



April 24, 2015

Mr. Walid Gemayel,  
Glaus, Pyle, Schomer, Burns and DeHaven, Inc.  
520 South Main Street, Suite 2531  
Akron, OH 44311

Attention: Mr. Walid Gemayel

**RE: I-70/I-71 WEST INTERCHANGE  
BRIDGE REPLACEMENTS OVER THE SCIOTO RIVER  
FRA-70-12.68, (PID # 77372), Project 4A &  
FRA-70-13.10, (PID # 89464), Project 6A**

Dear Mr. Gemayel:

We are pleased to submit this Bridge Waterway Hydraulic and Scour Analysis Report for the I-70 / I-71 West Interchange Projects. The report is for the bridges over the Scioto River that will be replaced as part of the **above referenced projects**.

Enclosed please find two copies of the bound report that contains:

- This cover letter;
- A Letter of Compliance, ODOT LD-51 form;
- A No-Rise Certification;
- The Report, Volume I, which consists of a paper copy of the report with the exhibits; and
- The Appendix, Volume II, which consists of a DVD / CD-ROM containing a pdf of the report with the exhibits and the associated data used and developed as part of this task.

This package is ready as – is for concurrent submittal to ODOT and the City of Columbus for Review and approval.

We thank you for the opportunity to assist you with this project.

Please feel free to contact me if you have any questions.

Sincerely,

David W. Becker, P.E., PTOE  
Senior Project Manager  
**URS Corporation - Ohio**

Enclosures

Cc: Davin Ng, GPD Group  
Phil Fry, URS



April 24, 2015

**Attn:** Ms. Renee Van Sickle, P.E.,  
Floodplain Administrator  
City of Columbus,  
Division of Sewerage and Drainage,  
Stormwater & Regulatory Section,  
1250 Fairwood Avenue  
Columbus, OH 43206

**RE: I-70/I-71 WEST INTERCHANGE  
BRIDGE REPLACEMENTS OVER THE SCIOTO RIVER  
FRA-70-12.68, (PID # 77372), Project 4A &  
FRA-70-13.10, (PID # 89464), Project 6A  
City of Columbus NFIP Permit Application  
Letter of Compliance**

Dear Ms. Van Sickle:

Enclosed please find the floodplain analysis for the ODOT projects, **FRA-70-12.68, (PID # 77372), Project 4A and FRA-70-13.10, (PID # 89464), Project 6A**. The subject roadway and bridge projects encroach upon Special Flood Hazard Area Zone AE within your community at the location identified in the attached report. The hydraulic calculations and No-Rise Certification Form provide the necessary documentation of compliance to all federal, state, and local floodplain standards as required. ODOT will be proceeding forward on this project if no concerns are brought to our attention.

On behalf of the Ohio Department of Transportation, I herewith submit an application to request approval of a Development Permit in an Area of Special Flood Hazard in accordance with the City of Columbus, Ohio, Code of Ordinances, Title 11 Water, Sewer and Electricity Code, Chapter 1150 Floodplain Management.

In support of this application the following items are enclosed:

- “No-Rise” Certification and
- Two (2) copies of the Hydraulic and Scour Analysis Report which shows the nature, location, dimensions, and details of the existing and proposed conditions along the Scioto River upstream and downstream of the existing I-70 / I-71 bridges over the river. Contained within this report are exhibits and a DVD / CD-ROM which includes the report appendices in pdf file format due to the volume of documentation.



Ms. Renee Van Sickle, P.E.,  
FRA-70-12.68, (PID # 77372), Project 4A &  
FRA-70-13.10, (PID # 89464), Project 6A  
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Letter of Compliance  
April 22, 2015  
Page 2 of 2

Included in the appendices are:

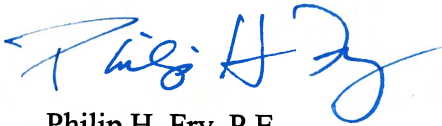
- The results and comparisons from the HEC-RAS models for the duplicate, corrected, existing and proposed conditions.
- The HEC-RAS electronic files for these models.
- The portions of the plans as developed to date for the proposed projects where the projects impact the existing Flood Hazard Zones.
- Other pertinent documentation for the report.

Based upon the submitted information, the permit approval is within the local Floodplain Administrator's approval authority.

If you need additional information please contact Dave Becker, 614-600-5810 or Josh Reinicke, 614-600-5858.

Thank you for your coordination regarding this project.

Respectfully,



Philip H. Fry, P.E.  
Project Manager / Senior Transportation Engineer  
**URS Corporation**

Enclosures

ODOT Form LD-51  
Revised January 2015



**ENGINEERING "NO-RISE" CERTIFICATION**

This is to certify that that the attached technical data supports a "No-Rise" certification for the work in the Flood Hazard Zones of the Scioto River associated with the:

**I-70/I-71 WEST INTERCHANGE  
BRIDGE REPLACEMENTS OVER THE SCIOTO RIVER  
FRA-70-12.68, (PID # 77372), Project 4A &  
FRA-70-13.10, (PID # 89464), Project 6A**

**Location:**

The proposed project is shown on the Flood Insurance Rate Map for Franklin County and Incorporated Areas, 29049C, Panel 0309K, dated June 17, 2008. The project is contained within the limits of the City of Columbus and involves the demolition and complete re-construction of the bridges that carry I-70 and I-71 over the Scioto River just downstream of lettered section AF.

As described in the attached report, the proposed project will not increase the Base Flood Elevations (100-year flood), floodway elevations and the floodway widths on the Scioto River at lettered sections from AE to AH in the FIS. This determination is based upon the results of a HEC-RAS hydraulic analysis and subsequent report which provides the documentation necessary for the NFIP Permit Application.

<b>Report Title:</b>	BRIDGE WATERWAY HYDRAULIC AND SCOUR ANALYSIS REPORT I-70/I-71 WEST INTERCHANGE BRIDGE REPLACEMENTS OVER THE SCIOTO RIVER for FRA-70-12.68, (PID # 77372), Project 4A & FRA-70-13.10, (PID # 89464), Project 6A
<b>Report Date:</b>	04/24/2015



Signature: \_\_\_\_\_

*Philip H. Fry*

Date: \_\_\_\_\_

*4/24/2015*



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**BRIDGE WATERWAY HYDRAULIC AND SCOUR ANALYSIS REPORT  
FOR  
I-70 / I-71 West Interchange  
Bridge Replacements  
Over  
Scioto River**

**PID NO. 77372, FRA-70-12.68, Project 4A  
And  
PID NO. 89464, FRA-70-13.10, Project 6A**



**LOCATION:  
City of Columbus,  
Franklin County, Ohio**

**OWNER: ODOT DISTRICT 6  
CLIENT: GPD GROUP  
PREPARED BY: URS CORPORATION  
DATE: 04/24/2015**



*Philip H. Fry*  
4/24/2015

**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
**I-70 / I-71 WEST INTERCHANGE**  
**BRIDGE REPLACEMENTS over THE SCIOTO RIVER**  
**PROJECT 4A – STAGE 2 and PROJECT 6A – TS&L**

Cover Letter  
 Flood Hazard Zone Compliance Letter / Permit Application  
 No-Rise Certification

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**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
**I-70 / I-71 WEST INTERCHANGE**  
**BRIDGE REPLACEMENTS over THE SCIOTO RIVER**  
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Exhibit 2	FEMA FIRM with Proposed Project Improvements and Flood Zone Impacts
Exhibit 3	Supplemental River Site Plan
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**Volume II**

**Appendices (DVD / CD ROM only)**

Appendix A	Existing Bridge Plans
Appendix B	Existing Floodwall Plans
Appendix C	FEMA FIS Data
Appendix D	Photographs
Appendix E	Proposed Project 4A: Stage 2 Plans
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Appendix G.	HEC-RAS Models
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Appendix I	Scour Analysis
Appendix J	Temporary Access Fill
Appendix K	FEMA Flood Zones Coordination
Appendix L	Letters, No-Rise Certification, Report, Exhibits and Appendix (Electronic PDF file Copy)

**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
**I-70 / I-71 WEST INTERCHANGE**  
**BRIDGE REPLACEMENTS over THE SCIOTO RIVER**  
**PROJECT 4A – STAGE 2 and PROJECT 6A – TS&L**

**Executive Summary**

The proposed improvements of this project are part of the Columbus Crossroads project that encompass the I-70 and I-71 highway network through downtown Columbus, Ohio and extends from the West Interchange (Project 6) near the west side of downtown eastward then northward to the interchange with I-71 and I-670 (Project 1). This bridge waterway hydraulic and scour analysis report was performed and prepared by URS Corporation (URS) on behalf of Glaus, Pyle, Shomer, Burns, and DeHaven, Inc. (GPD Group) for the FRA-13.54 project, PID Number 77372, Part 1 of the agreement between ODOT and GPD Group.

The purpose of the Bridge Waterway Hydraulic and Scour Analysis Report is to support the Bridge Type Structure Study and Stage 1 Bridge Design tasks to document the flood zone impacts and scour results for review and approval by ODOT and the Floodplain Administrator. The analysis scope was for Project 4A (eastbound bridges); one (1) project consisting of two (2) proposed bridges, the EB / NB Mainline and Collector Distributor bridges over the Scioto River, in Columbus, Ohio. The scope was later modified to include Project 6A, (3 westbound bridges to be designed by ms Consultants). This revised scope was performed by URS under contract with GPD Group.

During this initial phase of the Part 1 of the project development process for Project 4A, the project emphasis was on the Structure Type Study to evaluate the alternatives for a Structure Type Selection to move forward into the Stage 1 to Final Tracings design. URS prepared and submitted two prior reports entitled PRELIMINARY BRIDGE WATERWAY HYDRAULIC REPORT FOR I-70 / I-71 West Interchange Project 4A, Bridge Replacements Over Scioto River, FRA-70-13.54, PID NO. 77372, Structures: FRA-70-1321R & FRA-70-1321R 1321A, on the following dates:

- TS&L Submittal, Dated 10/16/2013;
- RAISED PROFILES – RC – 2, 3, & 4, Dated 10/28/2013.

The horizontal and vertical alignments have been altered significantly from those prior reports so that the proposed low beam elevations clear the 500-year water surface elevation in order to obtain results that will not impact the water surface elevations for all three events, the 100-year flood, the Special Protection Flood (SPF or Floodwall Design Flood) and the 500-year flood. Also, the TS&L submittal resulted in the direction to use the 5-span design for the all five bridges. This report replaces and supersedes those prior reports and all other communication resulting from those analyzes. This work was performed in accordance with the appropriate sections of the ODOT Project Development Process, Location and Design Manuals, and the Bridge Design Manual.

This Bridge Waterway Hydraulic and Scour Analysis Report documents the results of the Effective, Corrected, and Existing condition models and the revised proposed condition models. While the previous analyses looked at various pier span and beam type alternatives this report provides documentation for three proposed conditions. Each of the three proposed condition models are the same for the two southern, Project 4A bridges whereas the three northern, Project 6A bridges vary in the pier type. The Proposed Conditions 1 and 2 models were generated during the development of the Project 6A TS&L. As a result of the TS&L and third arrangement of piers was selected as the design to advance so the third proposed condition model was added for this submittal.

The proposed structures will involve work within the designated Floodway for the Scioto River which is regulated to a 0.00 foot increase in water surface elevations at the lettered cross sections designated in the

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PREPARED BY: URS

PID NO. 77372: FRA-70-1321R & 1321A  
PID NO. 89464: FRA-70-1322C & 1323L & FRA-71-1503L



**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
**I-70 / I-71 WEST INTERCHANGE**  
**BRIDGE REPLACEMENTS over THE SCIOTO RIVER**  
**PROJECT 4A – STAGE 2 and PROJECT 6A – TS&L**

FEMA Flood Insurance Study and on the Flood Insurance Rate Maps during the 1-percent annual chance (100-year) flood. The bridge site is also located within the West Columbus Local Protection Project limits which developed and constructed the floodwall along the west side of the river. Therefore, the impact of the proposed bridges and other project elements on the Special Protection Flood (SPF), (floodwall design flood) should also be considered. Therefore, the findings of this report are based upon the results of the HEC-RAS analysis of the Scioto River (which includes both the two proposed bridges as part of Project 4A bridges and the three proposed bridges as part of Project 6A) relative to the comparison of the existing 9-span steel beam conditions versus the proposed 5-span structures and conclude that there is no adverse impact to these two flood events due to the proposed projects.

Therefore, the modeling results support a No-Rise Certification for local floodplain administrator approval of work within a FEMA designated Flood Hazard Zones. This report also provides the scour analysis results, conclusions and recommendations for the selected alternative for the areas under and immediately upstream and downstream of the bridges. Finally, this report also provides miscellaneous hydraulic information necessary to support the plan development and Waterway Permit approvals. This report consists of a paper document containing the text and exhibits and a CD-ROM containing electronic files such as a pdf of the report, pdf of the appendices and HEC-RAS files. This document was prepared for concurrent submittal with the Project 4A, GPD Group, Stage 2 Bridge submittal and is being submitted to ODOT and the City of Columbus for concurrent review and approval.

In order to comply with FEMA requirements, the 100-year event will have to show a rise of 0.00 feet at the upstream limits of the project when compared to the currently effective (published) flood hazard information for the Scioto River. The No-Rise Certification is critical in order to meet the desired project schedule via local approval authority without dependency upon more stringent local or FEMA reviews that will be required associated with the Conditional Letter of Map Revision (CLOMR) process if there is a rise in the 100-year event elevations.

It should be noted however that for the 500-year and the SPF-year events, the calculated water surface elevations reported in **Tables 9 and 10** do report an increase to these elevations at the existing railroad bridge ranging from 0.15 to 0.24 feet and 0.12 to 0.20 feet, respectively. These reported increases however are not the result of the proposed interstate improvements but rather result from fill placed near these locations as part of the Scioto Greenways model for its post-project condition when compared to the Effective Model.

This report recommends that the proposed improvements be approved by the local floodplain administrator because the results are in accordance with the City of Columbus, Ohio Ordinances and FEMA regulations and guidelines which results in the submitted No-Rise Certification.

**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
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**BRIDGE REPLACEMENTS over THE SCIOTO RIVER**  
**PROJECT 4A – STAGE 2 and PROJECT 6A – TS&L**

**Introduction**

The proposed site is located in the southwest portion of downtown Columbus and traffic is currently conveyed over the Scioto River via two bridges, an eastbound and a westbound. The proposed project will construct a total of 5 bridges; 2 bridges eastbound as part of Project 4A and 3 bridges westbound as part of Project 6A. There are two dams and reservoirs located upstream in Delaware County; the O’Shaughnessy Dam on the Scioto River and the Delaware Dam on the Olentangy River. The Flood Insurance Study notes that the Scioto River has no mainstream regulation and the regulation of the flows since the construction of the Delaware Dam has had a major effect on reducing the flood peaks on the Olentangy River.

The existing bridges also span the Scioto Trail (bikeway) which follows the river along its east bank. The trail connects downtown Columbus with the Scioto Audubon Metro Park (immediately south of the project). Along the river’s west bank is a Special Flood Protection – Floodwall / Levee system that is known as the West Columbus Local Protection Project which protects the Franklinton area. A short distance upstream just beyond the study limits was the Main Street Dam that has now been removed. Additional channel grading work associated with the dam removal project is ongoing and is planned for completion before or as Project 4A commences. Downstream of the project site near Greenlawn Avenue there is another low head dam that is planned to remain. The project area is shown within a detailed (Zone AE) floodplain on the Flood Insurance Rate Map (FIRM) for Franklin County and Incorporated Areas, 39049 C, Panel 309K, with an effective date of June 17, 2008.

The existing bridges over the Scioto River are nine-span steel beam structures, and the record plans are dated 04/08/1970 for the Eastbound Structure and 06/16/1970 for the westbound. The bridges are along a curved roadway alignment and skewed to the curved river alignment. The overall bridge span length is approximately 958 feet and the width varies but narrows to approximately 77 feet for the Eastbound and the Westbound is approximately 897 feet span and narrows to 107 feet.

The proposed bridges over the Scioto River are five-span structures. The current plan is to replace the existing eastbound bridge and add a second eastbound bridge immediately downstream of the existing bridge as part of Project 4A. Then the three westbound bridges will be constructed in the vicinity of the existing bridges. The proposed construction will require the use of a temporary access fill (TAF) into the river. In order to maintain the required flow per the ODOT Bridge Design Manual / Location and Design Manual, Volume 2, the TAF may extend all the way across the river with the use of numerous culverts or with an open channel or combination thereof. The proposed bridges are summarized in **Table 1**. The hydraulic analysis indicates that the proposed improvements result in a No-Rise to the calculated water surface elevations. The scour analysis indicates the calculated scour based upon the soil and river conditions at the site however the report discusses the proposed counter measures that are incorporated into the design.

The proposed improvements will need to be permitted with the City of Columbus for work within the floodplain; and with the USACE for work within the waters of the U.S., impacts to the existing floodwall; and impacts within or to the flood protection line. The two projects will be built via separate construction contracts however given the close proximity of the projects, the hydraulic and scour analysis are combined in this document to simplify the analysis and permitting process.

**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
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**PROJECT 4A – STAGE 2 and PROJECT 6A – TS&L**

<b>Table 1.</b>									
<b>Proposed Structure Summary</b>									
<b>Project</b>		<b>PID #</b>	<b>Structure #</b>	<b>Reference #</b>	<b>Alignment</b>	<b>Traffic Conveyance</b>	<b>5-Span Structure Depth</b>	<b>Overall River Span Length</b>	<b>Typical Deck Width</b>
6A	FRA-70 -13.10	89464	FRA-71-1503L	RC1	I-71 SB	Southbound – I-71 Mainline	108 inches	1,289 feet	96 to 58 feet
			FRA-70-1323C	RC2	Ramp D3	Westbound – Collector Distributor	102 inches	1,010 feet	53.33 feet
			FRA-70-1322L	RC3	I-70 WB	Westbound – I-70 Mainline	102 inches	1,010 feet	43.33 feet
4A	FRA-70 -12.68	77372	FRA-70-1321R	RC4	I-70 EB	Eastbound - - I-70 & Northbound – I-71 Mainline	105 inches	1,082 feet	122 to 87 feet
			FRA-70-1321A	RC5	Ramp A5 / B5 / C5	Eastbound – Collector Distributor – Ramps A5/B5/C5	102 inches	1,026 feet	98 to 59 feet

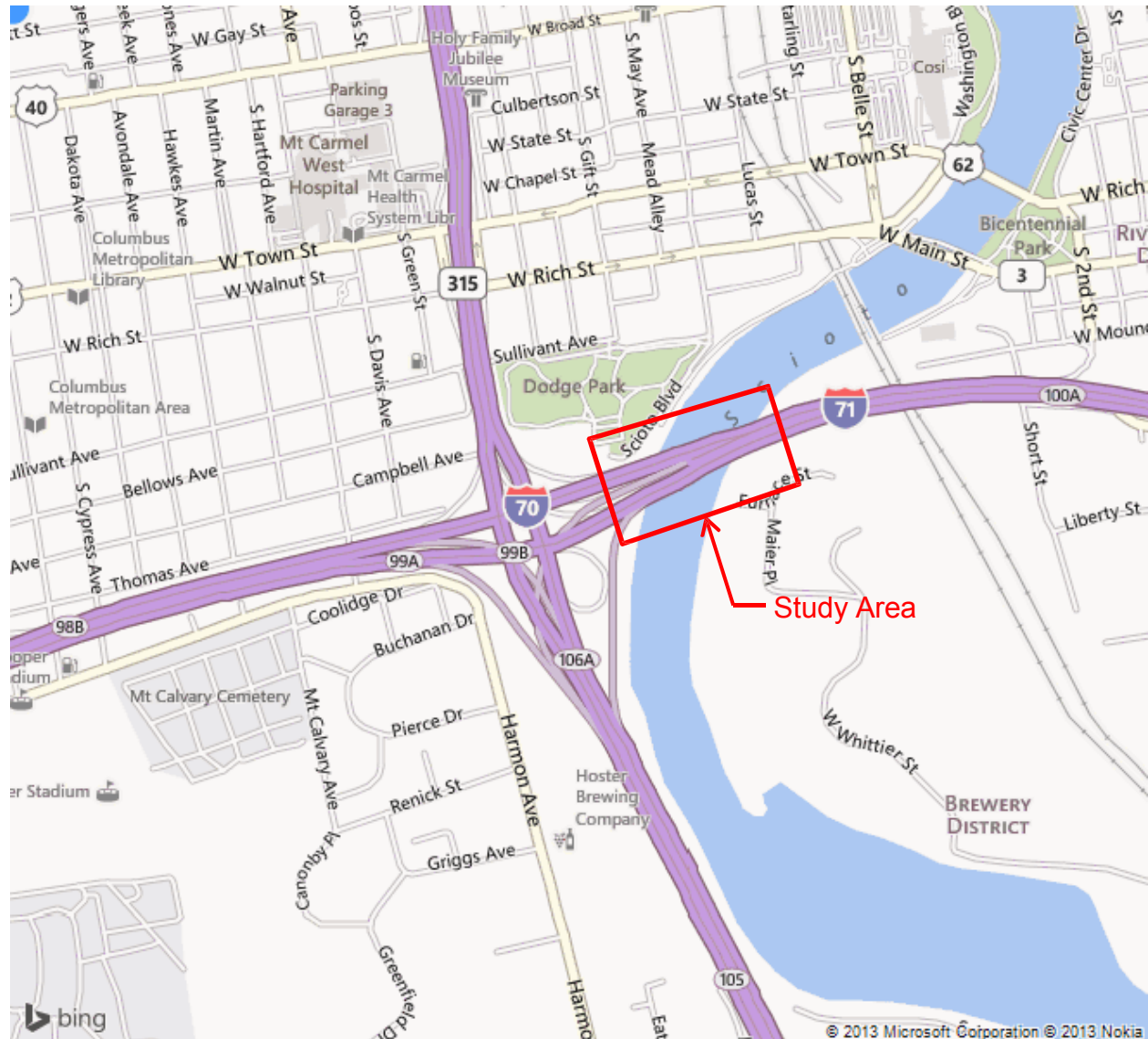
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**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
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**BRIDGE REPLACEMENTS over THE SCIOTO RIVER**  
**PROJECT 4A – STAGE 2 and PROJECT 6A – TS&L**

**Location**

The existing and proposed river crossings are located in the southeast part of downtown Columbus, Ohio. The study area is shown on **Figure 1: Vicinity Map**.



**Figure 1: Vicinity Map**

The bridges are approximately 1.4 miles downstream of the confluence with the Olentangy River. **Figures 2a and 2b: Study Area - Aerial View** shows an overall view of the area surrounding the study area. The study area is also located approximately 1.36 miles upstream of Greenlawn Avenue. Also, **Figure 3: USGS Quadrangle Maps: Southwest Columbus** shows a large scale view with contours. In addition, **Figures 4 – 5** provide aerial views of the study area.

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**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
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**Figure 2a: Study Area with Main Street Dam in Place – Aerial View**



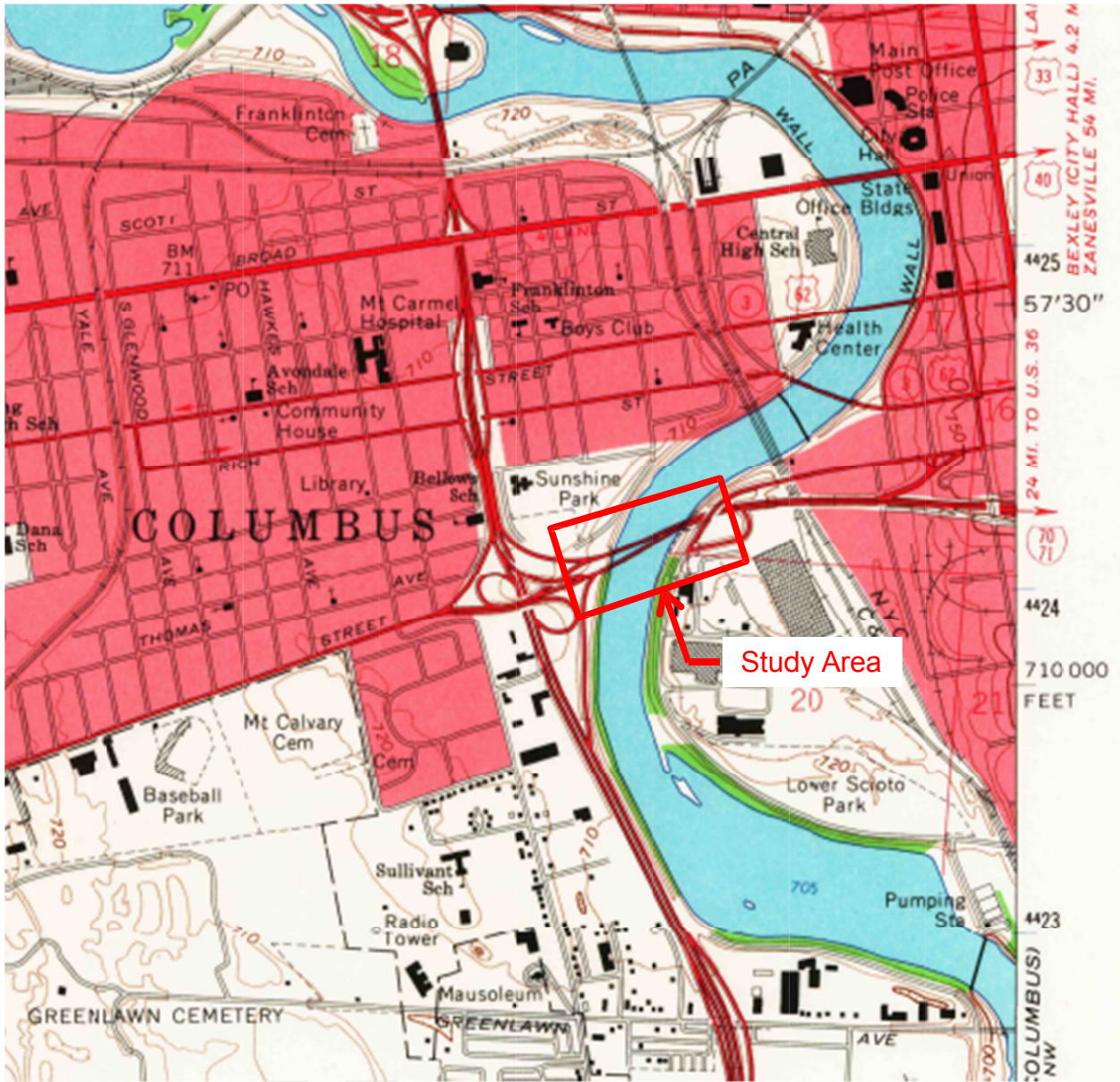
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**Figure 2b: Study Area with Main Street Dam Removed – Aerial View**



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**Figure 3: USGS Quadrangle Map: Southwest Columbus**

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**Figure 4: View: Study Area – Downstream looking Upstream**



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**Figure 5: View: Study Area – Upstream looking Downstream**

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**Jurisdiction / Coordination**

Based upon the project location and funding, coordination will be required with three primary jurisdictions and government agencies. These include the City of Columbus, the US Army Corp of Engineers (USACE), and Metro Parks.

- **City of Columbus, Floodplain Administrator:** The site along the Scioto River is within the City of Columbus corporation limits and will require approval from the City of Columbus Floodplain Administrator for the Flood Zone Coordination and Permitting process. The Floodplain Administrator is the point of contact for flood zone permitting, issues related to the river hydraulics analysis, and for project impacts associated with the flood protection system, floodwall / levee, along the west river bank. The purpose of this report is to provide the necessary documentation that is needed for this review and approval process and is hereby being submitted to the City of Columbus for review and approval.
- **United States Army Corp of Engineers:** Given the size of the tributary area the proposed work within / below Ordinary High Water, the project will require a 404 permit from the USACE, Huntington District, located in Huntington, West Virginia. The permanent and temporary impacts below the Ordinary High Water for this project are anticipated to consist of pier construction, removal of existing piers, channel bank stabilization and temporary access fill in the Scioto River. There is existing rock channel protection of an approximate size compatible with Type B along the east bank under the existing bridges that extends a considerable distance upstream of the Proposed Project 6A RC1 (I-71 Southbound) Bridge. The west bank is similar except the size is approximately compatible with Type C. The need for additional rock channel protection is minimal and may be limited to repairs to the existing rock disturbed during construction. The hydraulics for the temporary access fill is provided in this document and indicates that the peak discharge required per the ODOT Bridge Design Manual can be maintained with an open channel and / or culverts. The limits of existing and proposed rock channel protection and temporary access fill have been identified on the various exhibits provided however these impacts should be tabulated by the bridge designers when there is concurrence from both ODOT and the City of Columbus. It should be noted that the projects will be separate projects but there is considerable overlap due the close proximity of the bridges.

The USACE will also need to be engaged via technical review via contact from the City of Columbus Floodwall Operations and Management staff. The USACE will need to provide technical oversight relative to impacts, potential impacts, or concerns for such items as the floodwalls, gatewells, interchange infield existing surcharge embankment area, and a proposed encroachment to the flood protection line.

- **Metro Parks:** The Scioto Audubon Metro Park is located immediately south of Project 4A east of the river. The Scioto Trail connects the Metro Park with downtown and is located along the east river bank under the existing and proposed bridges. The trail will need to be relocated around the proposed piers without encroaching into the river. The analyses in this document accounted for the proposed re-alignment. As indicated by the bike path cross sections, the proposed sections are at or below the existing ground within the proposed re-alignment area. Via the public involvement process, Metro Parks has requested that the ground surface under the bridges be

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covered with concrete for maintenance purposes. The submitted No-Rise Certification is based upon a Manning's "n" value using concrete slope protection from the existing rock channel protection to the proposed abutment walls. This report also provides a brief discussion of other similar surfaces, concrete pavers and tied concrete block mat that have slightly higher "n" values and the impact to the calculated water surface elevation to determine if these materials could be used as alternates without adversely impacting the No-Rise Certification.

- **United States Geologic Survey:** According to USGS StreamStats website there are two stream gauges; one located upstream of the Broad Street Bridge and located downstream of the SR-104 Bridge. These gauges will not be disturbed by the project.

**Existing Information**

- **FEMA Flood Insurance Study for Franklin County and Incorporated Areas, Ohio:** The purpose of the Flood Insurance Study (FIS) is to investigate the existence and severity of flood hazards in the geographic area of Franklin County, Ohio, and aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The study developed flood risk data for various areas of the community that establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations, 44 CFR 60.3.

The two primary floods on the Scioto River noted in the FIS occurred in March 25, 1913 and January 22, 1959. **Tables 2 and 3** summarize the existing information collected from the Flood Insurance Study.

- **FEMA Flood Insurance Rate Maps:** The vast majority of the bridge span is over the river's Floodway with a small strip of Floodway Fringe on either side according to the FEMA Flood Insurance Rate Map 39049C, Panel 0309K dated June 17, 2008, The hydraulic analysis study limits for this report are from FEMA FIS Cross Section AE, downstream, at the existing interchange divergence point to FEMA FIS Cross Section AG, upstream at the existing Railroad Bridge.

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**Table 2.**  
**FEMA Flood Insurance Study Floodway Data – Scioto River**

FIS Cross Section	Distance		Floodway			1 Percent Annual Chance Flood Water Surface Elevation			
	River Mile	Downstream Distance	Width	Section Area	Mean Velocity	Regulatory	Without Floodway	With Floodway	Increase
		(feet)	(feet)	(square feet)	(feet per second)				
AH	130.579	691	617	12,933	5.4	717.2	717.2	717.6	0.4
AG	130.448	1,283	569	13,919	5.4	716.1	716.1	716.7	0.6
AF	130.205	2,165	522	14,240	5.3	715.6	715.6	716.1	0.5
AE	129.795	2,334	515	13,690	5.5	714.4	714.4	715.0	0.6

Source: Table 9: Floodway Data Scioto River:  
FEMA Flood Insurance Study for Franklin County, Ohio and Incorporated Areas *June 17, 2008.*



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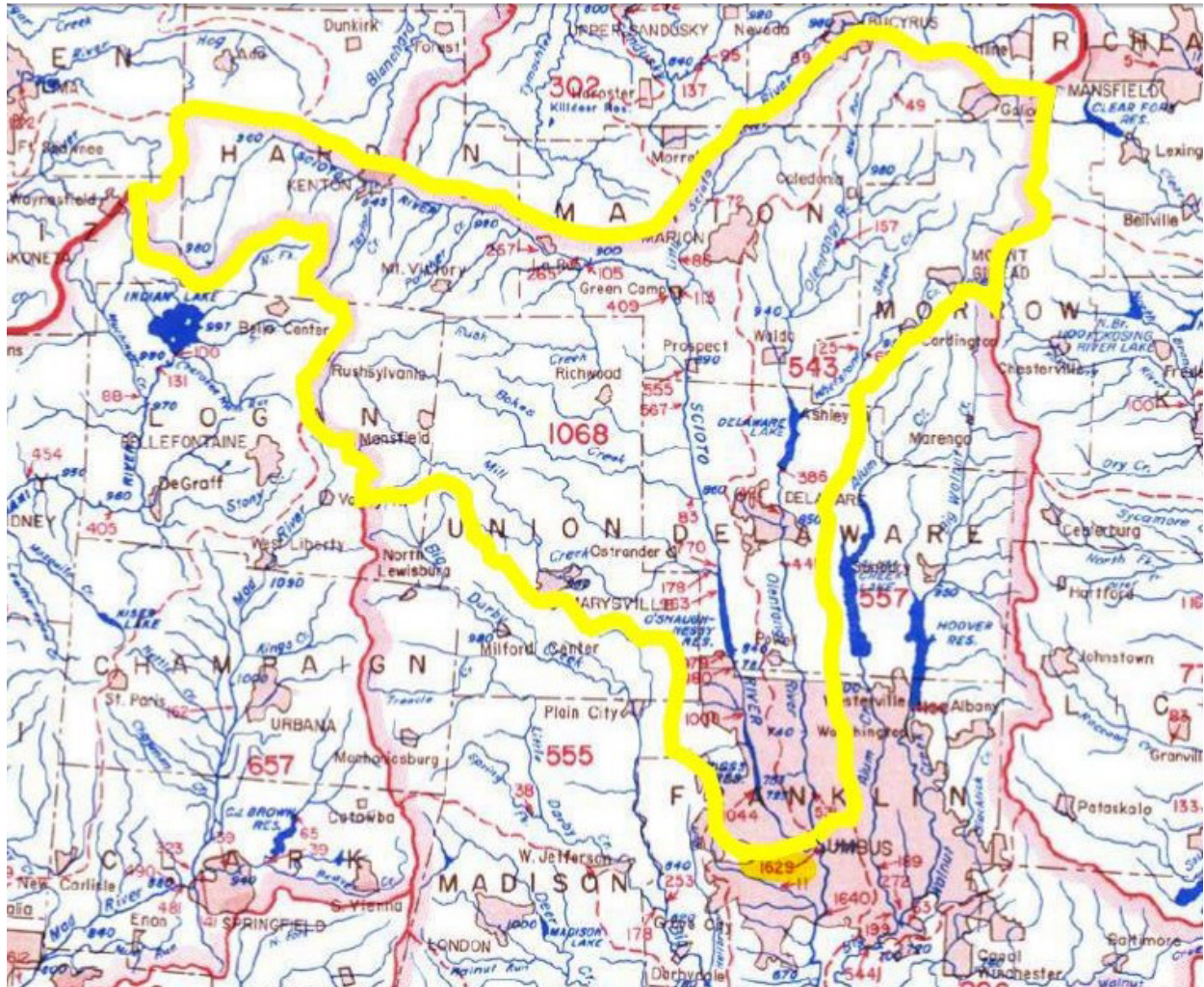
<b>Table 3. FEMA Flood Insurance Study Data Flood Profiles – Scioto River</b>					
<b>FIS Cross Section</b>	<b>Elevation (Graphical)</b> (feet NAVD88)				
	<b>River Bottom</b>	<b>10-year</b>	<b>50-year</b>	<b>100-year</b>	<b>500-year</b>
AH	692.0 (691.9)	711.0 (711.46)	715.0 (715.19)	717.2 (717.27)	723.3 (723.64)
AG	687.2 (684.5)	708.0 (708.07)	714.0 (713.64)	716.1 (715.94)	722.0 (721.51)
AF	685.2 (684.0)	708.0 (707.84)	713.3 (713.33)	715.6 (715.56)	720.7 (720.54)
AE	685.1 (684.9)	707.0 (707.07)	712.2 (712.30)	714.4 (714.39)	719.0 (718.87)

Source: Flood Profiles: Scioto River: 175P & 176P:  
 FEMA Flood Insurance Study for Franklin County, Ohio and Incorporated Areas *June 17, 2008*.  
 (xxx.xx) represents the elevations from the Corrected Effective Model from Stantec for the Scioto Greenways project.

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**Hydrology**

- **Drainage Area Determination:** The drainage area documented in the FEMA Flood Insurance Study, Franklin County, Ohio, dated June 16, 2008 is 1,629.0 square miles at the gauging station at Columbus which also coincides with the ODNR's Watershed Map. The record drawings indicate 1,615 square miles. Since the area determination is not critical to this task because the peak discharges to be used come from the FEMA FIS or Model. Therefore, for the purposes of the information on the plan the 1,629 square miles shall be used.



**Figure 6: Ohio Department of Natural Resources, Division of Water, Principal Streams and their Drainage Area Map, Reprinted 1999**

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- **Design Discharges:** The above referenced Flood Insurance Study also provided the peak discharges for the 10, 50, 100 and 500-year events. The values provided in the FIS differ from those contained in the West Columbus Local Protection Project. The latter discharges were used for the hydraulic analysis to be consistent with the model used for the floodwall design and the analyzes performed for subsequent projects, Town / Rich Street Bridge, Main Street Bridge, Scioto Mile, and the Main Street Dam Removal projects. **Table 4** presents these peak discharges.

		<b>Peak Discharges</b>	
<b>Flood Event</b>		<b>Peak Discharges</b>	
<b>Annual Chance</b>	<b>Year</b>	<b>FEMA FIS 06/17/2008</b>	<b>West Columbus Local Protection Project (SPF – Model)</b>
10%	10	37,000 cfs	36, 800 cfs
2%	50	60,400 cfs	62,100 cfs
1%	100 / Base	72,900 cfs	75,000 cfs
Floodwall Design (SPF)	460+/-	N/A	110,000 cfs
0.2%	500	108,500 cfs	114,000 cfs

**Site Survey**

The Scioto River was surveyed on the state plane coordinate system and elevations reference the NAVD 1988. The river bottom and banks were surveyed by the GPD Group in 2013. The survey was of sufficient detail to create a TIN. The river survey was performed upstream to the existing railroad bridge and approximately 500 downstream of the western abutment of proposed FRA-70-1321A (RC5). The TIN was then used to create hydraulic sections where desired for the analysis.

A review of the river bed contours leads one to believe the existing and proposed site is just downstream of the scour hole created over the years from the Main Street dam. Since this area has been surveyed the Main Street Dam has been removed and it is uncertain how the river bed will change overtime and may or may not influence the calculated water surface for the various events. Since the existing interstate bridge site may function as a weir downstream of the existing scour hole and the downstream low head dam crest elevation at Greenlawn Avenue is the downstream controlling elevation for this site, it is anticipated that the scour hole will begin to fill with sediment during the smaller flow events and the impact of the dam removal will not significantly change the results of the larger events.

It was also observed that the surveyed low beam elevations on the existing bridges ranged from 0.23 to 3.27 feet, with a 1.26 feet average lower than the elevations in the Scioto Greenways Post Project model. These differences are assumed to be due to bridge deck widening that may have occurred since the original FEMA model was created. The surveyed beam elevations are above the 100-year water surface elevations, but some are below the 500-year flood. Since the surveyed elevations were higher than the 100-year and

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lower than the 500-year it was decided not to update the ODOT Existing Condition model because:

- The results of the 100-year flood would not be affected;
- The results of the SPF event, floodwall, would be affected causing the results to indicate higher water surface elevations than presently accounted for which may lead to administrative challenges that may affect timely reviews and approvals; and
- The existing bridges will be demolished as part of these projects therefore the preliminary hydraulics effort recommended that the proposed bridges be raised above the 500-year event to avoid adverse impacts (increases to the water surface elevations) in relationship to the Floodwall, SPF event. The various vertical alignments were raised and updated accordingly in the various proposed condition models.

Therefore, the modeling results will remain rather consistent with the Effective Model as the analysis moves from one model to the next rather than having an Existing Condition model that raises the elevations only to bring the elevations back down again under the proposed conditions.

### **Hydraulic Analysis**

**Duplicate Effective Model:** The Duplicate Effective model is not actually just one model through the reach of the project. Significant changes have been made just upstream of the current project location in recent years, which have generated their own LOMR's, leaving this reach of the Scioto River with more than one Duplicate Effective model. The current effective model for the project location is based on the HEC-RAS model that was completed for the West Columbus Floodwall project that was first published in the FIS in 2004. Just upstream of the project, the local engineering firm of EMH&T applied for, and received a LOMR (Case Number 12-05-3607P, effective January 31, 2013) for two new bridges, one removed bridge and grading activities within the floodplain and floodway to create a new City park. It is due to these complexities that there is no one true Duplicate Effective model to compare to for this project.

**Corrected-Effective Model:** Stantec took the two Effective models, converted them to NAVD 1988, and then utilized them as a Corrected Effective model as part of a project to remove the Main Street Dam, which was located just upstream of the project area. The Stantec model was provided to URS and was further revised utilizing field surveyed cross sections within the limits of the ODOT I-70 / I-71 bridges approximately 500 feet up and down stream of the bridges. A best fit river centerline was established using the curvature of the existing water's edge along the west bank from the aerial photograph then offsetting that curve 250 feet to the center of the river. Cross Section lines were then created from that alignment. The location of the lines were established by extending an I-70 Eastbound (or other alignments as appropriate) cross section lines at 25 feet intervals then turning them perpendicular to the river alignment at the 500-year Flood Boundary as per the Franklin County Auditor's GIS Mapping. A routine within Geopak was then used to create the HEC-RAS format file containing the cross section input data extracted directly from the TIN. The analysis was performed using the U.S. Army Corp of Engineers HEC-RAS, version 4.0 software.

**Existing/Pre-Project Model:** A Pre-project model was created due to previously referenced ongoing work along the Scioto River. During the planning process for this project, the City of Columbus removed the Main St. Dam, which is upstream of the project reach. The pre-project conditions model provides water surface profile results for the Scioto River that are representative of the conditions with the existing interstate bridges across the river, but with the Main Street Dam removed. It is this model that water

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surface elevation comparisons should be made to ensure a “no-rise” condition exists as it is likely that the Stantec model that represents the dam removed condition will become the Effective Model (via a LOMR request once final river bank stabilization is performed which is likely to occur in 2015) prior to the commencement of construction of the proposed project. **Figures 7 and 8** provide a closer aerial view of the existing bridges. For the supplemental site plan that shows the hydraulic model cross section layout please refer to **Exhibit 3** and **Appendix H**. Also, for the existing bridge site plans refer to **Appendix A**.

**Post-Project Condition Model:** The prior preliminary hydraulic reports submitted circa October 2013 provided analyses of three separate span alternatives consisting of a 5-Span Steel Beam, a 7-Span Concrete, and a 7-Span Steel Beam. These three span arrangements were also analyzed for two different profiles. From these preliminary submittals it was determined that the 5-Span alternative will be used for all five bridges. Also, the pier type of pier caps on drilled shafts was selected for the Project 4A bridges. Finally, the horizontal and vertical alignments were revised as needed to raise the bottom beam elevations above the 500-year water surface elevation so that there would be no back water potentially causing a rise to the floodwall design storm.

Additional pier types and sizes were considered and analyzed individually. These designs were incorporated into the model for each of the three bridges and the results were reported. Each of the Proposed Condition models uses the same GPD Group Pier design for the two Projects 4A proposed bridges. The Proposed Condition 1 and 2 models have pier designs that were developed as the Project 6A bridge design developed. The Proposed Condition 1 has multiple drilled shafts with pier caps for each of the five proposed bridges. Proposed Condition 2 however uses a single large diameter drilled shaft for each of the three Projects 6A proposed bridges while the Project 4A bridges remained the same. For the flyover bridge ms consultants developed a pier design that will be referred to as “In-line Triangle”. Preliminary modeling and analysis was performed and reported and this design was incorporated into the Project 6A TS&L submittal in June 2014. In that TS&L submittal Alternate 4 single large diameter drilled was the recommended design for the two of the Project 6A bridges whereas the third bridge, I-71 SB flyover bridge, uses the In-line Triangle for the pier design. These Proposed Condition 1 and 2 models were developed, prepared, and checked, ready for report preparation when ODOT’s selected pier types were provided to URS in August 2014. The selected Project 6A pier types were different from those used in the Proposed Condition 1 and 2 models so a Proposed Condition 3 model was created and analyzed and incorporated into this submittal. **Table 5** provides a summary of the three proposed condition models and the pier types for each bridge used in those models. The selected bridge types are represented in the Proposed Condition 3 model and this model and its results is the basis of the No-Rise Certification.

**Manning’s “n”:** The Manning’s n values contained in the Duplicate Effective model was used throughout the Corrected Effective, Existing / Pre Project, and Post Project models. The n value used in the Effective model was 0.08 for the existing bridge condition. This value was initially used in the proposed condition model and resulted in an increase to the calculated water surface elevation. The n value of 0.08 is representative of trees lining the banks. Based upon the Public Involvement commitment to the Metro Parks to provide concrete under the bridges along the Scioto Trail, the Manning’s ‘n’ values were revised within the project limits to better represent the proposed condition under the proposed bridges. This area will be concrete lined, and the ‘n’ values were revised from 0.08 to 0.017 to better reflect the concrete surface.



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**Overtopping Condition / Flood Clearances:** No roadway overtopping was analyzed because the various flood water surface elevations are below the deck or low beam elevations. The record flood elevation, 714.4 feet, indicated on the record drawings is also below the deck or low beam elevations.



**Figure 7: View: Existing Bridge: Downstream looking Upstream**



**Figure 8: View: Existing Bridge: Upstream looking Downstream**



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**Number of Bridges:** The Corrected Effective and Existing models represented the existing bridges as one bridge which made sense due to their close proximity to each other. For the proposed condition model however it was decided to make each bridge its own, five separate bridges, in the model. Even though the proposed five bridges are in close proximity to each other, the radial channel alignment; the skewed bridges and the varying geometry and cross slopes of each bridge made it necessary and easier to represent the calculated results. Using a five bridge modeling approach interjects additional losses for each bridge that increase the water surface elevation compared to a single or three bridge modeling approach, however the more detailed water surface elevations for each bridge is of greater benefit.

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Table 5. Proposed Condition Models Summary									
Project	PID #	Structure #	Reference #	Alignment	Traffic Conveyance	Pier Type and Size			
						Proposed Condition 1	Proposed Condition 2	Proposed Condition 3	
6A	FRA-70-13.10	89464	FRA-71-1503L	RC1	I-71 SB	Southbound Mainline	<b>TSL Alt. 2:</b> Pier cap on 7, 6, & 5 drilled shafts, 7.0 / 7.5 & 7.5 / 6.0 feet diameter.	<b>TSL Alt. n/a:</b> Pier Cap on Single Column 8.0 / 8.5 feet diameter	<b>Selected:</b> 3.33 feet wide x 60.0 feet base In-line Triangle on 10 feet wide drilled shaft cap on 3 drilled shafts 8.0 feet diameter
			FRA-70-1323C	RC2	Ramp D3	Westbound Collector Distributor:	<b>TSL Alt. 2:</b> Pier cap on 4 drilled shafts, 4.0 / 5.0 feet diameter.	<b>TSL Alt. 4:</b> Pier Cap on Single Column 8.0 / 8.5 feet diameter	<b>Selected:</b> Pier cap on 3 drilled shafts, 5.0 / 5.5 feet diameter
			FRA-70-1322L	RC3	I-70 WB	Westbound Mainline	<b>TSL Alt. 2:</b> Pier cap on 4 drilled shafts, 4.0 / 5.0 feet diameter.	<b>TSL Alt. 4:</b> Pier Cap on Single Column 8.0 / 8.5 feet diameter	<b>Selected:</b> Pier cap on 3 drilled shafts, 5.0 / 5.5 feet diameter
4A	FRA-70-13.54	77372	FRA-70-1321R	RC4	I-70 EB	Eastbound & Northbound Mainline	<b>Selected:</b> Pier cap on 5 to 6 drilled shafts, 5.5 feet diameter		
			FRA-70-1321A	RC5	Ramp A5 / B5 / C5	Eastbound Collector Distributor:	<b>Selected:</b> Pier cap on 3 drilled shafts, 5.5 feet diameter		

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**Results**

The results of the various flood events are summarized in **Tables 6** through **9**. **Table 6** provides the hydraulic data needed for each bridge site plan. In addition, **Table 7** provides the Proposed Condition 3 Hydraulic Vertical Clearance Base Flood which notes that the minimum 100-year vertical clearance is 6.09 feet and the low beams will also clear the 500-year event by approximately 1.05 feet. Also, **Table 8** summarizes the various flood events analyzed and indicates the peak discharge and the calculated water surface elevations along the curved center line of the river. In addition to providing for the 10-year to 500-year events, the results for the normal water, temporary access flow, and the ordinary high-water flow are provided. Finally, **Tables 9** provides the comparison of the effective model through the Proposed Condition models for the various flood events ranging from the 10-year to the 500-year, 0.2% to the 10% Annual Chance, respectively. The table presents the results cross section by cross section so the changes that occurred from model to model may be seen in tabular format.

From these tables some observations should be noted.

- **Record Flood Elevation:** The 100-year Flood is approximately 0.8 to 1.3 feet above the 1913 Record Flood Elevation.
- **Normal Water Elevations:** The normal water elevation was determined by obtaining the highest monthly mean from Stream Stats which is 3,130 cfs. This discharge was used in the Existing / Pre Project Conditions Model to determine the normal water elevation. The results for each bridge are provided in **Table 8**. These elevations are at the center of the river at the upstream face of the bridge.
- **Temporary Access Fill Elevations:** The normal water elevation was determined by obtaining the highest monthly mean from Stream Stats which is 3,130 cfs and multiplying it by two as per the ODOT Location And Design Manual / ODOT Bridge Design Manual Guidance which results in a peak discharge of 6,260 cfs. This discharge was used in the Proposed Condition 3 Model along with boundary conditions for a 1 foot rise above the normal water elevations. The results for each bridge are provided in **Table 8**. These elevations are at the center of the river at the upstream face of the bridge.
- **Ordinary High Water Mark:** The Ordinary High Water elevation was determined by field survey of various piers that had distinct darker mud lines on the piers. The average of these elevations was calculated to be 698.3. The Existing / Pre-Project Condition model was used to determine the discharge equivalent to the average of the surveyed elevations. This trial and error analysis determined that the Ordinary High Water Discharge is equivalent to approximately 19,560 cfs. It should be noted that the Ordinary High Water Mark peak flow is significantly higher than Temporary Access Fill peak flow.
- **Scioto Greenways Project:** The calculated water surface elevations for the Scioto Greenways proposed condition model show:
  - When the Scioto Greenways models were imported into HEC-RAS the unedited models were run and the results were compared to the published results in the Scioto Greenways report for the calculated water surface elevations match exactly for each cross section for each flood event.

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- **At Cross Section 247.5** upstream of the existing railroad bridge shows that their proposed water surface elevation for the SPF is 721.42, +0.24 higher than their Corrective Effective model elevation of 721.18 however it is still lower than their Duplicate Effective model elevation of 721.48. Similarly, the calculated water surface elevation for the 500-year flood is 721.77, +0.24, higher than their Corrective Effective model elevation of 721.51 however it is still lower than their Duplicate Effective model elevation of 721.84.
- **At Cross Section 248.3** where the dam was removed their proposed water surface elevation for the SPF is 721.35, +0.16 higher than their Corrective Effective model elevation of 721.19 however it is still lower than their Duplicate Effective model elevation of 721.48. Similarly, the calculated water surface elevation for the 500-year flood is 721.70, +0.18, higher than their Corrective Effective model elevation of 721.52 however it is still lower than their Duplicate Effective model elevation of because the dam is removed.
- **At Cross Section 249** the first model section upstream of the removed dam location, their proposed elevations are lower than their Corrective Effective model elevations.
- **ODOT Projects:**
  - **Proposed Condition 3:** The calculated water surface elevations for the proposed Interstate improvements show:
    - **At Cross Section 246.5:** The results at this cross section, located upstream of the proposed ODOT bridges and downstream of the existing railroad bridge, show that the proposed water surface elevation for the 100-year flood will decrease 0.02 feet when compared to the Existing Condition model and 0.09 feet when compared to the Duplicate Effective model. In addition the 0.02 feet decrease is consistent for the remaining sections upstream.
    - **At Cross Section 246.5 and above:** The results for the 10 and 50 –year floods indicate that the proposed water surface elevation indicate a change ranging from a 0.00 to 0.02 feet decrease when compared to the Existing Condition model.
    - **At Cross Section 246.5 and above:** The results for the SPF and 500 –year floods indicate that the proposed water surface elevations show the calculated elevation fluctuating back and forth from 0.00 to a 0.01feet increase when compared to the Existing Condition model. These results are negligible because it is due to rounding as evidenced by the intermittent nature of the results. These results only occurs on the SPF and 500-year flood events were as the No-Rise Certification is based upon the 100-year flood results; and the ODOT Proposed Condition calculated water surface elevations actually decrease when compared to the Scioto Greenways’ Corrective Effective model.

These results are for the design that provides a concrete, ( $n=0.017$ ) under the proposed bridges and at the entrance and exit sections. Based upon these results the hydraulic analysis supports a No-Rise Certification.

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- **Manning’s “n”:** The Manning’s n values contained in the Duplicate Effective model were used throughout the Corrected Effective, Existing / Pre Project, and Post Project models. The n value used in the Effective model was 0.08 for the existing bridge condition. This value was initially used in the proposed condition model and resulted in an increase to the calculated water surface elevation. The n value of 0.08 is representative of trees lining the banks, any existing trees within the construction limits will be removed as a matter of necessity during construction. So the Proposed Condition 3 model revised the n value to be 0.04 consistent with rock channel protection. In addition, based upon the Public Involvement commitment to the Metro Parks to provide concrete under the bridges along the Scioto Trail, the Manning’s ‘n’ values were revised under the bridges and at the entrance and exit sections to 0.017 to reflect the proposed concrete surface along the east bank. The results were 0.02 feet decrease for the 100-year flood as reported above.

GPD Group also requested that alternative surface treatments be analyzed rather than only the concrete surface. Some suggestions were using pavers or tied concrete block mat in lieu of concrete. In researching n values, the pavers have the same n value as the 0.017 used for the concrete surface. The n value for tied concrete block mat is listed as 0.03 and 0.04 for Rock Channel Protection in the ODOT L&D Manual Volume 2. It was also noted that there is a fair amount of existing rock channel protection that will remain on in place. Since the typical treatment per the ODOT Manual is to use Rock Channel Protection (n = 0.04) it was determined run the analysis for Rock Channel Protection rather than Tied Concrete Block Mat (n = 0.03) to determine if the results for the worst case condition. A separate Proposed Condition 3 model was created and the locations where n = 0.017 were revised to n = 0.04. The results in the revised model indicate that the banks if lined with rock channel protection will also result in a No-Rise Condition as evidence by the calculated increase of 0.00 feet when compared to the Existing Condition model.

In conclusion, the modeling for the Proposed Condition 3 with Rock Channel Protection indicates that the No-Rise Condition will result whether a concrete surface, pavers, tied concrete block mat or rock channel protection is used under and at the entrance / exit sections of the bridges.

- **Proposed Condition 1:** The results of the Proposed Condition 1 at cross section 247.5, upstream of the existing railroad bridge, indicate that the proposed water surface elevation will decrease 0.02 feet when compared to the Existing Condition model. This model includes the n = 0.017 to represent the concrete surface under the bridges and at the entrance and exit sections. The analysis to increase the n value to 0.04 was not performed because the pier design represented in this model is not the selected pier designs.
- **Proposed Condition 2:** The results of the Proposed Condition 1 at cross section 247.5, upstream of the existing railroad bridge, indicate that the proposed water surface elevation will not change 0.00 feet when compared to the Existing Condition model. This model includes the n = 0.017 to represent the concrete surface under the bridges and at the entrance and exit sections. The analysis to increase the n value to 0.04 was not performed because the pier design represented in this model is not the selected pier designs.



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<b>Table 6. Proposed Condition 3 - Bridge Site Plan Hydraulic Data</b>						
<b>Description</b>	<b>Bridge</b>					<b>Source</b>
	FRA-71-1503L	FRA-70-1323C	FRA-70-1322L	FRA-70-1321R	FRA-70-1321A	
	RC1	RC2	RC3	RC4	RC5	
Normal Pool Elevation	696.2	696.2	696.2	696.2	696.2	USACE: West Columbus Local Protection Project HEC-RAS Model: Low Head Dam upstream of Greenlawn Avenue.
Normal Water Elevation	696.6	696.6	696.6	696.6	696.6	URS HEC-RAS Model: and the Stream Stats Mean of Daily Mean, 3,130 cfs.
Ordinary High Water Mark (OHWM)	698.3	698.3	698.3	698.3	698.3	Average of GPD Group field survey points, top of distinct darker mud line on existing piers.
Flow Line Elevation	As indicated on Bridge Site Plan					GPD Group River Survey TIN
Drainage Area	1,629 +/- Square Miles					ODNR Watershed Map / Gage Station / FIS
Q (100)	75,000 cfs					USACE: West Columbus Local Protection Project HEC-RAS Model
V (100)	5.38 fps	5.06 fps	5.20 fps	5.10 fps	5.67 fps	URS HEC-RAS Model
WSE (100)	715.68	715.43	715.38	715.30	715.21	URS HEC-RAS Model
Q (50)	62,100 cfs					USACE: West Columbus Local Protection Project HEC-RAS Model
V (50)	4.99 fps	4.84 fps	4.55 fps	4.46 fps	5.11 fps	URS HEC-RAS Model
WSE (50)	713.43	713.18	713.15	713.11	712.92	URS HEC-RAS Model
Record Flood	714.4					(1913) from record plans adjusted -0.60 feet for vertical datum.

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<b>Table 7. Proposed Condition 3 - Hydraulic Vertical Clearance Base Flood (feet)</b>								
<b>Structure #</b>	<b>Reference #</b>	<b>Description</b>	<b>Elevation</b>					
			<b>West Bank (Rear Abutment / Pier)</b>	<b>Pier 1</b>	<b>Pier 2</b>	<b>Pier 3</b>	<b>Pier 4</b>	<b>East Bank (Forward Abutment / Pier)</b>
FRA-71-1503L	RC1	Low Beam	776.61	777.12	777.41	778.80	782.39	783.50
		WSE	715.40	715.40	715.68	715.68	715.68	715.68
		<b>Clearance</b>	<b>61.21</b>	<b>61.72</b>	<b>61.73</b>	<b>63.12</b>	<b>66.71</b>	<b>67.92</b>
FRA-70-1323C	RC2	Low Beam	732.18	732.37	733.65	733.44	732.52	730.84
		WSE	715.34	715.34	715.34	715.40	715.40	715.68
		<b>Clearance</b>	<b>16.84</b>	<b>17.03</b>	<b>18.31</b>	<b>18.04</b>	<b>17.12</b>	<b>15.16</b>
FRA-70-1322L	RC3	Low Beam	721.60	723.94	727.35	729.76	729.40	729.60
		WSE	715.30	715.30	715.30	715.30	715.40	715.40
		<b>Clearance</b>	<b>6.30</b>	<b>8.64</b>	<b>12.05</b>	<b>14.46</b>	<b>14.00</b>	<b>14.20</b>
FRA-70-1321R	RC4	Low Beam	721.25	724.36	728.72	728.43	727.54	725.95
		WSE	715.09	715.09	715.21	715.30	715.29	715.30
		<b>Clearance</b>	<b>6.16</b>	<b>9.27</b>	<b>13.51</b>	<b>13.13</b>	<b>12.23</b>	<b>10.65</b>
FRA-70-1321A	RC5	Low Beam	743.50	722.87	724.13	729.20	737.97	721.50
		WSE	715.02	715.21	715.09	715.09	715.02	715.21
		<b>Clearance</b>	<b>28.03</b>	<b>7.66</b>	<b>9.04</b>	<b>14.11</b>	<b>22.95</b>	<b>6.09</b>

Notes:

1. These values account for the bridge skew and river curvature as represented on Exhibits 3 and 4.
2. The 500-year water surface elevations average 4.86 feet higher, and 5.05 feet maximum through the bridges so there is a minimum 1.05 feet vertical clearance during the 500-year event.

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<b>Table 8. Proposed Condition 3 Calculated Water Surface Elevations (feet)</b>						
<b>Event</b>	<b>Peak Discharge</b>	<b>FRA-71-1503L</b>	<b>FRA-70-1323C</b>	<b>FRA-70-1322L</b>	<b>FRA-70-1321R</b>	<b>FRA-70-1321A</b>
		<b>RC1</b>	<b>RC2</b>	<b>RC3</b>	<b>RC4</b>	<b>RC5</b>
Normal Water	3,130	696.6	696.6	696.6	696.6	696.6
Temporary Access Fill – Open Channel – Boundary Condition	6,260	697.4	697.2	697.1	697.0	696.8
Ordinary High Water Mark (OHWM)	19,560	698.3 (average surveyed)				
(10-year)	36,800	707.93	707.73	707.71	707.69	707.54
(50-year)	62,100	713.43	713.18	713.15	713.11	712.92
Base Flood (100-year)	75,000	715.68	715.40	715.34	715.30	715.09
Floodwall Design (460-year+/-)	110,000	720.45	720.08	719.96	719.91	719.63
Scour Design (500-year)	114,000	720.72	720.32	720.20	720.15	719.85
Note: These values are along the curved centerline of river based. Refer to Exhibits 3 and 4 for profile elevations along the River / Pier lines.						

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Net = Comparison of Water Surface Elevations (Current Model minus Corrected Effective)																										
Duplicate Effective				Corrected Effective				Post Project Condition				Pre-Project / Existing Condition				Post Project Condition 3					ODOT Alternatives					
(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(ODOT Projects 4A & 6A)				Proposed ODOT Bridges: 4A - Stage 2 & 6A - TSL Design					(See Table 6 for Descriptions)					
																East Bank under the bridges n=0.017			East Bank under the bridges n=0.04		Post Project Condition 1			Post Project Condition 2		
HEC-RAS Cross Section	Flood Event	Water Surface Elevation		Delta	Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation			Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation				
		NGVD29	NAVD88			NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	Net		NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	NAVD88	Delta	
249.795	<b>Existing Town / Rich Street Bridge</b>																									
249.79	100-Year	718.12	717.52	-0.60	249.79	717.73	0.21	249.79	716.85	-0.88	249.79	716.82	-0.03	249.79	716.80	-0.02	-0.93	249.79	716.82	0.00	249.79	716.79	-0.03	249.79	716.82	0.00
	10-Year	711.79	711.19	-0.60		711.77	0.58		708.65	-3.12		708.67	0.02		708.66	-0.01	-3.11		708.68	0.01		708.66	-0.01		708.67	0.00
	50-Year	715.89	715.29	-0.60		715.63	0.34		714.4	-1.23		714.38	-0.02		714.37	-0.01	-1.26		714.39	0.01		714.36	-0.02		714.38	0.00
	500-Year	724.55	723.95	-0.60		724.05	0.10		723.55	-0.50		723.51	-0.04		723.52	0.01	-0.53		723.51	0.00		723.51	0.00		723.54	0.03
	SPF	724.09	723.49	-0.60		723.58	0.09		723.08	-0.50		723.05	-0.03		723.05	0.00	-0.53		723.04	-0.01		723.04	-0.01		723.07	0.02
249.78	100-Year	718.06	717.46	-0.60																						
	10-Year	711.71	711.11	-0.60																						
	50-Year	715.81	715.21	-0.60																						
	500-Year	724.55	723.95	-0.60																						
	SPF	724.09	723.49	-0.60																						
249.76	100-Year	718.01	717.41	-0.60	249.76	717.26	-0.15	249.76	716.51	-0.75	249.76	716.48	-0.03	249.76	716.46	-0.02	-0.80	249.76	716.48	0.00	249.76	716.46	-0.02	249.76	716.48	0.00
	10-Year	711.7	711.1	-0.60		711.49	0.39		708.45	-3.04		708.48	0.03		708.46	-0.02	-3.03		708.48	0.00		708.46	-0.02		708.47	-0.01
	50-Year	715.77	715.17	-0.60		715.19	0.02		714.08	-1.11		714.07	-0.01		714.05	-0.02	-1.14		714.07	0.00		714.04	-0.03		714.06	-0.01
	500-Year	724.48	723.88	-0.60		723.57	-0.31		723.22	-0.35		723.17	-0.05		723.18	0.01	-0.39		723.17	0.00		723.17	0.00		723.21	0.04
	SPF	724.02	723.42	-0.60		723.11	-0.31		722.75	-0.36		722.71	-0.04		722.71	0.00	-0.40		722.7	-0.01		722.7	-0.01		722.74	0.03
249.74	100-Year	717.98	717.38	-0.60																						
	10-Year	711.66	711.06	-0.60																						
	50-Year	715.73	715.13	-0.60																						
	500-Year	724.47	723.87	-0.60																						
	SPF	724.01	723.41	-0.60																						
249.73	100-Year	717.99	717.39	-0.60																						
	10-Year	711.65	711.05	-0.60																						
	50-Year	715.73	715.13	-0.60																						
	500-Year	724.49	723.89	-0.60																						
	SPF	724.02	723.42	-0.60																						
249.5 AH	100-Year	718	717.4	-0.60	249.5 AH	717.27	-0.13	249.5 AH	716.61	-0.66	249.5 AH	716.58	-0.03	249.5 AH	716.56	-0.02	-0.71	249.5 AH	716.58	0.00	249.5 AH	716.55	-0.03	249.5 AH	716.58	0.00
	10-Year	711.65	711.05	-0.60		711.46	0.41		708.46	-3.00		708.49	0.03		708.48	-0.01	-2.98		708.49	0.00		708.47	-0.02		708.48	-0.01
	50-Year	715.74	715.14	-0.60		715.19	0.05		714.16	-1.03		714.14	-0.02		714.12	-0.02	-1.07		714.15	0.01		714.12	-0.02		714.14	0.00
	500-Year	724.51	723.91	-0.60		723.64	-0.27		723.36	-0.28		723.32	-0.04		723.32	0.00	-0.32		723.31	-0.01		723.31	-0.01		723.35	0.03
	SPF	724.05	723.45	-0.60		723.17	-0.28		722.88	-0.29		722.84	-0.04		722.85	0.01	-0.32		722.84	0.00		722.83	-0.01		722.87	0.03

OWNER: ODOT DISTRICT 6  
CLIENT: GPD GROUP  
PREPARED BY: URS

PID NO. 77372: FRA-70-1321R & 1321A  
PID NO. 89464: FRA-70-1322C & 1323L & FRA-71-1503L



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Duplicate Effective					Corrected Effective			Post Project Condition			Pre-Project / Existing Condition			Post Project Condition 3						ODOT Alternatives						
(Stantec - Scioto Greenways)					(Stantec - Scioto Greenways)			(Stantec - Scioto Greenways)			(ODOT Projects 4A & 6A)			Proposed ODOT Bridges: 4A - Stage 2 & 6A - TSL Design						(See Table 6 for Descriptions)						
														East Bank under the bridges n=0.017			East Bank under the bridges n=0.04			Post Project Condition 1			Post Project Condition 2			
HEC-RAS Cross Section	Flood Event	Water Surface Elevation		Delta	Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation			Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation				
		NGVD29	NAVD88			NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	Net		NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	NAVD88	Delta	
249.4	100-Year	717.81	717.21	-0.60																						
	10-Year	711.52	710.92	-0.60																						
	50-Year	715.56	714.96	-0.60																						
	500-Year	724.3	723.7	-0.60																						
	SPF	723.84	723.24	-0.60																						
249.3	<b>Existing Main Street Bridge</b>				249.30			249.30			249.30				249.30			249.3			249.3					
249.2	100-Year	717.46	716.86	-0.60																						
	10-Year	711.34	710.74	-0.60																						
	50-Year	715.28	714.68	-0.60																						
	500-Year	723.13	722.53	-0.60																						
	SPF	722.78	722.18	-0.60																						
249.1	100-Year	717.42	716.82	-0.60	249.1	716.96	0.14	249.1	716.38	-0.58	249.1	716.35	-0.03	249.1	716.33	<b>-0.02</b>	<b>-0.63</b>	249.1	716.35	<b>0.00</b>	249.1	716.32	-0.03	249.1	716.35	0.00
	10-Year	711.32	710.72	-0.60		711.31	0.59		708.34	-2.97		708.36	0.02		708.35	<b>-0.01</b>	<b>-2.96</b>		708.37	<b>0.01</b>		708.34	-0.02		708.36	0.00
	50-Year	715.25	714.65	-0.60		714.96	0.31		714.01	-0.95		713.99	-0.02		713.97	<b>-0.02</b>	<b>-0.99</b>		714	<b>0.01</b>		713.97	-0.02		713.99	0.00
	500-Year	723.07	722.47	-0.60		722.35	-0.12		722.33	-0.02		722.29	-0.04		722.30	<b>0.01</b>	<b>-0.05</b>		722.29	0.00		722.28	-0.01		722.32	<b>0.03</b>
	SPF	722.72	722.12	-0.60		722	-0.12		721.96	-0.04		721.92	-0.04		721.92	<b>0.00</b>	<b>-0.08</b>		721.92	0.00		721.91	-0.01		721.95	<b>0.03</b>
249.08	100-Year	717.41	716.81	-0.60																						
	10-Year	711.31	710.71	-0.60																						
	50-Year	715.24	714.64	-0.60																						
	500-Year	723.07	722.47	-0.60																						
	SPF	722.72	722.12	-0.60																						
249.06	100-Year	717.39	716.79	-0.60																						
	10-Year	711.29	710.69	-0.60																						
	50-Year	715.22	714.62	-0.60																						
	500-Year	723.05	722.45	-0.60																						
	SPF	722.69	722.09	-0.60																						
249.04	100-Year	717.38	716.78	-0.60																						
	10-Year	711.29	710.69	-0.60																						
	50-Year	715.21	714.61	-0.60																						
	500-Year	723.04	722.44	-0.60																						
	SPF	722.69	722.09	-0.60																						

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(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)			(Stantec - Scioto Greenways)			(ODOT Projects 4A & 6A)			Proposed ODOT Bridges: 4A - Stage 2 & 6A - TSL Design			(See Table 6 for Descriptions)										
													East Bank under the bridges n=0.017			East Bank under the bridges n=0.04			Post Project Condition 1			Post Project Condition 2				
HEC-RAS Cross Section	Flood Event	Water Surface Elevation		Delta	Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation			Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation				
		NGVD29	NAVD88			NAVD88	Delta		NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	Net		NAVD88	Delta		NAVD88	Delta	NAVD88	Delta	NAVD88
249.02	100-Year	717.37	716.77	-0.60																						
	10-Year	711.27	710.67	-0.60																						
	50-Year	715.2	714.6	-0.60																						
	500-Year	723.03	722.43	-0.60																						
	SPF	722.67	722.07	-0.60																						
249	100-Year	717.36	716.76	-0.60	249	716.46	-0.30	249	715.86	-0.60	249	715.82	-0.04	249	715.81	<b>-0.01</b>	<b>-0.65</b>	249	715.83	<b>0.01</b>	249	715.8	-0.02	249	715.83	0.01
	10-Year	711.27	710.67	-0.60		711.03	0.36		708.06	-2.97		708.09	0.03		708.07	<b>-0.02</b>	<b>-2.96</b>		708.09	0.00		708.07	-0.02		708.08	-0.01
	50-Year	715.18	714.58	-0.60		714.51	-0.07		713.57	-0.94		713.55	-0.02		713.53	<b>-0.02</b>	<b>-0.98</b>		713.56	<b>0.01</b>		713.53	-0.02		713.55	0.00
	500-Year	723.02	722.42	-0.60		721.75	-0.67		721.56	-0.19		721.51	-0.05		721.52	<b>0.01</b>	<b>-0.23</b>		721.51	0.00		721.51	0.00		721.55	<b>0.04</b>
	SPF	722.66	722.06	-0.60		721.42	-0.64		721.21	-0.21		721.17	-0.04		721.18	<b>0.01</b>	<b>-0.24</b>		721.17	0.00		721.16	-0.01		721.2	<b>0.03</b>
248.5	100-Year	717.5	716.9	-0.60																						
	10-Year	711.36	710.76	-0.60																						
	50-Year	715.31	714.71	-0.60																						
	500-Year	723.17	722.57	-0.60																						
	SPF	722.82	722.22	-0.60																						
248.4	100-Year	717.48	716.88	-0.60																						
	10-Year	711.35	710.75	-0.60																						
	50-Year	715.3	714.7	-0.60																						
	500-Year	723.16	722.56	-0.60																						
	SPF	722.8	722.2	-0.60																						
<b>Existing Main Street Dam</b>				<b>Main St Dam Removed -&gt;</b>																						
248.3	100-Year				248.3	715.95	-0.38	248.30	715.85	-0.10	248.3	715.81		248.3	715.79	<b>-0.02</b>		248.3	715.81	<b>0.00</b>	248.3	715.78	-0.03	248.3	715.81	0.00
	10-Year					708.08	-0.37		708.06	-0.02		708.09			708.07	<b>-0.02</b>			708.09	0.00		708.07	-0.02		708.08	-0.01
	50-Year					713.66	-0.36		713.55	-0.11		713.53			713.51	<b>-0.02</b>			713.54	<b>0.01</b>		713.5	-0.03		713.53	0.00
	500-Year					721.52	-0.59		721.7	<b>0.18</b>		721.66			721.67	<b>0.01</b>			721.65	-0.01		721.65	-0.01		721.69	<b>0.03</b>
	SPF					721.19	-0.56		721.35	<b>0.16</b>		721.31			721.31	<b>0.00</b>			721.3	-0.01		721.3	-0.01		721.34	<b>0.03</b>
248.2	100-Year	716.93	716.33	-0.60																						
	10-Year	709.05	708.45	-0.60																						
	50-Year	714.62	714.02	-0.60																						
	500-Year	722.71	722.11	-0.60																						
	SPF	722.35	721.75	-0.60																						

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(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(ODOT Projects 4A & 6A)				Proposed ODOT Bridges: 4A - Stage 2 & 6A - TSL Design					(See Table 6 for Descriptions)					
																East Bank under the bridges n=0.017			East Bank under the bridges n=0.04		Post Project Condition 1			Post Project Condition 2		
HEC-RAS Cross Section	Flood Event	Water Surface Elevation		Delta	Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation			Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation				
		NGVD29	NAVD88			NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	Net		NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	NAVD88	Delta	
248.1	100-Year	716.93	716.33	-0.60																						
	10-Year	709.05	708.45	-0.60																						
	50-Year	714.62	714.02	-0.60																						
	500-Year	722.72	722.12	-0.60																						
	SPF	722.36	721.76	-0.60																						
247.5 AG	100-Year	716.73	716.13	-0.60	247.5	715.94	-0.19	247.5	715.93	-0.01	247.5	715.89	-0.04	247.5	715.87	<b>-0.02</b>	<b>-0.07</b>	247.5	715.89	<b>0.00</b>	247.5	715.87	-0.02	247.5	715.89	0.00
	10-Year	708.91	708.31	-0.60		708.07	-0.24		708.1	0.03		708.13	0.03		708.12	<b>-0.01</b>	<b>0.05</b>		708.14	<b>0.01</b>		708.11	-0.02		708.13	0.00
	50-Year	714.44	713.84	-0.60		713.64	-0.20		713.62	-0.02		713.61	-0.01		713.59	<b>-0.02</b>	<b>-0.05</b>		713.61	0.00		713.58	-0.03		713.6	-0.01
	500-Year	722.44	<b>721.84</b>	-0.60		721.51	-0.33		721.77	<b>0.26</b>		721.73	-0.04		721.74	<b>0.01</b>	<b>0.23</b>		721.72	-0.01		721.72	-0.01		721.76	<b>0.03</b>
	SPF	722.08	<b>721.48</b>	-0.60		721.18	-0.30		721.42	<b>0.24</b>		721.38	-0.04		721.38	<b>0.00</b>	<b>0.20</b>		721.37	-0.01		721.37	-0.01		721.41	<b>0.03</b>
247.4	100-Year	716.59	715.99	-0.60																						
	10-Year	708.75	708.15	-0.60																						
	50-Year	714.29	713.69	-0.60																						
	500-Year	722.31	721.71	-0.60																						
	SPF	721.96	721.36	-0.60																						
247.3	<b>Existing Railroad Bridge</b>				247.3			247.3			247.3						247.3					247.3				
247.2	100-Year	716.41	715.81	-0.60																						
	10-Year	708.64	708.04	-0.60																						
	50-Year	714.16	713.56	-0.60																						
	500-Year	721.45	720.85	-0.60																						
	SPF	721.19	720.59	-0.60																						
247.1	100-Year	716.38	715.78	-0.60	247.1	715.76	-0.02	247.1	715.73	-0.03	247.1	715.70	-0.03	247.1	715.68	<b>-0.02</b>	<b>-0.08</b>	247.1	715.7	<b>0.00</b>	247.1	715.67	-0.03	247.1	715.7	0.00
	10-Year	708.62	708.02	-0.60		707.98	-0.04		707.98	0.00		708.00	0.02		707.99	<b>-0.01</b>	<b>0.01</b>		708.01	<b>0.01</b>		707.98	-0.02		708	0.00
	50-Year	714.14	713.54	-0.60		713.51	-0.03		713.49	-0.02		713.48	-0.01		713.46	<b>-0.02</b>	<b>-0.05</b>		713.48	0.00		713.45	-0.03		713.47	-0.01
	500-Year	721.36	720.76	-0.60		720.74	-0.02		720.71	-0.03		720.67	-0.04		720.67	<b>0.00</b>	<b>-0.07</b>		720.66	-0.01		720.66	-0.01		720.7	<b>0.03</b>
	SPF	721.1	720.5	-0.60		720.48	-0.02		720.45	-0.03		720.41	-0.04		720.42	<b>0.01</b>	<b>-0.06</b>		720.41	0.00		720.41	0.00		720.44	<b>0.03</b>
246.5	100-Year	716.16	715.56	-0.60	246.8	715.74	0.18	246.8	715.71	-0.03	246.8	715.67	-0.04	246.8	715.65	<b>-0.02</b>	<b>-0.09</b>	246.8	715.67	0.00	246.8	715.64	-0.03	246.8	715.67	0.00
	10-Year	708.44	707.84	-0.60		707.96	0.12		707.95	-0.01		707.98	0.03		707.96	<b>-0.02</b>	<b>0.00</b>		707.98	0.00		707.96	-0.02		707.97	-0.01
	50-Year	713.93	713.33	-0.60		713.49	0.16		713.46	-0.03		713.45	-0.01		713.43	<b>-0.02</b>	<b>-0.06</b>		713.45	0.00		713.42	-0.03		713.44	-0.01
	500-Year	721.09	720.49	-0.60		720.71	0.22		720.67	-0.04		720.63	-0.04		720.63	<b>0.00</b>	<b>-0.08</b>		720.62	-0.01		720.62	-0.01		720.66	<b>0.03</b>
	SPF	720.84	720.24	-0.60		720.46	0.22		720.41	-0.05		720.38	-0.03		720.38	<b>0.00</b>	<b>-0.08</b>		720.37	-0.01		720.37	-0.01		720.4	<b>0.02</b>

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PID NO. 77372: FRA-70-1321R & 1321A  
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**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT**  
**I-70 / I-71 WEST INTERCHANGE**  
**BRIDGE REPLACEMENTS over THE SCIOTO RIVER**  
**PROJECT 4A – STAGE 2 and PROJECT 6A – TS&L**

Table 9																									
HEC-RAS Model Results Summary																									
Delta = Comparison of Water Surface Elevations (Current Model minus Previous Model)																									
Net = Comparison of Water Surface Elevations (Current Model minus Corrected Effective)																									
Duplicate Effective				Corrected Effective				Post Project Condition				Pre-Project / Existing Condition				Post Project Condition 3						ODOT Alternatives			
(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(ODOT Projects 4A & 6A)				Proposed ODOT Bridges: 4A - Stage 2 & 6A - TSL Design						(See Table 6 for Descriptions)			
																East Bank under the bridges n=0.017			East Bank under the bridges n=0.04			Post Project Condition 1		Post Project Condition 2	
HEC-RAS Cross Section	Flood Event	Water Surface Elevation		Delta	Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation			Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation			
		NGVD29	NAVD88			NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	Net		NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	NAVD88	Delta
246.4	100-Year	715.92	715.32	-0.60	246.50	715.56	0.24	246.50	715.56	0.00															
	10-Year	708.33	707.73	-0.60		707.84	0.11		707.84	0.00															
	50-Year	713.74	713.14	-0.60		713.33	0.19		713.33	0.00															
	500-Year	720.76	720.16	-0.60		720.49	0.33		720.49	0.00															
	SPF	720.53	719.93	-0.60		720.24	0.31		720.24	0.00															
	100-Year								715.64		246.39	246.39	715.68	0.04	246.39	715.68	0.04	246.39	715.67	0.03	246.39	715.69	0.05		
	10-Year								707.92				707.93	0.01		707.94	0.02		707.92	0.00		707.94	0.02		
	50-Year												713.41			713.43	0.02		713.44	0.03		713.42	0.01	713.45	0.04
	500-Year												720.64			720.72	0.08		720.69	0.05		720.71	0.07	720.75	0.11
	SPF												720.39			720.46	0.07		720.43	0.04		720.45	0.06	720.49	0.10
												246.38	<b>RC 1 FRA-71-1503L I-71 SB</b>												
	100-Year								715.38		246.37	246.37	715.46	0.08	246.37	715.43	0.05	246.37	715.46	0.08	246.37	715.48	0.10		
	10-Year								707.75				707.75	0.00		707.75	0.00		707.75	0.00		707.77	0.02		
	50-Year												713.18			713.23	0.05		713.21	0.03		713.23	0.05	713.25	0.07
	500-Year												720.27			720.45	0.18		720.37	0.10		720.44	0.17	720.48	0.21
	SPF												720.03			720.20	0.17		720.12	0.09		720.19	0.16	720.23	0.20
	100-Year								715.32		246.35	246.35	715.41	0.09	246.35	715.36	0.04	246.35	715.4	0.08	246.35	715.43	0.11		
	10-Year								707.72				707.73	0.01		707.72	0.00		707.73	0.01		707.74	0.02		
	50-Year												713.13			713.19	0.06		713.16	0.03		713.18	0.05	713.2	0.07
	500-Year												720.18			720.35	0.17		720.28	0.10		720.34	0.16	720.38	0.20
	SPF												719.95			720.10	0.15		720.04	0.09		720.1	0.15	720.13	0.18
												246.34	<b>RC 2 FRA-70-1323C Ramp D3</b>												
	100-Year											246.33	715.39		246.33	715.38		246.33	715.38		246.33	715.4			
	10-Year								707.73				707.73			707.72			707.73						
	50-Year												713.17			713.17			713.17			713.18			
	500-Year												720.31			720.28			720.3			720.32			
	SPF												720.07			720.04			720.06			720.08			
	100-Year				246.40	715.32		246.40	715.32	0.00		246.31	715.35		246.31	715.33		246.31	715.35		246.31	715.36			
	10-Year								707.73				707.73	0.00		707.71			707.71			707.72			
	50-Year												713.14	0.00		713.15			713.13			713.15		713.16	
	500-Year												720.16	0.00		720.23			720.22			720.24			
	SPF												719.93	0.00		719.99			719.98			719.99		720.01	

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Table 9																																			
HEC-RAS Model Results Summary																																			
Delta = Comparison of Water Surface Elevations (Current Model minus Previous Model)																																			
Net = Comparison of Water Surface Elevations (Current Model minus Corrected Effective)																																			
Duplicate Effective				Corrected Effective				Post Project Condition				Pre-Project / Existing Condition				Post Project Condition 3					ODOT Alternatives														
(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(ODOT Projects 4A & 6A)				Proposed ODOT Bridges: 4A - Stage 2 & 6A - TSL Design					(See Table 6 for Descriptions)														
																East Bank under the bridges n=0.017			East Bank under the bridges n=0.04		Post Project Condition 1			Post Project Condition 2											
HEC-RAS Cross Section	Flood Event	Water Surface Elevation		Delta	Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation											
		NGVD29	NAVD88			NAVD88	Delta		NAVD88	Delta		NAVD88	Delta		NAVD88	Delta		NAVD88	Delta		Net	NAVD88		Delta	NAVD88	Delta	NAVD88	Delta	NAVD88	Delta					
246.3	<b>Existing I-70 / I-71 Bridges</b>												246.30	<b>RC 3 FRA-70-1322L I-70 WB</b>																					
	100-Year														246.29	715.31				246.29	715.3			246.29	715.31				246.29	715.31					
	10-Year														246.29	707.68				246.29	707.68			246.29	707.68				246.29	707.68					
	50-Year														246.29	713.11				246.29	713.1			246.29	713.11				246.29	713.11					
	500-Year														246.29	720.16				246.29	720.16			246.29	720.16				246.29	720.16					
	SPF														246.29	719.93				246.29	719.93			246.29	719.93				246.29	719.93					
	100-Year														246.27	715.32				246.27	715.32			246.27	715.32				246.27	715.32					
	10-Year														246.27	707.69				246.27	707.69			246.27	707.69				246.27	707.69					
	50-Year														246.27	713.12				246.27	713.11			246.27	713.12				246.27	713.12					
	500-Year														246.27	720.19				246.27	720.19			246.27	720.19				246.27	720.19					
	SPF														246.27	719.95				246.27	719.96			246.27	719.95				246.27	719.95					
															246.00	<b>RC 4 FRA-70-1321R I-70 EB</b>																			
	100-Year														245.46	715.15				245.46	715.24	0.09		245.46	715.22	0.07		245.46	715.24	0.09		245.46	715.24	0.09	
	10-Year														245.46	707.60				245.46	707.62	0.02		245.46	707.62	0.02		245.46	707.62	0.02		245.46	707.62	0.02	
	50-Year														245.46	712.98				245.46	713.04	0.06		245.46	713.03	0.05		245.46	713.04	0.06		245.46	713.04	0.06	
	500-Year														245.46	719.95				245.46	720.09	0.14		245.46	720.07	0.12		245.46	720.09	0.14		245.46	720.09	0.14	
	SPF														245.46	719.73				245.46	719.86	0.13		245.46	719.84	0.11		245.46	719.86	0.13		245.46	719.86	0.13	
246.2	100-Year	715.63	715.03	-0.60	246.2	715.03	0.00	246.2	715.03	0.00																									
	10-Year	708.16	707.56	-0.60	246.2	707.56	0.00	246.2	707.56	0.00																									
	50-Year	713.49	712.89	-0.60	246.2	712.89	0.00	246.2	712.89	0.00																									
	500-Year	720.33	719.73	-0.60	246.2	719.73	0.00	246.2	719.73	0.00																									
	SPF	720.12	719.52	-0.60	246.2	719.52	0.00	246.2	719.52	0.00																									
246.1	100-Year	715.65	715.05	-0.60	246.1	715.05	0.00	246.1	715.05	0.00	245.44	715.03			245.44	715.10	0.07			245.44	715.08	0.05		245.44	715.1	0.07		245.44	715.1	0.07		245.44	715.1	0.07	
	10-Year	708.15	707.55	-0.60	246.1	707.55	0.00	246.1	707.55	0.00	245.44	707.52			245.44	707.54	0.02			245.44	707.53	0.01		245.44	707.54	0.02		245.44	707.54	0.02		245.44	707.54	0.02	
	50-Year	713.49	712.89	-0.60	246.1	712.89	0.00	246.1	712.89	0.00	245.44	712.87			245.44	712.93	0.06			245.44	712.91	0.04		245.44	712.93	0.06		245.44	712.93	0.06		245.44	712.93	0.06	
	500-Year	720.36	719.76	-0.60	246.1	719.76	0.00	246.1	719.76	0.00	245.44	719.76			245.44	719.88	0.12			245.44	719.87	0.11		245.44	719.88	0.12		245.44	719.88	0.12		245.44	719.88	0.12	
	SPF	720.15	719.55	-0.60	246.1	719.55	0.00	246.1	719.55	0.00	245.44	719.55			245.44	719.66	0.11			245.44	719.65	0.10		245.44	719.66	0.11		245.44	719.66	0.11		245.44	719.66	0.11	
															245.43	<b>RC 5 FRA-70-1321A Ramp A5/B5/C5</b>																			
	100-Year														245.42	714.99				245.42	715.04	0.05		245.42	715.03	0.04		245.42	715.04	0.05		245.42	715.04	0.05	
	10-Year														245.42	707.49				245.42	707.50	0.01		245.42	707.5	0.01		245.42	707.5	0.01		245.42	707.5	0.01	
	50-Year														245.42	712.83				245.42	712.88	0.05		245.42	712.86	0.03		245.42	712.88	0.05		245.42	712.88	0.05	
	500-Year														245.42	719.70				245.42	719.80	0.10		245.42	719.79	0.09		245.42	719.8	0.10		245.42	719.8	0.10	
	SPF														245.42	719.50				245.42	719.59	0.09		245.42	719.58	0.08		245.42	719.59	0.09		245.42	719.59	0.09	

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Duplicate Effective				Corrected Effective				Post Project Condition				Pre-Project / Existing Condition				Post Project Condition 3				ODOT Alternatives											
(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(ODOT Projects 4A & 6A)				Proposed ODOT Bridges: 4A - Stage 2 & 6A - TSL Design				(See Table 6 for Descriptions)											
																East Bank under the bridges n=0.017				East Bank under the bridges n=0.04				Post Project Condition 1				Post Project Condition 2			
HEC-RAS Cross Section	Flood Event	Water Surface Elevation		Delta	Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation			Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation									
		NGVD29	NAVD88			NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	NAVD88		Delta	Net		NAVD88	Delta		NAVD88	Delta	NAVD88	Delta	NAVD88	Delta				
	100-Year										245.4	714.85			245.4	714.85	0.00		245.4	714.85	0.00	245.4	714.85	0.00	245.4	714.85	0.00				
	10-Year										245.4	707.38			245.4	707.38	0.00		245.4	707.38	0.00	245.4	707.38	0.00	245.4	707.38	0.00				
	50-Year										245.4	712.71			245.4	712.71	0.00		245.4	712.71	0.00	245.4	712.71	0.00	245.4	712.71	0.00				
	500-Year										245.4	719.51			245.4	719.51	0.00		245.4	719.51	0.00	245.4	719.51	0.00	245.4	719.51	0.00				
	SPF										245.4	719.31			245.4	719.31	0.00		245.4	719.31	0.00	245.4	719.31	0.00	245.4	719.31	0.00				
	100-Year										245.38	714.84			245.38	714.84	0.00		245.38	714.84	0.00	245.38	714.84	0.00	245.38	714.84	0.00				
	10-Year										245.38	707.38			245.38	707.38	0.00		245.38	707.38	0.00	245.38	707.38	0.00	245.38	707.38	0.00				
	50-Year										245.38	712.70			245.38	712.70	0.00		245.38	712.7	0.00	245.38	712.7	0.00	245.38	712.7	0.00				
	500-Year										245.38	719.49			245.38	719.49	0.00		245.38	719.49	0.00	245.38	719.49	0.00	245.38	719.49	0.00				
	SPF										245.38	719.30			245.38	719.30	0.00		245.38	719.3	0.00	245.38	719.3	0.00	245.38	719.3	0.00				
	100-Year										245.36	714.83			245.36	714.83	0.00		245.36	714.83	0.00	245.36	714.83	0.00	245.36	714.83	0.00				
	10-Year										245.36	707.37			245.36	707.37	0.00		245.36	707.37	0.00	245.36	707.37	0.00	245.36	707.37	0.00				
	50-Year										245.36	712.69			245.36	712.69	0.00		245.36	712.69	0.00	245.36	712.69	0.00	245.36	712.69	0.00				
	500-Year										245.36	719.47			245.36	719.47	0.00		245.36	719.47	0.00	245.36	719.47	0.00	245.36	719.47	0.00				
	SPF										245.36	719.28			245.36	719.28	0.00		245.36	719.28	0.00	245.36	719.28	0.00	245.36	719.28	0.00				
	100-Year										245.34	714.84			245.34	714.84	0.00		245.34	714.84	0.00	245.34	714.84	0.00	245.34	714.84	0.00				
	10-Year										245.34	707.38			245.34	707.38	0.00		245.34	707.38	0.00	245.34	707.38	0.00	245.34	707.38	0.00				
	50-Year										245.34	712.70			245.34	712.70	0.00		245.34	712.7	0.00	245.34	712.7	0.00	245.34	712.7	0.00				
	500-Year										245.34	719.49			245.34	719.49	0.00		245.34	719.49	0.00	245.34	719.49	0.00	245.34	719.49	0.00				
	SPF										245.34	719.29			245.34	719.29	0.00		245.34	719.29	0.00	245.34	719.29	0.00	245.34	719.29	0.00				
	100-Year										245.32	714.85			245.32	714.85	0.00		245.32	714.85	0.00	245.32	714.85	0.00	245.32	714.85	0.00				
	10-Year										245.32	707.38			245.32	707.38	0.00		245.32	707.38	0.00	245.32	707.38	0.00	245.32	707.38	0.00				
	50-Year										245.32	712.70			245.32	712.70	0.00		245.32	712.7	0.00	245.32	712.7	0.00	245.32	712.7	0.00				
	500-Year										245.32	719.51			245.32	719.51	0.00		245.32	719.51	0.00	245.32	719.51	0.00	245.32	719.51	0.00				
	SPF										245.32	719.31			245.32	719.31	0.00		245.32	719.31	0.00	245.32	719.31	0.00	245.32	719.31	0.00				
	100-Year										245.30	714.79			245.30	714.79	0.00		245.3	714.79	0.00	245.3	714.79	0.00	245.3	714.79	0.00				
	10-Year										245.30	707.35			245.30	707.35	0.00		245.3	707.35	0.00	245.3	707.35	0.00	245.3	707.35	0.00				
	50-Year										245.30	712.66			245.30	712.66	0.00		245.3	712.66	0.00	245.3	712.66	0.00	245.3	712.66	0.00				
	500-Year										245.30	719.42			245.30	719.42	0.00		245.3	719.42	0.00	245.3	719.42	0.00	245.3	719.42	0.00				
	SPF										245.30	719.23			245.30	719.23	0.00		245.3	719.23	0.00	245.3	719.23	0.00	245.3	719.23	0.00				

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Table 9																															
HEC-RAS Model Results Summary																															
Delta = Comparison of Water Surface Elevations (Current Model minus Previous Model)																															
Net = Comparison of Water Surface Elevations (Current Model minus Corrected Effective)																															
Duplicate Effective				Corrected Effective				Post Project Condition				Pre-Project / Existing Condition				Post Project Condition 3				ODOT Alternatives											
(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(Stantec - Scioto Greenways)				(ODOT Projects 4A & 6A)				Proposed ODOT Bridges: 4A - Stage 2 & 6A - TSL Design				(See Table 6 for Descriptions)											
																East Bank under the bridges n=0.017				East Bank under the bridges n=0.04				Post Project Condition 1				Post Project Condition 2			
HEC-RAS Cross Section	Flood Event	Water Surface Elevation		Delta	Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation			Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation		Cross Section	Water Surface Elevation									
		NGVD29	NAVD88			NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	Net		NAVD88	Delta		NAVD88	Delta		NAVD88	Delta	NAVD88	Delta						
	100-Year										245.28	714.79			245.28	714.79	0.00		245.28	714.79	0.00	245.28	714.79	0.00							
	10-Year										245.28	707.35			245.28	707.35	0.00		245.28	707.35	0.00	245.28	707.35	0.00							
	50-Year										245.28	712.66			245.28	712.66	0.00		245.28	712.66	0.00	245.28	712.66	0.00							
	500-Year										245.28	719.42			245.28	719.42	0.00		245.28	719.42	0.00	245.28	719.42	0.00							
	SPF										245.28	719.23			245.28	719.23	0.00		245.28	719.23	0.00	245.28	719.23	0.00							
	100-Year										245.26	714.78			245.26	714.78	0.00		245.26	714.78	0.00	245.26	714.78	0.00							
	10-Year										245.26	707.35			245.26	707.35	0.00		245.26	707.35	0.00	245.26	707.35	0.00							
	50-Year										245.26	712.65			245.26	712.65	0.00		245.26	712.65	0.00	245.26	712.65	0.00							
	500-Year										245.26	719.41			245.26	719.41	0.00		245.26	719.41	0.00	245.26	719.41	0.00							
	SPF										245.26	719.22			245.26	719.22	0.00		245.26	719.22	0.00	245.26	719.22	0.00							
	100-Year										245.24	714.77			245.24	714.77	0.00		245.24	714.77	0.00	245.24	714.77	0.00							
	10-Year										245.24	707.34			245.24	707.34	0.00		245.24	707.34	0.00	245.24	707.34	0.00							
	50-Year										245.24	712.64			245.24	712.64	0.00		245.24	712.64	0.00	245.24	712.64	0.00							
	500-Year										245.24	719.38			245.24	719.38	0.00		245.24	719.38	0.00	245.24	719.38	0.00							
	SPF										245.24	719.20			245.24	719.20	0.00		245.24	719.20	0.00	245.24	719.20	0.00							
	100-Year										245.22	714.76			245.22	714.76	0.00		245.22	714.76	0.00	245.22	714.76	0.00							
	10-Year										245.22	707.33			245.22	707.33	0.00		245.22	707.33	0.00	245.22	707.33	0.00							
	50-Year										245.22	712.63			245.22	712.63	0.00		245.22	712.63	0.00	245.22	712.63	0.00							
	500-Year										245.22	719.37			245.22	719.37	0.00		245.22	719.37	0.00	245.22	719.37	0.00							
	SPF										245.22	719.18			245.22	719.18	0.00		245.22	719.18	0.00	245.22	719.18	0.00							
245	100-Year	714.99	714.39	-0.60	245	714.39	0.00	245	714.39	0.00	245	714.39	0.00	245	714.39	<b>0.00</b>	<b>0.00</b>	245	714.39	<b>0.00</b>	245	714.39	0.00	245	714.39	0.00					
	10-Year	707.67	707.07	-0.60		707.07	0.00		707.07	0.00		707.07	<b>0.00</b>		<b>0.00</b>	707.07	0.00		707.07	0.00											
	50-Year	712.9	712.3	-0.60		712.3	0.00		712.3	0.00		712.30	<b>0.00</b>		<b>0.00</b>	712.3	0.00		712.3	0.00											
	500-Year	719.47	718.87	-0.60		718.87	0.00		718.87	0.00		718.87	<b>0.00</b>		<b>0.00</b>	718.87	0.00		718.87	0.00											
	SPF	719.31	718.71	-0.60		718.71	0.00		718.71	0.00		718.71	<b>0.00</b>		<b>0.00</b>	718.71	0.00		718.71	0.00											

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**Temporary Access Fill (TAF):** The discussion provides the information that will be needed related to the temporary access fill and associated waterway permit. The section provides the information that establishes the top elevation of and the design flows for the TAF.

The ODOT Bridge Design Manual states that the top surface of the TAF shall be located 1'-0" above the OHWM. For this project the OHWM was a distinct darker mud-line on the various existing piers. These mud-lines were surveyed by GPD Group and provided to URS. The average of the surveyed elevations was determined to be 698.3 and may be used for all proposed bridges, therefore the TAF elevation should be 699.3 in accordance with the ODOT Manual guidelines.

The Manual also states that the TAF shall be designed to maintain a flow equal to two times the highest average monthly flow (i.e. the largest of Q1, Q2, Q3, ...Q12), as reported by the USGS web based application, StreamStats, such that no rise in the backwater above OHWM is permitted. The highest monthly mean has already been established as 3,130 cfs which occurs in March. Therefore, the TAF design flow should be 6,260 cfs, in accordance with these guidelines.

GPD Group provided a sketch representing the TAF for their bridges. This sketch was also applied in similar fashion to the Project 6A bridges. A HEC-RAS analysis was performed to determine the adequacy of this design for the 6,260 cfs peak discharge. The Proposed Condition 3 model was copied and revised to represent the TAF in accordance with the sketch provided. The boundary condition for the TAF was set to be 0.5 feet above the crest elevation of the Greenlawn Avenue dam, located downstream of the project area. The results are provided in **Table 8** and TAF plan and profile views are provided in **Exhibit 5**. The open channel is adequate to convey the indicated flow.

An additional level of analysis was developed to determine the extent of Temporary Access Fill that could be placed without increasing the water surface elevations more than 1 foot above the OHW, 698.3, again using the peak discharge of 6,260 cfs. The results indicate that the open channel may be reduced such that the TAF may extend into the main channel approximately 15-feet past the piers and convey the indicated flow with a 1 foot rise.

Additionally, a conceptual culvert analysis was also performed using HY-8. The various input data for a single 96" concrete conduit was entered. The number of barrels was revised in order to determine the number of pipes that will be needed to convey the 6,260 cfs. It was determined that 17 pipes will be needed to convey the required flow if the TAF were constructed completely across the river. This analysis was based upon various assumptions or observed conditions such as:

- The river bottom elevations vary from as low as 684 to 691 to a typical high bottom elevation in the 687 to 690 range.
- Another constraint is that the downstream low head dam near Greenlawn Ave has a crest elevation of 696.3 which was used as the tailwater elevation.
- Minimum cover 1.5 feet.
- Pipe Size 96" diameter, (while portions of the channel could accommodate larger pipe the 96" was selected because it was the largest pipe size that fits in the shallow sections of the channel while maintaining the minimum cover).
- All pipe flowline elevations were 688.7, outlet and 689.8, inlet.
- The pipes are spaced 10 feet center to center or approximately 1 foot out-to-out separation and spaced no closer than 10 feet to an existing or proposed pier. Based upon these constraints it may be possible to place up to 26 pipes under the TAF with the open channel.

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- The pipe length was assumed to be continuous, approximately 400 feet, under all 5 bridges. This length accounts for overlapping TAF Phases and overlapping Projects all at one time which will not occur but some overlapping of Phases and Projects is anticipated. Since pipe needs to be laid generally in a straight line the actual placement details may vary and should be coordinated between projects if the construction schedules overlap.

Other noteworthy observations are:

- Although the TAF at any given time will not exceed 250 feet (the RGP requirement) the collectively the total length of temporary stream impact will exceed 250 feet).
- Since the TAF design flow, 6,260 cfs is significantly less than the flow equivalent to the OHWM. The Existing Condition model was used via trial and error to determine the peak discharge conveyed at the OHWM, elevation 698.3. This analysis determined the OHWM peak discharge to be approximately 19,560 cfs, as shown in **Table 8**.

In conclusion, the TAF design presented has the capacity to convey 6,260 cfs such that no rise in the backwater above OHWM will occur. The flow requirements can be met with either culverts or open channel or a combination of both, however an open channel is recommended. In order to minimize the potential damage to the TAF during construction due to higher flows, consideration may be given to designing the TAF for larger flows (such as the OHWM flow) which will reduce the temporary impact upon the river yet still provide the contractor's with the necessary pier accessibility and construction sequencing.

### **Scour Analysis**

This scour analysis takes into account both qualitative and quantitative information. The qualitative information includes reviewing various sources of information to gain a general assessment of changes in the river bed at or near the bridges over a period of time (long term aggradation or degradation). The quantitative information utilizes the proposed condition HEC-RAS model and soil data within a subroutine of HEC-RAS. This subroutine is based upon the HEC-18 scour computations. The following is a summary of the existing information reviewed for this project.

**Record Plans:** According to the record drawings for the existing eastbound bridge the bottom of footing is at elevations 703 feet and 702 feet and supported by piles for the abutments. The piers are also supported by footings with the bottom of footings ranging in elevations from 678 feet to 679 feet in the river and 686 feet to 691 feet on the east bank. Similarly, the westbound bridge record drawings indicate that the bottom of footing is at elevations 709 feet and 702 feet and supported by 30 feet deep piles for the abutments. The 25 to 30 feet deep piers are also supported by footings with the bottom of footings ranging in elevations from 678 feet to 679 feet in the river and 686 feet to 691 feet on the east bank. Crushed aggregate slope protection is indicated for the 2:1 slope in front of the east abutment.

**Bridge Inspection Reports:** Various bridge inspection reports for the existing bridges were obtained via ODOT. These reports range in dates from 1984 to 2013. These reports generally indicate that the site is stable.

**Aerial Photographs:** Franklin County Auditor's Aerial photographs and GIS mapping were reviewed to see there were any indications of the horizontal alignment changes to the river bed due to aggradation or degradation. There were no visual indications detected which was also confirmed with overlaying GIS

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cadd files. The cadd files reflect negligible changes to the waterlines which may be accounted for by the differences in the river flow at the time of the mapping. Therefore from this review there is no apparent qualitative scour concern.

**Detailed River Survey:** The river bed elevations, under the existing bridges, range from 686 feet to 691 feet. The location of elevation, 686 feet elevation occurs between Piers 5 and 6 toward the east bank. The 686 feet elevation is generally at mid span and is still approximately 8 feet higher than the bottom of footing elevations.

**Site Visit:** During various site visits existing rock channel protection of an approximate size compatible with Type B was observed. The existing rock channel protection is located along the east bank under the existing bridges and extends a considerable distance upstream of the proposed Project 6A, I-71 (Southbound) bridge. The rock channel protection seems to extend downstream a considerable distance as well although it is harder to observe due to the lower bank elevation and vegetation. The bank protection appears to be stable except for an area under the existing bridge that appears to be eroding from behind the piers when the overbank flow recedes back into the main channel flow. These areas should be identified and stabilized with Rock Channel Protection in the proposed plans.

The west bank upstream of the bridge is partially lined with Rock Channel Protection, Type C and the balance of the slope is grass up to the floodwall. In addition, the west bank has concrete slope protection under the existing bridges. There are few and small portions of the concrete that need repairs.

South, downstream, of the concrete slope protection there is no rock channel protection and the slopes are vegetated with trees. There is little observable evidence of scour within the construction limits other than the east bank concern noted.

**Scour Computations:**

The quantitative information utilizes the proposed condition HEC-RAS model and soil data within a subroutine of HEC-RAS. This subroutine is based upon the HEC-18 scour computations. The following is a summary of the scour computations performed for Proposed Condition 3. The soil scour analysis was performed using the U.S. Army Corps of Engineers HEC-RAS, version 4.1 software for the 2 bridges and part of Project 4A (RC1 and RC2) and the 3 bridges as part of project 6A (RC3, RC4 and RC5) over Scioto River. The computations are based upon the 500-year flood.

**Assumptions**

The following assumptions were used to determine the scour input parameters:

- The angle of attack for the pier scour calculation was assumed to be 0 degrees for all bridges since the piers are laid to be in-line to the Scioto River.
- The subsurface investigation for existing bridge location was done in 1957. A total of 4 borings were drilled to a depth of up to 50 feet. More recent geotechnical exploration was not provided therefore the scour analysis were based upon the historical (1957) subsurface investigation soil samples. Refer to **Appendix I** for this soil information.
- The mean value for D50 and D95 for borings B-001, B-005, B-013 and B-020 was determined by selecting the mean value per sample depth. After the mean value for each boring depth was selected, one mean value per depth was selected for all borings. See **Table 10** for D95 and **Table 11** for D50 grain size determination.
- Based on the USGS 03219500 Scioto River Gage near Prospect, Ohio, average water temperature in Scioto River is 60 degrees.

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- The scour analysis was performed using 114,000 cfs representing the 500-year flow on Scioto River.
- The RC-1, Piers 9 and 15, were considered vertical wall abutments.
- RC-2 and RC-3 have vertical wall abutments on west bank and spill through abutments on east bank. However, HEC-RAS can only model one kind of abutment per bridge and since vertical wall provides worst case scenario, both RC-2 and RC-3 were assumed to have vertical abutments on both banks.
- RC-4 and RC-5 were modeled as spill through abutments.
- All bridges have abutments that are parallel to the flow (0 degree angle to the flow direction). Additional assumptions have been identified in the detailed HEC-RAS output.

### **Scour Velocity**

In HEC-RAS contraction scour analysis, the river channel is subdivided into left overbank (LOB), channel, and right overbank (ROB). The approach velocity for all three sections of the river channel is separately calculated and is presented in the detailed HEC-RAS output (attached). For the pier scour analysis, a maximum velocity and maximum depth option was used to calculate the maximum velocity and depth in order to account for the potential of the main channel thawed to migrate back and forth within the bridge opening. Therefore, the velocity presented in **Table 12** is the maximum pier velocity.

### **Scour Results**

**Tables 10 and 11**, present mean values for the D95 and D50 particle size determination, respectively. This data was provided by Resource International and was based upon existing boring logs. The result of the scour analysis indicates that the calculated scour depth ranges from 10.8 feet to 22.0 feet for the piers if the natural channel soils remain unprotected. Based upon the river bed survey the bottom of the channel ranges from 686 feet to 691 feet therefore the scour calculations suggest that during a 500-year event the river bottom could be washed away to elevations 664 feet to 681 feet. The scour calculations also indicate that abutment scour ranges from 2.0 feet to 34.7 feet with the deeper locations being along the east bank at the upstream face for both I-71 Southbound pier and the Ramp D3 abutment. The drilled shafts or piles for the proposed piers and abutments will extend to bedrock, at approximately elevation 650, which is a minimum of 36 feet below the existing riverbed elevation. **Table 12** summarizes the pier scour and abutment scour results. Plots from the HEC-RAS analysis are provided in **Appendix I**.

### **Proposed Counter Measures**

The ODOT Location and Design Manual, Volume 2, Section 1107.3 provides the guidance for rock channel protection of bridges over waterways. This section states that the entire spill-through slope, front side of abutments, wingwalls, and corner cones should be protected. Based upon the mean velocity for this site the table provided indicates that 2'-0" thick Type C should be used. Given that:

- the river is in a horizontal curve at the bridge site;
- the maximum velocity calculated for the scour analysis is 9.3 fps;
- the existing east bank is lined with material more equivalent to Type B;
- the cost per cubic yard is insignificant; and
- the increase in rock size and depth is less likely to be disturbed during the larger events and undulating currents.

Rock Channel Protection, Type B, 2'-6" thick should be used. This recommendation is consistent with the special circumstances text within the section of the ODOT Manual.

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Under the bridges along the east bank overbank areas the area is proposed to be a concrete surface based upon a Public Involvement commitment to MetroParks. As previously stated under the Results section of this report, the use of rock channel protection type b in lieu of concrete under the bridges will still result in a No-Rise condition and may be used from a hydraulic / flood analysis perspective.

It is anticipated that the existing concrete slope protection under the existing bridges along the west bank will be disturbed. Therefore, Rock Channel Protection Type B should be used.

The length of new bank stabilization may be a waterway permit concern if it adds more than 200 feet in total length of Rock Channel Protection along the river. For jurisdictional purposes this would be any rock that is placed below the Ordinary High Water Elevation (698.3). The ODOT manual states that stream channel excavation should be limited to that portion of the channel one foot above normal water elevation (696.6) in order to minimize intrusion and to preserve the natural low water channel. So the permit requirements will need to be determined based upon the “new” rock channel protection that will be placed between elevations 697.6 and 698.3 +/- . The bank or slope protection that is placed above the ordinary high water elevation (698.3) should not be a waterway permit concern. The proposed limits of rock channel protection shown on the Site Plan provided in **Appendix E and F**.



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**Table 10**

**D95 Grain Size**

Depth (ft)	B-001	Depth (ft)	B-005	Depth (ft)	B-009	Depth (ft)	B-013	Depth (ft)	B-020	Mean	Depth (ft)
		6.00	4.50	6.00	3.63	8.00	4.49			<b>4.49</b>	<b>5.00</b>
11	4.49	11.00	3.87					11.00	4.49	<b>4.49</b>	<b>10.00</b>
15	4.52	16.00	4.45	15.00	4.15	15.00	1.78			<b>4.30</b>	<b>15.00</b>
20	0.43	21.00	4.48			19.00	4.49	22.00	4.23	<b>4.35</b>	<b>20.00</b>
25	4.38			25.00	4.48	25.00	4.39	27.00	0.13	<b>4.39</b>	<b>25.00</b>
31	4.51			28.00	4.47			31.00	4.38	<b>4.47</b>	<b>30.00</b>
36	4.54			33.00	4.51			36.00	4.51	<b>4.51</b>	<b>35.00</b>
41	4.49							41.00	4.49	<b>4.49</b>	<b>40.00</b>
45	4.41									<b>4.41</b>	<b>45.00</b>
50	3.97									<b>3.97</b>	<b>50.00</b>
<b>Mean</b>										<b>4.441</b>	mm

**Table 11**

**D50 Grain Size**

Depth (ft)	B-001	Depth (ft)	B-005	Depth (ft)	B-009	Depth (ft)	B-013	Depth (ft)	B-020	Mean	Depth (ft)
		6	2.766	6	0.781	8	2.689			<b>2.689</b>	<b>5</b>
11	2.689	11	0.265					11	2.709	<b>2.689</b>	<b>10</b>
15	2.889	16	2.491	15	0.837	15	0.491			<b>1.664</b>	<b>15</b>
20	0.01	21	2.648			19	2.709	22	0.179	<b>1.414</b>	<b>20</b>
25	2.132			25	2.627	25	2.164	27	0.008	<b>2.148</b>	<b>25</b>
31	2.821			28	2.605			31	2.132	<b>2.605</b>	<b>30</b>
36	3.041			33	2.821			36	2.838	<b>2.838</b>	<b>35</b>
41	2.689							41	2.689	<b>2.689</b>	<b>40</b>
45	2.253									<b>2.253</b>	<b>45</b>
50	0.038									<b>0.038</b>	<b>50</b>
<b>Mean</b>										<b>2.429</b>	mm

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Table 12 Summary of Scour Analysis Results					
<b>River Flow Direction</b>	Upstream to Downstream (left to right side of table)				
<b>Designer</b>	ms consultants			GPD Group	
<b>Project</b>	Project 6A			Project 4A	
<b>Roadway</b>	I-71 SB	Ramp D3	I-70 WB	I-70 EB & I-71 NB	Ramp A
<b>Structure No.</b>	FRA-70-1503L	FRA-70-1323C	FRA-70-1322L	FRA-70-1321R	FRA-70-1321A
<b>River Crossing</b>	RC1	RC2	RC3	RC4	RC5
<b>Foundation Type</b>	3 Drilled Shafts	4 / 6 Drilled Shafts	3 Drilled Shafts	5 or 6 Drilled	4 Drilled Shafts
<b>Existing Riverbed Elevation</b>	686.0 to 706.8	686.0 to 706.8	686.0 to 706.8	686.0 to 706.8	687.0 to 721.0
<b>Top of Rock Elevation</b>	650.0	644. to 652.5	650	644. to 652.5	643.8 to 652.2
<b>Rock Socket Depth</b>	14 feet	10 feet	8 feet	10 feet	10 feet
<b>Pier Scour Maximum Velocity</b>	7.8	6.6	7.0	8.3	9.3
<b>Pier Scour Depth in feet</b> (from left to right looking downstream)	Pier 1=22.0	Pier 1=21.8	Pier 1=20.3	Pier 1 =12.7	Pier 1 =13.1
	Pier 2=13.9	Pier 2 =10.8	Pier 2=11.6	Pier 2 =11.4	Pier 2 =14.3
	Pier 3 =13.9	Pier 3 =10.8	Pier 3=11.6	Pier 3 =11.4	Pier 3 =14.3
	Pier 4 =13.9	Pier 4 =10.8			Pier 4 =14.3
	Pier 5=13.9				Pier 4 =11.6
<b>Abutment and Contraction Scour in feet</b>	34.4 (left abutment+ contraction scour)	34.7 (left abutment & contraction scour)	9.4 (left contraction scour)	2.0 (left contraction scour)	2.2 (left contraction scour) 2.7 (channel contraction scour)
<b>Remarks</b>					

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**ODOT Hydraulic Summary**

**Supplemental Site Plan:** **Exhibit 1** identifies the study area on the USGS quadrangle maps. In addition, **Exhibit 2** shows the overall West Interchange geometry with the proposed Projects 4A and 6A over the FEMA Flood Insurance Rate Map, (FIRM). This exhibit also identifies the various encroachments that the proposed project will have on the existing Flood Hazard Zones. Also, the appropriate bridge, roadway, and bike path plan sheets have been included in the appendices for reference. In addition, the supplemental site plan, **Exhibit 3**, is a small-scale area plan showing the location of the river cross sections used for the hydraulic analysis, taken from the field surveys and shows the information necessary for the determination of the waterway opening. Additionally, **Exhibit 4** provides the Supplemental Site Profiles. These profiles were cut along the river in line with the proposed pier lines. These views show the variability of the river bed and the location of the proposed and existing bridges to clearly indicate the hydraulic clearances. Finally, **Exhibit 5** provides the concept of the Temporary Access Fills that will be needed for construction.

**Scour:** Based on a review of the river bottom survey performed by GPD Group there appears to be a localized high point located just downstream of the existing bridges. This localized high point ranges in elevation from 688.5 to 693.0 which is below the normal pool elevation of 696.2 created by the Greenlawn Avenue Dam. There is also a significantly sized depression located upstream of the existing bridges that seems to have a low elevation of 681.5 in the vicinity of the proposed northern most bridge, I-71 Southbound.

The scour computations reveal that the maximum velocity ranges 6.6 to 9.3 feet per second which may cause pier scour ranging from 10.8 to 22.0 feet deep. The piers will be drilled shafts that extend into rock (in the vicinity of elevation 650 feet +/-), from 8 to 14 feet deep well below the river bed surfaces indicated by the survey.

Also, the abutment scour computations indicate that the scour depth may range from 2.0 to 34.7 feet deep depending upon the location. The abutment / contraction scour of greatest depths occurs along the east bank at the upstream face of both the I-71 Southbound, (Pier 15), and Ramp D3 (forward abutment), bridges. The proposed bridge site plan for Ramp D3 shows that the H Piles will extend for 70 feet below the bottom of footing elevation of 709.0 to 719.0 with a proposed spill-through slope ground surface elevation at the face of the abutment of 723 +/- . The proposed bridge site plan does not indicate the pile length for Pier 15 which has a bottom of footing elevation of 718.50. If the piles are to extend to bedrock at a similar elevation as other locations, 650 +/-, then the pile lengths will be approximately 70 feet as well.

**Other Considerations:** During low flows, drift and ice conditions do not appear to be a significant factor. At this time there are no other known agricultural or other projects than the Scioto Greenways project (Main Street Dam Removal). Also, there are no other known drainage improvements that are being proposed that may influence these results or need coordination with this project.

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**Slope Protection:** This section summarizes the various slope treatments that may be needed for this project.

- Along the east bank under the proposed bridges much if not all of the existing bank is stabilized with rock channel protection however the existing material behind the existing piers has eroded. This erosion is probably due to when the out-of-bank flow re-enters the main channel. These areas will need repair.
- According to the ODOT design manuals, the spill-through slopes, abutments, wingwalls, and corner cones need to be armored. The wall and / or slope of the east bank at the I-71 Southbound Bridge Pier 15, and the Ramp D3 forward abutment should be protected due to abutment contraction scour. This protection should match the final treatment of what is placed under the bridges whether it is concrete, concrete pavers, tied concrete block mat, or rock channel protection.
- The abutment slope protection shall extend from the face of the abutment down to the toe of the slope and shall extend a minimum width of three feet beyond the outer edges of the superstructure. The base of the slope protection shall be toed-in and / or use a cut-off wall and where it is interrupted by the bikepath, (both sides). Tied Concrete Block Mat or Rock Channel Protection are not recommended within the “clear zone” of the proposed bikepath.
- When Rock Channel Protection, Type B, with Filter (Thickness = 30 inches) is used on the banks, typically, the filter below the normal water elevation plus one foot, (697.6), shall consist of a six-inch bed of crushed aggregate. Above the normal water elevation plus one foot, (697.6), the filter may be crushed aggregate or geotextile fabric.
- The scour and slope protection should extend up to 1-foot above the 500-year water surface elevation.

**Bikeway under the Bridge:** A review of the relocated bike path cross section sheets for both Project 4A and 6A indicate that the path and associated grading is at or below existing grade such that there is no reduction in the existing river cross sectional area under or near the proposed bridges.

**Drainage Plan Overview:** The proposed roadway drainage design was performed by GPD Group and was not included in URS’s Scope of Service. Please see their design submittals for more detailed information.

**Bridge Deck Drainage Design:** The pavement drainage spread and scupper analysis was performed by the GPD Group / Burgess & Niple, and was not included in URS’s Scope of Service. Please see their design submittals for more detailed information.

**Post Construction Stormwater Best Management Practices:** The proposed roadway Post Construction Stormwater Best Management Practices design was performed by GPD Group and was not included in URS’s Scope of Service. Please see their design submittals for more detailed information.

**Bridge and Waterway Permits:** The jurisdictional limit of the U.S. Army Corps of Engineers (USACE) is termed the “Waters of the United States” and, as noted in ODOT CMS 101.03, includes: rivers, streams, lakes and wetlands. For rivers and streams, the jurisdiction begins below the Ordinary High Water Mark (OHWM). The OHWM is defined as the elevation on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas.

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The USACE issued a Regional General Permit (RGP) for various activities conducted by ODOT within the “Waters of the United States”. This RGP authorizes the Department the responsibility of ensuring compliance with Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act for transportation projects meeting prescribed conditions. Permitted activities within “Waters of the United States” allowed by the RGP include: construction of permanent fills or structures; rehabilitation of authorized fills or structures; and the temporary placement of fills or structures. The proposed work intends to be within the thresholds of these permits.

ODOT - OES should be made aware the proposed Pier A for Ramp A5 / B5 / C5 Bridge, FRA-70-1321A, on the west bank encroaches upon the USACE Flood Protection Line. Based upon the hydraulic analysis this encroachment has no adverse impact on the water surface elevations. It should be noted however that this encroachment may require additional coordination with the real estate, regulatory, or other sections within the USACE.

**Temporary Access Fill:** A Temporary Access Fill (TAF) is a fill or structure that allows a contractor access to work on roads or bridges located within bodies of water. Examples of TAF’s include: cofferdams, temporary structures for maintaining traffic, causeways and work pads, and demolition debris. The placement of all TAF’s in “Waters of the United States” must be performed according to permits issued by the USACE. A Temporary Access Fill will be required for pier construction purposes. The construction pad will be in accordance with the ODOT Bridge Design Manual, Section 203.5. The temporary access fill will be removed upon completion of the bridge construction. The layout of the proposed construction pad is provided in the various sheets of Exhibit 5.

The Bridge Design Manual states that the side slopes of the TAF shall be no steeper than 1.5:1 (H:V) and the top surface of the TAF shall be located 1’-0” above the OHWM. Based upon the discussion provided in the hydraulic analysis section of this report the TAF design hydraulics may be achieved with the use of culverts or with the use of an open channel or with a combination of both.

The permit documentation requires the following information to be reported:

- During the construction of this project, the following activities in the waters of the United States that are anticipated are: cofferdams (for removal of the exiting piers to below the existing river bed elevation at each location), temporary access fill (e.g. causeways and work pads), demolition, and debris removal that may be required.
- The RGP requires an authorized temporary activity to accommodate a minimum flow equal to twice the highest mean monthly flow without creating a rise in backwater above the OHWM. The minimum flow to be maintained throughout construction for this location is 6,260 cfs.
- The means that will most likely be implemented by the Contractor to maintain this flow will be Conduit(s) and/ or Open channel(s)\Temporary Bridge.
- The RGP has limitations. The maximum length of temporary impact, as measured upstream to
- downstream along one bank, cannot exceed 250-feet. Proposed impact length for this project is feet.
- The proposed activity cannot be located within 2,000-feet of a flood control facility or within 1,000-feet of a stream gage. According to USGS StreamStats website there are two stream
- gauges; one located upstream of the Broad Street Bridge and located downstream of the SR-104
- Bridge. These gauges will not be disturbed by the project. The distance to the nearest flood control facility is greater than 2,000 feet and the distance to the nearest stream gage is more than 1,000 feet.
- The duration of the impact to waters of the United States cannot exceed two years. The proposed



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temporary river impact (below the ordinary high water elevation) duration is expected to be less than two years for each project.

**Flood Hazard Development Permit:** This project will also require floodplain coordination and permit approval with the City of Columbus. The hydraulic analysis study limits for this report are from FEMA FIS Cross Section AE, downstream, at the existing interchange divergence point to FEMA FIS Cross Section AG, upstream at the existing Railroad Bridge. This analysis concludes that the proposed improvements will not adversely impact the FEMA Flood Hazard Zones and approval of this work may be made by the local floodplain administrator based upon the submitted No-Rise Certification accompanying this report. Please refer to the FEMA Flood Hazard Zones section of the report for a summary of the FEMA documentation required for the floodplain permit approval.

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**FEMA Flood Hazard Zones**

The proposed roadway and bridge improvements require work within the existing FEMA Flood Hazard Zones. The two projects presented herein Project 4A and Project 6A are scheduled to begin construction 2017 and 2018, respectively. These projects are the early phases of an overall West Interchange reconstruction plan but those future phases are not currently scheduled for numerous years. Over the course of both projects the existing two 9-span bridges will be removed and replaced with 5 bridges, each having 5-spans crossing the river. Based upon earlier ODOT coordination with the City it was determined that these project would be submitted for review and approval under one permit rather than 2 separate processes. The resulting analysis indicates that the proposed improvements will be submitted via a No-Rise Certification for the within the City of Columbus’s local approval authority.

The project is in the area of the Scioto River where the west side is protected by the West Columbus Local Protection Project (floodwalls and levees). The proposed roadway and bridge improvements have no adverse impact on the main channel, floodway, floodway fringe, or 500-year flood events. The effective model does not account for any flow conveyance that occurs via the open area under the existing bridges over the railroad or the Short Street. It should be noted however that based upon the survey and the HEC-RAS results, events greater than the 100- year will flow out of banks between the railroad and Miranova as indicated via delineation on the FEMA FIRM.

The proposed roadway and bridge improvements east of the river will place fill in the form of roadways, bridges, embankments, piers or walls in the floodplain extending to the floodplain delineated east of Short Street. The placement of this fill has no impact on the river analysis because the model assumes all flow is confined to the main channel. While this fill will displace a certain amount of floodplain storage volume the City regulations exempt public roadway projects from compensatory storage volume mitigation. The surface areas and volumes have been provided in the appendices on the associated relevant plan sheets to comply with the City application process.

**Flood Hazard Development Permit:** The proposed improvements will require work to be performed within the floodplain; therefore, a floodplain permit will be required from the City of Columbus. Based upon the hydraulic analysis, the project will not result in an increase to the base flood elevation. This project may be approved by the local floodplain administrator via a “No-Rise Certification”. This “No – Rise Certification” is provided with and attached to this report. No further analysis is anticipated and will not require the FEMA CLOMR and LOMR approval process.

The work necessary within the Flood Zones is as follows:

- Construction of a bridge including piles, footings, abutments, and piers.
- Removal of the existing bridge structure, including portions of existing piers and of the river bottom adjacent to these existing piers.
- Roadway Embankment and associated ditches, drainage structures and conduits.
- Rock Channel Protection: in the river bottom at river banks where disturbed during TAF construction or removal.
- Placement of Overbank, Spill Through Abutment, Wingwall, and Embankment slope protection
- Roadway Embankments and Bridge Replacements east of the river including the proposed bridges over the railroad and Short Street.
- Temporary Access Fill will be designed and constructed in the river in accordance with the design requirements of the ODOT Bridge Design Manual and will be removed upon completion of the bridge construction.

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**Flood Hazard Evaluation:** The analysis shows that proposed improvements, including the various elements of this project, will not cause an increase to the base flood water surface elevations. The project may be approved by the local floodplain administrator based upon a No-Rise Certification.

**Flood Wall / Levee Evaluation:** The analysis shows that proposed improvements, including the various elements of this project, will not cause an increase to the SPF flood water surface elevations. However since this project is along the floodwall or levees of the West Columbus Local Protection Project an USACE technical review / coordination will be necessary and should be initiated through the City's review of this submittal. It should also be noted that in addition to the river analysis the project will also impact the following items:

- Project 4A and Project 6A have proposed piers on the west bank that encroach on the river side of the Flood Protection Line delineated on the FIRM and the record drawings of the West Columbus Local Protection Project. This encroachment may require additional USACE internal coordination during the review process with the real estate, regulatory and / or other sections.
- The proposed roadway improvements, on the west side of the river, revise the existing interchange infield grading. The West Columbus Local Protection Project placed embankment in within the existing interchange as part of the flood protection. The roadway plans have delineated this area and the associated plan sheets have been provided to show that the proposed grading either maintains the existing grade or places additional embankment over it to meet the needs of the interchange design.
- Project 4A will note impact 2 gatewells located within the proposed interchange footprint.

**FEMA Documentation:** This report will serve as the documentation for the Local Floodplain Administrator review and approval of the Floodplain Development Permit. The items presented below are necessary per City and / or FEMA regulations to document and demonstrate compliance with the criterion for simple floodway encroachments. This documentation includes:

- **No-Rise Certification:** Included with this report are the No-Rise Compliance Letter and the No-Rise Certification ready for submission to the City of Columbus Floodplain Administrator.
- **Exhibit 2:** Study limits on the January 6, 2005 FIRM. The channel is reasonably uniform in cross section.
- **Exhibits 3 and 4:** Topographic mapping of the project area indicating the locations of the cross sections used in the existing and post-project condition hydraulic models and a plan view of the project elements. Project 4 provides various river profiles for the study limits.
- **Conveyance:** A review of the HEC-RAS results indicates that the proposed bridge improvements will convey the same amount of flow at the same or lower water surface elevation when compared to the existing / pre-project condition. Therefore the proposed improvements do not have an adverse impact on the river's conveyance.

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- **Perpetual Maintenance:** The proposed bridge and roadway improvements are planned to be located within the proposed right-of-way, which is the evidence that the waterway conveyance provided for by this project will be maintained perpetually by ODOT District 6. The bridges are routinely inspected as part of a bridge inspection program.
- **Certification:** This report with the data and analysis presented provides the information that is the basis for a “No Rise Certification” for the purposes of floodplain coordination and permitting. This project will have no impact on the FEMA Designated Flood Zones and Base Flood Elevations.

**Floodplain Administrator Coordination:** The project will only require FEMA Flood Zone Coordination with the local floodplain administrator for the City of Columbus. Initial contact was made with the City under a predecessor project (West Interchange Re-Evaluation on behalf of ODOT and Burgess and Niple). Additionally, there was a meeting with the City of Columbus held on March 17, 2014. The meeting notes are provided in **Appendix K**. As part of the City’s review process, they will coordinate with the USACE for technical review as it pertains to the Floodwall and related features. This submittal is for review and approval for both Projects 4A and 6A.

**Flood Zone Impact Conclusion:** This project does not adversely impact the river based upon the comparison of the existing / pre-project conditions compared to the proposed conditions. The submitted No-Rise Certification and this report should justify the City’s approval of the proposed improvements within the FEMA Flood Hazard Zones.

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**Conclusion**

The conclusion of this hydraulic analysis and report show that the five proposed 5-span bridges do not increase (0.00 feet) the calculated water surface elevations during the 100-year flood, as such, mitigation is not required. Therefore, the submitted No-Rise Certification meets the City and FEMA requirements for local approval without the need for a CLOMR / LOMR and FEMA review.

It should also be noted that each of the proposed 5 bridges also provide hydraulic vertical clearance for the 500-year water surface elevation. As such, this design allows the calculated water surface elevations for the SPF and 500-year floods also reflect a no-rise condition for these flood events.

The scour analysis indicates that there will be pier and abutment scour at these bridges. The proposed improvements will provide bank and spill-through slope protection of either concrete, pavers, tied concrete block mat and / or rock channel protection. In addition, the pier and abutment foundations will be on drilled shafts or piles that extend to bedrock. Finally, the calculated scour depths will also be accounted for in the foundation design.

**Limitations**

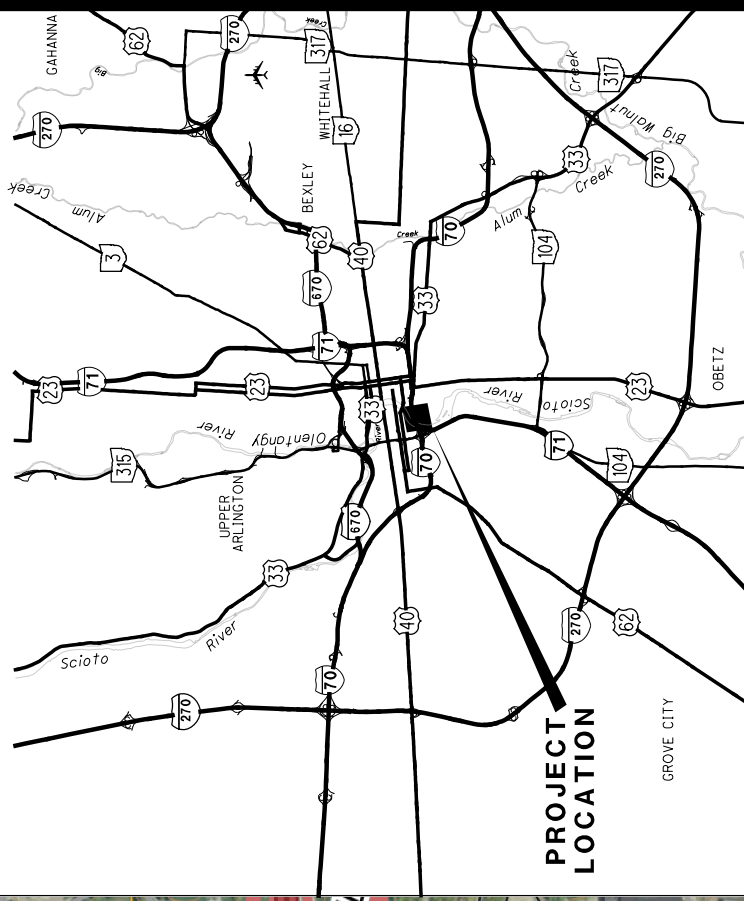
This report is based upon the following understanding:

- The scope of services did not include underwater inspection for scour.
- This document does not cover the detail design of the temporary access fills to be constructed in and removed from the river in order to build the bridges. These locations will be temporary and the design will be in accordance with the parameters established in the current ODOT Bridge Design Manual. The actual design is govern by the contractor. The hydraulic analysis provided is strictly to determine that the permit conditions can reasonably be met at this location and should not be used as the basis for a final TAF design.
- This report does not address future phases of the West Interchange project because the plans for this work are not being developed at this time.



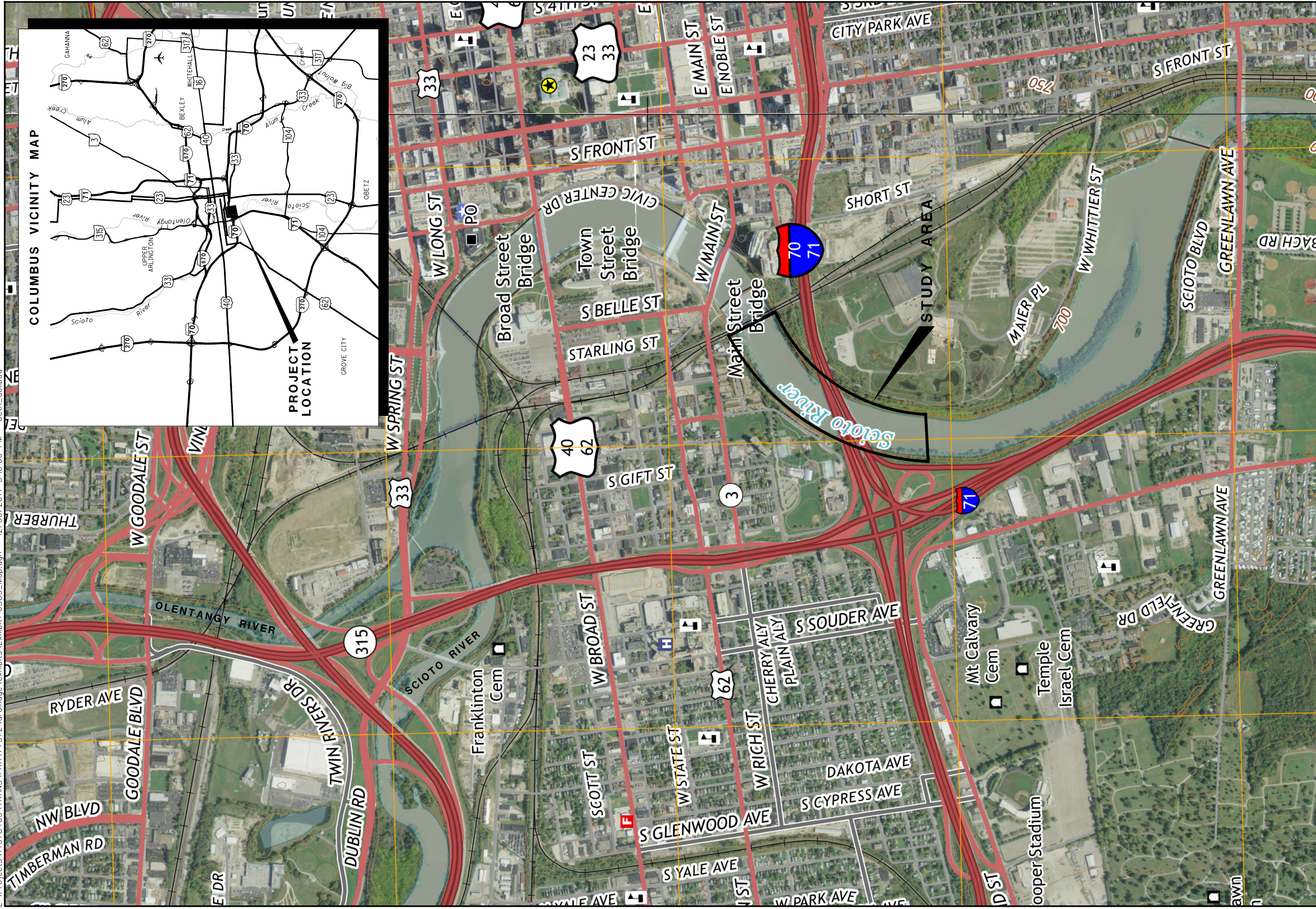
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COLUMBUS VICINITY MAP



PROJECT LOCATION

GROVE CITY



CALCULATED  
FGW  
CHECKED  
PHF

EXHIBIT 1 - USGS QUADRANGLE MAPS  
NW, NE, SW & SE COLUMBUS

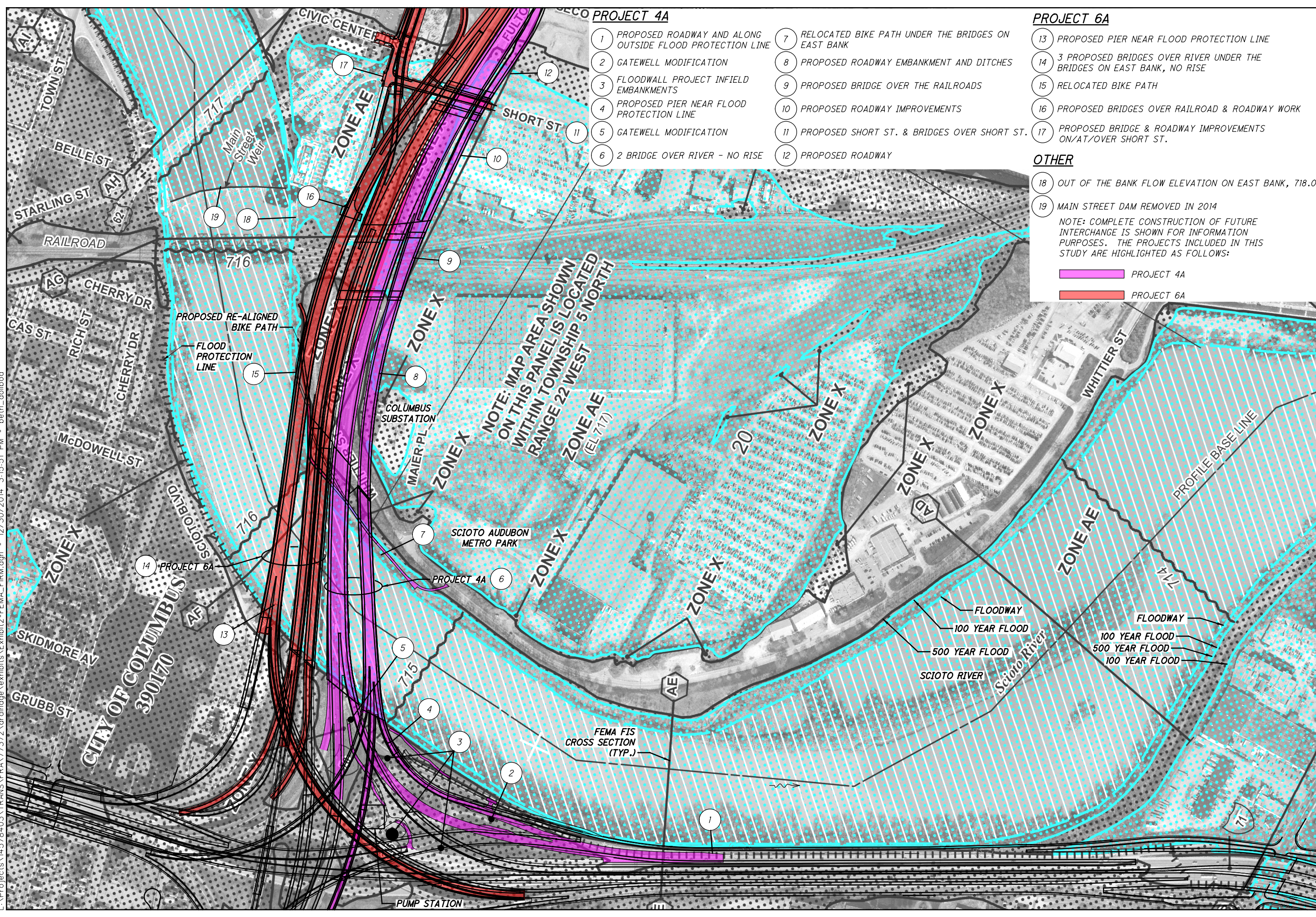
PID 77372 PROJECT 4A

PID 89464 PROJECT 6A





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**PROJECT 4A**

- 1 PROPOSED ROADWAY AND ALONG OUTSIDE FLOOD PROTECTION LINE
- 2 GATEWELL MODIFICATION
- 3 FLOODWALL PROJECT INFIELD EMBANKMENTS
- 4 PROPOSED PIER NEAR FLOOD PROTECTION LINE
- 5 GATEWELL MODIFICATION
- 6 2 BRIDGE OVER RIVER - NO RISE

**PROJECT 6A**

- 7 RELOCATED BIKE PATH UNDER THE BRIDGES ON EAST BANK
- 8 PROPOSED ROADWAY EMBANKMENT AND DITCHES
- 9 PROPOSED BRIDGE OVER THE RAILROADS
- 10 PROPOSED ROADWAY IMPROVEMENTS
- 11 PROPOSED SHORT ST. & BRIDGES OVER SHORT ST.
- 12 PROPOSED ROADWAY

**PROJECT 6A**

- 13 PROPOSED PIER NEAR FLOOD PROTECTION LINE
- 14 3 PROPOSED BRIDGES OVER RIVER UNDER THE BRIDGES ON EAST BANK, NO RISE
- 15 RELOCATED BIKE PATH
- 16 PROPOSED BRIDGES OVER RAILROAD & ROADWAY WORK
- 17 PROPOSED BRIDGE & ROADWAY IMPROVEMENTS ON/AT/OVER SHORT ST.

**OTHER**

- 18 OUT OF THE BANK FLOW ELEVATION ON EAST BANK, 718.0
- 19 MAIN STREET DAM REMOVED IN 2014

NOTE: COMPLETE CONSTRUCTION OF FUTURE INTERCHANGE IS SHOWN FOR INFORMATION PURPOSES. THE PROJECTS INCLUDED IN THIS STUDY ARE HIGHLIGHTED AS FOLLOWS:

PROJECT 4A  
 PROJECT 6A

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 5 NORTH RANGE 22 WEST

**EXHIBIT 2**  
**FEMA FLOOD INSURANCE RATE MAP**  
 PID 77372 PROJECT 4A  
 PID 89464 PROJECT 6A

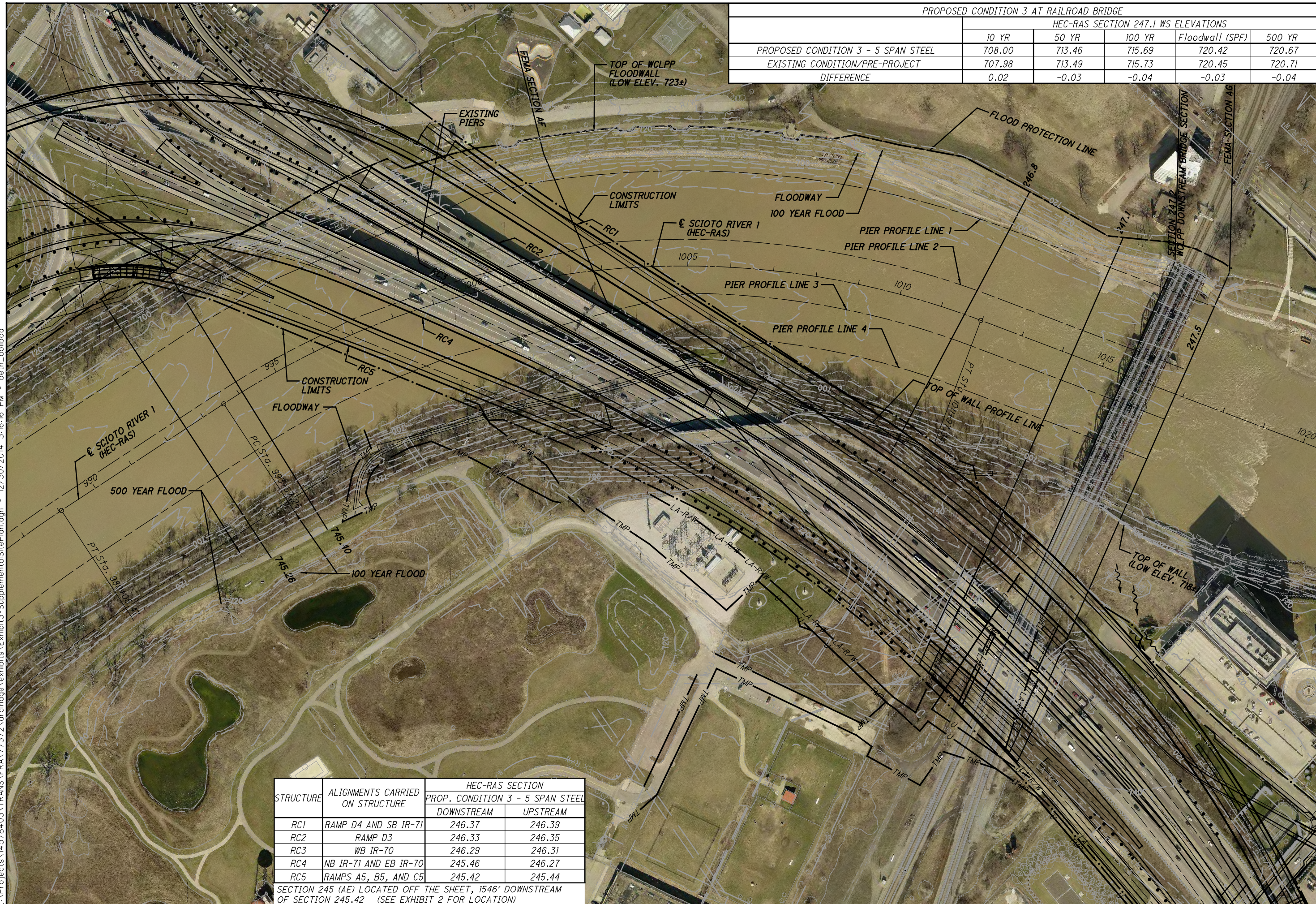


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PROPOSED CONDITION 3 AT RAILROAD BRIDGE

	HEC-RAS SECTION 247.1 WS ELEVATIONS				
	10 YR	50 YR	100 YR	Floodwall (SPF)	500 YR
PROPOSED CONDITION 3 - 5 SPAN STEEL	708.00	713.46	715.69	720.42	720.67
EXISTING CONDITION/PRE-PROJECT	707.98	713.49	715.73	720.45	720.71
DIFFERENCE	0.02	-0.03	-0.04	-0.03	-0.04

CALCULATED  
FGW  
CHECKED  
PHF



STRUCTURE	ALIGNMENTS CARRIED ON STRUCTURE	HEC-RAS SECTION	
		PROP. CONDITION 3 - 5 SPAN STEEL	
		DOWNSTREAM	UPSTREAM
RC1	RAMP D4 AND SB IR-71	246.37	246.39
RC2	RAMP D3	246.33	246.35
RC3	WB IR-70	246.29	246.31
RC4	NB IR-71 AND EB IR-70	245.46	246.27
RC5	RAMPS A5, B5, AND C5	245.42	245.44

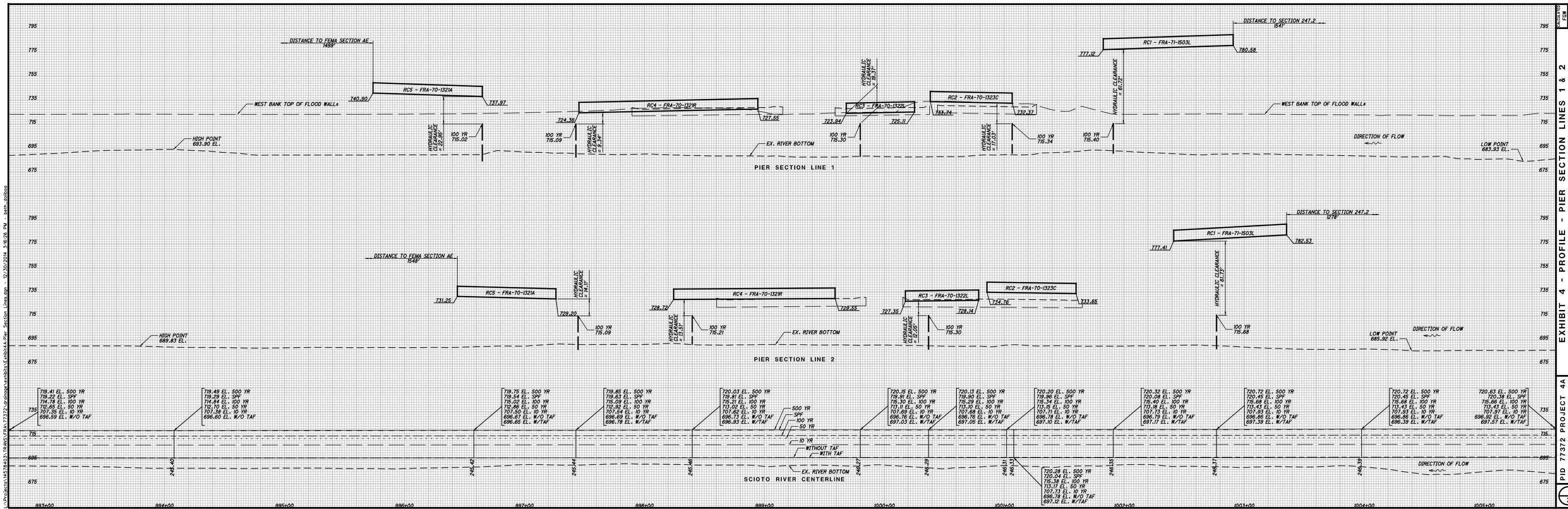
SECTION 245 (AE) LOCATED OFF THE SHEET, 1546' DOWNSTREAM OF SECTION 245.42 (SEE EXHIBIT 2 FOR LOCATION)

EXHIBIT 3 - SUPPLEMENTAL SITE PLAN

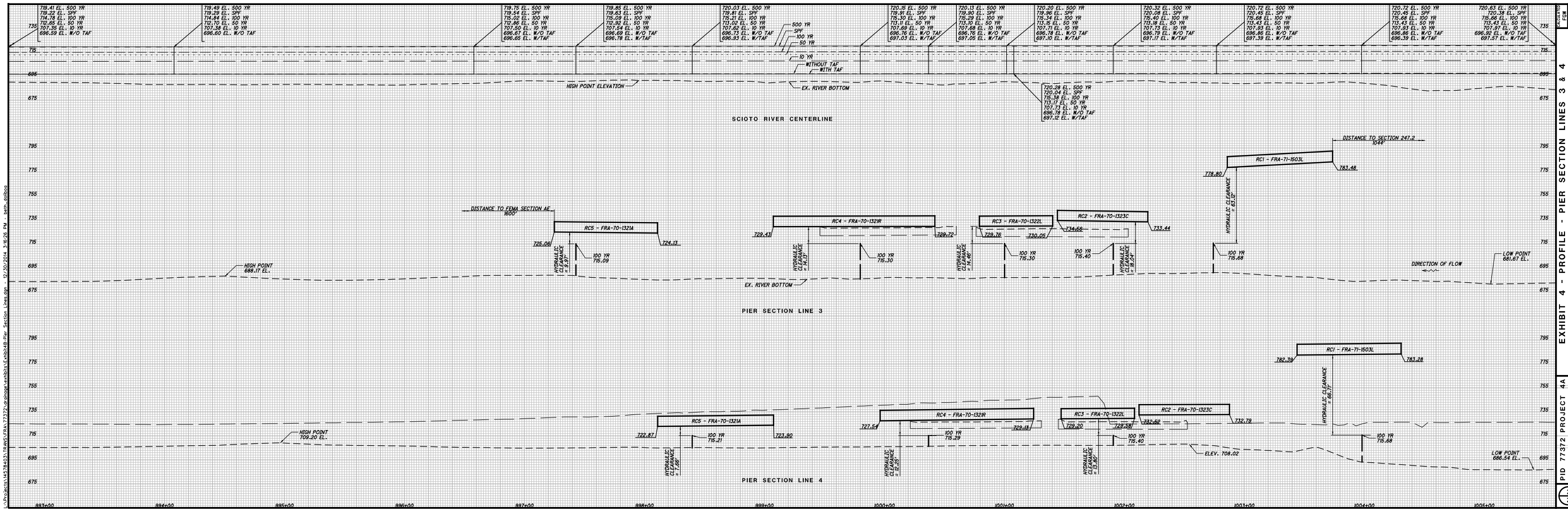
PID 77372 PROJECT 4A  
PID 89464 PROJECT 6A







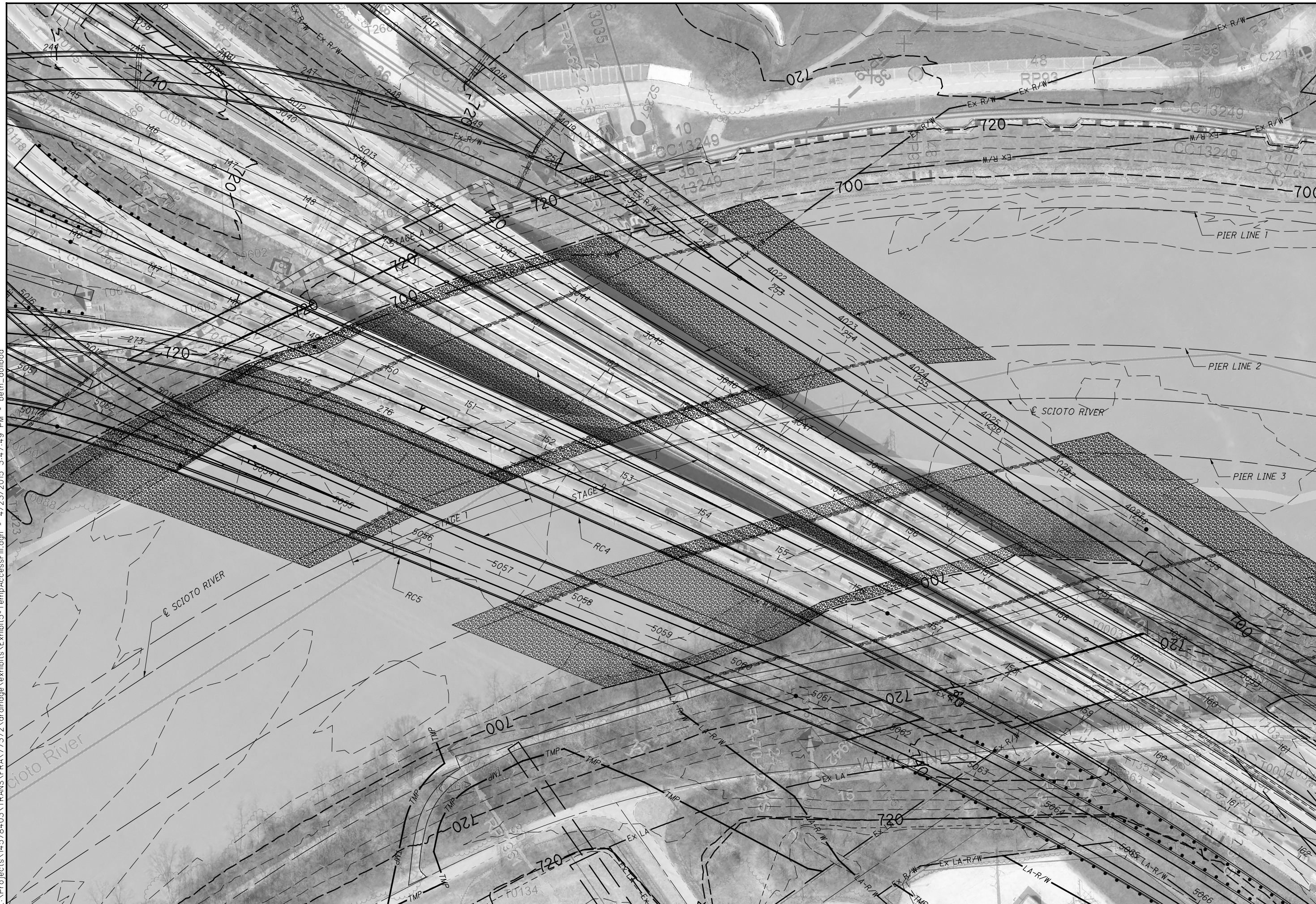
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 User: jwh  
 Date: 12/30/2014 9:56 PM  
 Plot: 145740.dwg



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 12/20/2014 9:16:26 PM - beta\_dobos



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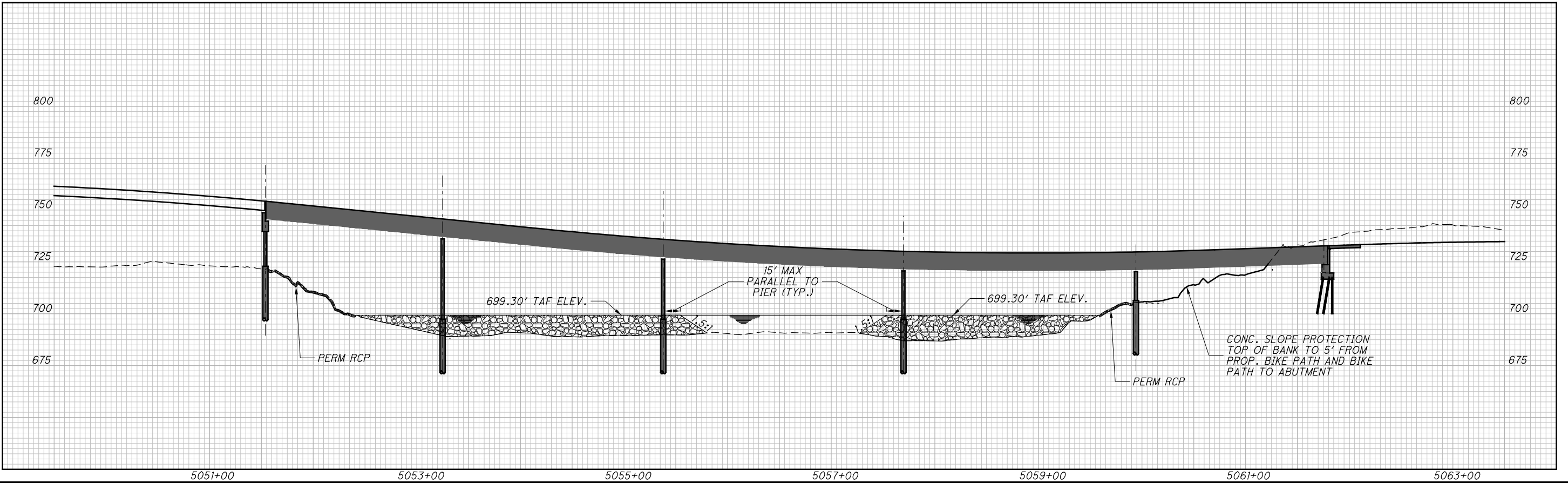
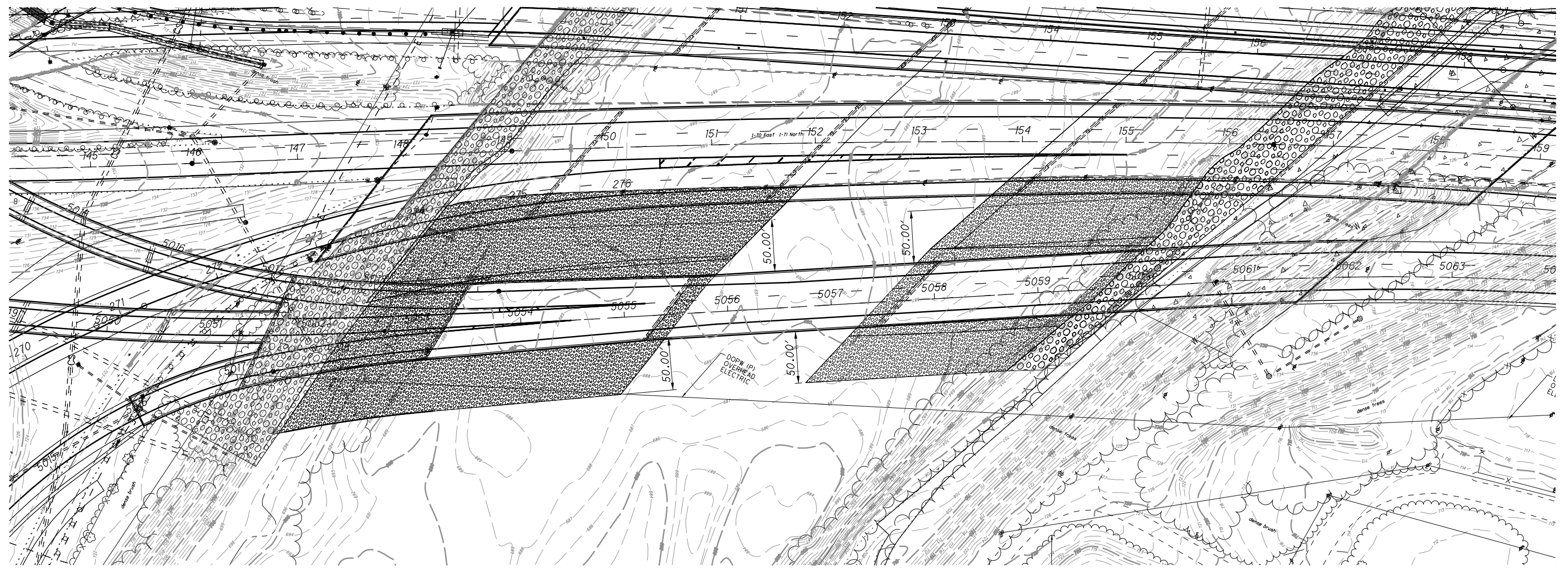
CALCULATED  
FGW  
CHECKED  
PHF

**EXHIBIT 5 - BANK STABILIZATION & TEMPORARY ACCESS FILL**

PID 77372 PROJECT 4A  
PID 89464 PROJECT 6A



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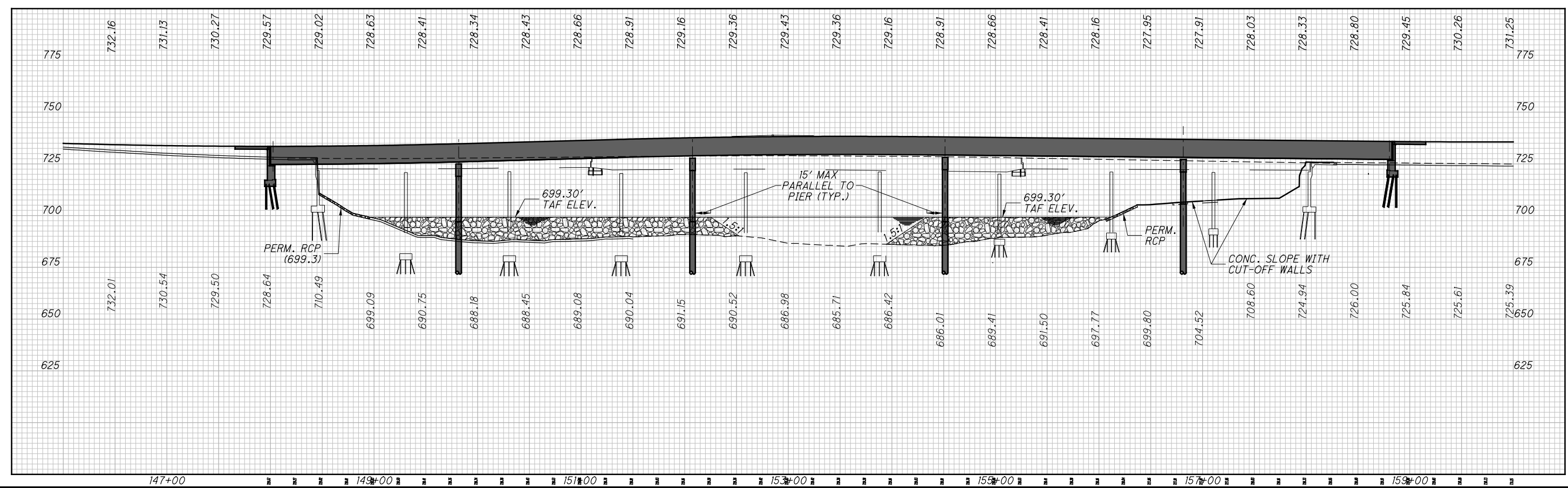
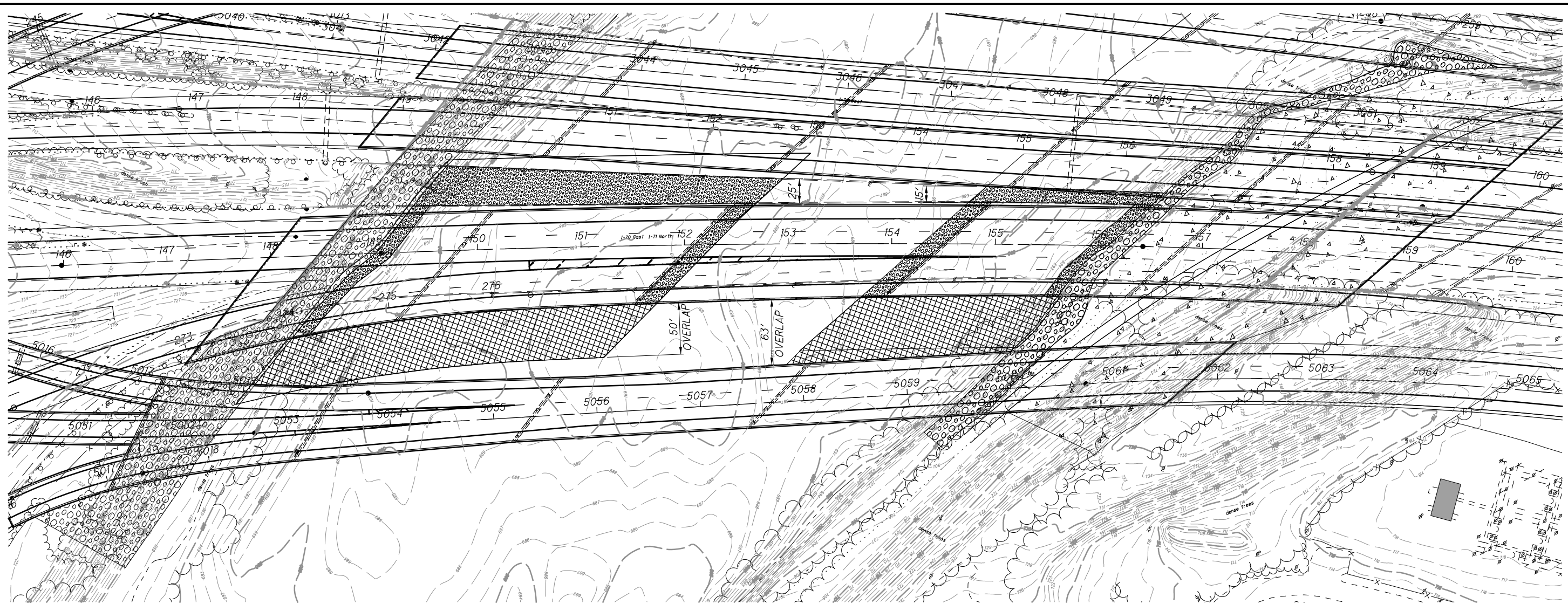


**EXHIBIT 5 - PROJECT 4A STAGE 1**  
**FRA70-1321A - PLAN AND PROFILE**

PID 77372 PROJECT 4A  
 PID 89464 PROJECT 6A



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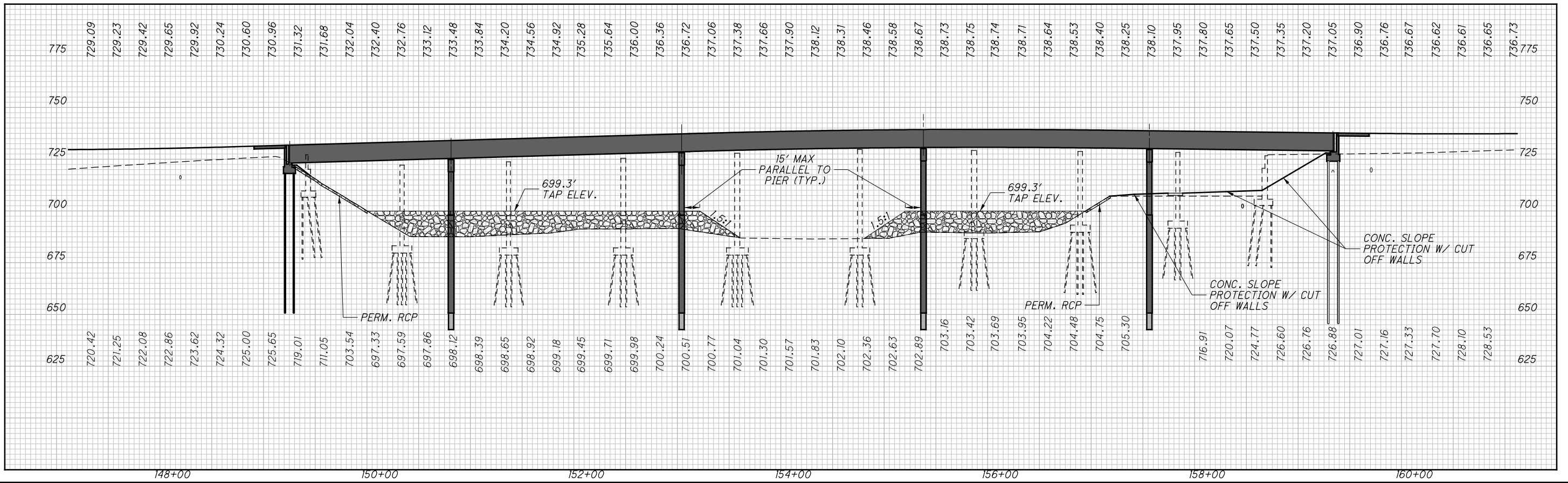
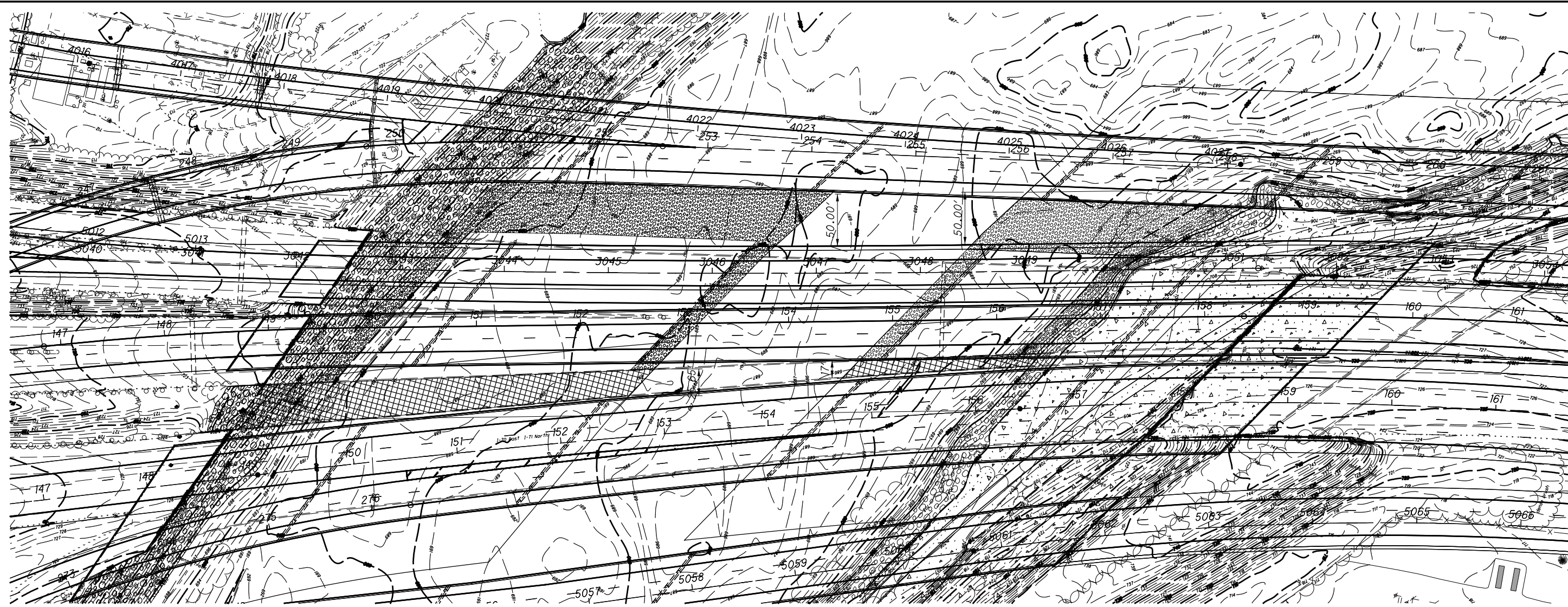


**EXHIBIT 5 - PROJECT 4A STAGE 2**  
**FRA70-1321R - PLAN AND PROFILE**

PID 77372 PROJECT 4A  
 PID 89464 PROJECT 6A

CALCULATED  
 BAD  
 CHECKED  
 PHF

L:\Projects\14578403\_TRANSPORT\FRA77372\drainage\exhibits\FRA70-1322L.dgn - 4/23/2015 3:52:52 PM - beth\_dolboia




CALCULATED: BAD  
 CHECKED: PHF

**EXHIBIT 5 - PROJECT 6A STAGE A**  
**FRA70-1322L - PLAN AND PROFILE**

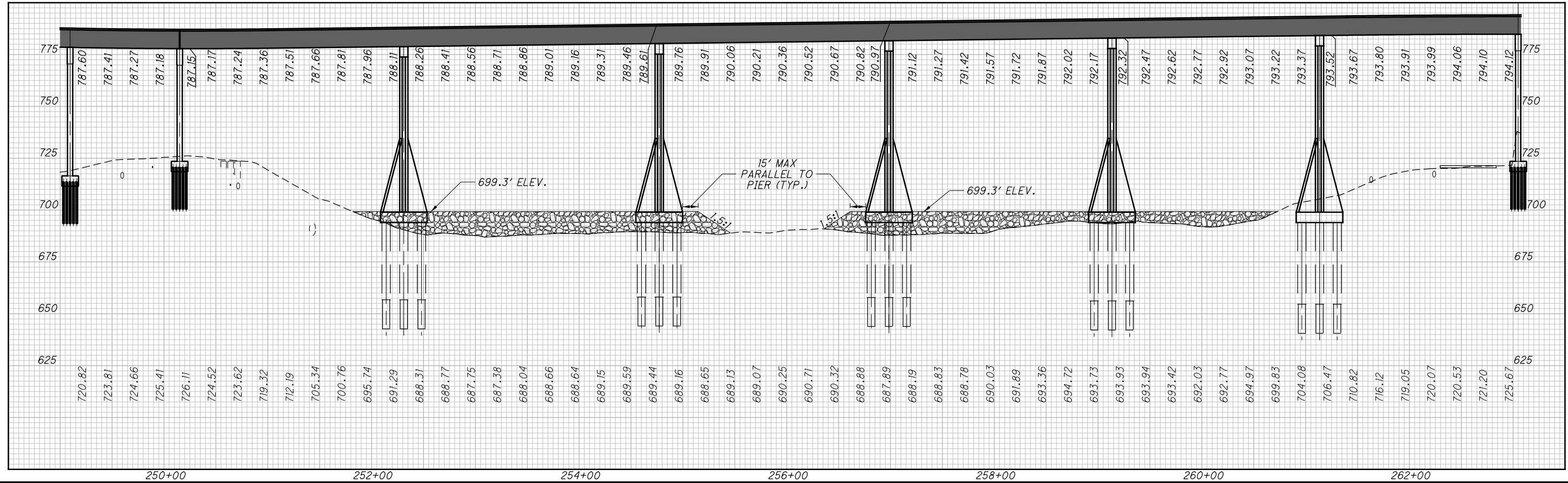
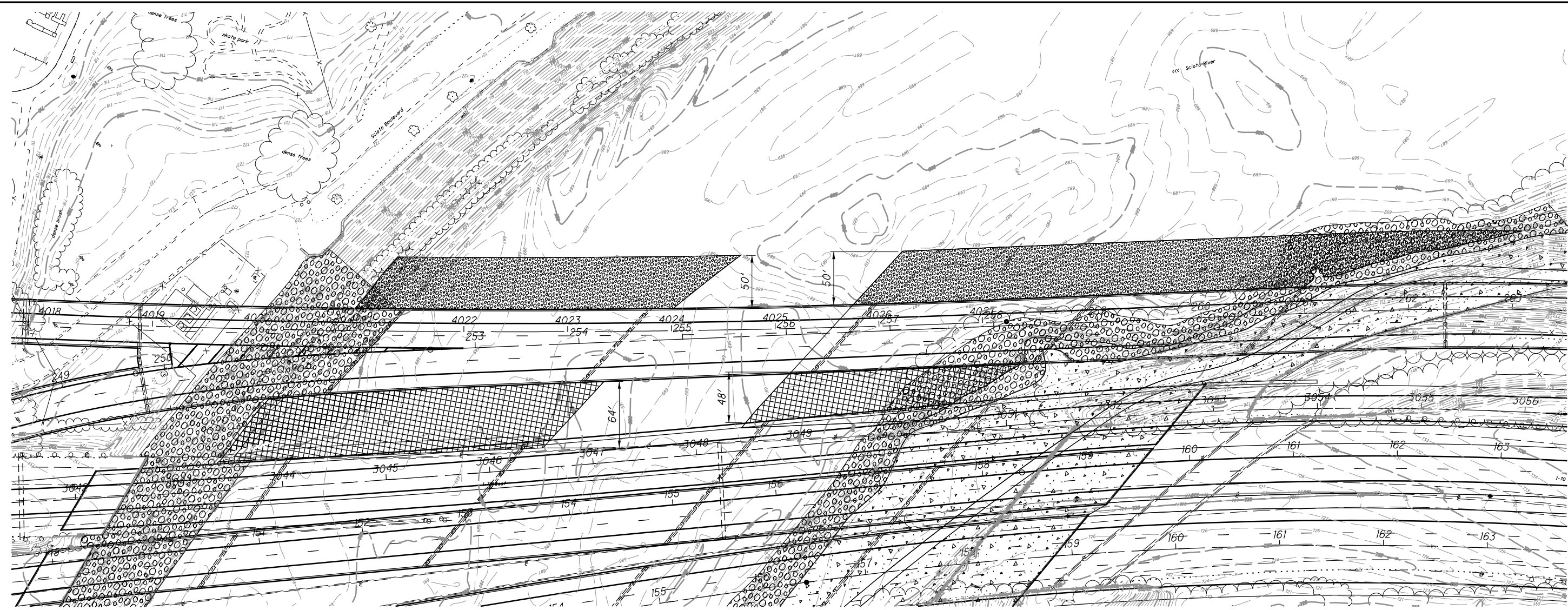
**PID 77372 PROJECT 4A**  
**PID 89464 PROJECT 6A**







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CALCULATED  
BAD  
CHECKED  
PHF

**EXHIBIT 5 - PROJECT 6A - STAGE C**  
**FRA71-1503L - PLAN AND PROFILE**

PID 77372 PROJECT 4A  
PID 89464 PROJECT 6A

6  
7

**BRIDGE WATERWAY HYDRAULIC and SCOUR ANALYSIS REPORT  
I-70 / I-71 WEST INTERCHANGE  
BRIDGE REPLACEMENTS over THE SCIOTO RIVER  
PROJECT 4A – STAGE 2 and PROJECT 6A – TS&L**

**Volume II**

**Appendices (DVD / CD-ROM - only)**

**Appendix A..... Existing Bridge Plans**

**Appendix B..... Existing Floodwall Plans**

**Appendix C..... FEMA FIS Data**

**Appendix D..... Photographs**

**Appendix E..... Proposed Project 4A: Stage 2 Plans**

**Appendix F..... Proposed Project 6A: TS&L / Stage 1 Plans**

**Appendix G.....HEC-RAS Files**

**Appendix H..... HEC-RAS Results**

**Appendix I.....Scour Analysis**

**Appendix J.....Temporary Access Fill**

**Appendix K.....FEMA Flood Zones Coordination**

**Appendix L.....(Electronic PDF file Copy: Cover Letter, Compliance Letter,  
.....No-Rise Certification, & Report with Exhibits)**