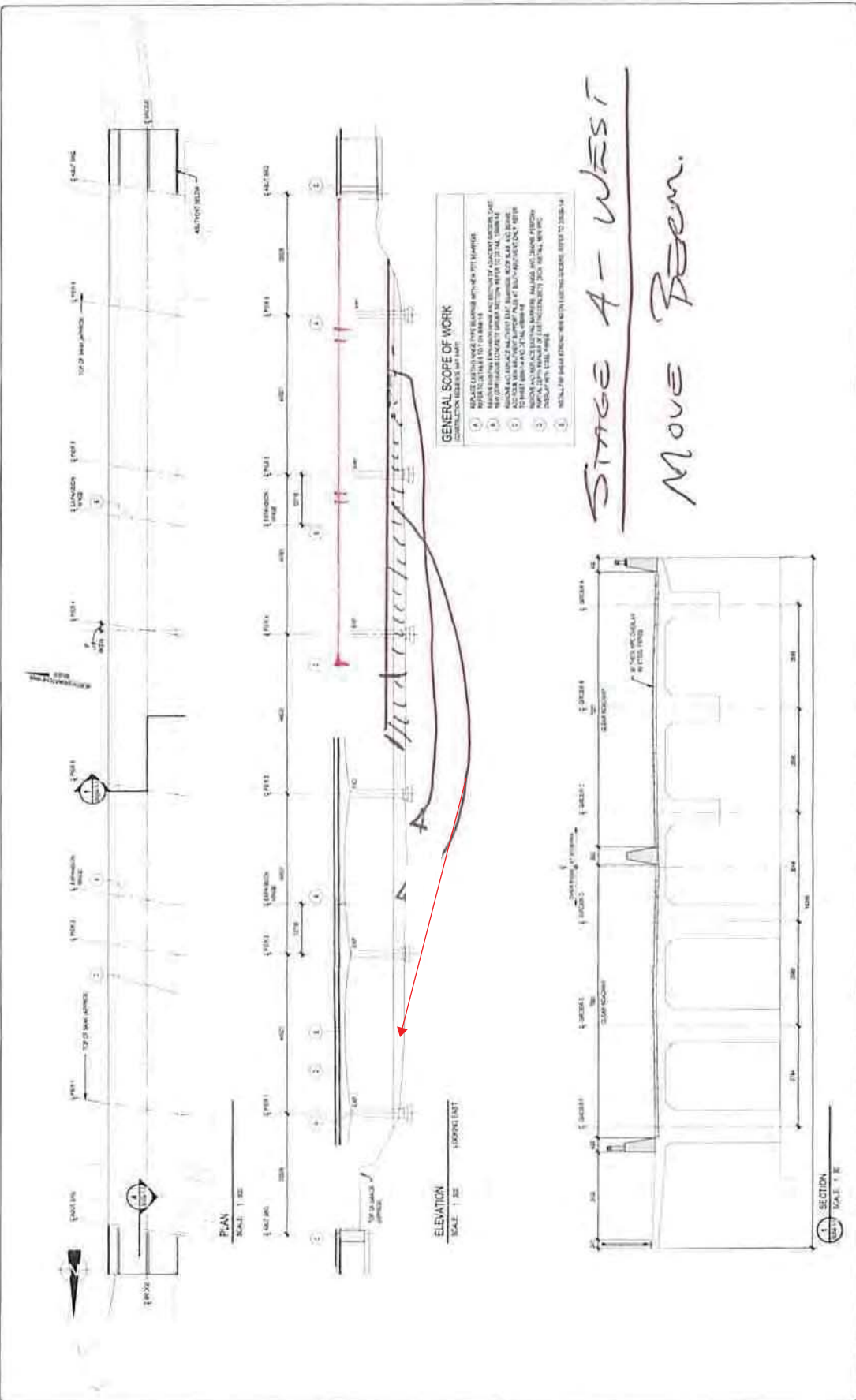
1. REMOVE EXISTING BRIDGE AND RECONSTRUCT WITH NEW BRIDGE
2. REMOVE EXISTING BRIDGE AND RECONSTRUCT WITH NEW BRIDGE
3. REMOVE EXISTING BRIDGE AND RECONSTRUCT WITH NEW BRIDGE
4. REMOVE EXISTING BRIDGE AND RECONSTRUCT WITH NEW BRIDGE

SINCE 3 - WEST
ERECT SOUTH
GIRDERS.
 G1 ~ 48 km
 G2 & G3 ~ 44 km



		PROJECT: MAINTENANCE & REPAIR CONTRACT NO.:	
GROAT ROAD OVER N SASKATCHEWAN RIVER		CONTRACT NO.:	
GENERAL AMENDMENT		B059-1-1	
DATE:	DRAWN BY:	CHECKED BY:	APPROVED BY:
SCALE:	DATE:	SCALE:	DATE:
DIALOG		PROJECT NO.:	
CONTRACT NO.:		PROJECT NO.:	
DATE:		DATE:	
SCALE:		SCALE:	
DATE:		DATE:	

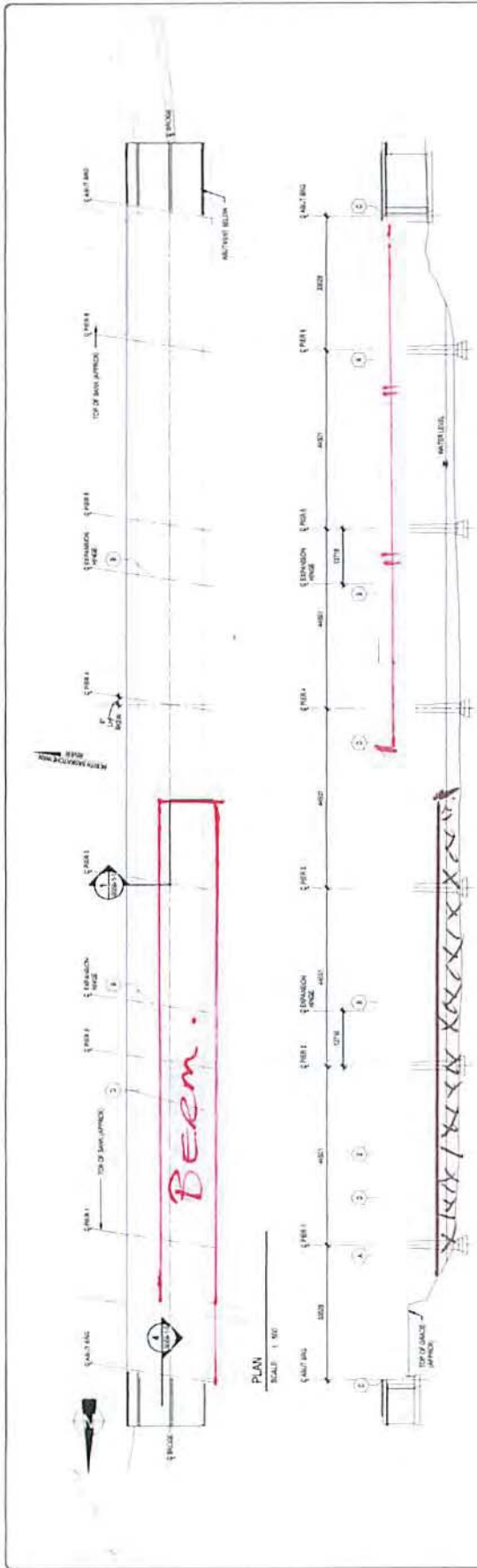
Estimated Construction Schedule:
 Erect Girders in October 2018



STAGE A - WEST
MOVE BERM.

		GROAT ROAD OVER N SASKATCHEWAN RIVER REHABILITATION ALTERNATIVE 1 GENERAL ARRANGEMENT		B059-1-1	
NO.	DATE	BY	CHECKED	APPROVED	SCALE
DIALOG		CONSTRUCTION METHOD:		PROJECT TITLE:	
PROJECT NO.:		DRAWING NO.:		SHEET NO.:	
CLIENT:		CONTRACT NO.:		DATE:	
PROJECT LOCATION:		CONTRACT VALUE:		PROJECT STATUS:	

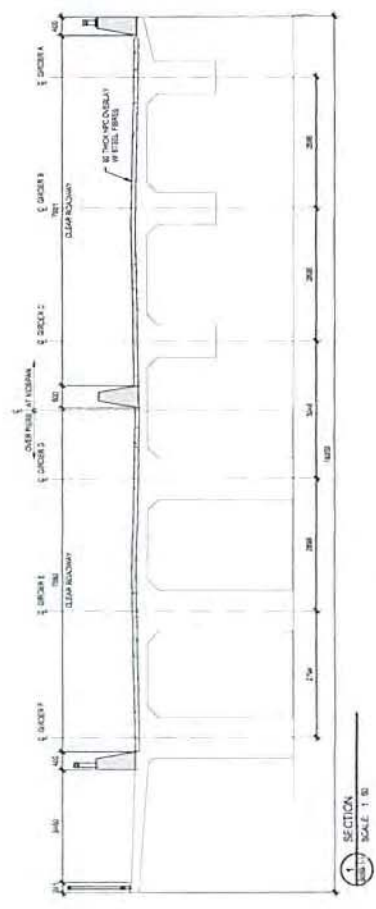
Estimated Construction Schedule:
Move berms material from south half of the river to north half of river in November 2018



GENERAL SCOPE OF WORK
CONSTRUCTION BEHIND MAT 101

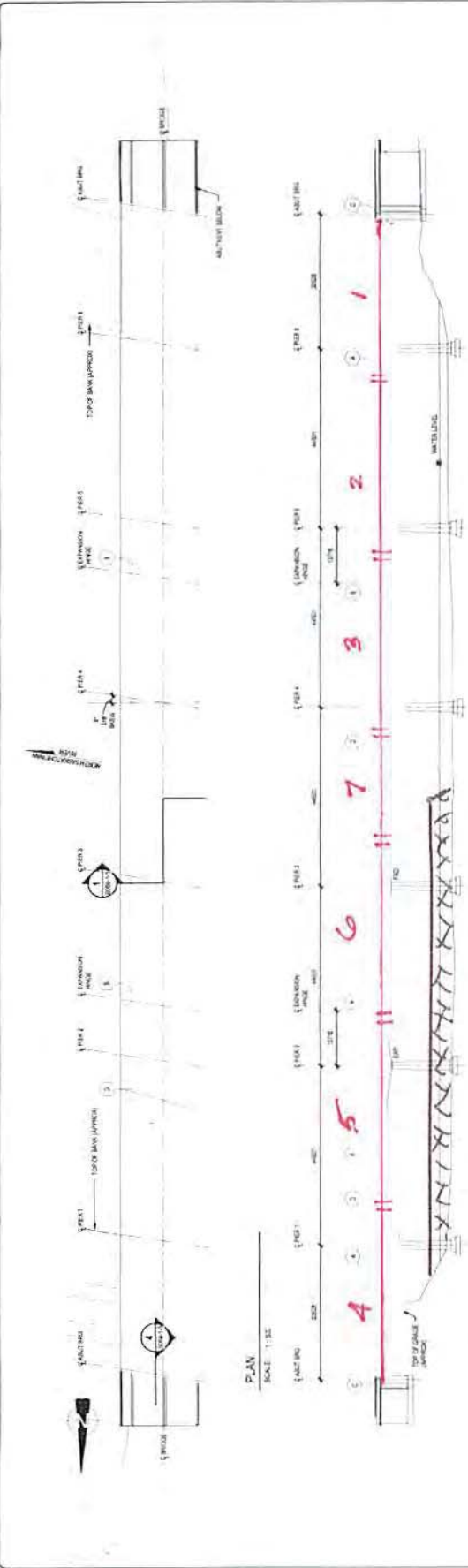
- REMOVE EXISTING BRIDGE TYPE BEAMS AND REINFORCING BARS TO BE REPLACED WITH PRECAST CONCRETE BEAMS.
- REMOVE EXISTING BRIDGE TYPE BEAMS AND REINFORCING BARS TO BE REPLACED WITH PRECAST CONCRETE BEAMS.
- REMOVE EXISTING BRIDGE TYPE BEAMS AND REINFORCING BARS TO BE REPLACED WITH PRECAST CONCRETE BEAMS.
- REMOVE EXISTING BRIDGE TYPE BEAMS AND REINFORCING BARS TO BE REPLACED WITH PRECAST CONCRETE BEAMS.
- REMOVE EXISTING BRIDGE TYPE BEAMS AND REINFORCING BARS TO BE REPLACED WITH PRECAST CONCRETE BEAMS.
- REMOVE EXISTING BRIDGE TYPE BEAMS AND REINFORCING BARS TO BE REPLACED WITH PRECAST CONCRETE BEAMS.

STAGE 5 - WEST
DEMO BALANCE
OF BRIDGE



		REGIONAL INFRASTRUCTURE SERVICES <small>Supporting the Growth of Alberta</small>	
GREAT ROAD OVER N SASKATCHEWAN RIVER REHABILITATION ALTERNATIVE 1 GENERAL ARRANGEMENT			
B059-1-1		SHEET NO.	
PROJECT NO.		DRAWING NO.	
DATE		SCALE	
DRAWN BY		CHECKED BY	
APPROVED BY		DATE	
PROJECT LOCATION		PROJECT NO.	
DRAWING NO.		SHEET NO.	
DATE		SCALE	
DRAWN BY		CHECKED BY	
APPROVED BY		DATE	

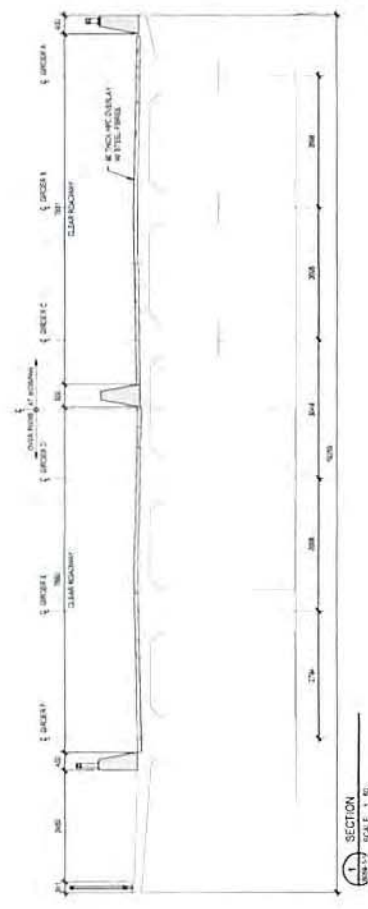
Estimated Construction Schedule:
Demolition in December 2018



PLAN
SCALE 1:300

GENERAL SCOPE OF WORK
 CONTRACTOR TO PROVIDE THE FOLLOWING WORK:
 1. REMOVE EXISTING BRIDGE WITH REMAINING
 REPORT TO STALS FOR APPROVAL
 2. REMOVE EXISTING BRIDGE AND RECONSTRUCT BRIDGE WITH
 1500 BAW JOINTS AND 1000 BAW JOINTS
 3. PROVIDE 1500 BAW JOINTS AND 1000 BAW JOINTS
 4. PROVIDE 1500 BAW JOINTS AND 1000 BAW JOINTS
 5. PROVIDE 1500 BAW JOINTS AND 1000 BAW JOINTS
 6. PROVIDE 1500 BAW JOINTS AND 1000 BAW JOINTS
 7. PROVIDE 1500 BAW JOINTS AND 1000 BAW JOINTS

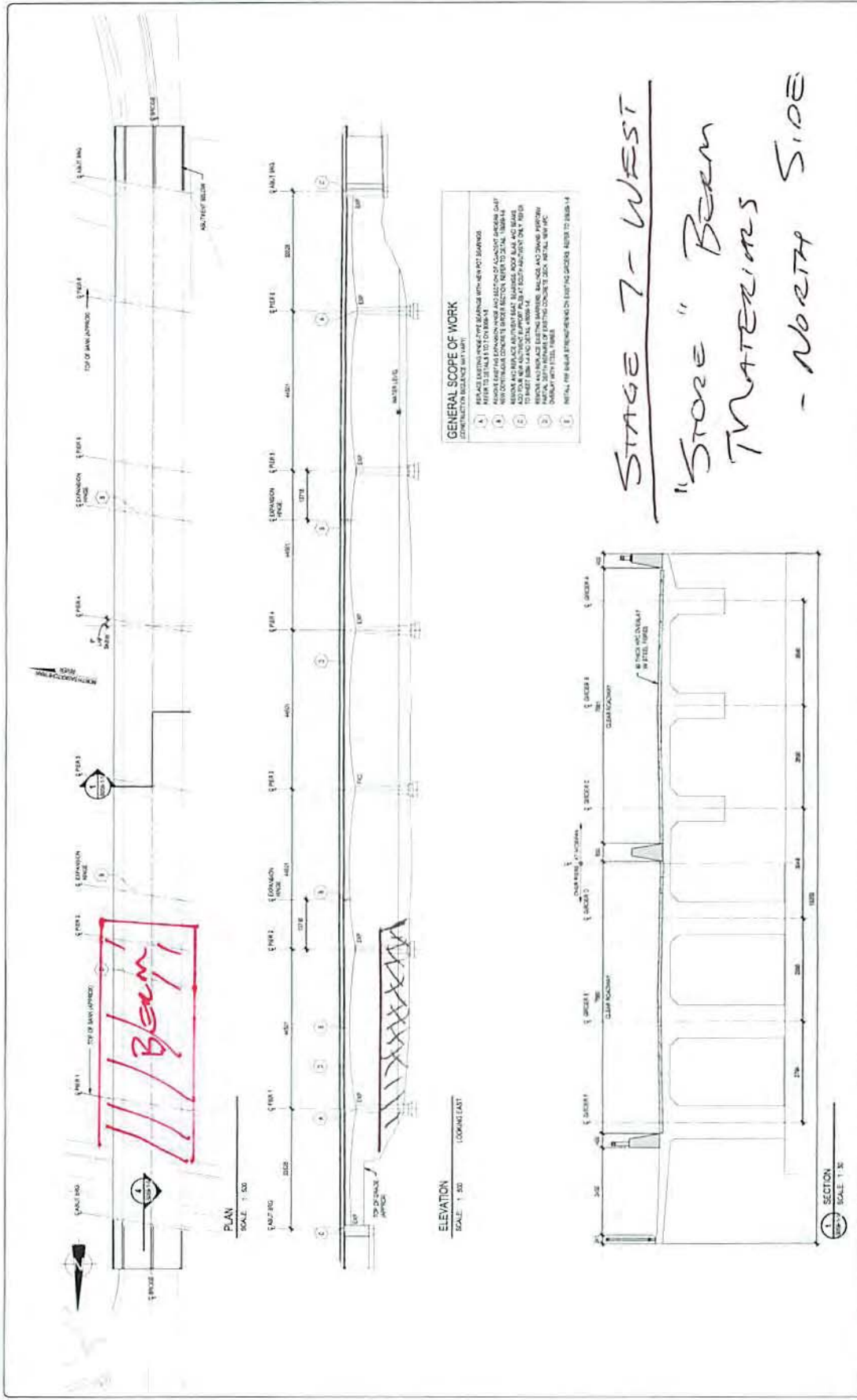
STAGE 6 - WEST
 ERECT REMAINING
 STEEL GIRDEARS
 G4 ~ 48 km
 G5 ~ 66 ~ 44 km
 G7 ~ 15 km



ELEVATION
SCALE 1:300
LOOKING EAST

		MUNICIPALITY OF EDMONTON 10000 101ST AVENUE EDMONTON, ALBERTA T5C 1H6 TEL: 780.427.3100 FAX: 780.427.3101 WWW.EDMONTON.CA	
GREAT ROAD OVER N SASKATCHEWAN RIVER REHABILITATION ALTERNATIVE 1 GENERAL ARRANGEMENT		B059-1-1	
PROJECT NO. 2019-01-001 DRAWING NO. 2019-01-001-01 SHEET NO. 1 OF 1 DATE: 2019-01-01	PROJECT NO. 2019-01-001 DRAWING NO. 2019-01-001-01 SHEET NO. 1 OF 1 DATE: 2019-01-01	PROJECT NO. 2019-01-001 DRAWING NO. 2019-01-001-01 SHEET NO. 1 OF 1 DATE: 2019-01-01	PROJECT NO. 2019-01-001 DRAWING NO. 2019-01-001-01 SHEET NO. 1 OF 1 DATE: 2019-01-01
DIALOG		CONSTRUCTION RETURN DATE: _____ BY: _____ CHECKED BY: _____ APPROVED BY: _____	
PROJECT NO. 2019-01-001 CONTRACT NO. _____ SHEET NO. 1 OF 1 DATE: 2019-01-01		PROJECT NO. 2019-01-001 CONTRACT NO. _____ SHEET NO. 1 OF 1 DATE: 2019-01-01	

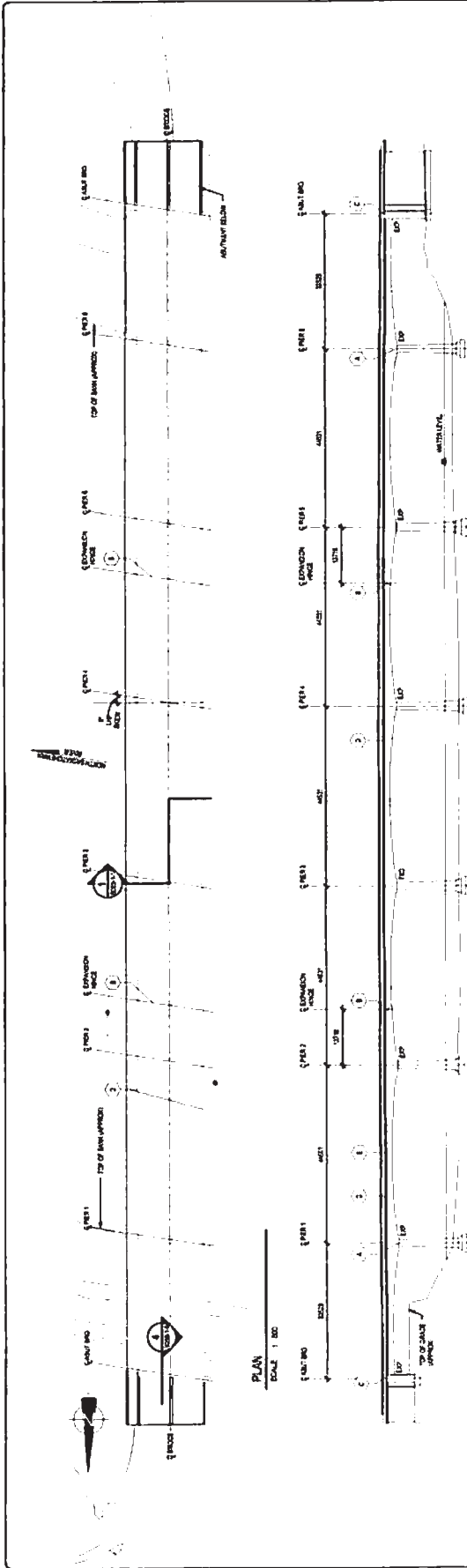
Estimated Construction Schedule:
 Erect Remaining Girders in January 2019



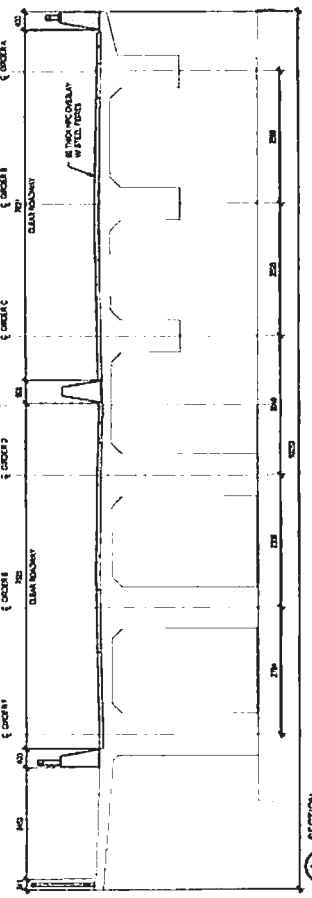
STAGE 7 - WEST
 "Store" Beam
 MATERIALS
 - NORTH SIDE

		PROJECT NUMBER: 1000000000 DRAWING NUMBER: 1000000000	
GROAT ROAD OVER N SASKATCHEWAN RIVER REPAIR/RECONSTRUCTION ALTERNATIVE 1 GENERAL ARRANGEMENT			
CONTRACTOR: PROJECT NO: SHEET NO: DATE:	CHECKED BY: DATE:	APPROVED BY: DATE:	PROJECT NO: SHEET NO: DATE:
DIALOG		PREPARED FOR: APPROVED:	
B059-1-1			

Estimated Construction Schedule:
 Shift Berm Material against North Bank in February 2019
 Berm material will remain here throughout the spring and summer of 2019



- GENERAL SCOPE OF WORK**
CONSTRUCTION AND MAINT.
1. REMOVE EXISTING PAVEMENT AND RECONSTRUCT WITH ASPHALT CONCRETE TO 150 MM.
 2. REPAIR AND REPLACE DAMAGED EXISTING BRIDGE ROAD AND SIDEWALKS.
 3. CONSTRUCT NEW INTERLUM BEHIND EXISTING BRIDGE ROAD AND SIDEWALKS.
 4. REPAIR AND REPLACE EXISTING DAMAGED BALANCE AND TRUSS MEMBERS.
 5. REPAIR AND REPLACE EXISTING DAMAGED BALANCE AND TRUSS MEMBERS.
 6. REPAIR AND REPLACE EXISTING DAMAGED BALANCE AND TRUSS MEMBERS.
 7. REPAIR AND REPLACE EXISTING DAMAGED BALANCE AND TRUSS MEMBERS.



*EAST SIDE
REPEAT IN
REVERSE ORDER
REMOVE BERM
MATERIALS ON
SOUTH END.*

		REGISTERED PROFESSIONAL ENGINEER BRIDGE ENGINEER (S.A.)	
GROAT ROAD OVER N SASKATCHEWAN RIVER RECONSTRUCTION AT TERMINAL 1 GENERAL ARRANGEMENT			
PROJECT NO.	DATE	SCALE	NO.
CONTRACT NO.	DATE	SCALE	NO.
CONTRACTOR	DATE	SCALE	NO.
DESIGNER	DATE	SCALE	NO.
CHECKER	DATE	SCALE	NO.
APPROVED	DATE	SCALE	NO.
PROJECT NO. _____ CONTRACT NO. _____		CONSTRUCTION RETURN DRAWING NO. _____ DATE _____ PROJECT NO. _____ CONTRACT NO. _____	
ESTIMATOR _____ DATE _____		CHECKED BY _____ DATE _____	
B059-1-1			

Estimated Construction Schedule:
 Extend berm extents in late August 2019
 Shift berm material from north to south in
 November 2019
 Remove all berm material in February 2020

BERM MATERIALS

ALLOW FOR BERM 3m WIDER THAN HOLE OF DECK.

LONGEST BERM OCCURS IN FIRST STAGE OF EACH SIDE

WIDEST BERM (SW)

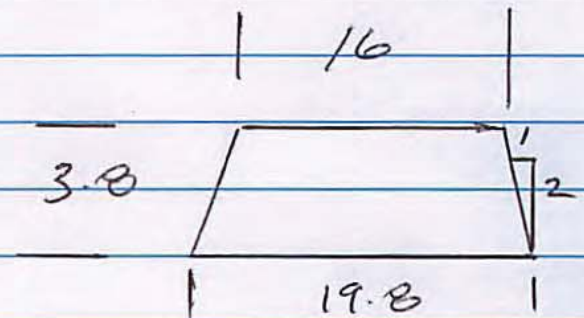
$$6'7'' + 9' - 2'' + 9' - 6'' + 5' = 30' - 3'' = 9.83 \text{ m}$$

$$\text{Berm} = 9.83 + 3 + 3 = 16 \text{ m}$$

$$\text{LENGTH} = 3 \times 146' = 438' = 138 \text{ m}$$

$$V = 138 \times 17.9 \times 3.8$$

$$V = 9400 \text{ m}^3$$

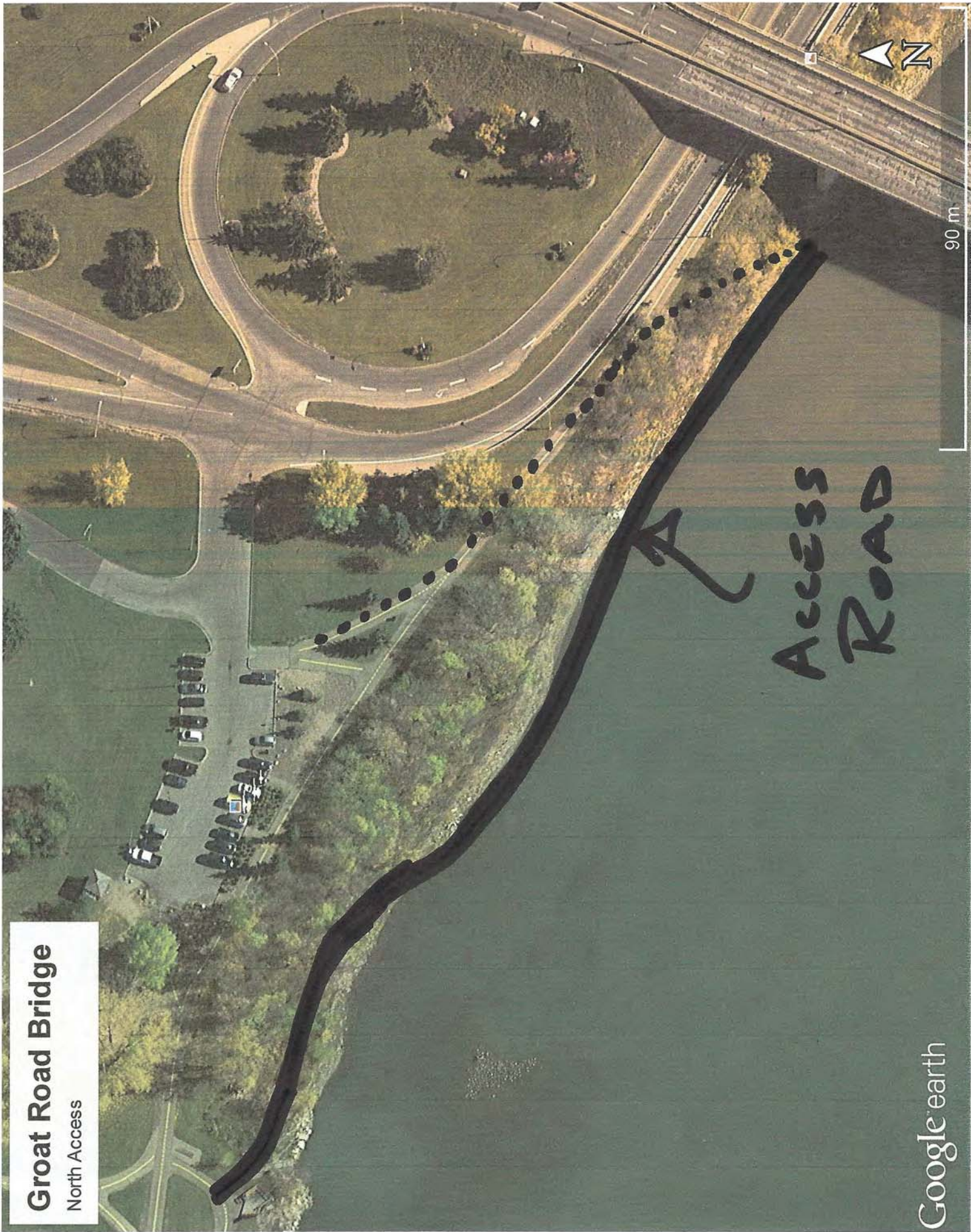


Assumption is that all material is rock riprap.

~~CLAY~~

Groat Road Bridge

North Access



APPENDIX B



A TETRA TECH COMPANY

December 31, 2014

Delcan Corporation
808 – 4th Avenue SW, Suite 100
Calgary, AB T2P 3E8

ISSUED FOR USE
EBA FILE: E22103052-01.001
Via Email: m.florendo@delcan.com

Attention: Michael Florendo
Senior Principal, Calgary Manager

Subject: Bathymetric Survey
Edmonton Bridge Scour Assessments

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA) performed a bathymetric survey in support of bridge pier scour assessments around 14 bridges across the North Saskatchewan River in Edmonton, AB. The river bottom was surveyed for water depth from a zodiac/kayak platform, using a combination of single-beam sonar echosounder and ground penetrating radar. The survey boundaries for each location were selected such that they extended at least 100 m downstream and approximately 30 – 50 m upstream of each bridge, with a survey line density of approximately 10 m, where possible. Special attention was paid to ensure that survey lines were specifically collected alongside all bridge piers to ensure adequate characterisation of scouring features at the pier footings.

2.0 SURVEY METHODOLOGY

The hydrographic survey was performed by Mr. James Mickle, P.Geoph., and Ms. Megan Caston, Geoph. I.T., of EBA's Geophysics group, and spanned four days, from September 17 – 20, 2013.

A Mala Geosciences Ramac CUII ground penetrating radar (GPR) system with shielded 500 MHz antenna and an Ohmex SonarLite single-beam echosounder were simultaneously used to measure water depths less than and greater than approximately 3 m, respectively. The sonar unit employs digital signal conditioning and analysis circuitry to output water depths at a rate of 1 Hz; the GPR system was configured to output full waveform data at a rate of 10 Hz. Positional data was provided by a Topcon Hiper+ GPS/Glonass unit outputting uncorrected NMEA data at a rate of 1 Hz, which was logged along with the GPR/sonar data. The Hiper+ unit also internally logged raw satellite observable data at a rate of 1 Hz, which was then post-processed in kinematic mode using NRCan's online Precise Point Positioning (PPP) Service, and subsequently merged back into the processed GPR/sonar data by matching UTC timestamps during the processing phase.

EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
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The GPR and sonar antennas were enclosed inside a plastic whitewater kayak such that they were transmitting and receiving their respective signals through the bottom of the kayak; the GPS unit was mounted directly above the sonar transducer. The kayak was then lashed to the right side of a 12' zodiac (Photo 1), which was used as the survey vehicle and contained all topside electronics. The horizontal and vertical positions of the instruments and water line relative to the GPS antenna were carefully measured so that these positional offsets could be accounted for when processing the data. The GPR and GPS data were simultaneously collected to a rugged field laptop using software supplied by the GPR manufacturer. The sonar and GPS data streams were collected to the same laptop using software developed by EBA's geophysics group.



Photo 1: Bird's Eye View of Bathymetry Survey Vessel. Note kayak with GPS unit mounted on top. The GPR and sonar heads were mounted inside the kayak, while all topside electronics were contained in the zodiac.

A Garmin GPSmap 276c was used for survey guidance during data collection. A straight centreline track was created at each bridge extending approximately 30 – 50 m upstream and at least 100 m downstream, and subsequent parallel 10 m offset tracks were collected by monitoring the crosstrack value on the GPS screen. Similarly, a straight line was created along the back side of the piers, and parallel cross-river profiles were collected at approximately 10 m intervals to a downstream distance of 50 – 60 m. One or two cross-river profiles were collected on the upstream side of the piers at each bridge.

In anticipation of having poor GPS data while directly beneath the bridges, survey lines were collected in a straight line while under the bridge, and with a constant upstream and downstream velocity as far as possible. This allowed bad GPS positions to be removed during data processing and positions interpolated, under the assumption that the bathymetric data is evenly distributed in a straight line between the last two good GPS points on either side of the GPS gap.

Following the GPR/sonar data collection at each bridge, a series of side-scan sonar profiles were then collected around each of the piers. This data was used to visually reveal any pier undercutting taking place, as well as the presence or absence of deep scours, bottom type, or any other abnormal features/bottom debris.

3.0 SYSTEM CALIBRATION

The properties of water pertinent to this type of study (acoustic velocity, radar pulse velocity) will change slightly under varying conditions, most notably temperature and turbidity. For this reason, the GPR and sonar systems were calibrated to obtain values specific to this study. The resulting values were then compared, and the preliminary depths obtained by using “typical” values of GPR pulse velocity and sonar acoustic velocity could be scaled accordingly.

In still water, a weighted cable with a reflective target is often used; in the shallow flowing water encountered during this bathymetry program, this was not possible. Instead, a 2 m long avalanche probe was used. The calibration was performed at two locations separated by approximately 20 m, both approximately 100 m upstream of the Groat Road Bridge (B059). The calibration was performed by holding the survey vessel at a fixed location and measuring the water depth with the probe, while simultaneously collecting data with both systems. The results of this calibration exercise were applied to the data collected over all four days.

The measurements obtained from each instrument while using “typical” velocities are summarized in the table below.

Location	Probed Depth	Sonar Reading	GPR Reading
1	1.10 m	1.10 m (+0%)	1.09 (-0.9%)
2	1.21 m	1.23 m (+1.65%)	1.27 (+5.0%)

The results at Location 1 all agree to within 1%, while the results at Location 2 exhibit slightly more discrepancy. This is likely explained by the fact that the GPR profile collected through the calibration points exhibits a relatively flat, smooth bottom at Location 1, but undulates considerably more at Location 2 and is rockier, as shown in the GPR profile image below.

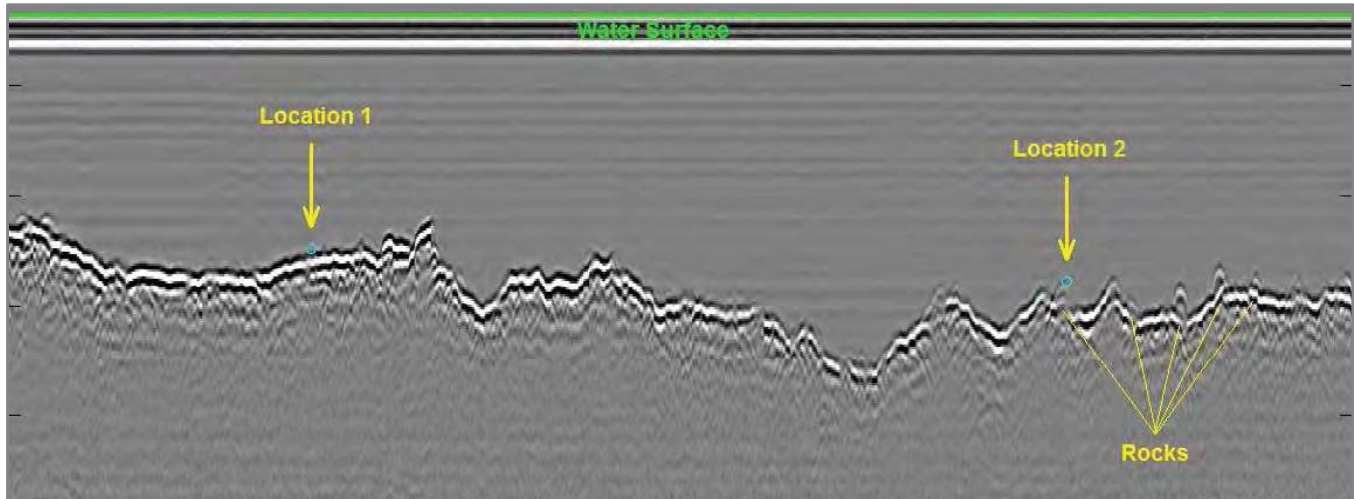


Photo 2: GPR profile collected during the two calibration events, exhibiting a flat river bottom surface at Location 1 and undulating, rocky river bottom at Location 2.

4.0 DATA PROCESSING

Once back at EBA offices, the GPR and sonar datasets were processed and analyzed using custom software developed by EBA's geophysics group. The raw GPS data at each bridge was submitted to NRCan's online post-processing service and the corrected results were subsequently merged back into their respective datasets by matching UTC timestamps between the post-processed GPS data and the real-time, uncorrected GPS data logged with the bathymetry datafiles. Bad GPS positions were removed from each dataset, and the bathymetric data at these locations was linearly distributed across these gaps. The river bottom outline was digitized in the various GPR profiles and water depths were subsequently calculated at each data point. GPR- and sonar-derived depths were compared at several locations where the depth ranges of the two instruments overlapped, and exhibited excellent agreement. Also, water depths were compared where profiles parallel to the river intersected profiles across the river, and generally exhibited very good agreement. Finally, the XYZ datasets from the sonar and GPR were merged for each survey area, favouring the GPR data, and only using the sonar data where the bottom reflection was not evident in the GPR profiles.

All bathymetry data was measured in reference to the river surface at the time of the survey. In order to convert the water depth measurements to river bottom elevations, the elevation of the river surface at the time of the survey needed to be determined. The GPS elevation data at the time of the survey was unsuitable for this purpose due to constant changes in visible satellite constellations as the GPS unit repeatedly passed under the bridge at each site. To address this issue, reference points were taken at most bridges, fixing the river level at the time of the survey to the bridge structures.

Several weeks after the main survey, a second survey to collect a single elevation profile down the middle of the river in one long run was carried out, using a third party real-time RTK correction service coupled with a Hiper+ GPS/Glonass receiver. The survey track information was recorded in RTK Fix mode at points both upstream and downstream of each bridge, enabling the measurement of the river surface elevation at each bridge to an accuracy of less than ± 10 mm and typically to less than ± 4 mm. The same reference points measured during the primary survey at the bridges were re-measured and found to have a consistent difference of 15 cm (i.e., the river level was 15 cm lower during the elevation survey than it was during the bathymetry survey). The river level at the upstream and downstream end of each survey area was thus assumed to be 15 cm higher than the data obtained during the elevation survey. These river level elevations were then used to create a water level “plane” at each bridge, from which the measured water depths were subtracted, resulting in river bottom elevations. This method assumes that the water level elevation profile *across* the river is flat and that the elevation drop at each bridge is linear across the survey areas.

Contour maps of the river bottom elevations for each survey area were created in Golden Software’s Surfer software package, using the Kriging contouring algorithm with a 20 m search radius. Separate georeferenced PNG image layers have been created for the river bottom elevation contours and the survey tracks; similar Google Earth KMZ files have also been generated. These image layers, as well as XYZ CSV data files for each bridge, have been included on the attached data CD. Figures for each bridge are included in the attached Figures section.

5.0 LIMITATION OF REPORT

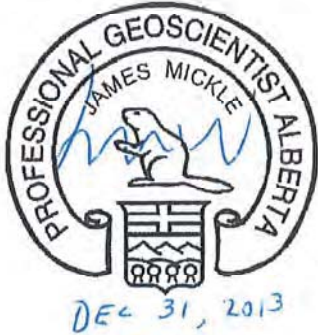
This report and its contents are intended for the sole use of Delcan Corporation and The City of Edmonton and their agents. EBA Engineering Consultants Ltd. does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Delcan Corporation and The City of Edmonton, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. EBA’s General Conditions are provided in Appendix A of this report.

6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

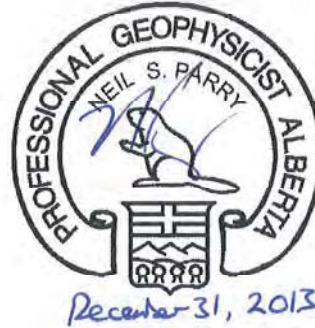
Respectfully submitted,
EBA Engineering Consultants Ltd.

Prepared by:



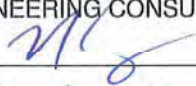
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Reviewed by:



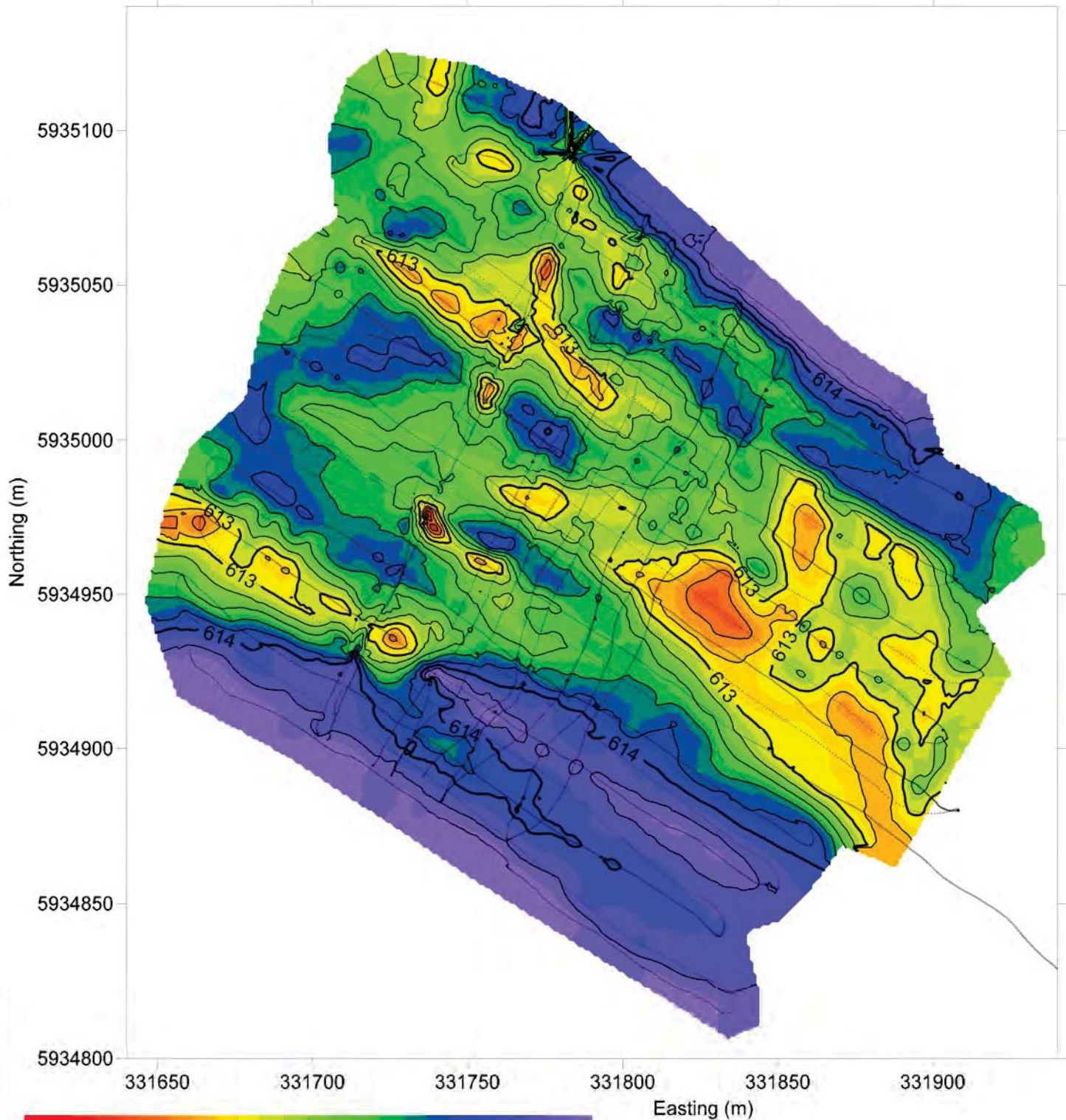
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/ln

<p>PERMIT TO PRACTICE EBA ENGINEERING CONSULTANTS LTD.</p> <p>Signature <u></u></p> <p>Date <u>December 31, 2013</u></p> <p>PERMIT NUMBER: P245 The Association of Professional Engineers and Geoscientists of Alberta</p>

FIGURES

Figure 1	B101 – Quesnell Bridge
Figure 2	B281 – Buena Vista Hawrelak Footbridge
Figure 3	B059 – Groat Road Bridge
Figure 4	B235 – Menzies LRT Bridge/B007 – High Level Bridge
Figure 5	B125 – James MacDonald Bridge
Figure 6	B001 – Low Level Bridge
Figure 7	B005 – Dawson Bridge
Figure 8	B112 – Capilano Bridge
Figure 9	B153 – Capilano Ped. Bridge
Figure 10	B158 – Gold Bar Ped. Bridge
Figure 11	B155 – Cloverbar Ped. Bridge
Figure 12	B292 – Cloverbar Bridge B143/Beverly Bridge



LEGEND



SCALE 1:1,800
NAD83
UTM z12

GPR Survey Tracks
Sonar Survey Tracks

CLIENT



**Edmonton Bridges
Pier Scour Survey**

**B059 - Groat Road Bridge
Riverbottom Bathymetry**

PROJECT NO. E22103052-01	DWN RJM	CKD NSP	APVD NSP	REV 0
OFFICE EBA-EDM	DATE November 22, 2013			

Figure 3

Appendix F. Vegetation Survey Results (20 June 2016)

Table D1. Vegetation Species Inventory* for Groat Road Bridges Rehabilitation (20 June 2016)

Species			Community					
Scientific Name	ACIMS Common Name	ACIMS Rank	Origin	Balsam Poplar-Aspen (P3)	Manitoba Maple (MIM)	Balsam Poplar-White Spruce (P2)	Aspen-Balsam Poplar (A2)	Grassland (G)
Tree								
<i>Acer negundo</i>	Manitoba maple	SU	exotic	D	D	F	F	O
<i>Betula neoalaskana</i>	Alaska birch	S5	native	F				
<i>Picea glauca</i>	white spruce	S5	native	O		F	O	
<i>Pinus mugo</i>	mugo pine	SNA	exotic	O				
<i>Populus balsamifera</i>	balsam poplar	S5	native	D	F	D	A	
<i>Populus tremulooides</i>	aspen	S5	native	A	O	O	D	
Shrub								
<i>Anelanchier alnifolia</i>	saskatoon	S5	native	O	O		F	
<i>Caragana arborescens</i>	common caragana	SNA	exotic	F				
<i>Cornus stolonifera</i>	red-osier dogwood	S5	native	O	A	A	A	
<i>Corylus cornuta</i>	beaked hazelnut	S5	native	O		O	O	
<i>Elaeagnus commutata</i>	silverberry	S5	native	R				
<i>Rosa acicularis</i>	prickly rose	S5	native	D	F	A	D	O/A
<i>Salix interior</i>	sandbar willow	S5	native	O	O			
<i>Salix lasiandra</i>	shining willow	S5	native		O			
<i>Sambucus racemosa</i>	red elderberry	S4	native	F				
<i>Symphoricarpos albus</i>	snowberry	S5	native	O			O	O/A
<i>Symphoricarpos occidentalis</i>	buckbrush	S5	native	A	F	A	A	O/A
<i>Viburnum opulus</i>	high-bush cranberry	S3S4	native		O			
Forb								
<i>Amoracia rusticana</i>	horseradish	SNA	exotic					R
<i>Apocynum androsaemifolium</i>	spreading dogbane	S5	native				A	

Species			Community					
Scientific Name	ACIMS Common Name	ACIMS Rank	Origin	Balsam Poplar-Aspen (P3)	Manitoba Maple (MM)	Balsam Poplar-White Spruce (P2)	Aspen-Balsam Poplar (A2)	Grassland (G)
<i>Aralia nudicaulis</i>	wild sarsaparilla	S5	native		A	A	A	
<i>Arctium minus</i>	common burdock	SNA	noxious		R			
<i>Artemisia frigida</i>	pasture sagewort	S5	native	O				
<i>Brassica</i> sp.	canola cultivar	SNA	exotic		O			
<i>Campanula rotundifolia</i>	harebell	S5	native		R			
<i>Chamerion angustifolium</i>	common fireweed	S5	native	F			O	
<i>Cirsium arvense</i>	creeping thistle	SNA	noxious	O	F	R	R	F
<i>Epilobium ciliatum</i>	northern willowherb	S5	native		O			
<i>Equisetum arvense</i>	common horsetail	S5	native	O		O		
<i>Equisetum sylvaticum</i>	woodland horsetail	S5	native			F		
<i>Erysimum cheiranthoides</i>	wormseed mustard	S5	native		O			
<i>Eurybia conspicua</i>	showy aster	S5	native				F	
<i>Galium boreale</i>	northern bedstraw	S5	native				A	
<i>Galium trifidum</i>	small bedstraw	S5	native	O				
<i>Galium trifolium</i>	sweet-scented bedstraw	S5	native				F	
<i>Lathyrus ochroleucus</i>	cream-colored vetchling	S5	native	O			O	
<i>Linaria vulgaris</i>	common toadflax	SNA	noxious				R	
<i>Maianthemum canadense</i>	wild lily-of-the-valley	S5	native			F	O	
<i>Maianthemum stellatum</i>	star-flowered Solomon's-seal	S5	native		A	F	F	
<i>Medicago lupulina</i>	black medick	SNA	exotic	O			O	
<i>Medicago sativa</i>	alfalfa	SNA	exotic	O	F		R	
<i>Mertensia paniculata</i>	tall lungwort	S5	native		F	O	A	
<i>Plantago major</i>	common plantain	SNA	exotic	O	O			
<i>Polygonum arenastrum</i>	prostrate knotweed	SNA	exotic					O
<i>Potentilla norvegica</i>	rough cinquefoil	S5	native	R				
<i>Ranunculus macounii</i>	Macoun's buttercup	S5	native		O		O	

Species			Community					
Scientific Name	ACIMS Common Name	ACIMS Rank	Origin	Balsam Poplar-Aspen (P3)	Manitoba Maple (MM)	Balsam Poplar-White Spruce (P2)	Aspen-Balsam Poplar (A2)	Grassland (G)
<i>Rumex occidentalis</i>	western dock	S5	native	O	O			
<i>Sanicula marilandica</i>	snakeroot	S4S5	native	O		O	O	
<i>Stellaria longifolia</i>	long-leaved chickweed	S5	native				O	
<i>Symphotrichum ciliolatum</i>	Lindley's aster	S5	native		R	F	F	
<i>Symphotrichum ericoides</i>	tufted white prairie aster	S5	native	O				
<i>Tanacetum vulgare</i>	common tansy	SNA	noxious	R			O	
<i>Taraxacum officinale</i>	common dandelion	SNA	exotic	F	F	O	O	F
<i>Thalictrum venulosum</i>	veiny meadow rue	S5	native			R	R	
<i>Tragopogon dubius</i>	common goat's-beard	SNA	exotic	O	O			O
<i>Trifolium hybridum</i>	alsike clover	SNA	exotic	O	O		O	O
<i>Trifolium repens</i>	white clover	SNA	exotic		O			
<i>Tripleurospermum inodorum</i>	scentless chamomile	SNA	noxious					O
<i>Vicia americana</i>	wild vetch	S5	native	F			O	
Graminoid								
<i>Agropyron cristatum</i> ssp. <i>pectiniforme</i>	crested wheatgrass	SNA	exotic	F				F
<i>Bromus inermis</i>	smooth brome	SNA	exotic	A	A	O	O	D
<i>Deschampsia caespitosa</i>	tufted hair grass	S5	native		O			
<i>Elymus repens</i>	quack grass	SNA	exotic	A	O		O	D
<i>Leymus innovatus</i>	hairy wild rye	S5	native	R				
<i>Phleum pratense</i>	timothy	SNA	exotic	O				O
<i>Poa pratensis</i>	Kentucky bluegrass	S5	native	F	F	O	O	D
Total Number of Species				40	32	21	36	16
Total Number of Native Species				25	20	17	26	4
Total Number of Exotic Species				13	10	3	7	9
Total Number of Noxious Weed Species				2	2	1	3	2

* Abbreviations are as follows: D=dominant, A=abundant, F=frequent, O=occasional, R=rare

Appendix G. Fisheries



Groat Road Bridge Rehabilitation:

Fisheries Resources Assessment for Alternative 4B Design Option Final Report

PREPARED FOR:

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**Issued March 2017
Revised April 2017**

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1.0 INTRODUCTION

1.1 BACKGROUND

The Groat Road Bridge over the North Saskatchewan River in the City of Edmonton is in need of major rehabilitation. At the request of the City of Edmonton, Dialog prepared a preliminary engineering report that discussed the merits of four alternatives for the rehabilitation of the bridge. One of the alternatives (identified as Alternative 4B) will require instream work in order to facilitate the replacement of the superstructure (Dialog 2016). Kingfisher Aquatics Ltd. (Kingfisher) was retained by Spencer Environmental Management Services Ltd. (Spencer Environmental), the Environmental Consultant for the project, to undertake a fisheries resources assessment of the North Saskatchewan River (NSR) in the vicinity of the Groat Road Bridge and to complete a fisheries impact assessment for the Alternative 4BB rehabilitation option.

1.2 OBJECTIVES

This document was developed with the intent of providing the City of Edmonton with sufficient fisheries information to meet internal (City) requirements, and to support pertinent Provincial and Federal regulatory permitting processes. The primary objectives of this document were as follows:

- Describe the existing fish and fish habitat of the NSR in the vicinity of the Groat Road Bridge.
- Assess the potential impacts to fisheries resources that may occur as a result of the proposed Alternative 4B bridge rehabilitation option.
- Identify strategies that will be employed to mitigate impacts to fisheries resources.
- If necessary, identify the need for habitat offsetting to avoid serious harm to fish.

2.0 PROJECT INFORMATION

2.1 SETTING

The Groat Road Bridge is located on the NSR in NW 31-52-24 W4M. The bridge consists of two northbound lanes and two southbound lanes with one sidewalk on the east side (Dialog 2016). In total the bridge has seven spans and is 289.56 m long (Dialog 2016).

The NSR originates at the Saskatchewan Glacier in the Columbia Icefields and flows over 1000 km from its headwaters to the Alberta – Saskatchewan border. There are two dams on the river that regulate flow; the Bighorn is located on the NSR west of Nordegg and the Brazeau Dam is located on the Brazeau River (ASRD 2008). In the Edmonton area, the river meanders irregularly through a large stream cut valley. Allan (1984) divided the mainstem of the NSR into seven reaches based on flow regime and fish habitat characteristics. The lower reaches, which included the Edmonton area, were considered to be primarily suited to cool water species (Allan 1984).

According to the Code of Practice St. Paul Management Area Map the majority of the NSR in the vicinity of Edmonton is designated as a Class C water body and is subject to a restricted activity period of September 16 to July 31 (AESRD 2012). Class C habitat is defined as moderate sensitivity habitat that is broadly distributed and is sensitive enough to be potentially damaged by unconfined or unrestricted activities within

a waterbody (Alberta Environment 2001). There are also several small segments of the NSR within Edmonton that are considered to have greater sensitivity and have been designated as Class A habitat. These designations protect localized deep water habitat (generally >4 m depth) that have been identified as preferential habitat for Lake Sturgeon (AESRD 2012). The closest Class A habitat is located approximately 7.5 km downstream of the Groat Road Bridge (AESRD 2012).

2.2 DESCRIPTION

The rehabilitation option identified as Alternative 4B involves replacement of the existing superstructure with a deck slab supported on haunched structural steel plates girders Dialog (2016). The project will require installation of a berm to facilitate demolition and girder erection of the bridge as well as pier stabilization work. The berm sequencing plan was developed to allow for the demolition and construction to proceed while also maintaining traffic flows. A preliminary description of the construction process and berm staging is provided in Table 1. Additional design and construction information including sketches showing the various berm stages are provided in Appendix A.

Table 1. Description of construction process and berm staging.

Stage	Description
1	The two end spans (North and South) will be demolished.
2	The berm will be advanced from the south shore using the access from Emily Murphy Park. The following comments will apply to all berm work: <ul style="list-style-type: none"> - The berm will be constructed from Class 2 riprap. - The berm may be topped with some sort of granular material to make passage over the berm smoother. - The top of the berm will extend 6.0 m outside of the plan view of the bridge segment that is being demolished. - The sideslopes of the berm is expected to be a maximum of 2V:1H. - The berm height is expected to be 600 mm above the seasonal water level. - There may have to be crane pads (10 m by 10 m) incorporated into the berm footprint to allow for the girder erection. Demolition will be completed on spans 2, 3 and 4 from the south end.
3	The girders will be erected on the three most southern spans.
4	The berm will be moved from the south side to the north side. <ul style="list-style-type: none"> - Heavy equipment will be used to move the berm from the south side to the north side of the river.
5	The remaining two spans of the bridge will be demolished. The demolition materials will be removed using the north access. The existing slopes on the north side are quite steep and quite high (~12 m). As a result, the access will be created near the existing outfall approximately 190 m upstream of the bridge. An access road approximately 5 to 6m wide and constructed of Class 1 rip rap will be built along the north bank to the bridge site. <p>The cofferdam (10m by 26m) will be installed around the base of pier 2. This area will be dewatered to allow for pier base strengthening work to be completed.</p>
6	The remaining girders will be erected starting from the north end.
7	No instream work, a 30 m by 40 m berm will remain in the river between the north bank and the first pier.
8	The end spans will be demolished and abutment work completed
9	In August (the open construction window) the north berm would be constructed and the "reverse" of the works on the west side structure would be repeated on the east side of the structure.

2.3 SCHEDULE

In total the project is expected to take a total of approximately 26 months to complete. As identified in Table 1, the instream portion of work will be completed following a staged approach that involves installation of a berm at several locations. A chart showing the proposed schedule for the instream works is provided in Appendix B.

3.0 METHODS

Field investigations were conducted following Kingfisher's standard procedures for large-river watercourse crossings provided in Appendix C. The procedures were developed to be consistent with the methods described in the Alberta Fish Habitat Manual (AT 2009), which were designed to meet the requirements of the Code of Practice for Watercourse Crossings (AESRD 2013) as well as information requirements of Fisheries and Oceans Canada (DFO).

Field investigations were conducted on October 22, 2016. The investigations included:

- habitat inventory of a 2.5 km section of the NSR in the vicinity of the bridge;
- characterization of the river channel profile using a depth sounder at 12 transects established in the vicinity of the bridge;
- review of existing information regarding the fish community of the NSR in the vicinity of the bridge;
- analysis of select water quality variables at one location near the bridge.

Project plans, existing historical information, data collected during field investigations, and the hydraulic assessment completed by Northwest Hydraulic Consultants (NHC 2016) were used to assess potential impacts to existing fisheries resources as a result of the Alternative 4B rehabilitation option for the Groat Road Bridge. Potential impacts pathways to fisheries resources were identified and mitigation strategies were developed and assessed to determine the potential for residual serious harm to fish.

4.0 STUDY AREA

The study area was approximately 2.5 km long and encompassed a portion of the NSR extending from 500 m upstream of the Groat Road Bridge to 2 km downstream from the bridge (Figure 1). The entire study section is comprised of Class C habitat (AESRD 2012).

5.0 EXISTING CONDITIONS

5.1 FISH POPULATIONS

The NSR is considered a cool water fishery in the vicinity of Edmonton. A query of the Fish and Wildlife Management Information System (FWMIS) for the NSR in Edmonton found records of 24 fish species (Table 2). Sport fish included burbot, goldeye, lake sturgeon, mountain whitefish, mooneye, northern pike, sauger and walleye.

Most of the fish species typically encountered in this section of the NSR are not listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or the Species at Risk Act (SARA) and are considered to be Secure under the provincial Wildlife Act (Table 2). However, Saskatchewan River populations of lake sturgeon are considered Endangered by COSEWIC (COSEWIC 2006) and are ranked as Threatened under the provincial Wildlife Act. Their status under SARA is currently under consideration. Primary limiting factors to lake sturgeon recovery include habitat fragmentation due to dams, poor water quality, overharvesting, and life history characteristics that make them susceptible to declines (i.e. slow growth and delayed maturity) (ASRD 2002).