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LEADERS IN CUSTOMER CARE

MORTON ARBORETUM 206

LISLE, IL

DESIGN DOCUMENTATION REPORT

DRAFT

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March, 2015

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1.0 Introduction

1.1 Project Description and Background

The project location is in DuPage County, Illiniois within the Morton Arboretum Property. The restoration reach is approximately a 1.5 mile reach of the DuPage River East Branch (DPREB), just north of Interstate 88.

The DuPage River East Branch was first channelized in the project area during the 1920s for agricultural purposes. Since then, rapid urbanization of the watershed has increased the amount of impervious surfaces and has caused erratic riverine hydraulics. During the 1950s, the Valley View subdivision was constructed with over one hundred single family homes within the natural floodplain of the river. This severely affected the riverine ecology, and flood events have caused millions of dollars in damage to homes within the subdivision. To reduce these damages, extensive stream channelization was implemented during the 1970s in an attempt to relieve flooding by increasing the channel conveyance, but without success, and in turn further adversely affecting riverine ecology.

The Morton Arboretum, in partnership with the Forest Preserve District of DuPage County (FPDDC), Illinois Department of Transportation (IDOT), and Illinois Department of Natural Resources initiated a Feasibility Study with USACE under the Section 206 Acquatic Ecosystem Restoration authority to ascertain the feasibility of restaoration features to restore ecological integrity of the river and riparian zone on Morton Arboretum and Forest Preserve Properties. This report was completed and approved in 2011, and recommended measures to improve the ecology of the site.

1.2 Purpose and Scope of Work

The purpose of this Design Documentation Report (DDR) is to develop the design elements necessary to produce a set of construction Plans and Specifications (P&S) for invasive species removal, planting and bank/stream grading along the DuPage River. These measures, along with additional in stream structures, shall restore aquatic habitat in the area.

1.3 Status of Project Authorization

This study is authorized under Continuing Authority Program (CAP), Section 206 authority, Aquatic Ecosystem Restoration (WRDA 1996).

1.4 Project Cooperation Agreement

1.4.1 Cost Allocation and Cost Sharing

Under Section 206 Authority, the Local Sponsor is thus responsible for:

- Paying for 35% of the total cost for feasibility study and restoration features.
- Paying for 50% of the total cost for recreational features*
- Providing all Lands, Easements, Rights of Way, Relocations and Disposal Areas (LERRD). The value of LERRD is credited towards the Local Sponsor's share of the total project cost.
- Paying 100% of the Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) costs.

* The federal limit for recreation features is 10% of the federal cost share for restoration features. Design and Implementation (D&I) of recreational features beyond the federal limit will be 100% non-federally funded.

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1.5 Engineering Studies, Investigations, and Design

A study of the drain tile systems throughout Morton Arboretum's land was completed by Huddleston McBride in 2013, for the Arboretum. The information from this report was used in the design of the Morton Arboretum Section 206 project. A survey contractor was hired to perform topographic survey of the areas of the Arboretum proposed for grading work. The design firm Interfluve was met with to provide input on designs for in-stream structures. Other design was performed in-house.

2.0 References

U.S. Army Corps of Engineers, 1993, *Engineering and Design Cost Engineering Policy and General Requirements, Engineering Regulation 1110-1-1300,* Department of the Army, Washington D.C., 26 March 1993.

U.S. Army Corps of Engineers, 1999, *Engineering and Design for Civil Works Projects, Engineering Regulation 1110-2-1150,* Department of the Army, Washington D.C., 31 August 1999.

3.0 Appendix

3.1 A – Hydraulic Engineering Appendix

3.2 B - Civil Engineering Appendix

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Morton Arboretum Section 206

APPENDIX A
HYDRAULICS AND HYDROLOGY

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CHAPTER 1: PURPOSE

The objectives of this hydraulic analysis are to determine the location and design requirements for a riffle and a collection of boulder clusters and woody debris structures designed for the DuPage River East Branch (DPREB) in Lisle, IL within DuPage County. Stone sizing is recommended based on site-specific design considerations including water depth and anticipated channel velocity. A hydraulic model was used to calculate anticipated channel velocities and also to evaluate if there are any stage impacts due to the project.

CHAPTER 2: PROJECT OVERVIEW

As a portion of the ecosystem restoration efforts within the Morton Arboretum, in-stream measures to combat the negative effects of urbanization impacting the DPREB have been proposed. Within the project area, the DPREB shows evidence of degradation with hydrophytic vegetation located high on the banks, trees leaning into the channel area, lack of riffle-pool sequences and undercut banks. In order to minimize further degradation of the stream, proposed restoration measures including a rock riffle, boulder clusters and designed woody debris structures have been planned within the project area. Collectively these measures are intended to decrease the severity of bank erosion, create a more varied flow regime within the systems, and promote biodiversity and flourishing environment for aquatic habitat. Additionally, the grading of bank slopes is planned for portions of the right and left banks along the channel downstream of IL Route 53. Decreasing the slope of the banks will increase both bank stability and channel cross-sectional area, reducing the energy of the floodwaters and decreasing the rate of further incision. The graded stream banks will be planted with native vegetation that will further stabilize the banks and provide habitat. More details concerning the location and details of these measures can be found in the Civil Design Appendix.

CHAPTER 3: AVAILABLE INFORMATION

3.1: FEMA Floodplain and FIS information

The most recent Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for DuPage County, IL were effective on December 16, 2004. The floodplain boundaries are included on four map panels:

- 17043C0508H
- 17043C0509H
- 17043C0802H
- 17043C0803H

Plate HH 1 includes a composite map of the flood insurance rate maps for the project area. The floodplain of the DPREB is mapped as Zone AE with a base flood elevation and floodway area determined. The Base Flood Elevation (BFE) through the project area ranges from 675 ft to 671ft NGVD 1929.

3.2: Hydrology and Hydraulic Model

DuPage County Department of Engineering Stormwater Division was contacted to access the hydraulic model that was used to create the FEMA flood products. The hydraulic model that was used for the current effective FEMA products was recently updated and approved by the Illinois State Water Survey, so it was determined that the updated version of the model would be the most appropriate version to use. The available model is a Full Equations (FEQ) unsteady flow model which is used in combination

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with the USEPA Hydrologic Simulation Program FORTRAN (HSPF) and a peak-to-volume (PV) statistical procedure to determine the flow and stage quantiles at locations along the stream channel[i].
Figure HH-1, which is included in DuPage County's Floodplain Mapping report, represents the modeling strategy employed. This document describes the modeling methodology in detail.

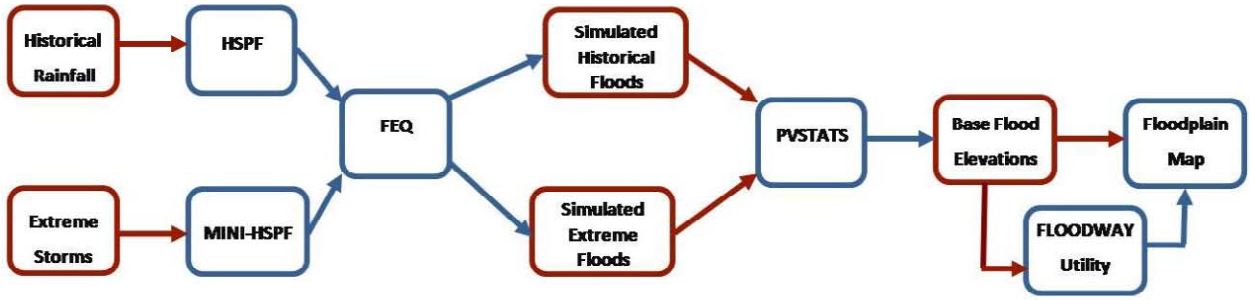

Figure HH-1
DuPage County Floodplain Mapping Procedure Flow Chart

The version(s) of computer software used to conduct the analyses includes the following:

Hydrologic Analysis: HSPF Version 12.0
Hydraulic Analysis: FEQ Version 10.61, 10.80
FEQUTL Version 5.80, 5.92, 5.96, 5.99
Statistical Analysis: BFILTER Version 10kv1_2
PVSTATS Version 3.3

The model includes 21 cross sections within the Morton Arboretum project area, labeled 001EBEB0102 – EBEB0122, which are represented on branches 96-114 of the FEQ model). Plate HH 2 includes the portion of the schematic of the FEQ model though the project area and Plate HH 3 includes an overview map with georeferenced documentation of the cross sections included in the model.

The hydraulic characteristics of the stream system for the FEQ model were obtained from field surveys performed between 1987 and 2002. Additional data was collected from DuPage County aerial photo and topographic maps. Watershed sub-basin delineations were conducted on DuPage County's 2-foot contour interval topographic maps and verified during field inspection. Five hydraulic structures were surveyed and included in the model in this area including:

- Morton Arboretum Entrance Road;
- Route 53;
- Morton Cemetery Entrance;
- Morton Arboretum Auto Bridge; and
- Warrenville Road.

The PVSTATS computer program was used to estimate the flood stage and flow quantiles at surveyed cross-sections. The basic input data for PVSTATS are records of simulated flood volume, peak flow, and peak elevation from the historical series (TSFLONG) of 157 events and from the extreme storm series (TSFBIG) of 16 events. The program fits the annual series of historical volumes to a statistical distribution and builds rating curves relating peak flow to flood volume and peak stage to flood volume. Thus, the estimates of flow and stage for a given quantile are computed independently of each other.

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The floodplain mapping report notes that the flows and stages are not always hydraulically consistent because of the estimation error inherent in all statistical fits. These estimation errors create situations where downstream stages are larger than upstream stages, split flows do not add up to the downstream total or there are small decreases in flow moving downstream. It is noted that this is of little consequence because DuPage County uses continuous simulation of historical events rather than flow quantiles to size hydraulic structures and flood management facilities. However this inherent error is important to note because significant "cleaning up" of the output data is required to produce reasonable flow and elevation profiles. Issues related to this "cleanup" of that data are discussed in Chapter 5.

Floodplain mapping based on these model results was not completed as part of the Floodplain Mapping Report.

3.3: Topography

A Digital Elevation Model (DEM) for DuPage County, Illinois is available. THE DEM is a 3.5 foot grid that was produced all or in part from LiDAR information as of 2006 by the Illinois State Geological Survey and the Illinois Department of Transportation.

CHAPTER 4: DATA COLLECTION

Survey data needs were identified based on the location of the County survey data availability and the anticipated locations of instream measures chosen to be placed within the channel. A site visit was completed on October 7, 2014 with PM-PL to identify and tag specific locations where measures were considered.

A survey was completed in October, 2014 which included 50 surveyed cross sections. Surveyed cross sections were used to confirm existing model cross sections or add additional detail to the hydraulic model, as summarized in Chapter 5 below. Plate HH 3 includes the locations of the cross sections which were surveyed.

Surveyed Data is based on the NAVD 88 datum. To be consistent with the DuPage County FEQ model, which references the NGVP 29 datum, the survey data was converted to NGVD 29 by applying a 0.271 ft adjustment to all data points. A comparison of survey data with FEQ cross sections at the same locations indicate that there has been little change in the channel geometry since the FEQ cross section data was collected.

CHAPTER 5: MODEL UPDATE AND CHANNEL DESIGN

The FEQ model and methodology employed by DuPage County is not an ideal program to use for small instream channel design calculations because modifications of the geometry (other than simple cross sections modifications) are cumbersome, the process to review flow and stage impacts requires multiple time-consuming steps with significant manual data clean up which introduces an opportunity for various interpretations of the results, and the statistical methods used are not set up to test low-flow conditions to confirm effectiveness of in-stream channel features for the flows for which they are intended to function. Therefore, a dual modeling methodology including review of flooding impacts using the County's FEQ model and construction of a HEC-RAS model to facilitate design was employed for this design project.

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5.1: FEQ Model

An initial review of the FEQ model was completed to confirm that the proposed channel grading and instream measures do not induces any flood stage increases for the 1% annual chance flood event and all more frequent event.

The FEQ model was run with generalized modification of cross sections to represent channel grading and addition of instream features. The geometry of the nearest cross sections were modified to represent the modifications of the channel banks based on the proposed grading plan. Based on the spacing of the cross sections present in the East Branch model, the slight changes of the cross sectional geometry introduced by the placement of instream features (boulder clusters, woody debris, and the riffle) are not significant enough to warrant modification of the geometry of the cross sections in the model. Instead, instream features were represented in the model by increasing the Manning's roughness coefficient in the channel in areas where instream structures were proposed.

A Manning's coefficient of 0.04 was conservatively assumed to represent instream features for the entire channel where instream features were proposed and a coefficient of 0.07 was assumed to represent the native vegetation plantings planned on regraded bank surfaces. Due to the uncertainty in the final design placement or instream features such as boulder clusters and woody vegetation features, the Manning's coefficient of 0.04 was used for the channel of the entire reach where instream features were being considered during the design phase. Most of the original cross sections in the FEQ model had a Manning's coefficient of 0.03 for the channel portion of the cross sections, so this increase in Manning's coefficient represents an increase in roughness from the current conditions. In reality, due to the spacing of the instream features and the small portion of the channel that these structures will impact, this assumption of increasing the Manning's coefficient for the entire channel is considered to be a very conservative approach. Appendix HH-1 includes information about channel modifications made to the FEQ model. All cross sectional changes were made to the cross section ".feq" file (EBEB01_EBEB23JULY2013_MortonModified.feq), which was used to create the ".tab" file used in the FEQ input file. The process documented in Figure HH-1 was completed in order to obtain the base flood elevation profile for the project area. Documentation of this process is included in Plate HH 5.

Note that the Du Page FEQ model and H&H Model report use the terminology"[x]-year flood", rather than the "percent chance exceedance" terminology that USACE guidance specifies should be used. For clarity, the FEQ output summary provided in this report includes both of these terminologies. The following correlations are made.

- 1-year → 99% annual chance exceedance
- 2-year → 50% annual chance exceedance
- 5-year → 20% annual chance exceedance
- 10-year → 10% annual chance exceedance
- 25-year → 4% annual chance exceedance
- 50-year → 2% annual chance exceedance
- 75-year → 1.33% annual chance exceedance
- 100-year → 1% annual chance exceedance

The output files of the PVSTATS runs were imported into an Excel file for further analysis. As mentioned in Chapter 3, the methodology employed in the FEQ analysis introduces an inherent error which require

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"clean up" of output to create a smoothed water surface profile. The same methodology that was used by DuPage County to smooth the profiles was used to smooth the results produced by the modified model. Note that the only manual smoothing required was associated with bridge crossings. The proposed project is not expected to have any impact on bridge flow. Appendix HH-2 includes the FEQ output results including a comparison of the flood elevations for the 50%, 20%, 10%, 4%, 2%, 1.3%, and 1% annual chance exceedance (2-, 5-, 10-, 25-, 50-, 75-, and 100-year frequency) events. The results of the modified FEQ model indicate that there are no significant impacts to the any of these flood profiles. IDNR-OWR interprets no stage impacts as 0.0 ft. (0.044 ft stage increase and less is rounded to zero as a courtesy).

The table in Appendix HH-2 highlights values for which the stage impacts are predicted to be greater than 0.044 ft based on the updated model geometry. The only stage impacts expected to be greater than this threshold occur within the Morton Arboretum project site and occur mostly during the 50% and 20% annual chance exceedance events. The greatest stage impact expected is 0.197 ft and all impacts are contained within the channel or areas being restored with native habitat for part of this restoration project do not impact any structures. This small impact is considered to be acceptable based on the location and extent of the impact.

5.2: HEC RAS Model

To calculate site-specific velocity regimes at proposed instream measures and to size and evaluate the effectiveness of proposed riffle , a HEC-RAS (v. 4.1.0) model was developed based on cross sectional geometry included in the FEQ model with the addition of new survey data collected as summarized in Chapter 4. The DuPage County DEM was used to extend surveyed cross sections to the overbank areas to provide similar cross section extents as the FEQ cross sections.

Since the FEQ model includes the entire DPREB, only cross sections sufficiently upstream and downstream of the project area were included in order to ensure that up- and downstream boundary conditions did not impact model results for the project area. Cross Sections 001EBEB01000 – EBEB0139 were included in the model. Normal depth was used for the upstream boundary condition (using local channel slope) and a rating curve derived from the FEQ model frequency analysis output results was used as the downstream boundary condition. A sensitivity analysis was performed on the boundary conditions and the portion of the project areas included in the model was not found to be extremely sensitive since the model extended well beyond the project area.

Bridges were not included, as the purpose of the model was to evaluate average and low flow conditions that are significantly influenced by the instream measures for the purpose of the sizing of riffle height and stone sizing. Bridge sections are included in the FEQ model, which was used to evaluate the impact of the project on flood events, as described above.

The stream flows used in the HEC RAS model were taken from various sources, summarized here:

- 50-, 20-, 10-, 4-, 2-, 1-, and 0.2% flows at each FEQ cross section were taken from PVSTATS output from the DuPage County East Branch FEQ model;
- Average flow based on USGS gage 05540160 (EAST BRANCH DU PAGE RIVER NEAR DOWNERS GROVE, IL), which is at the upstream extent of the model area;
- Bankfull flow (300 cfs) was estimated in the feasibility study for this project; and
- 7Q10 flows were estimated from a similar sized watershed in the ISWS (1993)[ii].

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The USGS has computed average flow for each water year within the period of record for gage 05540160 (1990 – 2013). An average of this period of record was computed to determine the average daily flow for the purposes of designing the riffle feature. The average daily flow was computed as 52 cfs. Figure HH-3 includes the location of the gage.

A comparison between the HEC-RAS profile and the FEQ profile was made to ensure consistency between models. Slight modifications were added to the HEC-RAS cross sections to provide a closer match to the FEQ output results. Modifications to cross sections included adding ineffective flow areas and modifying expansion and contraction coefficients.

A proposed HEC-RAS geometry file was created by adding the modified cross sections, summarized in Appendix HH-1, to the base model. This proposed project geometry file was used to determine the height of the riffle and to determine the velocities during low and high flow events for the purpose of sizing stone for the riffle design. A summary of the riffle and instream features design based on modeled outputs is included in Chapter 5.3.

Appendix HH-3 includes plots that were created based on the HEC-RAS model results. The HEC-RAS model indicates that the peak channel velocity varies along the reach with maximum velocity near the riffle being approximately 3.5 ft/s and peak velocities in the reach where bolder clusters are planned reaching up to nearly 5 ft/s. The profile demonstrates that the riffle design will have the desired impact on low and average daily flows by forming a small riffle pool. The FEQ model was used to evaluate stage impacts along the entire project area, as the impacts of bridges is included in that model.

5.3: Instream Measure Design Specifications

A rock riffle and boulder clusters are proposed to simulate a natural riffle/pool sequence found in healthy streams, reduce bank erosion, and to diversify the flow regime to promote increased biodiversity in the stream.

The proposed riffle is a rock structure that spans the width of the stream, with slight impedance of low flows. It is parabolic in shape with the vertex in the middle of the channel at the most upstream side of the structure (see design specifications for details). The riffle is expected to improve fish habitat by providing cover for aquatic species and increasing oxygen levels downstream. Upstream of the riffle, the velocity and streambed slope is expected to be reduced allowing for increased fish passage into the transitional flow regime downstream of the riffle. The parabolic shape of the riffle will help redirect average flows to the center of the channel, therefore reducing shear stresses on the banks.

The proposed boulder clusters are groups of large rocks placed to improve habitat and create small scour holes and areas of reduced velocity during average flow conditions. Placing these boulders in the stream creates eddies in their wake, which also create overhead cover for fish. The structures also cause deeper pockets of water to develop which adds to the physical diversity of the stream. The design specifications include further design details.

The riffle structure and boulder clusters were designed in a manner such that the structures will perform their respective ecological functions during average flow conditions, but made of materials sufficient to withstand washout during increased velocities up to the 1% annual chance flood. To meet the multi-objective design parameters, the riffle design was determined by using HEC-RAS to predict flow

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conditions which will induce ecological function and to estimate stream velocities in various conditions. The pertinent velocities reported in the RAS model were then used to evaluate rock gradations for stability in the necessary flow conditions, as summarized below.

Riffle Design

Surveyed cross sections at the proposed riffle location as well as 2 interpolated sections 10 feet upstream and downstream of the riffle were used to model the riffle. The riffle was sized by raising the channel bed in a localized cross section at the location of the proposed riffle until a Froude number close to 1 was achieved and pools could be observed forming upstream in the stream profile at low and average flow conditions. Achieving a Froude number close to 1 at the riffle crest during normal flow conditions would serve as a justification that the flow would be close to supercritical or in a transition zone, thereby creating the desired diverse flow regime to support aquatic habitat migration downstream of the riffle. In addition to predicting the riffle performance through hydraulic modeling, a monitoring plan is proposed to evaluate the performance of the structures in the long term and adjust parameters to optimize the effectiveness.

The riffle crest should be 2 feet high based on the model results. The elevation should be placed at elevation 666.43 ft NAVD88 (modeled as 665.9 ft NGVD29).

The HEC-RAS model indicates that the maximum average channel velocity that can be expected at the riffle location is 3.5 ft/s. A 33% factor was applied to this velocity to account for localized velocity high points. Two methods were applied to determine the appropriate stone size and gradation to construct the riffle.

- Application of the Isbash equation, as summarized in "Hydraulic Design Chart Criteria Sheet 712, Velocity vs. Stone Diameter"[iii]
- Method summarized in "Rock Sizing for Waterway Riffles, Waterway Management Practices"[iv]

Plate HH 4 summarizes the calculations that were used to determine the appropriate stone sizing and gradation of the riffle structure. The table below summarizes design recommendations for the rock riffle.

Crest Elevation of Riffle	
2 ft high (665.9 ft NAVD88)	
Rock Gradation	
d_{50} =	6"
d_{100} =	12"
d_{75} =	9"
d_{25} =	3"

Additionally, the design specifications indicate that in-field confirmation that critical flow is induced during normal flow conditions be made following placement of the riffle structure.

Boulder Clusters Design

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Various boulder Clusters are proposed to enhance fish habitat by creating small localized eddies and to facilitate upstream fish migration. These structures are recommended to be placed along an approximately 1,200 foot long stretch of channel stretching from about 200 feet upstream of the Arboretum Entrance Bridge to about 300 feet downstream of the IL 53 bridge. Two types of boulder clusters will be placed. This stretch of the channel was observed to have a fairly uniform cobble bottom, which provides for ideal structure for the placement of boulder clusters to induce eddies and create fish habitat.

- **Boulder Cluster #1:** (Small Scour Cluster). This structure should be placed at the center or thalweg of the channel. Boulders are placed in a 'Vee' configuration facing upstream, which directs flow towards the center of the channel. Clusters generally consist of 5 boulders with the apex (upstream) boulder being the smallest boulder. The diameter of the apex boulder should be slightly larger than the average depth of flow such that it overtops during low or medium flow events. The other boulders should be slightly larger in size and overtop during large flow events.
- **Boulder Cluster #2:** (Eddy Cluster). This structure should be placed just outside (adjacent to) the thalweg of the channel. Three boulders are placed in a triangular formation with the largest boulder at the upstream end. The cluster acts to split flow and create an eddy downstream of the cluster. The upstream boulder should overtop only during medium to high flows.

The design sheets and specifications contain further details of the required placement of these boulder cluster structures.

The nature of designs is such that the boulders should be large enough to be only partially submerged during average and low flow events. As summarize in Chapter 4, the survey data was collected in October 2014. The flows at that time were considered to closely approximate average flow. The survey data included a collection of the edge of water elevation as well as the channel thalweg. A review of the data was completed to estimate average flow water depth for the portion of the channel where boulder clusters are proposed. The survey data collected suggests that the water depth along this stretch ranges from approximately 1.6 ft to 3.9 ft, with an average water depth of 2.3 feet.

The results of the HEC-RAS model along the stretch where boulder clusters are proposed (cross sections EBEB0120-EBEB0116) indicate that a maximum channel velocity of approximately 5 ft/s can be expected in this region for the 1% annual chance event. Because this section includes bridge section and the bridge sections were not include in the HEC-RAS model, a 50% factor was applied to this velocity. Applying the Isbash equation using this velocity and assuming a rounded stone would be used, a 1 ft stone was determined to be adequate sizing to resist this velocity. However, it was determined that due to the nature of the design requirements and the water depths along stretch of the channel, water depths will dictate boulder sizing for these boulder clusters, not channel velocities. The design specifications call for an in-field inspection of the channel at the time of construction to confirm exact locations for the placement of each structure. In-field confirmation of the appropriate placement of the structures will be important to ensure that the structures are able to induce the flow regimes they are intended to induce.

The following recommendations for placement and sizing of these structures are made:

- Boulder Cluster 1, which is placed in the thalweg of the channel, should be placed in localized areas identified to have shallower water depth.

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  - The apex boulder should be a minimum of 20 inches in diameter, to ensure that it is not fully submerged during average flow.
  - Larger stones should range from 24 inches to 36 inches.
- Boulder Cluster 2, which is placed adjacent to the thalweg of the channel, can be placed in slightly deeper portions of the channel because the structure will not be placed along the deepest part of the cross section.
  - The upstream boulder should be a minimum of 30 inches to ensure that it is not fully submerged during average and normal flow events and that it has the flow divergence ability to induce a downstream eddy.
  - Smaller boulders should be a minimum of 20 inches.

Woody Debris Structures Design

Root wad structures will be used to improve habitat conditions in the channel as well as to provide protection from bank erosion in areas where erosion and scour are a concern. The design drawings contain specific information related to the placement of these structures. The root wads will be placed along the channel bank in order to provide erosion protection as well as aquatic habitat along the banks.

It is difficult to size the woody debris structures based on channel velocity, therefore, structures which include appropriate tie downs were selected to ensure that the debris would not be carried away during high flow events. Based on consultation with restoration specialists, this type of tie down is appropriate for this type of structure.

The following recommendations for placement and sizing of these structures are made:

- **Rootwat Bank Structure:** (Woody Structure #1).
  Root wads will be secured by anchoring their trunks perpendicularly into the natural bank. Root wad diameter of 3' – 4' is suggested and a 7 – 10 foot long trunk for anchoring is required. The design specifications state that the root wad placement will be tight enough such that additional bank armoring (stone/ riprap) will not be required. Temporary erosion control measures may need to be implemented.

- **Wood Jam Structure:** (Woody Structure #2).
  Root wads will be secured by anchoring their trunks perpendicularly into the natural bank. Root wad diameter of 3' – 4' is suggested. The design drawings and specifications require that the rootwads will be anchored appropriately to a vertical pile or a buried 'deadman' anchor with cables to ensure stability during high flow events. Temporary erosion control measures may need to be implemented.

CHAPTER 6: REGULATORY REQUIREMENTS/ FLOODING IMPACTS

Regulatory Requirements

District Counsel was consulted to determine floodplain or floodway permitting requirements for this project. District Counsel confirmed that "There is no waiver of sovereign immunity that applies to the floodway permit program, so we are not subject to regulation by either the state or the county."

Flooding Impacts

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Although a permit is not required, as Chapter 5.1 summarizes, stage impacts due to the proposed measures were evaluated. The results of the hydraulic modeling indicate no significant stage increases will result from this project. Detailed stage impacts can be found in Appendix HH-2.

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[i] DuPage County Department of Engineering and Stormwater Management (July 2013). Floodplain Mapping Report and Documentation for East Branch of the DuPage River Watershed. Wheaton, IL.

[ii] Illinois State Water Survey, Hydrology Division (January 1993). 7Day, 10-Year Low Flows of Streams in Northeastern Illinois. Champaign, Illinois

[iii] U.S Army Corps of Engineers. Hydraulic Design Chart Criteria Sheet 712 Velocity vs. Stone Diameter. http://chl.erdc.usace.army.mil/Media/2/8/4/700.pdf

[iv] Catchments and Creeks Pty Ltd (August 2011). Rock Sizing for Waterway Riffles, Waterway Management Practices. Ferny Hills, Australia. http://www.catchmentsandcreeks.com.au/docs/Rock-Sizing-For-Waterway-Riffles.pdf

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Plate HH 1:

Composite map for FEMA Flood Insurance Rate Map for Project area

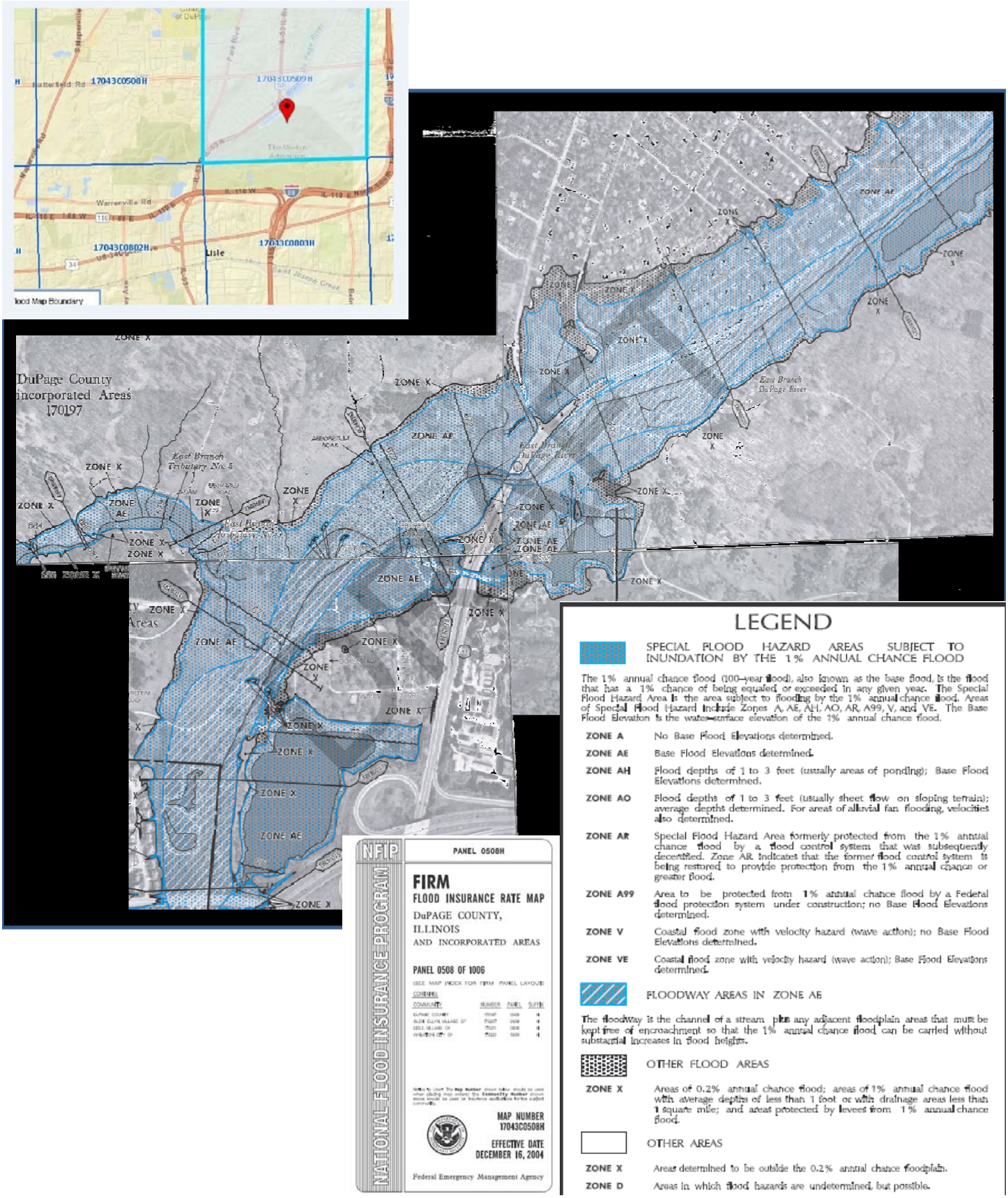

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Plate HH 2:

Portion of the schematic of the FEQ model though the project area

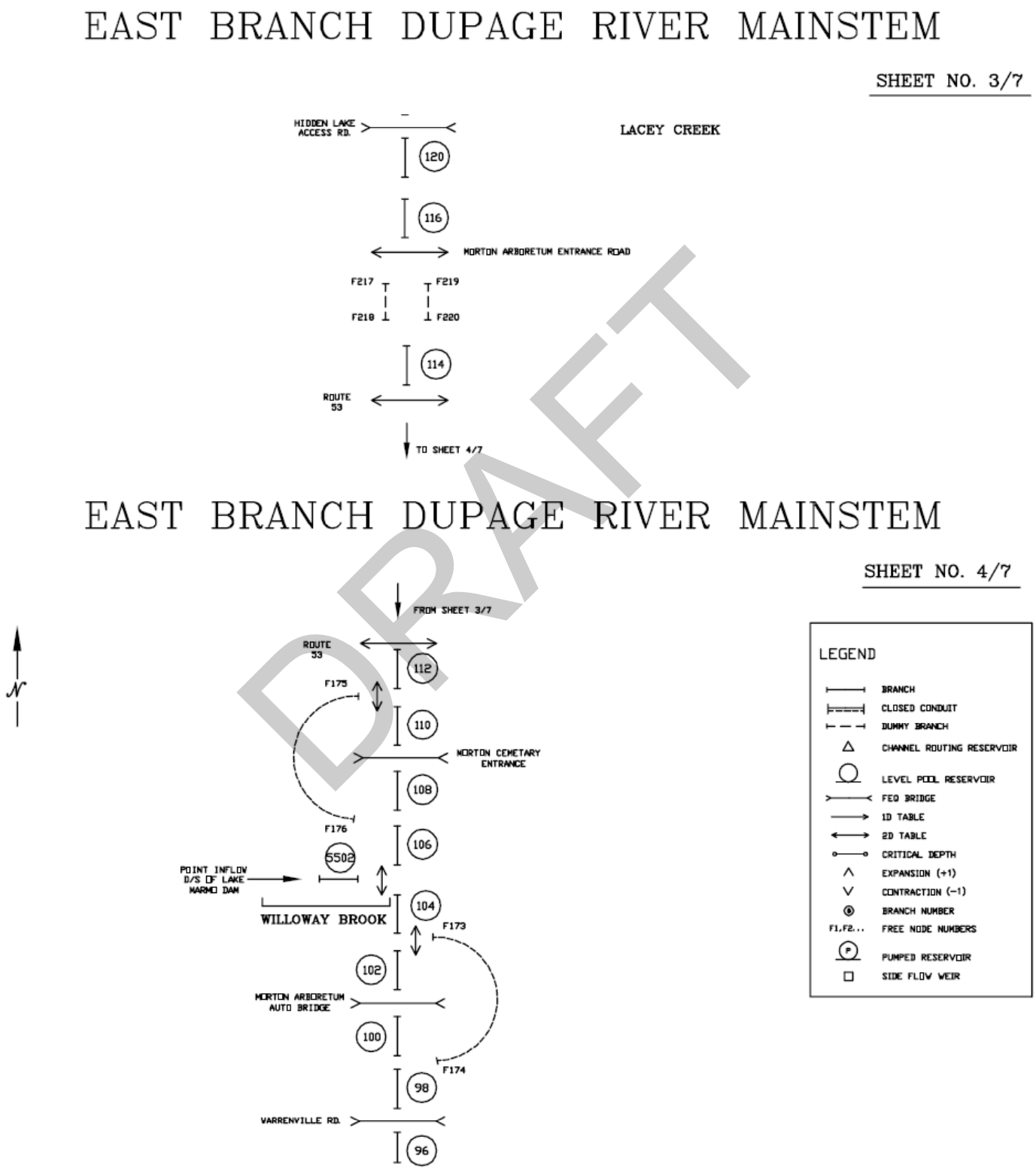

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Plate HH3: FEQ Model and Surveyed Cross Sections

US. ARMY CORPS of ENGINEERS
CHICAGO DISTRICT

Legend

STAID

- 05540160
- East Branch DuPage River
- USACE Surveyed Cross Sections
- EastBranch_XS

Location Map

N
W E
S

0 0.125 0.25 0.5
Miles

Plate HH4 - Stone Sizing for Rock Riffle

Hydraulic Design Criteria - Sheet 712-1 - Stone stability method					
Source: Hydraulic Design Chart Criteria Sheet 712 Velocity vs. Stone Diameter http://chl.erdc.usace.army.mil/Media/2/8/4/700.pdf					
Va =	3.5	ft/s	maxiumum velocity at riffle cross section - HEC RAS		
Max V =	4.655	ft/s	Apply factor to velocity to account for localized velocity. HEC RAS reports average for cross section.		
C =	0.86		1.5 - low turbulent flow ; .86- turbulent flow		
g =	32.2	ft/s^2			
SW water	62.4	lb/ft^3			
SW riprap	165	lb/ft^3			

3. Theory. According to Isbash the basic equation for the movement of stone in flowing water can be written as:

$$V = C\left[2g\left(\frac{\gamma_s - \gamma_w}{\gamma_w}\right)\right]^{1/2}(D)^{1/2} \qquad (1)$$

where

V = velocity, fps
C = a coefficient
g = acceleration of gravity, ft/sec^2
γ_s = specific weight of stone, lb/ft^3
γ_w = specific weight of water, lb/ft^3
D = stone diameter, ft

Isbash Equation					
d_{50} =	0.277	ft	3.320282801	**in**	
w_{50} =	1.830	lb			**for angular riprap**
d_{50} =	0.387	ft	4.648395921	**in**	
w_{50} =	5.022	lb			**for rounded stone**

If rounded stone is preferred to riprap, a 40% increase of recommended riprap sizing to provide the same protection as angular riprap[1].

[1] Gallegos, Humberto, Steven Abt, U.S. Forest Service. *Design Criteria for Rounded/ Angular Rock Riprap in Overtopping Flow*. 2001. Web December 2014. http://www.stream.fs.fed.us/fishxing/fplibrary/Gallegos_2001_Design_criteria_for_roundedangular_rock_riprap.pdf

w_{50} =	5.022	lb	d_{50} =	0.387	ft

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Plate HH4 - Stone Sizing for Rock Riffle

Alternative design calculation:

From "Rock Sizing for Waterway Riffles" Waterway Management Practices
http://www.catchmentsandcreeks.com.au/docs/Rock-Sizing-For-Waterway-Riffles.pdf

This hydraulic check requires the determination of the maximum flow velocity that occurs on the riffle prior to the riffle being drown-out by downstream flow conditions (Figure 1). This usually requires numerical modelling of the stream for a range of flow conditions. Minimum, mean rock size is determined from Equation 1.

$$d_{50} = \frac{SF.K_1.V^2}{(A - B.\ln(S_o)).(s_r - 1)} \qquad (1)$$

where:

- A & B = equation constants: A = 3.95 and B = 4.97 for SF = 1.2
- d_{50} = nominal rock size (diameter) of which 50% of the rocks are smaller [m]
- K_1 = correction factor for rock shape
  = 1.0 for angular (fractured) rock, 1.36 for rounded rock (i.e. smooth, spherical rock)
- SF = factor of safety = 1.2 (recommended)
- S_o = gradient of the riffle face [m/m]
- s_r = specific gravity of rock (e.g. sandstone 2.1–2.4; granite 2.5–3.1, typically 2.6; limestone 2.6; basalt 2.7–3.2)
- V = maximum depth-average flow velocity over the rocks during low flow [m/s]

SF=	1.2	(safety factor)
K_1 =	1.36	(rounded rock)
V =	1.419	m/s
A =	3.95	constants (recommended)
B =	4.97	constants (recommended)
s_r =	2.64	specific gravity of rock
S_o =	0.167	slope of riffle (m/m)

d_{50} =	0.155437 m	0.509962386 ft	**for rounded stone**

MOST CONSERVATIVE DESIGN.
THEREFORE, THIS SIZING IS SELECTED

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RECOMMENDED STONE SIZING:
Gradation based on recommendations in "Rock Sizing for Waterway Riffles"

d_{50} =	0.510	ft	≈	6	in
d_{100} =	1.020	ft	≈	12	in
d_{75} =	0.765	ft	≈	9	in
d_{25} =	0.229483	ft	≈	3	in

Appendix HH-1:
Cross Section Modifications for Proposed Project Model

The following sheets includes documentation of changes made to the original FEQ cross sections to represent the proposed project

On the sheets labeled "Instream Measures Cross Sections":
- A coefficient of 0.04 was used for the channel portion. These changes are hilighted in yellow.

On the sheets labeled "Regraded Cross Sections":
regraded bank surfaces.
These changes are bolded.

- For those cross sections that also contain channel improvements (riffle, boulder cluster, or woody debris),
a coefficient of 0.04 was used for the channel portion.

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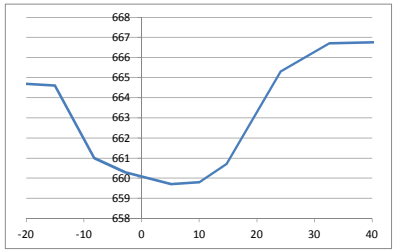
Instream Measures Cross Sections

Original FEQ Cross Sections
FILE= XSections\EBEB01_EBEB23JULY2013.tab
(select cross sections between EBEB108 - EBEB121)

FEQX
GISID= 0 01EBEB0108 ' 6 66.736 668044 669.85 671.019 672.247 675.613 NGVD29
TABID= 1 08 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= 5863.57
NAVM= 0 LEFT= 543 .1 RI GHT= -51.7 SCALE= 1.0 SHIFT= 0.00 1 2 3 4 5 6
NSUB 6 0.001 0.12 0 0.080 0.030 0. 120 0.010 0.001 0.12 0.08 0.03 0.12 0.01
X-Sect 924 from Lowe r Mai nstem Moc LOWXSE22 TL

-148.14	685.04	1	1874207	1053518	%0001% FRICTIONLESS WALL
-148.04	671.26	2	1874207	1053518	%0002% TM Extend Sta.
-95.8	670	2	1874238	1053475	%0003% TOS 2
-67.46	669.3	2	1874254	1053452	%0004% BIS 3
-44.06	665.1	2	1874267	1053433	%0005% BIS 4
-15.02	664.6	3	1874283	1053409	%0006% TOB 5
-8.18	661	4	1874287	1053403	%0007% BOB 6
-2.85	660.3	4	1874290	1053399	%0008% CHP 7
5.17	659.7	4	1874295	1053392	%0009% CFL 8
10.04	659.8	4	1874297	1053388	%0010% CHP 9
14.72	660.7	5	1874300	1053384	%0011% BOB 10
24.13	665.3	5	1874305	1053377	%0012% BIS 11
32.54	666.7	5	1874310	1053370	%0013% TOB 12
167.92	667.6	5	1874387	1053258	%0014% CLP 13
476.48	667.8	5	1874561	1053004	%0015% OVB 14
615.24	669.83	5	1874638	1052888	%0016% TM Extend Sta.
699.95	672.51	5	1874683	1052816	%0017% TM Extend Sta.
904.68	690.13	6	1874794	1052644	%0018% TM Insert Sta.
1023.81	700.4	6	1874859	1052544	%0019% TM Insert Sta.
1167.38	711.12	-1	1874937	1052424	%0020% TM Extend Sta.



PROJECT CROSS SECTIONS
mannings coefficients due to instream measures (HEC-RAS input)
(108 - 121)

-148.14	685.04	0.001	1
-148.04	671.26	0.12	2
-95.8	670		2
-67.46	669.3		2
-44.06	665.1		2
-15.02	664.6	0.08	3
-8.18	661	0.04	4
-2.85	660.3		4
5.17	659.7		4
10.04	659.8		4
14.72	660.7	0.12	5
24.13	665.3		5
32.54	666.7		5
167.92	667.6		5
476.48	667.8		5
615.24	669.83		5
699.95	672.51		5
904.68	690.13	0.01	6
1023.81	700.4		6
1167.38	711.12		-1

PROJECT CROSS SECTIONS
FOR FEQX INPUT
Inserted into: FILE= XSections\EBEB01_EBEB23JULY2013_Morton Modified.tab

1	2	3	4	5	6
0.001	0.12	0.08	0.04	0.12	0.01

-148.14	685.04	1	1874207	1053518	%0001% FRICTIONLESS WALL
-148.04	671.26	2	1874207	1053518	%0002% TM Extend Sta.
-95.8	670	2	1874238	1053475	%0003% TOS 2
-67.46	669.3	2	1874254	1053452	%0004% BIS 3
-44.06	665.1	2	1874267	1053433	%0005% BIS 4
-15.02	664.6	3	1874283	1053409	%0006% TOB 5
-8.18	661	4	1874287	1053403	%0007% BOB 6
-2.85	660.3	4	1874290	1053399	%0008% CHP 7
5.17	659.7	4	1874295	1053392	%0009% CFL 8
10.04	659.8	4	1874297	1053388	%0010% CHP 9
14.72	660.7	5	1874300	1053384	%0011% BOB 10
24.13	665.3	5	1874305	1053377	%0012% BIS 11
32.54	666.7	5	1874310	1053370	%0013% TOB 12
167.92	667.6	5	1874387	1053258	%0014% CLP 13
476.48	667.8	5	1874561	1053004	%0015% OVB 14
615.24	669.83	5	1874638	1052888	%0016% TM Extend Sta.
699.95	672.51	5	1874683	1052816	%0017% TM Extend Sta.
904.68	690.13	6	1874794	1052644	%0018% TM Insert Sta.
1023.81	700.4	6	1874859	1052544	%0019% TM Insert Sta.
1167.38	711.12	-1	1874937	1052424	%0020% TM Extend Sta.

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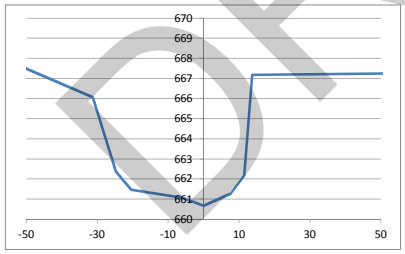
TABID= 1 12 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= 6344.16
NAVM= 0 LEFT= 579 .5 RI GHT= -49.5 SCALE= 1.0 SHIFT= 0.00 1 2 3 4 5 6 7
NSUB 7 0.035 0.01 0 0.080 0.030 0. 080 0.070 0.010 0.035 0.01 0.08 0.03 0.08 0.07 0.01
X-Sect 921 from Lowe r Mai nstem Moc LOWXSE22 TL

-288.89	682.75	1	1874579	1053889	%0001% TM Extend Sta.
-259.97	673.99	1	1874592	1053864	%0002% TM Extend Sta.
-200.66	672.02	2	1874619	1053811	%0003% TM Insert Sta.
-95.48	670.93	2	1874667	1053717	%0004% TM Insert Sta.
-31.28	666.07	3	1874696	1053660	%0005%
-24.77	662.37	4	1874699	1053654	%0006%
-20.4	661.47	4	1874701	1053650	%0007%
-5.96	661.07	4	1874708	1053638	%0008%
0	660.67	4	1874711	1053632	%0009%
7.61	661.27	4	1874714	1053625	%0010%
11.4	662.17	5	1874716	1053622	%0011%
13.69	667.17	6	1874717	1053620	%0012%
163.92	667.45	6	1874785	1053486	%0013% TM Extend Sta.
291.88	668.32	7	1874849	1053376	%0014% TM Extend Sta.
305.1	668.58	7	1874856	1053364	%0015% TM Extend Sta.
514.59	667.4	7	1874954	1053179	%0016% TM Extend Sta.
691.56	671.5	7	1875040	1053024	%0017% TM Extend Sta.
879.98	680.79	-1	1875133	1052861	%0018% TM Extend Sta.



Incorporated in 'Regraded cross sections' tab

-288.89	682.75	0.035	1
-259.97	673.99		1
-200.66	672.02	0.01	2
-95.48	670.93		2
-31.28	666.07	0.08	3
-24.77	662.37	0.04	4
-20.4	661.47		4
-5.96	661.07		4
0	660.67		4
7.61	661.27		4
11.4	662.17	0.08	5
13.69	667.17	0.07	6
163.92	667.45		6
291.88	668.32	0.01	7
305.1	668.58		7
514.59	667.4		7
691.56	671.5		7
879.98	680.79		-1

Incorporated in 'Regraded cross sections' tab

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Instream Measures Cross Sections

Original FEQ Cross Sections
FILE= XSections\EBEB01_EBEB23JULY2013.tab
(select cross sections between EBEB108 - EBEB121)

PROJECT CROSS SECTIONS
mannings coefficients due to instream measures (HEC-RAS input)
(108 - 121)

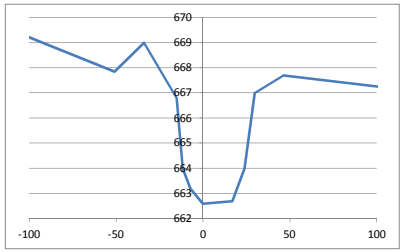
PROJECT CROSS SECTIONS
FOR FEQX INPUT
Inserted into: FILE= XSections\EBEB01_EBEB23JULY2013_Morton Modified.tab

FEQX
GISID= 0 01EBEB0115 ' 6 69.469 67(478 671.81672.826 673.877 676.571 NGVD29
TABID= 1 15 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= ı 7649.87
NAVM= (LEFT= 621 RIGH T= -347.2 S CALE= 1.00 SHIFT= 0.00

	1	2	3	4
NSUB 4	0.12	0.03	0.12	0.01

X-Sect 918 from Lowe r Mai nstem Moc LOWXSE22 TL

-768.41	680.87	1	1874824	1054899	%0001% TM Extend Sta.
-693.56	679.89	1	1874893	1054868	%0002% TM Extend Sta.
-453.57	671.67	1	1875113	1054773	%0003% TM Extend Sta.
-141.22	670.35	1	1875400	1054650	%0004% TM Extend Sta.
-50.89	667.84	1	1875483	1054616	%0005% TM Extend Sta.
-34.01	668.99	1	1875499	1054609	%0006%
-15.21	666.79	1	1875516	1054602	%0007%
-11.7	663.99	2	1875520	1054601	%0008%
-7.35	663.19	2	1875524	1054599	%0009%
0	662.59	2	1875530	1054596	%0010%
16.86	662.69	2	1875546	1054589	%0011%
23.93	663.99	3	1875552	1054587	%0012%
29.78	666.99	3	1875558	1054584	%0013%
46.34	667.69	3	1875573	1054578	%0014%
130.49	667	3	1875651	1054545	%0015% TM Extend Sta.
617.47	667.26	3	1876099	1054355	%0016% TM Extend Sta.
871.72	684.07	4	1876333	1054256	%0017% TM Insert Sta.
1175.37	707.73	4	1876613	1054138	%0018% TM Insert Sta.
1485.92	727.02	-1	1876899	1054017	%0019% TM Extend Sta.



-768.41	680.87	0.12	1	-768.41	680.87
-693.56	679.89		1	-693.56	679.89
-453.57	671.67		1	-453.57	671.67
-141.22	670.35		1	-141.22	670.35
-50.89	667.84		1	-50.89	667.84
-34.01	668.99		1	-34.01	668.99
-15.21	666.79		1	-15.21	666.79
-11.7	663.99	0.03	2	-11.7	663.99
-7.35	663.19	0.04	2	-7.35	663.19
0	662.59		2	0	662.59
16.86	662.69		2	16.86	662.69
23.93	663.99	0.12	3	23.93	663.99
29.78	666.99		3	29.78	666.99
46.34	667.69		3	46.34	667.69
130.49	667		3	130.49	667
617.47	667.26		3	617.47	667.26
871.72	684.07	0.01	4	871.72	684.07
1175.37	707.73		4	1175.37	707.73
1485.92	727.02		-1	1485.92	727.02

	1	2	3	4	5
NSUB 4	0.12	0.03	0.04	0.12	0.01

-768.41	680.87	1	1874824	1054899	%0001% TM Extend Sta.
-693.56	679.89	1	1874893	1054868	%0002% TM Extend Sta.
-453.57	671.67	1	1875113	1054773	%0003% TM Extend Sta.
-141.22	670.35	1	1875400	1054650	%0004% TM Extend Sta.
-50.89	667.84	1	1875483	1054616	%0005% TM Extend Sta.
-34.01	668.99	1	1875499	1054609	%0006%
-15.21	666.79	1	1875516	1054602	%0007%
-11.7	663.99	2	1875520	1054601	%0008%
-7.35	663.19	3	1875524	1054599	%0009%
0	662.59	3	1875530	1054596	%0010%
16.86	662.69	3	1875546	1054589	%0011%
23.93	663.99	4	1875552	1054587	%0012%
29.78	666.99	4	1875558	1054584	%0013%
46.34	667.69	4	1875573	1054578	%0014%
130.49	667	4	1875651	1054545	%0015% TM Extend Sta.
617.47	667.26	4	1876099	1054355	%0016% TM Extend Sta.
871.72	684.07	5	1876333	1054256	%0017% TM Insert Sta.
1175.37	707.73	5	1876613	1054138	%0018% TM Insert Sta.
1485.92	727.02	-1	1876899	1054017	%0019% TM Extend Sta.

FEQX
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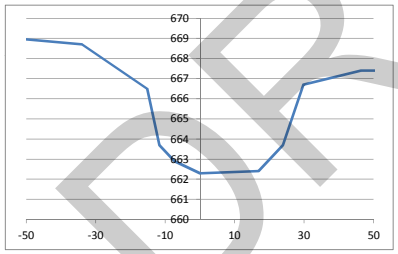
TABID= 1 16 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= ı 7834.68
NAVM= (LEFT= 148 .4 RI GHT= -253 SCALE= 1.0 0 SHIFT= 0.00

	1	2	3	4
NSUB 4	0.12	0.03	0.12	0.01

X-Sect 918 from Lowe r Mai nstem Moc LOWXSE22 TL

-792.23	679	1	1874902	1055077	%0001% TM Extend Sta.
-636.95	677.03	1	1875045	1055017	%0002% TM Extend Sta.
-529.38	673.16	1	1875143	1054972	%0003% TM Extend Sta.
-286.38	670.66	1	1875364	1054872	%0004% TM Extend Sta.
-150.26	670.5	1	1875488	1054816	%0005% TM Extend Sta.
-34.01	668.7	1	1875594	1054768	%0006%
-15.21	666.5	1	1875611	1054760	%0007%
-11.7	663.7	2	1875615	1054759	%0008%
-7.35	662.9	2	1875619	1054757	%0009%
0	662.3	2	1875625	1054754	%0010%
16.86	662.4	2	1875641	1054747	%0011%
23.92	663.7	3	1875647	1054744	%0012%
29.78	666.7	3	1875652	1054742	%0013%
46.34	667.4	3	1875668	1054735	%0014%
142.4	667.4	3	1875755	1054695	%0015% TM Extend Sta.
245.26	675.1	3	1875849	1054653	%0016% TM Extend Sta.
533.56	675.5	3	1876111	1054534	%0017% TM Extend Sta.
695.93	678.8	3	1876259	1054467	%0018% TM Extend Sta.
931.84	683.62	4	1876475	1054372	%0019% TM Insert Sta.
1191.19	705.69	4	1876712	1054267	%0020% TM Insert Sta.
1480.34	726.48	-1	1876977	1054150	%0021% TM Extend Sta.



Incorporated in 'Regraded cross sections' tab

-792.23	679	0.12	1
-636.95	677.03		1
-529.38	673.16		1
-286.38	670.66		1
-150.26	670.5		1
-34.01	668.7		1
-15.21	666.5		1
-11.7	663.7	0.04	2
-7.35	662.9		2
0	662.3		2
16.86	662.4		2
23.92	663.7	0.12	3
29.78	666.7		3
46.34	667.4		3
142.4	667.4		3
245.26	675.1		3
533.56	675.5		3
695.93	678.8		3
931.84	683.62	0.01	4
1191.19	705.69		4
1480.34	726.48		-1

Incorporated in 'Regraded cross sections' tab

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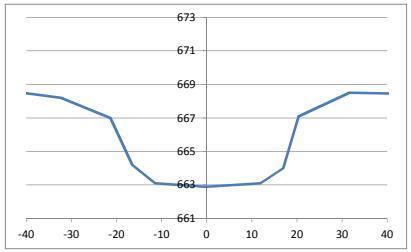
05 OCTOBER 2015

Instream Measures Cross Sections	Original FEQ Cross Sections FILE= XSections\EBEB01_EBEB23JULY2013.tab (select cross sections between EBEB108 - EBEB121)	PROJECT CROSS SECTIONS mannings coefficients due to instream measures (HEC-RAS input) (108 - 121)	PROJECT CROSS SECTIONS FOR FEQX INPUT Inserted into: FILE= XSections\EBEB01_EBEB23JULY2013_Morton Modified.tab

FEQX
GISID= 0 01EBEB0117 ' 6 69.877 67(589 671.81 672.826 673.877 676.571 NGVD29
TABID= 1 17 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= (8497.68
NAVM= (LEFT= 352 .3 RI GHT= -635 SCALE= 1.0 0 SHIFT= 0.00 1 2 3 4 5 6 7
NSUB 7 0.001 0.1 0 0.080 0.050 0. 080 0.100 0.010 0.001 0.1 0.08 0.05 0.08 0.1 0.01
X-Sect 917 from Lowe r Mai nstem Mo(LOWXSE22 TL

-680.79	680.02	1	1875371	1054927	%0001% FRICTIONLESS WALL	-680.79	680.02	0.001	1		
-680.68	670.18	2	1875371	1054927	%0002% TM Extend Sta.	-680.68	670.18	0.1	2		
-491.9	669.4	2	1875526	1055036	%0003% BIS 2	-491.9	669.4		2		
-304.02	668.6	2	1875690	1055128	%0004% OVB 3	-304.02	668.6		2		
-71.54	669.6	2	1875892	1055242	%0005% OVB 4	-71.54	669.6		2		
-32.28	668.2	3	1875926	1055261	%0006% TOB 5	-32.28	668.2	0.08	3		
-21.32	667	3	1875936	1055266	%0007% BIS 6	-21.32	667	0.04	3		
-16.49	664.2	4	1875940	1055269	%0008% BOB 7	-16.49	664.2		4		
-11.44	663.1	4	1875945	1055271	%0009% CHP 8	-11.44	663.1		4		
-0.21	662.9	4	1875954	1055277	%0010% CFL 9	-0.21	662.9		4		
11.95	663.1	4	1875965	1055283	%0011% CHP 10	11.95	663.1		4		
16.92	664	5	1875969	1055285	%0012% BOB 11	16.92	664	0.08	5		
20.33	667.1	5	1875972	1055287	%0013% BIS 12	20.33	667.1		5		
31.6	668.5	6	1875982	1055292	%0014% TOB 13	31.6	668.5	0.1	6		
166.29	667.8	6	1876100	1055358	%0015% BIS 14	166.29	667.8		6		
314.69	668.1	6	1876229	1055431	%0016% BIS 15	314.69	668.1		6		
487.41	672.7	7	1876380	1055515	%0017% TOS 16	487.41	672.7	0.01	7		
520.55	672.96	-1	1876403	1055539	%0018% TM Extend Sta.	520.55	672.96		-1		

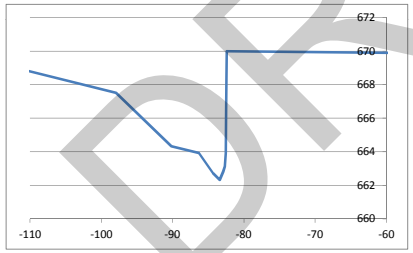


Incorporated in 'Regraded cross sections' tab

Incorporated in 'Regraded cross sections' tab

FEQX
GISID= 0 01EBEB0118 ' 6 69.946 67(679 671.81 672.826 673.877 676.849 NGVD29
TABID= 1 18 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= (8825.5
NAVM= (LEFT= 92. 55 RI GHT= -189 35 SCALE= .00 SHIFT= 0.00 1 2 3 4 5 6 7 9 10
NSUB 1 0 0.080 0 95 0.035 0.095 0 .035 0.080 0.095 0.035 0.100 0.08 0.095 0.035 0.095 0.035 0.08 0.095 0.1 0.001
X-Sect 915 from Lowe r Mai nstem Mo(LOWXSE22 TL

-1891.35	713.53	1	1874427	1056607	%0001% TM Extend Sta.	-1891.35	713.53	0.08	1	-1891.35	713.53	1	1874427	1056607	%0001% TM Extend Sta.								
-1468.04	690.76	1	1874606	1056223	%0002% TM Extend Sta.	-1468.04	690.76		1	-1468.04	690.76	1	1874606	1056223	%0002% TM Extend Sta.								
-1274.16	682.1	1	1874782	1056143	%0003% TM Extend Sta.	-1274.16	682.1		1	-1274.16	682.1	1	1874782	1056143	%0003% TM Extend Sta.								
-1215.5	680.97	1	1874836	1056119	%0004% TM Extend Sta.	-1215.5	680.97		1	-1215.5	680.97	1	1874836	1056119	%0004% TM Extend Sta.								
-1139.86	678.14	1	1874904	1056086	%0005% TM Extend Sta.	-1139.86	678.14		1	-1139.86	678.14	1	1874904	1056086	%0005% TM Extend Sta.								
-1004.63	675.13	1	1875027	1056031	%0006% TM Extend Sta.	-1004.63	675.13		1	-1004.63	675.13	1	1875027	1056031	%0006% TM Extend Sta.								
-929.79	665.79	2	1875096	1056001	%0007% TM Extend Sta.	-929.79	665.79	0.095	2	-929.79	665.79	2	1875096	1056001	%0007% TM Extend Sta.								
-679.76	665.79	2	1875324	1055898	%0008% TM Extend Sta.	-679.76	665.79		2	-679.76	665.79	2	1875324	1055898	%0008% TM Extend Sta.								
-631.01	671.85	3	1875368	1055878	%0009% TM Insert Sta.	-631.01	671.85	0.035	3	-631.01	671.85	3	1875368	1055878	%0009% TM Insert Sta.								
-587.93	671.92	3	1875407	1055860	%0010% TM Extend Sta.	-587.93	671.92		3	-587.93	671.92	3	1875407	1055860	%0010% TM Extend Sta.								
-442.07	671.54	3	1875540	1055800	%0011% CLP 4	-442.07	671.54		3	-442.07	671.54	3	1875540	1055800	%0011% CLP 4								
-350.84	670.68	3	1875622	1055759	%0012%	-350.84	670.68		3	-350.84	670.68	3	1875622	1055759	%0012%								
-144.46	670.58	3	1875807	1055667	%0013% CLP 6	-144.46	670.58		3	-144.46	670.58	3	1875807	1055667	%0013% CLP 6								
-113.44	669.16	4	1875834	1055653	%0014% TOB 8	-113.44	669.16	0.095	4	-113.44	669.16	4	1875834	1055653	%0014% TOB 8								
-97.94	667.52	4	1875848	1055646	%0015%	-97.94	667.52	0.04	4	-97.94	667.52	5	1875848	1055646	%0015%								
-90.19	664.32	5	1875855	1055643	%0016%	-90.19	664.32		5	-90.19	664.32	5	1875855	1055643	%0016%								
-86.3	663.92	5	1875859	1055641	%0017%	-86.3	663.92		5	-86.3	663.92	5	1875859	1055641	%0017%								
-84.36	662.72	5	1875860	1055640	%0018%	-84.36	662.72		5	-84.36	662.72	5	1875860	1055640	%0018%								
-83.39	662.32	5	1875861	1055640	%0019%	-83.39	662.32		5	-83.39	662.32	5	1875861	1055640	%0019%								
-82.91	662.82	5	1875862	1055640	%0020%	-82.91	662.82		5	-82.91	662.82	5	1875862	1055640	%0020%								
-82.67	663.12	5	1875862	1055640	%0021%	-82.67	663.12		5	-82.67	663.12	5	1875862	1055640	%0021%								
-82.55	663.92	6	1875862	1055640	%0022%	-82.55	663.92	0.08	6	-82.55	663.92	6	1875862	1055640	%0022%								
-82.49	666.42	6	1875862	1055640	%0023%	-82.49	666.42		6	-82.49	666.42	6	1875862	1055640	%0023%								
-82.46	668.32	7	1875862	1055640	%0024% TOB 18	-82.46	668.32	0.095	7	-82.46	668.32	7	1875862	1055640	%0024% TOB 18								
-82.43	670	8	1875862	1055639	%0025% CLP 7	-82.43	670	0.035	8	-82.43	670	8	1875862	1055639	%0025% CLP 7								
57.63	669.4	9	1875988	1055577	%0026% BIS 19	57.63	669.4	0.1	9	57.63	669.4	9	1875988	1055577	%0026% BIS 19								
87.1	673.94	9	1876014	1055564	%0027% CHL 20	87.1	673.94		9	87.1	673.94	9	1876014	1055564	%0027% CHL 20								
92.45	674.47	1 0	1876018 8	1055561 6	%0028% EOP 21	92.45	674.47	0.001	1	92.45	674.47	10 0	1876018. 8	1055561 6	%0028% EOP 21								
92.55	685.04	-1	1876019	1055561	%0029% FRICTIONLESS WALL	92.55	685.04		-1	92.55	685.04	-1	1876019	1055561	%0029% FRICTIONLESS WALL								



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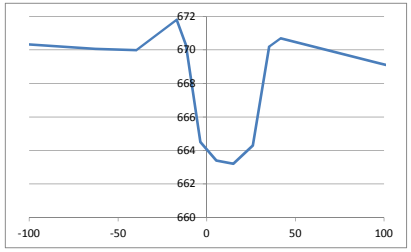
05 OCTOBER 2015

Instream Measures Cross Sections

Original FEQ Cross Sections
FILE= XSections\EBEB01_EBEB23JULY2013.tab
(select cross sections between EBEB108 - EBEB121)

GISID= 0 01EBEB0119 ' 6 69.993 67(713 671.81672.826 673.877 676.849 NGVD29
TABID= 1 19 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= 8919.9
NAVM= (LEFT= 159 .65 R IGHT= -181.45 SCALE= 1.00 SHIFT= 0.00 1 2 3 4 5 6 7
NSUB 8 0.032 0.01 0 0.032 0.080 0. 035 0.090 0.070 0.001 0.032 0.01 0.032 0.08 0.035 0.09 0.07
X-Sect 806 from Lowe r Mai nstem Moc LOWXSE22 TL

-1814.45	715.54	1	1874476	1056709	%0001% TM Extend Sta.
-1257.04	683.37	1	1874974	1056459	%0002% TM Extend Sta.
-1136.22	677.6	1	1875071	1056386	%0003% TM Extend Sta.
-992.18	678.05	1	1875187	1056301	%0004% TM Extend Sta.
-886.15	672.97	1	1875273	1056238	%0005% TM Extend Sta.
-819.66	665.79	1	1875326	1056198	%0006% TM Extend Sta.
-602.29	665.79	1	1875501	1056069	%0007% TM Extend Sta.
-568.14	675	1	1875528	1056049	%0008% OVB X
-372.65	671.9	2	1875680	1055926	%0009% TM Insert Sta.
-168.13	670.8	3	1875838	1055797	%0010% OVB 1
-62.77	670.06	3	1875920	1055730	%0011% EOP 2
-39.68	669.99	3	1875938	1055716	%0012% EOP 3
-16.98	671.8	3	1875956	1055701	%0013% TOB 4
-11.76	670.3	4	1875960	1055698	%0014% TOB 5
-3.55	664.5	5	1875966	1055693	%0015% BOB 6
5.44	663.4	5	1875973	1055687	%0016% CHP 7
14.94	663.2	5	1875980	1055681	%0017% CFL 8
26.04	664.3	6	1875989	1055674	%0018% BOB 10
35.24	670.2	7	1875996	1055668	%0019% TOB 11
41.64	670.7	7	1876001	1055664	%0020% TOB 12
97.24	669.2	7	1876044	1055629	%0021% OVB 13
112.65	668.8	7	1876056	1055619	%0022% BIS 14
131.23	675.89	7	1876071	1055608	%0023% EOP 15
159.57	676.59	8	1876090	1055587	%0024% TM Extend Sta.
159.65	685.04	-1	1876090	1055586	%0025% FRICTIONLESS WALL



PROJECT CROSS SECTIONS
mannings coefficients due to instream measures (HEC-RAS input)
(108 - 121)

-1814.45	715.54	0.032	1
-1257.04	683.37		1
-1136.22	677.6		1
-992.18	678.05		1
-886.15	672.97		1
-819.66	665.79		1
-602.29	665.79		1
-568.14	675		1
-372.65	671.9	0.01	2
-168.13	670.8	0.032	3
-62.77	670.06		3
-39.68	669.99		3
-16.98	671.8		3
-11.76	670.3	0.08	4
-3.55	664.5	0.04	5
5.44	663.4		5
14.94	663.2		5
26.04	664.3	0.09	6
35.24	670.2	0.07	7
41.64	670.7		7
97.24	669.2		7
112.65	668.8		7
131.23	675.89		7
159.57	676.59	0.001	8
159.65	685.04		-1

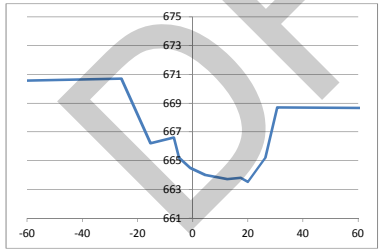
PROJECT CROSS SECTIONS
FOR FEQX INPUT
Inserted into: FILE=
XSections\EBEB01_EBEB23JULY2013_Morton Modified.tab

1 2 3 4 5 6 7 8
0.032 0.01 0.032 0.08 0.04 0.09 0.07 0.001

-1814.45	715.54	1	1874476	1056709	%0001% TM Extend Sta.
-1257.04	683.37	1	1874974	1056459	%0002% TM Extend Sta.
-1136.22	677.6	1	1875071	1056386	%0003% TM Extend Sta.
-992.18	678.05	1	1875187	1056301	%0004% TM Extend Sta.
-886.15	672.97	1	1875273	1056238	%0005% TM Extend Sta.
-819.66	665.79	1	1875326	1056198	%0006% TM Extend Sta.
-602.29	665.79	1	1875501	1056069	%0007% TM Extend Sta.
-568.14	675	1	1875528	1056049	%0008% OVB X
-372.65	671.9	2	1875680	1055926	%0009% TM Insert Sta.
-168.13	670.8	3	1875838	1055797	%0010% OVB 1
-62.77	670.06	3	1875920	1055730	%0011% EOP 2
-39.68	669.99	3	1875938	1055716	%0012% EOP 3
-16.98	671.8	3	1875956	1055701	%0013% TOB 4
-11.76	670.3	4	1875960	1055698	%0014% TOB 5
-3.55	664.5	5	1875966	1055693	%0015% BOB 6
5.44	663.4	5	1875973	1055687	%0016% CHP 7
14.94	663.2	5	1875980	1055681	%0017% CFL 8
26.04	664.3	6	1875989	1055674	%0018% BOB 10
35.24	670.2	7	1875996	1055668	%0019% TOB 11
41.64	670.7	7	1876001	1055664	%0020% TOB 12
97.24	669.2	7	1876044	1055629	%0021% OVB 13
112.65	668.8	7	1876056	1055619	%0022% BIS 14
131.23	675.89	7	1876071	1055608	%0023% EOP 15
159.57	676.59	8	1876090	1055587	%0024% TM Extend Sta.
159.65	685.04	-1	1876090	1055586	%0025% FRICTIONLESS WALL

FEQX
GISID= 0 01EBEB0120 ' 6 70.35 671.75 672.138 673.063 674.106 676.971 NGVD29
TABID= 1 20 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= 246.79
NAVM= (LEFT= 189 5.57 RIGHT= -74.18 SCALE= 1.00 SHIFT= 0.00 1 2 3 4 5 6
NSUB 6 0.09 0.08 0 0.040 0.080 0. 100 0.250 0.09 0.08 0.04 0.08 0.1 0.25
X-Sect 914 from Lowe r Mai nstem Moc LOWXSE22 TL

-740.18	695.39	1	1875970	1057049	%0001% TM Extend Sta.
-454.5	674.81	1	1876214	1056900	%0002% EOP 3
-381.7	672.06	1	1876283	1056880	%0003% EOP 4
-375.17	670.9	1	1876290	1056878	%0004% TOS 6
-226.97	669.9	1	1876432	1056836	%0005% TOS 10
-25.78	670.7	1	1876625	1056780	%0006% TOB 14
-15.3	666.2	1	1876635	1056777	%0007% BIS 15
-6.74	666.6	2	1876643	1056774	%0008% TOB 16
-4.92	665.2	3	1876645	1056774	%0009% BOB 17
-0.87	664.5	3	1876649	1056773	%0010% CHP 18
4.6	664	3	1876654	1056771	%0011% CHP 19
12.53	663.7	3	1876662	1056769	%0012% CHP 20
17.34	663.8	3	1876666	1056767	%0013% CHP 21
19.95	663.5	3	1876669	1056767	%0014% CFL 22
26.39	665.2	4	1876675	1056765	%0015% BOB 23
30.64	668.7	5	1876679	1056764	%0016% TOB 24
105.25	668.6	5	1876751	1056743	%0017% ROB 25
134.65	669.9	5	1876779	1056734	%0018% ROB 26
156.64	671.2	5	1876800	1056728	%0019% ROB 28
170.81	672.05	6	1876813	1056724	%0020% EOP 29
194.81	672.85	6	1876837	1056717	%0021% EOP 30
224.71	672.03	6	1876865	1056709	%0022% EOP 31
248.71	672.8	6	1876888	1056702	%0023% EOP 32
258.7	672.52	6	1876898	1056699	%0024% SHL 33
278.31	671.6	6	1876917	1056694	%0025% BIS 35
401.91	672.4	6	1877035	1056659	%0026% ROB 36
537.2	671.6	6	1877165	1056621	%0027% ROB 37
601.21	673.5	6	1877226	1056603	%0028% ROB 38
1051.21	676	6	1877658	1056476	%0029% ROB XX
1100.67	677.32	6	1877705	1056459	%0030% TM Extend Sta.
1448.69	679.37	6	1878031	1056339	%0031% TM Extend Sta.
1671.36	681.58	6	1878164	1056160	%0032% TM Extend Sta.



-740.18	695.39	0.09	1
-454.5	674.81		1
-381.7	672.06		1
-375.17	670.9		1
-226.97	669.9		1
-25.78	670.7		1
-15.3	666.2		1
-6.74	666.6	0.08	2
-4.92	665.2	0.04	3
-0.87	664.5		3
4.6	664		3
12.53	663.7		3
17.34	663.8		3
19.95	663.5		3
26.39	665.2	0.08	4
30.64	668.7	0.1	5
105.25	668.6		5
134.65	669.9		5
156.64	671.2		5
170.81	672.05	0.25	6
194.81	672.85		6
224.71	672.03		6
248.71	672.8		6
258.7	672.52		6
278.31	671.6		6
401.91	672.4		6
537.2	671.6		6
601.21	673.5		6
1051.21	676		6
1100.67	677.32		6
1448.69	679.37		6
1671.36	681.58		6

1 2 3 4 5 6
0.09 0.08 0.04 0.08 0.1 0.25

-740.18	695.39	1	1875970	1057049	%0001% TM Extend Sta.
-454.5	674.81	1	1876214	1056900	%0002% EOP 3
-381.7	672.06	1	1876283	1056880	%0003% EOP 4
-375.17	670.9	1	1876290	1056878	%0004% TOS 6
-226.97	669.9	1	1876432	1056836	%0005% TOS 10
-25.78	670.7	1	1876625	1056780	%0006% TOB 14
-15.3	666.2	1	1876635	1056777	%0007% BIS 15
-6.74	666.6	2	1876643	1056774	%0008% TOB 16
-4.92	665.2	3	1876645	1056774	%0009% BOB 17
-0.87	664.5	3	1876649	1056773	%0010% CHP 18
4.6	664	3	1876654	1056771	%0011% CHP 19
12.53	663.7	3	1876662	1056769	%0012% CHP 20
17.34	663.8	3	1876666	1056767	%0013% CHP 21
19.95	663.5	3	1876669	1056767	%0014% CFL 22
26.39	665.2	4	1876675	1056765	%0015% BOB 23
30.64	668.7	5	1876679	1056764	%0016% TOB 24
105.25	668.6	5	1876751	1056743	%0017% ROB 25
134.65	669.9	5	1876779	1056734	%0018% ROB 26
156.64	671.2	5	1876800	1056728	%0019% ROB 28
170.81	672.05	6	1876813	1056724	%0020% EOP 29
194.81	672.85	6	1876837	1056717	%0021% EOP 30
224.71	672.03	6	1876865	1056709	%0022% EOP 31
248.71	672.8	6	1876888	1056702	%0023% EOP 32
258.7	672.52	6	1876898	1056699	%0024% SHL 33
278.31	671.6	6	1876917	1056694	%0025% BIS 35
401.91	672.4	6	1877035	1056659	%0026% ROB 36
537.2	671.6	6	1877165	1056621	%0027% ROB 37
601.21	673.5	6	1877226	1056603	%0028% ROB 38
1051.21	676	6	1877658	1056476	%0029% ROB XX
1100.67	677.32	6	1877705	1056459	%0030% TM Extend Sta.
1448.69	679.37	6	1878031	1056339	%0031% TM Extend Sta.
1671.36	681.58	6	1878164	1056160	%0032% TM Extend Sta.

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Instream Measures Cross Sections

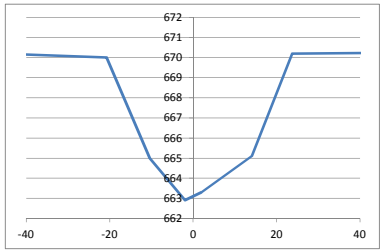
Original FEQ Cross Sections
FILE= XSections\EBEB01_EBEB23JULY2013.tab
(select cross sections between EBEB108 - EBEB121)

1895.57	696.1	-1	1878297	1055980	%0033% TM Extend Sta.

FEQX
GISID= 0 01EBEB0121 ' 6 71.712 672342 673.23674.001 674.848 677.062 NGVD29
TABID= 1 21 EXTEND SAVE 22 OUT22 NOTONE N ETAM
STATION= ' 1996.17
NAVM= 0LEFT= 232 8.4 R IGHT= -73085 SCALE= .00 SHIFT= 0.00
NSUB 5 0.05 0.09 0 0.040 0.090 0. 60
X-Sect 913 from Lowe r Mai nstem MocLOWXSE22 TL

1	2	3	4	5
0.05	0.09	0.04	0.09	0.06

-730.85	728.75	1	1876824	1058613	%0001% TM Extend Sta.
-453.22	679.51	1	1877075	1058494	%0002% TM Extend Sta.
-411.83	676.1	1	1877113	1058478	%0003% TOS 1
-324.05	669.8	1	1877190	1058437	%0004% BIS 2
-269.89	669.8	1	1877239	1058412	%0005% EOP 3
-253.25	669.91	1	1877253	1058405	%0006% EOP 4
-138.56	670.9	1	1877355	1058352	%0007% TOS 6
-20.75	670	2	1877460	1058298	%0008% TOB 7
-10.42	665	3	1877469	1058293	%0009% BOB 8
-1.94	662.9	3	1877476	1058289	%0010% CFL 9
2.08	663.3	3	1877480	1058287	%0011% CHP 10
14.09	665.1	4	1877491	1058282	%0012% BOB 11
23.78	670.2	5	1877499	1058277	%0013% TOB 12
103.28	670.34	5	1877570	1058241	%0014% SHL 14
113.99	670.72	5	1877579	1058236	%0015% EOP 15
247.69	672.1	5	1877698	1058174	%0016% ROB 17
328.59	672.7	5	1877770	1058137	%0017% OVB 18
517.79	673	5	1877938	1058050	%0018% OVB 19
580.1	677.1	5	1877993	1058022	%0019% OVB 20
747.51	676.97	5	1878096	1057889	%0020% TM Extend Sta.
1697.58	685.13	5	1878676	1057137	%0021% TM Extend Sta.
2158.64	687.37	5	1878954	1056769	%0022% TM Extend Sta.
2328.4	695.28	-1	1879058	1056635	%0023% TM Extend Sta.



PROJECT CROSS SECTIONS
mannings coefficients due to instream measures (HEC-RAS input)
(108 - 121)

1895.57	696.1		-1
-730.85	728.75	0.05	1
-453.22	679.51		1
-411.83	676.1		1
-324.05	669.8		1
-269.89	669.8		1
-253.25	669.91		1
-138.56	670.9		1
-20.75	670	0.09	2
-10.42	665	0.04	3
-1.94	662.9		3
2.08	663.3		3
14.09	665.1	0.09	4
23.78	670.2	0.06	5
103.28	670.34		5
113.99	670.72		5
247.69	672.1		5
328.59	672.7		5
517.79	673		5
580.1	677.1		5
747.51	676.97		5
1697.58	685.13		5
2158.64	687.37		5
2328.4	695.28		-1

PROJECT CROSS SECTIONS
FOR FEQX INPUT
Inserted into: FILE= XSections\EBEB01_EBEB23JULY2013_Morton Modified.tab

1895.57	696.1	-1	1878297	1055980	%0033% TM Extend Sta.

1	2	3	4	5
0.05	0.09	0.04	0.09	0.06

-730.85	728.75	1	1876824	1058613	%0001% TM Extend Sta.
-453.22	679.51	1	1877075	1058494	%0002% TM Extend Sta.
-411.83	676.1	1	1877113	1058478	%0003% TOS 1
-324.05	669.8	1	1877190	1058437	%0004% BIS 2
-269.89	669.8	1	1877239	1058412	%0005% EOP 3
-253.25	669.91	1	1877253	1058405	%0006% EOP 4
-138.56	670.9	1	1877355	1058352	%0007% TOS 6
-20.75	670	2	1877460	1058298	%0008% TOB 7
-10.42	665	3	1877469	1058293	%0009% BOB 8
-1.94	662.9	3	1877476	1058289	%0010% CFL 9
2.08	663.3	3	1877480	1058287	%0011% CHP 10
14.09	665.1	4	1877491	1058282	%0012% BOB 11
23.78	670.2	5	1877499	1058277	%0013% TOB 12
103.28	670.34	5	1877570	1058241	%0014% SHL 14
113.99	670.72	5	1877579	1058236	%0015% EOP 15
247.69	672.1	5	1877698	1058174	%0016% ROB 17
328.59	672.7	5	1877770	1058137	%0017% OVB 18
517.79	673	5	1877938	1058050	%0018% OVB 19
580.1	677.1	5	1877993	1058022	%0019% OVB 20
747.51	676.97	5	1878096	1057889	%0020% TM Extend Sta.
1697.58	685.13	5	1878676	1057137	%0021% TM Extend Sta.
2158.64	687.37	5	1878954	1056769	%0022% TM Extend Sta.
2328.4	695.28	-1	1879058	1056635	%0023% TM Extend Sta.

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Regraded Cross Sections

05 OCTOBER 2015

Regraded Cross Sections	Original FEQ Cross Sections FILE= XSections\EBEB01_EBEB23JULY2013.tab (108 - 121)	BASE MODEL FEQ Section For HEC RAS imput All Elevations are NGVD29	PROJECT CROSS SECTIONS (110 - 117) All Elevations are NGVD29	Note: refer to spreadshet titled 'Morton_Existing and proposed cross sections for documentation of creating of the proposed sections based on Civil design	PROJECT CROSS SECTIONS FOR FEQX INPUT Inserted into: FILE= XSections\EBEB01_EBEB23JULY2013_MortonModified.tab

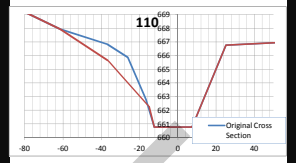
FEQX
GISID= 0 01EBEB0110 ' 6 67.331 668. 76 670.515 671.683 672.958 676.504 NGVD29
TABID= 1 10 EXTEND SAVE 22 OUT22 MO NOTONE NEWB ETAM
STATION= 6051.27
NAVM= (LEFT= 616 .5 RI GHT= -109.8 SCALE= 1.0 0 SHIFT= 0.00 1 2 3 4 5 6 7
NSUB 7 0.001 0.12 0 0.080 0.030 0. 080 0.120 0.010 0.001 0.12 0.08 0.03 0.08 0.12 0.01
X-Sect 922 from Lowe r Mai nstem Model LOWXSE22.F TL

-243.52	685.04	1	1874334.03	1053700.14	%0001% FRICTIONLESS WALL
-243.42	673.11	2	1874334.08	1053700.05	%0002% TM Extend Sta.
-100.16	670.55	2	1874405.6	1053575.92	%0003% TM Extend Sta.
-61.49	667.93	2	1874424.49	1053542.18	%0004% TM Extend Sta.
-36.93	666.83	2	1874436.72	1053520.88	%0005%
-26.13	665.86	3	1874442.1	1053511.52	%0006%
-16.71	662.79	4	1874446.79	1053503.34	%0007%
-12.28	660.77	4	1874449	1053499.51	%0008%
0	660.77	4	1874455.12	1053488.86	%0009%
4.83	660.77	4	1874457.52	1053484.67	%0010%
7.39	660.77	5	1874458.79	1053482.45	%0011%
25.08	666.76	6	1874467.61	1053467.11	%0012%
168.8	667.77	6	1874539.18	1053342.48	%0013% TM Extend Sta.
427.83	668.86	6	1874678.16	1053123.89	%0014% TM Extend Sta.
654.26	670.25	6	1874800.95	1052933.64	%0015% TM Extend Sta.
871.81	685.01	7	1874918.65	1052750.69	%0016% TM Insert Sta.
1113.14	701.33	-1	1875049.23	1052547.73	%0017% TM Extend Sta.

-243.52	685.04	0.001
-243.42	673.11	0.12
-100.16	670.55	
-61.49	667.93	
-36.93	666.83	
-26.13	665.86	0.08
-16.71	662.79	0.03
-12.28	660.77	
0	660.77	
4.83	660.77	
7.39	660.77	0.08
25.08	666.76	0.12
168.8	667.77	
427.83	668.86	
654.26	670.25	
871.81	685.01	0.01
1113.14	701.33	

-243.52	685.04	0.001
-243.42	673.11	0.12
-100.16	670.55	
-61.49	667.93	
-36.52	**665.641**	**0.07**
-35.65	**665.511**	
-30.66	**664.721**	
-17.04	**662.561**	
-14.98	**662.261**	
-12.28	660.77	**0.03**
0	660.77	
4.83	660.77	
7.39	660.77	0.08
25.08	666.76	0.12
168.8	667.77	
427.83	668.86	
654.26	670.25	
871.81	685.01	0.01
1113.14	701.33	

Adjusted based on XS 25+00 regrading



01EBEB0110

1	2	3	4	5	6	7
0.001	0.120	**0.07**	0.030	0.080	0.120	0.010

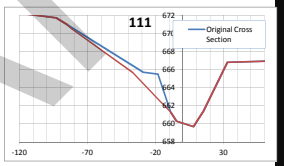
-243.52	685.04	1	1874334.03	1053700.14	%0001% FRICTIONLESS WALL
-243.42	673.11	2	1874334.08	1053700.05	%0002% TM Extend Sta.
-100.16	670.55		1874405.6	1053575.92	%0003% TM Extend Sta.
-61.49	667.93		1874424.49	1053542.18	%0004% TM Extend Sta.
-36.52	**665.64**	3			
-35.65	**665.51**				
-30.66	**664.72**				
-17.04	**662.56**				
-14.98	**662.26**				
-12.28	660.77	4	1874449	1053499.51	%0008%
0.00	660.77		1874455.12	1053488.86	%0009%
4.83	660.77		1874457.52	1053484.67	%0010%
7.39	660.77	5	1874458.79	1053482.45	%0011%
25.08	666.76	6	1874467.61	1053467.11	%0012%
168.80	667.77		1874539.18	1053342.48	%0013% TM Extend Sta.
427.83	668.86		1874678.16	1053123.89	%0014% TM Extend Sta.
654.26	670.25		1874800.95	1052933.64	%0015% TM Extend Sta.
871.81	685.01	7	1874918.65	1052750.69	%0016% TM Insert Sta.
1113.14	701.33	-1	1875049.23	1052547.73	%0017% TM Extend Sta.

FEQX
GISID= 0 01EBEB0111 ' 6 67.331 668. 76 670.515 671.684 672.964 676.527 NGVD29
TABID= 1 11 EXTEND SAVE 22 OUT22 MO NOTONE NEWB ETAM
STATION= 6086.54
NAVM= (LEFT= 548 1 RI GHT= -40.6 SCALE= 1.00 SHIFT= 0.00 1 2 3 4 5 6 7
NSUB 7 0.001 0.12 0 0.080 0.030 0. 080 0.120 0.010 0.001 0.12 0.08 0.03 0.08 0.12 0.01
X-Sect 922 from Lowe r Mai nstem Model LOWXSE22.F TL

-495.69	685.04	1	1874327.41	1053922.76	%0001% FRICTIONLESS WALL
-495.59	676.63	2	1874327.34	1053922.69	%0002% TM Extend Sta.
-423.06	673.18	2	1874274.71	1053872.79	%0003% TM Extend Sta.
-228.77	674.3	2	1874369.15	1053702.99	%0004% TOS 2
-93.02	671.74	2	1874438.39	1053586.23	%0005% CLP 3
-29.16	665.7	2	1874470.96	1053531.3	%0006% BIS 4
-18.37	665.5	3	1874476.46	1053522.02	%0007% TOB 5
-8.93	661.3	4	1874481.28	1053513.9	%0008% BOB 6
-4.52	660.3	4	1874483.53	1053510.1	%0009% CHP 7
7.77	659.7	4	1874489.79	1053499.53	%0010% CFL 8
12.61	660.8	4	1874492.26	1053495.37	%0011% CHP 9
15.15	661.4	5	1874493.56	1053493.19	%0012% BOB 10
32.84	666.8	6	1874502.58	1053477.97	%0013% TOB 11
96.34	667.1	6	1874534.97	1053423.35	%0014% OVB 12
321.26	668.9	6	1874649.69	1053229.89	%0015% OVB 13
536.32	669.1	6	1874759.37	1053044.9	%0016% OVB 14
661.32	670.55	6	1874827.94	1052940.38	%0017% TM Extend Sta.
892.78	686.23	7	1874956.03	1052747.6	%0018% TM Insert Sta.
1139.22	700.79	-1	1875092.41	1052542.33	%0019% TM Extend Sta.

-495.69	685.04	0.001
-495.59	676.63	0.12
-423.06	673.18	
-228.77	674.3	
-93.02	671.74	
-84.69	**670.931**	**0.07**
-83.92	**670.821**	
-83.46	**670.751**	
-81.88	**670.521**	
-36.52	**665.641**	
-35.65	**665.511**	
-30.66	**664.721**	
-17.04	**662.561**	
-14.98	**662.261**	
-13.85	**662.091**	
-13.79	**662.081**	
-13.77	**662.081**	
-13.1	**661.971**	
-13.03	**661.971**	
-8.93	661.3	0.03
-4.52	660.3	
7.77	659.7	
12.61	660.8	
15.15	661.4	0.08
32.84	666.8	0.12
96.34	667.1	
321.26	668.9	
536.32	669.1	
661.32	670.55	
892.78	686.23	0.01
1139.22	700.79	

Adjusted based on XS 25+00 regrading



01EBEB0111

1	2	3	4	5	6	7
0.001	0.120	**0.07**	0.030	0.080	0.120	0.010

-495.69	685.04	1	1874327.41	1053922.76	%0001% FRICTIONLESS WALL
-495.59	676.63	2	1874327.34	1053922.69	%0002% TM Extend Sta.
-423.06	673.18		1874274.71	1053872.79	%0003% TM Extend Sta.
-228.77	674.30		1874369.15	1053702.99	%0004% TOS 2
-93.02	671.74		1874438.39	1053586.23	%0005% CLP 3
-84.69	**670.93**	**3**			
-83.92	**670.82**				
-83.46	**670.75**				
-81.88	**670.52**				
-36.52	**665.64**				
-35.65	**665.51**				
-30.66	**664.72**				
-17.04	**662.56**				
-14.98	**662.26**				
-13.85	**662.09**				
-13.79	**662.08**				
-13.77	**662.08**				
-13.10	**661.97**				
-13.03	**661.97**				
-8.93	661.30	4	1874481.28	1053513.9	%0008% BOB 6
-4.52	660.30		1874483.53	1053510.1	%0009% CHP 7
7.77	659.70		1874489.79	1053499.53	%0010% CFL 8
12.61	660.80		1874492.26	1053495.37	%0011% CHP 9
15.15	661.40	5	1874493.56	1053493.19	%0012% BOB 10
32.84	666.80	6	1874502.58	1053477.97	%0013% TOB 11
96.34	667.10		1874534.97	1053423.35	%0014% OVB 12
321.26	668.90		1874649.69	1053229.89	%0015% OVB 13
536.32	669.10		1874759.37	1053044.9	%0016% OVB 14
661.32	670.55		1874827.94	1052940.38	%0017% TM Extend Sta.
892.78	686.23	7	1874956.03	1052747.6	%0018% TM Insert Sta.
1139.22	700.79	-1	1875092.41	1052542.33	%0019% TM Extend Sta.

DRAFT

05 OCTOBER 2015

Regraded Cross Sections

Original FEQ Cross Sections
FILE= XSections\EBEB01_EBEB23JULY2013.tab
(108 - 121)

FEQX
GISID= 0 01EBEB0112 ' 6 67.8 668.76 670.515 67 1.684 672.964 676.527 NGVD29
TABID= 1 12 EXTEND SAVE 22 OUT22 MO NOTONE NEWB ETAM
STATION= 6344.16
NAVM= (LEFT= 579 .5 RI GHT= -49.5 SCALE= 1.00 SHIFT= 0.00 1 2 3 4 5 6 7
NSUB 7 0.035 0.01 0 0.080 0.030 0. 080 0.070 0.010 0.035 0.01 0.08 0.03 0.08 0.07 0.01
X-Sect 921 from Lowe r Mai nstem Model LOWXSE22.F TL

-288.89	682.75	1	1874578.62	1053889.3	%0001% TM Extend Sta.
-259.97	673.99	1	1874591.79	1053863.55	%0002% TM Extend Sta.
-200.66	672.02	2	1874618.91	1053810.81	%0003% TM Insert Sta.
-95.48	670.93	2	1874667.01	1053717.27	%0004% TM Insert Sta.
-31.28	666.07	3	1874696.37	1053660.18	%0005%
-24.77	662.37	4	1874699.31	1053654.37	%0006%
-20.4	661.47	4	1874701.28	1053650.47	%0007%
-5.96	661.07	4	1874707.81	1053637.59	%0008%
0	660.67	4	1874710.5	1053632.27	%0009%
7.61	661.27	4	1874713.94	1053625.48	%0010%
11.4	662.17	5	1874715.65	1053622.1	%0011%
13.69	667.17	6	1874716.69	1053620.06	%0012%
163.92	667.45	6	1874785.18	1053486.35	%0013% TM Extend Sta.
291.88	668.32	7	1874849.25	1053375.58	%0014% TM Extend Sta.
305.1	668.58	7	1874855.84	1053364.12	%0015% TM Extend Sta.
514.59	667.4	7	1874953.53	1053178.81	%0016% TM Extend Sta.
691.56	671.5	7	1875039.69	1053024.23	%0017% TM Extend Sta.
879.98	680.79	-1	1875133.45	1052860.79	%0018% TM Extend Sta.

BASE MODEL
FEQ Section For HEC RAS imput
All Elevations are NGVD29

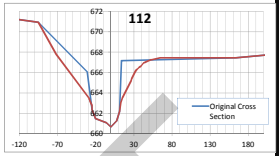
-288.89	682.75	0.035
-259.97	673.99	
-200.66	672.02	0.01
-95.48	670.93	
-31.28	666.07	0.08
-24.77	662.37	0.03
-20.4	661.47	
-5.96	661.07	
0	660.67	
7.61	661.27	
11.4	662.17	0.08
13.69	667.17	0.07
163.92	667.45	
291.88	668.32	0.01
305.1	668.58	
514.59	667.4	
691.56	671.5	
879.98	680.79	

PROJECT CROSS SECTIONS
(110 - 117)
All Elevations are NGVD29

-288.89	682.75	0.035
-259.97	673.99	
-200.66	672.02	0.01
-95.48	670.93	
-90.49	**670.271**	**0.07**
-89.76	**670.221**	
-71.92	**667.801**	
-28.75	**663.481**	
-28.72	**663.471**	
-28.68	**663.461**	
-28.58	**663.421**	
-28.51	**663.401**	
-28.23	**663.351**	
-28.08	**663.331**	
-27.96	**663.311**	
-27.77	**663.281**	
-27.7	**663.261**	
-27.62	**663.251**	
-26.49	**663.051**	
-26.46	**663.041**	
-26.46	**663.041**	
-26.43	**663.041**	
-26.4	**663.031**	
-24.86	**662.761**	
-24.77	662.37	0.04
-20.4	661.47	
-5.96	661.07	
0	660.67	
7.61	661.27	
11.4	662.17	0.08
12.73	**663.041**	**0.07**
13.24	**663.141**	
14.02	**663.321**	
14.48	**663.421**	
15.12	**663.511**	
26.18	**665.181**	
27.22	**665.391**	
31.73	**666.111**	
31.76	**666.111**	
31.94	**666.141**	
32.05	**666.141**	
33.66	**666.271**	
34.28	**666.321**	
34.66	**666.351**	
34.76	**666.361**	
35.37	**666.401**	
35.39	**666.401**	
35.46	**666.411**	
35.89	**666.441**	
36.12	**666.451**	
36.22	**666.461**	
36.37	**666.471**	
36.8	**666.491**	
39.39	**666.631**	
42.61	**666.931**	
42.81	**666.931**	
43.81	**666.971**	
46.54	**667.061**	
51.69	**667.241**	
52.43	**667.251**	
52.67	**667.251**	
53.7	**667.271**	
64.65	**667.431**	0.07
163.92	667.45	
291.88	668.32	0.01
305.1	668.58	
514.59	667.4	
691.56	671.5	
879.98	680.79	

Note: refer to spreadshet titled 'Morton_Existing and proposed cross sections for documentation of creating of the proposed sections based on Civil design

Adjusted based on average of XS 23+00 regrading



PROJECT CROSS SECTIONS
FOR FEQX INPUT
Inserted into: FILE=
XSections\EBEB01_EBEB23JULY2013_MortonModified.tab

01EBEB0112
1 2 3 4 5 6 7
0.035 0.010 **0.07** 0.040 0.080 **0.07** 0.070

-288.89	682.75	1	1874578.62	1053889.3	%0001% TM Extend Sta.
-259.97	673.99		1874591.79	1053863.55	%0002% TM Extend Sta.
-200.66	672.02	2	1874618.91	1053810.81	%0003% TM Insert Sta.
-95.48	670.93		1874667.01	1053717.27	%0004% TM Insert Sta.
-90.49	**670.27**	**3**			
-89.76	**670.22**				
-71.92	**667.80**				
-28.75	**663.48**				
-28.72	**663.47**				
-28.68	**663.46**				
-28.58	**663.42**				
-28.51	**663.40**				
-28.23	**663.35**				
-28.08	**663.33**				
-27.96	**663.31**				
-27.77	**663.28**				
-27.70	**663.26**				
-27.62	**663.25**				
-26.49	**663.05**				
-26.46	**663.04**				
-26.46	**663.04**				
-26.43	**663.04**				
-26.40	**663.03**				
-24.86	**662.76**				
-24.77	662.37	4	1874699.31	1053654.37	%0006%
-20.40	661.47		1874701.28	1053650.47	%0007%
-5.96	661.07		1874707.81	1053637.59	%0008%
0.00	660.67		1874710.5	1053632.27	%0009%
7.61	661.27		1874713.94	1053625.48	%0010%
11.40	662.17	5	1874715.65	1053622.1	%0011%
12.73	**663.04**	**6**			
13.24	**663.14**				
14.02	**663.32**				
14.48	**663.42**				
15.12	**663.51**				
26.18	**665.18**				
27.22	**665.39**				
31.73	**666.11**				
31.76	**666.11**				
31.94	**666.14**				
32.05	**666.14**				
33.66	**666.27**				
34.28	**666.32**				
34.66	**666.35**				
34.76	**666.36**				
35.37	**666.40**				
35.39	**666.40**				
35.46	**666.41**				
35.89	**666.44**				
36.12	**666.45**				
36.22	**666.46**				
36.37	**666.47**				
36.80	**666.49**				
39.39	**666.63**				
42.61	**666.93**				
42.81	**666.93**				
43.81	**666.97**				
46.54	**667.06**				
51.69	**667.24**				
52.43	**667.25**				
52.67	**667.25**				
53.70	**667.27**				
64.65	**667.43**	**7**			
163.92	667.45		1874785.18	1053486.35	%0013% TM Extend Sta.
291.88	668.32	8	1874849.25	1053375.58	%0014% TM Extend Sta.
305.10	668.58		1874855.84	1053364.12	%0015% TM Extend Sta.
514.59	667.40		1874953.53	1053178.81	%0016% TM Extend Sta.
691.56	671.50		1875039.69	1053024.23	%0017% TM Extend Sta.
879.98	680.79	-1	1875133.45	1052860.79	%0018% TM Extend Sta.

DRAFT

Regraded Cross Sections

05 OCTOBER 2015

Regraded Cross Sections	Original FEQ Cross Sections FILE= XSections\EBEB01_EBEB23JULY2013.tab (108 - 121)	BASE MODEL FEQ Section For HEC RAS imput All Elevations are NGVD29	PROJECT CROSS SECTIONS (110 - 117) All Elevations are NGVD29	Note: refer to spreadshet titled 'Morton_Existing and proposed cross sections for documentation of creating of the proposed sections based on Civil design	PROJECT CROSS SECTIONS FOR FEQX INPUT Inserted into: FILE= XSections\EBEB01_EBEB23JULY2013_MortonModified.tab

FEQX
GISID= 0 01EBEB0113 ' 6 68.795 669. 803 671.15 672.169 673.23 676.527 NGVD29
TABID= 1 13 EXTEND SAVE 22 OUT22 MO NOTONE NEWB ETAM
STATION= 7501.39
NAVM= （LEFT= 559 .5 RI GHT= -344.7 SCALE= 1.0 0 SHIFT= 0.00

	1	2	3	4	5	6
NSUB 6 0.12 0.08 0 0.030 0.080 0. 120 0.010	0.12	0.08	0.03	0.08	0.12	0.01

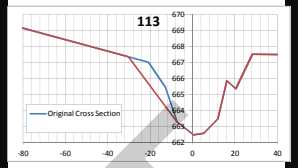
X-Sect 920 from Lowe r Mai nstem Model LOWXSE22.F TL

-671.33	679.14	1	1874852.01	1054740.38	%0001% TM Extend Sta.
-536.99	673.2	1	1874966.2	1054669.6	%0002% OVB 1
-355.56	670	1	1875133.8	1054600.13	%0003% OVB 2
-105.4	670.05	1	1875364.89	1054504.34	%0004% CLP 3
-20.89	667	2	1875442.96	1054471.98	%0005% TOB 4
-12.88	665.45	2	1875450.36	1054468.91	%0006% BIS 5
-7.19	663.25	3	1875455.62	1054466.73	%0007% CHP 6
0.4	662.45	3	1875462.63	1054463.83	%0008% CHL 7
5.21	662.55	3	1875467.07	1054461.99	%0009% CHP 8
11.9	663.45	3	1875473.25	1054459.42	%0010% CHP 9
16.2	665.85	3	1875477.23	1054457.78	%0011% CHP 10
20.34	665.35	4	1875481.05	1054456.19	%0012% BOB 11
28.18	667.5	5	1875488.29	1054453.19	%0013% TOB 12
282.13	667.11	5	1875722.9	1054355.98	%0014% CLP 13
619.5	670.1	5	1876034.54	1054226.77	%0015% BIS 14
804.12	683.9	5	1876205.09	1054156.07	%0016% TOS 15
1017.89	702.19	6	1876403.15	1054075.64	%0017% TM Insert Sta.
1278	716.43	6	1876644.15	1053977.77	%0018% TM Insert Sta.
1472.91	726.94	-1	1876824.73	1053904.43	%0019% TM Extend Sta.

-671.33	679.14	0.12
-536.99	673.2	
-355.56	670	
-105.4	670.05	
-20.89	667	0.08
-12.88	665.45	
-7.19	663.25	0.03
0.4	662.45	
5.21	662.55	
11.9	663.45	
16.2	665.85	
20.34	665.35	0.08
28.18	667.5	0.12
282.13	667.11	
619.5	670.1	
804.12	683.9	
1017.89	702.19	0.01
1278	716.43	
1472.91	726.94	

-671.33	679.14	0.12
-536.99	673.2	
-355.56	670	
-105.4	670.05	
-30.2	**667.35**	**0.07**
-7.19	663.25	0.03
0.4	662.45	
5.21	662.55	
11.9	663.45	
16.2	665.85	
20.34	665.35	0.08
28.18	667.5	0.12
282.13	667.11	
619.5	670.1	
804.12	683.9	
1017.89	702.19	0.01
1278	716.43	
1472.91	726.94	

Adjusted based on XS 11+00 regrading



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	1	2	3	4	5	6
	0.12	**0.07**	0.03	0.08	0.12	0.01

-671.33	679.14	1	1874852.01	1054740.38	%0001% TM Extend Sta.
-536.99	673.20		1874966.2	1054669.6	%0002% OVB 1
-355.56	670.00		1875133.8	1054600.13	%0003% OVB 2
-105.40	670.05		1875364.89	1054504.34	%0004% CLP 3
-30.2	**667.35**	**2**			
-7.19	663.25	3	1875455.62	1054466.73	%0007% CHP 6
0.40	662.45		1875462.63	1054463.83	%0008% CHL 7
5.21	662.55		1875467.07	1054461.99	%0009% CHP 8
11.90	663.45		1875473.25	1054459.42	%0010% CHP 9
16.20	665.85		1875477.23	1054457.78	%0011% CHP 10
20.34	665.35	4	1875481.05	1054456.19	%0012% BOB 11
28.18	667.50	5	1875488.29	1054453.19	%0013% TOB 12
282.13	667.11		1875722.9	1054355.98	%0014% CLP 13
619.50	670.10		1876034.54	1054226.77	%0015% BIS 14
804.12	683.90		1876205.09	1054156.07	%0016% TOS 15
1017.89	702.19	6	1876403.15	1054075.64	%0017% TM Insert Sta.
1278.00	716.43		1876644.15	1053977.77	%0018% TM Insert Sta.
1472.91	726.94	-1	1876824.73	1053904.43	%0019% TM Extend Sta.

FEQX
GISID= 0 01EBEB0114 ' 6 68.878 669. 842 671.15 672.169 673.23 676.527 NGVD29
TABID= 1 14 EXTEND SAVE 22 OUT22 MO NOTONE NEWB ETAM
STATION= 7529.28
NAVM= （LEFT= 611 .7 RI GHT= -365.3 SCALE= 1.0 0 SHIFT= 0.00

	1	2	3	4
NSUB 4 0.12 0.03 0 0.120 0.01	0.12	0.03	0.12	0.01

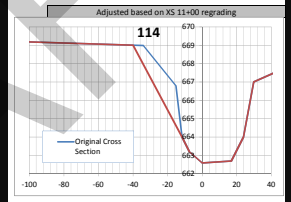
X-Sect 918 from Lowe r Mai nstem Model LOWXSE22.F TL

-695.2	679.3	1	1874846.95	1054780.93	%0001% TM Extend Sta.
-526.01	673.12	1	1874989.45	1054689.73	%0002% TM Extend Sta.
-461.08	671.01	1	1875050.25	1054666.93	%0003% TM Extend Sta.
-221.83	669.55	1	1875270.64	1054573.83	%0004% TM Extend Sta.
-34.01	668.99	1	1875443.89	1054501.31	%0005%
-15.21	666.79	1	1875461.32	1054494.27	%0006%
-11.71	663.99	2	1875464.57	1054492.95	%0007%
-7.35	663.19	2	1875468.61	1054491.32	%0008%
-0.01	662.59	2	1875475.42	1054488.57	%0009%
16.85	662.69	2	1875491.05	1054482.25	%0010%
23.92	663.99	3	1875497.6	1054479.61	%0011%
29.77	666.99	3	1875503.03	1054477.41	%0012%
46.34	667.69	3	1875518.39	1054471.21	%0013%
292.64	666.71	3	1875745.64	1054376.23	%0014% TM Extend Sta.
596.06	667.48	3	1876026.83	1054262.23	%0015% TM Extend Sta.
649.7	669.42	3	1876076.23	1054241.33	%0016% TM Extend Sta.
920.16	691.51	4	1876328.24	1054143.15	%0017% TM Insert Sta.
1207.13	712.8	4	1876595.64	1054038.98	%0018% TM Insert Sta.
1471.44	727.29	-1	1876841.92	1053943.04	%0019% TM Extend Sta.

-695.2	679.3	0.12
-526.01	673.12	
-461.08	671.01	
-221.83	669.55	
-34.01	668.99	
-15.21	666.79	
-11.71	663.99	0.03
-7.35	663.19	
-0.01	662.59	
16.85	662.69	
23.92	663.99	0.12
29.77	666.99	
46.34	667.69	
292.64	666.71	
596.06	667.48	
649.7	669.42	
920.16	691.51	0.01
1207.13	712.8	
1471.44	727.29	

-695.2	679.3	0.12
-526.01	673.12	
-461.08	671.01	
-221.83	669.55	
-40	**669**	**0.07**
-11.71	663.99	0.03
-7.35	663.19	
-0.01	662.59	
16.85	662.69	
23.92	663.99	0.12
29.77	666.99	
46.34	667.69	
292.64	666.71	
596.06	667.48	
649.7	669.42	
920.16	691.51	0.01
1207.13	712.8	
1471.44	727.29	

Adjusted based on XS 11+00 regrading



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	1	2	3	4	5
	0.120	**0.07**	0.030	0.120	0.010

-695.20	679.30	1	1874846.95	1054780.93	%0001% TM Extend Sta.
-526.01	673.12		1874989.45	1054689.73	%0002% TM Extend Sta.
-461.08	671.01		1875050.25	1054666.93	%0003% TM Extend Sta.
-221.83	669.55		1875270.64	1054573.83	%0004% TM Extend Sta.
-40.00	**669.00**	2			
-11.71	663.99	3	1875464.57	1054492.95	%0007%
-7.35	663.19		1875468.61	1054491.32	%0008%
-0.01	662.59		1875475.42	1054488.57	%0009%
16.85	662.69		1875491.05	1054482.25	%0010%
23.92	663.99	4	1875497.6	1054479.61	%0011%
29.77	666.99		1875503.03	1054477.41	%0012%
46.34	667.69		1875518.39	1054471.21	%0013%
292.64	666.71		1875745.64	1054376.23	%0014% TM Extend Sta.
596.06	667.48		1876026.83	1054262.23	%0015% TM Extend Sta.
649.70	669.42		1876076.23	1054241.33	%0016% TM Extend Sta.
920.16	691.51	5	1876328.24	1054143.15	%0017% TM Insert Sta.
1207.13	712.80		1876595.64	1054038.98	%0018% TM Insert Sta.
1471.44	727.29	-1	1876841.92	1053943.04	%0019% TM Extend Sta.

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05 OCTOBER 2015

Regraded Cross Sections	Original FEQ Cross Sections FILE= XSections\EBEB01_EBEB23JULY2013.tab (108 - 121)	BASE MODEL FEQ Section For HEC RAS imput All Elevations are NGVD29	PROJECT CROSS SECTIONS (110 - 117) All Elevations are NGVD29	Note: refer to spreadshet titled 'Morton_Existing and proposed cross sections for documentation of creating of the proposed sections based on Civil design	PROJECT CROSS SECTIONS FOR FEQX INPUT Inserted into: FILE= XSections\EBEB01_EBEB23JULY2013_MortonModified.tab

FEQX
GISID= 0 01EBEB0115 ' 6 69.469 670. 478 671.815 672.826 673.877 676.571 NGVD29
TABID= 1 15 EXTEND SAVE 22 OUT22 MO NOTONE NEWB ETAM
STATION= 7649.87
NAVM= (LEFT= 621 RIGH T= -347.2 S CALE= 1.00 SHIFT= 0.00 1 2 3 4
NSUB 4 0.12 0.03 0 0.120 0.01 0.12 0.03 0.12 0.01
X-Sect 918 from Lowe r Mai nstem Model LOWXSE22.F TL

-768.41	680.87	1	1874824.15	1054898.72	%0001% TM Extend Sta.	-768.41	680.87	0.12
-693.56	679.89	1	1874892.55	1054868.33	%0002% TM Extend Sta.	-693.56	679.89	
-453.57	671.67	1	1875112.94	1054773.33	%0003% TM Extend Sta.	-453.57	671.67	
-141.22	670.35	1	1875399.84	1054649.83	%0004% TM Extend Sta.	-141.22	670.35	
-50.89	667.84	1	1875483.44	1054615.63	%0005% TM Extend Sta.	-50.89	667.84	
-34.01	668.99	1	1875499.07	1054609.25	%0006%	-34.01	668.99	
-15.21	666.79	1	1875516.37	1054601.88	%0007%	-15.21	666.79	
-11.7	663.99	2	1875519.6	1054600.51	%0008%	-11.7	663.99	0.03
-7.35	663.19	2	1875523.6	1054598.8	%0009%	-7.35	663.19	
0	662.59	2	1875530.36	1054595.92	%0010%	0	662.59	
16.86	662.69	2	1875545.87	1054589.31	%0011%	16.86	662.69	
23.93	663.99	3	1875552.37	1054586.54	%0012%	23.93	663.99	0.12
29.78	666.99	3	1875557.76	1054584.25	%0013%	29.78	666.99	
46.34	667.69	3	1875572.99	1054577.75	%0014%	46.34	667.69	
130.49	667	3	1875650.64	1054545.33	%0015% TM Extend Sta.	130.49	667	
617.47	667.26	3	1876099.03	1054355.33	%0016% TM Extend Sta.	617.47	667.26	
871.72	684.07	4	1876333.21	1054256.32	%0017% TM Insert Sta.	871.72	684.07	0.01
1175.37	707.73	4	1876612.89	1054138.08	%0018% TM Insert Sta.	1175.37	707.73	
1485.92	727.02	-1	1876898.92	1054017.14	%0019% TM Extend Sta.	1485.92	727.02	

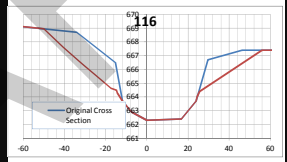
No Adjustment

GISID= 0 01EBEB0116 ' 6 69.469 670. 478 671.815 672.826 673.877 676.571 NGVD29
TABID= 1 16 EXTEND SAVE 22 OUT22 MO NOTONE NEWB ETAM
STATION= 7834.68
NAVM= (LEFT= 148 .4 RI GHT= -253.7 SCALE= 1.0 0 SHIFT= 0.00 1 2 3 4
NSUB 4 0.12 0.03 0 0.120 0.01 0.12 0.03 0.12 0.01
X-Sect 918 from Lowe r Mai nstem Model LOWXSE22.F TL

-792.23	679	1	1874902.05	1055077.32	%0001% TM Extend Sta.	-792.23	679	0.12
-636.95	677.03	1	1875045.06	1055016.82	%0002% TM Extend Sta.	-636.95	677.03	
-529.38	673.16	1	1875143.06	1054972.45	%0003% TM Extend Sta.	-529.38	673.16	
-286.38	670.66	1	1875364.42	1054872.21	%0004% TM Extend Sta.	-286.38	670.66	
-150.26	670.5	1	1875488.42	1054816.06	%0005% TM Extend Sta.	-150.26	670.5	
-34.01	668.7	1	1875594.32	1054768.11	%0006%	-34.01	668.7	
-15.21	666.5	1	1875611.44	1054760.35	%0007%	-15.21	666.5	
-11.7	663.7	2	1875614.64	1054758.91	%0008%	-11.7	663.7	0.03
-7.35	662.9	2	1875618.6	1054757.11	%0009%	-7.35	662.9	
0	662.3	2	1875625.3	1054754.08	%0010%	0	662.3	
16.86	662.4	2	1875640.66	1054747.13	%0011%	16.86	662.4	
23.92	663.7	3	1875647.09	1054744.21	%0012%	23.92	663.7	0.12
29.78	666.7	3	1875652.43	1054741.81	%0013%	29.78	666.7	
46.34	667.4	3	1875667.51	1054734.97	%0014%	46.34	667.4	
142.4	667.4	3	1875755.02	1054695.34	%0015% TM Extend Sta.	142.4	667.4	
245.26	675.1	3	1875848.72	1054652.91	%0016% TM Extend Sta.	245.26	675.1	
533.56	675.5	3	1876111.35	1054533.99	%0017% TM Extend Sta.	533.56	675.5	
695.93	678.8	3	1876259.27	1054467.02	%0018% TM Extend Sta.	695.93	678.8	
931.84	683.62	4	1876475.07	1054371.72	%0019% TM Insert Sta.	931.84	683.62	0.01
1191.19	705.69	4	1876712.31	1054266.94	%0020% TM Insert Sta.	1191.19	705.69	
1480.34	726.48	-1	1876976.82	1054150.13	%0021% TM Extend Sta.	1480.34	726.48	

-792.23	679	0.12
-636.95	677.03	
-529.38	673.16	
-286.38	670.66	
-150.26	670.5	
-50	**668.95**	**0.07**
-40.53	**667.6**	
-31.46	**666.41**	
-29.51	**666.16**	
-24.63	**665.56**	
-17.35	**664.64**	
-14.65	**664.5**	
-14.24	**664.28**	
-11.7	663.7	0.04
-7.35	662.9	
0	662.3	
16.86	662.4	
23.92	663.7	0.12
24.5	**664**	**0.07**
25.67	**664.4**	
56	**667.4**	
142.4	667.4	
245.26	675.1	
533.56	675.5	
695.93	678.8	
931.84	683.62	0.01
1191.19	705.69	
1480.34	726.48	

Adjusted based on XS 8+00 regrading



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1	2	3	4	5	6
0.120	**0.07**	0.040	0.120	**0.07**	0.010

-792.23	679.00	1	1874902.05	1055077.32	%0001% TM Extend Sta.
-636.95	677.03		1875045.06	1055016.82	%0002% TM Extend Sta.
-529.38	673.16		1875143.06	1054972.45	%0003% TM Extend Sta.
-286.38	670.66		1875364.42	1054872.21	%0004% TM Extend Sta.
-150.26	670.50		1875488.42	1054816.06	%0005% TM Extend Sta.
-50.00	**668.95**	**2**			
-40.53	**667.6**				
-31.46	**666.41**				
-29.51	**666.16**				
-24.63	**665.56**				
-17.35	**664.64**				
-14.65	**664.5**				
-14.24	**664.28**				
-11.70	663.70	3	1875614.64	1054758.91	%0008%
-7.35	662.90		1875618.6	1054757.11	%0009%
0.00	662.30		1875625.3	1054754.08	%0010%
16.86	662.40		1875640.66	1054747.13	%0011%
23.92	663.70	4	1875647.09	1054744.21	%0012%
24.50	**664**	**5**			
25.67	**664.4**				
56.00	**667.4**				
142.40	667.40		1875755.02	1054695.34	%0015% TM Extend Sta.
245.26	675.10		1875848.72	1054652.91	%0016% TM Extend Sta.
533.56	675.50		1876111.35	1054533.99	%0017% TM Extend Sta.
695.93	678.80		1876259.27	1054467.02	%0018% TM Extend Sta.
931.84	683.62	6	1876475.07	1054371.72	%0019% TM Insert Sta.
1191.19	705.69		1876712.31	1054266.94	%0020% TM Insert Sta.
1480.34	726.48	-1	1876976.82	1054150.13	%0021% TM Extend Sta.

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Regraded Cross Sections

05 OCTOBER 2015

Regraded Cross Sections

Original FEQ Cross Sections
FILE= XSections\EBEB01_EBEB23JULY2013.tab
(108 - 121)

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FEQX
GISID=  0 01EBEB0117     ' 6          69.877 670.      589 671.815        672.826 673.877 676.571 NGVD29
TABID=  1 17 EXTEND      SAVE         22 OUT22 MO      NOTONE NEWB        ETAM
STATION=          8497.68
NAVM=  (LEFT= 352        .3 RI        GHT= -635.2      SCALE= 1.0         0 SHIFT= 0.00                    1      2      3      4      5      6      7
NSUB  7          0.001        0.1 0  0.080             0.050  0.          080  0.100  0.010              0.001  0.1    0.08   0.05   0.08   0.1    0.01
X-Sect 917 from Lowe        r Mai        nstem Model      LOWXSE22.F         TL
  -680.79     680.02    1   1875371.25    1054927.16 %0001% FRICTIONLESS WALL
  -680.68     670.18    2   1875371.34    1054927.22 %0002% TM Extend Sta.
   -491.9     669.4     2   1875525.65    1055035.98 %0003% BIS 2
  -304.02     668.6     2    1875689.5    1055127.92 %0004% OVB 3
   -71.54     669.6     2   1875892.24    1055241.68 %0005% OVB 4
   -32.28     668.2     3   1875926.49    1055260.88 %0006% TOB 5
   -21.32     667       3   1875936.05    1055266.24 %0007% BIS 6
   -16.49     664.2     4   1875940.26     1055268.6 %0008% BOB 7
   -11.44     663.1     4   1875944.66    1055271.07 %0009% CHP 8
    -0.21     662.9     4   1875954.46    1055276.57 %0010% CFL 9
    11.95     663.1     4   1875965.06    1055282.52 %0011% CHP 10
    16.92     664       5    1875969.4    1055284.95 %0012% BOB 11
    20.33     667.1     5   1875972.37    1055286.62 %0013% BIS 12
     31.6     668.5     6    1875982.2    1055292.13 %0014% TOB 13
   166.29     667.8     6   1876099.66    1055358.04 %0015% BIS 14
   314.69     668.1     6   1876229.07    1055430.67 %0016% BIS 15
   487.41     672.7     7   1876379.72    1055515.16 %0017% TOS 16
   520.55     672.96   -1   1876403.19    1055538.55 %0018% TM Extend Sta.
```

BASE MODEL
FEQ Section For HEC RAS imput
All Elevations are NGVD29

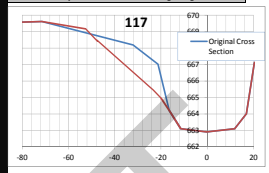
-680.79	680.02	0.001
-680.68	670.18	0.1
-491.9	669.4	
-304.02	668.6	
-71.54	669.6	
-32.28	668.2	0.08
-21.32	667	
-16.49	664.2	0.05
-11.44	663.1	
-0.21	662.9	
11.95	663.1	
16.92	664	0.08
20.33	667.1	
31.6	668.5	0.1
166.29	667.8	
314.69	668.1	
487.41	672.7	0.01
520.55	672.96	

PROJECT CROSS SECTIONS
(110 - 117)
All Elevations are NGVD29

-680.79	680.02	0.001
-680.68	670.18	0.1
-491.9	669.4	
-304.02	668.6	
-71.54	669.6	
-52.6	**669.171**	**0.07**
-47.52	**668.431**	
-47.51	**668.471**	
-26.95	**665.901**	
-25.54	**665.731**	
-23.38	**665.441**	
-20	**664.971**	
-16.49	664.2	0.05
-11.44	663.1	
-0.21	662.9	
11.95	663.1	
16.92	664	0.08
20.33	667.1	
31.6	668.5	0.1
166.29	667.8	
314.69	668.1	
487.41	672.7	0.01
520.55	672.96	

Note: refer to spreadshet titled 'Morton_Existing and proposed cross sections for documentation of creating of the proposed sections based on Civil design

Adjusted based on XS 2+00 regrading



NOTE: CHANNEL MANNING'S MAINTAINED AT .05
RATHER THAN SET TO 0.04 BECAUSE INSTREAM
MEASURES WILL NOT LOWER CHANNEL MANNING'S
#

PROJECT CROSS SECTIONS
FOR FEQX INPUT
Inserted into: FILE=
XSections\EBEB01_EBEB23JULY2013_MortonModified.tab

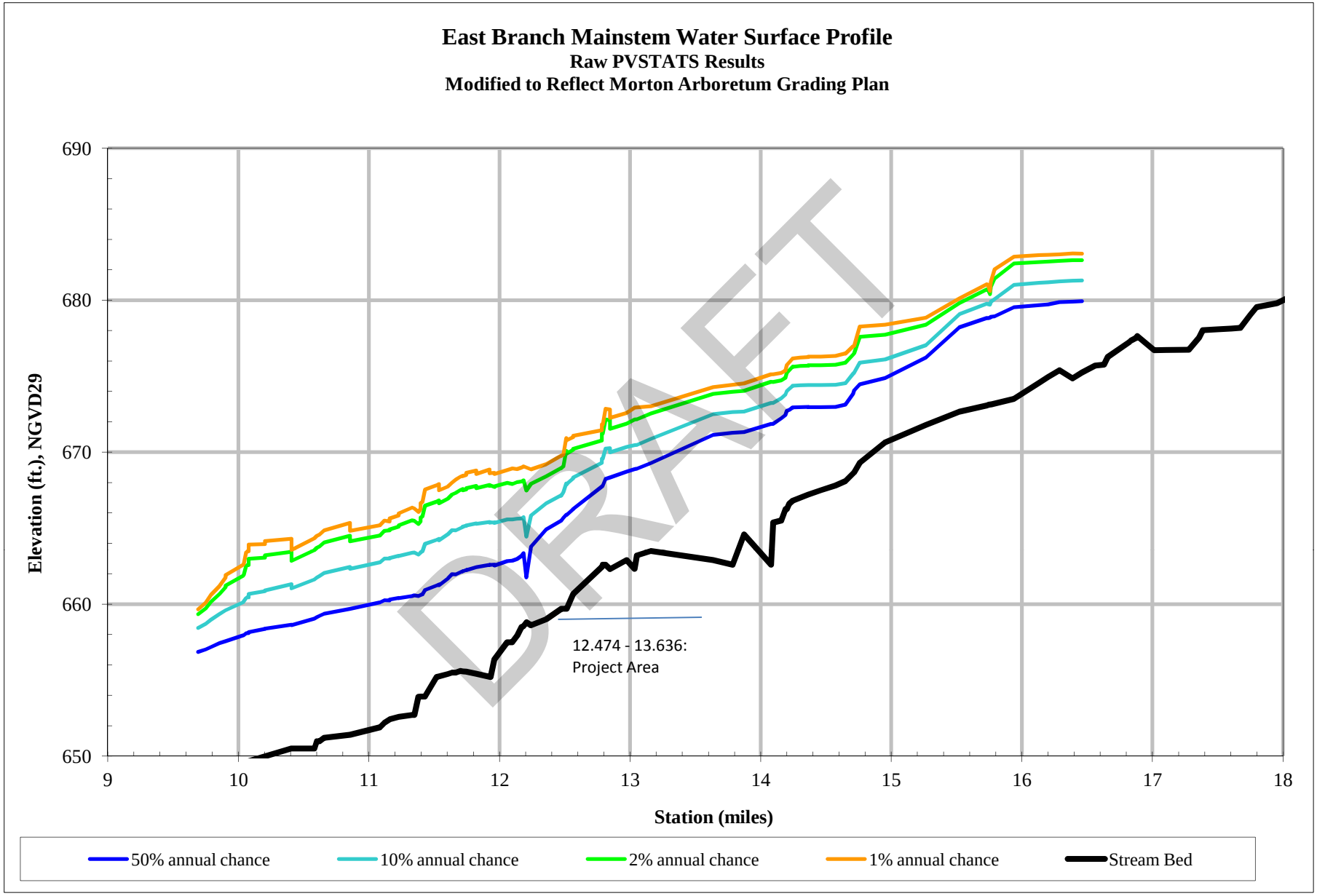
01EBEB0117

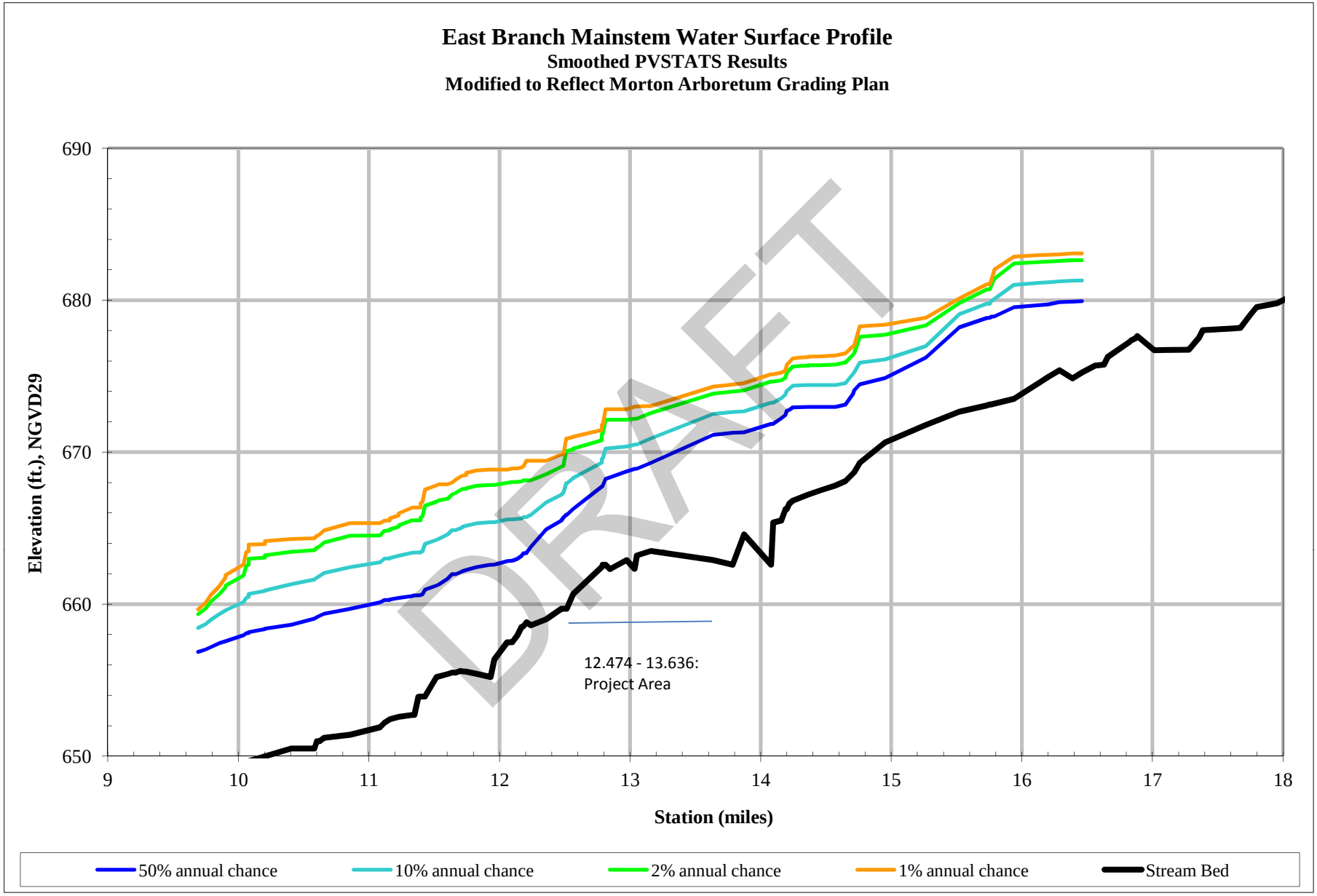
1	2	3	4	5	6	7
0.001	0.100	**0.07**	0.050	0.080	0.100	0.010

-680.79	680.02	1	1875371.25	1054927.16	%0001% FRICTIONLESS WALL
-680.68	670.18	2	1875371.34	1054927.22	%0002% TM Extend Sta.
-491.90	669.40		1875525.65	1055035.98	%0003% BIS 2
-304.02	668.60		1875689.5	1055127.92	%0004% OVB 3
-71.54	669.60		1875892.24	1055241.68	%0005% OVB 4
-52.60	**669.17**	**3**			
-47.52	**668.43**				
-47.51	**668.47**				
-26.95	**665.90**				
-25.54	**665.73**				
-23.38	**665.44**				
-20.00	**664.97**				
-16.49	664.20	4	1875969.4	1055284.95	%0012% BOB 11
-11.44	663.10		1875972.37	1055286.62	%0013% BIS 12
-0.21	662.90		1875982.2	1055292.13	%0014% TOB 13
11.95	663.10		1876099.66	1055358.04	%0015% BIS 14
16.92	664.00	5	1876229.07	1055430.67	%0016% BIS 15
20.33	667.10		1876379.72	1055515.16	%0017% TOS 16
31.60	668.50	6	1876403.19	1055538.55	%0018% TM Extend Sta.
166.29	667.80		0	0	0
314.69	668.10		0	0	0
487.41	672.70	7	0	0	0
520.55	672.96	-1	0	0	0

DRAFT

05 OCTOBER 2015




East Branch Mainstem Water Surface Profile
Smoothed PVSTATS Results
Modified to Reflect Morton Arboretum Grading Plan
690
680
670
660
650
Elevation (ft.), NGVD29
9
10
11
12
13
14
15
16
17
18
Station (miles)
12.474 - 13.636:
Project Area
DRAFT
50% annual chance
10% annual chance
2% annual chance
1% annual chance
Stream Bed

05 OCTOBER 2015

East Branch Mainstem (East Branch DuPage River Watershed)

Composite Summary of Flood Frequency on Peak Elevation (PVSTATSs - Original Versio

				Original - Base Model							Modified Based on Morton Grading Plan							Differrence between Base and Modified Model						
				50%	20%	10%	4%	2%	1.33%	1%	50%	20%	10%	4%	2%	1.33%	1%	50%	20%	10%	4%	2%	1.33%	1%
GISID	Branch	Reach	RM	(2-yr)	(5-yr)	(10-yr)	(25-yr)	(50-yr)	(75-yr)	(100-yr)	(2-yr)	(5-yr)	(10-yr)	(25-yr)	(50-yr)	(75-yr)	(100-yr)	(2-yr)	(5-yr)	(10-yr)	(25-yr)	(50-yr)	(75-yr)	(100-yr)
001EBEB0154	138	EB1	16.460	679.926	680.606	681.287	682.121	682.630	682.892	683.068	679.926	680.606	681.288	682.123	682.630	682.892	683.067	0.000	0.000	0.001	0.002	0.000	0.000	-0.001
001EBEB0153	138	EB1	16.389	679.904	680.589	681.275	682.118	682.630	682.892	683.068	679.904	680.589	681.275	682.119	682.630	682.892	683.067	0.000	0.000	0.000	0.001	0.000	0.000	-0.001
001EBEB0152	138	EB1	16.288	679.869	680.548	681.237	682.073	682.582	682.843	683.017	679.867	680.547	681.231	682.069	682.579	682.840	683.015	-0.002	-0.001	-0.006	-0.004	-0.003	-0.003	-0.002
001EBEB0151	138	EB1	16.200	679.710	680.454	681.166	682.021	682.536	682.799	682.974	679.710	680.453	681.165	682.020	682.535	682.798	682.974	0.000	-0.001	-0.001	-0.001	-0.001	-0.001	0.000
001EBEB0150	138	EB1	16.134	679.674	680.435	681.141	681.991	682.512	682.781	682.962	679.674	680.435	681.141	681.991	682.513	682.781	682.963	0.000	0.000	0.000	0.000	0.001	0.000	0.001
001EBEB0149	138	EB1	15.939	679.525	680.266	681.004	681.888	682.418	682.685	682.862	679.525	680.266	681.003	681.887	682.418	682.684	682.861	0.000	0.000	-0.001	-0.001	0.000	-0.001	-0.001
001EBEB0149	136	EB1	15.939	679.525	680.266	681.004	681.888	682.418	682.685	682.862	679.525	680.266	681.003	681.887	682.418	682.684	682.861	0.000	0.000	-0.001	-0.001	0.000	-0.001	-0.001
001EBEB0148	136	EB1	15.792	678.942	679.542	680.076	680.832	681.422	681.773	682.026	678.942	679.542	680.076	680.831	681.421	681.772	682.025	0.000	0.000	0.000	-0.001	-0.001	-0.001	-0.001
001EBEB0147	136	EB1	15.763	678.908	679.422	679.893	680.478	680.866	681.076	681.220	678.908	679.422	679.893	680.477	680.864	681.073	681.216	0.000	0.000	0.000	-0.001	-0.002	-0.003	-0.004
001EBEB0146	134	EB1	15.756	678.844	679.312	679.767	680.339	680.716	680.918	681.055	678.844	679.311	679.768	680.340	680.716	680.915	681.050	0.000	-0.001	0.001	0.001	0.000	-0.003	-0.005
001EBEB0145	134	EB1	15.742	678.824	679.312	679.767	680.339	680.716	680.918	681.055	678.826	679.311	679.768	680.340	680.716	680.915	681.050	0.002	-0.001	0.001	0.001	0.000	-0.003	-0.005
001EBEB0145	132	EB1	15.742	678.824	679.312	679.767	680.339	680.716	680.918	681.055	678.826	679.311	679.768	680.340	680.716	680.915	681.050	0.002	-0.001	0.001	0.001	0.000	-0.003	-0.005
001EBEB0144	132	EB1	15.733	678.824	679.312	679.767	680.339	680.716	680.918	681.055	678.826	679.311	679.768	680.340	680.716	680.915	681.050	0.002	-0.001	0.001	0.001	0.000	-0.003	-0.005
001EBEB0143	132	EB1	15.522	678.216	678.711	679.069	679.499	679.811	679.992	680.120	678.216	678.710	679.068	679.497	679.805	679.983	680.109	0.000	-0.001	-0.001	-0.002	-0.006	-0.009	-0.011
001EBEB0142	132	EB1	15.265	676.220	676.513	677.027	677.823	678.381	678.679	678.882	676.221	676.510	677.031	677.839	678.386	678.663	678.849	0.001	-0.003	0.004	0.016	0.005	-0.016	-0.033
001EBEB0141	132	EB1	14.953	674.878	675.467	676.099	677.038	677.730	678.115	678.385	674.877	675.467	676.098	677.035	677.728	678.114	678.384	-0.001	0.000	-0.001	-0.003	-0.002	-0.001	-0.001
001EBEB0140	132	EB1	14.759	674.463	675.200	675.891	676.872	677.592	677.991	678.268	674.464	675.200	675.891	676.870	677.590	677.989	678.267	0.001	0.000	0.000	-0.002	-0.002	-0.002	-0.001
001EBEB0139	130	EB1	14.716	674.065	674.691	675.234	675.973	676.500	676.788	676.987	674.065	674.691	675.233	675.969	676.496	676.785	676.984	0.000	0.000	-0.001	-0.004	-0.004	-0.003	-0.003
001EBEB0138	130	EB1	14.707	673.819	674.594	675.148	675.868	676.407	676.726	676.955	673.819	674.594	675.148	675.866	676.405	676.724	676.953	0.000	0.000	0.000	-0.002	-0.002	-0.002	-0.002
001EBEB0137	130	EB1	14.649	673.125	673.957	674.536	675.305	675.894	676.245	676.499	673.125	673.957	674.533	675.301	675.888	676.240	676.494	0.000	0.000	-0.003	-0.004	-0.006	-0.005	-0.005
001EBEB0137	128	EB1	14.649	673.125	673.957	674.536	675.305	675.894	676.245	676.499	673.125	673.957	674.533	675.301	675.888	676.240	676.494	0.000	0.000	-0.003	-0.004	-0.006	-0.005	-0.005
001EBEB0136	128	EB1	14.573	672.974	673.844	674.412	675.171	675.758	676.108	676.361	672.975	673.850	674.425	675.177	675.747	676.085	676.328	0.001	0.006	0.013	0.006	-0.011	-0.023	-0.033
001EBEB0136	126	EB1	14.573	672.974	673.844	674.412	675.170	675.757	676.107	676.360	672.975	673.850	674.425	675.177	675.747	676.085	676.328	0.001	0.006	0.013	0.007	-0.010	-0.022	-0.032
001EBEB0135	126	EB1	14.461	672.974	673.844	674.412	675.161	675.723	676.056	676.295	672.975	673.843	674.410	675.155	675.717	676.050	676.289	0.001	-0.001	-0.002	-0.006	-0.006	-0.006	-0.006
001EBEB0134	126	EB1	14.364	672.974	673.844	674.412	675.159	675.718	676.048	676.285	672.975	673.843	674.410	675.154	675.712	676.043	676.280	0.001	-0.001	-0.002	-0.005	-0.006	-0.005	-0.005
001EBEB0134	124	EB1	14.364	672.974	673.844	674.412	675.143	675.694	676.021	676.256	672.975	673.843	674.409	675.138	675.687	676.014	676.249	0.001	-0.001	-0.003	-0.005	-0.007	-0.007	-0.007
001EBEB0133	124	EB1	14.304	672.963	673.832	674.398	675.126	675.673	675.997	676.230	672.964	673.832	674.396	675.122	675.668	675.991	676.224	0.001	0.000	-0.002	-0.004	-0.005	-0.006	-0.006
001EBEB0132	124	EB1	14.245	672.942	673.807	674.365	675.089	675.626	675.941	676.166	672.942	673.806	674.363	675.083	675.620	675.934	676.159	0.000	-0.001	-0.002	-0.006	-0.006	-0.007	-0.007
001EBEB0132	122	EB1	14.245	672.926	673.798	674.362	675.089	675.626	675.941	676.166	672.926	673.798	674.360	675.083	675.620	675.934	676.159	0.000	0.000	-0.002	-0.006	-0.006	-0.007	-0.007
001EBEB0131	122	EB1	14.219	672.780	673.624	674.173	674.883	675.406	675.712	675.930	672.779	673.624	674.170	674.876	675.398	675.704	675.922	-0.001	0.000	-0.003	-0.007	-0.008	-0.008	-0.008
001EBEB0130	122	EB1	14.201	672.717	673.505	674.023	674.714	675.226	675.525	675.739	672.717	673.504	674.020	674.708	675.220	675.519	675.733	0.000	-0.001	-0.003	-0.006	-0.006	-0.006	-0.006
001EBEB0129	120	EB1	14.190	672.440	673.271	673.783	674.424	674.895	675.170	675.365	672.440	673.269	673.778	674.416	674.886	675.161	675.357	0.000	-0.002	-0.005	-0.008	-0.009	-0.009	-0.008
001EBEB0128	120	EB1	14.158	672.228	673.017	673.541	674.228	674.730	675.022	675.231	672.229	673.014	673.534	674.216	674.718	675.010	675.218	0.001	-0.003	-0.007	-0.012	-0.012	-0.012	-0.013
001EBEB0127	120	EB1	14.095	671.854	672.633	673.248	674.081	674.641	674.930	675.122	671.854	672.630	673.241	674.065	674.627	674.920	675.114	0.000	-0.003	-0.007	-0.016	-0.014	-0.010	-0.008
001EBEB0124	116	EB1	14.079	671.854	672.633	673.248	674.081	674.641	674.930	675.122	671.854	672.630	673.241	674.065	674.627	674.920	675.114	0.000	-0.003	-0.007	-0.016	-0.014	-0.010	-0.008
001EBEB0123	116	EB1	13.872	671.317	672.083	672.684	673.511	674.063	674.349	674.540	671.314	672.077	672.671	673.481	674.035	674.324	674.519	-0.003	-0.006	-0.013	-0.030	-0.028	-0.025	-0.021
001EBEB0122	116	EB1	13.785	671.280	672.053	672.643	673.458	673.996	674.268	674.447	671.279	672.046	672.629	673.426	673.964	674.241	674.424	-0.001	-0.007	-0.014	-0.032	-0.032	-0.027	-0.023
001EBEB0121	116	EB1	13.636	671.134	671.925	672.514	673.330	673.863	674.131	674.307	671.131	671.915	672.499	673.295	673.829	674.103	674.283	-0.003	-0.010	-0.015	-0.035	-0.034	-0.028	-0.024
001EBEB0120	116	EB1	13.160	669.324	670.218	670.946	671.987	672.601	672.881	673.178	669.279	670.157	670.874	671.913	672.547	672.841	673.026	-0.045	-0.061	-0.072	-0.074	-0.054	-0.040	-0.152
001EBEB0119	114	EB1	13.053	668.964	669.887	670.567	671.550	672.365	672.825	673.178	668.909	669.814	670.476	671.408	672.158	672.616	672.950	-0.055	-0.073	-0.091	-0.142	-0.207	-0.209	-0.228
001EBEB0118	114	EB1	13.035	668.945	669.872	670.556	671.550	672.365	672.818	673.155	668.888	669.794	670.457	671.397	672.148	672.602	672.934	-0.057	-0.078	-0.099	-0.153	-0.217	-0.216	-0.221
001EBEB0117	112	EB1	12.973	668.785	669.768	670.443	671.550	672.365	672.818	673.133	668.717	669.678	670.336	671.397	672.148	672.561	672.850	-0.068	-0.090	-0.107	-0.153	-0.217	-0.257	-0.283
001EBEB0116	112	EB1	12.847	668.268	669.332	670.287	671.550	672.365	672.818	673.133	668.326	669.366	670.257	671.397	672.148	672.561	672.850	0.058	0.034	-0.030	-0.153	-0.217	-0.257	-0.283
001EBEB0116	110	EB1	12.847	668.268	669.332	670.287	671.550	672.365	672.818	673.133	668.326	669.366	670.257	671.397	672.148	672.561	672.850	0.058	0.034	-0.030	-0.153	-0.217	-0.257	-0.283
001EBEB0115	110	EB1	12.812	668.200	669.291	670.260	671.540	672.365	672.818	673.133	668.231	669.310	670.224	671.397	672.148	672.561	672.850	0.031	0.019	-0.036	-0.143	-0.217	-0.257	-0.283
001EBEB0114	108	EB1	12.790	667.747	668.700	669.602	670.764	671.511	671.918	672.201	667.795	668.734	669.568	670.589	671.226	671.578	671.826	0.048	0.034	-0.034	-0.175	-0.285	-0.340	-0.375
001EBEB0113	108	EB1	12.784	667.660	668.663	669.581	670.764	671.511	671.918	672.201	667.733	668.702	669.549	670.584	671.226	671.578	671.826	0.073	0.039	-0.032	-0.180	-0.285	-0.340	-0.375
001EBEB0113	106	EB1	12.784	667.654	668.619	669.282	670.174	670.877	671.305	671.616	667.733	668.665	669.301	670.126	670.770	671.161	671.446	0.079	0.046	0.019	-0.048	-0.107	-0.144	-0.170
001EBEB0112	106	EB1	12.565	666.199	667.336	668.286	669.629	670.625	671.130	671.467	666.258	667.486	668.324	669.399	670.219	670.713	671.072	0.059	0.150	0.038	-0.230	-0.406	-0.417	-0.395
001EBEB0112	104	EB1	12.565	666.148	667.235	668.207	669.629	670.625	671.130	671.467	666.252	667.432	668.269	669.348	670.153	670.635	670.984	0.104	0.197	0.062	-0.281	-0.472	-0.495	-0.483
001EBEB0111	104	EB1	12.516	665.818	666.896	668.005	669.629	670.625	671.130	671.467	665.881	667.047	667.932	669.216	670.083	670.572	670.922	0.063	0.151	-0.073	-0.413	-0.542	-0.558	-0.545
001EBEB0111	102	EB1	12.516	665.818	666.896	668.005	669.629	670.625	671.130	671.467	665.881	666.977	667.932	669.216	670.083	670.572	670.922	0.063	0.081	-0.073	-0.413	-0.542	-0.558	-0.545
001EBEB0110	102	EB1	12.510	665.818	666.896	668.005	669.629	670.625	671.130	671.467	665.873	666.977	667.932	669.216	670.083	670.572	670.922	0.055	0.081	-0.073	-0.413	-0.542	-0.558	-0.545
001EBEB0109	100	EB1	12.490	665.687	666.615	667.471	668.872	669.719	670.215	670.556	665.680	666.667	667.368	668.329	669.066	669.511	669.836	-0.007	0.052	-0.103	-0.543	-0.653	-0.704	-0.720
001EBEB0108	100	EB1	12.474	665.513	666.486	667.330	668.783	669.719	670.215	670.556	665.499	666.465	667.166	668.178	668.956	669.424	669.764	-0.014	-0.021	-0.164	-0.605	-0.763	-0.791	-0.792
001EBEB0108	98	EB1	12.474	665.488	666.486	667.302	668.503	669.414	669.959	670.354	665.499	666.465	667.166	668.178	668.956	669.424	669.764	0.011	-0.021	-0.136	-0.325	-0.458	-0.535	-0.590
001EBEB0107	98	EB1	12.358	664.925	665.845	666.731	668.125	669.158	669.735	670.135	664.914	665.917	666.625	667.625	668.399	668.864	669.202	-0.011	0.072	-0.106	-0.500	-0.759	-0.871	-0.933
001EBEB0106	98	EB1	12.241	663.794	664.950	666.053	667.680	668.896	669.498	669.940	663.783	664.972	665.824	667.142	668.143	668.685	669.059	-0.011	0.022	-0.229	-0.538	-0.753	-0.813	-0.881
001EBEB0105	98	EB1	12.206	663.373	664.724	665.755	667.104	668.896	669.498	669.940	663.356	664.665	665.722	667.142	668.143	668.685	669.059	-0.017	-0.059	-0.033	0.038	-0.753	-0.813	-0.881
001EBEB0104	96	EB1	12.184	663.373	664.724	665.755	667.104	668.100	668.694	669.124	663.356	664.665	665.722	667.142	668.143	668.685	669.059	-0.017	-0.059	-0.033	0.038	0.043	-0.009	-0.065
001EBEB0103	96	EB1	12.170	663.202	664.601	665.661	667.028	668.031	668.627	669.057	663.185	664.544	665.631	667.072	668.074	668.615	668.988	-0.017	-0.057	-0.030	0.044	0.043	-0.012	-0.069
001EBEB0102	96	EB1	12.135	662.985	664.518	665.635	667.013	667.983	668.542	668.940	662.958	664.460	665.613	667.050	668.017	668.566	668.924	-0.027	-0.058	-0.022	0.037	0.034	0.024	-0.016
	96	EB1	12.098	662.884	664.471	665.626	667.013	667.983	668.542	668.940	662.864	664.390	665.573	667.050	667.972	668.566	668.924	-0.020	-0.081	-0.053	0.037	-0.011	0.024	-0.016
	94	EB1	12.059	662.860	664.438	665.592	666.974	667.939	668.497	668.892	662.823	664.380	665.567	667.014	667.972	668.477	668.850	-0.037	-0.058	-0.025	0.040	0.033	-0.020	-0.042
001EBEB0100	94	EB1	11.961	662.605	664.178	665.387	666.827	667.827	668.420	668.842	662.602	664.184	665.397	666.849	667.837	668.429	668.850	-0.003	0.006	0.010	0.022	0.010	0.009	0.008
	92	EB1	11.961	662.605	664.178	665.387	666.827	667.827	668.420	668.842	662.602	664.184	665.397	666.849	667.837	668.429	668.850	-0.003	0.006	0.010	0.022	0.010	0.009	0.008
001EBEB0099	92	EB1	11.932	662.591	664.178	665.387	666.827	667.827	668.420	668.842	662.582	664.184	665.397	666.849	667.837	668.429	668.850	-0.009	0.006	0.010	0.022	0.010	0.009	0.008
001EBEB0099	90	EB1	11.932	662.591	664.178	665.387	666.826	667.827	668.420	668.842	662.582	664.184	665.397	666.849	667.837	668.429	668.850	-0.009	0.006	0.010	0.023	0.010	0.009	0.008
001EBEB0098	90	EB1	11.923	662.587	664.178	665.387	666.812	667.827	668.420	668.842	662.582	664.184	665.397	666.824	667.837	668.429	668.850	-0.005	0.006	0.010	0.012	0.010	0.009	0.008
001EBEB0098	88	EB1	11.923	662.587	664.178	665.387	666.812	667.827	668.420	668.842	662.582	664.184	665.397	666.823	667.837	668.429	668.850	-0.005	0.006	0.010	0.011	0.010	0.009	0.008
001EBEB0097	88	EB1	11.822	662.426	664.068	665.305	666.742	667.765	668.360	668.782	662.433	664.074	665.317	666.755	667.778	668.373	668.794	0.007	0.006	0.012	0.013	0.013	0.013	0.012
001EBEB0097	86	EB1	11.822	662.426	664.068	665.305	666.742	667.765	668.360	668.782	662.433	664.074	665.317	666.755	667.778	668.373	668.794	0.007	0.006	0.012	0.013	0.013	0.013	0.012

Summary of XS Modifications	
EB121	(modified n)
EB120	(modified n)
EB119	(modified n)
EB118	(modified n)
EB117	regrading and modified n
EB116A	regrading and modified n
EB116B	regrading and modified n
EB115	(modified n)
EB114	Cross section regrading
EB113A	Cross section regrading
EB113B	Cross section regrading
EB112A	regrading and modified n
EB112B	regrading and modified n
EB111A	Cross section regrading
EB111B	Cross section regrading
EB110	Cross section regrading
EB109	NO CHANGE
EB108A	(modified n)
EB108B	(modified n)

001EBEB0096	86	EB1	11.745	662.242	663.902	665.161	666.602	667.618	668.204	668.619	662.238	663.908	665.172	666.614	667.630	668.215	668.629	-0.004	0.006	0.011	0.012	0.012	0.011	0.010
001EBEB0096	84	EB1	11.745	662.242	663.901	665.152	666.575	667.562	668.089	668.480	662.238	663.901	665.156	666.593	667.578	668.103	668.492	-0.004	0.000	0.004	0.018	0.016	0.014	0.012
001EBEB0095	84	EB1	11.719	662.181	663.828	665.068	666.575	667.562	668.088	668.447	662.173	663.832	665.095	666.593	667.578	668.103	668.458	-0.008	0.004	0.027	0.018	0.016	0.015	0.011
001EBEB0095	82	EB1	11.719	662.181	663.828	665.051	666.575	667.562	668.088	668.446	662.173	663.832	665.062	666.593	667.578	668.103	668.458	-0.008	0.004	0.011	0.018	0.016	0.015	0.012
001EBEB0094	82	EB1	11.700	662.101	663.750	664.973	666.496	667.484	668.012	668.371	662.094	663.753	664.984	666.513	667.499	668.024	668.381	-0.007	0.003	0.011	0.017	0.015	0.012	0.010
001EBEB0093	82	EB1	11.666	661.974	663.665	664.864	666.338	667.308	667.825	668.176	661.967	663.662	664.873	666.354	667.323	667.838	668.187	-0.007	-0.003	0.009	0.016	0.015	0.013	0.011
001EBEB0092	80	EB1	11.637	661.974	663.665	664.864	666.295	667.193	667.666	667.987	661.967	663.662	664.873	666.319	667.215	667.678	667.986	-0.007	-0.003	0.009	0.024	0.022	0.012	-0.001
001EBEB0091	80	EB1	11.605	661.697	663.391	664.588	666.021	666.924	667.427	667.871	661.683	663.392	664.596	666.035	666.936	667.448	667.893	-0.014	0.001	0.008	0.014	0.012	0.021	0.022
001EBEB0090	80	EB1	11.536	661.315	663.062	664.294	665.746	666.806	667.427	667.871	661.297	663.063	664.300	665.757	666.824	667.448	667.893	-0.018	0.001	0.006	0.011	0.018	0.021	0.022
001EBEB0090	78	EB1	11.536	661.315	663.062	664.294	665.746	666.806	667.427	667.871	661.297	663.063	664.300	665.757	666.824	667.448	667.893	-0.018	0.001	0.006	0.011	0.018	0.021	0.022
001EBEB0089	78	EB1	11.518	661.219	662.982	664.212	665.661	666.720	667.342	667.785	661.213	662.991	664.225	665.677	666.738	667.360	667.803	-0.006	0.009	0.013	0.016	0.018	0.018	0.018
001EBEB0088	78	EB1	11.429	660.944	662.711	663.952	665.407	666.461	667.076	667.513	660.934	662.719	663.963	665.420	666.475	667.090	667.527	-0.010	0.008	0.011	0.013	0.014	0.014	0.014
001EBEB0087	76	EB1	11.410	660.644	662.326	663.465	664.792	665.751	666.309	666.704	660.643	662.331	663.474	664.804	665.765	666.323	666.719	-0.001	0.005	0.009	0.012	0.014	0.014	0.015
001EBEB0086	76	EB1	11.395	660.599	662.274	663.408	664.728	665.682	666.237	666.630	660.595	662.279	663.415	664.738	665.695	666.251	666.645	-0.004	0.005	0.007	0.010	0.013	0.014	0.015
001EBEB0086	74	EB1	11.395	660.599	662.272	663.391	664.640	665.505	665.999	666.346	660.595	662.278	663.396	664.645	665.513	666.007	666.353	-0.004	0.006	0.005	0.005	0.008	0.008	0.007
001EBEB0085	74	EB1	11.379	660.571	662.272	663.391	664.640	665.505	665.999	666.346	660.569	662.278	663.396	664.645	665.513	666.007	666.353	-0.002	0.006	0.005	0.005	0.008	0.008	0.007
001EBEB0084	72	EB1	11.348	660.571	662.272	663.391	664.640	665.505	665.999	666.346	660.569	662.278	663.396	664.645	665.513	666.007	666.353	-0.002	0.006	0.005	0.005	0.008	0.008	0.007
001EBEB0083	72	EB1	11.332	660.550	662.262	663.391	664.640	665.505	665.999	666.346	660.532	662.235	663.383	664.645	665.513	666.007	666.353	-0.018	-0.027	-0.008	0.005	0.008	0.008	0.007
001EBEB0082	72	EB1	11.229	660.411	662.104	663.167	664.355	665.171	665.634	665.959	660.405	662.109	663.174	664.362	665.178	665.641	665.965	-0.006	0.005	0.007	0.007	0.007	0.007	0.006
001EBEB0082	70	EB1	11.229	660.411	662.104	663.167	664.313	665.090	665.528	665.833	660.405	662.109	663.174	664.320	665.095	665.532	665.837	-0.006	0.005	0.007	0.007	0.005	0.004	0.004
001EBEB0081	70	EB1	11.159	660.322	661.990	663.038	664.160	664.917	665.342	665.640	660.302	661.966	663.034	664.163	664.918	665.341	665.636	-0.020	-0.024	-0.004	0.003	0.001	-0.001	-0.004
001EBEB0081	68	EB1	11.159	660.251	661.894	662.979	664.160	664.872	665.228	665.462	660.258	661.908	663.001	664.158	664.848	665.221	665.497	0.007	0.014	0.022	-0.002	-0.024	-0.007	0.035
001EBEB0080	68	EB1	11.120	660.216	661.866	662.961	664.158	664.872	665.228	665.462	660.258	661.908	663.001	664.102	664.822	665.221	665.497	0.042	0.042	0.040	-0.056	-0.050	-0.007	0.035
001EBEB0079	66	EB1	11.085	660.135	661.781	662.747	663.802	664.508	664.978	665.320	660.121	661.783	662.753	663.808	664.514	664.992	665.334	-0.014	0.002	0.006	0.006	0.006	0.014	0.014
001EBEB0078	66	EB1	10.856	659.696	661.378	662.430	663.641	664.491	664.978	665.320	659.690	661.383	662.440	663.654	664.505	664.992	665.334	-0.006	0.005	0.010	0.013	0.014	0.014	0.014
001EBEB0078	64	EB1	10.856	659.696	661.378	662.430	663.641	664.491	664.978	665.320	659.690	661.383	662.440	663.654	664.505	664.992	665.334	-0.006	0.005	0.010	0.013	0.014	0.014	0.014
001EBEB0077	64	EB1	10.658	659.367	661.021	662.035	663.208	664.035	664.509	664.843	659.358	661.028	662.044	663.219	664.046	664.520	664.854	-0.009	0.007	0.009	0.011	0.011	0.011	0.011
001EBEB0076	64	EB1	10.622	659.239	660.862	661.849	662.989	663.790	664.248	664.571	659.221	660.859	661.853	662.994	663.796	664.254	664.576	-0.018	-0.003	0.004	0.005	0.006	0.006	0.005
001EBEB0075	62	EB1	10.601	659.141	660.732	661.720	662.868	663.679	664.144	664.471	659.132	660.751	661.739	662.886	663.694	664.157	664.483	-0.009	0.019	0.019	0.018	0.015	0.013	0.012
001EBEB0074	62	EB1	10.583	659.052	660.627	661.603	662.735	663.533	663.990	664.311	659.048	660.636	661.616	662.748	663.545	664.001	664.322	-0.004	0.009	0.013	0.013	0.012	0.011	0.011
001EBEB0073	62	EB1	10.408	658.644	660.197	661.284	662.547	663.436	663.941	664.296	658.641	660.215	661.308	662.565	663.445	663.944	664.294	-0.003	0.018	0.024	0.018	0.009	0.003	-0.002
001EBEB0073	60	EB1	10.408	658.644	660.197	661.284	662.547	663.436	663.941	664.296	658.641	660.215	661.308	662.565	663.445	663.944	664.294	-0.003	0.018	0.024	0.018	0.009	0.003	-0.002
001EBEB0072	60	EB1	10.205	658.379	659.843	660.886	662.235	663.213	663.769	664.157	658.380	659.854	660.897	662.241	663.213	663.764	664.150	0.001	0.011	0.011	0.006	0.000	-0.005	-0.007
001EBEB0072	58	EB1	10.205	658.372	659.824	660.847	662.128	663.054	663.583	663.955	658.367	659.826	660.857	662.138	663.058	663.582	663.950	-0.005	0.002	0.010	0.010	0.004	-0.001	-0.005
001EBEB0071	58	EB1	10.079	658.156	659.608	660.666	662.009	662.976	663.528	663.916	658.152	659.612	660.674	662.016	662.980	663.529	663.914	-0.004	0.004	0.008	0.007	0.004	0.001	-0.002
001EBEB0071	56	EB1	10.079	658.098	659.488	660.450	661.666	662.562	663.080	663.445	658.095	659.492	660.462	661.687	662.588	663.108	663.475	-0.003	0.004	0.012	0.021	0.026	0.028	0.030
001EBEB0070	56	EB1	10.070	658.098	659.488	660.450	661.666	662.562	663.080	663.445	658.095	659.492	660.462	661.687	662.588	663.108	663.475	-0.003	0.004	0.012	0.021	0.026	0.028	0.030
001EBEB0069	56	EB1	10.060	658.081	659.451	660.382	661.578	662.479	663.000	663.369	658.073	659.448	660.389	661.596	662.501	663.026	663.395	-0.008	-0.003	0.007	0.018	0.022	0.026	0.026
001EBEB0068	54	EB1	10.041	657.950	659.277	660.145	661.163	661.904	662.333	662.635	657.956	659.295	660.170	661.189	661.924	662.348	662.647	0.006	0.018	0.025	0.026	0.020	0.015	0.012
001EBEB0067	54	EB1	10.036	657.938	659.248	660.106	661.113	661.849	662.275	662.575	657.938	659.257	660.118	661.128	661.864	662.290	662.589	0.000	0.009	0.012	0.015	0.015	0.015	0.014
001EBEB0066	54	EB1	9.903	657.559	658.800	659.587	660.514	661.205	661.607	661.889	657.558	658.809	659.601	660.531	661.223	661.625	661.908	-0.001	0.009	0.014	0.017	0.018	0.018	0.019
001EBEB0066	52	EB1	9.903	657.556	658.795	659.574	660.460	661.095	661.463	661.721	657.556	658.805	659.588	660.475	661.109	661.475	661.732	0.000	0.010	0.014	0.015	0.014	0.012	0.011
001EBEB0065	52	EB1	9.857	657.438	658.654	659.348	660.126	660.662	660.964	661.174	657.437	658.658	659.355	660.134	660.670	660.972	661.182	-0.001	0.004	0.007	0.008	0.008	0.008	0.008
001EBEB0064	52	EB1	9.791	657.171	658.320	658.959	659.663	660.143	660.414	660.602	657.171	658.326	658.966	659.671	660.152	660.422	660.610	0.000	0.006	0.007	0.008	0.009	0.008	0.008
001EBEB0063	50	EB1	9.751	657.025	658.109	658.693	659.307	659.712	659.936	660.092	657.017	658.112	658.698	659.313	659.717	659.942	660.097	-0.008	0.003	0.005	0.006	0.005	0.006	0.005
001EBEB0062	50	EB1	9.692	656.853	657.933	658.518	659.117	659.510	659.725	659.873	656.850	657.886	658.426	658.975	659.328	659.522	659.656	-0.003	-0.047	-0.092	-0.142	-0.182	-0.203	-0.217

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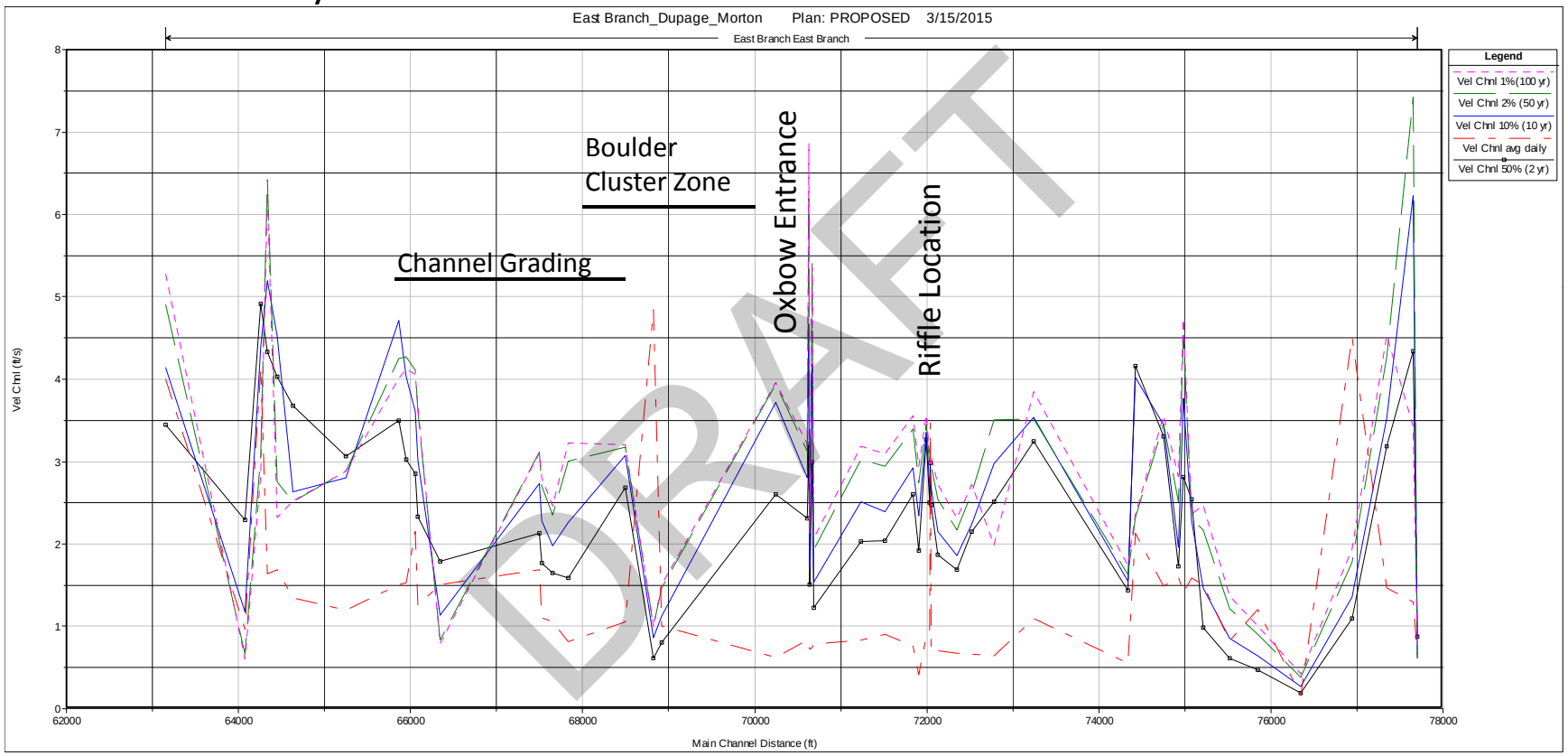
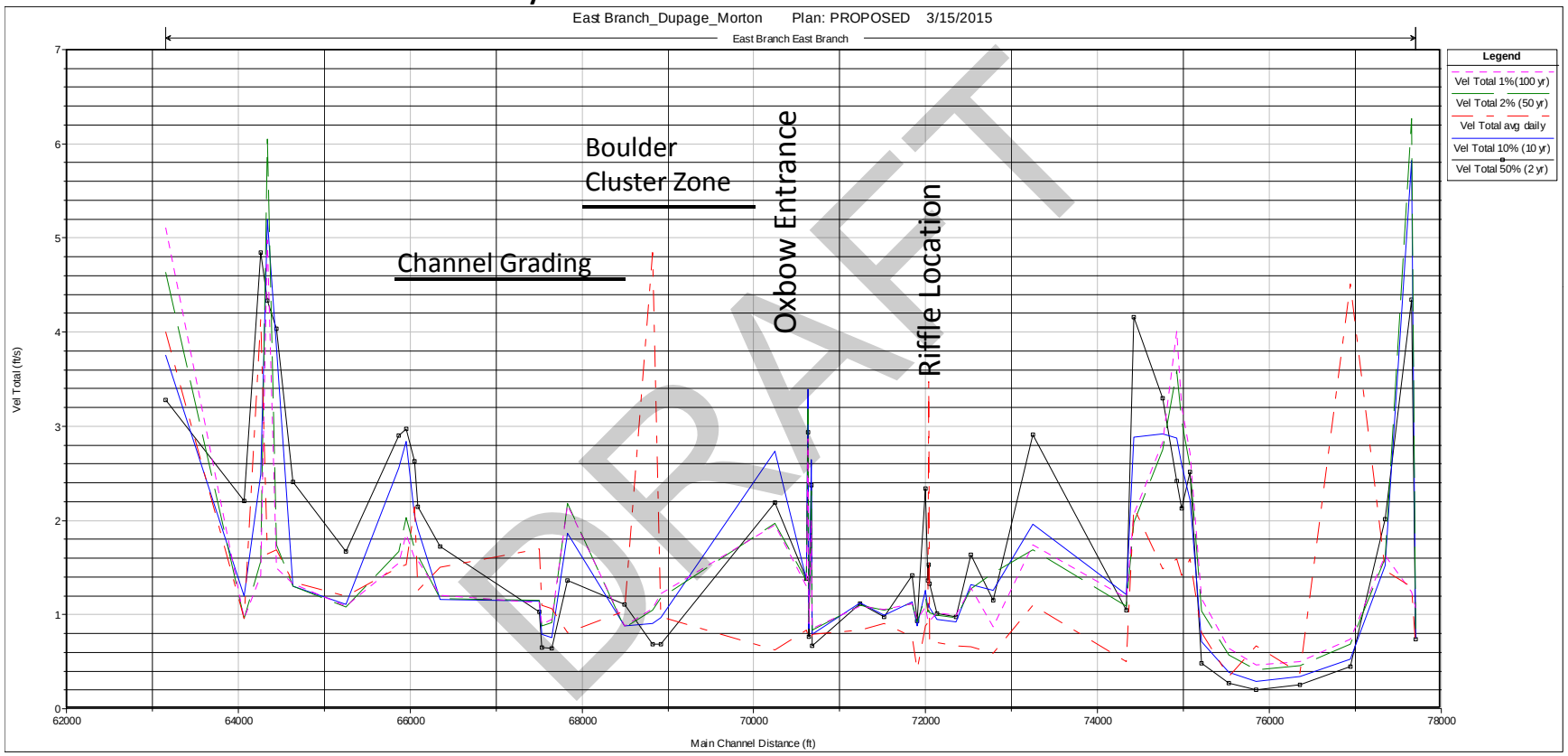
Appendix HH-3 – HEC-RAS model Results

Channel Velocity



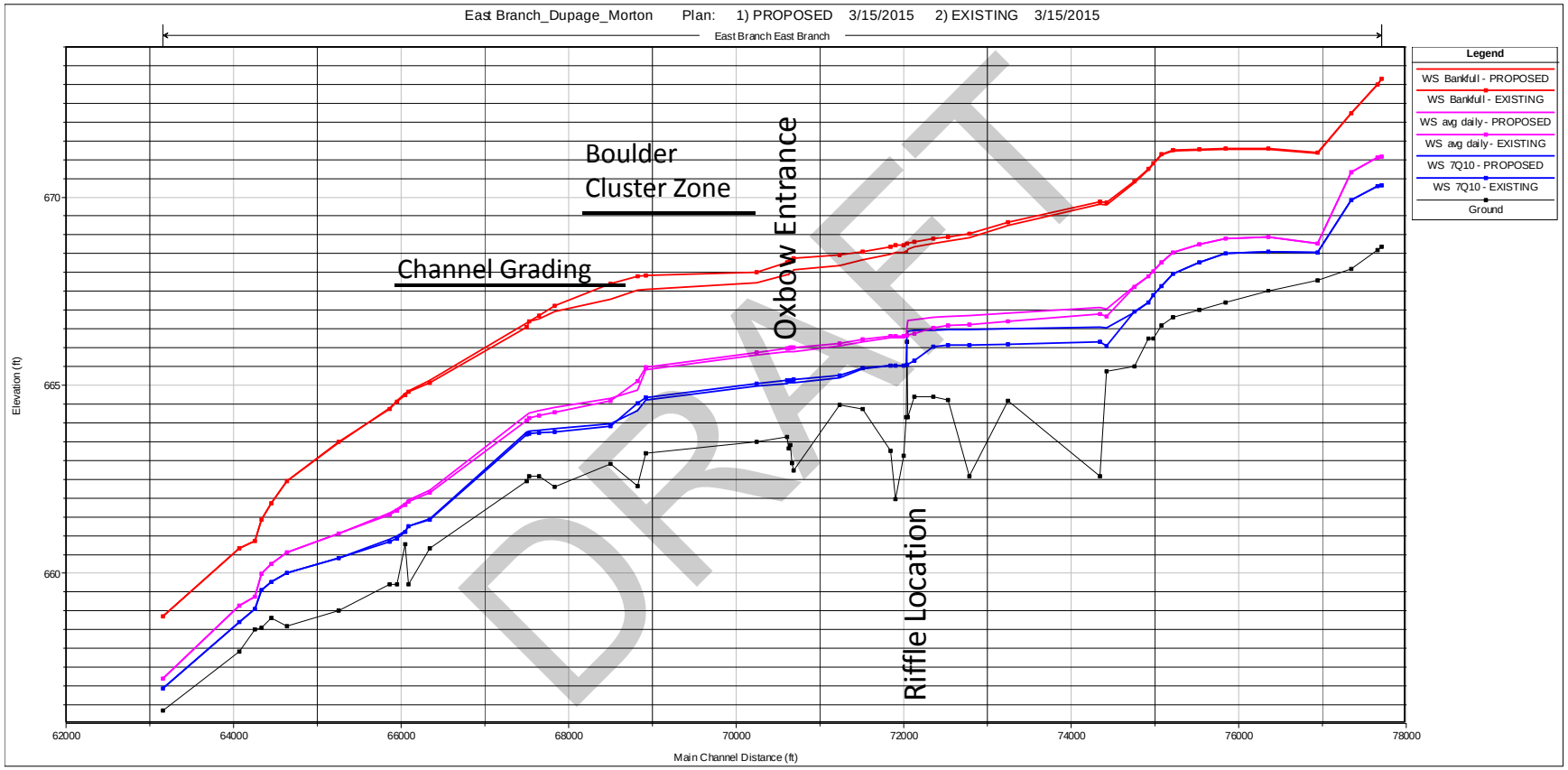
Appendix HH-3 – HEC-RAS model Results

Total Cross Sectional Velocity



Appendix HH-3 – HEC-RAS model Results

Low flow profiles - Riffle Design. Critical flow induced



US Army Corps of Engineers®

CHICAGO DISTRICT

LEADERS IN CUSTOMER CARE

MORTON ARBORETUM 206

LISLE, IL

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B - Civil Engineering Appendix

100% ATR Backcheck

March 2014

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Appendices

Appendix B-1 – Volume Reports

Appendix B-2 – Quantities

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1.0 Site selection and project development

The project location is in DuPage County, Illiniois within the Morton Arboretum Property. The restoration reach is approximately a 1.5 mile reach of the DuPage River East Branch (DPREB), just north of Interstate 88. The original feasibility study reach covered approximately 2.5 miles, but this was reduced when the Forest Preserve District of DuPage County pulled out at a sponsor. The finalized project work limits were coordinated with Morton Arboretum to remove areas that are being mitigated and add other areas that can be improved by the proposed measures. The project area consists of the river and the immediately surrounding habitat, and at 72.5 acres is a small increase in area from the Arboretum's portion of the feasibility project. The overall project area is smaller than that which was approved in the feasibility report.

Other changes from the feasibility report include a small increase in the area of grading along the DuPage River, and removing the grading proposed in the Oxbow area. It was determined grading was not needed to restore habitat at the Oxbow, whereas additional areas along the river will benefit from a restored channel cross section. The restoration within the river was revised to include more woody debris structures, and reduce the amount of stone and riffles placed. This is due to improved stream restoration knowledge of the PDT, and improved restoration techniques.

2.0 Real Estate

The entirety of the project area is owned by Morton Arboretum, the Local Sponsor. Care was taken to avoid any work in areas that are currently undergoing mitigation.

2.1 Staging and Storage

Staging and storage areas were provided by Morton Arboretum in areas they already use for similar purposes. This eliminates the need to damage potential habitat areas by using them for staging and storage. The area chosen is referred to as the 'old picnic grounds', and covers approximately one acre on the north corner of the intersection of IL 53 and S Park Blvd. The area will be restored by the contractor to its original condition. Project work areas can also be used for temporary staging and storage of smaller items.

2.2 Access Roads\Haul Routes

Access to the Arboretum will be from IL Route 53 into Morton Arboretum's main entrance. From there several of the Arboretum's roads allow access to the project areas. See the plan sheets for specific access routes.

Haul routes will be installed at the contractor's discretion and restored after project completion. Only one haul route has been called out specifically on the plans, because of a difficult to access area of the project. The isthmus of land adjacent to Lake Jopamaca is only accessible via a small land bridge and over a culvert, so this access route is called out on the plan. The existing mulch path in that area will be improved to a haul road for the contractor's work.

3.0 Interior Drainage

All grading being performed along the shoreline maintains the drainage path to the DuPage River, simply lessoning the slope. Current drainage paths will not be affected. The site is within the floodway and floods regularly during high water, which will continue and is beneficial for the ecological measures being placed. Refer to the Hydraulic Appendix for details of the river modeling performed of the existing and proposed conditions.

4.0 Utilities

Full utility information for the site was provided by the Morton Arboretum staff. Shapefiles of all utility locations were provided to include in the plans, and utilities in the grading areas were verified via survey. The files included

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were electric, fiber optic, gas, drain tiles, sanitary sewer, storm sewer, and water lines. Lines that intersected the project area are included on the plans and called out for the contractor to note.

5.0 Surveying and Mapping

Control, topographic, and bathymetric surveys were performed in November of 2014 by Seaside Engineering And Surveying (SEAS), LLC throughout various reaches of the project area. All data collected met, or exceeded Third-Order survey standards and was adjusted to NAD83 horizontally, and NAVD88 vertically. This was accomplished by recovering and surveying nearby NGS monuments prior to beginning the surveys. As a result, accurate and up-to-date drawings were created depicting existing site conditions within the predetermined survey areas, to include the topography of the land, all permanent type features and structures, bridge data and sketches, utilities, trees, and river cross-sections, all of which is described in greater detail within the submitted survey report by SEAS.

Aerial map data and location shapefiles of existing Arboretum utilities were provided by Morton Arobretum.

6.0 Maintenance of Traffic

Traffic maintenance plan will be submitted by the contractor per 01 52 02 Temporary Construction Facilities. The plan must also be approved by the local sponsor, since they will be using the roads in and surrounding the contractor's work area throughout the project's duration.

7.0 Grading

All excess cut from the following grading areas will be stored on site by Morton Arboretum.

7.1 DuPage River Grading

The area of grading along the DuPage River extends from the IL 53 bridge to the bridge just north of Arbor Lake, a river length of approximately 0.5 miles. The purpose of grading in this area is to draw back the banks from their unnatural, channelized state to a more naturally sloped bank which will allow the river to spread over a wider area during periods of high water. This grading will also provide habitat for native floodplain plantings. Most of the grading along the east bank is relatively unimpeded by trees and brush and contains gradual slopes for ease of access. The west bank ties into areas of high ground and existing trails, limiting the amount of grading that can be done without major earth removal. The Arboretum is coordinating relocating the trees in its collections that will need to be removed for the work. All other vegetation in the impact area will be cleared by the contractor. The new slopes range from the existing grade down to 10:1. The slope gradually ties back into the existing grade at the three bridge crossings to avoid any rebuilding of the bridges or roads. Refer to Attachment 14.1 for InRoads volume reports. Hydraulic modeling was also performed for this portion of the river, to assure no negative upstream or downstream impacts were imposed.

Two sections of the existing mulch path along the west bank will be temporarily removed and then replaced in a slightly revised alignment to accommodate the new river slopes. The total replaced length will be 600 linear feet.

There is an existing storm sewer pipe outlet on the east bank of the DuPage River just north of Ginkgo Way road. As it exists the outlet is causing significant erosion to the bank. This sewer pipe will be cut off approximately 25 feet back from the bank and the area around the new outlet graded into a swale to the river. A level spreader will be installed at the outlet of the pipe to diffuse the flow. The new swale area will be planted with native species to further stabilize the grade.

7.2 Lake Jopamaca

This area will be used as a placement area for a portion of the excess cut from the other site grading. PM-PL-E has determined the lake would be a prime location to place fill to create marsh habitat along the banks. The banks are currently steep and do not provide good habitat opportunities. Approximately 2000 CY of excess fill will be placed along the north bank as shown on the plans. On the north and south banks, material will be placed 20 feet into the

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water from just landward of the existing toe, at slopes of 5:1 to 10:1. On the banks of the existing island, material will be placed 15 feet into the water from just landward the existing tow, at slopes of 5:1 to 10:1.

7.3 Arbor Lake (Option)

An optional item is included in the contract for grading at the south bank of Arbor Lake. There is a spoil pile existing between the south bank of the lake and Warrenville Road, contributing to excessively steep banks in this area. The spoil pile will be removed and the banks graded down to a 10:1 slope above the water line, to create a more natural habitat ideal for plantings. The grading is estimated at 3500 CY of cut material. This will be the maximum cut for the work; the topography in this area is older than in other grading areas, so accuracy is not ensured. Allowing a maximum will prevent cost overruns if the existing topography varies from the survey. The area will be cleared of trees and brush prior to the work, and replanted with more desirable species.

8.0 In-Stream Features

8.1 Riffle

Just one riffle will be placed in the river, at the northern boundary of the project. The riffle construction is described in detail in the project plans and specifications. It includes a trench underneath, a center line of large boulders, and a build-up of smaller sized stones. See quantities for details of the structure and materials used.

8.2 Boulder Clusters

Two types of boulder clusters will be placed in the stream: large boulder cluster and small boulder cluster. There will also be some stones placed individually in the channel as indicated on the plans. All stone shall be glacial and meet specific type and sizing requirements from the specifications.

8.3 Woody Structures

Several woody structures will be used within the DuPage River, for habitat creation and naturalizing of the flow. The first proposed structure places trees into the side of the bank with rootwads extending into the channel, reinforced with vegetation along the bank (Woody Structure #1). The other proposed structure places several large trucks on top of the bank with rootwads extending into the channel, stabilized with piles or deadman anchors (Woody Structure #2). These structures will use trees that have been cleared from the project site. Full details are included in the specifications and on the plans.

9.0 Prescriptive Burning

Burn areas are identified on the plans for a total of 35 acres. Other areas cannot be burned and will be 'mow only', meaning they should be mowed once a year during the dormant season to protect the Arbretum's collection trees.

10.0 Drain Tile Disablement

A drain tile disablement plan was previously completed for Morton Arboretum by Huddleston McBride in 2013. The portion of the drain tiles which intersect this project's area are referred to in the plan as the 'Elm Geo' area, and the recommendations for that area are included in this project. It was recommended to place 9 cut off abandonment valves in various locations of the drain tile in the Elm Geo area. The locations of the existing drain tile and the proposed valves are shown on the plans.

11.0 References

U.S. Army Corps of Engineers, 1993, *Engineering and Design Cost Engineering Policy and General Requirements, Engineering Regulation 1110-1-1300,* Department of the Army, Washington D.C., 26 March 1993.

U.S. Army Corps of Engineers, 1999, *Engineering and Design for Civil Works Projects,*

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Engineering Regulation 1110-2-1150, Department of the Army, Washington D.C., 31 August 1999.

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Triangle Volume Report

05 OCTOBER 2015

Report Created: 12/17/2014
Time: 4:48pm

Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: **Chicago 2014 Oxbow**
Description:
Preference: Default
Type: Existing
Design Surface: **Oxbow with Landbridge**
Description:
Preference: Default
Type: Design
Cut Factor: 1.00
Fill Factor: 1.00

Cut:	19049.2 cu ft
Fill:	1099.5 cu ft
Net:	17949.7 cu ft

Cut:	705.5 cu yd
Fill:	40.7 cu yd
Net:	664.8 cu yd

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Triangle Volume Report

05 OCTOBER 2015

Report Created: 11/25/2014
Time: 2:09pm

Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: **Chicago 2014 Lower**
Description:
Preference: Default
Type: Existing
Design Surface: **Lower DuPage proposed_east bank**
Description:
Preference: Default
Type: Design
Cut Factor: 1.00
Fill Factor: 1.00

Cut:	130888.8 cu ft
Fill:	1064.9 cu ft
Net:	129823.9 cu ft

Cut:	4847.7 cu yd
Fill:	39.4 cu yd
Net:	4808.3 cu yd

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Triangle Volume Report

05 OCTOBER 2015

Report Created: 11/25/2014
Time: 2:07pm

Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: **Chicago 2014 Lower**
Description:
Preference: Default
Type: Existing
Design Surface: **Lower DuPage proposed_west bank_North**
Description:
Preference: Default
Type: Design
Cut Factor: 1.00
Fill Factor: 1.00

Cut:	3795.8 cu ft
Fill:	264.6 cu ft
Net:	3531.2 cu ft

Cut:	140.6 cu yd
Fill:	9.8 cu yd
Net:	130.8 cu yd

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Triangle Volume Report

05 OCTOBER 2015

Report Created: 11/25/2014
Time: 2:04pm

Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: **Chicago 2014 Lower**
Description:
Preference: Default
Type: Existing
Design Surface: **Lower DuPate proposed_west bank**
Description:
Preference: Default
Type: Design
Cut Factor: 1.00
Fill Factor: 1.00

Cut:	1817.5 cu ft
Fill:	88.9 cu ft
Net:	1728.6 cu ft

Cut:	67.3 cu yd
Fill:	3.3 cu yd
Net:	64.0 cu yd

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Triangle Volume Report

05 OCTOBER 2015

Report Created: 12/9/2014
Time: 2:05pm

Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: **Chicago 2014 Lower**
Description:
Preference: Default
Type: Existing
Design Surface: **Jopamaca 5:1**
Description:
Preference: Default
Type: Design
Cut Factor: 1.00
Fill Factor: 1.00

Cut:	42985.6 cu ft
Fill:	277.2 cu ft
Net:	42708.4 cu ft

Cut:	1592.1 cu yd
Fill:	10.3 cu yd
Net:	1581.8 cu yd

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Triangle Volume Report

05 OCTOBER 2015

Report Created: 12/30/2014
Time: 2:44pm

Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: **Existing Topo-Zach**
Description:
Preference: Existing
Type: Existing
Design Surface: **Arbor Lake South**
Description:
Preference: Existing
Type: Design
Cut Factor: 1.00
Fill Factor: 1.00

Cut:	93225.4 cu ft
Fill:	353.9 cu ft
Net:	92871.5 cu ft

Cut:	3452.8 cu yd
Fill:	13.1 cu yd
Net:	3439.7 cu yd

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Triangle Volume Report

05 OCTOBER 2015

Report Created: 2/17/2015
Time: 9:44am

Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: **Bathy plus topo**
Description:
Preference: Default
Type: Design
Design Surface: **West bank Sunfish Lake**
Description:
Preference: Default
Type: Design
Cut Factor: 1.00
Fill Factor: 1.00

Cut:	13736.2 cu ft
Fill:	30.1 cu ft
Net:	13706.1 cu ft

Cut:	508.7 cu yd
Fill:	1.1 cu yd
Net:	507.6 cu yd

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US Army Corps of Engineers, Chicago District

PROJECT TITLE:	COMPUTED BY:	DATE:
MORTON ARBORETUM	LAURA VANDENBERG	2/12/2015
COMPUTATION TITLE:	**CHECKED BY:**	**DATE:**
BASIC QUANTITIES CALCULATIONS	ADAM TENNANT	3/10/2015

I. BANK GRADING*

FLOODPLAIN

MicroStation InRoads was utilized to determine the earthwork quantities. It was calculated using Triangular Volume and End-Area Method.

Refer to the InRoads reports sheets for the Floodplain as the design surface.

** Volume for both sides of the existing stream.

	Area (SF)	Depth topsoil (FT)	Volume Topsoil(CY)
***Assume 6" top soil over area	137664	0.50	2549

Triangle Volume Report

Report Created: 11/25/2014
Time: 2:09pm

Mode:	Entire Surface	
Input Grid Factor:	1-Jan-00	
Original Surface:	**Chicago 2014 Lower**	
Description:		
Preference:	Default	
Type:	Existing	
Design Surface:	**Lower DuPage proposed_east bank**	
Description:		
Preference:	Default	
Type:	Design	
Cut Factor:	1-Jan-00	
Fill Factor:	1-Jan-00	
Cut:	10-May-58	cu ft
Fill:	29-Nov-02	cu ft
Net:	10-Jun-55	cu ft
Cut:	8-Apr-13	cu yd
Fill:	8-Feb-00	cu yd
Net:	**28-Feb-13**	**cu yd**
Surface Area:	92018	SF

Triangle Volume Report

Report Created: 11/14/2014
Time: 1:03pm

Mode:	Entire Surface	
Input Grid Factor:	1-Jan-00	
Original Surface:	**Chicago 2014 Lower**	
Description:		
Preference:	Default	
Type:	Existing	
Design Surface:	**Lower DuPage proposed_west bank_North**	
Description:		
Preference:	Default	
Type:	Design	
Cut Factor:	1-Jan-00	
Fill Factor:	1-Jan-00	
Cut:	22-May-10	cu ft
Fill:	20-Sep-00	cu ft
Net:	31-Aug-09	cu ft
Cut:	19-May-00	cu yd
Fill:	9-Jan-00	cu yd
West bank north Net:	**9-May-00**	**cu yd**
Surface Area:	26-Dec-12	SF

Triangle Volume Report

Report Created: 11/14/2014
Time: 1:04pm

Mode:	Entire Surface	
Input Grid Factor:	1-Jan-00	
Original Surface:	**Chicago 2014 Lower**	
Description:		

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Preference:	Default	
Type:	Existing	
Design Surface:	**Lower DuPate proposed_west bank**	
Description:		
Preference:	Default	
Type:	Design	
Cut Factor:	1-Jan-00	
Fill Factor:	1-Jan-00	
Cut:	24-Jul-03	cu ft
Fill:	3-Feb-01	cu ft
Net:	18-Jun-02	cu ft
Cut:	17-Feb-00	cu yd
Fill:	14-Jan-00	cu yd
West Bank South Net:	**2-Feb-00**	**cu yd**
Surface Area	5-Jan-15	

Triangle Volume Report

Report Created: 12/9/2014		
Time: 2:05pm		
Mode:	Entire Surface	
Input Grid Factor:	1-Jan-00	
Original Surface:	**Chicago 2014 Lower**	
Description:		
Preference:	Default	
Type:	Existing	
Design Surface:	**Jopamaca 5:1**	
Description:		
Preference:	Default	
Type:	Design	
Cut Factor:	1-Jan-00	
Fill Factor:	1-Jan-00	
Cut:	7-Sep-17	cu ft
Fill:	3-Oct-00	cu ft
Net:	4-Dec-16	cu ft
Cut:	10-May-04	cu yd
Fill:	10-Jan-00	cu yd
Net:	**29-Apr-04**	**cu yd**
Surface Area:	27-Aug-45	SF

Triangle Volume Report

Report Created: 12/3/2014		
Time: 1:29pm		
Mode:	Entire Surface	
Input Grid Factor:	1-Jan-00	
Original Surface:	**Bathy plus topo**	
Description:		
Preference:	Default	
Type:	Design	
Design Surface:	**West bank Sunfish Lake**	
Description:		
Preference:	Default	
Type:	Design	
Cut Factor:	1-Jan-00	
Fill Factor:	1-Jan-00	
Cut:	9-Aug-37	cu ft
Fill:	30-Jan-00	cu ft
Net:	10-Jul-37	cu ft
Cut:	22-May-01	cu yd
Fill:	1-Jan-00	cu yd
Net:	**21-May-01**	**cu yd**
Surface Area:	23-Apr-51	SF

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West Bank Net Total Volume:		**2254**
West Bank Total Cut:	**2290**	
West Bank Total Fill:	**36**	
Total Cut:	**7137**	
Total Fill:	**75**	

Arbor Lake Grading: Option Item 0015AA

Triangle Volume Report

Report Created: 12/30/2014
Time: 2:44pm

Mode:	Entire Surface
Input Grid Factor:	1-Jan-00
Original Surface:	**Existing Topo-Zach**
Description:	
Preference:	Existing
Type:	Existing
Design Surface:	**Arbor Lake South**
Description:	
Preference:	Existing
Type:	Design
Cut Factor:	1-Jan-00
Fill Factor:	1-Jan-00

Cut:	28-Mar-55	cu ft
Fill:	18-Dec-00	cu ft
Net:	8-Apr-54	cu ft
Cut:	13-Jun-09	cu yd
Fill:	13-Jan-00	cu yd
Net:	**31-May-09**	**cu yd**
Grading Area:	**22000**	**sf**

****Note:** Haul roads are considered incidental to grading, and placement shall be determined by the contractor. One haul Road has been called out specifically on the plans, due to the difficulty of access to the isthmas of land by Lake Jopamaca.

III. PLACEMENT OF FILL

Total excess from Cut:	10502	**CY**

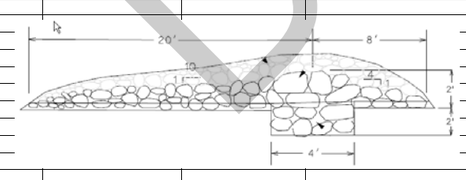
Placement in Lake Jopamaca (Bid Item 00011AE) Temporary bridges must be placed for access to island area

Area of Lake:	48615	SF
Proposed Marsh area:		
North bank	10000	SF
South bank	9000	SF
Island banks	7000	SF
Avg depth:	3	FT
Volume:	**2407**	**CY**

*Max fill of 2500 CY Allowed per specs

Stockpile excess fill (Bid item 0011AD)
Remainder: stockpile on site at Arbordale (location shown on plan sheet C-101)

excess cut from base earthwork:		
Volume:	4654	CY
Avg. haul distance, round trip:	1-Jan-00	mi
excess cut from Arbor Lake option:		
Volume:	3440	CY
haul distance, round trip:	1-Jan-00	mi



IV. RIFFLE (Bid item 0014AA)
See sheet C-501 for details

	Station	# of Riffles	Length ft	Width ft	Depth ft	Area ft^2	Area * ft^2	Volume yd^3
IN STREAM		**Each**	28.00	40.00	2.00	28.00	8.00	53.33
Trench In Section	North end of project	1.00	4.00	40.00	2.00	8.00		11.85

* Additional Area by the Bank with 1 to 2 slope

	Unit Weight (lb/cy)	**Weight**
	11-Aug-07	**ton**
GRAND TOTAL		**90.61**

V. BOULDER CLUSTER (Bid item 0014AB)
See sheet C-501 for details
1200LF of boulder cluster area, with ~2 clusters per 100'

Large cluster	# of Boulders	Length	Width	Depth	Area	Volume

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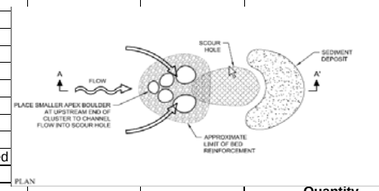
	Each	Each*	ft	ft	ft	ft^2	yd^3
	12	60	2.00	2.00	2.00	4.00	0.30
	Small cluster:	**# of Boulders**	**Length**	**Width**	**Depth**	**Area**	**Volume**
	Each	**Each***	**ft**	**ft**	**ft**	**ft^2**	**yd^3**
	12	36	2.00	2.00	2.00	4.00	0.30



						Unit Weight (lb/cy)	**Weight**
						11-Aug-07	**ton**
					GRAND TOTAL		**39.54**
VI. WOODY DEBRIS PLACEMENT							
See plan sheet C-502 for details							
Bid Item 0014AC							
Woody structure #1: 6 Root wads in bank, reinforced							
	Structures:				**Large tree**	**Cobble (cy)**	**Vegetation on bank**
				Quantity	6-Jan-00	-	yes
Bid Item 0014AD							
Woody Structure #2: Wood Jam structure							
	Structures:	**7.00**			**Large tree**	**Cobble (cy)**	**Anchors**
				Quantity	4-Jan-00	-	8
VII. DRAIN TILE DISABLEMENT (Bid item 0013)							
Install abandonment valves as shown on plans							
Valves:	**9.00**	**EA**					
VII. FENCE REMOVAL (Option Bid item 0016)							
Measurement from Microstation	**Length (LF)**		This bid item to include replacement of 80 feet of the fence as incidental to the bid item.				
Between Gates:	**18-Dec-00**		Existing fence is chain link with 2 gates that will be replaced				
South along Arbor Lake:	**13-May-03**						
Total:	**30-Apr-04**						
VIII. PATH RELOCATION (Option Bid item 0017)							
	Length (LF)	**Width (FT)**					
Trail near Sunfish Lake:	**360.00**	**5.00**					
Trail near Lake Jopamaca:	**240.00**	**5.00**					
Total:	**600.00**						
IX. BURN ZONES (Bid item 0010)							
Measurements taken from Microstation							
Base:	9.20						
Option:	16.00						

X. PLANTING QUANTITIES (Bid items 0012 and 0013)

BASE

Habitat Type	Area (AC)	Plugs/AC (EA)	Seeds/AC (LB)	**Total Plugs (EA)**	**Total Seeds (LB)**
Wet mesic prairie	0.16	100.00	7.93	**16.00**	**1.27**
wet mesic forest	2.10	350.00	5.58	**735.00**	**11.72**
stream bank toe	2.20	17850.00	0.00	**39270.00**	**0.00**
wet prairie	0.60	75.00	5.95	**45.00**	**3.57**
wet forest	1.20	0.00	6.01	**0.00**	**7.21**
japanese marsh	0.88	975.00	5.41	**975.00**	**4.76**
sedge meadow	0.00	825.00	8.35	**0.00**	**0.00**
marsh	0.09	700.00	5.60	**63.00**	**0.50**
wet oak woodland	0.00	225.00	3.50	**0.00**	**0.00**
mesic prairie	1.36	0.00	10.10	**0.00**	**13.74**
graded stream bank	3.10	0.00	39.94	**381.30**	**123.81**
Jopamaca wetland shelf	0.32	2225.00	5.08	**712.00**	**1.63**
oak savanna	0.00	0.00	11.74	**0.00**	**0.00**
mesic prairie short	0.00	2060.00	2.98	**0.00**	**0.00**
Mesic Oak woodland	0.00	50.00	6.78	**0.00**	**0.00**
Wet Mesic Forest Entrance	0.00	1450.00	4.08	**0.00**	**0.00**
Arbor Lake Wetland shelf	0.00	10500.00	0.00	**0.00**	**0.00**
Marsh Low Div	0.00	0.00	2.88	**0.00**	**0.00**
Mesic forest	3.08	350.00	5.70	**1078.00**	**17.56**
Open Water	0.00	100.00	0.00	**0.00**	**0.00**
Wet Mesic Prairie short	2.40	2060.00	2.98	**4944.00**	**7.15**
Wetland Swale	0.02	2300.00	38.68	**2300.00**	**0.77**
Wet Prairie Entrance	0.00	675.00	2.01	**0.00**	**0.00**
	17.51				

OPTION

Habitat Type	Area (AC)	Plugs/AC (EA)	Seeds/AC (LB)	**Total Plugs (EA)**	**Total Seeds (LB)**
Wet mesic prairie	9.54	100.00	7.93	**954.00**	**75.65**
wet mesic forest	7.90	350.00	5.58	**2,765.00**	**44.08**
stream bank toe	0.00	17850.00	0.00		
wet prairie	0.76	75.00	5.95	**57.00**	**4.52**
wet forest	0.00	0.00	6.01	**0.00**	**0.00**
japanese marsh	0.00	975.00	5.41	**0.00**	**0.00**
sedge meadow	0.13	825.00	8.35	**825.00**	**1.09**
marsh	1.00	700.00	5.60	**700.00**	**5.60**
wet oak woodland	1.07	225.00	3.50	**240.75**	**3.75**
mesic prairie	14.22	0.00	10.10	**0.00**	**143.62**
graded stream bank	0.00	0.00	39.94		
Jopamaca wetland shelf	0.00	2225.00	5.08		
oak savanna	1.28	0.00	11.74	**0.00**	**15.03**
mesic prairie short	2.39	2060.00	2.98	**4,923.40**	**7.12**
Mesic Oak woodland	0.37	50.00	6.78	**18.50**	**2.51**
Wet Mesic Forest Entrance	0.79	1450.00	4.08	**1,145.50**	**3.23**
Arbor Lake Wetland shelf	0.89	10500.00	0.00	**9,345.00**	**0.00**
Marsh Low Div	0.30	0.00	2.88	**0.00**	**0.86**
Mesic forest	2.30	350.00	5.70	**805.00**	**13.11**
Open Water	0.40	100.00	0.00	**40.00**	**0.00**
Wet Mesic Prairie short	0.00	2060.00	2.98	**0.00**	**0.00**
Wetland Swale	0.00	2300.00	38.68		
Wet Prairie Entrance	0.07	675.00	2.01	**47.25**	**0.14**
	43.34				

Establishment (Bid items 5 and 18)		
Base:	18.00	AC
Option:	44.00	AC
Selective Clearing (Bid Items 7 and 19)		
	Management Unit	**Area**

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Base	1, 7, 2	31.00	**AC**	
Options	3, 4, 5, 6, 8	33.00	**AC**	
XI. RECREATION AREA (OPTION BID ITEM 0019)				
Limestone steps:	15 feet wide at top to 20 feet wide at base			
	30 feet in length			
Patio	Limestone patio, 32' by 20'			
	Stone Seating area around north perimeter			
XII. GENERAL NOTES				
1. Incidental Items: Cut off storm sewer outlet pipe at Ginkgo Way and install Level spreader at outlet				

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