170th & Switzer Stormwater Improvements

SMP Project No. BR-10-001 and BR-10-002
City Project No. SD-1438

Overland Park, Kansas

Preliminary Engineering Study

January 28, 2019

PREPARED BY

HNTB Corporation
7400 West 129th Street
Suite 100
Overland Park, Kansas 66213
Contact: Zach Jarchow, P.E.
Phone: (913) 312-4926

January 30, 2019

Mr. Lee Kellenberger
Program Manager
Johnson County Public Works Department - Stormwater Program
1800 West 56 Highway
Olathe, KS 66061

Re: 170th and Switzer
SMP Project No. BR-10-001 and BR-10-002; City Project No. SD-1438
Preliminary Engineering Study
City of Overland Park

Dear Lee:

We are pleased to submit the Preliminary Engineering Study for the above referenced project. The report outlines the findings and recommendations of our study to reduce habitable structure and street flooding in the study area. In accordance with County requirements, the PES has been revised so that each crossing in the project area is considered its own project for SMP funding purposes. The west crossing in the report is BR-10-001 and the east crossing is BR-10-002.

Our recommended alternatives include storm sewer installation and will alleviate three homes from the flooding limits of the 1% and more frequent storm events. The recommended alternatives will also alleviate street flooding of 170th Terrace at two locations.

The recommended alternatives meet the current Johnson County Stormwater Management Program adopted standards. For BR-10-002, the recommend alternative achieves the project goals at the most reasonable cost. For BR-10-001, county funding will be limited to the lowest cost alternative, which is not the recommended alternative. The BR-10-001 total project cost is estimated at $0.5 million and the priority rating is 2,900. The BR-10-002 total project cost is estimated at $0.4 million and the priority rating is 2,887.

Please don't hesitate to call if you have any questions or require additional information to complete your review of this Preliminary Engineering Study.

Best Regards,

HNTB CORPORATION

Pete Jarchow

Peter G. Jarchow, P.E.
Senior Project Manager
816-527-2248

CC: Lorraine Basalo (City of Overland Park)
Ybairy Duin (City of Overland Park)

Attachments

Contents

Figures:

Tables:

I. PROJECT OVERVIEW

The 170th & Switzer Stormwater Improvements project area is along 170th Terrace (170th), east of Switzer Road and is located entirely within the City of Overland Park. The project is located within the Blue River watershed. The drainage systems in the project area consists of open swales flowing south to north through the properties fronting 170th, roadside ditches along 170th, and two culverts under 170th. The systems are referred to in this study as the *east* and *west* crossings. The specific area studied is shown in **Figure 1**. For the Johnson County Stormwater Management Program (SMP), each crossing is considered a separate project. The *west* crossing is identified as BR-10-001 and the *east* crossing is identified as BR-10-002.

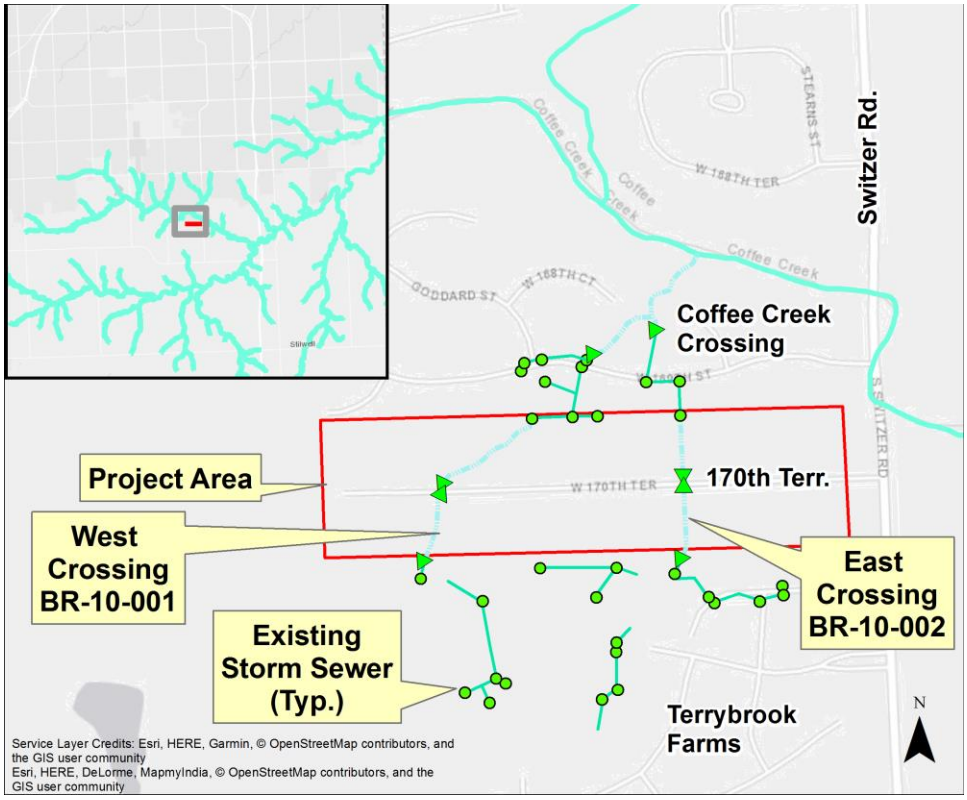


Figure 1: Project Location Map

A. Flood Problem Rating Table

The City of Overland Park submitted an initial funding request to Johnson County's Stormwater Management Program (SMP) in September of 2018. The initial request indicated a preliminary score of 180 points per the County's Flood Problem Rating Table. The rating exceeded the 100 point minimum required for eligibility for funding under the County SMP and the development of this Preliminary Engineering Study (PES) was authorized. The initial funding request is included in **APPENDIX F– Preliminary Funding Packet.**

For the Preliminary Engineering Study, the rating table was broken out into a separate rating table for each crossing in accordance with the County's requirements. The Flood Problem Rating Tables for each crossing reflect flooding impacts identified with this study and revised with the preliminary cost estimate information. The final Flood Problem Rating Tables are included in APPENDIX D– Cost Estimates and Flood Problem Rating Sheets.

B. Background

The City of Overland Park retained HNTB Corporation to complete a Preliminary Engineering Study to evaluate the existing flooding problems and develop improvement alternatives. This report summarizes that work and includes project impacts and costs for the different alternatives analyzed, as well as a recommended solution.

The City of Overland Park has previously received reports of excessive flow in swales, street overtopping and structure flooding within the project. As part of this study, questionnaires were mailed to all residents in the area and a summary of their responses can be found in APPENDIX E– Resident Flood Survey Summary.

Drainage analysis was performed for the conveyance system within the project area according to City and County Criteria. Three houses were determined to be at risk of flooding in the 1% or more frequent events and 170th was identified as flooding in excess of current design standards.

The upstream and downstream limits of the project area are within the City of Overland Park, and there will not be impacts outside of the project area.

C. Existing Conditions

1. Structure/Roadway Flooding

The detailed existing conditions analysis shows three habitable structures at risk of flooding in the 1% annual storm event from the open channels in the project area. Furthermore, two of these are modeled to flood as frequently as the 50% storm event and the third as frequently as the 10% event.

Based on the existing conditions analysis, 170th was found to overtop in the 50% event at both crossings. In the 50% event, the west crossing was found to overtop by 6 inches and the east crossing was found to overtop by 3 inches. In the 10% event, the west crossing was found to overtop by 8 inches and the east crossing was found to overtop by 5 inches. In the 1% event, the west crossing was found to overtop by 12 inches and the east crossing was found to overtop by 7 inches.

2. **Soil Types and Bedrock Depths**

Soil type and characteristic information was obtained from the USDA-SCS Soil Survey of Johnson County (2005). There are four soil types in the project area.

- 23.5% - Sogn-Vinland complex– HSG D – somewhat excessively drained
- 0.5% - Kennebec silt loam– HSG C – moderately well drained
- 40.6% - Martin silty clay loam– HSG C/D – moderately well drained
- 35.4% - Oska-Martin silty clay loams – HSG D – well drained

No field borings or geotechnical investigation were conducted for this study. No coring or depth to bedrock information was available in as-built plans.

Further evaluation should be performed during preliminary and final design to obtain geotechnical design parameters and confirm that limited rock excavation would be expected during storm sewer trenching and construction.

3. **Utilities**

Aerial photography, visible above-ground facilities, and One-Call utility locates were utilized to identify existing utilities in the vicinity of the project. The following is a preliminary list of the facilities in the area:

- Kansas City Power & Light (KCP&L) distribution power poles and lines generally run overhead along the north side of 170th .
- AT&T Distribution, Consolidated Communications, Google Fiber, Spectrum Communications share the KCP&L poles along 170th. Surface mounted cabinets and pull boxes are also present within the street right-of-way.
- Johnson County Wastewater's sanitary trunk sewer crosses 170th in between the east and west systems and does not cross either system. Most houses within the project limits have private septic systems instead of JCW service lines.
- Atmos Energy service gas main is located along the north side of 170th.
- Johnson County Water District No. 1 underground water line runs along the north side of 170th.

No private utility easements were identified during the utility research. A title research company should be engaged during final design to verify this.

Specific impacts to utilities are identified in the discussion of proposed Alternatives 1 & 2.

Approximate locations of these utilities, by utility type, are shown in the preliminary drawings in **APPENDIX A – Preliminary Drawings.**

4. **Right of Way**

170th is within public right-of-way. Based on Johnson County AIMS mapping, the properties fronting 170th are unplatted. The city is unaware of existing drainage easements within the project limits. Property lines shown in this study are based on AIMS mapping and will need to be verified during preliminary and final design. Proposed drainage easements will need to be acquired for new public drainage systems in the proposed solution alternatives.

D. Standards

The project is located upstream of the limits of the Blue River Watershed Study and the entire project is located outside the regulatory FEMA floodplain.

The City of Overland Park criteria, APWA 5600 Guidelines, and Johnson County SMP guidelines were used for the project design criteria. The following key components of the respective agencies' criteria shall govern this project:

- According to the Johnson County Stormwater Management Program Administrative Procedures, houses currently flooding must be provided a minimum one foot of freeboard from the low opening (LO) to the 1% storm event hydraulic grade line (HGL) with any proposed solution alternatives.
- The City of Overland Park criteria further restricts freeboard, requiring a minimum one foot of freeboard between the low opening of a habitable structure and the energy grade line (EGL) of adjacent flow for the 1% storm.
- In addition to protecting habitable structures, excessive roadway flooding shall be alleviated with the proposed alternatives and limited to 7 inches at the crown of the road in the 1% design storm.
- The project will be designed based on fully developed / future conditions hydrology.

If it is determined that these criteria cannot be reasonably met without significantly increasing project costs, a waiver from the County Program Manager may be required, however no criteria exceptions are anticipated for this project.

E. Utility Contacts

Atmos Energy
25090 W. 110th Terr.
Olathe, KS 66061
(913) 254-6355
Attn: Richard Yunghans

KCP&L Distribution
16215 W. 108th Street
Lenexa, KS 66219
(913) 681-7420
Attn: Gary Price

AT&T
9444 Nall Avenue
Overland Park, KS 66207
(816) 392-0353
Attn: Darrin Welch

Spectrum Communications
8221 W. 119th Street
Overland Park, KS 66213
(913) 915-0553
Attn: Alex Cashman

Google Fiber
908 Broadway Boulevard
Kansas City, MO 64105
(816)-605-6936
Kc-google-uc@google.com (Attn: Greg Link)

Water District No. 1
10747 Renner Boulevard
Lenexa, KS 66219
(913) 895-5775
Attn: Jan Hardie, P.E.

Johnson County Wastewater
11811 S. Sunset Drive, Suite 2500
Olathe, KS 66061
(913) 715-8537
Attn: Mike Piller

F. Permits

The following federal, state, and local permits will be required for an improvement project in the project area:

1. KDHE Construction Stormwater Discharge Permit (NPDES-NOI)
2. City of Overland Park Land Disturbance Permit

The KSDA Division of Water Resources Stream Obstruction Permit will not be required as the improvement area has a drainage area less than one square mile. FEMA CLOMR and LOMR will not be required as the project is not within the limits of the regulatory FEMA Zone AE floodplain / floodway. A United States Department of the Army Section 404 permit is not required, as no jurisdictional streams with ordinary highwater will be impacted by the project improvements.

G. Conformance with Watershed Studies

The project is located within the Coffee Creek Watershed (part of the Blue River Watershed Study), however the specific project area is upstream of any hydrologic or hydraulic analysis performed as part of that study. The project is not proposed to reroute flow patterns or change assumptions used in the development of that watershed study.

II. SUMMARY OF FINDINGS

A. Field Investigations

Topographic field surveys of key features in the project area were obtained, including:

- Verification of eight habitable structure Lowest Adjacent Grade (LAG) and Low Opening (LO) elevations
- Pipe culvert inverts and sizes at 170th Terrace crossings
- Pipe inverts and structure elevations of upstream and downstream storm sewer systems

Information from these surveys was used throughout the design process. Johnson County AIMS was used as the source for topographic data for swale analysis. A field visit was conducted by the design team so appropriate Manning's "n" values could be assigned at the proposed storm sewer alignments reviewed. A full ground survey and geotechnical investigation of the project area should be completed during the preliminary design phase of the project.

B. Hydrology and Hydraulics

1. Existing Conditions Hydrology

The drainage area for the west crossing is 25.32 acres and the drainage area to the east crossing is 44.66 acres. Hydrologic calculations were performed with the Rational Method due to size of the watersheds, in accordance with APWA 5600, the upstream Terrybrook Farms development was assumed to be fully developed residential (rational C=0.51). In accordance with City criteria and direction, the public storm sewer system was analyzed using peak flows, neglecting the privately owned upstream detention basins. The drainage area is shown in **Figure 2**

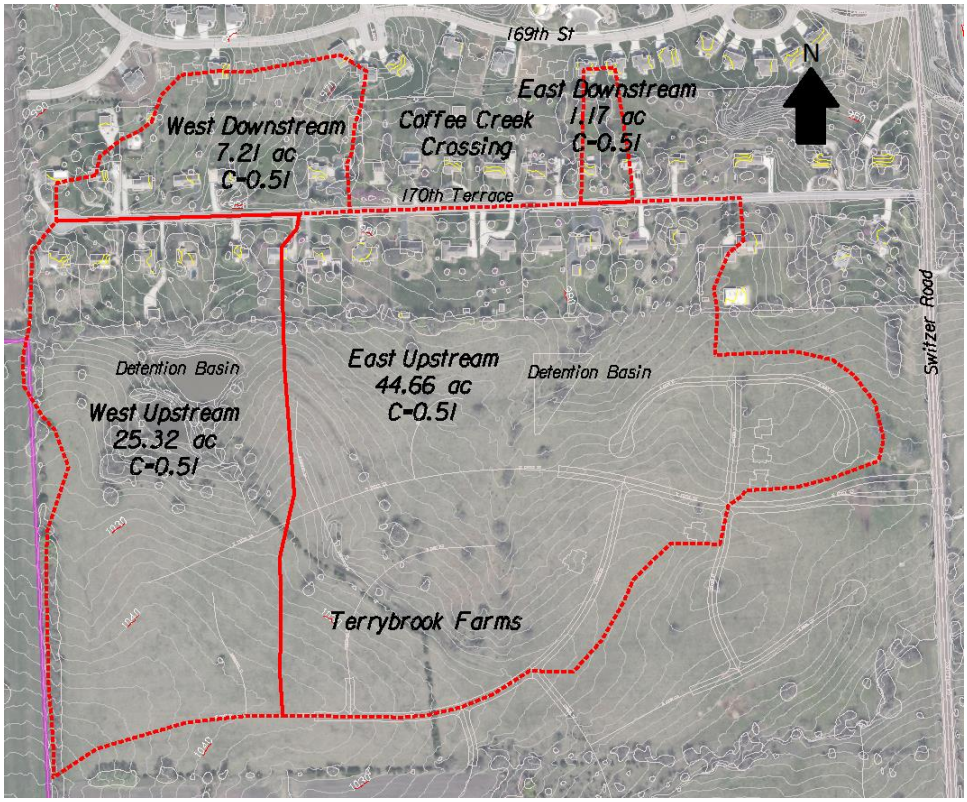


Figure 2: Drainage Area Map

Steady flow data for the project is shown in Table 1. Detailed hydrologic Calculations are available in **APPENDIX C – Storm Sewer Calculations.**

Table 1: Steady flow data from Indian Creek Watershed Study

Location	Crossing	Cumulative Area (acre)	Time of Concentration (min.)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Upstream end of Swale	West	25.3	13.0	51	71	126
Downstream 170th crossing	West	32.5	14.9	62	86	153
Upstream end of Swale	East	44.7	16.4	81	113	203
Downstream 170th crossing	East	45.8	17.4	81	113	204

2. Existing Conditions Hydraulics

The project area includes both open channel flow and culverts. The existing swale and culvert system was analyzed using HEC-RAS 5.0.4 based on AIMS contour data and surveyed flowlines of the east and west culvert. An existing conditions hydraulic model was created to model the east and west swales and culverts. Water surface profiles and flooding extents were computed for the 50%, 10%, and 1% storms. HEC-RAS output can be found in **APPENDIX B – HEC-RAS Output**.

The HEC-RAS 5.0 RAS Mapper application was used to plot a floodplain delineation of the 1% existing floodplain. **Figure 3** illustrates HEC-RAS cross sections, the existing 1% floodplain, and the structures identified as being susceptible to flooding.

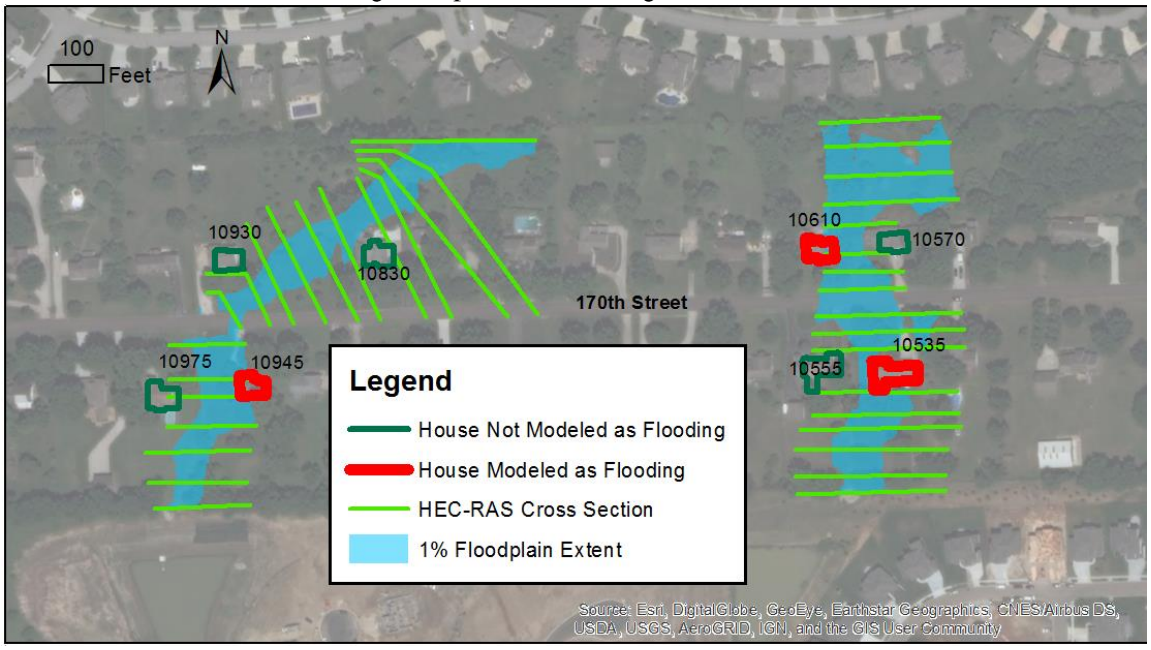


Figure 3: Existing Flooding Conditions

The surveyed LAG and LO elevations of each structure were compared with the results of the hydraulic model to determine the magnitude and frequency of flooding. If a HEC-RAS cross section was not located directly adjacent to a specific habitable structure, a water surface was linearly interpolated between the two bounding cross sections.

Table 2 indicates the magnitude of habitable structure flooding from open channels in the 1% storm event and the most frequent storm for which the structure is modeled as flooding. The highlighted cells indicate a water surface elevation (WSEL) above the controlling structure elevation.

Table 2: Existing Structure Flood Depths Summary

				WSEL			LAG Flood Depth (+) / Freeboard (-)			LO Flood Depth (+) / Freeboard (-)		
		LAG	LO	50%	10%	1%	50 %	10 %	1%	50 %	10 %	1%
West	10930 W 170th Terr	982.05	983.69	976.70	976.91	977.13	-5.35	-5.14	-4.92	-6.99	-6.78	-6.56
	10830 W 170th Terr	971.79	972.20	970.77	970.83	971.09	-1.02	-0.96	-0.7	-1.43	-1.37	-1.11
	10975 W 170th Terr	986.25	986.64	984.27	984.39	984.61	-1.98	-1.86	-1.64	-2.37	-2.25	-2.03
	10945 W 170th Terr	983.30	983.34	983.44	983.56	983.79	0.14	0.26	0.49	0.10	0.22	0.45
East	10610 W 170th Terr	966.61	966.75	967.51	967.65	967.80	0.9	1.04	1.19	0.76	0.9	1.05
	10570 W 170th Terr	969.95	971.26	968.20	968.40	968.60	-1.75	-1.55	-1.35	-3.06	-2.86	-2.66
	10555 W 170th Terr	975.51	977.71	973.71	973.86	974.00	-1.8	-1.65	-1.51	-4.00	-3.85	-3.71
	10535 W 170th Terr	973.76	973.64	973.71	973.86	974.00	-0.05	0.10	0.24	0.07	0.22	0.36

In summary, the hydraulic model identified the following problems in the study area:

- Flooding of three habitable structures
- Overtopping of 170th Terrace

3. Proposed Hydrology

Overall existing and proposed hydrologic parameters are the same. Hydrology for off-site areas is based on ultimate conditions hydrology. Solution alternatives are designed to maintain the same outflow points as the existing hydrologic conditions. For alternative II, drainage areas were subdivided slightly differently than for the existing conditions analysis and alternative I as the drainage system for alternative II consists of a storm sewer with area inlets, rather than an open channel swale and culvert system. The exterior boundary for each system is constant for each analysis.

4. Proposed Hydraulics

HEC-RAS Analysis for Alternative I

The existing conditions hydraulic model was used as the basis for proposed conditions hydraulic model for alternative I. Cross sections in the proposed model are in the same location as in existing conditions model. Culvert sizes and configurations were updated in the Alternative I model to alleviate the excessive street flooding at the crossings of 170th. Details of improvements are presented in the **Improvement Alternatives** section.

Output from the proposed HEC-RAS analysis is available in **APPENDIX B – HEC-RAS Output.** Proposed hydraulic results at habitable structures are indicated in the **Improvement Alternatives** section.

Storm Sewer Analysis for Alternative II

Alternative II consists of a proposed storm sewer system designed to convey the 1% design storm, in order to alleviate the flooding of adjacent structures. The Bentley Storm & Sanitary software package was used to model and analyze the proposed storm sewer system. This software package is capable of modeling storm sewer systems in accordance with both open channel flow and pressure pipe scenarios by rational method hydrology. Details of Alternative II are indicated in the **Improvement Alternatives** section. Rational method storm sewer calculations are detailed in **APPENDIX C – Storm Sewer Calculations.** A summary of hydraulic data at each house is located below, in **Table 3**.

Table 3: Alternative II Storm Sewer Freeboard

		LAG	LO	1% HGL*	HGL Freeboard	1% EGL*	EGL Freeboard
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
West	10930 W 170th Terr	982.05	983.69	977.6	4.45	978.51	3.54
	10830 W 170th Terr	971.79	972.2	965.94	5.85	968.56	3.23
	10975 W 170th Terr	986.25	986.64	977.37	8.88	978.99	7.26
	10945 W 170th Terr	983.3	983.34	977.37	5.93	978.99	4.31
East	10610 W 170th Terr	966.61	966.75	959.05	7.56	960.81	5.8
	10570 W 170th Terr	969.95	971.26	959.05	10.9	960.81	9.14
	10555 W 170th Terr	975.51	977.71	965.00	10.51	971.51	4
	10535 W 170th Terr	973.76	973.64	965.00	8.64	971.51	2.13

*At Nearest Inlet opening / manhole.

C. Improvement Alternatives

As previously discussed, in the existing conditions three habitable structures are projected to flood in excess of design standards. The Alternative I (Buyout) considers buyout of all homes flooding in the existing conditions, as well as improvements to the stream crossings to meet current APWA and City standards for roadways. The Alternative II (Storm Sewer) provides flood protection for these homes currently modeled as susceptible to flooding and alleviates the excessive street flooding.

Alternative I

Alternative I consists of buyouts of structures subject to flooding and culvert improvements to alleviate excessive flooding of streets. The east and west crossings at 170th would be improved and replaced with reinforced concrete boxes (RCBs) order to meet roadway overtopping criteria.

In Alternative I, project elements are sized as follows:

- 8 ft x 3 ft RCB at west crossing

- 8 ft x 3 ft RCB at east crossing

Larger sizes for these RCBs are required than the storm sewer for Alternative II, as the RCBs must remain shallow enough to outlet to the existing swales.

Each proposed culvert crossing would limit 100 year roadway overtopping depths to at most 7 inches at the roadway centerline.

APPENDIX A – Preliminary Drawings includes a drawing showing the location and size of the proposed improvements.

Alternative II – Storm Sewer Improvements

For Alternative II, the proposed drainage system for this area consists of two storm sewer systems to convey stormwater through the project area. An overflow swale should also be graded along the surface path of the pipe system. A conceptual storm sewer routing, sizing, and profile was developed to meet City of Overland Park criteria. The following were set as additional considerations for this system:

- Overall system (combination of pipes and overflow swale) should convey the 1% storm with the EGL 1' below the low openings of adjacent homes per City criteria
- Directly connect the detention basin outlets to the proposed pipe system to minimize future erosion issues and remove the potential for the basin outlet to bypass the pipe system
- Minimum pipe sizes for the east and west systems will match the outlet pipe size of the adjacent detention basin and maximum pipe sizes will be the size of the downstream system (pipes will not decrease in size going downstream)
- Minimize property owner impacts where possible

The following exhibit (Figure 4) illustrates the overall layout of the proposed system. The west system consists of 42" RCP from the detention basin to the north side of 170th , where size is increased to 48" to the tie in with the existing area inlet and 48" RCP at the south property line of the Coffee Creek development. The east system consists of 48" RCP from the detention basin outlet to the area inlet at the south property line of the Coffee Creek development.

Figure 4 Conceptual Enclosed System Layout

Both systems should be directly connected to the outlet pipes of the detention basins with junction boxes. Details of the junction boxes will need to be addressed during final design to minimize the height of exposed junction box at the face of the detention basin berm. Final design plans and construction will also need to minimize impacts to the existing detention basin berms during construction. As placed in the conceptual drawings, a 1:1 slope could be graded during construction to facilitate installation of the junction boxes without disturbing the berm crest.

Area inlets are provided on each system just downstream of the proposed junction boxes to capture un-detained flow from the back of the side of the adjacent Terrybrook Farms lots. These structures also allow the pipes to be aligned with the property lines within the project limits. Area inlets are also provided upstream of 170th in order to capture runoff from between 170th and the detention basin and convey it under the roadway. A driveway culvert at 10930 W. 170th Terrace will need to be reconstructed and connected to a junction box due to the proximity of the driveway. A conceptual plan & profile of the recommended storm sewer system is shown in **APPENDIX A – Preliminary Drawings.**

Alternative III – Not Applicable

SMP guidelines typically require the development and evaluation of three (3) alternatives as part of the Preliminary Engineering Study. Generally, stormwater improvement options within this neighborhood are limited to an enclosed system or an improved open channel system. Minimal open channel improvements are included with Alternative I (Buyout), because it is required to reduce the flooding of the roadway.

Since the project area is already served by an enclosed system upstream and downstream of the study area, the City considers an enclosed system the only alternative (besides the house buyout option) consistent with Overland Park's design criteria and practices. Any additional alternatives to improvements in this neighborhood would be limited to slight variations in the alignment of the enclosed system. At the concurrence of the Johnson County Stormwater Management program, only two alternatives were developed for this study.

Facilities: The proposed solution alternatives have been designed to preserve existing infrastructure where possible.

Road/Traffic: Some vehicular traffic will be impacted during construction at each roadway/culvert crossing. Each crossing will likely need to be at least partially closed to traffic during the construction. Traffic control accommodations and detailed construction sequencing should be considered during future design phases to limit the impacts to residents when possible.

Utilities: A preliminary utility investigation was completed as a part of this PES. The proposed alternatives described have been evaluated for potential impacts to utilities.

Utility impacts along the alignment for Alternative II were considered. The *west* system will likely require:

- Multiple power poles (also holding the communication lines in the area) to be braced during construction.
- Potential relocation of existing water main within right-of-way crossing the proposed storm sewer.
- Potential relocation of existing gas main outside of right-of-way crossing the proposed storm sewer. It is unknown if the gas main is in an existing private easement. The proposed alignment runs parallel to the gas main but is offset in order to allow construction of the storm sewer without impacting the majority of the gas line.

The *east* system will likely require:

- Potential relocation of existing water main within right-of-way crossing the proposed storm sewer.
- Potential relocation of existing gas main outside of right-of-way crossing the proposed storm sewer. It is unknown if the gas main is in an existing private easement.

Existing water mains appear to be in City of Overland Park right-of-way, and are assumed to not be reimbursable relocations. The existing gas main that is crossed and power poles are located outside of the right-of-way shown in the AIMS mapping, and it is unknown if they are in a private easement. Therefore, the cost estimate includes an allowance for utility relocation (in conjunction with septic system relocation).

For alternative I, the buyout alternative, utility service lines to each house will need to be disconnected or capped as part of the demolition and construction operations. Existing septic systems would need to be abandoned in accordance with County and KDHE requirements.

Right-of-Way/Easements: Alternative I would require the City to maintain the lots purchased for habitable structure buyout.
Alternatives II would require proposed permanent drainage easements and temporary construction easements. Based on City criteria, permanent easements will need to be approximately 20 ft wide along the proposed storm pipe. Temporary construction easements were laid out to provide additional construction access along the alignment.

Preliminary Drawings: Preliminary exhibits including typical sections and plan sheets have been prepared to illustrate the improvements and are included in **APPENDIX A – Preliminary Drawings**.

Opinion of Probable Costs: Cost estimates have been prepared for both crossings, for both alternatives. The detailed estimates are provided in APPENDIX D– Cost Estimates and Flood Problem Rating Sheets. The total SMP eligible project costs for each alternative are:

West Crossing:
Alternative I (Buyout) – $522,000
Alternative II (Storm Sewer) – $617,000

East Crossing:
Alternative I (Buyout) – $816,000
Alternative II (Storm Sewer) – $450,000

Relationship to Other City Stormwater Facilities: As previously stated, existing infrastructure is utilized when possible. For alternative II, direct connections would be made to existing City storm sewer facilities.

Effects on Surrounding Cites: The project will not impact other cities.

Conformance with Current Design Standards: Both PES alternatives are in accordance with City and County design standards and no designed exceptions are required.

III. RECOMMENDATIONS

A. Evaluation of Alternatives

Flood protection benefits for habitable structures are equal for all proposed alternatives. The alternatives for each crossing have the same pros and cons.

Alternative I (Buyout)

- Pros
  - This alternative requires less construction out of existing street right-of-way
- Cons
  - Buyout would result in empty lots that would disrupt the continuity of the neighborhood
  - A gap between the upstream and downstream enclosed systems would continue and therefore the neighborhood would continue to experience excessive overland flow and backyard flooding

Alternative II (Storm Sewer)

- Pros
  - This alternative would not disrupt the continuity of the neighborhood.
  - This alternative provides a continuous enclosed system between the upstream and downstream enclosed system
  - Storm sewer would alleviate the excessive overland flow and backyard flooding currently experienced.
- Cons
  - Alternative requires more disturbance out of existing street right-of-way than Alternative I

For BR-10-001 (west crossing), Alternative II (Storm Sewer) is the recommended alternative as the proposed storm sewer would provide a continues enclosed system and alleviate the excessive overland flow, in addition to alleviating the street and structure flooding. SMP procedures allow the City to construct Alternative II if the City can provide the remaining funding in excess of the SMP funded amount.

For BR-10-002 (east crossing), Alternative II (Storm Sewer) is the recommended solution because there would be a continuous enclosed system which would alleviate excessive overland flow, no buyouts are necessary, and it is the least expensive of the two possible alternatives.

B. Recommended Alternative

The recommended alternative for BR-10-001 (west crossing) is Alternative II (Storm Sewer) and for BR-10-002 (east crossing) is Alternative II (Storm Sewer). These alternatives alleviate flooding issues for three houses within the project areas by conveying the 1% event through new storm

sewer systems and do not require purchasing the habitable structure. These alternatives also address the overtopping of the 170th crossings.

The recommended alternatives meet the current program adopted standards. Since the funding for BR-10-001 (West Crossing) is limited to the lowest cost alternative, funding from the County will be limited to the lowest cost alternative (Buyout).

Engineering design and construction plans for the recommended alternatives could be completed within a year of the project funding being approved by Johnson County SMP. Project construction is expected to be completed within a single construction season.

C. Flood Problem Rating Tables (Appendix D)

The following hydraulic conditions were used to justify setting the frequency and severity multipliers on the Flood Problem Rating Tables:

- Factor #2 was applied as follows for each crossing:
  - The frequency multiplier for Factor #2, "Flooding of habitable buildings", was set to 3 for both crossings because structures are modeled to flood from lowest opening in under 5-year design storm for both crossings
  - The severity multiplier for Factor #2, "Flooding of habitable buildings", was set to 1 for the west crossing as 1 building was identified as flooding in the 1% storm event in the existing conditions analysis.
  - The severity multiplier for Factor #2, "Flooding of habitable buildings", was set to 1 for the east crossing as 2 buildings were identified as flooding in the 1% storm event in the existing conditions analysis.
- Factor #5 was applied as follows for each crossing:
  - The frequency multiplier for Factor #6, "Flooding of residential street of more than 7 inches", was set to 2 for the west crossing because it was determined in the existing conditions analysis that 170th Street floods by more than 7 inches in the 10% storm event, indicating that 7 inches of overtopping depth occurs between the 20% and 10% events.
  - The frequency multiplier for Factor #6, "Flooding of residential street of more than 7 inches", was set to 1 for the east crossing because it was determined in the existing conditions analysis that 170th Street floods by more than 7 inches in the 1% storm event.
  - The severity multiplier for Factor #5 was set to 1.5 for both crossings because the flooding would restrict emergency vehicle access as 170th is a dead end street terminating in a cul-de-sac.

The Johnson County Stormwater Management Plan Flood Problem Rating Table has been included in Appendix C. The 170th & Switzer Stormwater Improvements west crossing totals 180 project points and the east crossing totals 150 points. The conceptual cost estimate for the least cost alternative for BR-10-001 (west crossing) is Alternative I (Buyout) totaling $522,000 with a priority rating of 2,900. The conceptual cost estimate for the least cost alternative for BR-10-002 (east crossing) is Alternative II (Storm Sewer) totaling $433,000 and the priority rating is 2,887.

IV. ACCEPTANCE OF PROJECT BY SURROUNDING CITIES

There were no changes to upstream or downstream conditions that would affect surrounding cities. The combined drainage area of the east and west crossings at the downstream end of the project is 78.3 acres. The drainage area of the Blue River Metcalf Ave, at the boundary between the City of Overland Park and unincorporated Johnson County, is 48.3 square miles (30,912 acres). The drainage area at the downstream end of the project is 0.25% of this value.

APPENDIX A – Preliminary Drawings

The information shown on these drawings concerning type and location of utilities for feasibility purposes only and is not guaranteed to be accurate or all inclusive.
Existing right-of-way, property line and easement information is based on AIMS mapping, as-builts, and plats, is not based on field survey and is for feasibility purposes only.

10970 W 170th Terrace
10930 W 170th Terrace
10830 W 170th Terrace
10770 W 170th Terrace
10610 W 170th Terrace
Buyout and Demolition
10570 W 170th Terrace
10975 W 170th Terrace
10945 W 170th Terrace
10555 W 170th Terrace
10535 W 170th Terrace

Install 18" RCP Driveway Culvert
Connect to RCB
Replace Aggregate Surface
Perm. Drain. Esmt.
Ex. R/W
℄ 170th Terr.
W 170TH TER
Asphalt Street Patch
8' x 3' RCB
24" Riprap (Typ.)
Buyout and Demolition

SCALE
100' 0 100' 200'

SHEET NO.	TOTAL SHEETS
1	6

HNTB
7400 W 129th St., Suite 100
Overland Park, KS 66213
(913) 491-3333

OVERLAND PARK KANSAS
ABOVE AND BEYOND. BY DESIGN.

NO.	DATE	REVISIONS	BY	APP'D
1				
2				
3				
4				

170th Terrace Preliminary Engineering Study
Alternative 1 (Buyout)
Demolition and Culvert Replacement Plan

Plotted on:8-JAN-2019 06:56 PM Models:#####models#####
By: zjarchow Plot Scale: 1:100 Pen Tables:\\vvpw001\jobs\62887\PlanProduction\Library\PrintPlot\22x34.Utility - Altspen
Design Filename: \\vvpw001\jobs\62887\PlanProduction\WaterRes\170plan- alt.dgn

The information shown on these drawings concerning type and location of utilities for feasibility purposes only and is not guaranteed to be accurate or all inclusive. Existing right-of-way, property line and easement information is based on AIMS mapping, as-builts, and plats, is not based on field survey and is for feasibility purposes only.

Existing Drainage Easement
Temp. Const. Easement
Existing Detention Basin
Remove End Section and Connect Junction Box to Existing Pipe
Abandon Existing 10" Storm Pipe
Ex1
1
2
5' Temp. Const. Esmt.
20' Perm. Drain. Esmt.
5' Temp. Const. Esmt.
POLE
OVERHEAD POWER
Replace Wood Fence
SEPTIC CLEANOUTS
10975 W 170th Terrace
Ex. R/W
℄ 170th Terr.
Abandon Existing 10" Storm Pipe
OVERHEAD POWER / COMMUNICATIONS
GAS
WATER
Ex. R/W
Install 18" RCP Driveway Culvert Connect to Junction Box
Replace Aggregate Surface
10970 W 170th Terrace
3
4
Asphalt Patch
10930 W 170th Terrace
22' Perm. Drain. Esmt.
10945 W 170th Terrace
MATCH LINE - SEE SHEET 3

SCALE
20' 0 20' 40'

Existing Pond Riser
Ex1
Const. 6' x 6 Junction Box
Top Elev. 999.00
1
2
Const. 6' x 6' Area Inlet
Top Elev. 990.74
Openings E & W
1% EGL
1% HGL
Existing 42" x 59.4' S.S. @ 1.30%
P-Ex-1
℄ 993.82
℄ 993.16
42" 60.5' S.S. @ 4.75%
P-1
℄ 986.04
℄ 983.54
℄ 980.69
Existing Ground
42" x 282.5' S.S. @ 2.39%
P-2
3
4
Const. 6' x 6' Area Inlet
Top Elev. 981.36
Openings E & W
170th Terr.
Water
Gas
Const. 6' x 6' Junction Box
Top Elev. 978.90
48" x 62.0' x S.S. @ 1.77%
48" x 239.8' S.S. @ 1.64%
℄ 974.09
P-3
℄ 973.59
℄ 972.61
℄ 971.88
P-4

1005 1000 995 990 985 980 975 970

Plotted on: 1-JAN-2009 06:59 PM Model: $$$$$$model$$$$$$
By: zjarchow Plot Scale: 1:20 Pen Table: \\vapw001\jobs\62887\PlanProduction\Library\PrintPlot\22x34_Utility.pen
Design Filename: \\vapw001\jobs\62887\PlanProduction\WaterRes\17Dplanprofile.dgn

SHEET NO.	TOTAL SHEETS
2	6

HNTB
7400 W 129th St., Suite 100
Overland Park, KS 66213
(913) 491-9333

OVERLAND PARK KANSAS
ABOVE AND BEYOND. BY DESIGN.

NO.	DATE	REVISIONS	BY	APP'D
4				
3				
2				
1				

170th Terrace Preliminary Engineering Study
Alternative II (Storm Sewer)
PLAN & PROFILE: West System #1

MATCH LINE - SEE SHEET 4

10930 W 170th Terrace

LANDSCAPING / PATIO

20' Perm. Drain. Esmt.

10830 W 170th Terrace

Temp. Const. Easement

Temp. Const. Easement

10770 W 170th Terrace

OVERHEAD POWER

POLE

5

6

Replace Driveway

Replace Driveway

22' Perm. Drain. Esmt.

GAS

GAS

GAS

WATER

WATER

OVERHEAD POWER / COMMUNICATIONS

MATCH LINE - SEE SHEET 2

℄ 170th Terr.

SCALE

20' 0 20' 40'

Plotted on:11-JAN-2019 06:59 PM Models:#####models#####
By: zjarchow Plot Scale: 1:20 Pen Tables:\\ovpw00\Jobs\62887\PlanProduction\Library\PrintPlot\22x34_Utility.pen
Design Filenames:\\ovpw00\Jobs\62887\PlanProduction\WaterRes\170planprofile.dgn

SHEET NO. 3 | TOTAL SHEETS 6

HNTB
7400 W 129th St., Suite 100
Overland Park, KS 66213
(913) 491-9333

OVERLAND PARK KANSAS
ABOVE AND BEYOND. BY DESIGN.

NO.	DATE	REVISIONS	BY	APP'D
4				
3				
2				
1				

170th Terrace Preliminary Engineering Study
Alternative II (Storm Sewer)
PLAN & PROFILE: West System #2

SHEET NO.	TOTAL SHEETS
4	6

HNTB
7400 W 129th St., Suite 100
Overland Park, KS 66213
(913) 491-9333

OVERLAND PARK KANSAS
ABOVE AND BEYOND. BY DESIGN.

NO.	DATE	REVISIONS	BY	APP'D
1				
2				
3				
4				

170th Terrace Preliminary Engineering Study
Alternative II (Storm Sewer)
PLAN & PROFILE: West System #3

Plotted on:1-JAN-2009 06:59 PM Models:$$$$$$models$$$$$
By: zjarchow Plot Scale: 1:20 Pen Tables\\ovpw001\jobs\62887\PlanProduction\Library\Print Plot\22x34_Utility.pen
Design Filename: \\ovpw001\jobs\62887\PlanProduction\WaterRes\170planprofile.dgn

Detention Basin

Ex3

Existing Drainage Easement

7

Remove End Section and Connect Junction Box

8

Abandon Existing 10" Storm Pipe

Replace Wood Fence

Replace Fence

5' Temp. Const. Esmt.

20' Perm. Drain. Esmt.

5' Temp. Const. Esmt.

PL

10555 W 170th Terrace

10535 W 170th Terrace

9

℄ 170th Terr.

Ex. R/W

Ex. R/W

W.M.

WATER

6"

Asphalt Patch

OVERHEAD POWER / COMMUNICATIONS

MATCH LINE - SEE SHEET 6

SCALE

20' 0 20' 40'

Existing Pond Riser Ex4

Const. 6' x 6' Junction Box
Top Elev. 982.61

7

1% EGL

1% HGL

Existing 48" x 60.0' S.S. (RCP) @ 0.44%

℄ 977.42 ℄ 977.19
P-Ex-4

48" x 83.5' S.S. (RCP) @ 2.07%

℄ 968.32

P-7

℄ 966.72

℄ 966.22

8

Const. 6' x 6' Area Inlet
Top Elev. 974.97
Openings E & W

Existing Ground

48" x 269.0' S.S. (RCP) @ 1.50%

P-8

9

Const. 6' x 6' Area Inlet
Top Elev. 971.66
Openings E & W

170th Terr.

Water

Gas

48" x 364.4' S.S. (RCP) @ 2.43%

℄ 962.27

℄ 961.77

P-9

990 985 980 975 970 965 960 955

Plotted on:11-JAN-2019 06:59 PM Model:$$$$$model$$$$$
By: zigrochow Plot Scale: 1:20 Pen Table:\\ovpw00\Jobs\62887\PlanProduction\Library\PrintPlot\22x34_Utility.pen
Design Filename:\\ovpw00\Jobs\62887\PlanProduction\WaterRes\170planprofile.dgn

SHEET NO.	TOTAL SHEETS
5	6

HNTB
7400 W 129th St., Suite 100
Overland Park, KS 66213
(913) 491-9333

OVERLAND PARK KANSAS
ABOVE AND BEYOND. BY DESIGN.

NO.	DATE	REVISIONS	BY	APP'D
1				
2				
3				
4				

170th Terrace Preliminary Engineering Study
Alternative II (Storm Sewer)
PLAN & PROFILE: East System #1

MATCH LINE - SEE SHEET 5

10610 W 170th Terrace

5' Temp. Const. Esmt.

20' Perm. Drain. Esmt.

5' Temp. Const. Esmt.

Replace Wood Fence

10570 W 170th Terrace

10513 W 169th St

10509 W 169th St

℄ 169th St.

Ex5

Ex6

Existing Drainage Easement

AREA INLET 8'x8' PRECAST RIM=959.37 OUT(N)=952.09 (60" RCP)

60" RCP

JUNCTION BOX #1125 8'x8' PRECAST RIM=958.02 OUT(S)=950.06 (60" RCP) OUT(W)=949.52 (60" RCP)

970 965 960 955 950

SCALE

20' 0 20' 40'

SHEET NO.	TOTAL SHEETS
6	6

HNTB
7400 W 129th St., Suite 100
Overland Park, KS 66213
(913) 491-9333

OVERLAND PARK KANSAS
ABOVE AND BEYOND. BY DESIGN.

NO.	DATE	REVISIONS	BY	APP'D
1				
2				
3				
4				

170th Terrace Preliminary Engineering Study
Alternative II (Storm Sewer)
PLAN & PROFILE: East System #2

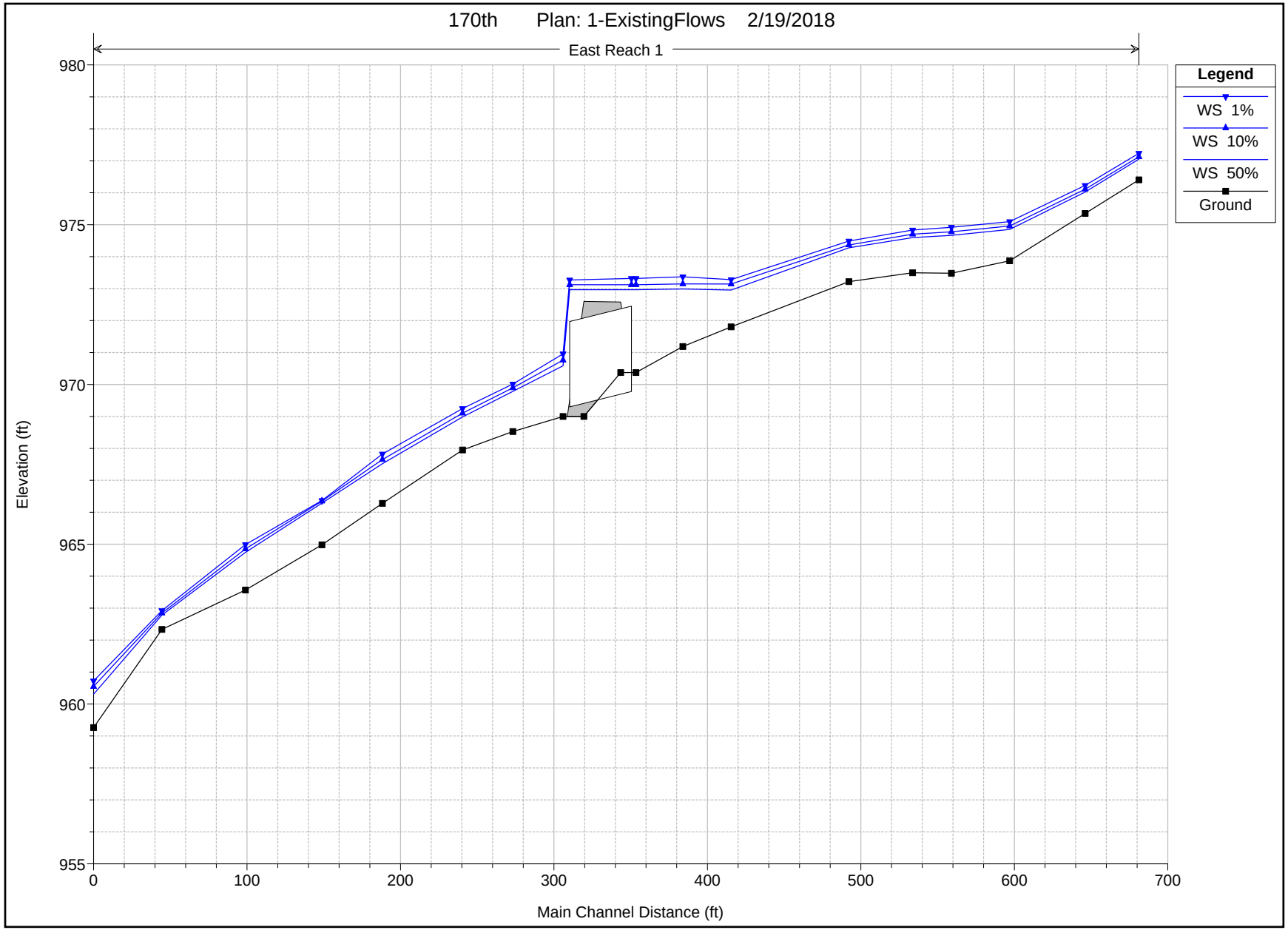
Plotted on:11-JAN-2019 06:59 PM Models:#####models#####
By: zjarchow Plot Scale: 1:20 Pen Tables:\\ovpw00\Jobs\62887\PlanProduction\Library\PrintPlot\22x34_Utility.pen
Design Filenames:\\ovpw00\Jobs\62887\PlanProduction\WaterRes\170planprofile.dgn

APPENDIX B – HEC-RAS Output

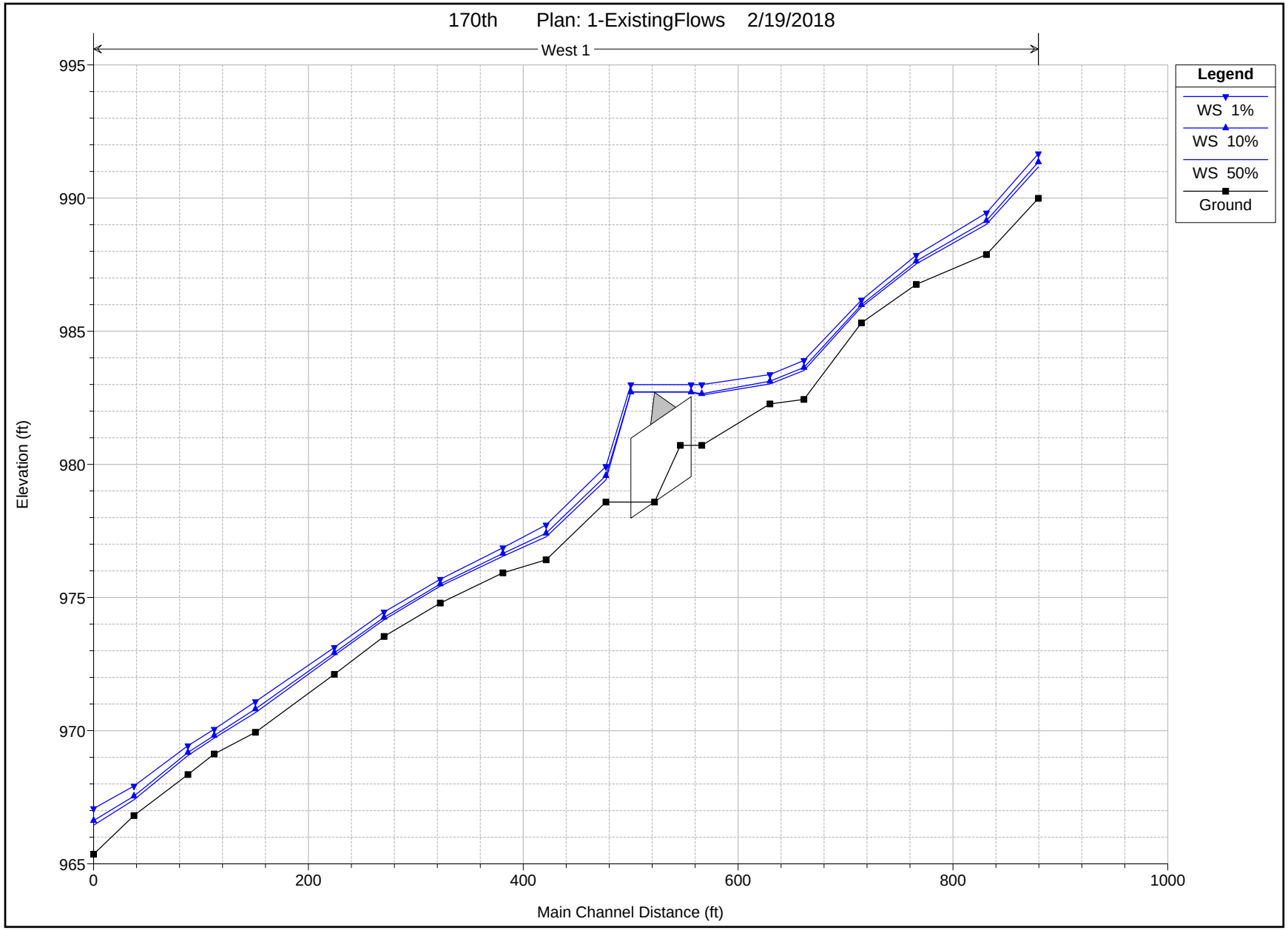
- Existing Conditions

- Alternative I

Existing - East



Existing - West



HEC-RAS Plan: Existing

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
West	West	889	50%	80.70	989.99	991.17	991.17	991.47	0.022284	4.42	18.28	31.32	1.02
West	West	889	10%	113.10	989.99	991.36	991.36	991.67	0.018935	4.54	25.50	45.19	0.97
West	West	889	1%	203.10	989.99	991.67	991.67	992.09	0.015909	5.33	40.64	51.84	0.94
West	West	840	50%	80.70	987.88	989.01	989.00	989.27	0.021264	4.03	20.02	38.02	0.98
West	West	840	10%	113.10	987.88	989.15	989.15	989.46	0.021472	4.44	25.48	42.19	1.01
West	West	840	1%	203.10	987.88	989.44	989.44	989.87	0.018725	5.24	39.31	51.39	1.00
West	West	775	50%	80.70	986.76	987.53	987.53	987.72	0.025800	3.54	22.78	60.79	1.02
West	West	775	10%	113.10	986.76	987.63	987.63	987.86	0.024009	3.84	29.42	65.90	1.01
West	West	775	1%	203.10	986.76	987.85	987.85	988.18	0.020878	4.57	44.75	73.17	1.00
West	West	724	50%	80.70	985.31	985.91	985.91	986.06	0.027584	3.13	25.77	87.08	1.01
West	West	724	10%	113.10	985.31	985.99	985.99	986.17	0.025489	3.41	33.17	96.05	1.01
West	West	724	1%	203.10	985.31	986.17	986.17	986.41	0.021360	3.93	52.76	115.79	0.98
West	West	671	50%	80.70	982.44	983.52	983.35	983.59	0.006221	2.16	39.08	86.26	0.53
West	West	671	10%	113.10	982.44	983.64	983.46	983.72	0.005956	2.42	49.19	88.77	0.54
West	West	671	1%	203.10	982.44	983.90	983.63	984.03	0.005472	2.93	73.17	92.14	0.54
West	West	639	50%	80.70	982.27	983.02	983.02	983.22	0.024022	3.61	22.33	54.81	1.00
West	West	639	10%	113.10	982.27	983.12	983.12	983.37	0.023468	3.99	28.32	58.79	1.01
West	West	639	1%	203.10	982.27	983.37	983.37	983.70	0.021349	4.58	44.31	69.70	1.01
West	West	575	50%	80.70	980.71	982.60	981.91	982.67	0.001688	2.54	51.88	99.80	0.34
West	West	575	10%	113.10	980.71	982.65	982.48	982.76	0.002648	3.25	57.18	100.47	0.43
West	West	575	1%	203.10	980.71	982.99	982.71	983.10	0.002461	3.51	92.16	104.43	0.42
West	West	545		Culvert									
West	West	486	50%	80.70	978.59	979.42	979.42	979.71	0.021725	4.37	18.47	31.58	1.01
West	West	486	10%	113.10	978.59	979.58	979.58	979.93	0.020714	4.74	23.87	34.85	1.01
West	West	486	1%	203.10	978.59	979.92	979.92	980.40	0.018684	5.53	36.75	39.39	1.01
West	West	430	50%	80.70	976.42	977.28	977.26	977.53	0.020939	4.04	20.00	37.51	0.97
West	West	430	10%	113.30	976.42	977.41	977.41	977.72	0.021081	4.46	25.40	41.18	1.00
West	West	430	1%	203.80	976.42	977.73	977.73	978.14	0.019636	5.16	39.49	48.79	1.01
West	West	390	50%	80.70	975.93	976.55	976.51	976.71	0.018656	3.24	24.93	59.76	0.88
West	West	390	10%	113.30	975.93	976.66	976.62	976.86	0.018249	3.58	31.69	64.32	0.90
West	West	390	1%	203.80	975.93	976.87	976.85	977.17	0.019354	4.42	46.11	71.18	0.97

HEC-RAS Plan: Existing (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
West	West	332	50%	80.70	974.79	975.43	975.38	975.57	0.020679	3.00	26.89	77.99	0.90
West	West	332	10%	113.30	974.79	975.51	975.49	975.69	0.021903	3.38	33.56	85.19	0.95
West	West	332	1%	203.80	974.79	975.69	975.69	975.95	0.022653	4.12	49.45	95.44	1.01
West	West	280	50%	80.70	973.54	974.16	974.16	974.33	0.026660	3.31	24.37	73.75	1.02
West	West	280	10%	113.30	973.54	974.25	974.25	974.46	0.024951	3.64	31.09	77.55	1.01
West	West	280	1%	203.80	973.54	974.45	974.45	974.74	0.021932	4.32	47.19	82.83	1.01
West	West	233	50%	80.70	972.12	972.83	972.83	973.00	0.025209	3.38	23.90	67.38	1.00
West	West	233	10%	113.30	972.12	972.93	972.93	973.13	0.023971	3.64	31.09	75.27	1.00
West	West	233	1%	203.80	972.12	973.13	973.13	973.42	0.022161	4.37	46.66	81.15	1.02
West	West	160	50%	80.70	969.94	970.68	970.68	970.92	0.023458	3.91	20.64	44.23	1.01
West	West	160	10%	113.30	969.94	970.81	970.81	971.08	0.022739	4.16	27.22	51.86	1.01
West	West	160	1%	203.80	969.94	971.09	971.09	971.44	0.020709	4.78	42.65	61.60	1.01
West	West	122	50%	80.70	969.13	969.72	969.72	969.91	0.024545	3.51	23.00	60.04	1.00
West	West	122	10%	113.30	969.13	969.82	969.82	970.05	0.023686	3.89	29.16	63.54	1.01
West	West	122	1%	203.80	969.13	970.06	970.06	970.37	0.021424	4.48	45.47	74.20	1.01
West	West	97	50%	80.70	968.35	969.07	969.07	969.28	0.024255	3.67	22.00	53.19	1.01
West	West	97	10%	113.30	968.35	969.18	969.18	969.43	0.024051	3.98	28.46	60.49	1.02
West	West	97	1%	203.80	968.35	969.44	969.44	969.72	0.022154	4.29	47.47	84.72	1.01
West	West	47	50%	80.70	966.81	967.41	967.41	967.60	0.025029	3.57	22.60	58.24	1.01
West	West	47	10%	113.30	966.81	967.54	967.51	967.75	0.018910	3.67	30.87	61.88	0.92
West	West	47	1%	203.80	966.81	967.92		968.13	0.010164	3.62	56.26	72.19	0.72
West	West	9	50%	80.70	965.36	966.45	966.45	966.80	0.017646	4.79	17.32	210.53	0.95
West	West	9	10%	113.30	965.36	966.62	966.62	967.06	0.016968	5.38	21.99	212.31	0.97
West	West	9	1%	203.80	965.36	967.07	967.07	967.65	0.013810	6.27	35.50	219.04	0.93
East	East	693	50%	68.50	976.40	977.05	977.05	977.20	0.026339	3.10	22.09	73.08	0.99
East	East	693	10%	96.00	976.40	977.12	977.12	977.31	0.026065	3.49	27.48	75.48	1.02
East	East	693	1%	137.90	976.40	977.23	977.23	977.46	0.023569	3.86	35.84	82.92	1.01
East	East	658	50%	68.50	975.35	976.02	976.02	976.20	0.026406	3.36	20.38	60.36	1.02
East	East	658	10%	96.00	975.35	976.11	976.11	976.32	0.024536	3.69	26.14	65.59	1.01
East	East	658	1%	137.90	975.35	976.23	976.23	976.49	0.021675	4.10	34.12	69.88	0.99
East	East	609	50%	68.50	973.87	974.85		974.91	0.005402	2.05	33.95	74.20	0.50
East	East	609	10%	96.00	973.87	974.96		975.04	0.005506	2.34	42.73	85.61	0.52

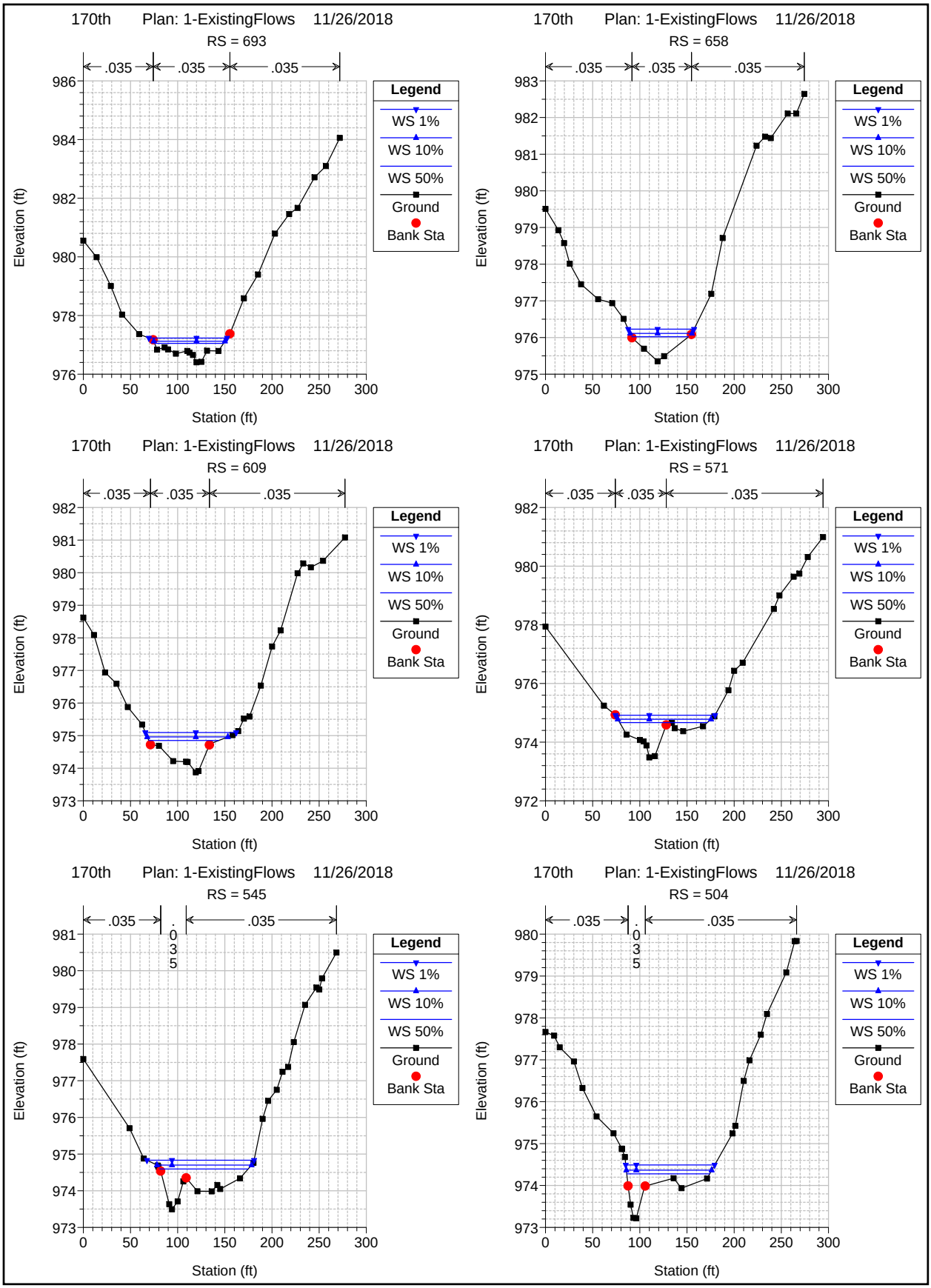
HEC-RAS Plan: Existing (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	East	609	1%	137.90	973.87	975.10		975.20	0.005625	2.69	55.17	96.36	0.54
East	East	571	50%	68.50	973.48	974.67		974.73	0.004418	2.04	37.84	92.84	0.46
East	East	571	10%	96.00	973.48	974.78		974.85	0.004527	2.25	48.61	98.91	0.47
East	East	571	1%	137.90	973.48	974.92		975.00	0.004664	2.51	62.77	105.56	0.49
East	East	545	50%	68.50	973.50	974.59		974.63	0.002842	1.74	46.70	93.88	0.37
East	East	545	10%	96.00	973.50	974.70		974.75	0.003070	1.99	57.05	100.42	0.40
East	East	545	1%	137.90	973.50	974.83		974.90	0.003311	2.29	71.21	113.50	0.42
East	East	504	50%	68.50	973.22	974.28	974.28	974.42	0.010280	3.50	27.73	87.87	0.72
East	East	504	10%	96.00	973.22	974.36	974.36	974.52	0.010571	3.82	35.47	90.47	0.74
East	East	504	1%	137.90	973.22	974.49		974.66	0.009971	4.08	46.96	94.20	0.74
East	East	427	50%	68.50	971.80	972.95	972.95	973.22	0.022399	4.13	16.60	31.59	1.00
East	East	427	10%	96.00	971.80	973.14	973.14	973.38	0.022172	3.90	24.62	57.76	0.99
East	East	427	1%	137.90	971.80	973.28	973.27	973.57	0.020791	4.31	32.02	68.92	0.99
East	East	396	50%	68.50	971.19	972.99	972.19	973.01	0.000577	1.33	61.03	128.01	0.19
East	East	396	10%	96.00	971.19	973.15	972.29	973.18	0.000730	1.60	70.82	134.97	0.22
East	East	396	1%	137.90	971.19	973.37	972.44	973.41	0.000887	1.92	84.61	151.69	0.25
East	East	365	50%	68.50	970.37	972.97	971.70	972.99	0.000438	1.46	62.08	207.12	0.18
East	East	365	10%	96.00	970.37	973.12	971.85	973.16	0.000587	1.77	76.08	222.70	0.21
East	East	365	1%	137.90	970.37	973.32	972.06	973.38	0.000983	2.43	100.20	228.58	0.27
East	East	346		Culvert									
East	East	317	50%	68.50	969.00	970.58	970.57	970.89	0.020855	4.45	15.39	24.56	0.99
East	East	317	10%	96.00	969.00	970.76	970.76	971.11	0.018399	4.76	20.57	77.09	0.96
East	East	317	1%	137.90	969.00	970.96	970.96	971.38	0.016686	5.29	27.19	110.33	0.95
East	East	285	50%	68.70	968.53	969.78	969.77	969.95	0.035155	3.26	21.33	64.25	0.93
East	East	285	10%	96.60	968.53	969.90	969.90	970.07	0.028172	3.41	30.05	93.24	0.86
East	East	285	1%	139.00	968.53	970.01	970.01	970.20	0.024045	3.64	42.02	108.55	0.83
East	East	252	50%	68.70	967.95	968.98	968.87	969.11	0.018834	2.83	24.24	48.84	0.71
East	East	252	10%	96.60	967.95	969.10	968.98	969.26	0.019136	3.20	30.18	51.29	0.74
East	East	252	1%	139.00	967.95	969.25	969.13	969.46	0.020289	3.68	37.81	54.54	0.78
East	East	200	50%	68.70	966.28	967.52	967.52	967.76	0.037009	3.95	17.38	75.01	0.99
East	East	200	10%	96.60	966.28	967.65	967.65	967.94	0.034354	4.33	22.42	80.41	0.99

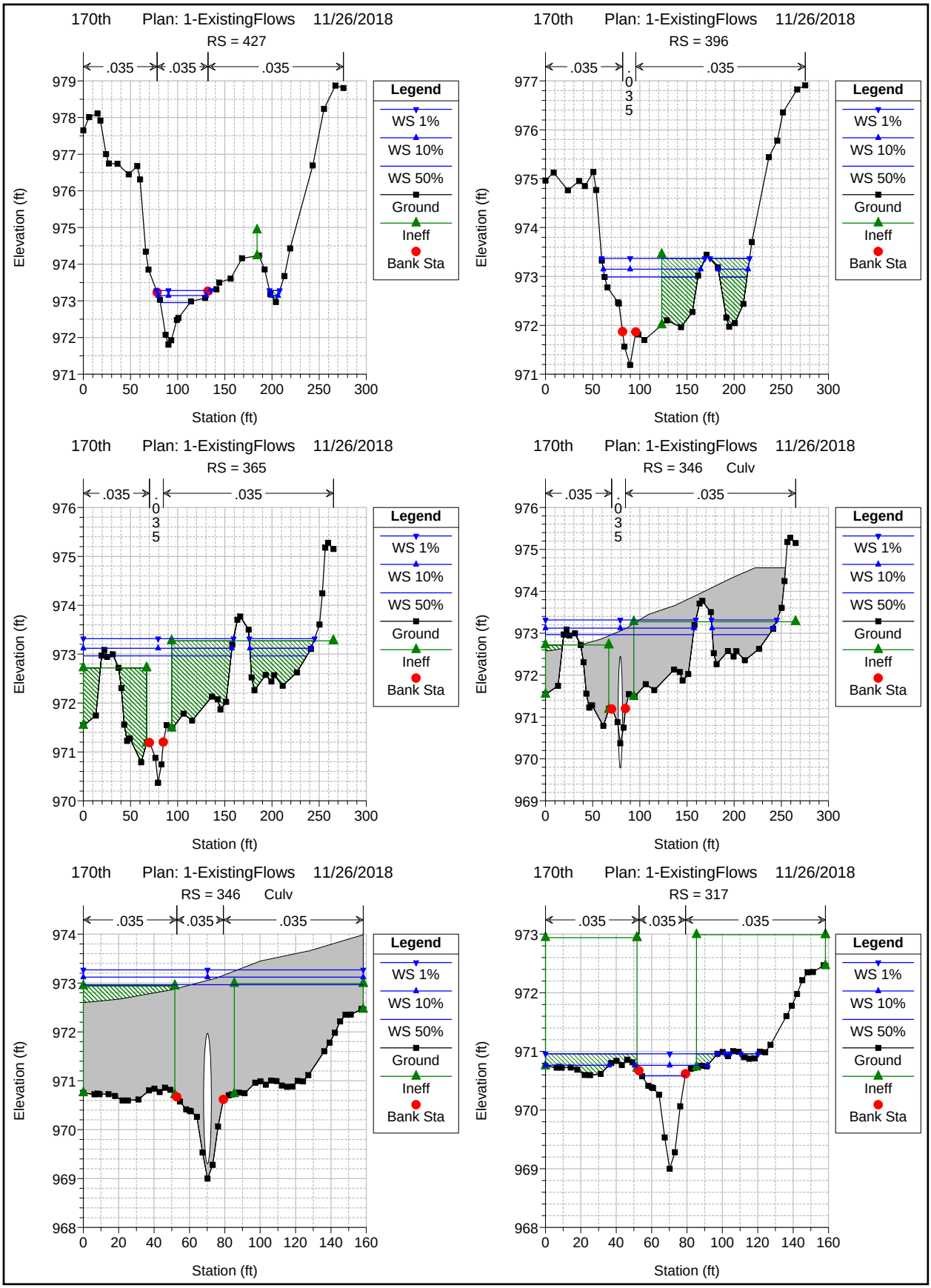
HEC-RAS Plan: Existing (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	East	200	1%	139.00	966.28	967.82	967.82	968.17	0.029720	4.78	29.65	83.80	0.96
East	East	160	50%	68.70	964.98	966.29	966.22	966.35	0.021815	2.03	34.08	241.21	0.69
East	East	160	10%	96.60	964.98	966.35	966.29	966.43	0.021466	2.31	42.26	243.85	0.71
East	East	160	1%	139.00	964.98	966.37	966.37	966.39	0.000950	0.50	142.06	244.63	0.15
East	East	111	50%	68.70	963.57	964.75	964.73	964.93	0.038137	3.45	19.93	219.49	0.97
East	East	111	10%	96.60	963.57	964.85	964.85	965.07	0.034857	3.75	26.10	231.14	0.96
East	East	111	1%	139.00	963.57	964.99	964.99	965.00	0.000768	0.66	158.32	231.14	0.15
East	East	56	50%	68.70	962.34	962.78	962.78	962.90	0.035811	2.29	25.65	162.83	0.86
East	East	56	10%	96.60	962.34	962.84	962.84	962.98	0.032230	2.51	33.51	176.08	0.84
East	East	56	1%	139.00	962.34	962.92	962.92	963.09	0.028505	2.76	43.99	197.81	0.82
East	East	12	50%	68.70	959.26	960.31	960.31	960.61	0.034408	4.45	15.45	24.88	0.99
East	East	12	10%	96.60	959.26	960.55	960.55	960.82	0.021774	4.23	24.67	52.20	0.83
East	East	12	1%	139.00	959.26	960.72	960.72	961.01	0.019459	4.55	34.77	63.98	0.81

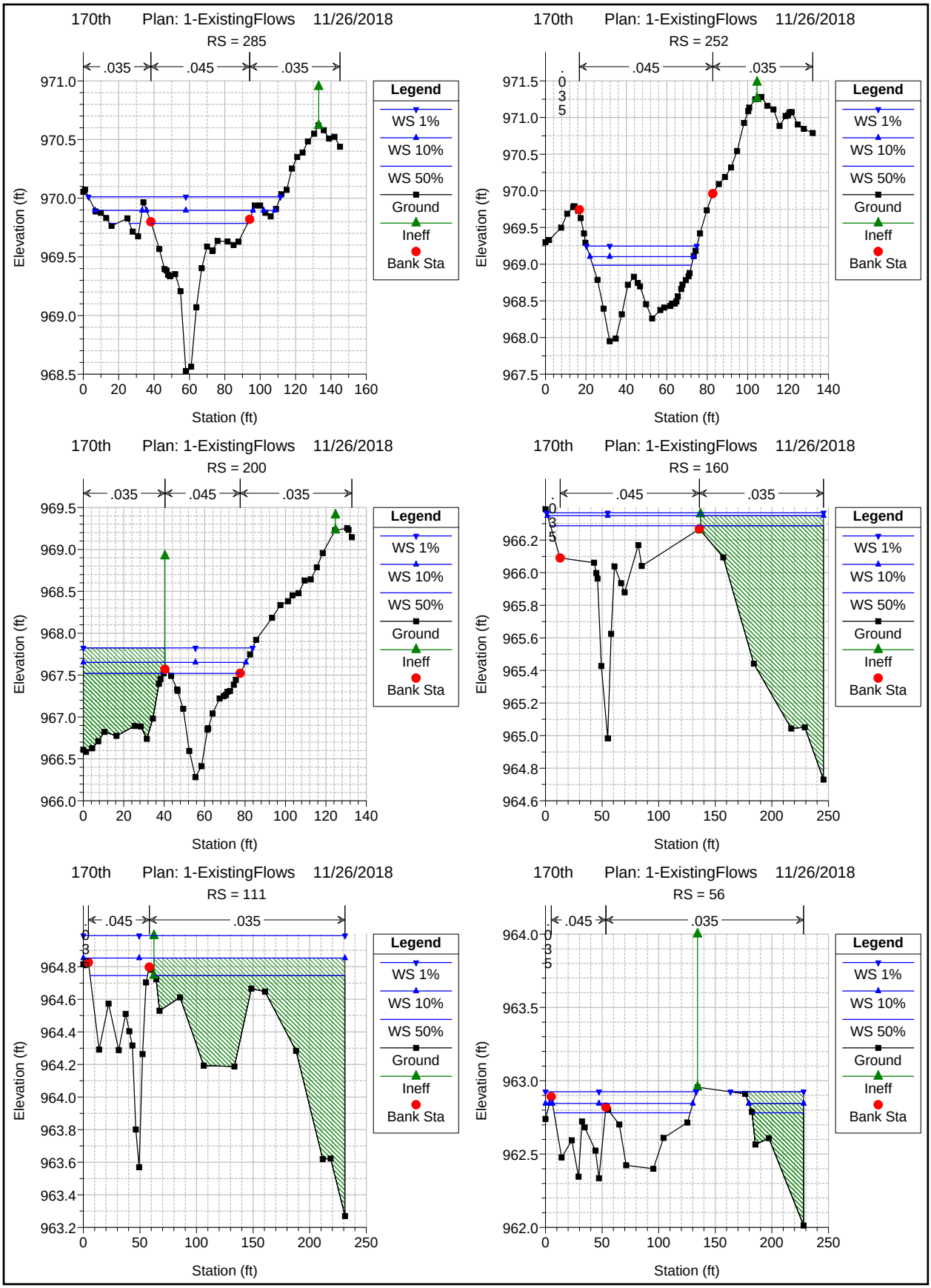
Existing - East



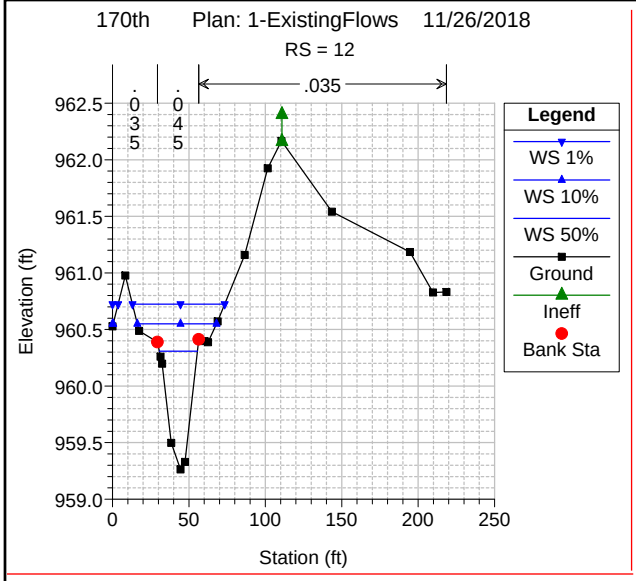
Existing - East



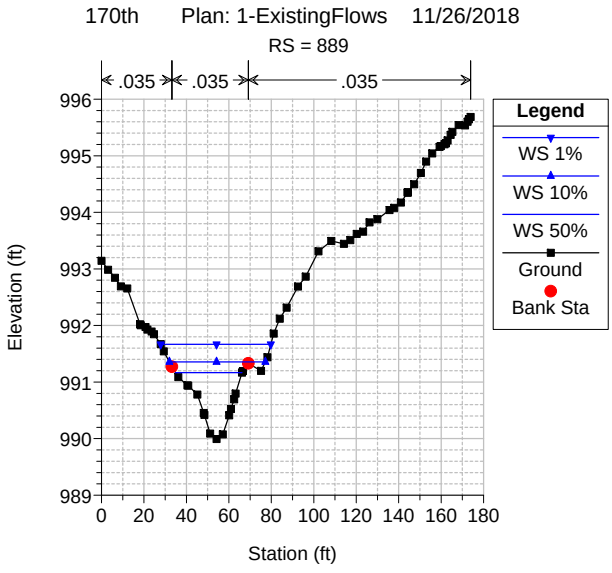
Existing - East

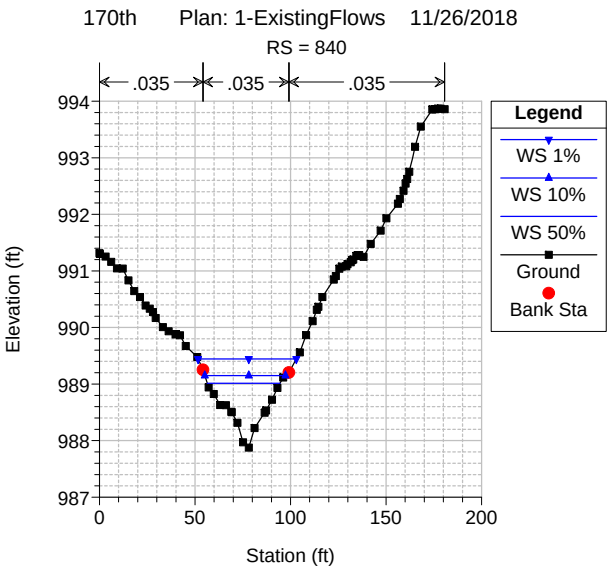


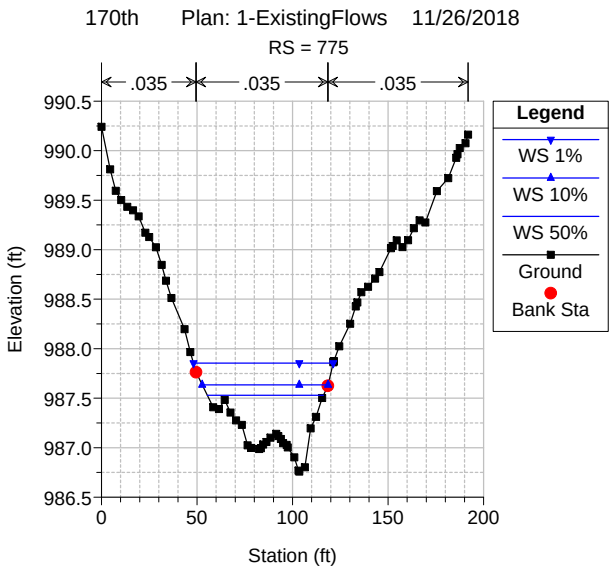
Existing - East

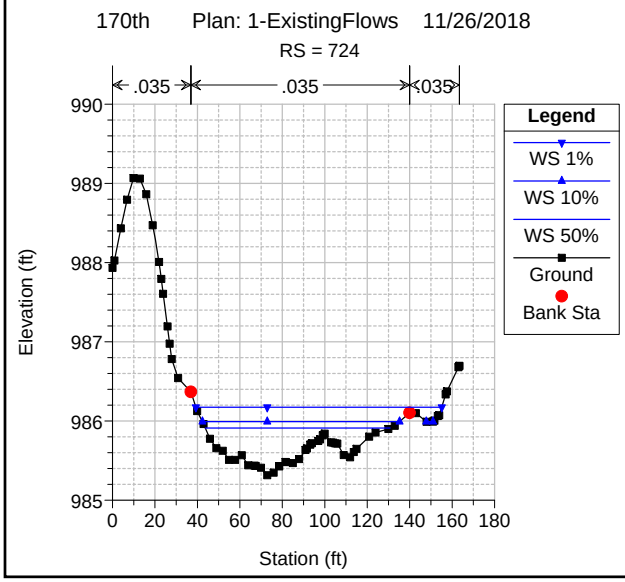


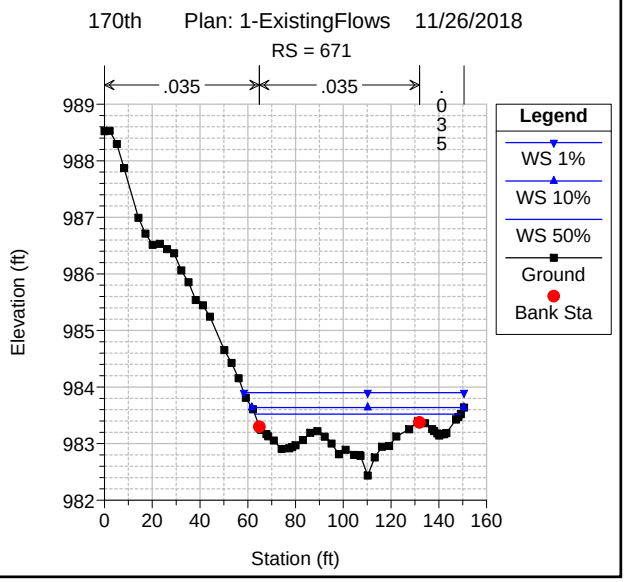
Existing - West



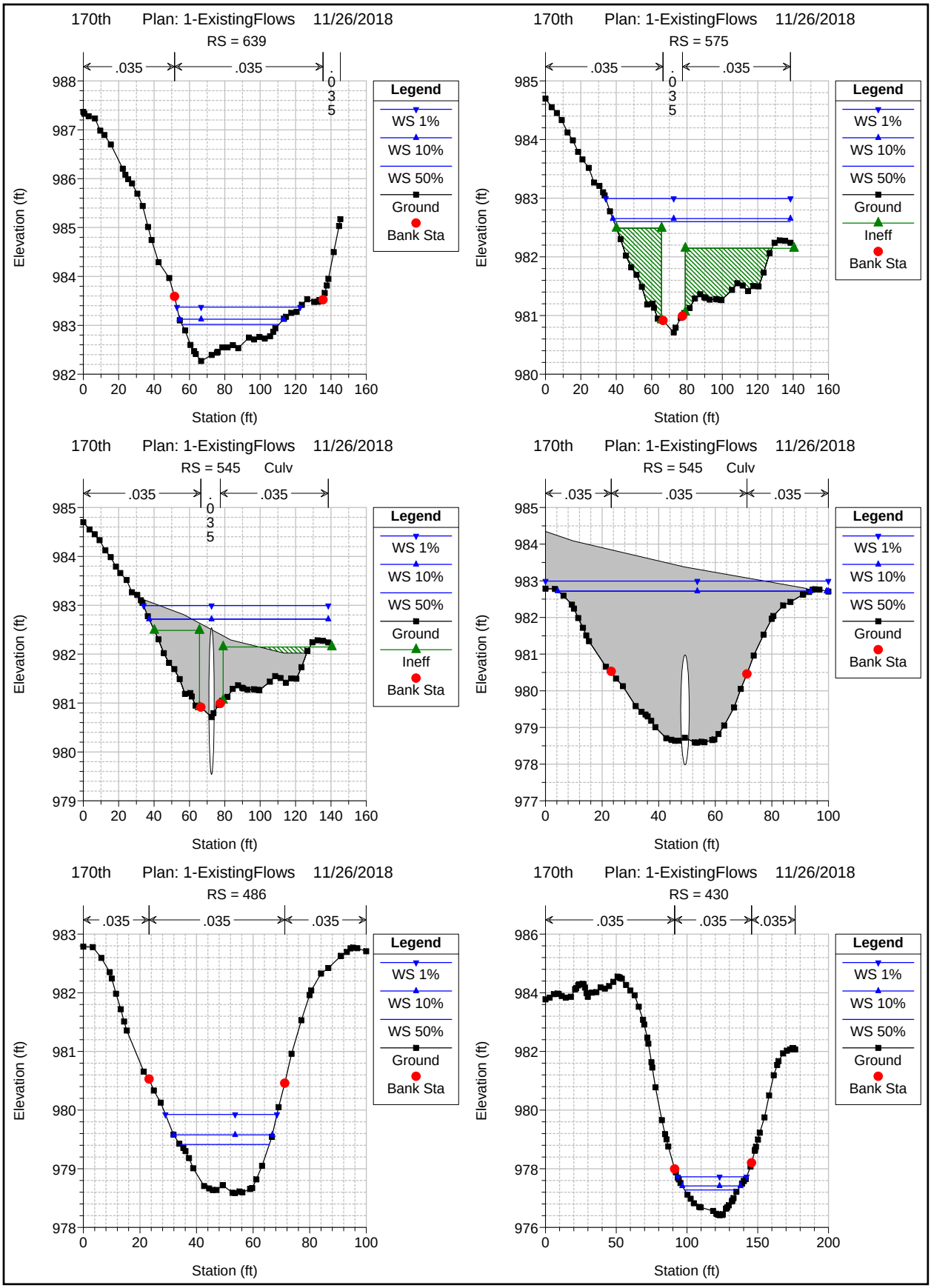




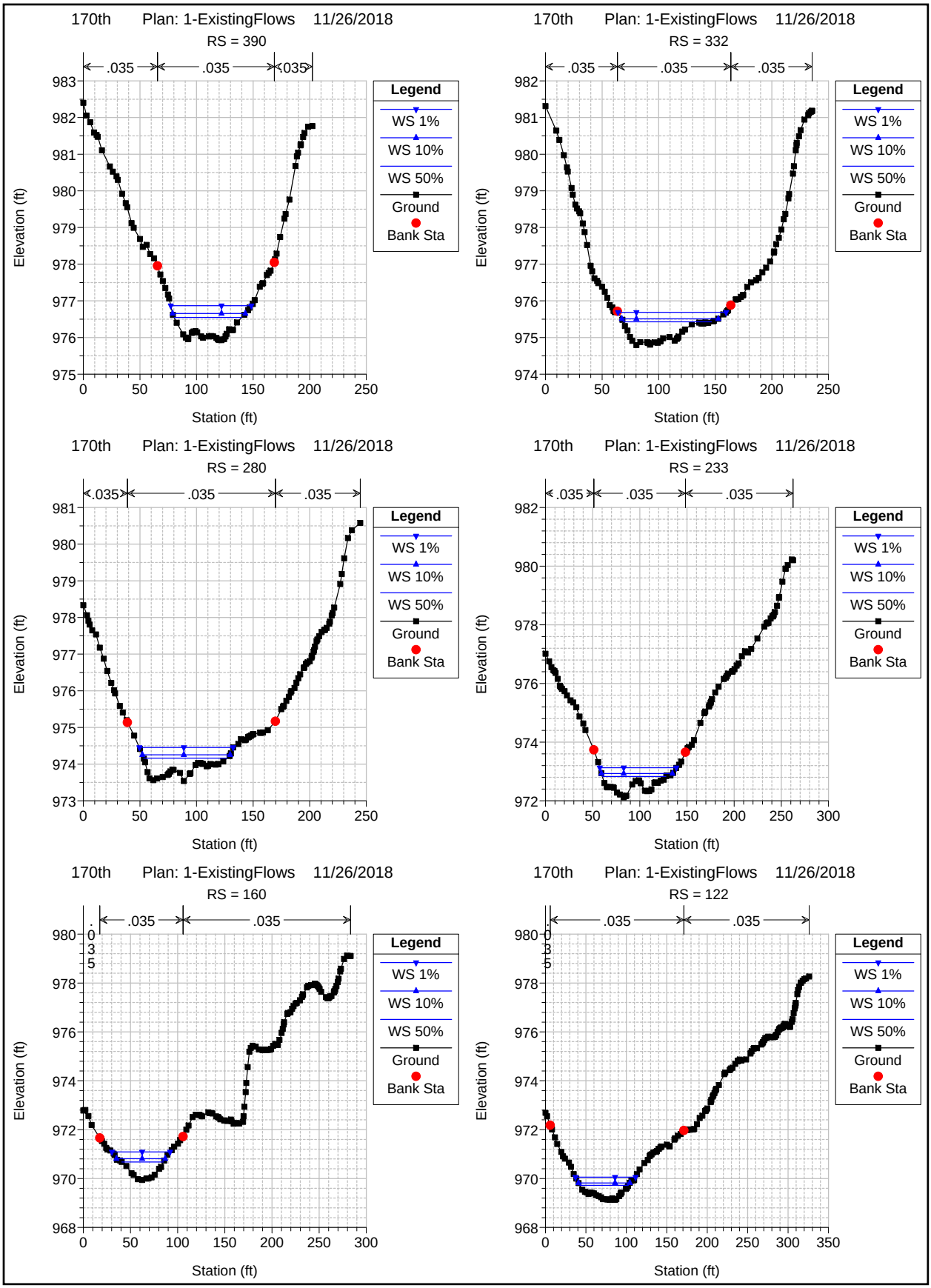




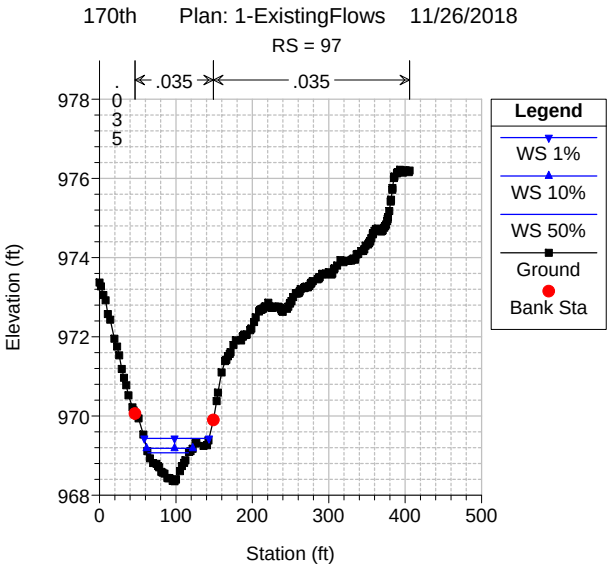
Existing - West

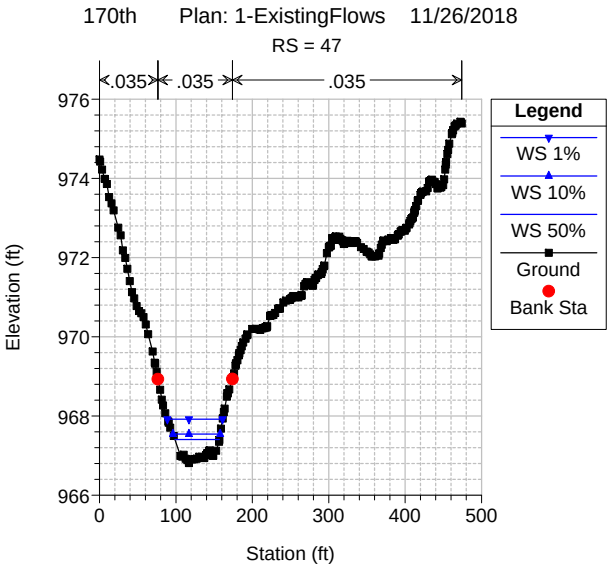


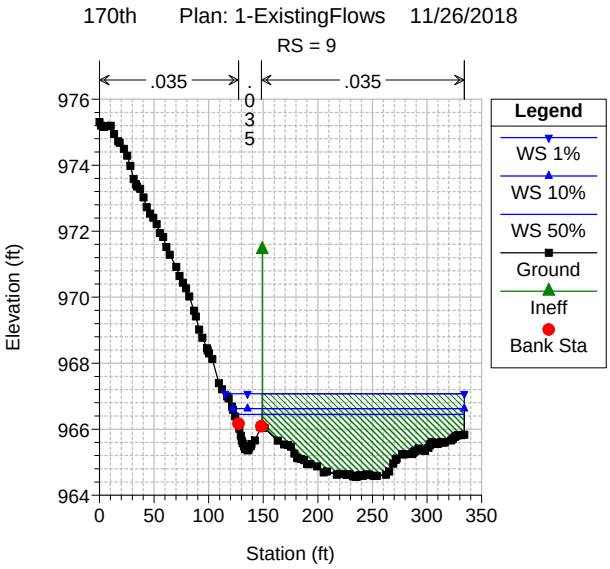
Existing - West



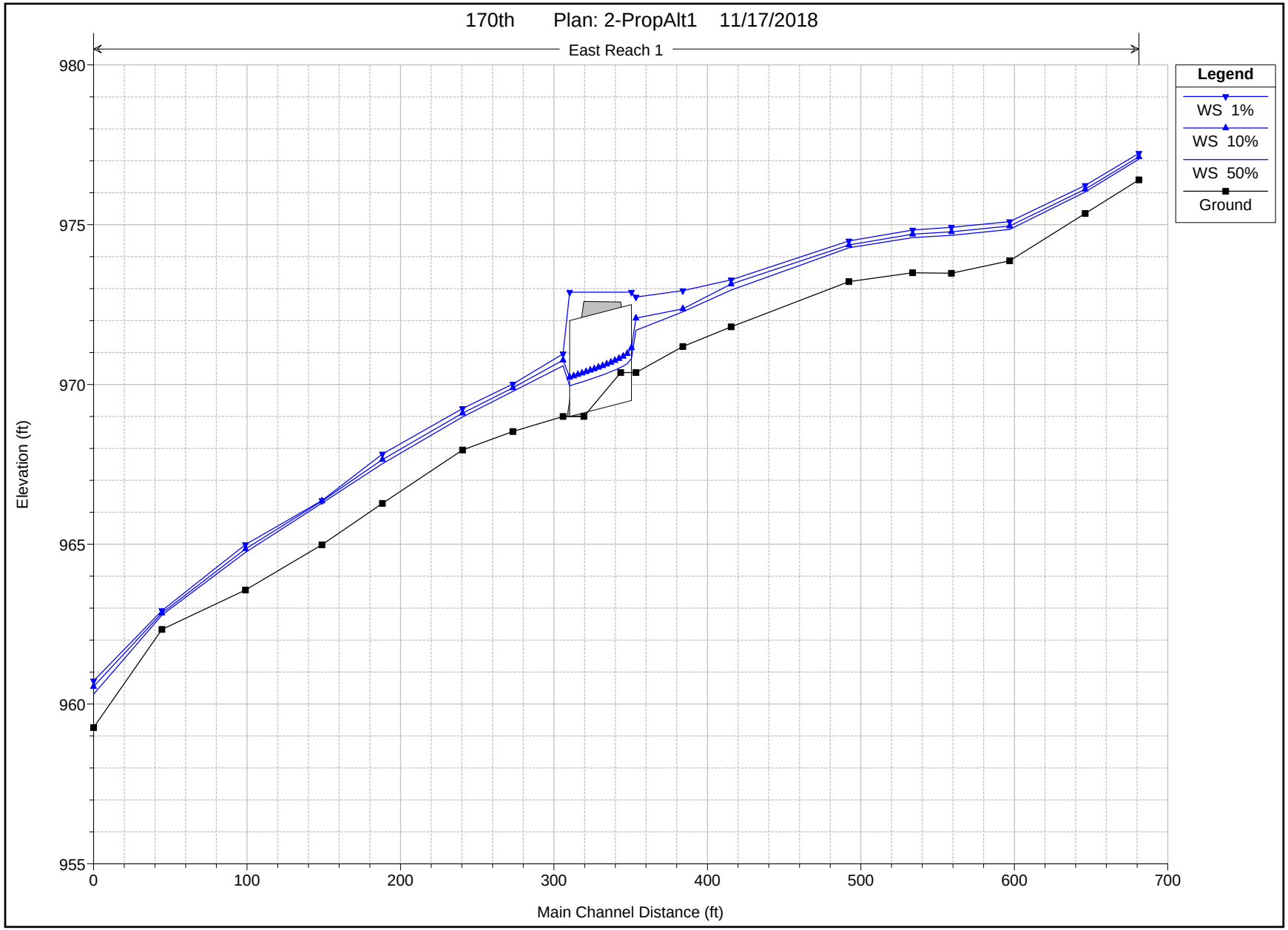
Existing - West



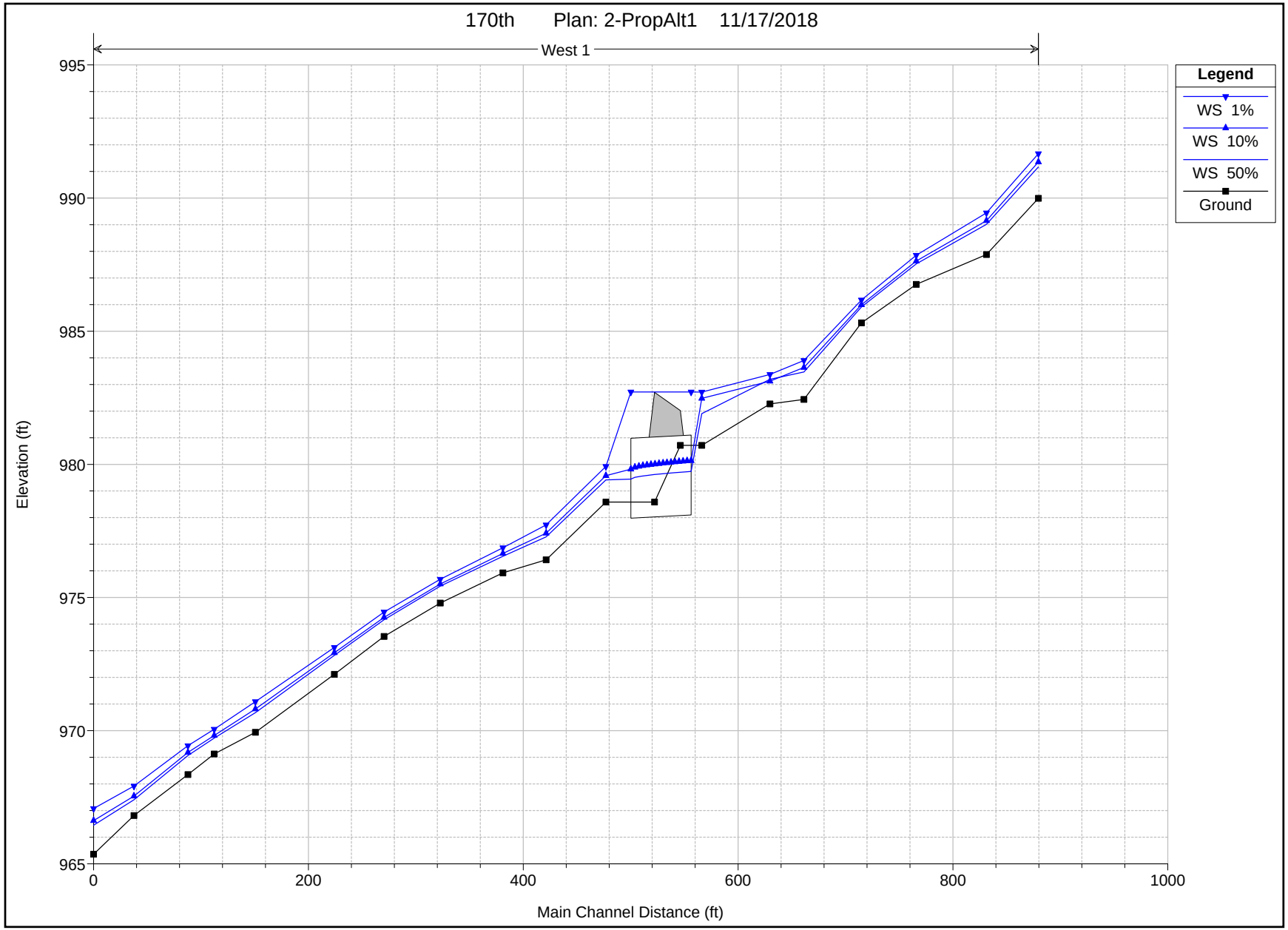




Alt 1 - East


170th Plan: 2-PropAlt1 11/17/2018
East Reach 1
Legend
WS 1%
WS 10%
WS 50%
Ground
Elevation (ft)
980
975
970
965
960
955
0
100
200
300
400
500
600
700
Main Channel Distance (ft)

Alt 1 - West


170th Plan: 2-PropAlt1 11/17/2018
West 1
Legend
WS 1%
WS 10%
WS 50%
Ground
Elevation (ft)
995
990
985
980
975
970
965
0
200
400
600
800
1000
Main Channel Distance (ft)

HEC-RAS Plan: PropAlt1

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
West	West	889	50%	80.70	989.99	991.17	991.17	991.47	0.022284	4.42	18.28	31.32	1.02
West	West	889	10%	113.10	989.99	991.36	991.36	991.67	0.018935	4.54	25.50	45.19	0.97
West	West	889	1%	203.10	989.99	991.67	991.67	992.09	0.015909	5.33	40.64	51.84	0.94
West	West	840	50%	80.70	987.88	989.01	989.00	989.27	0.021264	4.03	20.02	38.02	0.98
West	West	840	10%	113.10	987.88	989.15	989.15	989.46	0.021472	4.44	25.48	42.19	1.01
West	West	840	1%	203.10	987.88	989.44	989.44	989.87	0.018725	5.24	39.31	51.39	1.00
West	West	775	50%	80.70	986.76	987.53	987.53	987.72	0.025800	3.54	22.78	60.79	1.02
West	West	775	10%	113.10	986.76	987.63	987.63	987.86	0.024009	3.84	29.42	65.90	1.01
West	West	775	1%	203.10	986.76	987.85	987.85	988.18	0.020878	4.57	44.75	73.17	1.00
West	West	724	50%	80.70	985.31	985.91	985.91	986.06	0.027584	3.13	25.77	87.08	1.01
West	West	724	10%	113.10	985.31	985.99	985.99	986.17	0.025489	3.41	33.17	96.05	1.01
West	West	724	1%	203.10	985.31	986.17	986.17	986.41	0.021360	3.93	52.76	115.79	0.98
West	West	671	50%	80.70	982.44	983.47		983.56	0.008910	2.42	34.81	84.87	0.62
West	West	671	10%	113.10	982.44	983.64	983.46	983.72	0.005937	2.42	49.24	88.78	0.53
West	West	671	1%	203.10	982.44	983.90		984.02	0.005514	2.93	72.99	92.12	0.55
West	West	639	50%	80.70	982.27	983.19		983.29	0.007942	2.48	32.57	61.38	0.60
West	West	639	10%	113.10	982.27	983.12	983.12	983.37	0.023512	4.00	28.30	58.78	1.02
West	West	639	1%	203.10	982.27	983.38	983.37	983.70	0.020996	4.56	44.56	69.80	1.01
West	West	575	50%	80.70	980.71	981.91	981.91	982.43	0.017671	5.90	13.90	77.95	1.01
West	West	575	10%	113.10	980.71	982.48	982.48	982.69	0.005205	4.26	40.18	98.28	0.59
West	West	575	1%	203.10	980.71	982.71	982.71	982.98	0.006621	5.25	63.49	101.26	0.68
West	West	545		Culvert									
West	West	486	50%	80.70	978.59	979.42	979.42	979.71	0.021725	4.37	18.47	31.58	1.01
West	West	486	10%	113.10	978.59	979.58	979.58	979.93	0.020714	4.74	23.87	34.85	1.01
West	West	486	1%	203.10	978.59	979.92	979.92	980.40	0.018684	5.53	36.75	39.39	1.01
West	West	430	50%	80.70	976.42	977.28	977.26	977.53	0.020939	4.04	20.00	37.51	0.97
West	West	430	10%	113.30	976.42	977.41	977.41	977.72	0.021081	4.46	25.40	41.18	1.00
West	West	430	1%	203.80	976.42	977.73	977.73	978.14	0.019636	5.16	39.49	48.79	1.01
West	West	390	50%	80.70	975.93	976.55	976.51	976.71	0.018656	3.24	24.93	59.76	0.88
West	West	390	10%	113.30	975.93	976.66	976.62	976.86	0.018249	3.58	31.69	64.32	0.90
West	West	390	1%	203.80	975.93	976.87	976.85	977.17	0.019354	4.42	46.11	71.18	0.97

HEC-RAS Plan: PropAlt1 (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
West	West	332	50%	80.70	974.79	975.43	975.38	975.57	0.020679	3.00	26.89	77.99	0.90
West	West	332	10%	113.30	974.79	975.51	975.49	975.69	0.021903	3.38	33.56	85.19	0.95
West	West	332	1%	203.80	974.79	975.69	975.69	975.95	0.022653	4.12	49.45	95.44	1.01
West	West	280	50%	80.70	973.54	974.16	974.16	974.33	0.026660	3.31	24.37	73.75	1.02
West	West	280	10%	113.30	973.54	974.25	974.25	974.46	0.024951	3.64	31.09	77.55	1.01
West	West	280	1%	203.80	973.54	974.45	974.45	974.74	0.021932	4.32	47.19	82.83	1.01
West	West	233	50%	80.70	972.12	972.83	972.83	973.00	0.025209	3.38	23.90	67.38	1.00
West	West	233	10%	113.30	972.12	972.93	972.93	973.13	0.023971	3.64	31.09	75.27	1.00
West	West	233	1%	203.80	972.12	973.13	973.13	973.42	0.022161	4.37	46.66	81.15	1.02
West	West	160	50%	80.70	969.94	970.68	970.68	970.92	0.023458	3.91	20.64	44.23	1.01
West	West	160	10%	113.30	969.94	970.81	970.81	971.08	0.022739	4.16	27.22	51.86	1.01
West	West	160	1%	203.80	969.94	971.09	971.09	971.44	0.020709	4.78	42.65	61.60	1.01
West	West	122	50%	80.70	969.13	969.72	969.72	969.91	0.024545	3.51	23.00	60.04	1.00
West	West	122	10%	113.30	969.13	969.82	969.82	970.05	0.023686	3.89	29.16	63.54	1.01
West	West	122	1%	203.80	969.13	970.06	970.06	970.37	0.021424	4.48	45.47	74.20	1.01
West	West	97	50%	80.70	968.35	969.07	969.07	969.28	0.024255	3.67	22.00	53.19	1.01
West	West	97	10%	113.30	968.35	969.18	969.18	969.43	0.024051	3.98	28.46	60.49	1.02
West	West	97	1%	203.80	968.35	969.44	969.44	969.72	0.022154	4.29	47.47	84.72	1.01
West	West	47	50%	80.70	966.81	967.41	967.41	967.60	0.025029	3.57	22.60	58.24	1.01
West	West	47	10%	113.30	966.81	967.54	967.51	967.75	0.018910	3.67	30.87	61.88	0.92
West	West	47	1%	203.80	966.81	967.92		968.13	0.010164	3.62	56.26	72.19	0.72
West	West	9	50%	80.70	965.36	966.45	966.45	966.80	0.017646	4.79	17.32	210.53	0.95
West	West	9	10%	113.30	965.36	966.62	966.62	967.06	0.016968	5.38	21.99	212.31	0.97
West	West	9	1%	203.80	965.36	967.07	967.07	967.65	0.013810	6.27	35.50	219.04	0.93
East	East	693	50%	68.50	976.40	977.05	977.05	977.20	0.026339	3.10	22.09	73.08	0.99
East	East	693	10%	96.00	976.40	977.12	977.12	977.31	0.026065	3.49	27.48	75.48	1.02
East	East	693	1%	137.90	976.40	977.23	977.23	977.46	0.023569	3.86	35.84	82.92	1.01
East	East	658	50%	68.50	975.35	976.02	976.02	976.20	0.026406	3.36	20.38	60.36	1.02
East	East	658	10%	96.00	975.35	976.11	976.11	976.32	0.024536	3.69	26.14	65.59	1.01
East	East	658	1%	137.90	975.35	976.23	976.23	976.49	0.021675	4.10	34.12	69.88	0.99
East	East	609	50%	68.50	973.87	974.85		974.91	0.005402	2.05	33.95	74.20	0.50
East	East	609	10%	96.00	973.87	974.96		975.04	0.005506	2.34	42.73	85.61	0.52

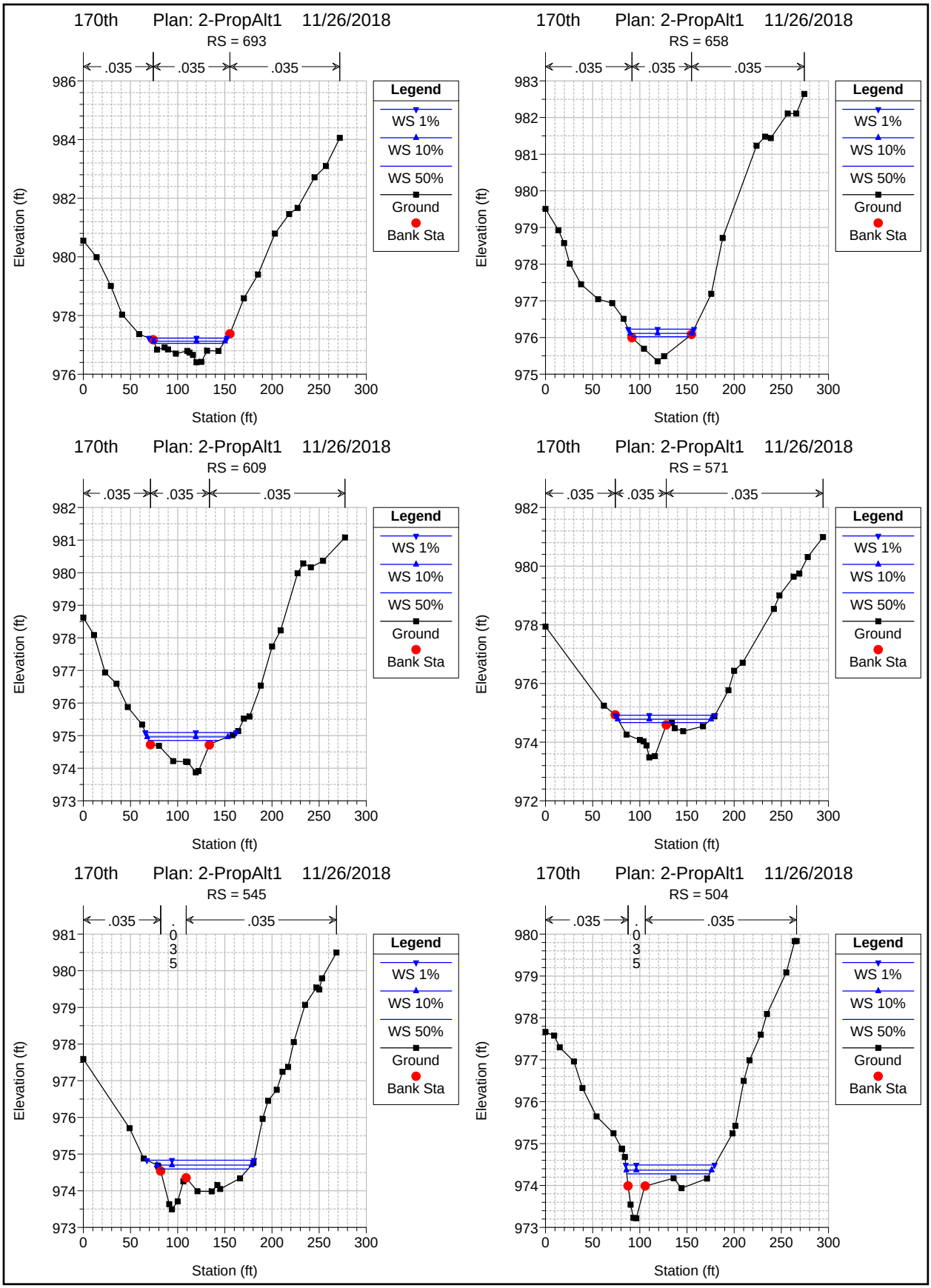
HEC-RAS Plan: PropAlt1 (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	East	609	1%	137.90	973.87	975.10		975.20	0.005624	2.69	55.18	96.36	0.54
East	East	571	50%	68.50	973.48	974.67		974.73	0.004418	2.04	37.84	92.84	0.46
East	East	571	10%	96.00	973.48	974.78		974.85	0.004527	2.25	48.61	98.91	0.47
East	East	571	1%	137.90	973.48	974.92		975.00	0.004660	2.50	62.79	105.56	0.49
East	East	545	50%	68.50	973.50	974.59		974.63	0.002842	1.74	46.70	93.88	0.37
East	East	545	10%	96.00	973.50	974.70		974.75	0.003070	1.99	57.05	100.42	0.40
East	East	545	1%	137.90	973.50	974.83		974.90	0.003307	2.29	71.24	113.52	0.42
East	East	504	50%	68.50	973.22	974.28	974.28	974.42	0.010280	3.50	27.73	87.87	0.72
East	East	504	10%	96.00	973.22	974.36	974.36	974.52	0.010571	3.82	35.47	90.47	0.74
East	East	504	1%	137.90	973.22	974.49		974.66	0.009919	4.07	47.04	94.23	0.74
East	East	427	50%	68.50	971.80	972.95	972.95	973.22	0.022399	4.13	16.60	31.59	1.00
East	East	427	10%	96.00	971.80	973.14	973.14	973.38	0.022172	3.90	24.62	57.76	0.99
East	East	427	1%	137.90	971.80	973.27	973.27	973.57	0.021666	4.37	31.61	67.43	1.01
East	East	396	50%	68.50	971.19	972.27	972.19	972.42	0.009548	3.51	23.66	91.99	0.70
East	East	396	10%	96.00	971.19	972.37	972.29	972.57	0.011277	4.12	27.88	96.43	0.78
East	East	396	1%	137.90	971.19	972.94	972.44	973.04	0.002718	2.82	57.93	126.06	0.41
East	East	365	50%	68.50	970.37	971.70	971.70	972.01	0.014992	4.68	16.28	76.12	0.89
East	East	365	10%	96.00	970.37	972.08	971.85	972.30	0.006774	4.02	26.42	117.34	0.64
East	East	365	1%	137.90	970.37	972.74	972.06	972.92	0.003176	3.65	44.80	188.78	0.47
East	East	346		Culvert									
East	East	317	50%	68.50	969.00	970.58	970.57	970.89	0.020855	4.45	15.39	24.56	0.99
East	East	317	10%	96.00	969.00	970.76	970.76	971.11	0.018399	4.76	20.57	77.09	0.96
East	East	317	1%	137.90	969.00	970.96	970.96	971.38	0.016686	5.29	27.19	110.33	0.95
East	East	285	50%	68.70	968.53	969.78	969.77	969.95	0.035155	3.26	21.33	64.25	0.93
East	East	285	10%	96.60	968.53	969.90	969.90	970.07	0.028172	3.41	30.05	93.24	0.86
East	East	285	1%	139.00	968.53	970.01	970.01	970.20	0.024045	3.64	42.02	108.55	0.83
East	East	252	50%	68.70	967.95	968.98	968.87	969.11	0.018834	2.83	24.24	48.84	0.71
East	East	252	10%	96.60	967.95	969.10	968.98	969.26	0.019136	3.20	30.18	51.29	0.74
East	East	252	1%	139.00	967.95	969.25	969.13	969.46	0.020289	3.68	37.81	54.54	0.78
East	East	200	50%	68.70	966.28	967.52	967.52	967.76	0.037009	3.95	17.38	75.01	0.99
East	East	200	10%	96.60	966.28	967.65	967.65	967.94	0.034354	4.33	22.42	80.41	0.99

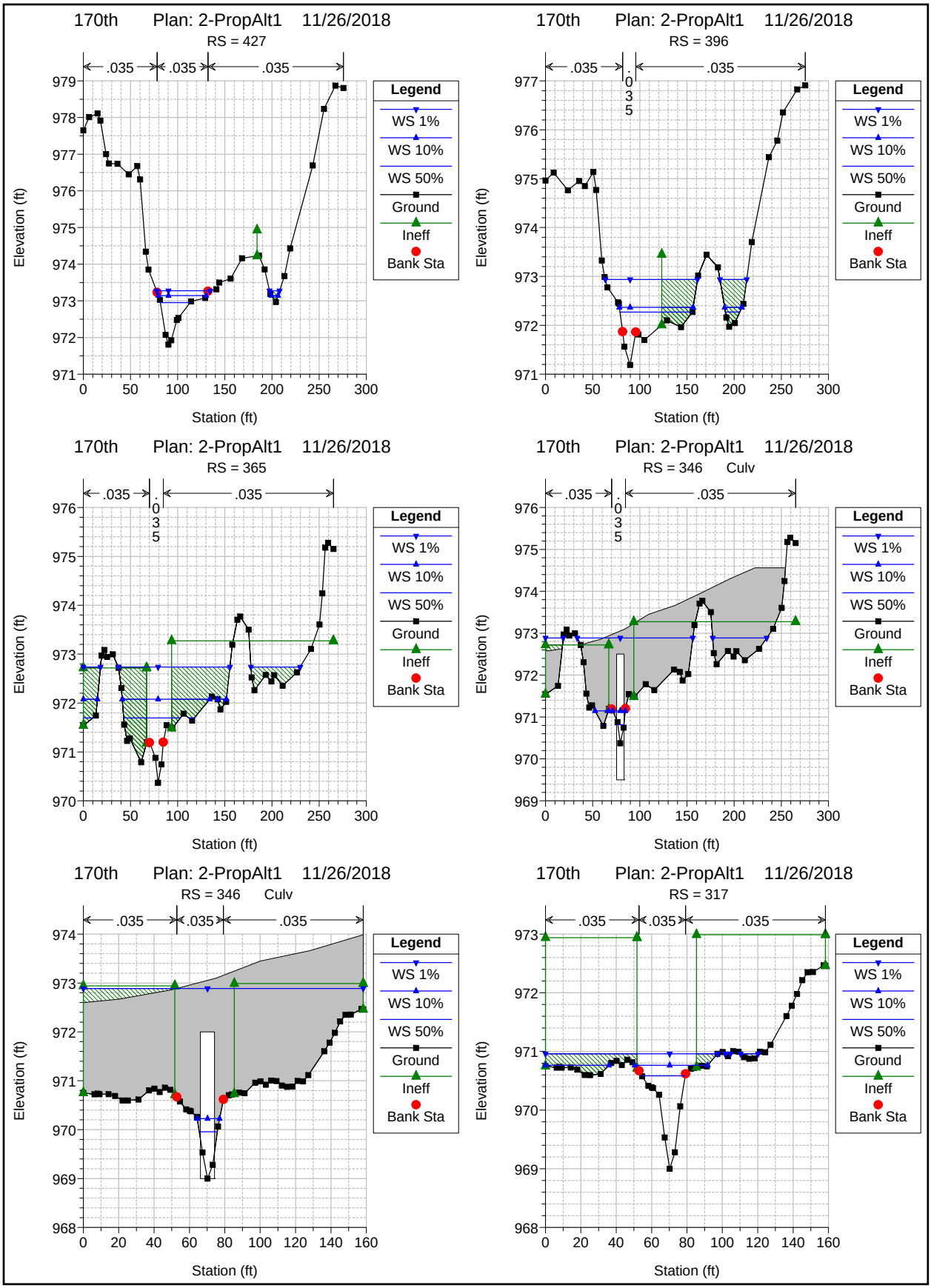
HEC-RAS Plan: PropAlt1 (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East	East	200	1%	139.00	966.28	967.82	967.82	968.17	0.029720	4.78	29.65	83.80	0.96
East	East	160	50%	68.70	964.98	966.29	966.22	966.35	0.021815	2.03	34.08	241.21	0.69
East	East	160	10%	96.60	964.98	966.35	966.29	966.43	0.021466	2.31	42.26	243.85	0.71
East	East	160	1%	139.00	964.98	966.37	966.37	966.39	0.000950	0.50	142.06	244.63	0.15
East	East	111	50%	68.70	963.57	964.75	964.73	964.93	0.038137	3.45	19.93	219.49	0.97
East	East	111	10%	96.60	963.57	964.85	964.85	965.07	0.034857	3.75	26.10	231.14	0.96
East	East	111	1%	139.00	963.57	964.99	964.99	965.00	0.000768	0.66	158.32	231.14	0.15
East	East	56	50%	68.70	962.34	962.78	962.78	962.90	0.035811	2.29	25.65	162.83	0.86
East	East	56	10%	96.60	962.34	962.84	962.84	962.98	0.032230	2.51	33.51	176.08	0.84
East	East	56	1%	139.00	962.34	962.92	962.92	963.09	0.028505	2.76	43.99	197.81	0.82
East	East	12	50%	68.70	959.26	960.31	960.31	960.61	0.034408	4.45	15.45	24.88	0.99
East	East	12	10%	96.60	959.26	960.55	960.55	960.82	0.021774	4.23	24.67	52.20	0.83
East	East	12	1%	139.00	959.26	960.72	960.72	961.01	0.019459	4.55	34.77	63.98	0.81

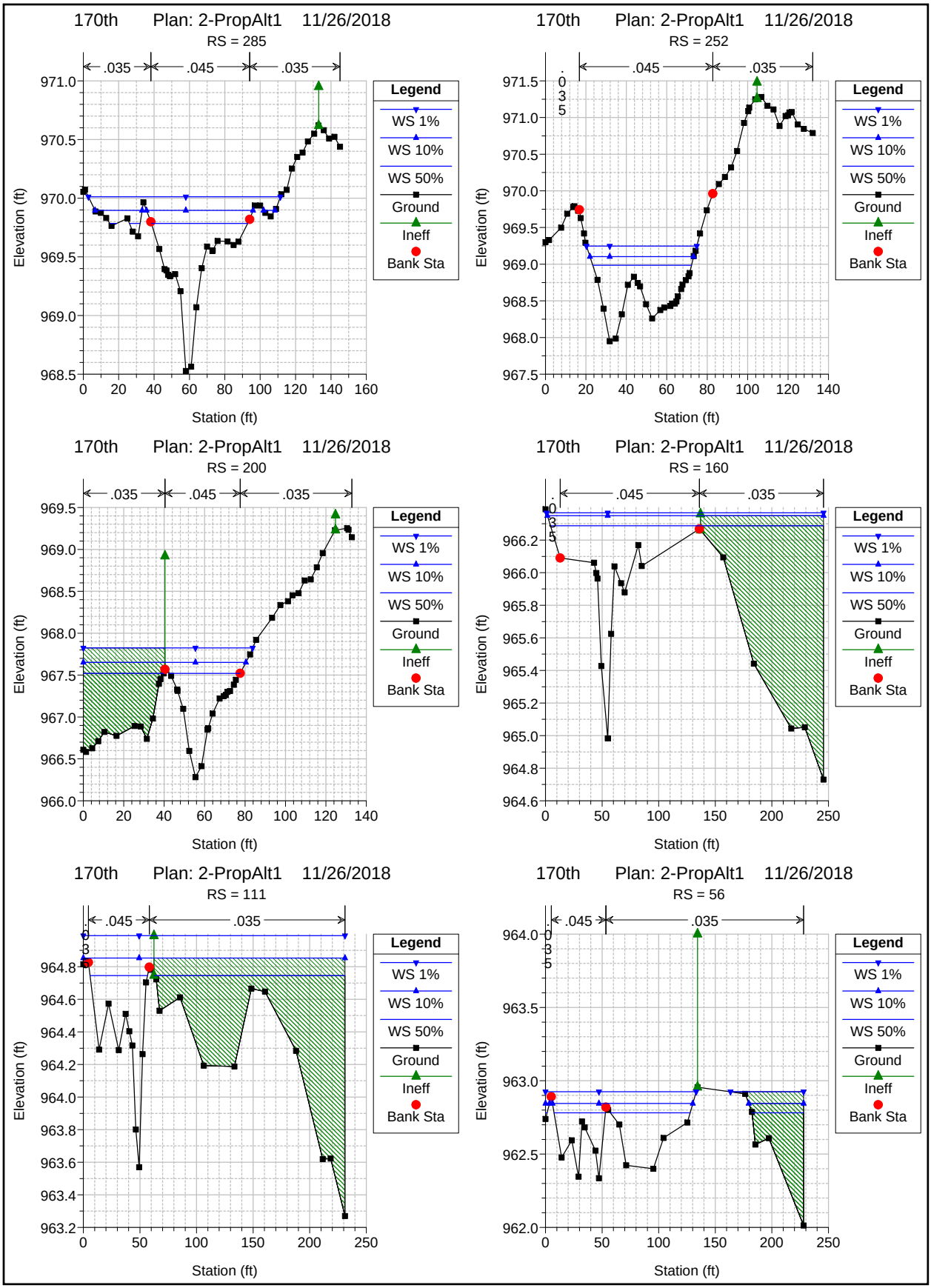
Alt 1 - East


170th Plan: 2-PropAlt1 11/26/2018
RS = 693
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 658
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 609
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 571
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 545
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 504
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)

Alt 1 - East

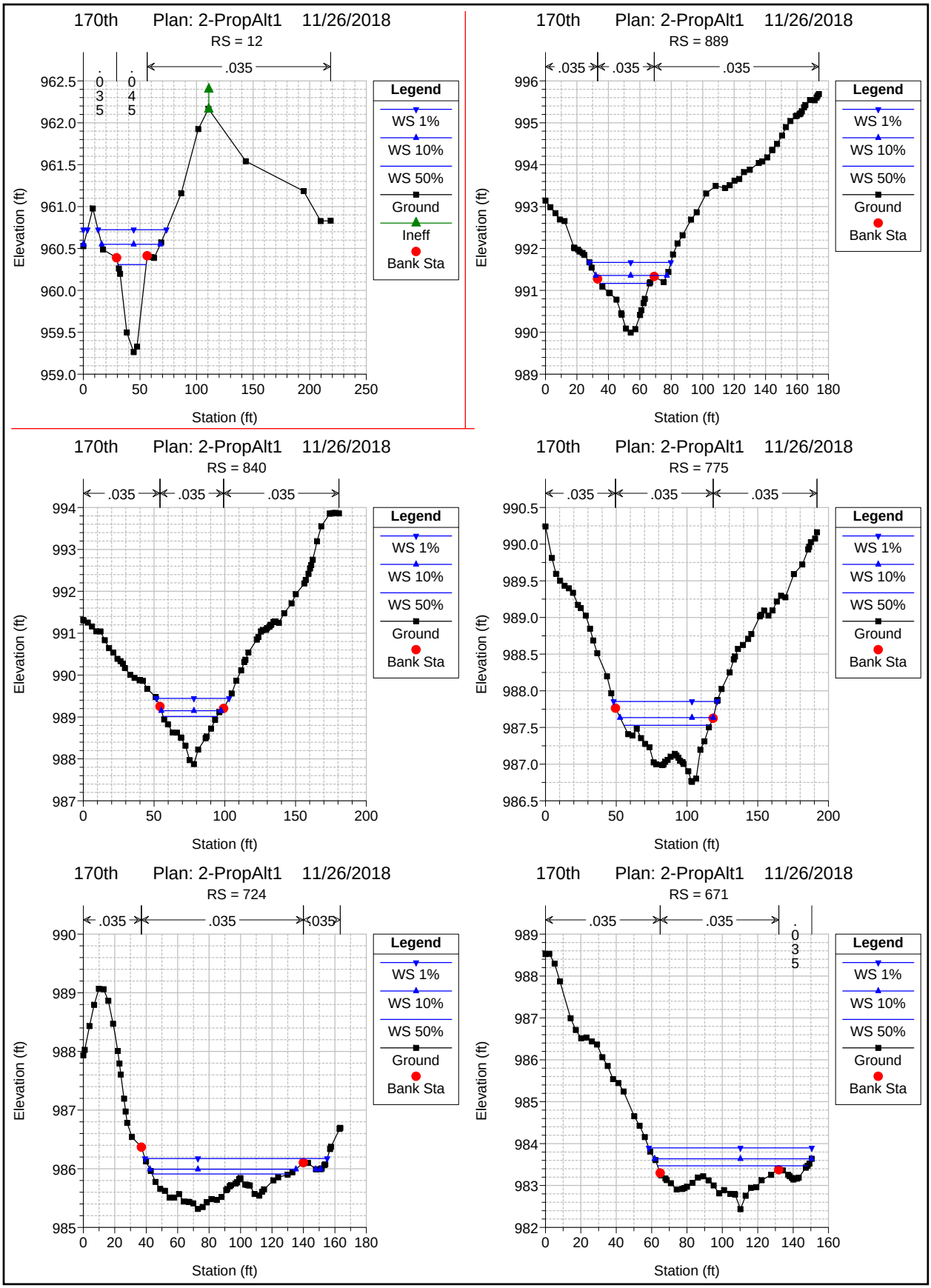

170th Plan: 2-PropAlt1 11/26/2018
RS = 427
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 396
.035 .035
.035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 365
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 346 Culv
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 346 Culv
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 317
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta

Alt 1 - East

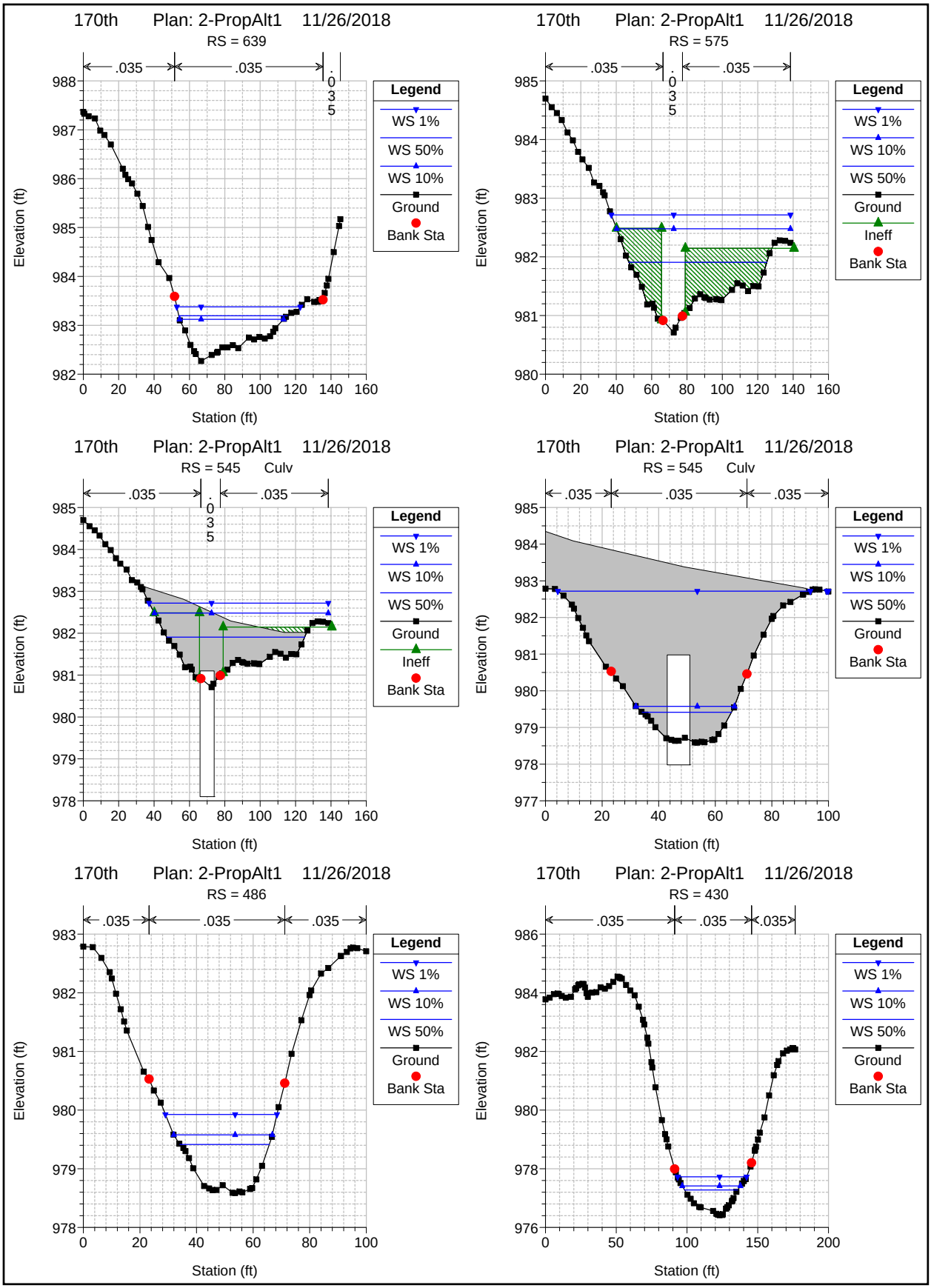

170th Plan: 2-PropAlt1 11/26/2018
RS = 285
.035 .045 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 252
.035 .045 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 200
.035 .045 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 160
.035 .045 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 111
.045 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 56
.045 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta

Alt 1 - East

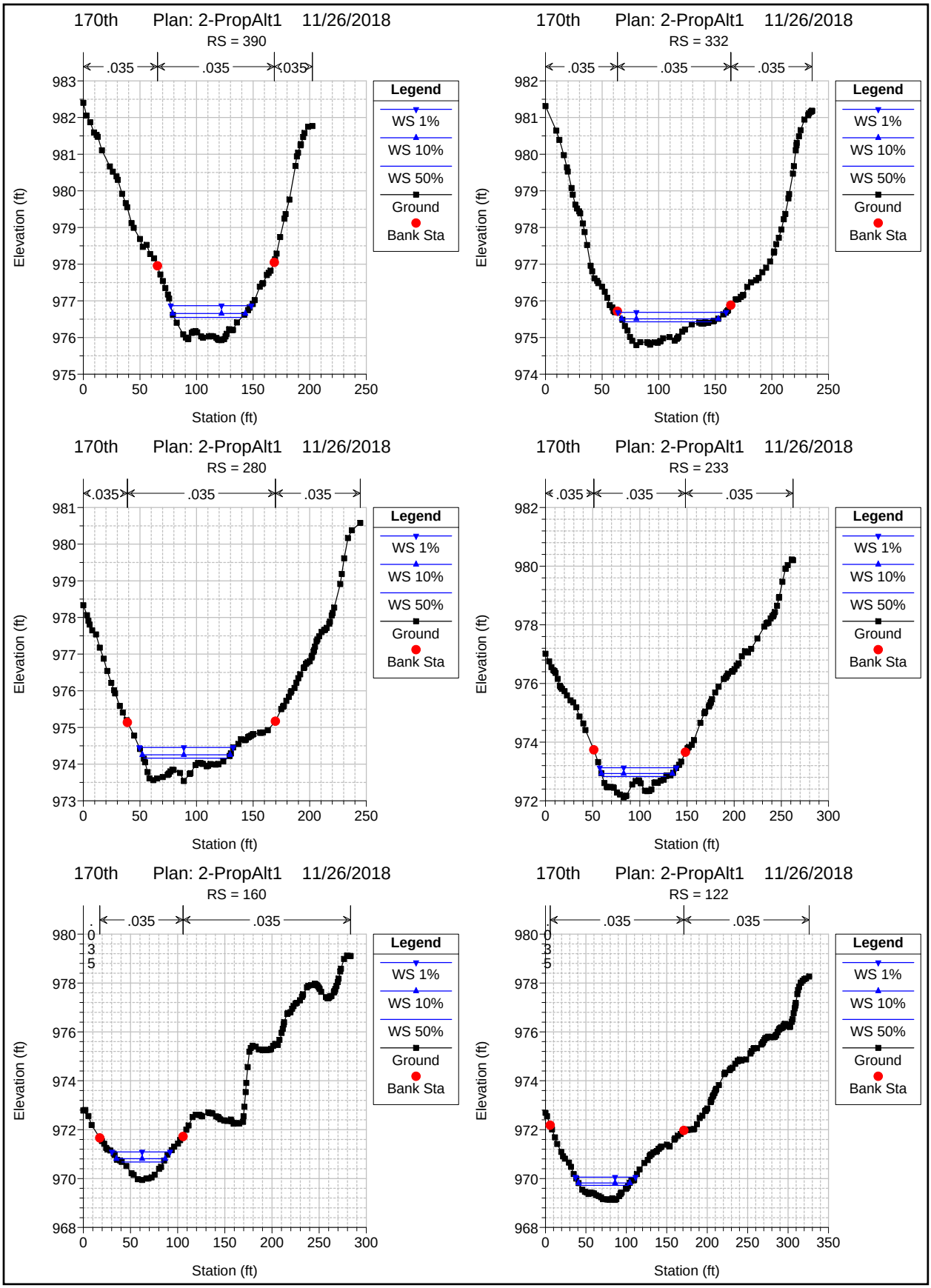
Alt 1 - West



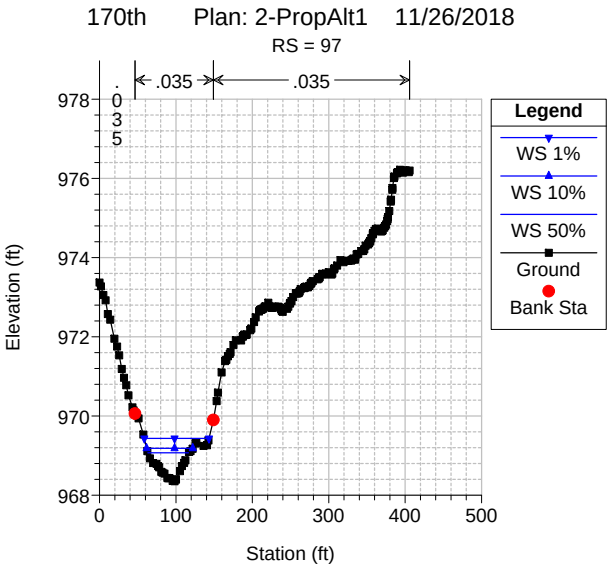
Alt 1 - West

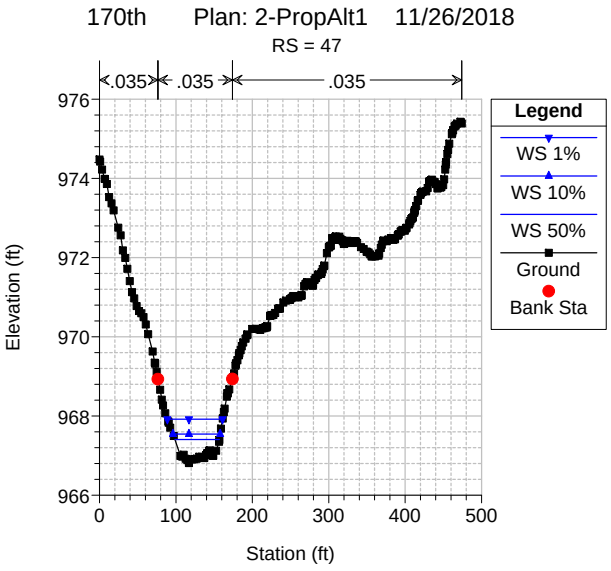

170th Plan: 2-PropAlt1 11/26/2018
RS = 639
.035 .035 .035
Legend
WS 1%
WS 50%
WS 10%
Ground
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 575
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 545 Culv
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 545 Culv
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 486
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)
170th Plan: 2-PropAlt1 11/26/2018
RS = 430
.035 .035 .035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)

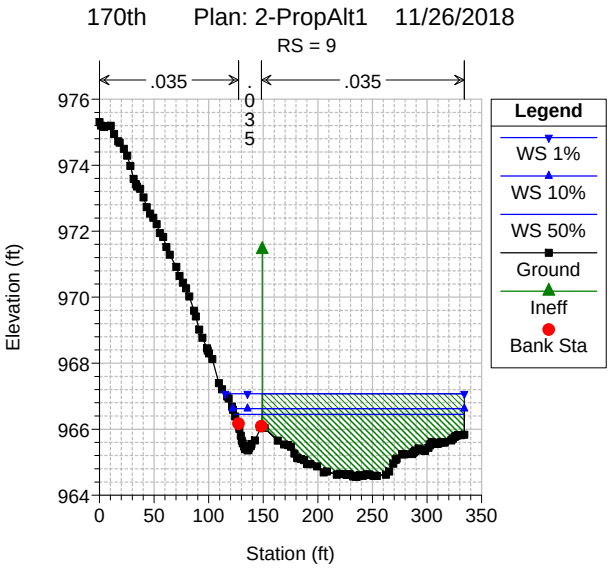
Alt 1 - West


170th Plan: 2-PropAlt1 11/26/2018
RS = 390
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 332
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 280
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 233
.035 .035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 160
.035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
170th Plan: 2-PropAlt1 11/26/2018
RS = 122
.035 .035
Elevation (ft)
Station (ft)
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta

Alt 1 - West


170th Plan: 2-PropAlt1 11/26/2018
RS = 97
.035
.035
.035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)


170th Plan: 2-PropAlt1 11/26/2018
RS = 47
.035
.035
.035
Legend
WS 1%
WS 10%
WS 50%
Ground
Bank Sta
Elevation (ft)
Station (ft)


170th Plan: 2-PropAlt1 11/26/2018
RS = 9
.035
.035
.035
Legend
WS 1%
WS 10%
WS 50%
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

APPENDIX C – Storm Sewer Calculations

- Alternative II

Proposed Pipe Design Calculations

	STRUCTURE		DELTA A (ac)	SUM A (ac)	C	DELTA CA	SUM CA	DELTA T (min)	T (min)	STORM FREQ	I (in/hr)	Q (cfs)	CAP (cfs)	DIA (in)	TYPE	FL UP (ft)	FL DOWN (ft)	SLOPE (%)	VEL (ft/s)	Q/Qf	TOP ELEV. (ft)	HGL (ft)	EGL (ft)
	NO.	TYPE																					
West System																							
	Ex-1	Existing Pond Riser	18.28		0.51	9.32		11.57													1000.80	996.25	999.01
P-Ex-1				18.28			9.32		11.57	1%	10.23	95.32	114.71	42	RCP	993.82	993.16	1.30%	13.33	0.83			
	1	6' x 6' Junction Box	0.00		0.00	0.00		0.05													999.00	987.66	995.16
P-1				18.28			9.32		11.62	1%	10.20	95.10	219.36	42	RCP	986.04	983.54	4.75%	21.97	0.43			
	2	6' x 6' Area Inlet	0.66		0.51	0.34		0.28													990.14	982.71	987.25
P-2				18.94			9.66		11.89	1%	10.19	98.38	155.44	42	RCP	980.69	974.09	2.39%	17.09	0.63			
	3	6' x 6' Area Inlet	6.39		0.51	3.26		0.06													981.36	977.37	978.99
P-3				25.32			12.92		11.96	1%	10.09	130.38	191.07	48	RCP	973.59	972.61	1.77%	10.38	0.68			
	4	6' x 6' Junction Box	0.00		0.00	0.00		0.25													980.17	977.60	978.51
P-4				27.38			13.96		12.21	1%	10.07	140.66	183.95	48	RCP	971.88	968.04	1.64%	11.19	0.76			
	5	6' x 6' Junction Box	0.00		0.00	0.00		0.22													977.25	972.70	974.61
P-5				27.38			13.96		12.43	1%	10.00	139.61	143.74	48	RCP	967.84	966.18	1.00%	11.11	0.97			
	6	6' x 6' Junction Box	0.00		0.00	0.00		0.30													975.97	970.93	972.82
P-6				27.38			13.96		12.72	1%	9.93	138.68	202.74	48	RCP	965.68	959.65	1.99%	11.04	0.68			
	Ex-2	Existing 6' x 6' Area Inlet	5.16		0.51	2.63		0.18													964.37	965.94	968.56
P-Ex-2				32.54			16.60		12.91	1%	9.84	163.36	222.51	48	RCP	959.45	954.48	2.40%	13.00	0.73			
	Ex-3	Existing 6' x 6' Area Inlet	0.00		0.00	0.00		0.00													961.10	961.10	963.73
																					TW =	**961.10**	**983.29**
East System																							
	Ex-4	Existing Pond Riser	30.54		0.51	15.58		15.29													986.20	981.78	983.78
P-Ex-4				30.54			15.58		15.29	1%	9.15	142.48	94.77	48	RCP	977.42	977.19	0.44%	11.34	1.50			
	7	6' x 6' Junction Box	0.00		0.00	0.00		0.07													982.61	981.19	983.19
P-7				30.54			15.58		15.36	1%	9.13	142.13	227.12	48	RCP	968.32	966.72	2.07%	19.07	0.63			
	8	6' x 6' Area Inlet	1.59		0.51	0.81		0.29													974.97	969.05	972.88
P-8				32.13			16.39		15.65	1%	9.11	149.23	175.93	48	RCP	966.22	962.27	1.50%	15.71	0.85			
	9	6' x 6' Junction Box	12.52		0.51	6.39		0.30													971.66	965.00	971.51
P-9				44.65			22.77		15.94	1%	9.03	205.69	227.12	48	RCP	961.77	953.09	2.43%	20.47	0.91			
	Ex-5	Existing 8' x 8' Area Inlet	1.16		0.51	0.59		0.12													959.37	959.05	960.81
P-Ex-5				45.81			23.36		16.06	1%	8.95	209.23	338.64	60	RCP	952.09	950.06	1.69%	10.66	0.62			
	Ex-6	Existing 8' x 8' Junction Box	0.00		0.00	0.00		0.00													958.02	958.02	959.78
																					TW =	**958.02**	**983.29**

Note: Tailwater for both systems assumed at the rim elevation of downstream surveyed structure.

APPENDIX D– Cost Estimates and Flood Problem Rating Sheets

HNTB

CITY OF OVERLAND PARK

170th Terrace & Switzer Preliminary Engineering Study

Johnson County SMP. No BR-10-001

City Project No. SD-1438

Date: January 24, 2019

West Crossing - Alternative 1 (Buyout) Estimate

Bid Items No.	Item Description	Unit	Unit Price	Quantity	Total Cost
1	Clearing and Grubbing	Lump Sum	$ 5,000	1	$ 5,000
2	Removal of Existing Structures	Lump Sum	$ 5,000	1	$ 5,000
3	Ditch / Swale Grading	Each	$ 2,500	1	$ 2,500
3	Type I Street Repair	Sq. Yd.	$ 90	116	$ 10,450
4	Aggregate Driveway	Sq. Yd.	$ 30	57	$ 1,713
5	West Culvert (8x3 ft RCB)	Each	$ 500	56	$ 28,000
6	8 x 3 ft RCB Headwall (with wingwalls)	Each	$ 8,000	2	$ 16,000
7	18" Storm Sewer (RCP)	Ln. Ft.	$ 95	25	$ 2,375
8	18" End Section (RCP)	Each	$ 2,000	1	$ 2,000
9	Riprap (24")	Cubic Yard	$ 80	30	$ 2,370
10	Traffic Control	Lump Sum	$ 8,000	1	$ 8,000
11	Sodding	Sq. Yd.	$ 5	356	$ 1,778
12	Landscaping	Lump Sum	$ 3,000	1	$ 3,000
13	Lawn Sprinkler System (Est.)	Each	$ 2,000	4	$ 8,000
14	Erosion Control	Each	$ 9,000	1	$ 9,000
15	Contractor Construction Staking	Lump Sum	$ 8,000	1	$ 8,000

Notes:

All Unit Prices based on 2018 values. The costs shown on this estimate represent an estimate of probable costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from this estimate.

Construction Cost	**$**	**113,000**
Contingency (20%)	**$**	**23,000**
2018 Total Construction Cost	**$**	**136,000**

House No.	Address	2018 Johnson County Appraised Value
1	10945 W 170th Terr.	**$ 262,700**

2018 Property Acquisition Total	**$**	**263,000**
Demolition, Grading, Utility Disconnection (25% of Property Value)	**$**	**66,000**
Engineering & Survey (Design)	**$**	**30,000**
Utility Relocation (5% of Construction)	**$**	**7,000**
Construction Inspection onstruction Inspection	**$**	**20,000**
2018 SMP Eligible Project Cost	**$**	**522,000**
Easement Acquisition (Administrative)	**$**	**7,000**
2018 Total Project Cost	**$**	**529,000**

Due to the conceptual nature of this estimate, sums have been rounded to the nearest $1000.

City:	Overland Park	Basin & Watershed:	Blue River
Location:	170th Terrace and Switzer - West Crossing		
Description of problem:	Residential homes and excessive residential street flooding (Alternative I)		

Flood Problem Rating

Factor #	Factor Description	Eliminates Factor	Rating Points	Frequency Multiplier	Severity Multiplier	Total Points
1	Loss of Life		40			
2	Flooding of habitable building	3	40	3	1	120
3	Flooding of garages and outbuildings	2	20			
4	Flooding arterial street of more than 7 inches	5,6,7	30			
5	Flooding collector street of more than 7 inches	4,6,7	25			
6	Flooding residential street of more than 7 inches	4,5,7	20	2	1.5	60
7	Widespread or long-term ponding in streets	4,5,6	20			
8	Erosion threatens habitable buildings, utilities, streets, bridges	9	30			
9	Erosion significant in unmaintained areas	8	10			
10	Erosion causes imminent drainage structure collapse	11,12	30			
11	Erosion causes marginal drainage structural collapse	10,12	15			
12	Erosion causes failure of drainage structure	10,11	10			
13	Other cities receiving benefits		20			
14	Other cities contributing to flooding problem		10			
Project Total Points						180
Estimated Total Project Cost						522,000
Priority Rating = Total Project Cost/Total Points						2,900

Applies To	Frequency Multiplier	Multiplier Value
2-7	One time in ten years or by 6 to 10- to 100-year design storm	1
2-7	Two time in ten years or by 5- to 10-year design storm	2
2-7	Three or more times in ten years or less than under 5-year design storm	3
13,14	1 city receiving benefit	1
13,14	2 cities receiving benefit	2
13,14	3 or more cities receiving benefit	3

Applies to #	Severity Description	Multiplier Value
1	Number of known deaths *=1 for each death	*
2,3	1-5 buildings flooded historically or by 100-year design storm	1
2,3	6-9 buildings flooded historically or by 100-year design storm	2
2,3	10 or more buildings flooded historically or by 100-year design storm	3
4, 5, 6	Restricts emergency vehicles	1.5
8	Nuisance erosion creates maintenance problems	1
8	Moderate erosion, failure of structure or facility within next 5 years possible	2
8	Severe erosion, failure of structure or facility imminent	3
10-12	Collapse causes flooding of land by 100-year design storm	1
10-12	Collapse causes flooding of garages/outbuildings by 100-year design storm	1.5
10-12	Collapse causes 1-3 habitable buildings to be flooded	2
10-12	Collapse Causes 4-6 habitable building to flooded	3
10-12	Collapse Causes more than 6 habitable buildings to be floodec	4

HNTB

CITY OF OVERLAND PARK

170th Terrace & Switzer Preliminary Engineering Study

Johnson County SMP. No BR-10-001

City Project No. SD-1438

Date: January 24, 2019

West Crossing - Alternative 2 (Storm Sewer) Cost Estimate

Bid Items No.	Item Description	Unit	Unit Price	Quantity	Total Cost
1	Pre Construction Survey	Each	$ 400	4	$ 1,600
2	Clearing and Grubbing	Lump Sum	$ 5,000	1	$ 5,000
3	Removal of Existing Structures	Lump Sum	$ 5,000	1	$ 5,000
4	Ditch / Swale Grading	Each	$ 2,500	1	$ 2,500
5	Type I Street Repair	Sq. Yd.	$ 90	98	$ 8,860
6	Aggregate Driveway	Sq. Yd.	$ 30	57	$ 1,713
7	Concrete Driveway	Sq. Yd.	$ 60	88	$ 5,307
8	Inlet (6'x6') (Area)	Each	$ 6,500	4	$ 26,000
9	Junction Box (6'x6')	Each	$ 6,500	4	$ 26,000
10	18" Storm Sewer (RCP)	Ln. Ft.	$ 95	25	$ 2,375
11	42" Storm Sewer (RCP)	Ln. Ft.	$ 190	344	$ 65,360
12	48" Storm Sewer (RCP)	Ln. Ft.	$ 240	784	$ 188,160
13	18" End Section (RCP)	Each	$ 2,000	1	$ 2,000
14	Fence (Ornamental Metal)	Ln. Ft.	$ 40	50	$ 2,000
15	Fence (Wood)	Ln. Ft.	$ 30	126	$ 3,780
16	Traffic Control	Lump Sum	$ 8,000	1	$ 8,000
17	Tree Replacement	Each	$ 350.00	18	$ 6,300
18	Sodding	Sq. Yd.	$ 5	3,760	$ 18,800
19	Temporary Seeding	Acre	$ 1,000	1	$ 1,000
20	Landscaping	Lump Sum	$ 8,000	1	$ 8,000
21	Lawn Sprinkler System (Est.)	Each	$ 2,000	4	$ 8,000
22	Erosion Control	Each	$ 15,000	1	$ 15,000
23	Contractor Construction Staking	Lump Sum	$ 8,000	1	$ 8,000

Notes:

All Unit Prices based on 2018 values. The costs shown on this estimate represent an estimate of probable costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from this estimate.

Due to the conceptual nature of this estimate, sums have been rounded to the nearest $1000.

Construction Cost	**$**	**419,000**
Contingency (20%)	**$**	**84,000**
2018 Total Construction Cost	**$**	**503,000**
Engineering & Survey (Design)	**$**	**50,000**
Utility / Septic Relocation (5% of Construction)	**$**	**25,000**
Construction Inspection	**$**	**39,000**
2018 SMP Eligible Project Cost	**$**	**617,000**
Easement Acquisition (Administrative)	**$**	**25,000**
2018 Total Project Cost	**$**	**642,000**

City:	Overland Park	Basin & Watershed:	Blue River
Location:	170th Terrace and Switzer - West Crossing		
Description of problem:	Residential homes and excessive residential street flooding (Alternative II)		

Flood Problem Rating

Factor #	Factor Description	Eliminates Factor	Rating Points	Frequency Multiplier	Severity Multiplier	Total Points
1	Loss of Life		40			
2	Flooding of habitable building	3	40	3	1	120
3	Flooding of garages and outbuildings	2	20			
4	Flooding arterial street of more than 7 inches	5,6,7	30			
5	Flooding collector street of more than 7 inches	4,6,7	25			
6	Flooding residential street of more than 7 inches	4,5,7	20	2	1.5	60
7	Widespread or long-term ponding in streets	4,5,6	20			
8	Erosion threatens habitable buildings, utilities, streets, bridges	9	30			
9	Erosion significant in unmaintained areas	8	10			
10	Erosion causes imminent drainage structure collapse	11,12	30			
11	Erosion causes marginal drainage structural collapse	10,12	15			
12	Erosion causes failure of drainage structure	10,11	10			
13	Other cities receiving benefits		20			
14	Other cities contributing to flooding problem		10			
Project Total Points						180
Estimated Total Project Cost						617,000
Priority Rating = Total Project Cost/Total Points						3,428

Applies To	Frequency Multiplier	Multiplier Value
2-7	One time in ten years or by 6 to 10- to 100-year design storm	1
2-7	Two time in ten years or by 5- to 10-year design storm	2
2-7	Three or more times in ten years or less than under 5-year design storm	3
13,14	1 city receiving benefit	1
13,14	2 cities receiving benefit	2
13,14	3 or more cities receiving benefit	3

Applies to #	Severity Description	Multiplier Value
1	Number of known deaths *=1 for each death	*
2,3	1-5 buildings flooded historically or by 100-year design storm	1
2,3	6-9 buildings flooded historically or by 100-year design storm	2
2,3	10 or more buildings flooded historically or by 100-year design storm	3
4, 5, 6	Restricts emergency vehicles	1.5
8	Nuisance erosion creates maintenance problems	1
8	Moderate erosion, failure of structure or facility within next 5 years possible	2
8	Severe erosion, failure of structure or facility imminent	3
10-12	Collapse causes flooding of land by 100-year design storm	1
10-12	Collapse causes flooding of garages/outbuildings by 100-year design storm	1.5
10-12	Collapse causes 1-3 habitable buildings to be flooded	2
10-12	Collapse Causes 4-6 habitable building to flooded	3
10-12	Collapse Causes more than 6 habitable buildings to be floodec	4

HNTB

CITY OF OVERLAND PARK

170th Terrace & Switzer Preliminary Engineering Study

Johnson County SMP. No BR-10-002

City Project No. SD-1438

Date: January 24, 2019

East Crossing - Alternative 1 (Buyout) Estimate

Bid Items No.	Item Description	Unit	Unit Price	Quantity	Total Cost
1	Clearing and Grubbing	Lump Sum	$ 10,000	1	$ 10,000
2	Removal of Existing Structures	Lump Sum	$ 5,000	1	$ 5,000
3	Ditch / Swale Grading	Each	$ 2,500	1	$ 2,500
3	Type I Street Repair	Sq. Yd.	$ 90	63	$ 5,650
4	East Culvert (8x3 ft RCB)	Each	$ 500	41	$ 20,500
5	8 x 3 ft RCB Headwall (with wingwalls)	Each	$ 4,000	2	$ 8,000
6	Riprap (24")	Cubic Yard	$ 80	30	$ 2,370
7	Traffic Control	Lump Sum	$ 8,000	1	$ 8,000
8	Tree Replacement	Each	$ 350.00	1	$ 350
	Sodding	Sq. Yd.	$ 5	356	$ 1,778
9	Landscaping	Lump Sum	$ 3,000	1	$ 3,000
10	Lawn Sprinkler System (Est.)	Each	$ 2,000	2	$ 4,000
10	Erosion Control	Each	$ 9,000	1	$ 9,000
11	Contractor Construction Staking	Lump Sum	$ 8,000	1	$ 8,000

Notes:

All Unit Prices based on 2018 values. The costs shown on this estimate represent an estimate of probable costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from this estimate.

Construction Cost	**$**	**88,000**
Contingency (20%)	**$**	**18,000**
2018 Total Construction Cost	**$**	**106,000**

House No.	Address	2018 Johnson County Appraised Value
1	10610 W 170th Terr.	**$ 250,800**
2	10535 W 170th Terr.	**$ 273,000**

2018 Property Acquisition Total	**$**	**524,000**
Demolition, Grading, Utility Disconnection (25% of Property Value)	**$**	**131,000**
Engineering & Survey (Design)	**$**	**30,000**
Utility Relocation (5% of Construction)	**$**	**5,000**
Construction Inspection	**$**	**20,000**
2018 SMP Eligible Project Cost	**$**	**816,000**

Due to the conceptual nature of this estimate, sums have been rounded to the nearest $1000.

Easement Acquisition (Administrative)	**$**	**5,000**
2018 Total Project Cost	**$**	**821,000**

City:	Overland Park	Basin & Watershed:	Blue River
Location:	170th Terrace and Switzer - East Crossing		
Description of problem:	Residential homes and excessive residential street flooding (Alternative I)		

Flood Problem Rating

Factor #	Factor Description	Eliminates Factor	Rating Points	Frequency Multiplier	Severity Multiplier	Total Points
1	Loss of Life		40			
2	Flooding of habitable building	3	40	3	1	120
3	Flooding of garages and outbuildings	2	20			
4	Flooding arterial street of more than 7 inches	5,6,7	30			
5	Flooding collector street of more than 7 inches	4,6,7	25			
6	Flooding residential street of more than 7 inches	4,5,7	20	1	1.5	30
7	Widespread or long-term ponding in streets	4,5,6	20			
8	Erosion threatens habitable buildings, utilities, streets, bridges	9	30			
9	Erosion significant in unmaintained areas	8	10			
10	Erosion causes imminent drainage structure collapse	11,12	30			
11	Erosion causes marginal drainage structural collapse	10,12	15			
12	Erosion causes failure of drainage structure	10,11	10			
13	Other cities receiving benefits		20			
14	Other cities contributing to flooding problem		10			
Project Total Points						150
Estimated Total Project Cost						816,000
Priority Rating = Total Project Cost/Total Points						5,440

Applies To	Frequency Multiplier	Multiplier Value
2-7	One time in ten years or by 6 to 10- to 100-year design storm	1
2-7	Two time in ten years or by 5- to 10-year design storm	2
2-7	Three or more times in ten years or less than under 5-year design storm	3
13,14	1 city receiving benefit	1
13,14	2 cities receiving benefit	2
13,14	3 or more cities receiving benefit	3

Applies to #	Severity Description	Multiplier Value
1	Number of known deaths *=1 for each death	*
2,3	1-5 buildings flooded historically or by 100-year design storm	1
2,3	6-9 buildings flooded historically or by 100-year design storm	2
2,3	10 or more buildings flooded historically or by 100-year design storm	3
4, 5, 6	Restricts emergency vehicles	1.5
8	Nuisance erosion creates maintenance problems	1
8	Moderate erosion, failure of structure or facility within next 5 years possible	2
8	Severe erosion, failure of structure or facility imminent	3
10-12	Collapse causes flooding of land by 100-year design storm	1
10-12	Collapse causes flooding of garages/outbuildings by 100-year design storm	1.5
10-12	Collapse causes 1-3 habitable buildings to be flooded	2
10-12	Collapse Causes 4-6 habitable building to flooded	3
10-12	Collapse Causes more than 6 habitable buildings to be floodec	4

HNTB

CITY OF OVERLAND PARK

170th Terrace & Switzer Preliminary Engineering Study

Johnson County SMP. No BR-10-002

City Project No. SD-1438

Date: January 24, 2019

East Crossing - Alternative 2 (Storm Sewer) Cost Estimate

Bid Items No.	Item Description	Unit	Unit Price	Quantity	Total Cost
1	Pre Construction Survey	Each	$ 400	4	$ 1,600
2	Clearing and Grubbing	Lump Sum	$ 5,000	1	$ 5,000
3	Removal of Existing Structures	Lump Sum	$ 5,000	1	$ 5,000
4	Ditch / Swale Grading	Each	$ 2,500	1	$ 2,500
5	Type I Street Repair	Sq. Yd.	$ 90	63	$ 5,650
6	Inlet (6'x6') (Area)	Each	$ 6,500	2	$ 13,000
7	Junction Box (6'x6')	Each	$ 6,500	1	$ 6,500
8	48" Storm Sewer (RCP)	Ln. Ft.	$ 240	718	$ 172,320
9	Fence (Wood)	Ln. Ft.	$ 30	305	$ 9,150
10	Traffic Control	Lump Sum	$ 8,000	1	$ 8,000
11	Tree Replacement	Each	$ 350.00	15	$ 5,250
12	Sodding	Sq. Yd.	$ 5	2,393	$ 11,967
13	Temporary Seeding	Acre	$ 1,000	1	$ 1,000
14	Landscaping	Lump Sum	$ 8,000	1	$ 8,000
15	Lawn Sprinkler System (Est.)	Each	$ 2,000	4	$ 8,000
16	Erosion Control	Each	$ 15,000	1	$ 15,000
17	Contractor Construction Staking	Lump Sum	$ 8,000	1	$ 8,000

Notes:

All Unit Prices based on 2018 values. The costs shown on this estimate represent an estimate of probable costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from this estimate.

Due to the conceptual nature of this estimate, sums have been rounded to the nearest $1000.

Construction Cost	**$**	**286,000**
Contingency (20%)	**$**	**57,000**
2018 Total Construction Cost	**$**	**343,000**
Engineering & Survey (Design)	**$**	**34,000**
Utility / Septic Relocation (5% of Construction)	**$**	**17,000**
Construction Inspection	**$**	**39,000**
2018 SMP Eligible Project Cost	**$**	**433,000**
Easement Acquisition (Administrative)	**$**	**17,000**
2018 Total Project Cost	**$**	**450,000**

City:	Overland Park	Basin & Watershed:	Blue River
Location:	170th Terrace and Switzer - East Crossing		
Description of problem:	Residential homes and excessive residential street flooding (Alternative II)		

Flood Problem Rating

Factor #	Factor Description	Eliminates Factor	Rating Points	Frequency Multiplier	Severity Multiplier	Total Points
1	Loss of Life		40			
2	Flooding of habitable building	3	40	3	1	120
3	Flooding of garages and outbuildings	2	20			
4	Flooding arterial street of more than 7 inches	5,6,7	30			
5	Flooding collector street of more than 7 inches	4,6,7	25			
6	Flooding residential street of more than 7 inches	4,5,7	20	1	1.5	30
7	Widespread or long-term ponding in streets	4,5,6	20			
8	Erosion threatens habitable buildings, utilities, streets, bridges	9	30			
9	Erosion significant in unmaintained areas	8	10			
10	Erosion causes imminent drainage structure collapse	11,12	30			
11	Erosion causes marginal drainage structural collapse	10,12	15			
12	Erosion causes failure of drainage structure	10,11	10			
13	Other cities receiving benefits		20			
14	Other cities contributing to flooding problem		10			
Project Total Points						150
Estimated Total Project Cost						433,000
Priority Rating = Total Project Cost/Total Points						2,887

Applies To	Frequency Multiplier	Multiplier Value
2-7	One time in ten years or by 6 to 10- to 100-year design storm	1
2-7	Two time in ten years or by 5- to 10-year design storm	2
2-7	Three or more times in ten years or less than under 5-year design storm	3
13,14	1 city receiving benefit	1
13,14	2 cities receiving benefit	2
13,14	3 or more cities receiving benefit	3

Applies to #	Severity Description	Multiplier Value
1	Number of known deaths *=1 for each death	*
2,3	1-5 buildings flooded historically or by 100-year design storm	1
2,3	6-9 buildings flooded historically or by 100-year design storm	2
2,3	10 or more buildings flooded historically or by 100-year design storm	3
4, 5, 6	Restricts emergency vehicles	1.5
8	Nuisance erosion creates maintenance problems	1
8	Moderate erosion, failure of structure or facility within next 5 years possible	2
8	Severe erosion, failure of structure or facility imminent	3
10-12	Collapse causes flooding of land by 100-year design storm	1
10-12	Collapse causes flooding of garages/outbuildings by 100-year design storm	1.5
10-12	Collapse causes 1-3 habitable buildings to be flooded	2
10-12	Collapse Causes 4-6 habitable building to flooded	3
10-12	Collapse Causes more than 6 habitable buildings to be floodec	4

APPENDIX E– Resident Flood Survey Summary

Flood Questionnaire Responses

Prior to the start of the Preliminary Engineering Study, the City of Overland Park distributed questionnaires to residents in the project area. Four total responses were received within the study limits.

- Residents were asked to indicate whether their house flooded from stormwater sources.
  - 25% indicated "Yes"
  - 75% indicated "No"
- Residents were asked to indicate if they noted excessive street flooding in their neighborhood.
  - 50% indicated "Yes"
  - 50% indicated "No"
- Residents were asked if they would support improvement to alleviate flooding with the addition or changes to public infrastructure on or in the vicinity of their property.
  - 100% indicated "Yes"

Specific written responses were reviewed and considered by the project team during the development of the Preliminary Engineering Study. City staff also met with several homeowners during the study phase to discuss stormwater issues in the project area.

APPENDIX F– Preliminary Funding Pack

OVERLAND PARK
KANSAS
ABOVE AND BEYOND. BY DESIGN.

Basalo, Lorraine <lorraine.basalo@opkansas.org>

170th Terrace & Switzer Road Stormwater Improvements - PES Request

1 message

Basalo, Lorraine <lorraine.basalo@opkansas.org> Thu, Sep 20, 2018 at 11:40 AM
To: "Kellenberger, Lee, PWK" <lee.kellenberger@jocogov.org>, Sarah PWK Smith <Sarah.Smith@jocogov.org>
Cc: Ybairy Duin <ybairy.duin@opkansas.org>, Pete Jarchow <pjarchow@hntb.com>, Lauren Garwood <lauren.garwood@opkansas.org>

Lee:

This email pertains to our telephone conversation last week concerning a Preliminary Engineering Study (PES) we are interested in submitting for stormwater improvements in the vicinity of 170th Terrace and Switzer.

The general project area extends along 170th Terrace, from Switzer Road west a cul-de-sac where 170th Terrace ends. The stormwater drainage system consists of natural swales, ditches and driveway culverts generally directing stormwater to two (2) major culvert crossings along 170th Terrace. The area upstream and downstream of the project area are enclosed systems. Drainage area for each culvert crossing, are 25.5 acres for the west culvert crossing and 44.7 acres for the east culvert crossing.

In September, 2017, the City hired HNTB to complete a conceptual study of the project area, and it was determined that the existing stormwater system is inadequate to capture and convey the 100-year design storm. The study assessed that three (3) residential structures would occur less than the 5-year design storm and street flooding would between the 5 and 10-year design storm. The benefit points assigned are shown in the attached Flood Rating Table.

The upstream limits of the project area is 171st Street, from Switzer Road to Magnolia Street. No impacts of the upstream area are expected as a result of proposed improvements. The downstream impact limits of the study area are also within Overland Park city limits, extending to Coffee Creek, between 168th Street and 168th Terrace, west of Switzer Road. The PES would include engineering analyses to ensure there are no significant increases in runoff rates or adverse effects on conditions downstream

I have also attached a memo that summarizes the findings of the feasibility study and includes a map of the proposed project area map (refer to Figure 1 of memo), and a figure illustrating the existing conditions for the stormwater system (refer to Figure 2 of memo).

We would like HNTB to proceed with the completion of the PES as soon as possible. However, we request your concurrence that the project area meets the minimum requirements for submittal in accordance with the Johnson County Stormwater Management Program prior to providing HNTB with the notice to proceed.

It is our intent to submit the PES in December 2018.

Please let me know if you have any questions. I can be reached at 913/895-6023. We look forward to your response.

Best Regards,
Lorraine Basalo

Lorraine Basalo, P.E.
Assistant City Engineer
Public Works

City of Overland Park
8500 Santa Fe Dr
Overland Park, KS 66212

(w) 913-895-6023
lorraine.basalo@opkansas.org | www.opkansas.org

OVERLAND PARK
KANSAS
ABOVE AND BEYOND. BY DESIGN.

Forward OP
Imagine Tomorrow • Inspire Action

2 attachments

170th Rating Table.pdf
28K

170th Terrace Concept Memo 5-1-18.pdf
1977K

OVERLAND PARK
KANSAS
ABOVE AND BEYOND. BY DESIGN.

Duin, Ybairy <ybairy.duin@opkansas.org>

170th Terrace & Switzer Road Stormwater Improvements - PES Request

Smith, Sarah, PWK <Sarah.Smith@jocogov.org> Wed, Oct 3, 2018 at 3:53 PM
To: "Basalo, Lorraine" <lorraine.basalo@opkansas.org>, "Kellenberger, Lee, PWK" <Lee.Kellenberger@jocogov.org>, "Lage, Kent, PWK" <Kent.Lage@jocogov.org>
Cc: Ybairy Duin <ybairy.duin@opkansas.org>, Pete Jarchow <pjarchow@hntb.com>, Lauren Garwood <lauren.garwood@opkansas.org>

Lorraine, I have reviewed the PES request and it appears to meet our requirements. Kent will assign a project number shortly. Will you be requesting any funds for the PES? If yes we will need a copy of your agreement with the consultant.

Sarah

Sarah D. Smith, PE, ENV SP

Stormwater Engineer/Project Manager

Public Works & Infrastructure

1800 Old Highway 56, Olathe, Kansas 66061

Direct 913-715-8330 | Fax 913-715-2453

Office 913-715-8300 | TDD 800-766-3777

JOHNSON COUNTY KANSAS
Public Works

jocogov.org | @jocogov | F/jocogov

From: Basalo, Lorraine [mailto:lorraine.basalo@opkansas.org]
Sent: Wednesday, October 3, 2018 3:34 PM
To: Kellenberger, Lee, PWK <Lee.Kellenberger@jocogov.org>
Cc: Smith, Sarah, PWK <Sarah.Smith@jocogov.org>; Ybairy Duin <ybairy.duin@opkansas.org>; Pete Jarchow <pjarchow@hntb.com>; Lauren Garwood <lauren.garwood@opkansas.org>
Subject: Re: 170th Terrace & Switzer Road Stormwater Improvements - PES Request

[Quoted text hidden]

City:	Overland Park	Basin & Watershed:	Blue River
Location:	170th Terrace and Switzer		
Description of problem:	Residential homes and excessive residential street flooding		

Flood Problem Rating

Factor #	Factor Description	Eliminates Factor	Rating Points	Frequency Multiplier	Severity Multiplier	Total Points
1	Loss of Life		40			
2	Flooding of habitable building	3	40	3	1	120
3	Flooding of garages and outbuildings	2	20			
4	Flooding arterial street of more than 7 inches	5,6,7	30			
5	Flooding collector street of more than 7 inches	4,6,7	25			
6	Flooding residential street of more than 7 inches	4,5,7	20	2	1.5	60
7	Widespread or long-term ponding in streets	4,5,6	20			
8	Erosion threatens habitable buildings, utilities, streets, bridges	9	30			
9	Erosion significant in unmaintained areas	8	10			
10	Erosion causes imminent drainage structure collapse	11,12	30			
11	Erosion causes marginal drainage structural collapse	10,12	15			
12	Erosion causes failure of drainage structure	10,11	10			
13	Other cities receiving benefits		20			
14	Other cities contributing to flooding problem		10			
Project Total Points						180
Estimated Total Project Cost						973,000
Priority Rating = Total Project Cost/Total Points						5,406

Applies To	Frequency Multiplier	Multiplier Value
2-7	One time in ten years or by 6 to 10- to 100-year design storm	1
2-7	Two time in ten years or by 5- to 10-year design storm	2
2-7	Three or more times in ten years or less than under 5-year design storm	3
13,14	1 city receiving benefit	1
13,14	2 cities receiving benefit	2
13,14	3 or more cities receiving benefit	3

Applies to #	Severity Description	Multiplier Value
1	Number of known deaths *=1 for each death	*
2,3	1-5 buildings flooded historically or by 100-year design storm	1
2,3	6-9 buildings flooded historically or by 100-year design storm	2
2,3	10 or more buildings flooded historically or by 100-year design storm	3
4, 5, 6	Restricts emergency vehicles	1.5
8	Nuisance erosion creates maintenance problems	1
8	Moderate erosion, failure of structure or facility within next 5 years possible	2
8	Severe erosion, failure of structure or facility imminent	3
10-12	Collapse causes flooding of land by 100-year design storm	1
10-12	Collapse causes flooding of garages/outbuildings by 100-year design storm	1.5
10-12	Collapse causes 1-3 habitable buildings to be flooded	2
10-12	Collapse Causes 4-6 habitable building to flooded	3
10-12	Collapse Causes more than 6 habitable buildings to be flooded	4