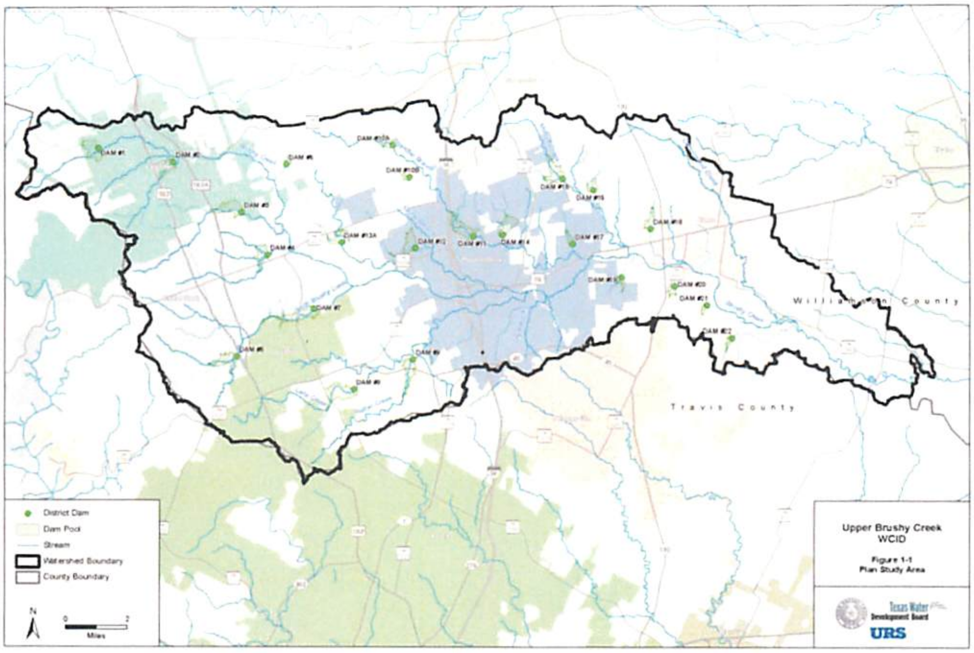
FINAL
Upper Brushy Creek Watershed Flood Protection Plan



Williamson County, Texas
June 2016

Prepared by:
URS
TX Firm 3162

UPPER BRUSHY CREEK W.C.I.D.

Texas Water Development Board

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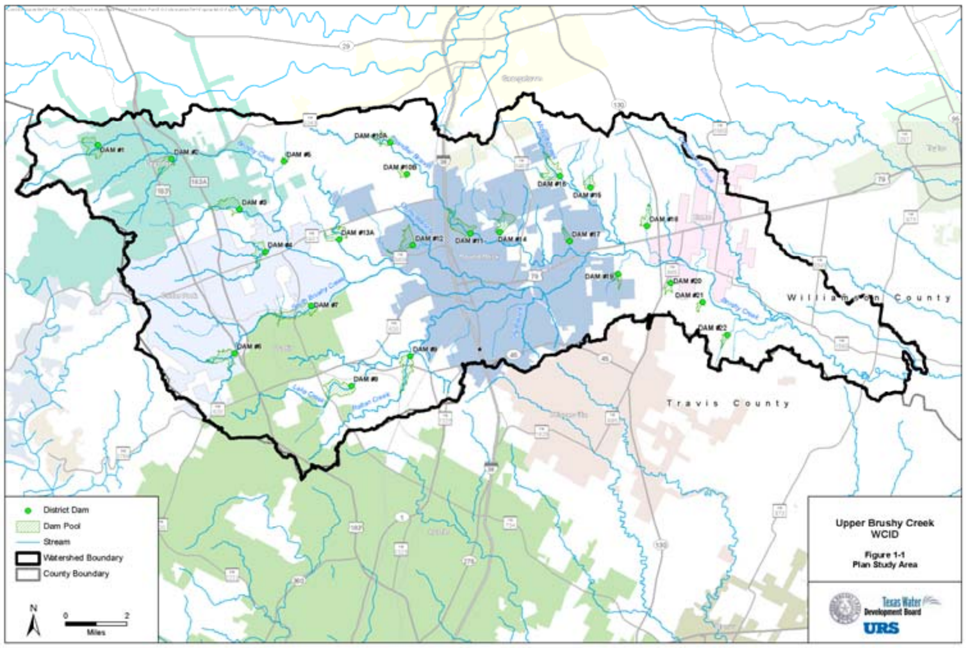

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Prepared for:
Upper Brushy Creek
Water Control & Improvement District
1850 Round Rock Avenue
Suite 100
Round Rock, TX 78681

June 2016

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6-23-16

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EXECUTIVE SUMMARY

Background

The Upper Brushy Creek Watershed Control and Improvement District (District) is located in Williamson County within an area that encompasses portions of the cities of Austin, Cedar Park, Hutto, Leander, and Round Rock (see Figure ES-1). The original district was formed by the Texas Legislature in 1956 to provide flood and erosion control within the Brushy Creek Watershed. The primary focus of the District has been operation and maintenance of 23 dams (see Figure ES-1) constructed with federal support (U.S. Department of Agriculture) in the 1950s and 1960s. The current mission of the District is to maintain and improve flood control structures within the Brushy Creek Watershed within the District boundaries and take appropriate measures to protect public safety as well as economic infrastructure of the District, in consultation and cooperation with other governmental entities.

In furtherance of this mission, in 2011 the District applied for and received a flood protection planning grant from the Texas Water Development Board (TWDB) to develop an Upper Brushy Creek Watershed Flood Protection Plan (FPP). The study area includes approximately 187 square miles in the Upper Brushy Creek Watershed and contains approximately 139 river miles of creeks with drainage areas greater than 1 square mile. The five cities (Austin, Cedar Park, Hutto, Leander, and Round Rock) and Williamson County have endorsed the need for the FPP and have been active participants in preparation of the FPP, through participation with the two lead agencies in a Technical Advisory Committee (TAC). The TAC was formed specifically for providing input and review to the watershed flood protection planning process.

Plan Purpose and Organization

The purpose of the FPP is to identify existing creek flooding concerns, prioritize those concerns, propose potential alternatives for the mitigation of the highest priority concerns, develop concept designs and cost estimates for selected alternatives, and provide benefit analyses of each alternative. The FPP therefore provides flood mitigation alternatives, each with an associated concept design, cost, and benefit (relative to other alternatives). This information is provided for the benefit of the stakeholders (cities and county) within the District for consideration in development of capital improvement plans by each stakeholder. Additional benefits to stakeholders include:

- Development of improved watershed hydrologic (runoff prediction) models, consistent with current development and available recently improved topographic data; and
- Development of improved watershed hydraulic (flood elevation prediction) models, consistent with current development and available recently improved topographic data.

The FPP models are planned to form the basis for revised Federal Emergency Management Agency (FEMA) regulatory floodplain maps and are developed per *Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix C: Guidance for Riverine Flooding Analyses and Mapping* (FEMA, Appendix C, 2009). This mapping process is being financially supported by FEMA, TWDB, and the District and will be completed after completion of this FPP.

The FPP organization includes the following sections, each documenting a step in the FPP development.

Section 2, Hydrologic Modeling Methodology. Hydrologic modeling predicts the temporal pattern of runoff (flow rate versus time) for a given storm (rainfall versus time). This section provides details of the software used, parameter development methodology, and model calibration method.

Section 3, Hydraulic Modeling Methodology. Hydraulic modeling predicts the water surface elevation (and associated floodplain extent) associated with the peak flow rates derived per hydrologic modeling. This section provides details of the software used, parameter development methodology, methodology for assigning flows to cross-sections, model boundary conditions, and model calibration.

Section 4, Hydrologic Model Analysis and Results. This section provides documentation of hydrologic modeling: data sources used in parameter derivation, tabular and spatial (map) summaries of parameter values throughout the watershed, graphical summary of model structure, map of model flow prediction points, model calibration results, and tabular results for the series of scenarios modeled.

Section 5, Hydraulic Model Analysis and Results. This section provides documentation of hydraulic modeling: data sources used in parameter/ cross-section geometry derivation, model summary output data, model flood extents maps, and details of model calibration.

Section 6, Flood Hazard Assessment. This section provides documentation of the procedure used to obtain TAC consensus approval for the FPP hazard assessment method. The section also provides details and results of the risk assessment method applied to habitable structures, the aggregation of habitable structures into damage centers, the aggregation of damage centers into Priority Areas (PAs), and the ranking of PAs in terms of hazard. Similarly, the section also provides details and results of the risk assessment method applied to in-line structures (road crossings of flood extents: bridges, culverts, etc.).

Section 7, Flood Mitigation Alternatives. This section provides documentation for: 1) the identification of flood mitigation structural alternatives to address flooding within the identified PAs; 2) the methodology used in concept design and cost estimation of these alternatives; 3) the methodology used to estimate benefits of alternatives; 4) presentation of those benefits; and 5) qualitative discussion of project prioritization for consideration by stakeholders in development of local jurisdiction (county, city) capital improvement plans.

Summary of Hydrologic Modeling

The hydrologic modeling was used to develop a predicted flow versus time (hydrograph) relationship at 574 points along the streamlines within the Study Area for a wide range of statistical storms, varying from the routine 50% annual exceedance probability (AEP) storm through the 1% AEP storm to the very rare 0.2% AEP storm. These three storms are sometimes referred to as the 2-year, 100-year, and 500-year average return period storms. Figure ES-2 showing the Leander area provides an example of the size of subwatersheds considered in the model. The District watershed presents a number of challenges to flow prediction, including:

- Storms are historically of significantly higher intensity in the western half of the watershed than in the eastern half;
- The watershed is developing at a fast pace, which makes quantification of subwatershed pavement area a rapidly evolving estimate;
- Portions of the watershed have existing quarries, which are large depressions that strongly affect runoff volume; and
- The watershed encompasses five cities and a county, each of whom specify particular technical methods for hydrologic analysis.

To address these issues, hydrologic modeling methods were proposed, reviewed, and revised with ultimate consent of the TAC prior to modeling being performed. Importantly, the models were calibrated so that predicted volume of runoff and predicted time of flow peak matched historic storms. Two major storms that had caused significant flooding were chosen for calibration: the large, regional Tropical Storm Hermine from September 2010 and a June 2007 intense thunderstorm event. The District dams collected continuous rainfall data and stage data throughout each of these two events. The records from 11 of the District's dams were used in the calibration.

The flow estimates presented in the FPP represent a major improvement in accuracy over the models in use prior to the FPP, notably:

- Modeling considered development up to 2011, while previous modeling represented a development condition from the early 1970s.
- Modeling was calibrated at 11 points within the watershed; i.e., the models' predictions are demonstrated to be consistent with physical data collected during the most significant storms in the watershed in the past decade.
- Modeling used rainfall depths and spatial distribution from a 2004 publication; previous modeling used a 1962 reference. The significance is that the statistics in the new reference considered more than double the duration of rainfall data and a much more dense spatial distribution of gages than considered in the old dataset.
- Watershed boundaries, quarry capacities, etc. were based upon vastly more accurate topographic data collected using state-of-the-art methods (LiDAR) in 2006 and 2012.

Summary of Hydraulic Modeling

The hydraulic modeling performed developed water surface elevations (WSEs) for over 210 stream miles and included over 3,800 hydraulic model cross-sections. Figure ES-3 shows the streamlines for which detailed models were developed. WSEs were estimated for each of the statistical storm scenarios (50%, 10%, 4%, 2%, 1% and 0.2% AEP floods for existing conditions, and 4% and 1% AEP floods for ultimate [full] development conditions) considered in the hydrologic modeling.

As with the hydrologic modeling, hydraulic modeling methods were proposed, reviewed, and revised with ultimate consent of the TAC prior to modeling being performed. Again, models were calibrated so that predicted WSEs matched historic high water marks (HWMs) collected during historic events, notably Tropical Storm Hermine (September 2010) over the full watershed and the July 2012 large storm over the Lake Creek/Rattan Creek watershed. The Lake Creek watershed was identified as having significantly greater rainfall losses (i.e., more rain goes into the ground) than other District watersheds, and the hydrologic model had to be revised to achieve a model match between predicted WSEs and numerous measured HWMs.

The hydraulic models presented in the FPP represent a major improvement in hydraulic accuracy and community utility over hydraulic models in use prior to the FPP, notably:

- Most importantly, floodplain extents were based upon vastly more accurate topographic data collected: 1) using state-of-the-art methods (LiDAR) in 2006 and 2012; and 2) via extensive ground surveys in 2011-2012 (survey of 415 bridges/ culverts, 267 other cross-sections);
- Existing hydraulic models, many developed over 20 years ago, had poor or non-existent documentation , making their utility in estimating impacts of proposed projects on WSE complex and problematic; and
- Detailed models were developed for 29 miles of stream that were previously mapped as FEMA Zone A (i.e., regulatory floodplains mapped without a hydraulic model).

Summary of Hazard Assessment

The FPP includes a study to quantify relative flood risk level within the watershed, so that flood mitigation measures can be identified within the FPP that address the areas within the District of highest flood risk. The hydraulic model results provided for all modeled reaches of the watershed a predicted WSE for each modeled statistical flood scenario. Watershed-wide, over 600 structures (likely to be occupied) were found to be within the 0.2% AEP flood, and over 350 of those structures were found to be within the 1% AEP flood. The latter flood is analogous, but not equal to the regulatory flood, as models will not be finalized until formally submitted to FEMA after a future cycle of stakeholder and FEMA review.

The consensus hazard assessment method was developed over a series of TAC meetings. The basic method is similar to that used by the City of Austin and includes developing a Flood Score (FS) from the hydraulic model results for each habitable structure. The FS equation associated with individual habitable structures is documented in Section 6 of the FPP. Adjacent structures and their FSs were aggregated into Damage Centers (DCs); then DCs were aggregated into PAs. Figure ES-4 shows the distribution of DCs through the watershed and the associated PAs. The boundaries of the PAs were approved by consensus and reflect a judgment that the risk to structures within the entire PA would likely be addressed by the same flood mitigation project or suite of projects. FS were estimated for each structure, then aggregated by DC and PA.

The 13 PAs were prioritized during a TAC meeting in which stakeholders considered aggregate FS and a series of qualitative factors. A sensitivity study was performed to estimate changes associated with altering relative importance assigned between FS and qualitative factors, and order of ranking was generally minimally altered between various weighting scenarios. The priority of PAs from highest to lowest were 3, 2, 6, 9, 13, 11, 10, 12, 5, 8, 7, 4, and 1.

The estimated priority of a PA had no effect on consideration of the PA within the remainder of the study. Each PA was considered an area of significant risk and flood mitigation alternatives were considered to address each PA.

A similar hazard assessment process was followed for assigning relative flood risk to road crossings over modeled flood extents within the watershed. A FS equation was developed and applied, and a table quantifying FS for watershed road crossings was developed for the higher FS crossings in each watershed jurisdiction (Table ES-1).

Summary of Flood Mitigation Alternatives

Flood mitigation alternatives were developed watershed-wide to address the flood risks associated with each of the PAs. A series of meetings was held with each stakeholder (five cities and one county) to discuss feasibility and worthiness for further study of each proposed alternative. The resulting suite of flood mitigation alternatives is depicted in Figure ES-5. The types of alternatives proposed included in-line and off-line flood retarding structures (dams), new channel diversions, and existing channel improvements. Crossing-specific alternatives to address high flood risk associated with road crossings were not developed unless that alternative also resulted in substantive risk reduction in a PA.

A concept design and cost estimate were developed for each alternative deemed feasible in Figure ES-5. Individual project site plans, tables of rough project dimensions, and concept design discussions are included in Exhibit S of the FPP. The site plans in Exhibit S depict project locations, extent of the physical project, and where relevant, extent of the flood pool associated with dams. These sites have been chosen to produce desired flood risk reductions, but the site locations can be moved within the general area and produce similar flood benefits. Features depicted in an Exhibit T site map are not fixed in location and will likely move if the associated project is selected for further level of design. Estimated construction costs, not including real estate costs, are included for each alternative in Exhibit T.

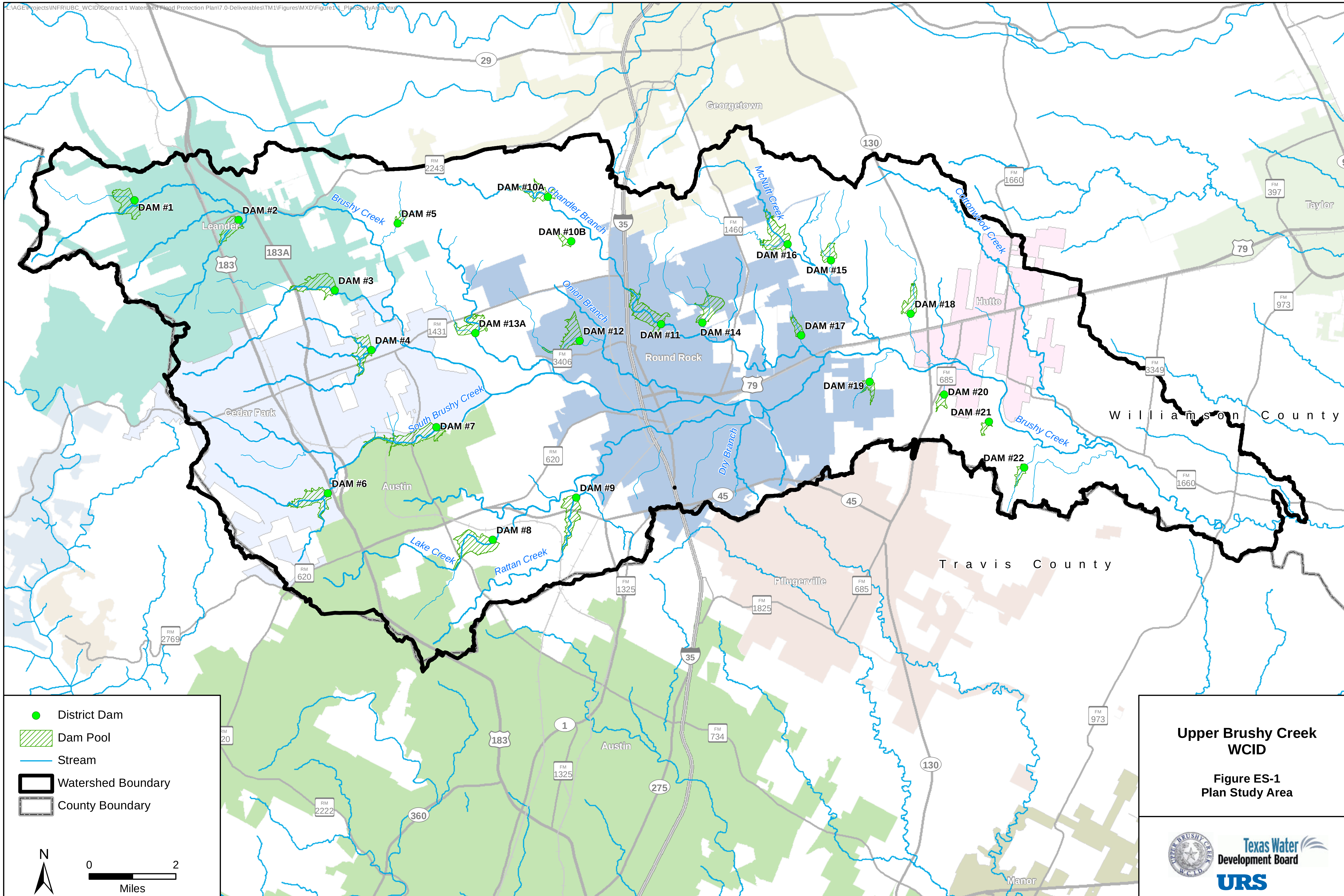
The benefits of each project in terms of FS reduction (per the consensus FS equation) were quantified by running the FPP hydrologic models with the added project and estimating changes in flood depth at each currently flooded habitable structure throughout the watershed (not just structures within PAs). Flood retarding (dam) projects designed primarily to reduce flood risk in PAs along the Brushy Creek main stem were assumed to be constructed along furthest upstream tributaries first. If a project also materially reduced risk at a road crossing previously identified as high risk, that was noted.

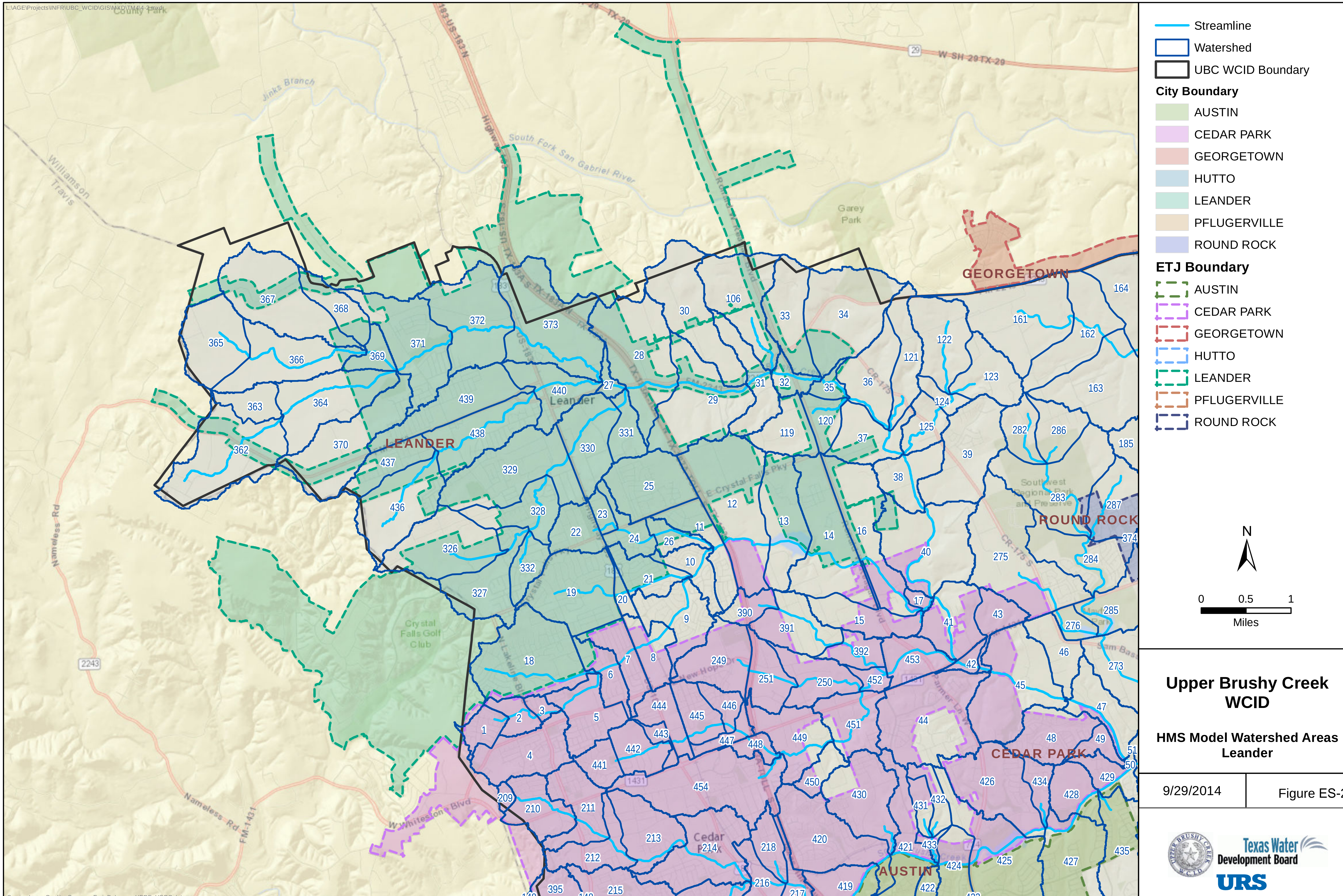
In upstream locations where an alternative primarily improved one PA (e.g., PAs 1, 2, and 3 in Figure ES-4), a comparison was made between the benefits and costs associated with competing or partially competing alternatives. In downstream locations where multiple alternatives were considered for risk reduction along a specific tributary and the downstream Brushy Creek main stem, the benefits and costs of these competing (or partially competing) alternatives were compared.

Table ES-1. Roadways Overtopped in 50-Year Flood

ISID	Roadway Name	Location	Type	Total Flood Score	Flood Depth 50-Year	Flood Depth 100-Year	Flood Depth 500-Year	Velocity 50-Year	Velocity 100-Year	Velocity 500-Year
City of Austin										
IS372	Mellow Meadows	Lake Creek R2	Single Access Road	6.1	0.8	1.4	2.8	1.9	2.6	3.5
IS371	San Felipe Blvd	Rattan Creek	Minor Collector	8.2	0.8	1.5	2.9	2.1	3.1	4.1
City of Cedar Park										
IS360	Cardinal Ln	Cluck Creek	Single Access Road	19.9	1.5	1.8	2.6	2.7	3.0	3.6
IS357	Cedar Park Dr	Cluck Creek	Minor Collector	21.9	1.6	1.9	2.4	2.7	2.9	3.4
IS354	RR 1431/W Whitestone Blvd	Cluck Creek	Major Arterial	21.8	1.4	1.5	1.8	2.5	2.6	2.8
City of Hutto										
IS68	Coyote Trail	Brushy Creek Trib9	Local	7.9	2.0	2.3	2.8	3.0	3.1	3.4
IS66	CR 110	McNutt Creek Trib3	Minor Arterial	40.6	2.1	2.5	3.0	3.3	3.6	3.8
IS65	CR 110	McNutt Creek Trib3	Minor Arterial	24.6	1.6	1.8	2.1	2.6	2.7	3.0
IS63	CR 110	McNutt Creek Trib2 R2	Minor Arterial	16.6	1.2	1.4	1.8	2.5	2.7	3.0
IS62	CR 112	McNutt Creek Trib1	Minor Collector	10.5	0.9	1.3	1.9	2.3	2.7	3.3
IS69	CR 135	Brushy Creek Trib9	Single Access Road	10.6	1.2	2.1	3.0	2.2	3.0	3.6
IS169	CR 199	Cottonwood	Local	9.3	5.3	6.1	5.6	1.3	1.3	2.3
City of Leander										
IS39	Emerald Isle Dr	Blockhouse Trib2	Minor Collector	6.9	0.7	0.8	1.0	1.8	2.0	2.2
IS249	FM 2243	S Fork Brushy	Major Arterial	7.7	1.1	1.4	1.8	2.2	2.2	2.5
IS54	Los Vista Dr	Mason Creek Trib1	Minor Collector	11.5	1.0	1.1	1.3	2.2	2.3	2.6
IS252	Ridgmar Rd	Brushy Creek	Local	56.8	7.8	8.7	11.0	5.6	5.7	5.8
IS251	RR 2243	Brushy Creek	Major Arterial	37.1	2.3	2.5	3.3	2.9	3.2	3.8
City of Round Rock										
IS158	A W Grimes Blvd Northbound	Brushy Creek	Major Arterial	128.1	5.7	7.6	11.5	4.5	5.2	6.4
IS318	Burnet St S	Lake Creek R1	Local	5.6	1.8	3.4	7.1	2.9	4.2	5.8
IS254	Chisholm Trail Rd	Brushy Creek	Minor Collector	176.8	6.1	7.1	10.6	5.8	6.3	6.5
IS377	Deep Wood Dr	Lake Creek R1	Minor Collector	85.4	4.2	6.5	9.5	4.3	3.8	4.5
IS7	Greenlawn Blvd	Dry Branch Trib1	Major Arterial	15.6	1.3	1.5	2.0	2.1	2.4	2.8
IS64	Harrell Pkwy	Chandler Branch Trib5 R1	Local	4.7	1.5	1.7	2.1	2.5	2.7	3.0
IS15	Nash St W	Lake Creek Trib6	Local	12.2	2.9	3.2	3.7	3.3	3.5	3.9
IS375	Oak Ridge Dr	Lake Creek R1	Minor Collector	34.9	2.2	4.2	8.1	3.4	4.7	4.9

ISID	Roadway Name	Location	Type	Total Flood Score	Flood Depth			Velocity		
					50-Year	100-Year	500-Year	50-Year	100-Year	500-Year
IS4	Oxford Blvd	Dry Branch Trib1	Local	5.2	1.5	2.1	2.9	2.9	3.3	3.5
IS10	Purple Sage	Lake Creek Trib6	Local	6.5	1.8	2.1	2.5	2.8	3.0	3.4
IS274	Railroad Crossing	Onion Branch R1	Railroad	25.3	1.6	2.0	2.7	2.7	3.0	3.2
IS159	Red Bud Ln	Brushy Creek	Major Arterial	13.9	1.4	2.2	6.7	2.6	3.3	5.6
IS376	Round Rock W Dr	Lake Creek R1	Minor Collector	24.7	1.7	4.1	8.1	3.3	4.4	6.3
IS48	Twin Ridge Pkwy	Brushy Creek Trib5A	Minor Collector	6.6	0.8	1.3	1.8	2.0	2.5	2.9
Williamson County										
IS304	Brushy Bend	Brushy Creek	Local	82.1	10.7	12.0	15.1	6.1	6.1	5.9
IS310	CR 110	McNutt Creek R1	Minor Arterial	63.0	3.0	4.0	5.9	3.7	4.3	5.3
IS173	CR 110	McNutt Creek Trib2A	Minor Arterial	43.8	2.3	2.6	3.1	3.3	3.5	3.7
IS83	CR 129	Brushy Creek	Local	19.8	4.0	5.0	7.0	4.2	4.7	5.8
IS162	CR 137	Brushy Creek	Minor Arterial	108.0	4.4	6.1	9.5	5.0	5.8	7.1
IS125	CR 176	Brushy Creek Trib4 R2	Local	11.2	2.9	3.0	3.5	3.0	3.2	3.5
IS217	CR 177	Brushy Creek	Local	38.6	10.4	11.0	12.5	2.8	2.9	3.4
IS277	CR 179	Brushy Creek	Minor Collector	230.7	7.3	8.0	10.2	6.0	6.2	6.4
IS117	FM 1325	Rattan Creek Trib1 R2	Major Arterial	23.6	1.6	2.1	2.9	2.5	3.1	3.8
IS308	FM 1660	Cottonwood	Major Arterial	19.7	1.5	1.9	2.5	2.4	2.9	3.4
IS89	Hairy Man Rd	Brushy Creek	Major Arterial	73.2	5.7	6.8	9.9	4.3	4.2	5.5
IS130	Lemens Ave	Dam 18 R2	Local	6.6	1.8	2.0	2.4	2.8	3.0	3.0
IS248	Mesa Rd	N Fork Brushy R1	Single Access Road	6.7	0.7	0.7	0.9	1.8	1.8	2.0
IS306	Old TX 180 Dirt Road	Post Oak	Local	5.5	1.8	2.0	2.5	2.6	2.7	3.1
IS313	Railroad Crossing	Chandler Branch R3	Railroad	41.4	2.1	2.3	2.8	3.1	3.3	3.6
IS334	Railroad Crossing	Blockhouse R2	Railroad	6.3	1.0	1.3	1.8	1.5	1.8	2.3
IS365	Skyview St	Spanish Oak R2	Single Access Road	70.0	3.1	3.4	4.3	3.9	4.1	4.5
IS155	Spanish Oak Trail	Brushy Creek	Local	52.4	9.3	10.4	13.6	4.4	4.4	4.4
IS186	Tonkawa Trail	Dry Fork	Local	4.8	1.6	1.8	2.3	2.4	2.6	3.1


Upper Brushy Creek WCID
Figure ES-1
Plan Study Area
District Dam
Dam Pool
Stream
Watershed Boundary
County Boundary
N
0
2
Miles
Texas Water Development Board
URS
DAM #1
DAM #2
DAM #3
DAM #4
DAM #5
DAM #6
DAM #7
DAM #8
DAM #9
DAM #10A
DAM #10B
DAM #11
DAM #12
DAM #13A
DAM #14
DAM #15
DAM #16
DAM #17
DAM #18
DAM #19
DAM #20
DAM #21
DAM #22
Brushy Creek
South Brushy Creek
Chandler Branch
Onion Branch
McNutt Creek
Cottonwood Creek
Dry Branch
Lake Creek
Rattan Creek
Georgetown
Leander
Cedar Park
Round Rock
Hutto
Taylor
Austin
Pflugerville
Manor
Williamson County
Travis County



Upper Brushy Creek WCID

HMS Model Watershed Areas Leander

9/29/2014

Figure ES-2

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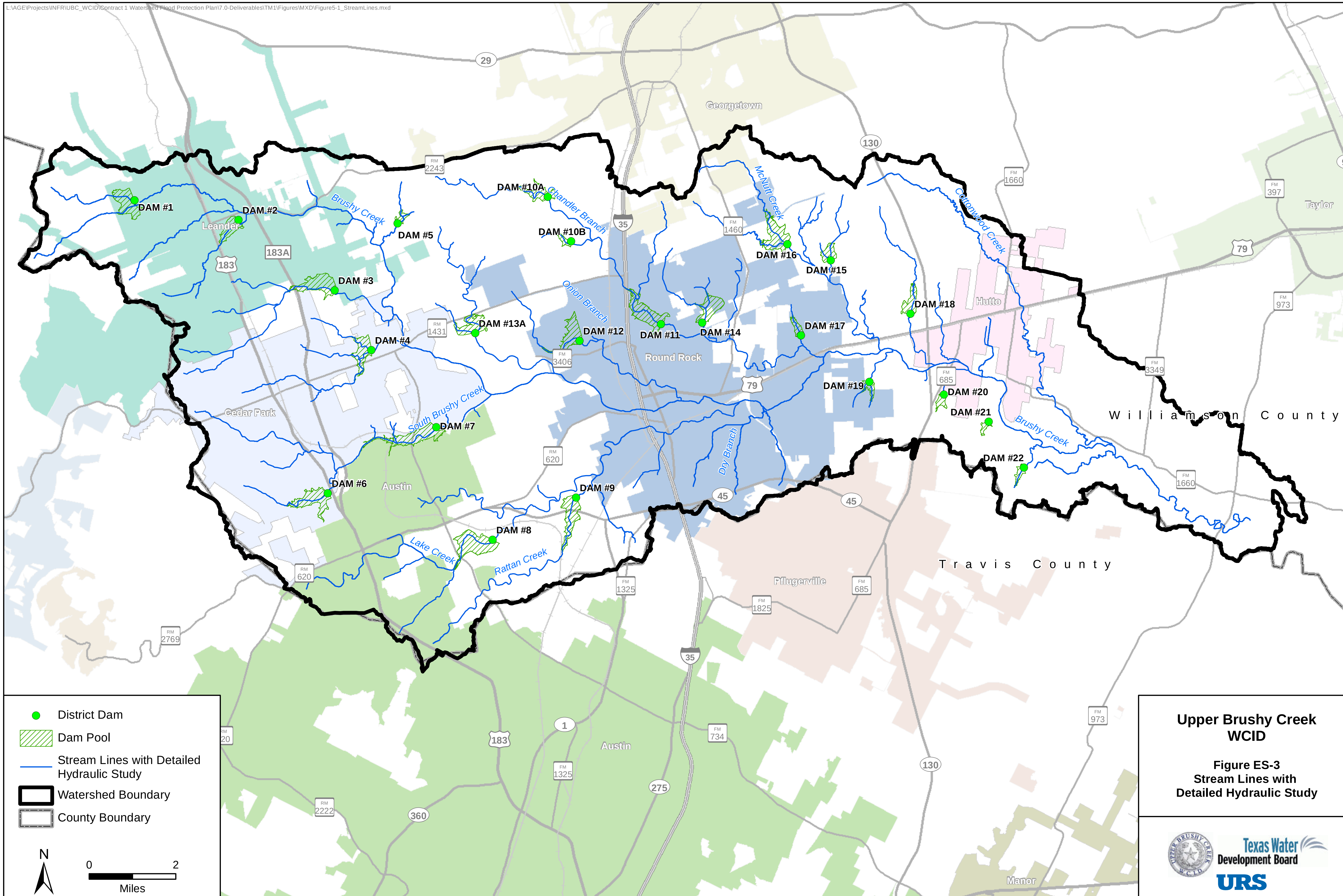
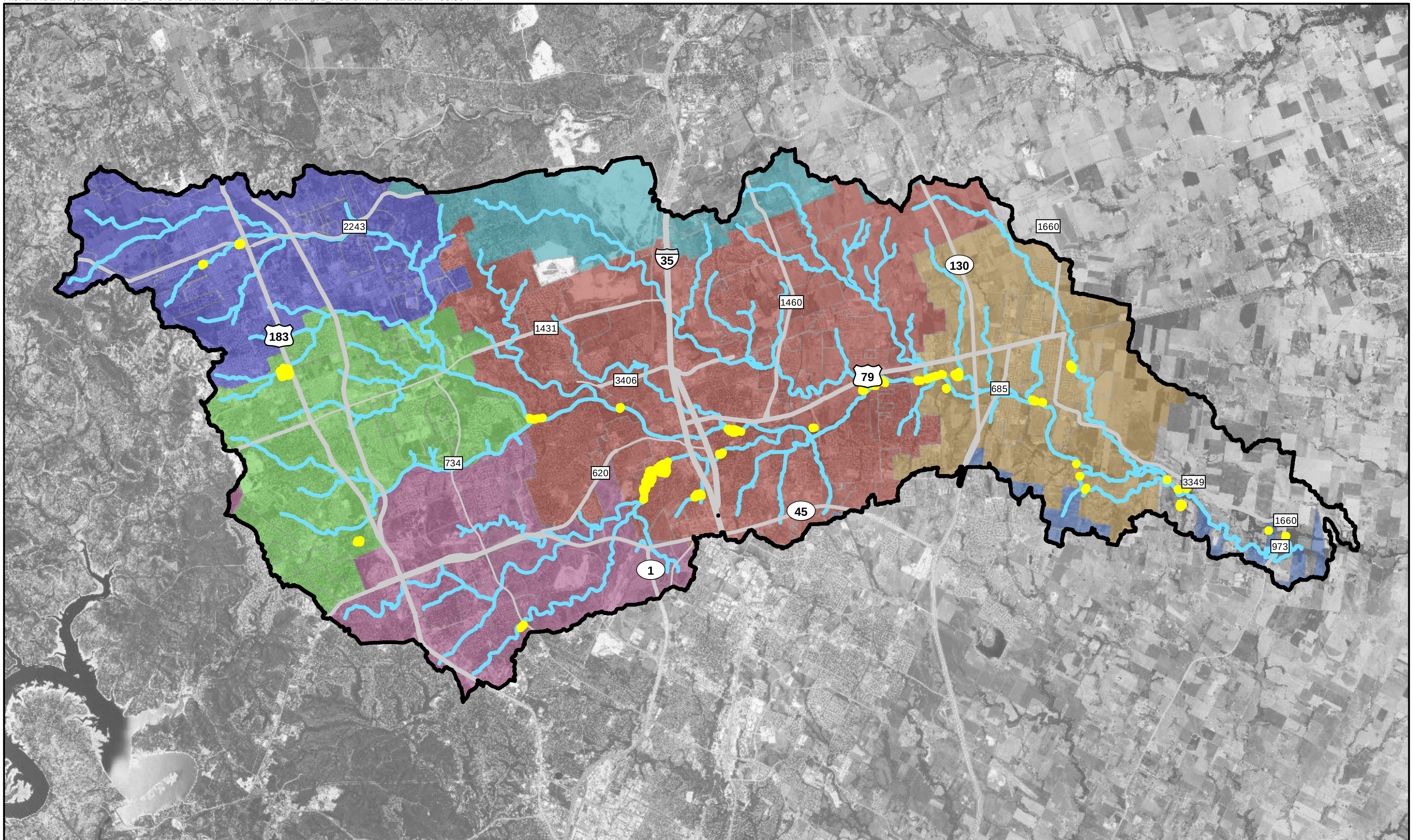


Upper Brushy Creek WCID

Figure ES-3
Stream Lines with Detailed Hydraulic Study

File: L:\AGE\Projects\INFR\UBC_WCID\GIS\MXD\TM6\PriorityAreas\Fig02_HSDC.mxd 5/12/2014 4:55:55 PM



N
0 1.6 3.2 Miles

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Legend

Habitable Structures Damage Center

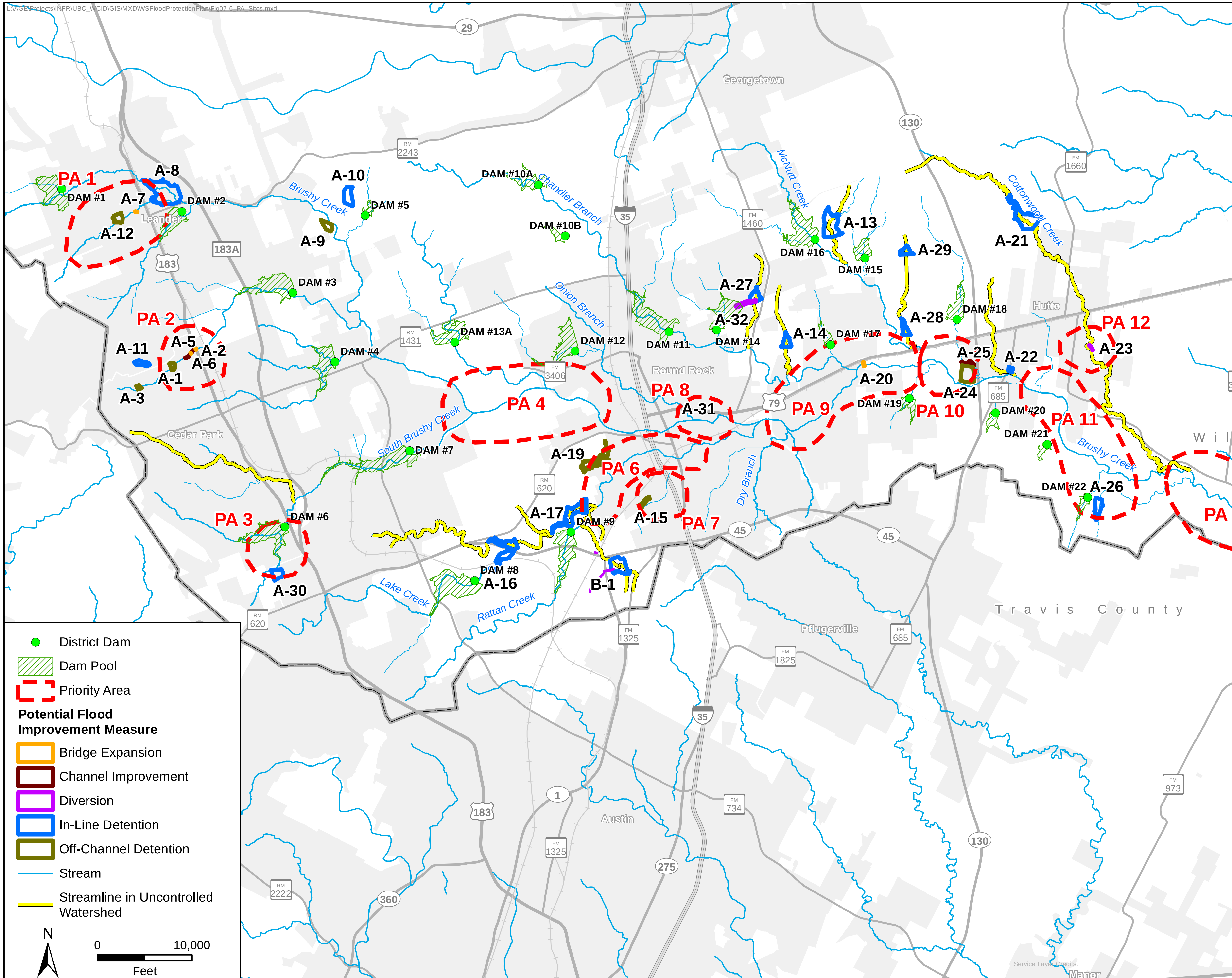
Stream

Upper Brushy Creek WCID

Habitable Structures Damage Centers

Date: 5/12/2014

Figure ES-4



Upper Brushy Creek WCID

Figure ES-5
Potential Flood Improvement Measures

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1.0 UPPER BRUSHY CREEK WATERSHED FLOOD PROTECTION PLAN

1.1 Background

The Upper Brushy Creek Watershed Control and Improvement District (District) is located in Williamson County, Texas within an area that encompasses portions of the cities of Austin, Cedar Park, Hutto, Leander, and Round Rock (see Figure 1-1). The original district was formed by the Texas Legislature in 1956 to provide flood and erosion control within the Brushy Creek Watershed. The primary focus of the District has been operation and maintenance of 23 dams (see Figure 1-1) constructed with federal support (U.S. Department of Agriculture) in the 1950s and 1960s. The current mission of the District is to maintain and improve flood control structures within the Brushy Creek Watershed within the District boundaries and take appropriate measures to protect public safety, as well as economic infrastructure of the District, in consultation and cooperation with other governmental entities.

In furtherance of this mission, in 2011, the District applied for and received a flood protection planning grant from the Texas Water Development Board (TWDB) to develop an Upper Brushy Creek Watershed Flood Protection Plan (FPP). The study area includes approximately 187 square miles in the Upper Brushy Creek Watershed and contains approximately 139 river miles of creeks with drainage areas greater than 1 square mile. The five cities (Austin, Cedar Park, Hutto, Leander, and Round Rock) and Williamson County have endorsed the need for the FPP and have been active participants in its preparation, through participation with the two lead agencies in a Technical Advisory Committee (TAC). The TAC was formed specifically for providing input and review to the watershed flood protection planning process.

In this section, the overall structure of the FPP is described, and the initial project efforts in the identification of watershed flooding issues of concern are presented.

1.2 FPP Purpose and Organization

The purpose of the FPP is to identify existing creek flooding concerns, prioritize those concerns, propose potential alternatives for the mitigation of the highest priority concerns, develop concept designs and cost estimates for selected alternatives, and provide benefit analyses of each alternative. The FPP therefore provides flood mitigation alternatives, each with an associated concept design, cost, and benefit (relative to other alternatives). This information is provided for the benefit of the stakeholders (cities and county) within the District for consideration in development of capital improvement plans by each stakeholder. Additional benefits to stakeholders include:

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Section 3, Hydraulic Modeling Methodology. Hydraulic modeling predicts the water surface elevation (and associated flood plain extent) associated with the peak flow rates derived per hydrologic modeling. This section provides details of the software used, parameter development methodology, methodology for assigning flows to cross-sections, model boundary conditions, and model calibration.

Section 4, Hydrologic Model Analysis and Results. This section documents the hydrologic modeling: data sources used in parameter derivation, tabular and spatial (map) summaries of parameter values throughout the watershed, graphical summary of model structure, map of model flow prediction points, model calibration results, and tabular results for the series of scenarios modeled.

Section 5, Hydraulic Model Analysis and Results. This section documents the hydraulic modeling: data sources used in parameter/cross-section geometry derivation, model summary output data, model flood extents maps, and details of model calibration.

Section 6, Flood Hazard Assessment. This section documents the procedure used to obtain TAC consensus approval for the plan hazard assessment method. It also provides details and results of the risk assessment method applied to habitable structures, the aggregation of habitable structures into damage centers, the aggregation of damage centers into Priority Areas (PAs), and the ranking of PAs in terms of hazard. Similarly, the section provides details and results of the risk assessment method applied to in-line structures (road crossings of flood extents: bridges, culverts, etc.).

Section 7, Flood Mitigation Alternatives. This section documents: 1) the identification of flood mitigation structural alternatives to address flooding within the identified PAs; 2) the methodology used in concept design and cost estimation of these alternatives; 3) the methodology used to estimate benefits of alternatives; 4) presentation of those benefits; and 5) qualitative discussion of project prioritization for consideration by stakeholders in development of local jurisdiction (county, city) capital improvement plans.

1.3 Identification of Flooding Issues

To provide a basis for initial discussion (in 2011), URS performed brief analyses using existing data relating to these flood issues within the District:

- Dam backwater elevations versus structures;
- Road crossings versus frequency of flooding; and
- Structures in current regulatory floodplain.

URS prepared figures that relate to each of these issues. Additionally, URS conducted interviews with stakeholders prior to commencing analysis to identify key features such as detention/retention structures and new developments as well as areas of historical flooding. This section documents the initial phase of planning. All of the information presented below was assembled prior to the development of watershed hydrologic and hydraulic models (documented in Sections 2 through 5) and provides the baseline understood flooding issues at the time of start of planning.

1.3.1 Dam Backwater Elevations Versus Structures

Figure 1-2 shows dams owned by the District and divides them into three categories:

- Type A. Dams where there are structures upstream located within the flood pool (i.e., located within a contour set at the auxiliary spillway elevation);
- Type B. Dams where there are structures within the emergency flood pool (i.e., located within the area bounded by a contour set at the auxiliary spillway elevation and a contour set at the lowest top-of-dam crest elevation); and
- Type C. Dams where no structures are currently located within a contour set at the lowest top-of-dam crest elevation.

All dam elevations are based on NRCS as-built plans available on the District website.

1.3.2 Road Crossings Versus Frequency of Flooding

Figure 1-3 shows road crossings within stream reaches recently modeled by FEMA and identifies a rough frequency of overtopping associated with each structure.

1.3.3 Structures in Current Regulatory Floodplain

Figure 1-4 identifies structures in the current regulatory 100-year return period (1% Annual Exceedance Probability [AEP]) floodplain.

1.4 Stakeholder Interviews

During initial meetings with Stakeholders from each city within the district as well as Williamson County, preliminary watershed delineations were reviewed, and areas that stakeholders perceived as requiring particular attention were identified. Topics discussed with each stakeholder included:

- Watershed delineations;
- Discrepancies between past and proposed delineations;
- Additional detention/retention to consider;
- Significant storm sewers;
- Linear structures;
- High water marks; and
- Areal reduction.

The dates for each meeting held were:

Stakeholder	Meeting Date
City of Austin	12/12/2011
City of Cedar Park	12/8/2011
City of Hutto	12/15/2011
City of Leander	12/7/2011
City of Round Rock	12/6/2011
Williamson County	12/15/2011

1.4.1 City of Austin

The identified areas of particular concern listed below for the City of Austin are shown on Figure 1-5.

A. In addition to the District dams to be included in the model, the City of Austin identified the following detention structures to potentially include in the hydrologic analysis:

   1) SH45 Main Pond; and

   2) SH45 North Branch Pond.

B. Additional detail should be included in the modeling of significant structures at Tamayo Drive and Los Indios Trail.

C. At the intersection of TX 45, McNeil Road, and a railroad line, flows are diverted into a quarry, which fills and discharges uncontrolled flows to the north into Rattan Creek. For extreme flows, there is the likelihood that the railroad and/or McNeil Road may overtop.

1.4.2 City of Cedar Park

The identified areas of particular concern listed below for the City of Cedar Park are shown on Figure 1-6.

A. In addition to the District dams to be included in the model, the City of Cedar Park identified the following detention structures to potentially include in the hydrologic analysis:
   1) Twin Lakes;
   2) Bagdad Pond;
   3) LISD Pond;
   4) Wal-Mart Pond;
   5) Cedar Park Medical Center Pond; and
   6) Cedar Park Town Center Ponds.

B. Localized flooding within the Rivera subdivision.

C. Localized flooding within the Ranchettes 4 subdivision.

D. Flooding from Cluck Creek in the Ranchettes 2 subdivision (a small number of homeowners were flooded).

E. A large number of homes within Ranchettes 6 and 6A subdivisions are located within the effective 100-year floodplain for Block House Creek.

F. There is no defined channel where Post Oak Creek passes through Lakewood Country Estates.

1.4.3 City of Hutto

The identified area of particular concern listed below for the City of Hutto is shown on Figure 1-7.

A. FM 685 overtopped at Brushy Creek during Tropical Storm (TS) Hermine.

1.4.4 City of Leander

The identified issues listed below for the City of Leander are shown on Figure 1-8.

A. In addition to the District dams to be included in the model, the City of Leander identified the detention structure at Horizon Park Blvd./Gateway.

B. The First Baptist Church of Leander suffered damage from TS Hermine in 2010.

C. County Road 273 experiences frequent road closure due to backwater from NRCS Dam No. 2.

D. The Old Towne Village Detention structure was blown out by a flood event in 2004.

E. The low-water crossing at West Broade St. flooded in a major event in 2004.

F. The low-water crossing on Maple Creek Dr. upstream of NRCS Dam No. 1 has had to be closed due to flooding.

1.4.5 City of Round Rock

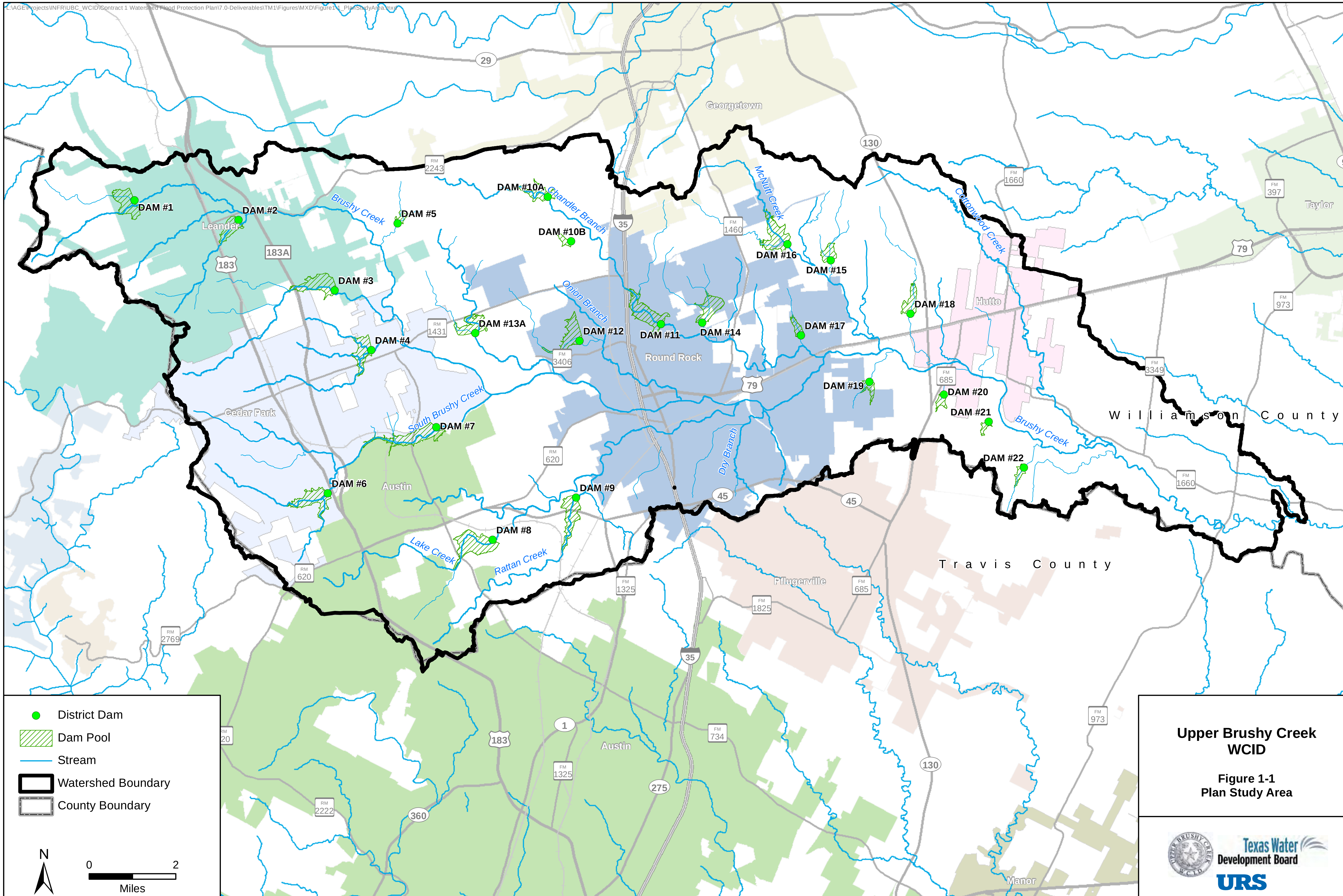
Identified areas of particular concern listed below for the City of Round Rock are shown on Figure 1-9.

A. In addition to the District dams to be included in the model, the City of Round Rock identified the following detention structures to potentially include in the hydrologic analysis:
    1) La Frontera;
    2) Stone Oak Inline Structure;
    3) Randall's Town Center;
    4) South Creek;
    5) Terra Vista;
    6) Eagles Nest; and
    7) Lake Forest.
B. The 620 Quarry requires detailed consideration during modeling to ensure any storage accounted for in the model is realistic. The City of Round Rock would also like to determine if a drainage easement is needed to preserve the existing storage in the quarry to prevent future downstream flooding.
C. The McNeil Quarry and the SH45/Mopac interchange need to be reviewed to determine complex split flow characteristics in this location. URS and the City of Round Rock will coordinate on the modeling of this location to ensure flow characteristics are accurately modeled.
D. For east of town, discrepancies in LIDAR elevations were observed in the preliminary HEC-RAS models.

1.4.6 Williamson County

Identified areas of particular concern listed below for Williamson County are shown on Figure 1-10.

A. Houses along County Road 123 are in the Brushy Creek floodplain.
B. Regular flooding of the low-water crossing at County Road 123 and Brushy Creek Main Stem.
C. A potential additional useful flow node location at Hutto Road and McNutt Fork 1.
D. A potential additional useful flow node location at Limmer Loop and Brushy Creek Fork 3. Teravista Ponds should be reviewed and included in the model, if appropriate.
E. Flooding occurred during TS Hermine and a 2007 storm event along the South Fork of Brushy Creek near West Broade. Photographs and approximate high water mark elevations were provided by Williamson County.



Upper Brushy Creek WCID

Figure 1-1
Plan Study Area

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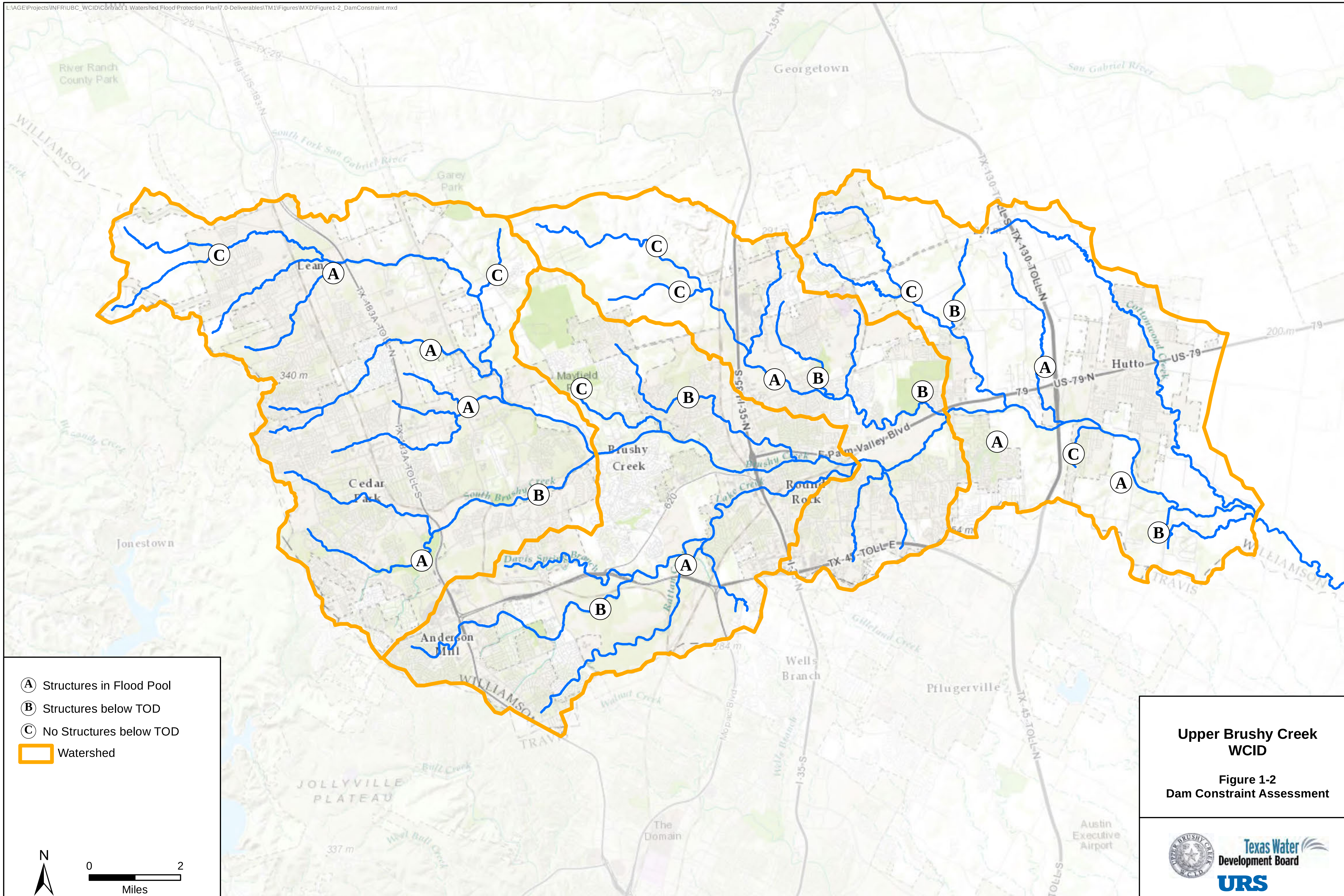
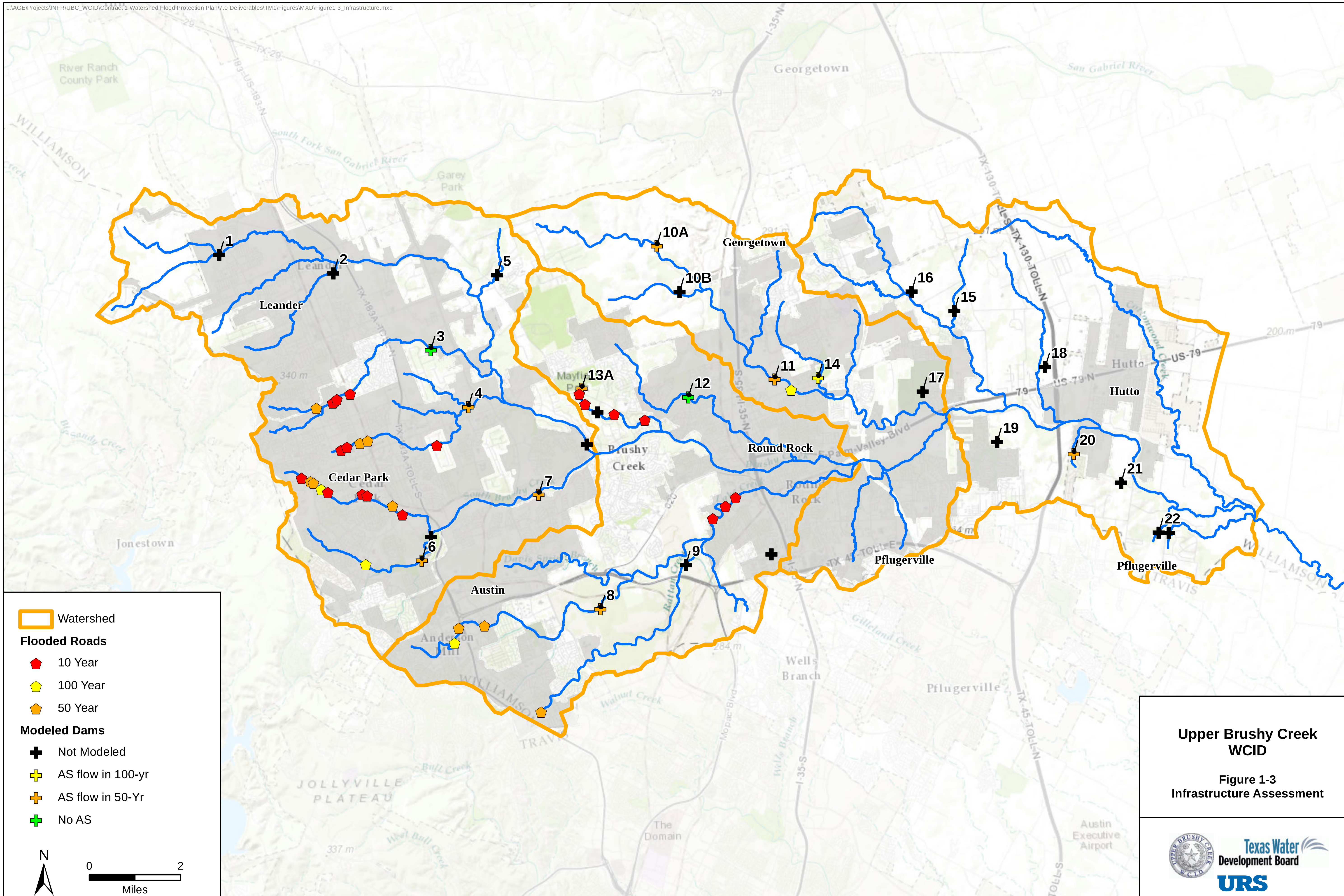


Upper Brushy Creek WCID

Figure 1-2
Dam Constraint Assessment

Texas Water Development Board
URS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Watershed
Flooded Roads
10 Year
100 Year
50 Year
Modeled Dams
Not Modeled
AS flow in 100-yr
AS flow in 50-Yr
No AS
N
0
2
Miles
Georgetown
Leander
Cedar Park
Brushy Creek
Round Rock
Hutto
Pflugerville
Austin
Anderson Mill
Jonestown
Wells Branch
The Domain
Jollyville Plateau
River Ranch County Park
Garey Park
Austin Executive Airport
1
2
3
4
5
6
7
8
9
10A
10B
11
12
13A
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22
Upper Brushy Creek WCID
Figure 1-3
Infrastructure Assessment
Texas Water Development Board
URS

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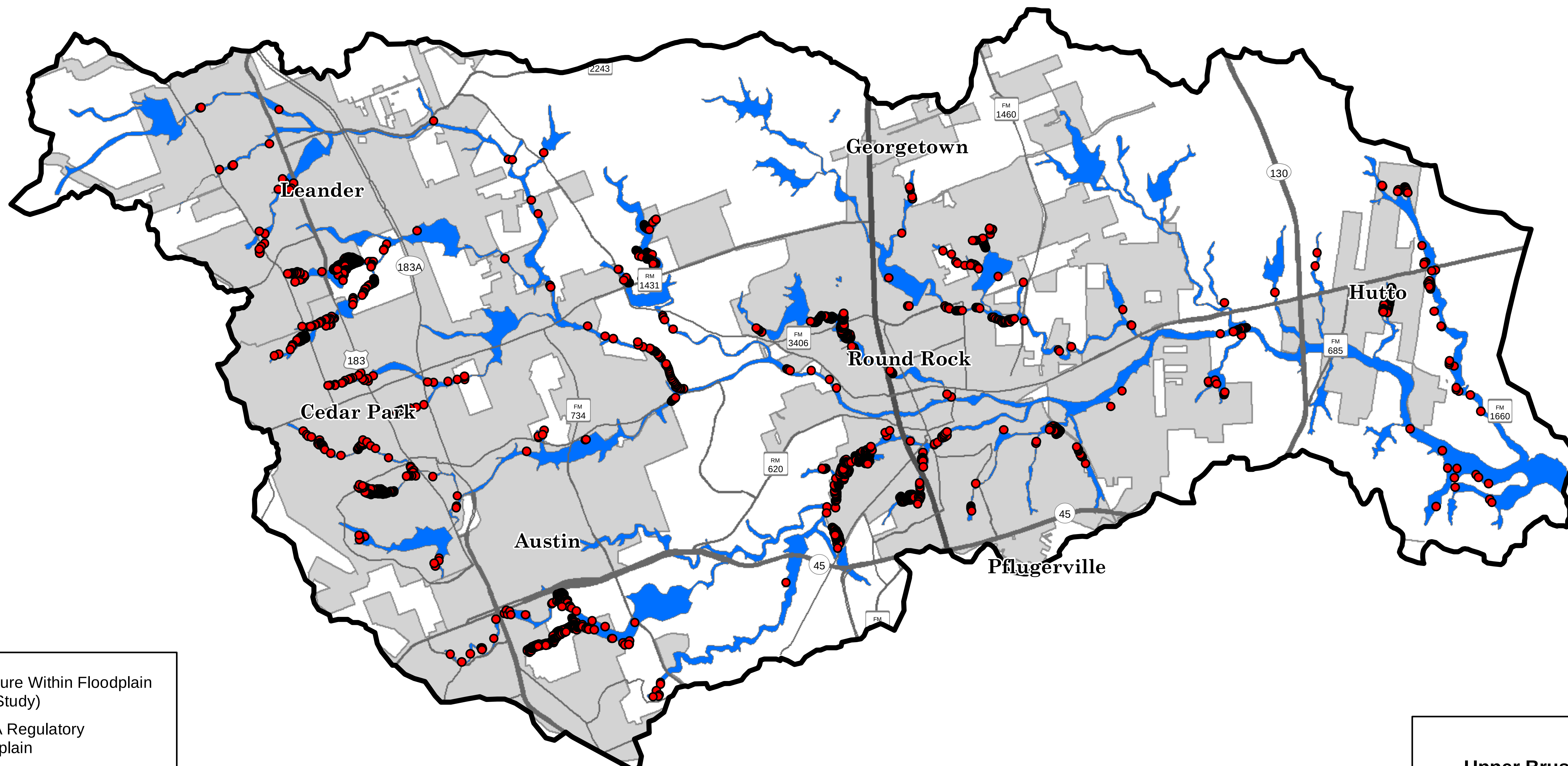


Structure Within Floodplain (Pre-Study)

FEMA Regulatory Floodplain

1590 Structures Within Pre-Study Regulatory Floodplain

N

0 2

Miles

Upper Brushy Creek WCID

Figure 1-4
Floodplain Structure Assessment

Texas Water Development Board

URS

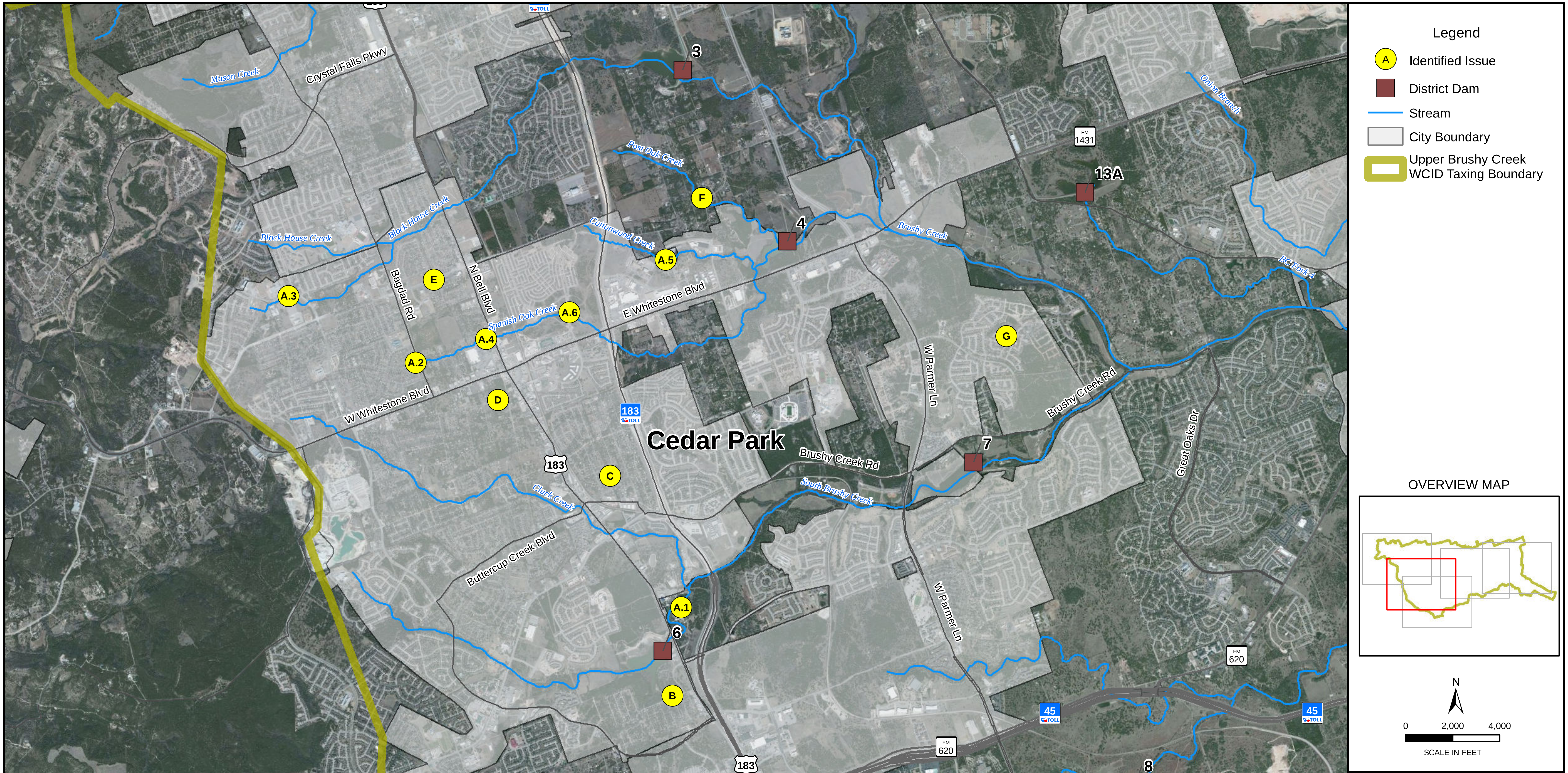
OVERVIEW MAP

Upper Brushy Creek WCID

City of Austin
Identified Areas
for Particular Concern

Date: 3/18/2012 | Figure 1-5

Source Data: Capital Area Council of Governments (CAPCOG), Upper Brushy Creek Water Control District (UBCWCID), URS, Bing



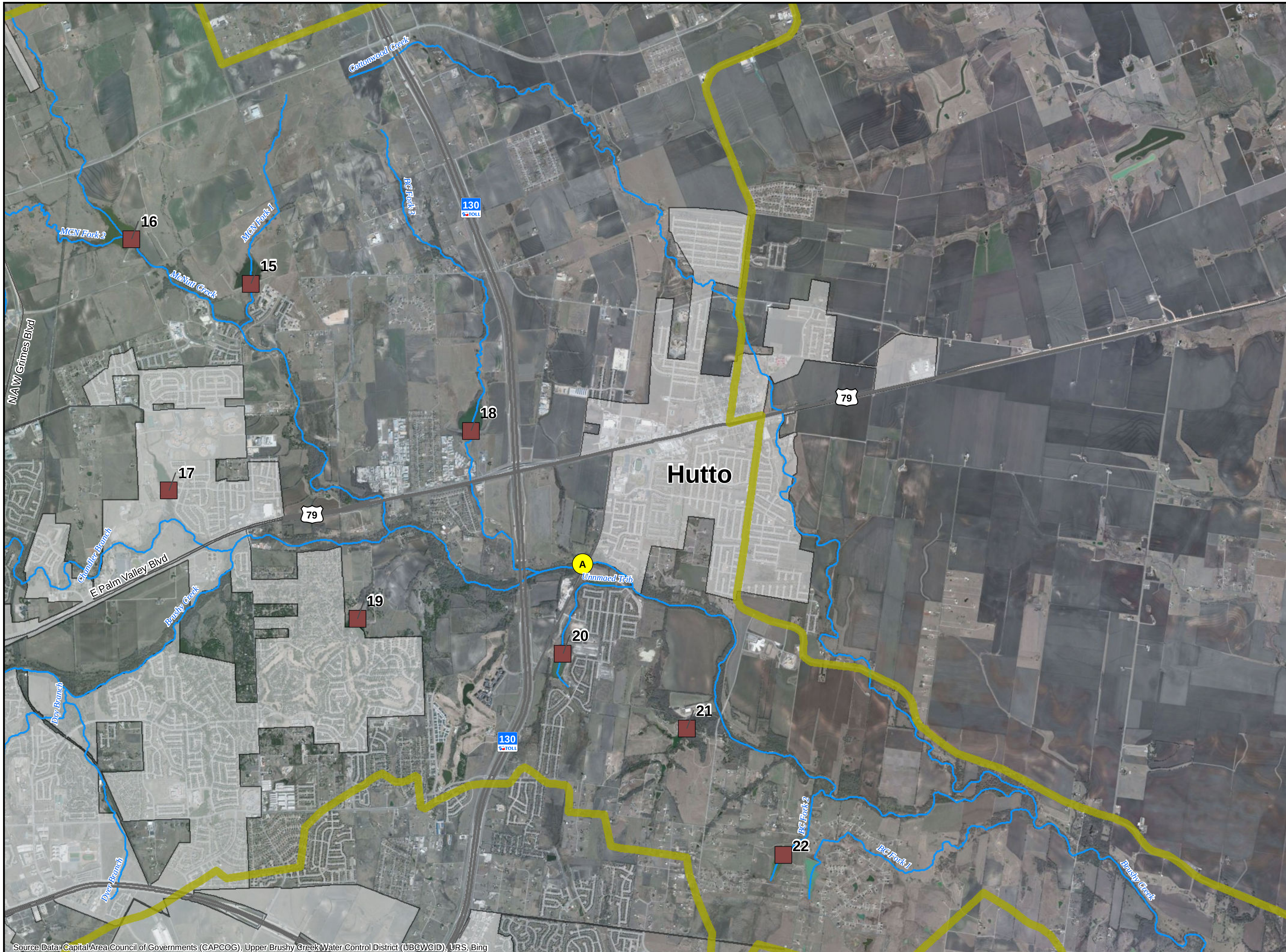
Upper Brushy Creek WCID

City of Cedar Park
Identified Areas
for Particular Concern

Date: 3/18/2012 | Figure 1-6

Texas Water Development Board

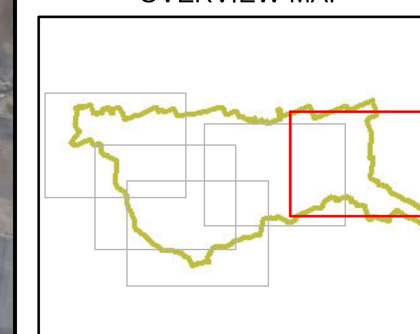
URS



Legend

- A Identified Issue
- District Dam
- Stream
- City Boundary
- Upper Brushy Creek WCID Taxing Boundary

OVERVIEW MAP



N

0 2,000 4,000

SCALE IN FEET

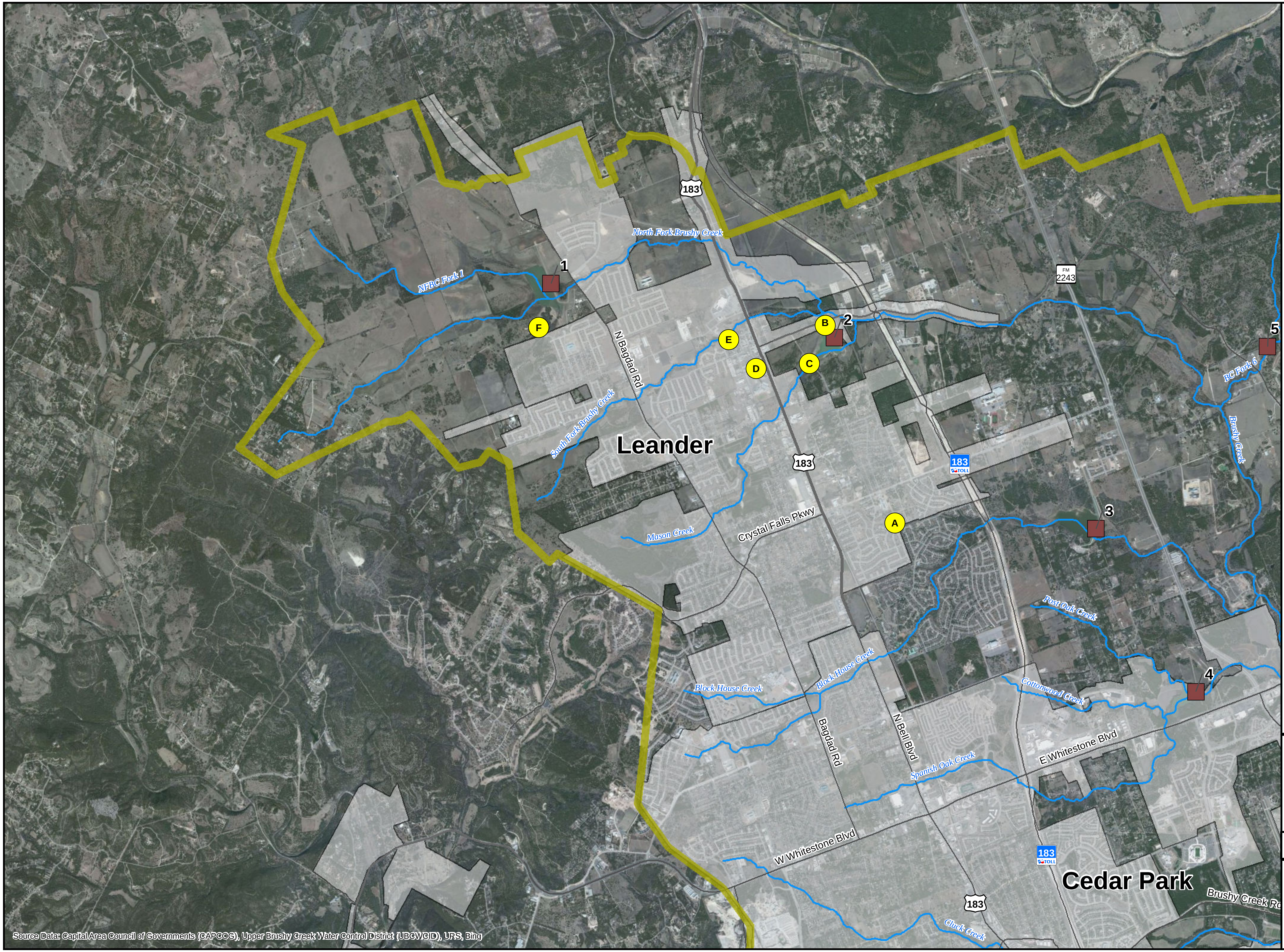
Upper Brushy Creek WCID

City of Hutto
Identified Areas
for Particular Concern

Date: 3/18/2012	Figure 1-7

Texas Water Development Board

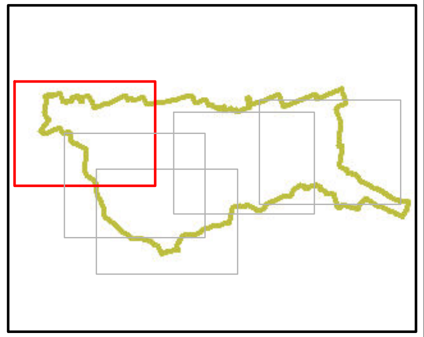
URS



Legend

- A Identified Issue
- District Dam
- Stream
- City Boundary
- Upper Brushy Creek WCID Taxing Boundary

OVERVIEW MAP



N

0 2,000 4,000

SCALE IN FEET

Upper Brushy Creek WCID

City of Leander
Identified Areas
for Particular Concern

Date: 3/18/2012 | Figure 1-8

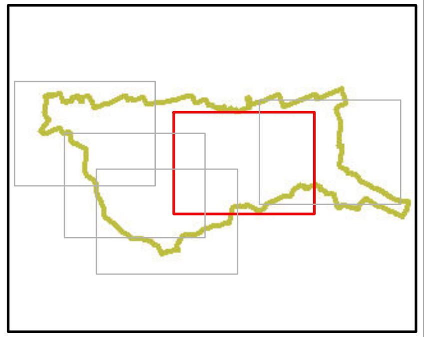
Texas Water Development Board

URS

Legend

- A Identified Issue
- District Dam
- Stream
- City Boundary
- Upper Brushy Creek WCID Taxing Boundary

OVERVIEW MAP



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0 2,000 4,000

SCALE IN FEET

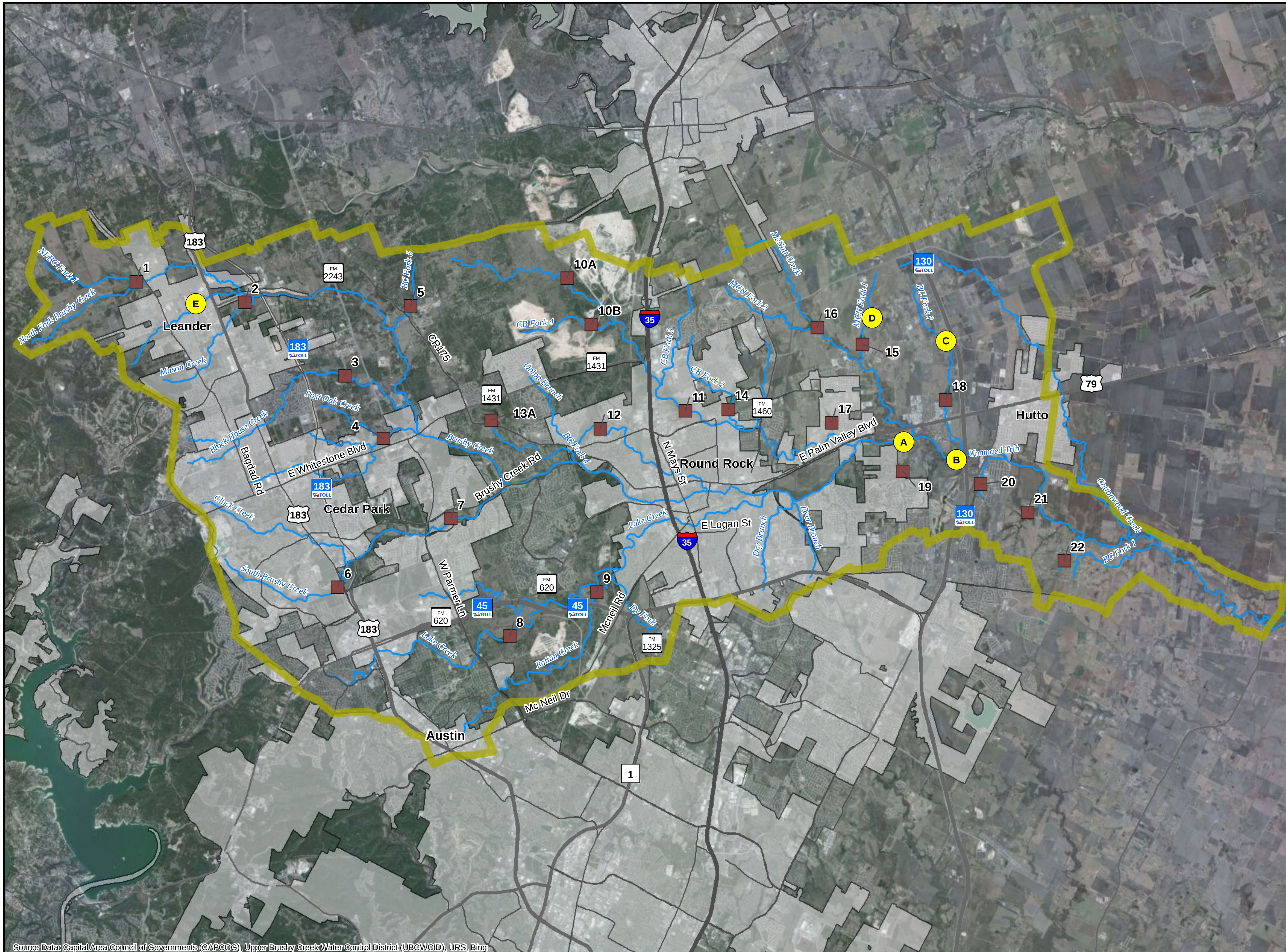
Upper Brushy Creek WCID

City of Round Rock
Identified Areas
for Particular Concern

Date: 3/18/2012	Figure 1-9

Texas Water Development Board

URS



Legend

- A Identified Issue
- District Dam
- Stream
- City Boundary
- Upper Brushy Creek WCID Taxing Boundary

N

0 1 2

SCALE IN MILES

Upper Brushy Creek WCID

Williamson County
Identified Areas
for Particular Concern

Date: 3/14/2012 | Figure 1-10

Texas Water Development Board

URS

2.0 HYDROLOGIC MODELING METHODOLOGY

The District is located in Williamson County and encompasses multiple jurisdictional entities, including portions of Austin, Cedar Park, Hutto, Leander, and Round Rock. Because each entity has its own drainage design guidance, a consistent methodology was decided upon for the hydrologic modeling to be completed as part of the Upper Brushy Creek Watershed Plan. In Section 2, a matrix of current hydrologic modeling standards within the District has been assembled that provided the basis for discussion of study methods in meetings with the District and Stakeholders. Portions of the District have recently been mapped as part of FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) initiative. These Risk MAP models were integrated into the analysis to ensure consistency as appropriate. Exhibit A, Method Summary provides a tabular summary of the hydrologic parameter derivation methods described in this section. This section also addresses sources of likely inconsistency with Risk MAP model hydrology. This section (in future tense) reflects instructions developed with the TAC prior to model development. The methods in this section were followed in later modeling.

2.1 Software

- ArcGIS Desktop 10;
- HEC-HMS model, version 3.5; and
- SITES, version 2005.1.4.

2.2 Parameter Development

2.2.1 Watershed Boundaries

The watersheds delineated as part of the Risk MAP initiative will be used as the starting point for the hydrologic modeling. The Risk MAP watersheds are based on LiDAR data from 2006, which is the best available data and will also serve as the base topography for this analysis. Modifications to the watersheds will be made as needed in areas where more recent or more detailed data are available. For this study, storm sewer systems will not be considered due to the large storm events being modeled, unless directed otherwise by stakeholders/city staff. All data will be assembled for each city, and watersheds will be reviewed on a watershed-by-watershed basis with a city representative to identify areas of interest and resolve any conflicts between data sources. Sub-basins will be delineated for all creeks with drainage areas greater than 1 square mile within the District.

2.2.2 Rainfall

Hydrologic analysis will be performed for the Upper Brushy Creek Watershed (Watershed) for the 50%, 10%, 4%, 2%, 1%, and 0.2% annual-channel flood events, as well as the Ultimate Condition 1% annual-chance flood event. Rainfall depths will be derived using U.S. Geological Survey (USGS) Scientific Investigations Report (SIR) 2004-5041, *Atlas of Depth Duration Frequency of Precipitation Annual Maxima for Texas*. The USGS rainfall curves will be digitized using ESRI ArcGIS, and a surface will be created for the 1-day storm event for each return period. The rainfall depth will then be estimated at the centroid of the drainage area for each major tributary in the Watershed. Two commonly used methods of modeling the rainfall depth-distribution relationship are: 1) the Natural Resources Conservation Service (NRCS) 24-hour regional distributions; and 2) a frequency storm based on statistical data derived for a specific area. The appropriate NCRS 24-hour distribution for the Watershed is the Type III distribution. Table 2-1 provides a comparison between the NRCS Type III distribution depth-duration relationship and the Frequency Storm distribution depth-duration relationship for an example location. Consistent with the Risk MAP models, the NRCS Type III distribution will used to model the rainfall in the Watershed.

Table 2-1. Comparison Between the Frequency Storm and NRCS Type III Distributions

100-Year Rainfall Depths (inches)								
	5-min	**15-min**	**1-hr**	**2-hr**	**3-hr**	**6-hr**	**12-hr**	**24-hr**
SCS Type III Distribution	0.74	1.47	4.12	5.1	5.78	7.22	8.77	10.2
City of Austin Frequency Storm	1.05	2.29	4.37	5.66	6.11	6.85	7.96	10.2

2.2.3 Infiltration and Loss

Consistent with local drainage criteria and the Risk MAP study, the NRCS Curve Number method will be used to estimate runoff loss in the Watershed. Pre-calibration model setup will be made using an assumption of Antecedent Moisture Condition (AMC) II.

2.2.3.1 Existing Condition

Risk MAP Procedures for Existing Condition

In urban areas, the Risk MAP hydrologic models assumed that non-paved or roofed surfaces had the same rainfall loss characteristics as pasture/grass in good condition. The percent impervious used in the modeling was estimated based upon a table from Technical Report (TR) 55 that provides percent impervious versus development density (e.g., residential on 1/2-acre lots versus residential on 1/3-acre lots).

The Risk MAP procedure for delineating areas per the TR55 development density categories is, in short:

- Land use spatial data files have been obtained from cities (Cedar Park, Round Rock, Austin).
- These land use categories have been related to the TR55 categories. In general, these are not one-to-one matches. For example, a "single family" land use category per the city land use map may be subdivided in the Risk MAP spatial land use database into a series of development categories ranging from 0.5-acre to 0.125-acre lots.
- This subdivision of the city land use areas was performed by hand for the full watersheds of the modeled area using parcel data and application of professional judgment.

In rural, undeveloped areas, the Risk MAP hydrologic models assumed the ground surfaces had the same rainfall loss characteristics as pasture/grass in good condition.

Proposed Plan Modeling Procedures for Existing Condition

Watershed-wide, a geographical information system (GIS) layer will be developed (on a 1-meter pixel level) of impervious surface from available multispectral imagery. Percent impervious for each watershed will be estimated directly from this layer.

For urban areas, the portion of each watershed that is not impervious will be estimated to have the same rainfall loss characteristics as pasture/grass in good condition.

For rural areas, the portion of each watershed that is not impervious will be estimated to have the same rainfall loss characteristics as the land use descriptions derived from Technical Advisory Committee (TAC) survey (see the PowerPoint presentation provided as Exhibit B). The predominant (highest percentage) curve number from this survey will be used.

2.2.3.2 Future Condition

Risk MAP Procedures for Future Condition

A Risk MAP model for the future condition was only developed for land use within the boundaries of the City of Round Rock. This model was developed using the same procedure as described above for the existing condition with the change that a Round Rock future land use spatial database was used as the basis for assignment of percent impervious.

For areas outside the City of Round Rock jurisdiction within relevant watersheds, the watershed was assumed to be "fully developed based on a residential/commercial mixture" (not explicitly defined in the Technical Support Data Notebook [TSDN]).

Proposed Plan Modeling Procedures for Future Condition

The basic procedure/assumptions will be:

- Areas that are currently developed will have the same level of development in the future; i.e., percent impervious in these areas in the future can be represented by existing percent impervious.
- Land use percent impervious for future land use categories will be estimated from analysis of data from corresponding land use categories under existing conditions.

Per current understanding, spatial data layers for future land use are available from Austin, Round Rock, and Cedar Park only. For other jurisdictions, undeveloped areas will be assumed to be "fully developed based on a residential/commercial mixture." This mixture will be defined as an average impervious area for the new areas to be developed under the Cedar Park, Austin, and Round Rock plans. Future land use impervious values will be per review and input by the relevant planning jurisdiction for the watershed area modeled.

2.2.3.3 Soils

Hydrologic soil groups will be determined for each drainage area using the soil type shapefile for Williamson County available from the Soil Survey Geographic Database (SSURGO). The

SSURGO shapefile delineates soil according to type. A key code is also available from SSURGO correlating soil type to a hydrologic soil group (A, B, C, D, or W).

2.2.3.4 Initial Abstraction

Consistent with the Risk Assessment, Mapping, and Planning Partners (RAMPP) models, the Initial Abstraction will be left blank, resulting in a default value of (0.2S) used by the HEC-HMS model. This value is expected to be altered significantly in the model calibration process.

2.2.4 Reach Routing

The Muskingum-Cunge method of routing has been selected for reach routing within the watershed. An eight-point cross-section will be estimated for each reach based on the best available data for each reach. Survey cross-sections will be utilized wherever available and simplified to a representative eight-point section.

2.2.5 Time of Concentration

The Time of Concentration will be estimated utilizing the component method outlined in TR-55 (*Urban Hydrology for Small Watersheds*). The Time of Concentration for each flow type within a watershed (sheet flow, shallow concentrated flow, and channel flow) will be estimated, and a resulting total Time of Concentration will be developed for each watershed. A maximum overland flow length of 100 feet will be utilized in the sheet flow segment, consistent with the Risk MAP modeling standards. Velocity for the channel flow segment will be estimated based on hydraulic modeling, if available. If a hydraulic model is not available, the bankfull velocity will be estimated based on survey or LiDAR cross-section geometry. The modeled lag time will be estimated to be 0.6 times the total Time of Concentration.

A separate Time of Concentration will be estimated for existing and ultimate conditions. The ultimate condition Time of Concentration will be estimated using the same flow path and segment lengths as the existing condition, but the shallow concentrated flow segment will be assumed to be 100% paved.

2.2.6 HEC-HMS Modeling

A HEC-HMS model will created for the Upper Brushy Creek Watershed with a separate basin model for existing condition and for ultimate condition.

Model Time Step: An initial 15-minute time step will be utilized consistent with Risk MAP models. During hydrologic modeling, if it appears that a shorter time step is required to accurately model the smaller sized watersheds included in the analysis, a 10-minute time step will be analyzed for comparison.

Model Run Duration: A 48-hour runtime will be utilized consistent with the Risk MAP models.

2.2.7 Flood Control Structures

For all significant detention structures included in the Watershed (see Figure 1-1), the initial water-surface-elevation at the beginning of the modeled storm event will be assumed to be at the elevation of the principal spillway or at the low flow port if one exists. TAC members will provide engineering data on public/private detention structures that they identify and which are expected to have a significant effect on downstream 1% AEP (i.e., 100-year) flood flows.

For structures included in the Risk MAP hydrologic model, the model parameters will be verified and incorporated into the Upper Brushy Creek Watershed model.

For additional structures not modeled in the Risk MAP study, the best available data will be utilized to generate elevation-storage-discharge curves using NRCS SITES modeling software. As-built data will be collected for these structures where available. If as-built data are not available, either 1) a survey will be obtained for the outlet works, or 2) if the structure is inaccessible for survey, engineering judgment will be used and documented in structure modeling. Elevation-storage-discharge curves will be estimated based on LiDAR topography data.

In addition to the significant detention structures located within the watershed, there are an abundance of smaller private in-line structures along the study reaches. These will be handled during the hydraulic modeling by including them as in-line structures in the HEC-RAS models.

2.3 Calibration

Calibration of model parameters used to estimate runoff volume and timing based on a significant historic event can greatly enhance model accuracy. For the Upper Brushy Creek Watershed, the ample data collected during TS Hermine will be utilized in model calibration. The gage rainfall over the Watershed from TS Hermine will be modeled in the preliminary HEC-HMS model, and the parameters will be adjusted until the model results approximate the water surface elevation gage data from TS Hermine.

2.3.1 Volume Calibration

Curve Numbers will be adjusted by changing the values of two factors: initial abstraction and undeveloped curve number hydrologic condition (e.g., good, fair, poor)/cover types (e.g., pasture, woods, etc.) until model runoff volumes match those observed in TS Hermine.

2.3.2 Time to Peak Calibration

The calculated lag times will be adjusted to approximately match the time to peak observed in TS Hermine. Initial adjustments in calculated lag times will be made by modifying the overland flow lengths (primarily) and Manning's n values (secondarily).

Depending upon results of the calibration to TS Hermine, additional historic storms of a different temporal nature (i.e., short duration, intense thunderstorm cloudbursts) may be modeled to make further adjustments to hydrologic parameters.

2.3.3 Application of Calibration Results to Planning

The calibration process will lead to loss rates and times of concentration that best replicate recent extreme flood(s). These calibrated values are to some extent dependent upon the antecedent moisture condition of the watershed (dryness of soil) prior to these historic flood(s). A planning decision will need to be made during the fourth Board review meeting and the later TAC meeting as to antecedent moisture condition to be used in development of flows for hydraulic modeling and subsequent watershed planning.

2.4 Discussion of Potential Changes to Preliminary Risk MAP Hydrologic Models

Per discussion with Risk MAP staff and a review of the Preliminary Risk MAP TSDN, there are some likely differences in approach that will lead to potential differences (of unknown magnitude) between flood flows estimated by Risk MAP and this District/ Texas Water Development Board (TWDB) plan. These differences are discussed below. These differences are not driven by any perceived need to improve Risk MAP modeling methodology, which clearly meets FEMA technical standards, but are driven by a need for consistency across the numerous watersheds within the District.

2.4.1 Hydrologic Model Calibration

The preliminary Risk MAP hydrologic model for upper Rattan Creek, per a phone call on November 8, 2011 with Risk MAP staff, was calibrated to available stage data from the period of TS Hermine. There were significant apparent losses tentatively attributed to unknown karst features which led to major adjustments in initial abstraction.

The other preliminary Risk MAP hydrologic models within Williamson County have not been calibrated to match data collected during TS Hermine at District dams. The District/TWDB plan will calibrate the assembled models (new models and preliminary Risk MAP models) to dam data and to other detention pond/ dam high water mark data collected per verified stakeholder/ public input. This will potentially involve changes in preliminary Risk MAP hydrologic model parameters – specifically, initial abstraction, curve number, and overland flow length – and lead to changes in estimated flood flows.

2.4.2 Watershed Size

The preliminary Risk MAP hydrologic models were configured specifically to estimate flows for the stream reaches to be mapped. Since some of these reaches were located at some distance downstream from headwaters, some Risk MAP watersheds exceed the proposed 1 square mile maximum. These watersheds will be subdivided in the assembled watershed model developed for this plan, again leading to some potential changes in estimated flood flows.

2.4.3 Detention Ponds

Two detention ponds (non-District) have been considered in the preliminary Risk MAP hydrologic models (see Figure 1-1). If other detention ponds within Risk MAP watersheds are to be considered in the model for this plan, there will be some changes in estimated flood flows.

2.4.4 District Dams

Per an initial review of how District dams were modeled in Risk MAP hydrologic models, there are some inconsistencies as to how these structures were modeled in different watersheds. These structures will be modeled in the District plan using recent survey data for dam structure elevations, 2006 LiDAR for pond elevation – storage above the principal spillway, as-builts for elevation – storage below the principal spillway, and SITES modeling for estimation of structure hydraulic capacity. This may lead to some potential changes in estimated flood flows.

2.4.5 Other Dams

There are five dams in the National Inventory of Dams (NID) within the study watershed (see Figure 1-1 and Table 2-2). These dams will be considered using best available information in plan modeling. Three of these dams (A, B, C) are in the Risk MAP watersheds and were not considered in Risk MAP models. This will potentially lead to changes in estimated flood flows.

Table 2-2. Non-NRCS Dams from NID

Name	Buttercup Creek State Dam	La Frontera Detention Dam	Tonkawa Springs Dam	Walsh Lake Dam	Zimmerhanzel Lake Dam
Map ID	A	B	C	D	E
Year Completed	1972	1958	1980	1930	1968
Type	Earth	Earth	Earth, Masonry	Gravity	Earth
Owner	Williamson County	Private	Private	Private	Private
Height (ft)	30	39	14	11	18
Length (ft)	438	800	182	175	600
Max Storage (ac-ft)	395	132	24	64	144
Surface Area (ac)	10	8	2	10	16
Spillway Width (ft)	125	0	50	165	58
Drainage Area (sq-mi)	6	0	0	0	0
On Streamline?	Yes	No	Yes	Yes	Yes

3.0 HYDRAULIC MODELING METHODOLOGY

Because each entity within the watershed has its own drainage design guidance, a consistent hydraulic methodology that all entities agreed upon was established as part of the FPP. Section 3 defines the hydraulic modeling standards within the District that provided a basis for discussion with the District and Stakeholders. Portions of the District have recently been mapped as part of FEMA's Risk MAP initiative. These Risk MAP models will be integrated into the analysis to ensure consistency, as appropriate. The proposed methods meet FEMA's guidelines per Appendix C (2009). The hydraulic methodology will also be consistent with the parameters previously used for the Williamson County FEMA Risk MAP. This section (in future tense) reflects instructions developed with the TAC prior to model development. The methods in this section were followed in later modeling.

3.1 Software

Various software will be used to build and develop both the channel characteristics and the hydraulic model. The multiple softwares identified for this task are listed below.

- ArcGIS Desktop 10.1;
- HEC-RAS, Version 4.1.0;
- HEC-Geo-RAS, Version 10.1; and
- LP360 – ArcGIS terrain extension.

3.2 Parameter Development

3.2.1 Topographic Data

See Section 6.2.3 for details on the LiDAR data procured and analyzed for this study. LiDAR data were obtained from Williamson County and the Capital Area Council of Governments (CAPCOG) and will be used to create the terrain model using a terrain processor (LP360) for the Upper Brushy Creek Watershed. Additional data collected as part of the study that will be used in the development of channel characteristics include field survey, photos, and field reconnaissance. All topographic data were referenced to the vertical datum of NAVD88.

3.2.2 Cross Section Development

The terrain dataset produced from the referenced LiDAR will serve as the spatial surface from which all cross sections will be digitized. The terrain surface, in conjunction with field survey data, will be used to obtain all cross-section station and elevation information. Field-surveyed cross sections at structures and at 2,500-ft intervals will be collected as part of this study and will be used to adjust the channel geometry, if applicable. Methodologies and processes developed internally by URS or provided by the City of Austin will be used to merge both the survey and LiDAR data within the hydraulic models. An example of how the two datasets will be merged within the hydraulic model is illustrated in Figure 3-1.

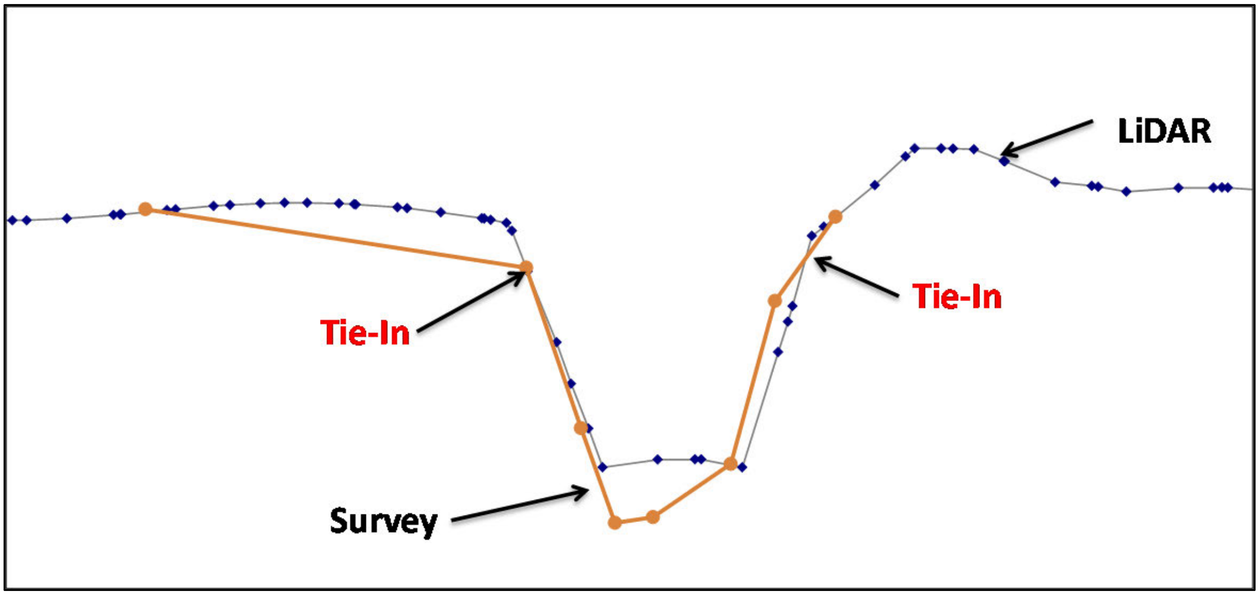


Figure 3-1. Cross Section Data Comparison

The majority of the channel cross sections will be cut directly from the LiDAR terrain dataset. The distance between any two digitized model cross sections will not exceed 500 ft with a maximum distance of 2,500 ft between any two surveyed cross sections. All cross sections will be placed in accordance with the FEMA guidelines and the HEC-RAS 4.1 *Hydraulic Reference Manual*.

Cross sections will also be placed at crossing structures, including bridges, culverts, and inline structures. Each structure cross section is categorized as a Top of Road (TOR) cross section. GeoRAS uses these cross sections to develop the crossing structure information as necessary for HEC-RAS modeling.

Additional cross sections will be placed to account for significant profile inflection points (profile breaks) or channel cross section changes as mentioned above. Cross sections at profile breaks are critical for accuracy in the development of base (1% annual-chance) flood elevations.

3.2.3 Parameter Estimation

3.2.3.1 Manning's "n" Values

Manning's "n" values for both the channel and overbanks will be entered into the hydraulic model to represent the actual physical conditions using information from field reconnaissance, aerial photography, and field survey. For each segment of the cross section, the selected average "n" value should represent the average ground surface conditions for that area halfway up to the next and halfway down to the next cross sections. An excerpt from Chow's book "Open Channel Hydraulics" [Chow, 1959] which identifies the Manning's n values for the most common types of channels is provided in Exhibit C. Manning's n values identified in the FEMA Risk MAP analysis range from 0.025 to 0.070 and from 0.050 to 0.100 for channel and overbank roughness coefficients, respectively. The Risk MAP roughness coefficients will be reviewed to ensure consistency between the Upper Brushy Creek Watershed Study and the Risk MAP Study.

3.2.3.2 Expansion and Contraction Coefficients

Expansion and contraction loss coefficients will be applied to all crossing structures within the HEC-RAS model to account for the additional energy losses. Expansion and contraction loss coefficients will be applied between cross sections to account for losses to the changing width of the channel in accordance with commonly accepted practices. Table 3-1 provides the loss coefficients that will used for most of the HEC-RAS modeling. In a few cases, abrupt contractions and expansions may require increasing the coefficients.

Table 3-1. Expansion and Contraction Coefficients

Location	Contraction Loss Coefficient	Expansion Loss Coefficient
Natural Cross Sections	0.1	0.3
Bridge/Culvert	0.3	0.5
Abrupt Transitions	0.4	0.6

3.2.3.3 Ineffective Areas and Obstructions

Additional losses in the cross sections will be considered by including obstructions and ineffective flow areas. The Upper Brushy Creek watershed includes heavily developed areas, and in some cases, structures will have been developed adjacent to the channel. These structures may obstruct overbank flow and must be considered. Obstructions will also be used to model buildings that intersect proposed hydraulic cross sections. The engineer will verify that the cross section characteristics in each cross section are representative of the channel reach before including in hydraulic models. An example of a cross section with structures is shown in Figure 3-2.

There are also areas of rapid expansion or contraction as an improved channel transitions to unimproved channel. Ineffective flow areas will also be included in these sections to better model the flow transition between improved and unimproved sections based on aerial photos and engineering judgment.

The ineffective flow areas will be based on physical conditions in an expanded area such as flow patterns, building distribution and shape, bridge/culvert orientation, creek bank location, topography, flow direction, etc. **A fixed expansion or contraction ratio is not recommended.**

Other structures considered for ineffective flow include detention ponds for neighboring development, local drainage features, or other low areas which were assumed to be full and therefore should be removed from conveyance in the cross section. Engineering judgment will be used in identifying and removing these features.

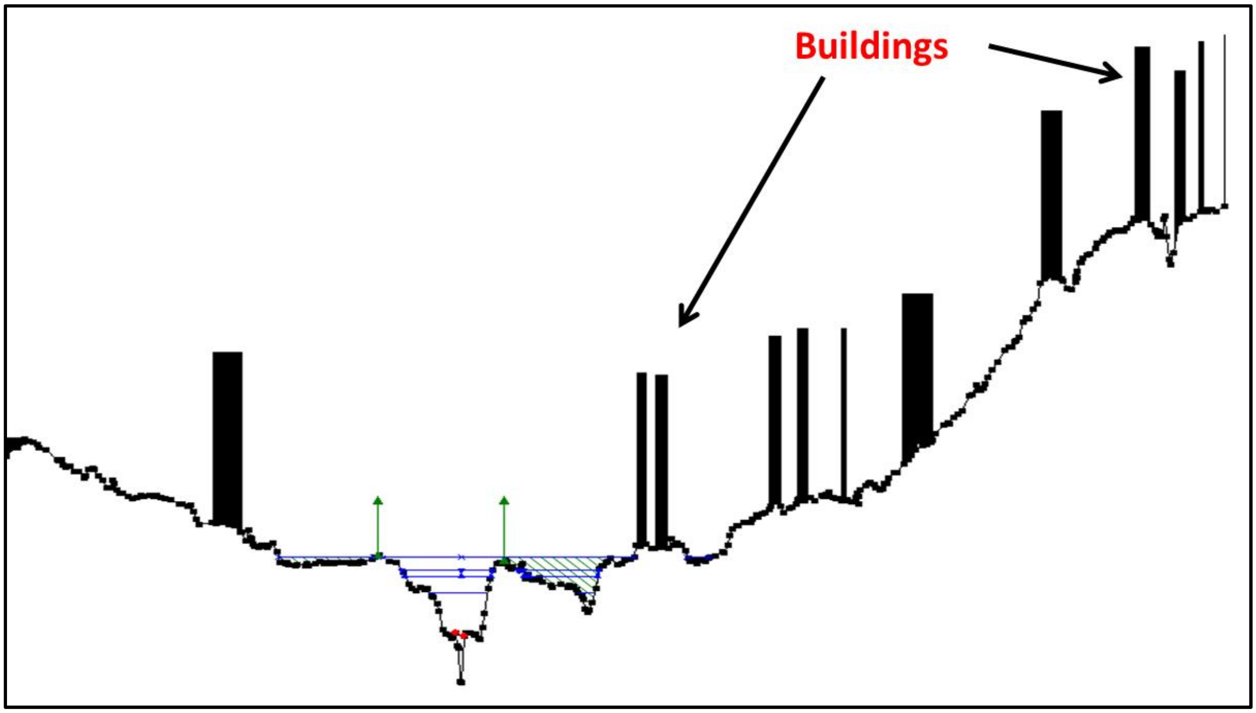


Figure 3-2. Cross Section with Structure Obstructions

3.2.4 Structures

Structures located along the study reaches may include concrete box culverts with concrete wingwalls, culvert crossings, bridges, earthen dams, concrete in-line structures, and non-standard structures designed to maintain local amenity ponds and other features. Where possible, structure dimensions and invert elevations will be based on field survey. In limited circumstances where survey data are not available, elevation data will be based on the available topographic data, aerial photography, and field reconnaissance. Examples of the survey data collected at each structure are provided in Exhibit D.

Low-water crossings observed in the field were removed from the study if the engineer believed the structure would be inundated in the 10% annual-chance event or if the engineer believed the structure would not withstand the flows from a significant event (e.g., wooden pedestrian bridge). All structures removed from study are identified on Figure 3-3.

Several in-line dams operated by the UBCWCID are present within the study reaches. The effects of these dams will be included in the hydrologic analysis. The flows and water surface elevation levels (WSELs) calculated in the hydrologic analysis will be used to input flows for the downstream section and plot WSELs (backwater) for the upstream section of study reach. This process is consistent with the modeling techniques used for the FEMA Risk MAP.

3.2.5 Peak Flow Insertion Points

Peak flows for the 50%, 10%, 4%, 2%, 1%, and 0.2% annual-chance flood events for existing conditions will be derived from the hydrologic modeling task. Also, peak flows for the 4% and

1% annual-chance flood events for ultimate development conditions will be derived. Peak flows at each of the hydrologic nodes corresponding to the study reaches will be used as direct flow inputs. Log-normal interpolations between nodes will be performed to limit large changes in flows along the study reach. The flow insertion points will be chosen so that the flow calculated at the downstream end of the reach is inserted upstream of the calculation point. Study reaches that extend upstream of the first flow node will have starting flows referenced by a ratio based on contributary area to the first flow node. This ensures that the flows included in the hydraulic models will be at or above the peak flows calculated by the hydrologic models ("above the curve"). An example plot of the flow insertion points is shown in Figure 3-4.

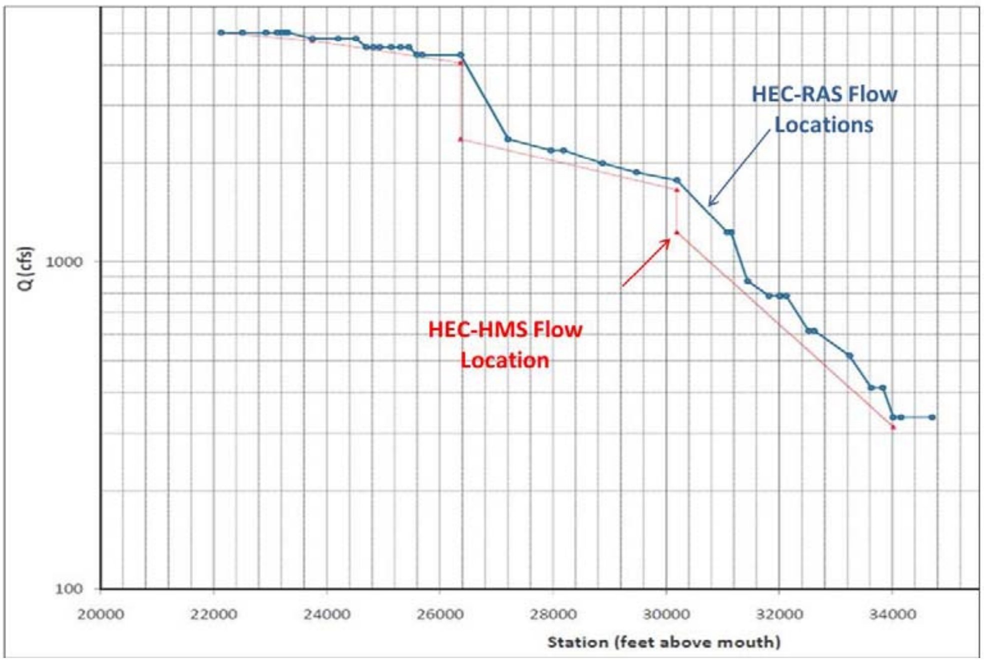


Figure 3-4. Log-Normal Interpolation Flow Profile

3.2.6 <u>Boundary Conditions</u>

The size of the Upper Brushy Creek Watershed Study requires that several scenarios be considered for boundary conditions. The three distinct downstream starting conditions identified include:

- Tributary stream entering the main stem;
- Downstream end of study reach ends in flood control reservoir; and
- Downstream end of study reach ends in middle of previously studied or unstudied reach.

Where tributary streams enter the main stem, normal depth calculations will be used to define the boundary condition on the tributary. The main stem's backwater WSELs will be considered in mapping conditions at junctions with contributing tributaries.

When the downstream end of the study reach ends at or near an area influenced by one of the flood control reservoirs included in the study, normal depth will be used as the starting condition in the study reach, with the reservoir elevations from the hydrologic model superimposed on the profile from the hydraulic model and considered as backwater effects. An example of a tie-in at a dam is shown in Figure 3-5.

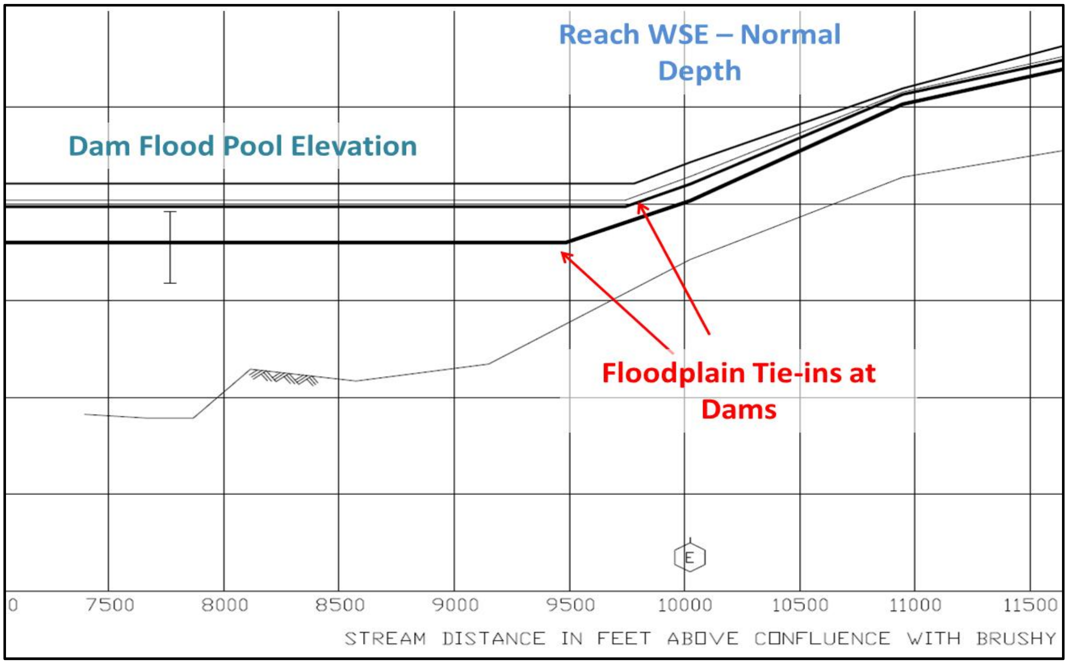


Figure 3-5. Water Surface Elevation Tie-In at Dam

3.2.7 Calibration

Calibration of the hydraulic models against significant historic events can greatly enhance model accuracy. The most useful data relative to historic floods are high-water marks. For the Upper Brushy Creek Watershed, the ample data collected during TS Hermine will be utilized for model calibration. The flows used in the hydraulic model will be based on the results from the calibrated hydrologic model. The calibration will be fully documented, including: dates, measurements, and locations of measurements of historic floods; parameters revised and rationale for revising; and the calibration model input and output data. Models should match known high-water marks within 0.5 foot.

3.2.8 Discussion of Potential Changes to Preliminary Risk MAP Hydrologic Models

Per discussion with Risk MAP staff and a review of the Preliminary Risk MAP TSDN, there are no significant differences in the approach that will lead to potential differences (of unknown magnitude) between WSEL estimated by Risk MAP and this District/TWDB plan. The hydraulic models will meet FEMA technical standards, and also be consistent across the numerous watersheds within the District.

4.0 HYDROLOGIC MODEL ANALYSIS AND RESULTS

Section 4 discusses the methodology utilized to analyze the watershed hydrology and to present the results of the hydrologic analysis for the Upper Brushy Creek Watershed within Williamson County. A more detailed discussion of methods can be found in Section 2. Exhibit E, Results Summary, provides a tabular summary of the hydrologic elements and peak flows for the range of storm events analyzed. Exhibit F provides tables of the model parameters used. Exhibit G provides data used in applying rainfall depths to watersheds. The modeled study area is depicted in overview on Figure 4-1. Figures 4-2 through 4-6 provide more detailed views of portions of the study area.

4.1 Software

The software used in this analysis included:

- HEC-HMS model, Version 3.5. This is the basic hydrologic model used for generation routing and summation of watershed hydrographs within the study area.
- ArcGIS Desktop 10. This software was used in the assembly and analysis of selected watershed spatial datasets.
- SITES, Version 2005.1.4. This software was used in the estimation of elevation-capacity curves for the spillways of modeled dams/detention structures.

4.2 Parameter Development

4.2.1 Watershed Boundaries

The preliminary FEMA watersheds delineated as part of the Risk MAP initiative were used as the base delineations and were further subdivided to achieve the level of detail required for this planning and mapping study. In areas beyond the Risk MAP coverage, watersheds were developed using Geo-HMS and 2006 LIDAR topography data obtained from CAPCOG. Per Section 2, the maximum allowable watershed size is 1 square mile; however, most watersheds are significantly smaller than 1 square mile to capture the level of detail needed for hydraulic mapping and planning. Initial watershed delineations were reviewed with stakeholders for agreement. The 449 watersheds were delineated with an average area of 0.4 square mile. Figures 4-2 through 4-6 provide maps of the Upper Brushy Creek Watershed showing the final hydrologic watershed delineations. Numbers in these figures are indexed to model watershed identifiers in Table F-1, Exhibit F.

4.2.2 Rainfall

In this study, hydrologic analyses were performed for the Upper Brushy Creek Watershed (Watershed) for the 50%, 10%, 4%, 2%, 1%, and 0.2% AEP flood events, as well as the ultimate condition 1% and 4% AEP flood events. Rainfall depths were derived using USGS SIR 2004-5041, *Atlas of Depth Duration Frequency of Precipitation Annual Maxima for Texas* and applied to the HEC-HMS model using the NRCS 24-hour Type III distribution. The USGS rainfall isohyetals (lines of equal rainfall depths) were digitized using ESRI ArcGIS, and a surface was created for the 1-day storm event for each return period. The rainfall depth was then estimated at the centroid of each of the 449 watersheds for each return period. A table was assembled which includes each model junction and identifies each of its upstream watersheds. A rainfall depth for each junction was then estimated as the area-weighted average of the rainfalls associated with its constituent upstream watersheds. A summary of rainfall depths for each model watershed and junction is provided in Exhibit G.

4.2.3 Areal Reduction

For watersheds with contributing areas greater than 10 square miles, precipitation was reduced per guidance provided in *Technical Paper No. 40, Rainfall Frequency Atlas of the United States,* (USDC, 1961). Rainfall depths for larger watersheds were reduced per Figure 15 in this reference, reproduced in this section as Figure 4-7.

4.2.4 Infiltration and Loss

The NRCS Curve Number method was used to estimate runoff loss in the Watershed. Pre-calibration model setup was made using an assumption of Antecedent Runoff Condition (ARC) II.

4.2.4.1 Existing Condition

Curve numbers were developed for the undeveloped land use based on the major land use types identified by TAC (Table 4-1). For rural areas, the portion of each watershed that was not impervious was estimated to have the same rainfall loss characteristics as the land use descriptions derived from TAC shown in Table 4-1. Figures 4-8 through 4-12 provide maps of delineated land uses.

Table 4-1. Undeveloped Land Use Types

Description	Curve Number by Soil Group			
	A	B	C	D
Pasture – Fair	49	69	79	84
Pasture – Poor	68	79	86	89
Woods – Good	30	55	70	77
Woods Grass – Fair	43	65	76	82
Pasture – Grass Good	39	61	74	80
Water	100	100	100	100

Development was accounted for by applying a percent impervious cover value to the above curve numbers. Watershed-wide, a Geographical Information Systems (GIS) layer was developed (on a 1-meter pixel level) of impervious surface from available multispectral imagery (TNRIS, 2010). Percent impervious and curve number for each watershed were then estimated directly from this layer and are provided in tabular form in Exhibit F. Figures 4-13 through 4-17 depict the extent of impervious area within the study area. For urban areas, the portion of each watershed that is not impervious was estimated to have the same rainfall loss characteristics as pasture/grass in good condition.

4.2.4.2 Ultimate Condition

For the ultimate condition, future percent impervious values were estimated based on information provided by each city. In general, the method used to estimate ultimate condition involved 1) assignment of percent impervious within city and extraterritorial jurisdiction (ETJ) boundaries using information provided by each city, then 2) per the method described in Section 1, assigning a percent impervious (36%) typical of a land use "fully developed based on a residential/commercial mixture" to all areas within watersheds where future land use information was not available.

Table 4-2 lists the provided data used to generate the ultimate condition percent impervious layer.

Table 4-2. Ultimate Condition Land Use Data Sources

City	Data Source
Austin	Ultimate condition land use shapefile that uses maximum allowable impervious cover per zoning category
Cedar Park	Ultimate condition land use GIS layer
Hutto	No ultimate condition land use GIS layer available
Leander	No ultimate condition land use GIS layer available
Round Rock	Ultimate condition land use shapefile with building code for percent impervious
Williamson County	Deferred to city data

The specific methods for assigning ultimate condition percent impervious within each city and associated ETJ are described below:

- City of Austin (COA). COA provided shapefiles for current and future land use categories. The future land use descriptions directly corresponded to current land use descriptions. A percent impervious was derived for each existing land use description, using zonal statistics analysis and the spatial percent impervious raster derived from 2010 TNRIS multi-spectral imagery. These percent impervious values were assigned to each of the corresponding future land use descriptions.
- City of Round Rock (CORR). CORR provided shapefiles for current and future land use categories. The future land use descriptions did not exactly match the current land use descriptions. A percent impervious was derived for each existing land use description, using zonal statistics analysis and the spatial percent impervious raster derived from 2010 TNRIS multi-spectral imagery. These percent impervious values were assigned to each of the future land use descriptions by matching similar descriptions. For example, the future condition descriptions "Avery Mixed Use", "Business Park", "Dell Mixed Use" and "Downtown Mixed Use" were each assigned the percent impervious (87%) derived for the Mixed Use existing land use.
- City of Cedar Park (COCP). COCP provided a detailed "current zone type" shapefile, and a substantially less detailed ultimate condition land use shapefile. A percent impervious was derived for each existing "current zone type" description, using zonal

statistics analysis and the spatial percent impervious raster derived from 2010 TNRIS multi-spectral imagery. Where the ultimate land uses intersected with the existing zone types, each ultimate land use description was assigned an area-weighted composite percent impervious based on each zone type percent impervious. For example, the ultimate land use "Employment Center" was assigned a percent impervious of 57% based upon the area-weighted average of 14 individual zone types. Some current zone types were very small in area, such that the percent impervious values were potentially not representative of future similar land uses. In these cases, zone types were assigned the percent impervious of a similar land use in the CORR shapefile. For example, the "utilities" zone type was assigned a percent impervious of 22%, based upon zonal statistics of the current land use areas labeled "Utilities" within CORR.

- City of Hutto, City of Leander. Neither of these cities had spatial current land use maps. A uniform percent impervious of 36% was assigned to the city and ETJ as an estimate of ultimate condition, corresponding to the CORR percent impervious developed for a typical residential/commercial mixture.
- Williamson County. Per Section 1, all watersheds within Williamson County outside of a municipal ETJ were assigned an ultimate condition percent impervious of 36%, again corresponding to the CORR percent impervious developed for a typical residential/commercial mixture.

As final check, the derived ultimate condition percent impervious for each model subwatershed was compared to the corresponding existing condition percent impervious and the larger of the two used in the ultimate condition model. This occurred in some cases where the future land use description had an assigned percent impervious less than the percent impervious derived for the area from 2010 imagery.

4.2.4.3 Soils

Hydrologic soil groups were determined for each drainage area using the soil series for Williamson County available from the Soil Survey Geographic Database (SSURGO). A key code was available from SSURGO correlating soil type to a hydrologic soil group (A, B, C, D, or Water/Quarry, in increasing imperviousness). Figure 4-18 provides a soils map for the Upper Brushy Creek Watershed.

4.2.4.4 Initial Abstraction

The model default value of initial abstraction (a direct function of curve number) was used in the study's HEC-HMS model. Calibration results indicate that it is a reasonable model for initial abstraction throughout the watershed, with the exception of the Lake Creek watershed. More detail is provided in the Curve Number Calibration Memo (Exhibit H) for areas other than the Lake Creek watershed.

For the Lake Creek watershed, initial rainfall losses have been found to greatly exceed values in the remainder of the watershed. This condition is due to the karstic nature of the watershed. A separate hydrologic model calibration was performed for this watershed, as documented in

Exhibit P. Calibration was achieved by adding 1 inch to the default initial abstraction used in the remainder of the watershed HEC-HMS model.

4.2.5 Reach Routing

The Muskingum-Cunge method of routing was used for reach routing within the watershed. An eight-point cross-section was estimated for each reach based on the LIDAR topography using hand-delineated cross-sections. Average channel slope was estimated as the upstream reach elevation minus the downstream reach elevation divided by the length of streamline within the reach. A check that the model cross-section fully contained the 1% AEP flood was performed as part of model quality assurance.

During the calibration of the model to TS Hermine high water marks, the validity of this method of routing was proven. Hydraulic model calibration was achieved by 1) reproducing watershed flowrates for a series of rainfall events using measured rainfall and this HECHMS model, then 2) matching predicted hydraulic model elevations to high water marks. This calibration is documented in Section 5.

4.2.6 Time of Concentration

Per Section 2, the Time of Concentration was estimated utilizing the component method outlined in *Technical Release-55: Urban Hydrology for Small Watersheds* (USDA, 1986). The Time of Concentration for each flow type within a watershed (sheet flow, shallow concentrated flow, and channel flow) was estimated, and a resulting total Time of Concentration was developed for each watershed. A maximum overland flow length of 100 feet was utilized in the sheet flow segment for pre-calibration runs, consistent with procedures in Section 2. Initial velocity for the channel flow segment was assumed to be 6 feet per second. The calibration of time of concentration (see Exhibit I) demonstrated that this assumption provided close calibration between measured lag times and estimated lag times.

The modeled lag time was estimated to be 0.6 times the total Time of Concentration. Final calibrated lag times are provided in Table F-1, Exhibit F.

4.2.7 HEC-HMS Model Basic Configuration

A HEC-HMS model was created for the Upper Brushy Creek Watershed with separate basin models for existing condition and for ultimate condition. The completed model includes 449 watersheds and 41 reservoirs.

4.2.7.1 Model Configuration

The locations of basic model elements (watersheds, dams/ponds modeled, streamlines used in routing, and selected primary model junctions) spatially within the watershed are shown in Figures 4-19 through 4-24. Figure 4-19 shows dam locations, and Figures 4-20 through 4-24 show locations for HMS model junctions. The flow logic diagrams showing all model elements are presented in Exhibit J.

4.2.7.2 Model Timestep

Per Section 2, a timestep of 10 minutes was used in modeling.

4.2.7.3 Model Run Duration

A 48-hour runtime was utilized.

4.2.8 Flood Control Structures

Structures of a size large enough to significantly affect peaks associated with 1% AEP floods were modeled. These included NRCS-designed dams (flood-retarding structures) administered by the District and regional detention structures identified by watershed stakeholders during project interaction.

4.2.8.1 NRCS Detention Structures

Twenty-three NRCS detention structures were included in the Upper Brushy Creek Watershed model. Thirteen of these structures were previously included in the Risk MAP hydrologic model. For 10 of these 13 structures (Dams No. 3, 4, 5, 6, 7, 8, 11, 12, 13A, 14, and 20), the final Risk MAP elevation-storage-discharge curves were compared against the current NRCS SITES models, where available, or confirmed to be the most recent through communication with Freese and Nichols, Inc. (FNI). For the existing SITES models, it was verified that recent LIDAR data were used to develop the elevation-storage relationship and that surveyed principal spillway elevations and auxiliary spillway profiles were utilized.

For the three remaining NRCS structures included in the Risk MAP model (9, 10A, and 10B), URS performed SITES modeling to estimate elevation-storage-discharge curves. The 2006 LIDAR data used in developing the current hydrologic model were used to derive the elevation-storage curves for these three dams. Surveyed principal spillway (PS) elevations, LIDAR-derived auxiliary spillway profiles, as-built plan data, and GIS measurements were used to complete the URS' SITES models.

For the 10 additional NCRS detention structures that were not included in the Risk MAP hydrologic model (1, 2, 5, 15, 16 ,17, 18, 19, 21, and 22), SITES models created by FNI and provided by UBC WCID were reviewed as described above and found to be acceptable. Therefore, the elevation-storage-discharge curves output from SITES were incorporated in the Upper Brushy Creek Watershed model.

For all NRCS detention structures included in the Watershed (see Figures 4-2 through 4-6), the initial water-surface-elevation at the beginning of the modeled storm event was assumed to be at the elevation of the principal spillway or at the low-flow port if one exists.

4.2.8.2 Public/Private Detention Structures

TAC members provided engineering data on 18 public/private detention structures that are expected to have a significant effect on downstream 1% AEP flood flows. The locations of these structures are shown in Figures 4-2 through 4-6. Analysis included reviewing as-built information and previous hydrologic modeling output to locate the elevation-storage-discharge relationships. For some of these detention structures, outflow was estimated using CulvertMaster or weir flow if not already provided. For one structure located in Cedar Park, Bagdad Pond, the elevation-discharge-storage curve was taken from the final Risk MAP hydrologic model. Elevation-discharge-storage curves were input to the Upper Brushy Creek Watershed model for all 18 public/private detention structures.

Exhibit K provides elevation-discharge-storage curves, principal spillway and auxiliary spillway elevations, structural configuration data source (as-builts, current survey), and the flow capacity estimation method used (SITES, CulvertMaster) for each structure modeled.

4.2.8.3 Quarries

Elevation-storage curves have been derived for the watershed quarries located south of RM 620, at the intersection of SH45 and McNeil Rd, and those downstream and adjacent to Dam 10A on Chandler Branch. These were developed using 2006 LiDAR, and model assumptions for quarry areas have been adjusted based upon stakeholder comments and descriptions of recent flood experience. Quarries associated with Dams 10A and 10B and the Dam 9 diversion project were restudied using the 2012 LiDAR.

4.2.8.4 In-Line Structures

In addition to the significant detention structures located within the watershed, there are an abundance of smaller private in-line structures along the study reaches. These will be handled during the hydraulic modeling by including them as in-line structures in the HEC-RAS models.

4.3 Calibration

See Exhibits H and I for additional details on the calibration methodology and results.

4.3.1 Curve Number Calibration

Extensive stage and rainfall data were collected at District dams throughout the watershed during two major storm events in the last decade (June 2007 and September 2010). The calibration of the HEC-HMS model to these events at multiple dams resulted in calibrated curve number values that were consistent with recent Texas Department of Transportation (TxDOT) *Hydraulic Design Manual* (2011) guidance. The TXDOT guidance, which recommends use of ARC II curve numbers reduced by a factor that varies statewide, is in turn supported by local model calibrations dating back several decades. The reduction factor for this watershed is 15 (i.e., a curve number of 80 was reduced to 65). Curve number values derived per TXDOT guidance were slightly more conservative than the values derived from the two local storms. The most technically defensible (supportable by numerous calibrations) and conservative curve number values for use in the watershed, therefore, are the TXDOT adjusted curve numbers. These values are provided in Table F-1, Exhibit F. Curve number calibration is discussed in detail in Exhibit H.

4.3.2 Lag Time Calibration

Lag time calibration included modifying the overland flow length from 100 to 400 ft with 100 ft providing the closest match to measured peak flow time data. Final lag times are provided in Table F-1, Exhibit F. Lag time calibration is discussed in detail in Exhibit I.

4.3.3 High Water Mark Calibration

The curve number and lag time calibrations were performed using data collected at the District dams. These calibrations provide confidence in the choices made for these parameters, and for peak flows (and hydrograph shapes) for watersheds less than 16 square miles (the largest gaged dam watershed used in calibration). For flows within stream segments with substantially larger watersheds than 16 square miles, peak flows can be substantially affected by hydrograph routing method. As noted above, calibration of the hydraulic models is documented in Section 5. The hydraulic model calibration provides further indirect calibration of the HEC-HMS models, as the flows used to demonstrate matching of high water marks were generated by the watershed HEC-HMS models.

4.4 Model Results

Model results are presented in Exhibit E. Table E-1 provides 1% AEP peak flows and also ultimate condition 1% AEP peak flows at each watershed and junction in the study area's HEC-HMS model. Table E-1 provides a cross-reference to watershed identifiers in Figures 4-2 through 4-6 and junction identifiers in Figures 4-20 through 4-24. Table E-2 provides a comparison to peak flow rates used in development of the current regulatory floodplains (Current FIS model) and peak flow rates (per Table E-1) developed per this section.

Caution is urged in the interpretation of the flow comparison results presented in Table E-2. The extent of the change in peak flow between the existing FIS and Table E-1 is not a direct indicator of the potential change in floodplain width. The use of revised topography will be a primary driver of floodplain changes and predictions of potential changes in width of floodplain based on flow changes alone will be necessarily inaccurate.

4.5 References

Baker-Aiklen & Associates, Inc. Drainage Study for Twin Lakes Trailhead Parking and YMCA Improvements, Appendix H. 2002.

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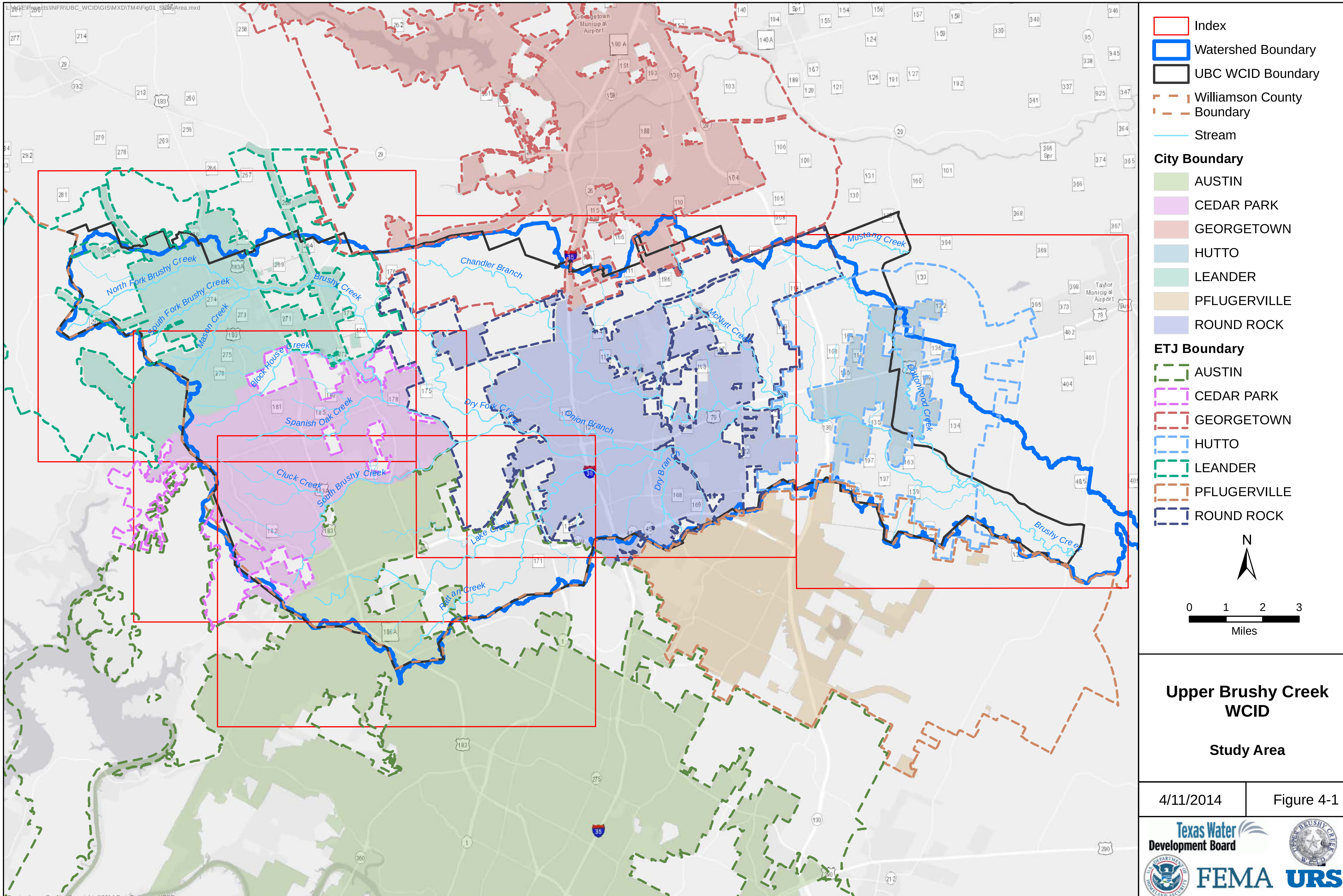
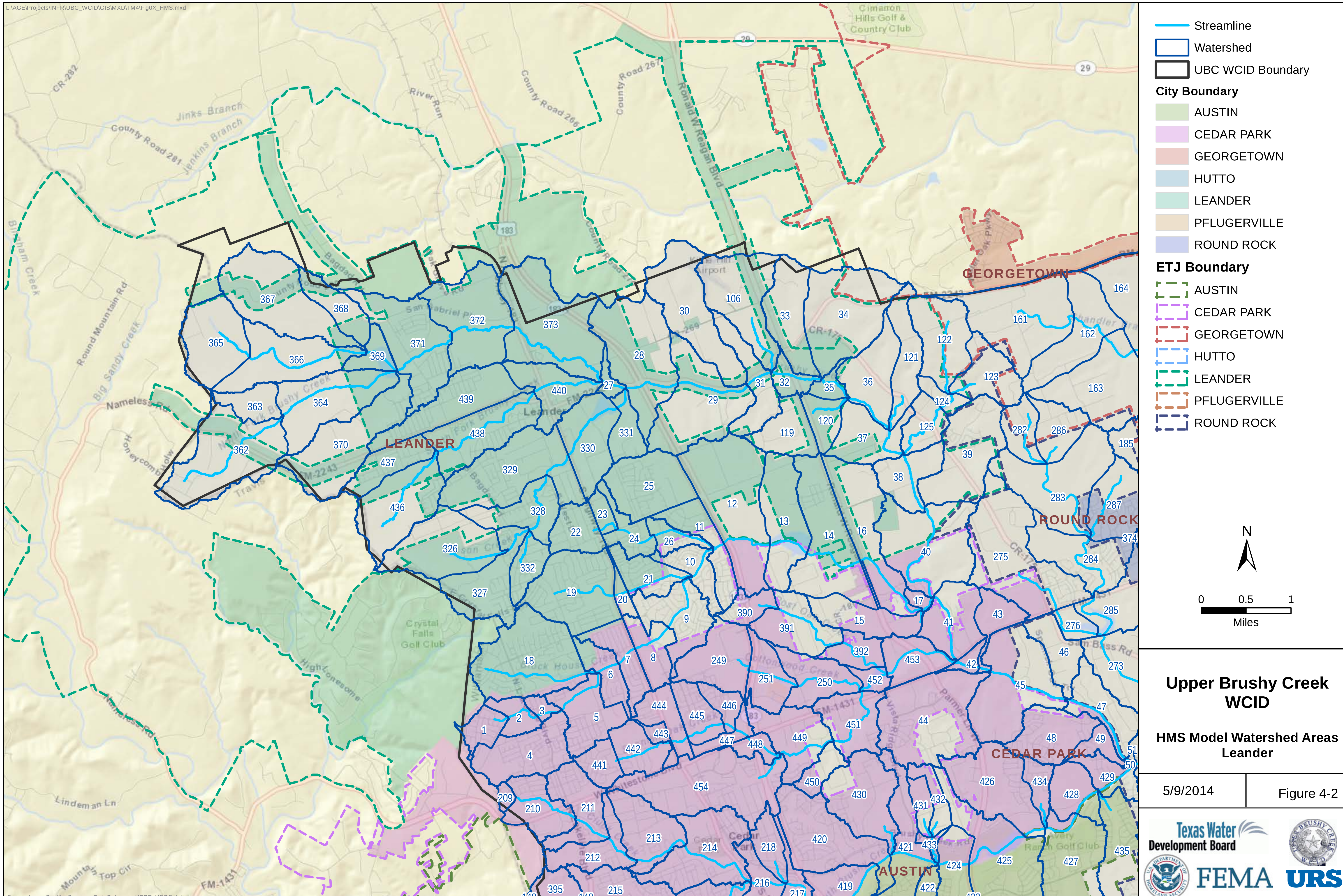

Index
Watershed Boundary
UBC WCID Boundary
Williamson County Boundary
Stream
City Boundary
AUSTIN
CEDAR PARK
GEORGETOWN
HUTTO
LEANDER
PFLUGERVILLE
ROUND ROCK
ETJ Boundary
AUSTIN
CEDAR PARK
GEORGETOWN
HUTTO
LEANDER
PFLUGERVILLE
ROUND ROCK
N
0 1 2 3
Miles
Upper Brushy Creek WCID
Study Area
4/11/2014
Figure 4-1
Texas Water Development Board
FEMA
URS
North Fork Brushy Creek
South Fork Brushy Creek
Mason Creek
Brushy Creek
Chandler Branch
Mustang Creek
McNutt Creek
Block House Creek
Spanish Oak Creek
Dry Fork Creek
Onion Branch
Cottonwood Creek
Cluck Creek
South Brushy Creek
Dry Branch
Lake Creek
Rattan Creek
Georgetown Municipal Airport
Taylor Municipal Airport
Service Layer Credits: Copyright: ©2014 Esri, DeLorme, HERE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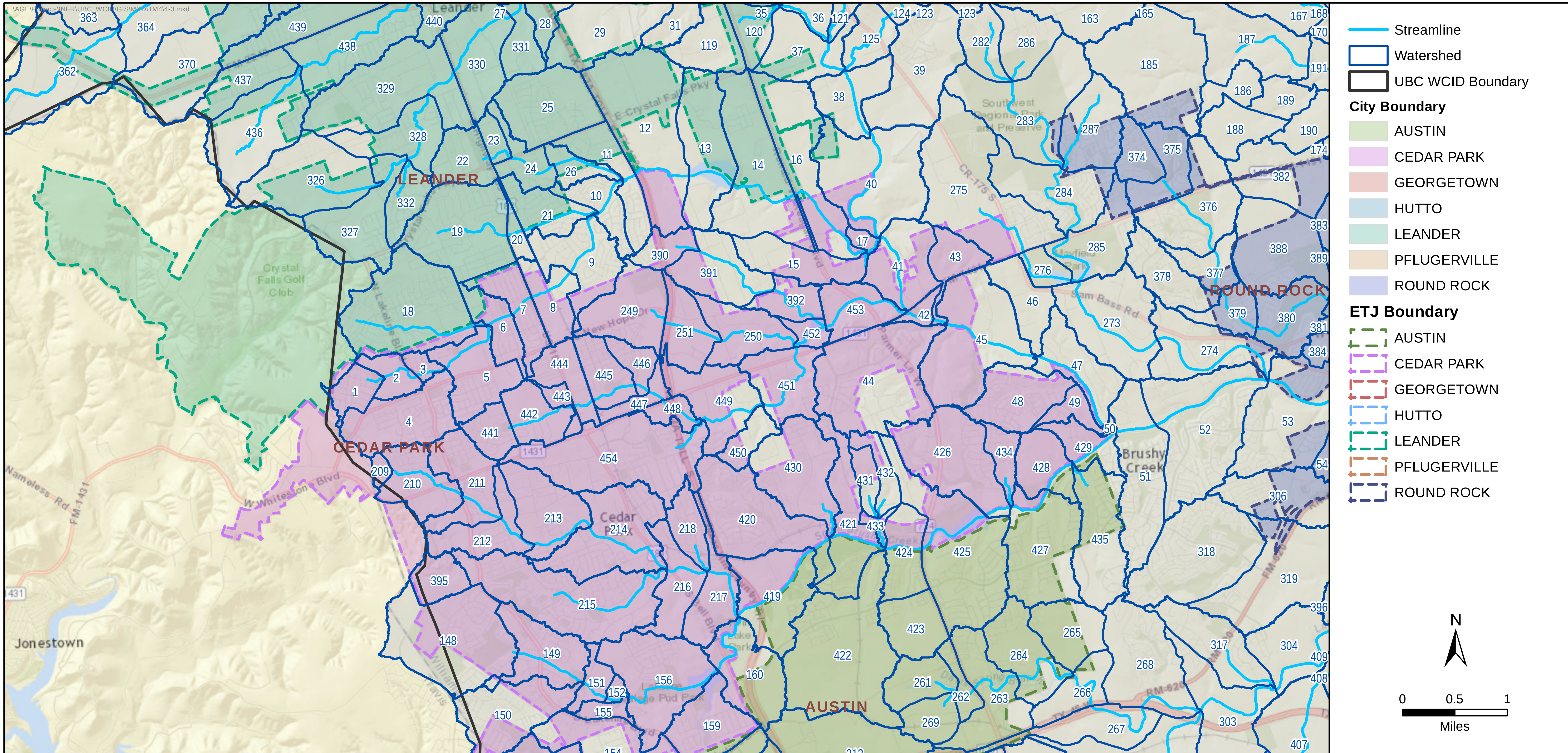
Streamline
Watershed
UBC WCID Boundary
City Boundary
AUSTIN
CEDAR PARK
GEORGETOWN
HUTTO
LEANDER
PFLUGERVILLE
ROUND ROCK
ETJ Boundary
AUSTIN
CEDAR PARK
GEORGETOWN
HUTTO
LEANDER
PFLUGERVILLE
ROUND ROCK
N
0 0.5 1
Miles
Upper Brushy Creek WCID
HMS Model Watershed Areas Leander
5/9/2014
Figure 4-2
Texas Water Development Board
FEMA
URS
LEANDER
GEORGETOWN
ROUND ROCK
CEDAR PARK
AUSTIN
Cimarron Hills Golf & Country Club
Crystal Falls Golf Club
Ronald W Reagan Blvd
Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap.



Upper Brushy Creek WCID

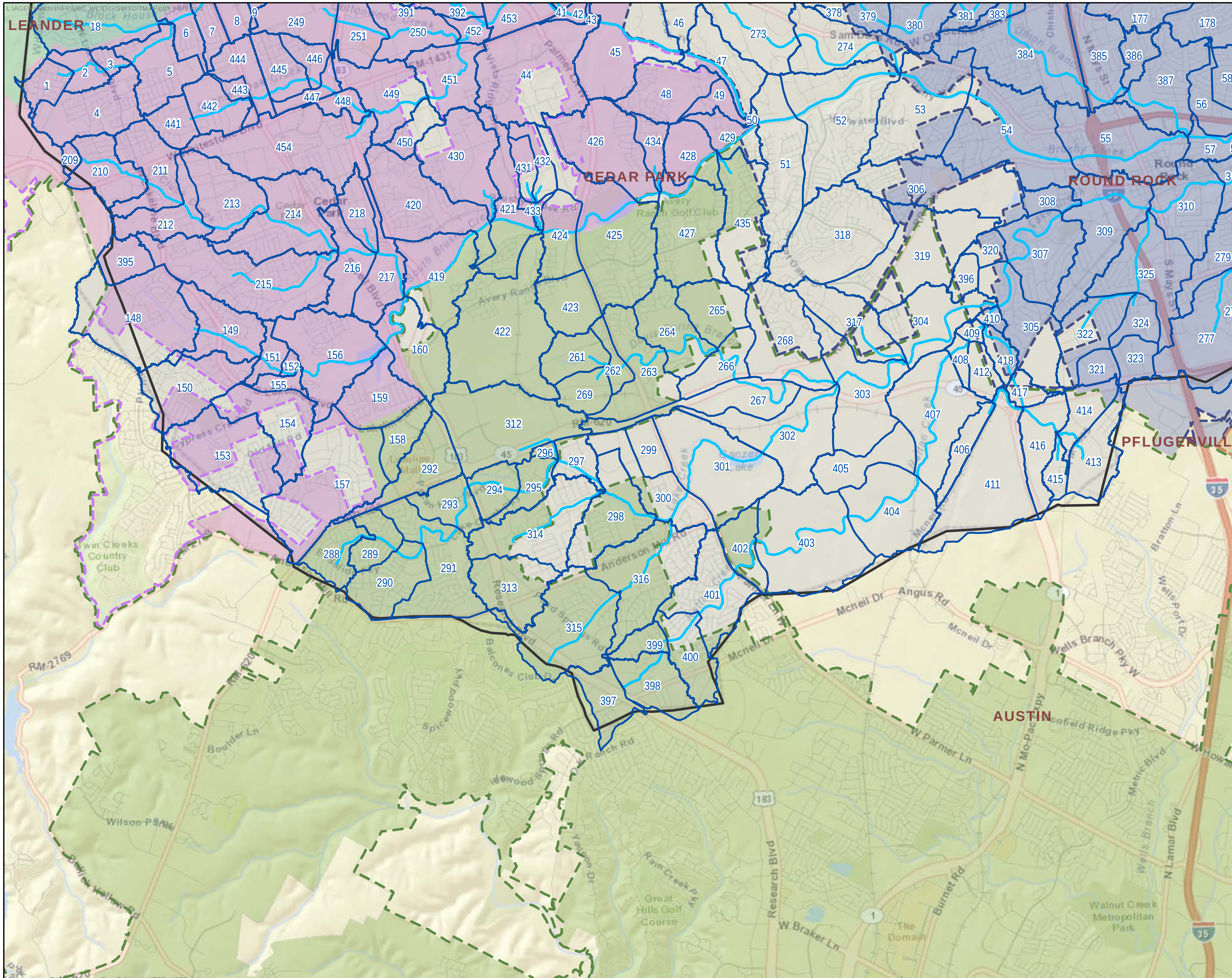
HMS Model Watershed Areas Cedar Park

9/29/2014

Figure 4-3

Texas Water Development Board

URS



- Streamline
- Watershed
- UBC WCID Boundary

City Boundary

- AUSTIN
- CEDAR PARK
- GEORGETOWN
- HUTTO
- LEANDER
- PFLUGERVILLE
- ROUND ROCK

ETJ Boundary

- AUSTIN
- CEDAR PARK
- GEORGETOWN
- HUTTO
- LEANDER
- PFLUGERVILLE
- ROUND ROCK

N

0 0.5 1
Miles

Upper Brushy Creek WCID

HMS Model Watershed Areas Austin

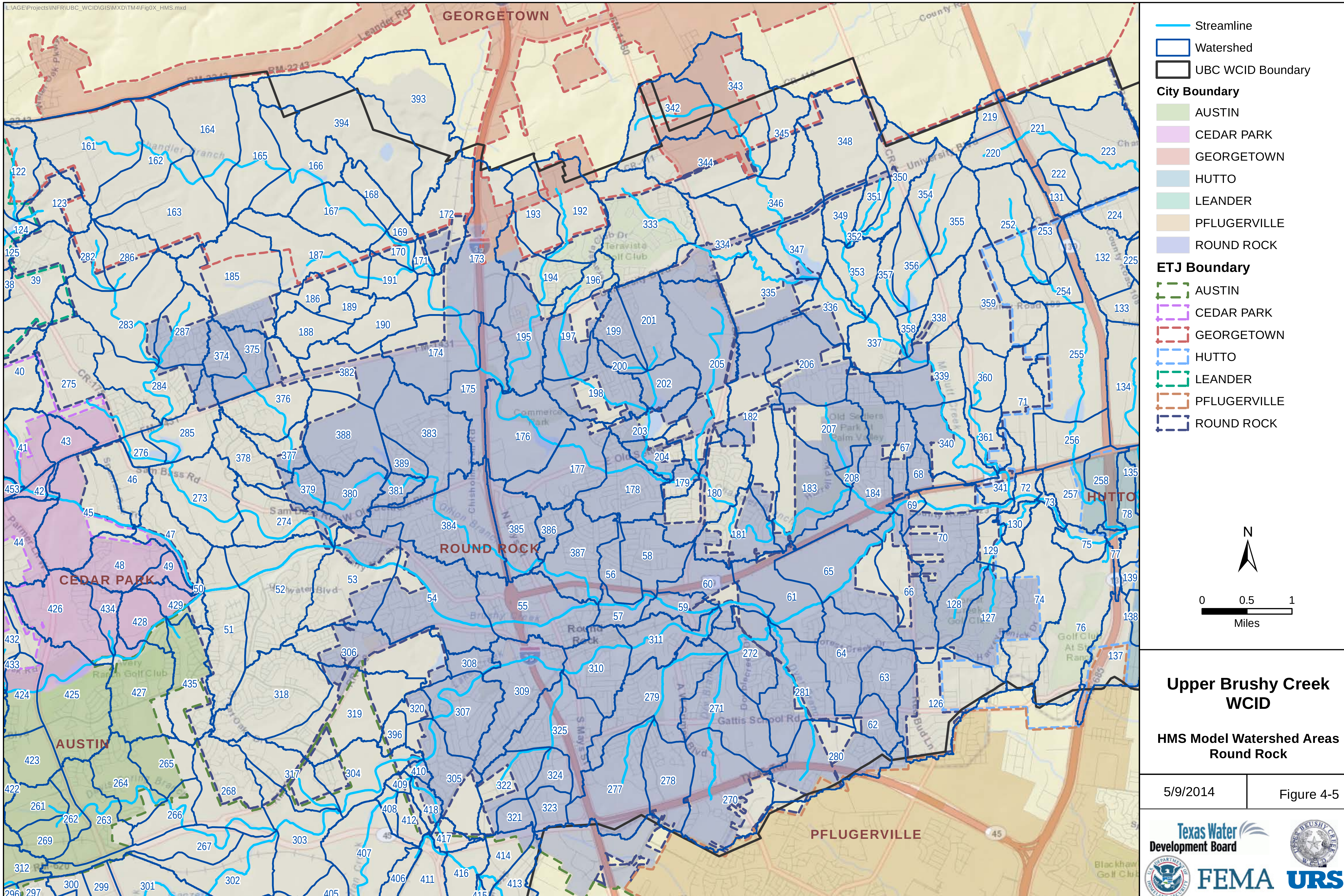
5/9/2014

Figure 4-4

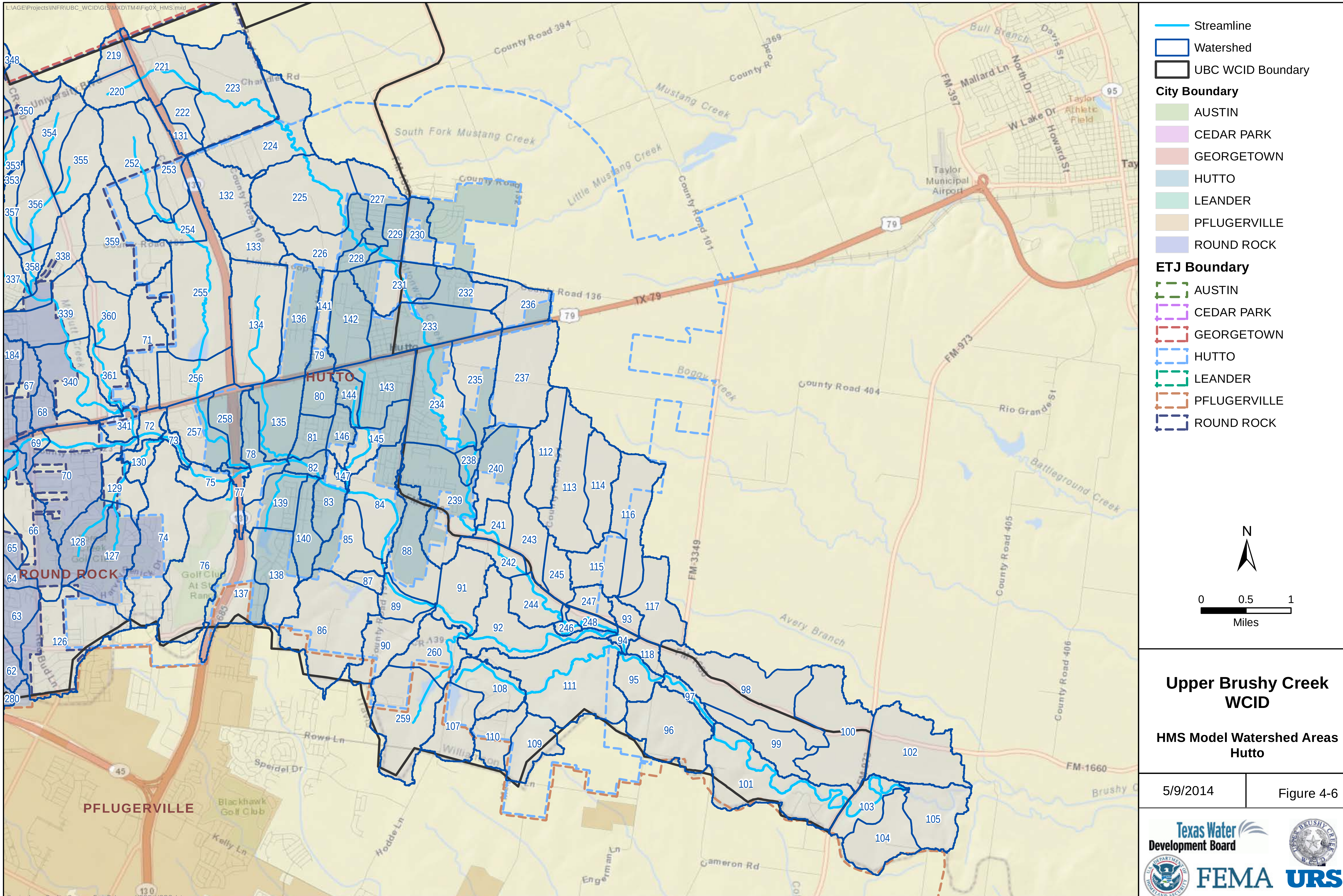
Texas Water Development Board

FEMA

URS



GEORGETOWN
ROUND ROCK
CEDAR PARK
AUSTIN
PFLUGERVILLE
HUTTO
Streamline
Watershed
UBC WCID Boundary
City Boundary
AUSTIN
CEDAR PARK
GEORGETOWN
HUTTO
LEANDER
PFLUGERVILLE
ROUND ROCK
ETJ Boundary
AUSTIN
CEDAR PARK
GEORGETOWN
HUTTO
LEANDER
PFLUGERVILLE
ROUND ROCK
N
0 0.5 1
Miles
Upper Brushy Creek WCID
HMS Model Watershed Areas Round Rock
5/9/2014
Figure 4-5
Texas Water Development Board
FEMA
URS



Streamline
Watershed
UBC WCID Boundary
City Boundary
AUSTIN
CEDAR PARK
GEORGETOWN
HUTTO
LEANDER
PFLUGERVILLE
ROUND ROCK
ETJ Boundary
AUSTIN
CEDAR PARK
GEORGETOWN
HUTTO
LEANDER
PFLUGERVILLE
ROUND ROCK
N
0 0.5 1
Miles
Upper Brushy Creek WCID
HMS Model Watershed Areas
Hutto
5/9/2014
Figure 4-6
Texas Water Development Board
FEMA
URS
HUTTO
ROUND ROCK
PFLUGERVILLE
Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap,

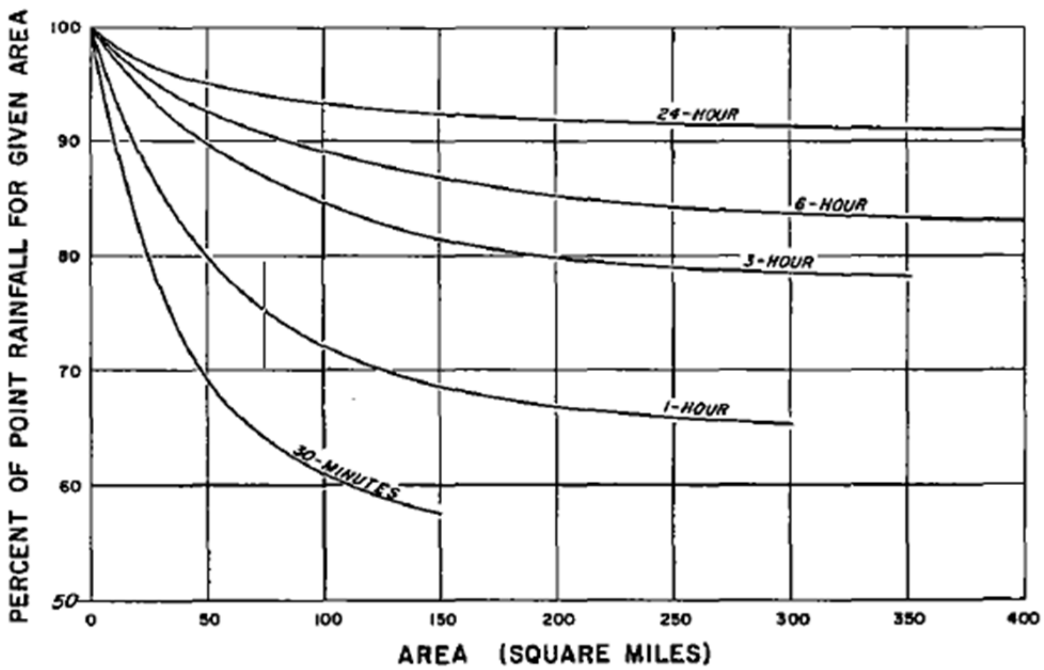
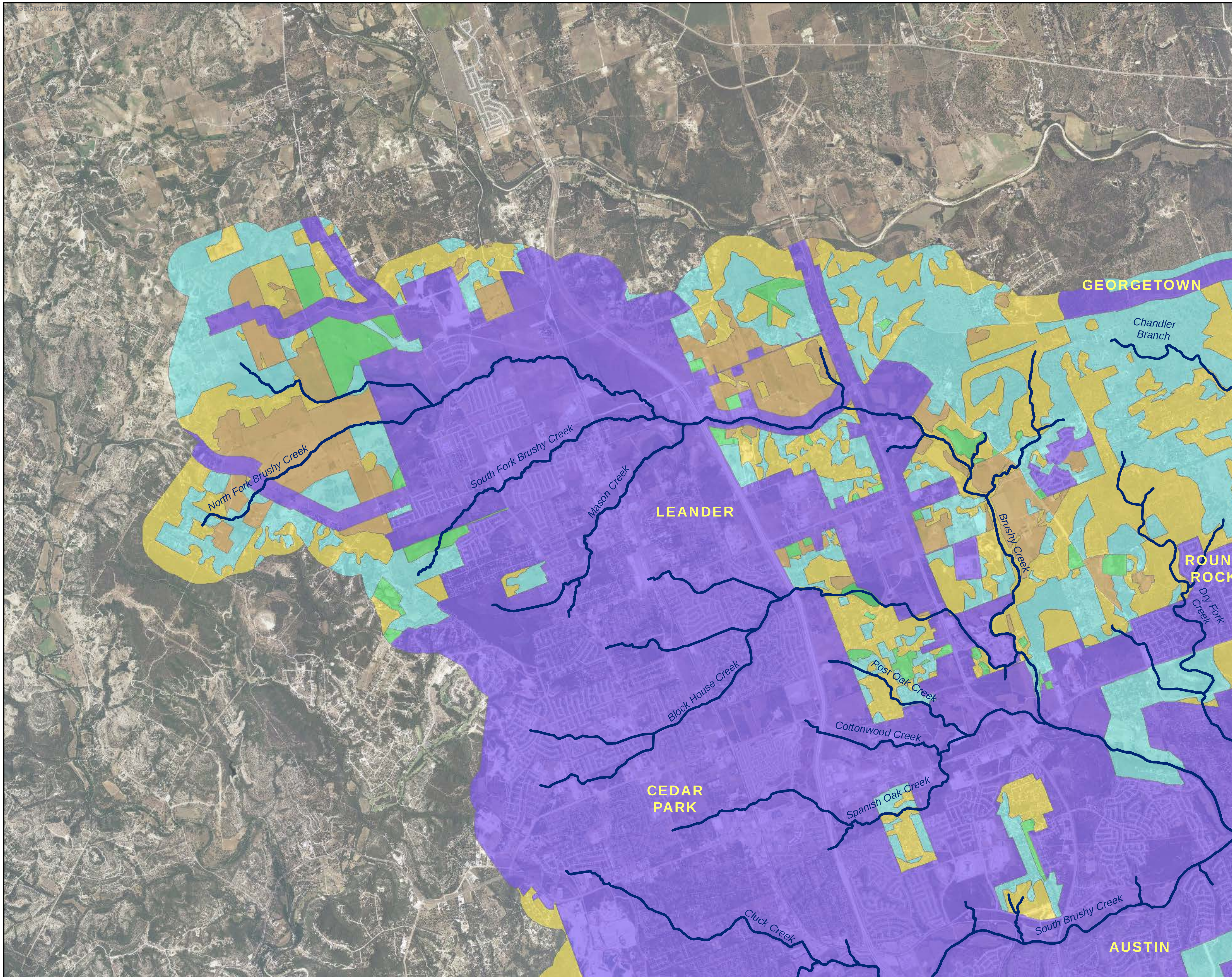


FIGURE 15.—Area-depth curves.

Figure 4-7
Areal Reduction Factors to be Applied to Point Rainfalls Based on Drainage Area
(From TP40, Figure 15)



Streamline

Land Use Type

- Pasture-Fair
- Pasture/Urban*
- Pasture-Poor
- Woods Grass-Fair
- Woods-Good

*Pervious areas within urbanized areas are modeled as grass. Impervious areas within urbanized areas are considered separately.

Upper Brushy Creek WCID

Land Use Leander

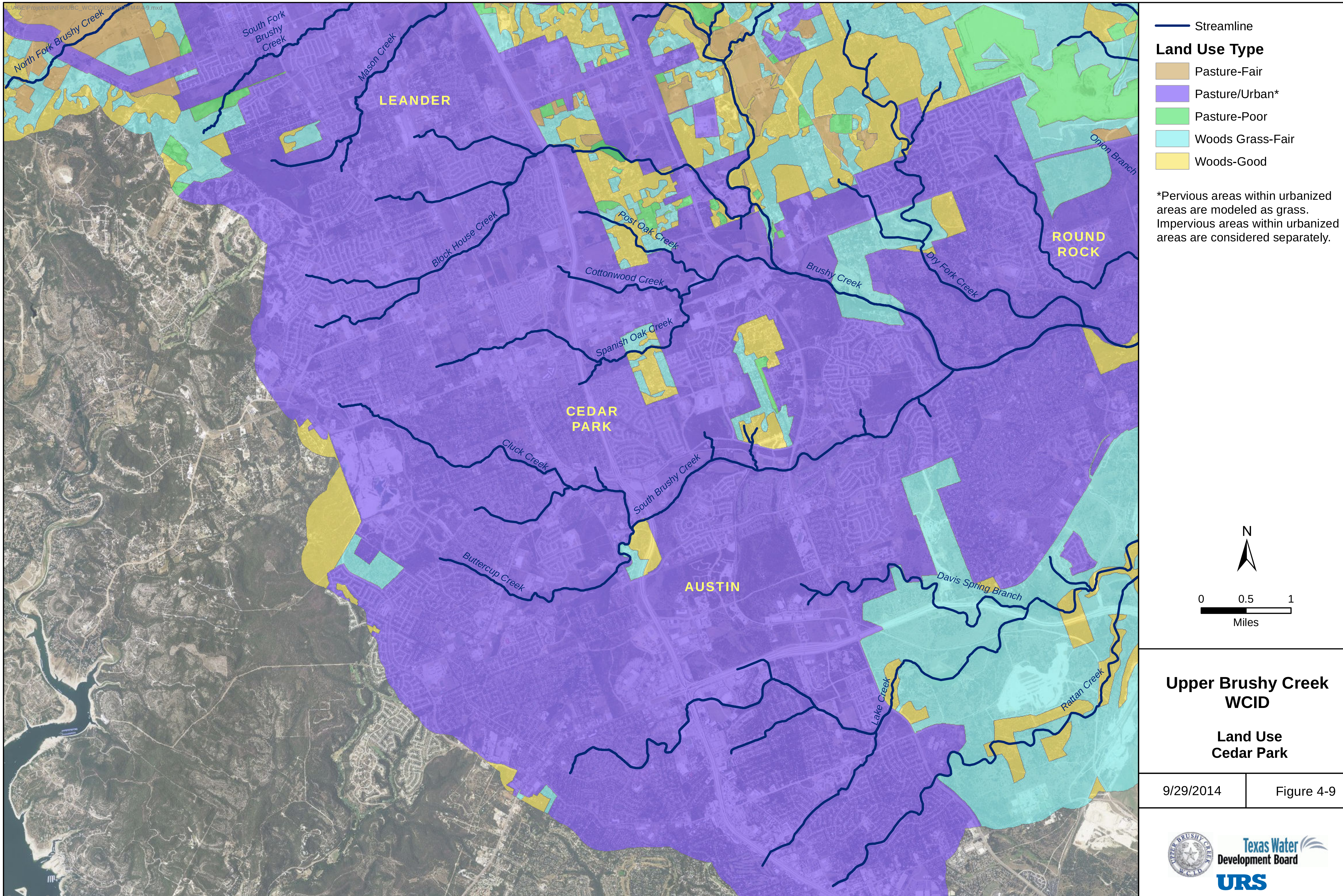
4/11/2014

Figure 4-8

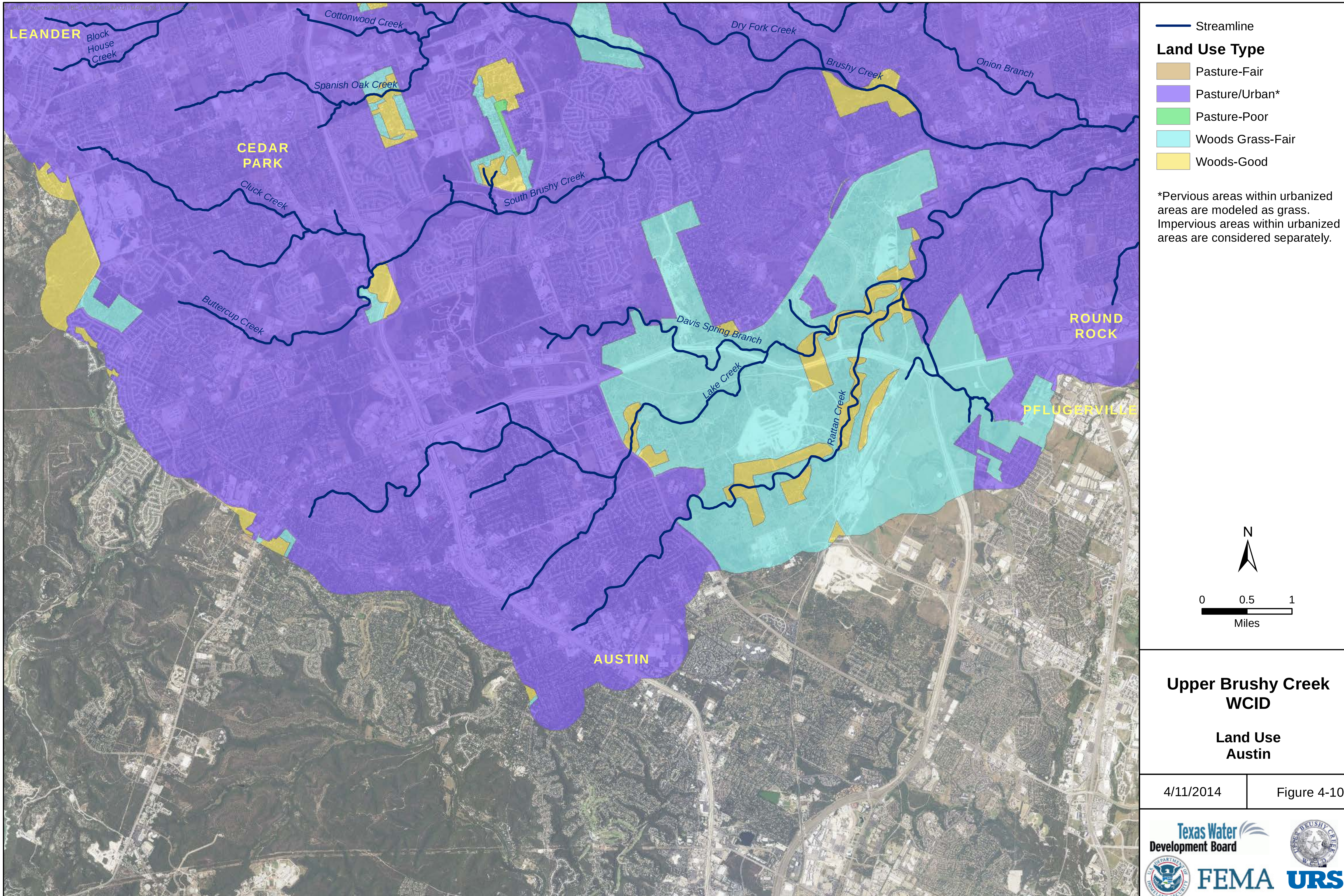
Texas Water Development Board

FEMA

URS



North Fork Brushy Creek
South Fork Brushy Creek
Mason Creek
LEANDER
Block House Creek
Post Oak Creek
Cottonwood Creek
Spanish Oak Creek
Brushy Creek
Dry Fork Creek
Onion Branch
ROUND ROCK
CEDAR PARK
Cluck Creek
South Brushy Creek
Buttercup Creek
AUSTIN
Davis Spring Branch
Lake Creek
Rattan Creek
Streamline
Land Use Type
Pasture-Fair
Pasture/Urban*
Pasture-Poor
Woods Grass-Fair
Woods-Good
*Pervious areas within urbanized areas are modeled as grass. Impervious areas within urbanized areas are considered separately.
N
0
0.5
1
Miles
Upper Brushy Creek WCID
Land Use
Cedar Park
9/29/2014
Figure 4-9
Texas Water Development Board
URS

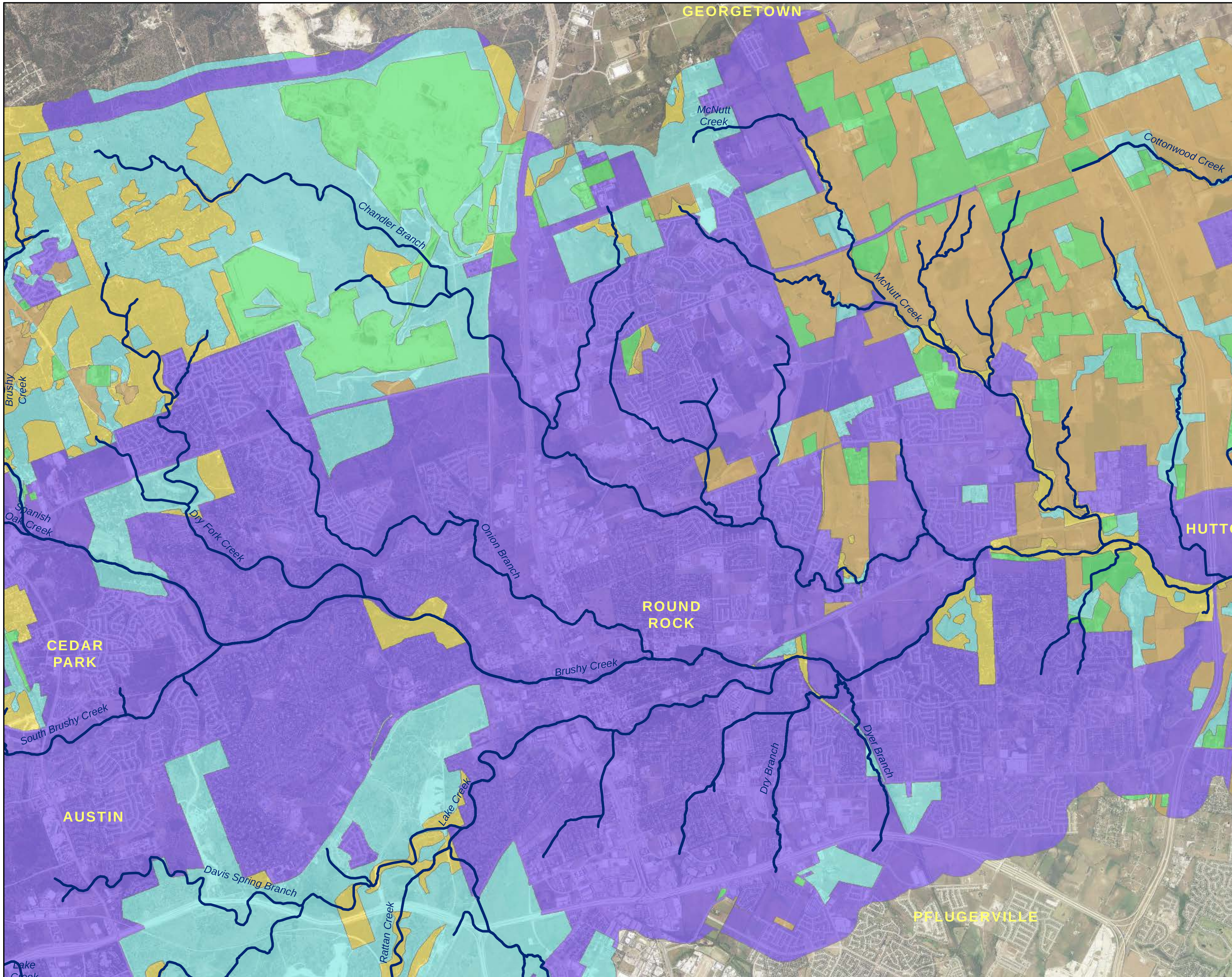


Upper Brushy Creek WCID

Land Use Austin

4/11/2014

Figure 4-10



Upper Brushy Creek WCID

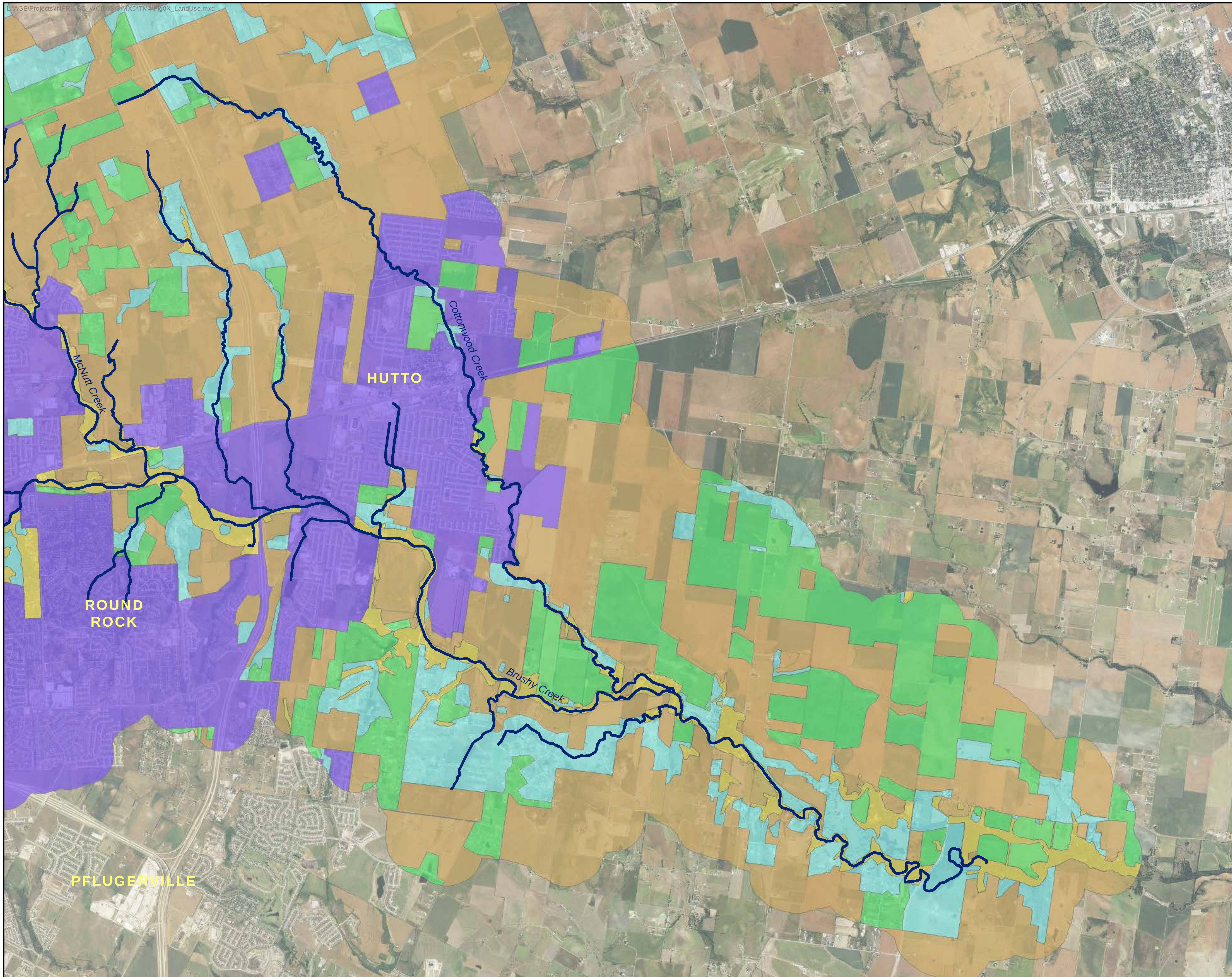
Land Use Round Rock

4/11/2014	Figure 4-11

Texas Water Development Board

FEMA

URS



Streamline

Land Use Type

- Pasture-Fair
- Pasture/Urban*
- Pasture-Poor
- Woods Grass-Fair
- Woods-Good

*Pervious areas within urbanized areas are modeled as grass. Impervious areas within urbanized areas are considered separately.

N

0 0.5 1

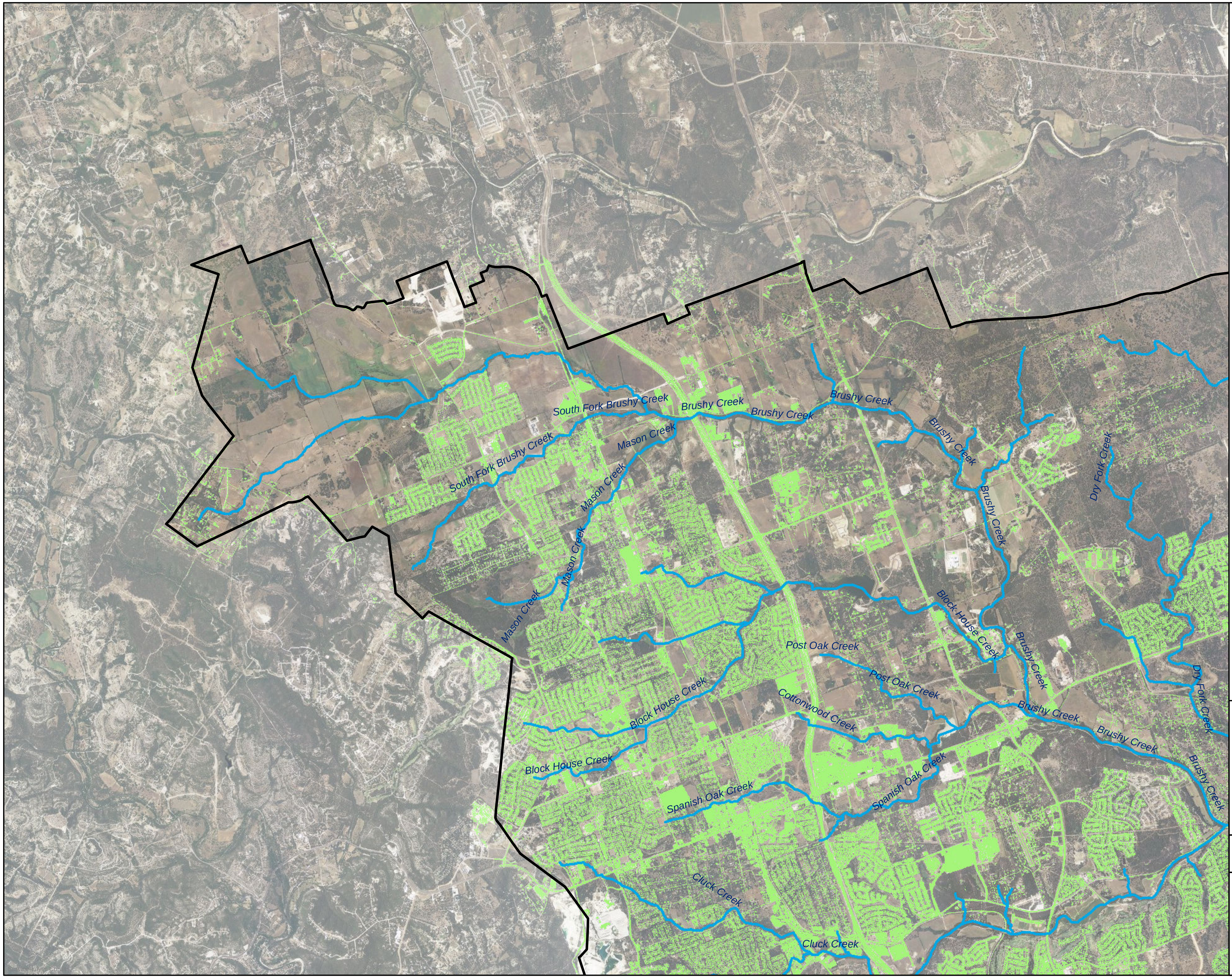
Miles

Upper Brushy Creek WCID

Land Use Hutto

4/11/2014 | Figure 4-12

Texas Water Development Board
FEMA
URS



Streamline
UBC WCID Boundary
Impervious Surface

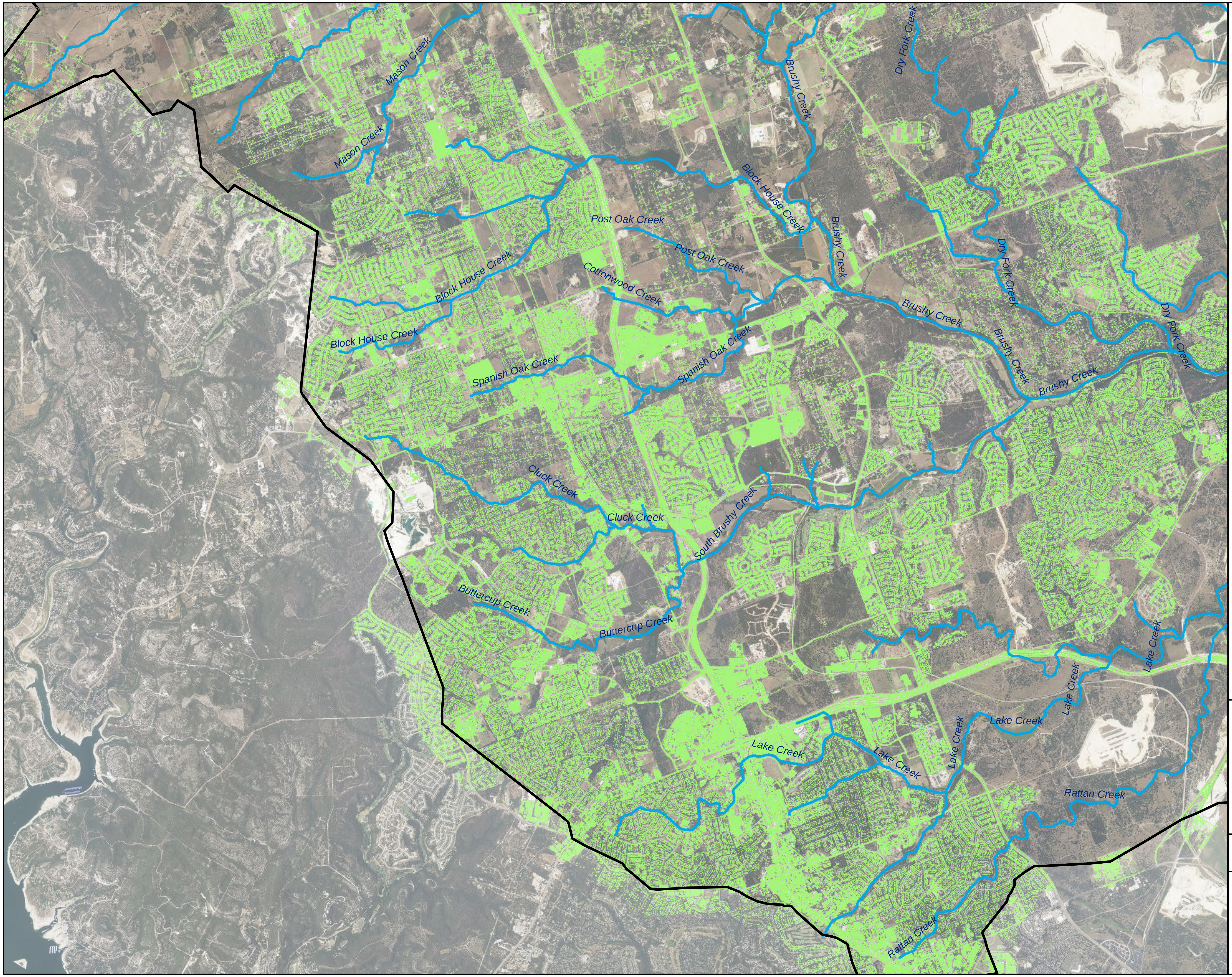
N
0 0.5 1
Miles

Upper Brushy Creek WCID

Extent of Impervious Surface Leander

9/29/2014 | Figure 4-13

Texas Water Development Board
URS



Streamline
UBC WCID Boundary
Impervious Surface

N

0 0.5 1
Miles

Upper Brushy Creek WCID

Extent of Impervious Surface Cedar Park

9/29/2014	Figure 4-14

Texas Water Development Board
URS

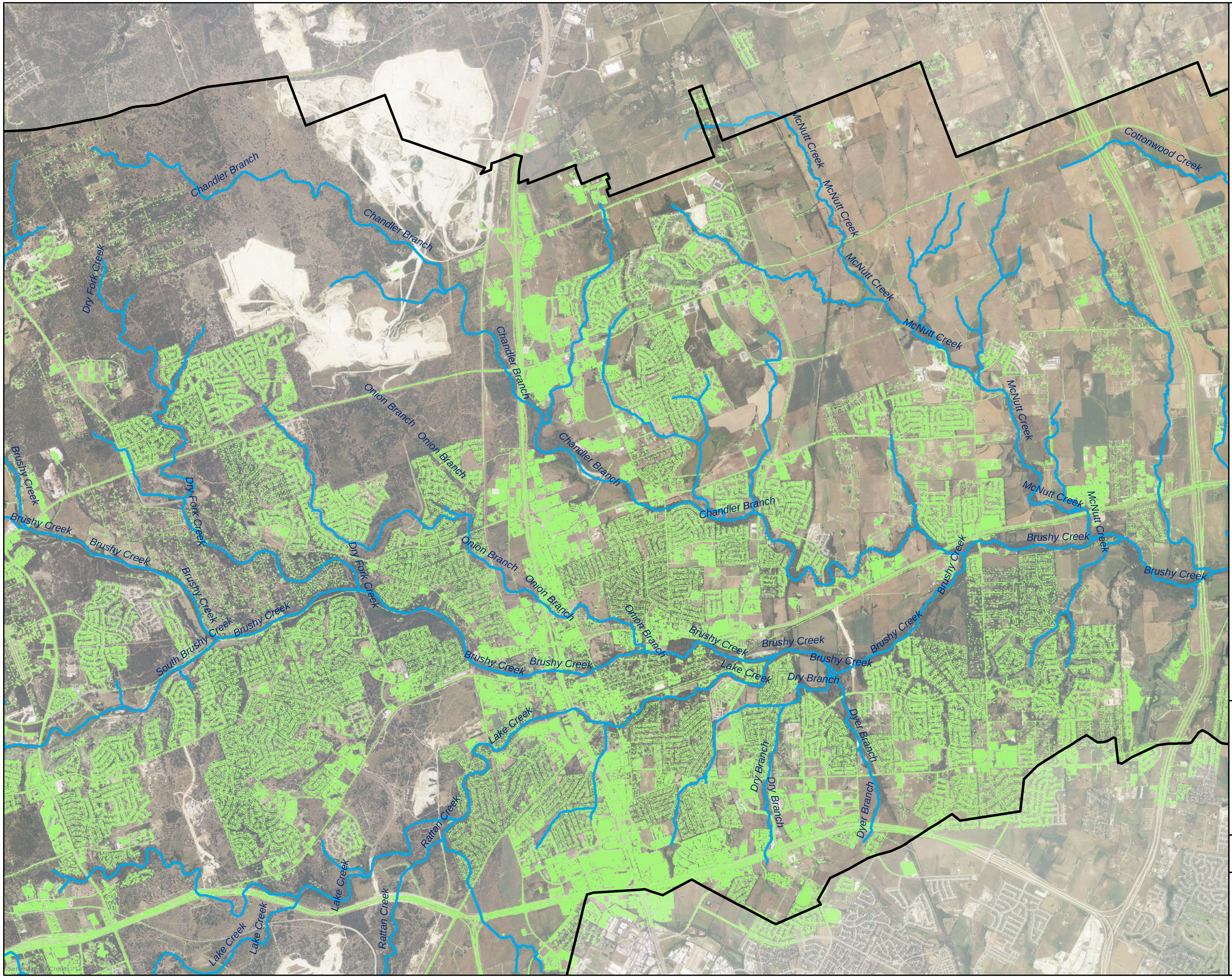
Upper Brushy Creek WCID

Extent of Impervious Surface Austin

9/29/2014	Figure 4-15

Texas Water Development Board

URS



Streamline
UBC WCID Boundary
Impervious Surface

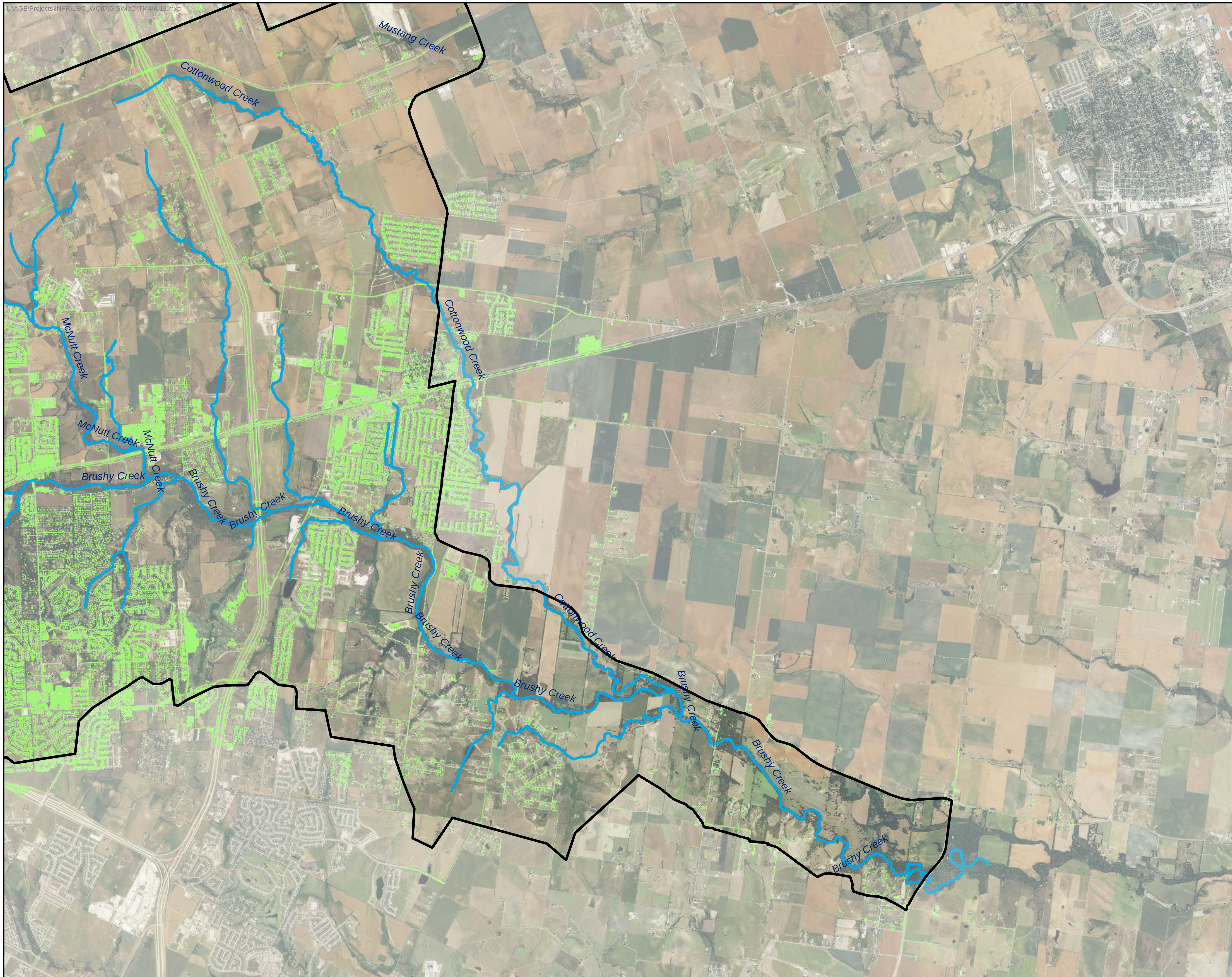
N

0 0.5 1
Miles

Upper Brushy Creek WCID

Extent of Impervious Surface Round Rock

9/29/2014	Figure 4-16



Streamline
UBC WCID Boundary
Impervious Surface

N

0 0.5 1
Miles

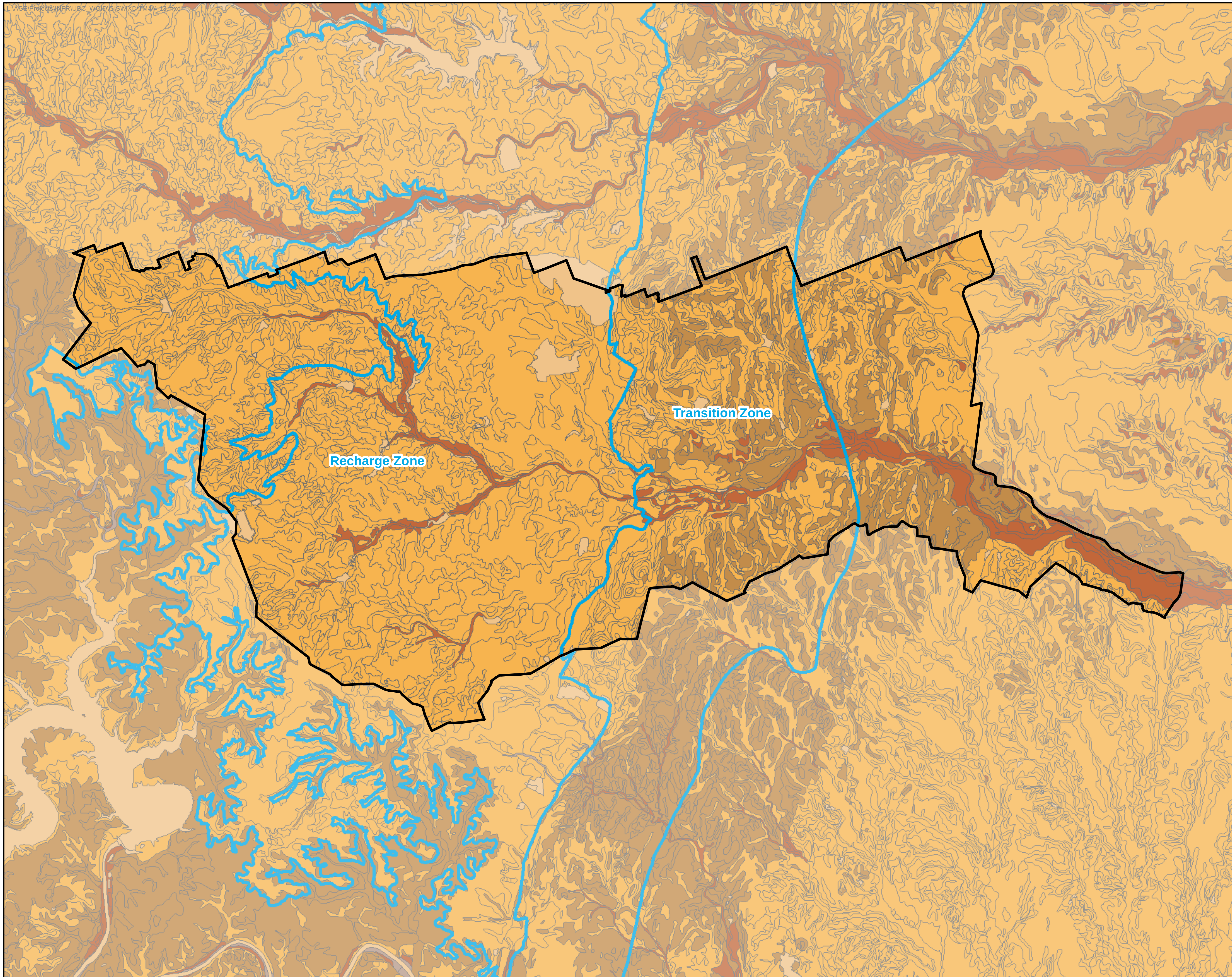
Upper Brushy Creek WCID

Extent of Impervious Surface Hutto

9/29/2014	Figure 4-17

Texas Water Development Board

URS

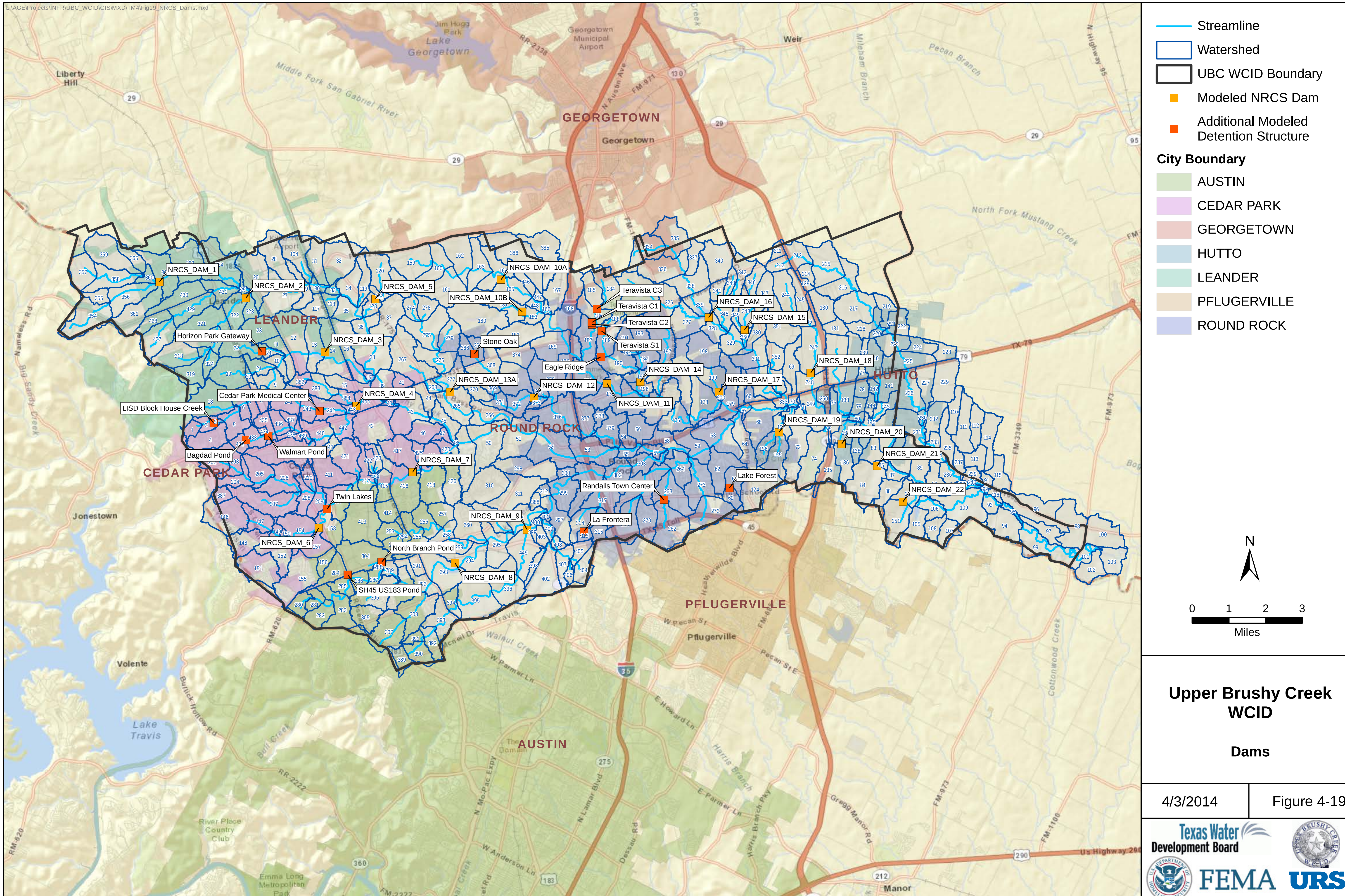


Upper Brushy Creek WCID

Soils per SSURGO

9/29/2014

Figure 4-18



Upper Brushy Creek WCID

Dams

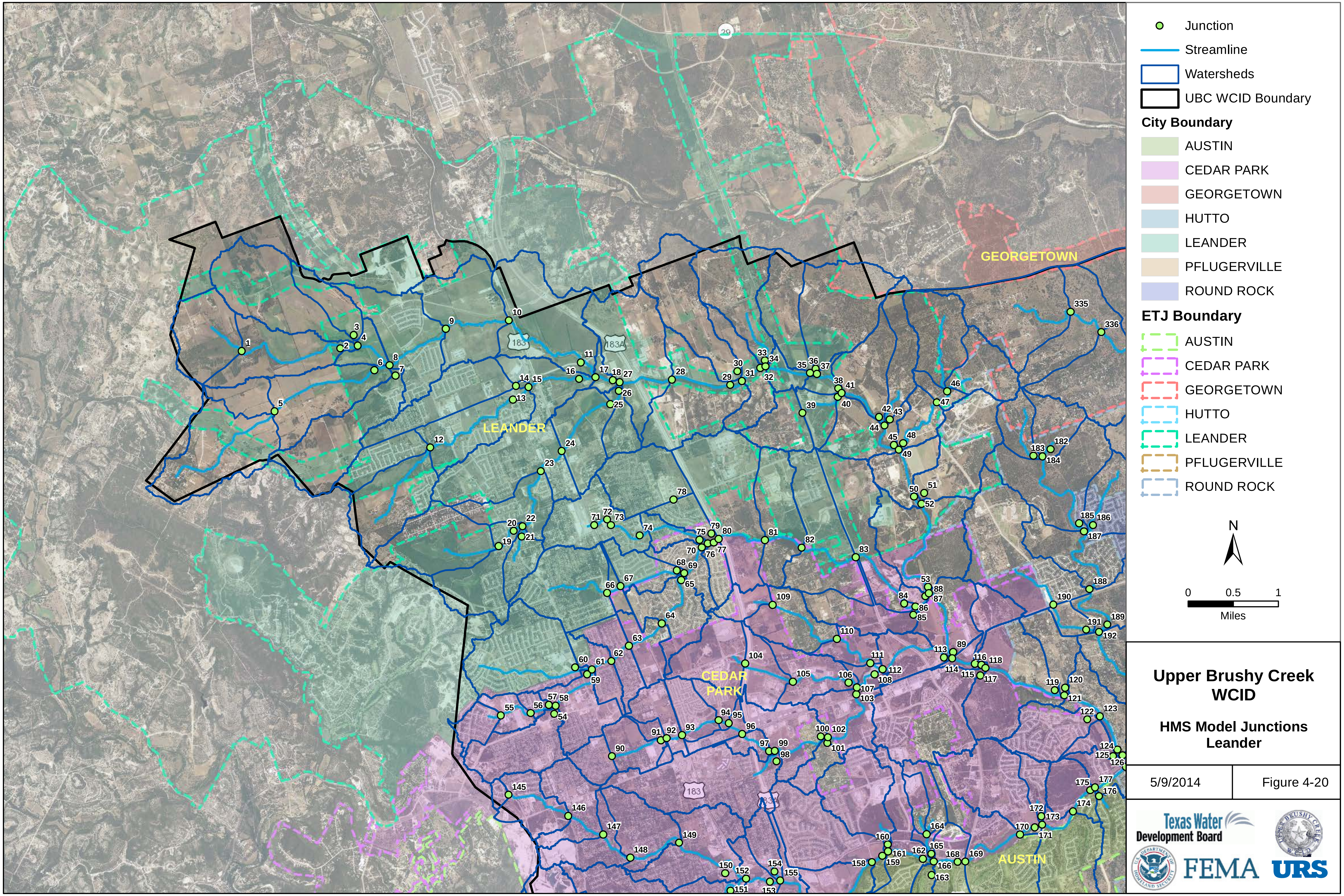
4/3/2014

Figure 4-19

Texas Water Development Board

FEMA

URS



Upper Brushy Creek WCID

HMS Model Junctions Leander

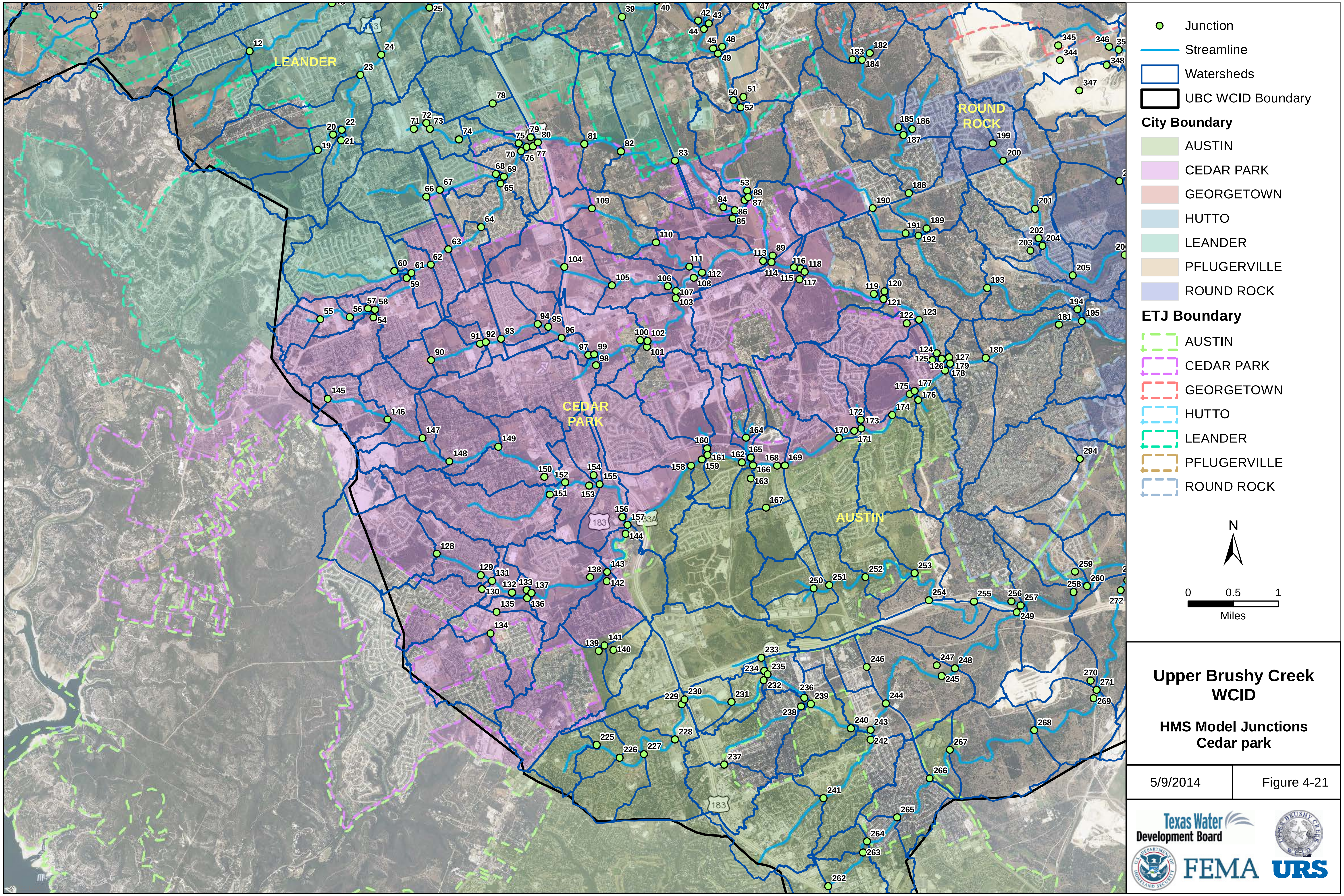
5/9/2014

Figure 4-20

Texas Water Development Board

FEMA

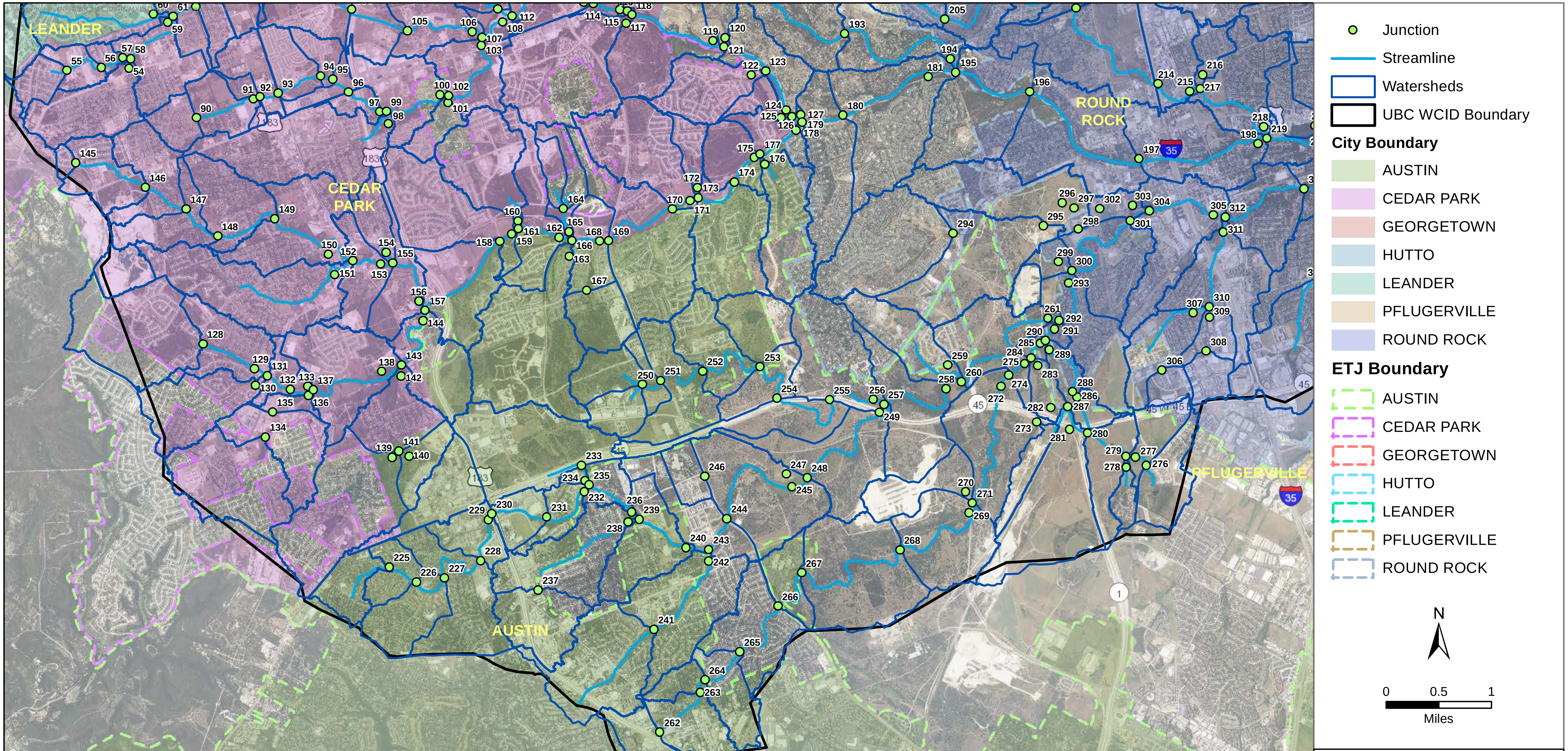
URS



Upper Brushy Creek WCID

HMS Model Junctions Cedar park

5/9/2014 Figure 4-21

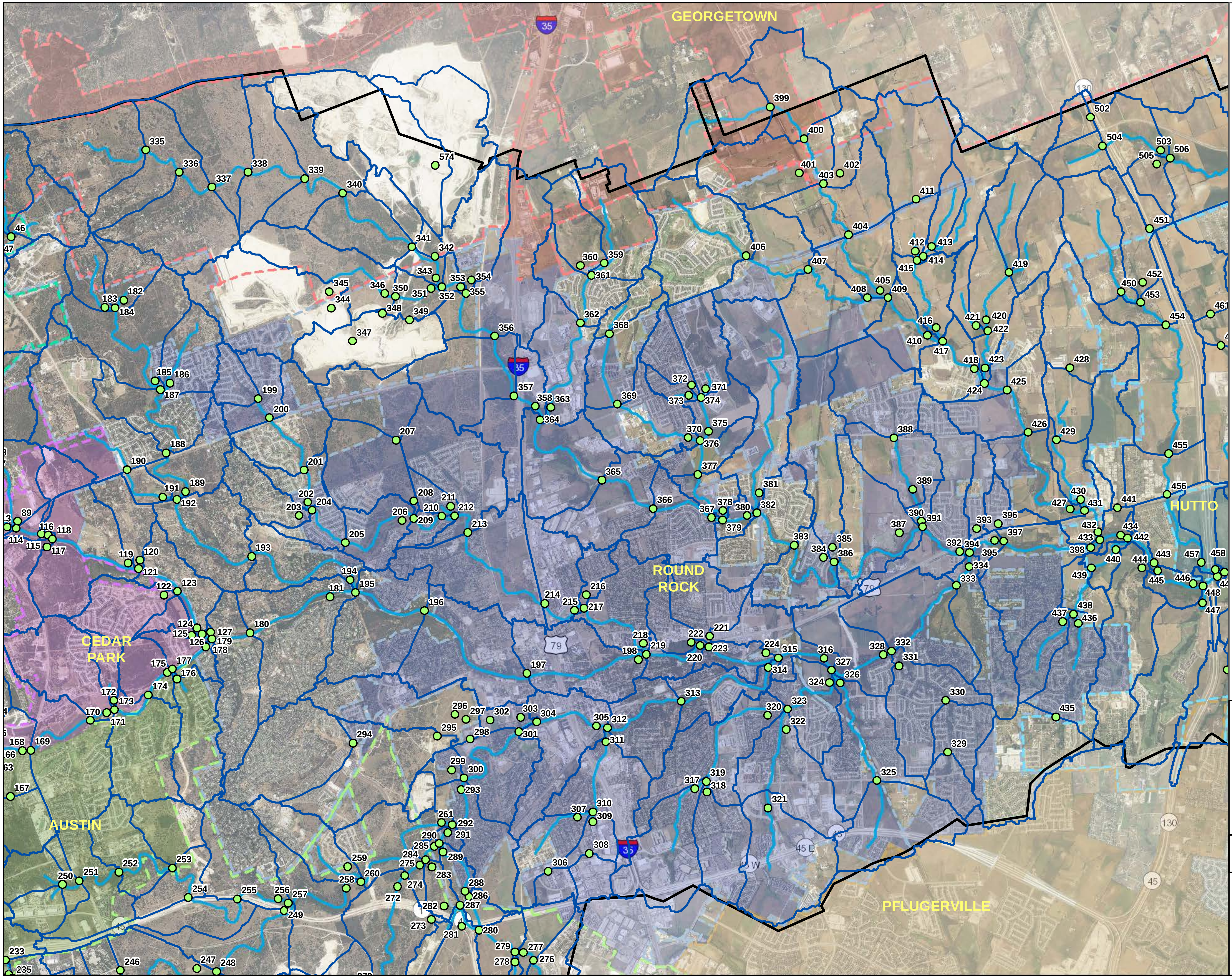


Upper Brushy Creek WCID

HMS Model Junctions Austin

5/9/2014 | Figure 4-22

Texas Water Development Board
FEMA
URS



- Junction
- Streamline
- Watersheds
- UBC WCID Boundary

City Boundary
- AUSTIN
- CEDAR PARK
- GEORGETOWN
- HUTTO
- LEANDER
- PFLUGERVILLE
- ROUND ROCK

ETJ Boundary
- AUSTIN
- CEDAR PARK
- GEORGETOWN
- HUTTO
- LEANDER
- PFLUGERVILLE
- ROUND ROCK

N

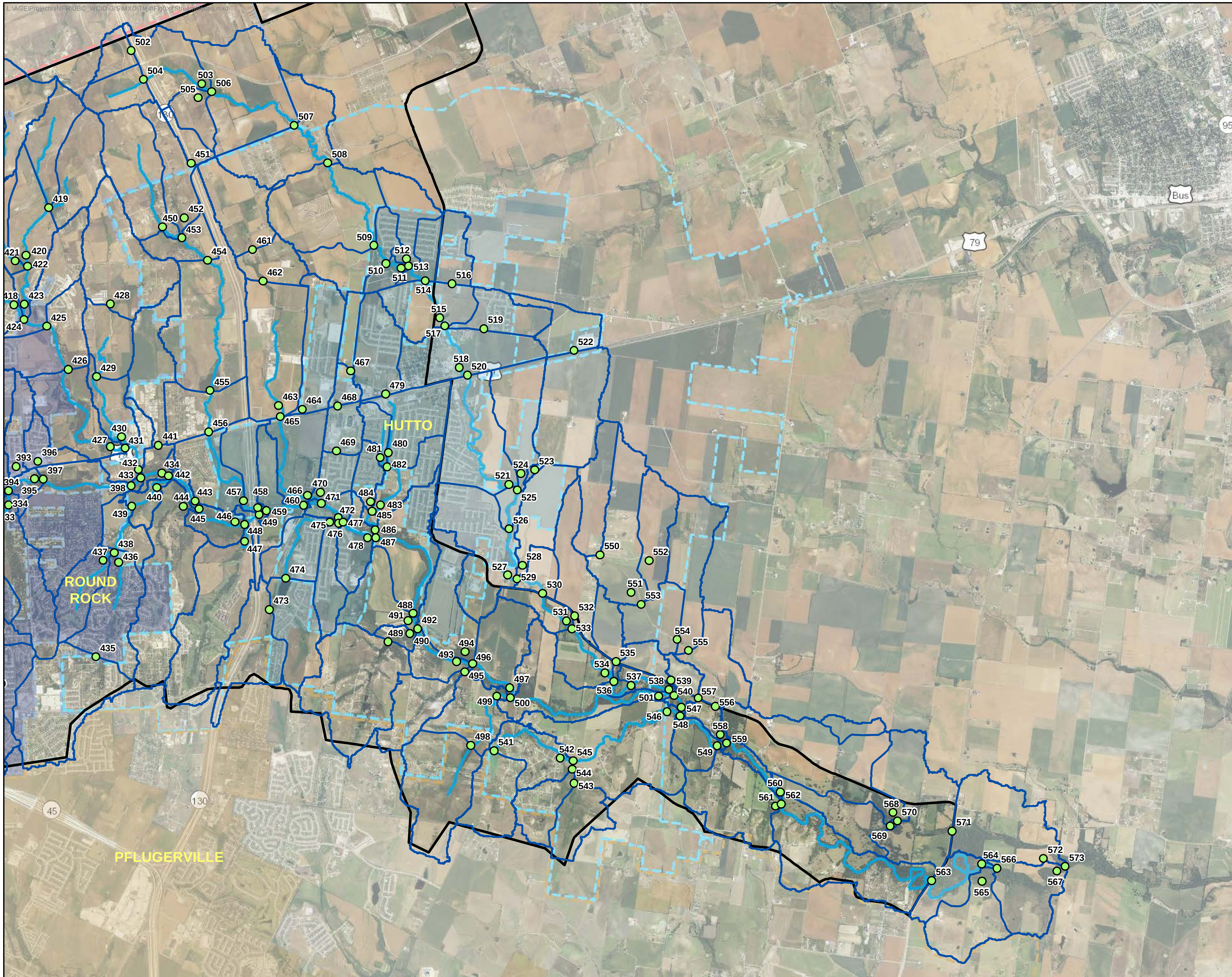
0 0.5 1
Miles

Upper Brushy Creek WCID

HMS Model Junctions Round Rock

5/9/2014	Figure 4-23

Texas Water Development Board
FEMA URS



- Junction
- Streamline
- Watersheds
- UBC WCID Boundary

City Boundary

- AUSTIN
- CEDAR PARK
- GEORGETOWN
- HUTTO
- LEANDER
- PFLUGERVILLE
- ROUND ROCK

ETJ Boundary

- AUSTIN
- CEDAR PARK
- GEORGETOWN
- HUTTO
- LEANDER
- PFLUGERVILLE
- ROUND ROCK

N

0 0.5 1
Miles

Upper Brushy Creek WCID

HMS Model Junctions Hutto

5/9/2014

Figure 4-24

Texas Water Development Board
FEMA
URS

5.0 HYDRAULIC MODELING

5.1 Task Summary

In February 2012, a Technical Memorandum (TM) was issued (TM3, provided as Section 3 in this report) which detailed the methods to be used for hydraulic study of the full Upper Brushy Creek Watershed as part of the FPP. This TM had been reviewed and the methods accepted by the FPP TAC, which included representatives from the District, City of Austin, City of Cedar Park, City of Leander, City of Round Rock, City of Hutto, TWDB, and Williamson County. The TM3 methods meet FEMA's guidelines per Appendix C (2009). TM3 is hereafter referred to as Section 3.

This section:

- Provides a description of the overall work scope to include model extents of watershed component models;
- Provides a description of hydraulic model methodology, primarily via reference to TM3 (Section 3);
- Documents changes/enhancements to hydraulic methods since the issuance of TM3; and
- Provides hydraulic model results.

Hydraulic analyses and results presented in this section only address the discharge from the 1% annual-chance flood (100-year flood), as this is the primary flood to be addressed by the FPP. Future revisions will address discharge for the 50%, 10%, 4%, 2%, 1%, and 0.2% annual-chance flood events for existing conditions as well as the 4% and 1% annual-chance flood events for ultimate development conditions.

This section is structured to be consistent with the structure of a hydraulic computations TSDN associated with development of FEMA Flood Insurance Rate Maps (FIRMs), to facilitate future development of that document.

5.1.1 Project Work Scope

The work scope includes the development of hydraulic models for the study area shown on Figure 5-1, and the use of these models to develop WSELs and floodplain maps for the 1% AEP flood (100-year flood). Streamlines for which detailed models are developed are depicted in Figure 5-1.

Table 5-1 includes the flooding source, type of study, and stream mileage included in the hydraulic model. Figure M-1 in Exhibit M depicts the location of the studied sources.

Standards. All hydraulic computations and analyses were performed in accordance with FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners,* as amended, Appendix C (2009). The outputs and deliverables for hydraulic analyses will be prepared in accordance with FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners*,

Appendix M. Specific methods not explicitly described in Appendix M are described in the previously referenced TM3.

Table 5-1. Scope of Study

Study Stream Name	Type of Study	Stream Length (mi.)
Blockhouse Creek	Detailed	11.73
Chandler Branch	Detailed	25.87
Cottonwood Creek	Detailed	12.38
Dam 18	Detailed	4.85
Dam 22	Detailed	1.33
Dry Branch	Detailed	7.18
Dry Fork	Detailed	9.06
Lake Creek	Detailed	36.49
McNutt Creek	Detailed	18.77
Onion Branch	Detailed	6.70
South Brushy Creek	Detailed	26.17
Spanish Oak	Detailed	8.96
Upper Brushy Creek	Detailed	47.59
Upper Brushy Tributary 5	Detailed	2.51
Upper Brushy Tributary 6	Detailed	0.29
Upper Brushy Tributary 7	Detailed	2.41
Upper Brushy Tributary 8	Detailed	1.09
Upper Brushy Tributary 9	Detailed	2.22
Zimmerman	Detailed	2.69

5.1.2 Background

5.1.2.1 Historic Flooding

The effective Flood Insurance Study (FIS), dated September 26, 2008, notes that there have been documented flooding events within the studied portions of Williamson County in 1984, 1986, 2007, and 2010. More frequent events are known to cause flooding on roadways and in other low-lying areas of Williamson County. Detailed studies of major 2007 and 2010 events are provided in Section 4, which analyzes data collected in these events to calibrate the hydrologic model-generated flows for the hydraulic model.

5.1.2.2 Existing Hydraulic Studies

The current FIS for Williamson County, Texas, identifies the 1981 flood hazards for many of the streams included in this study area. WSP 2 hydraulic model was used to study the flooding sources using detailed methods. A subset of the streams was studied using approximate methods. The FIS was originally issued in 1981, reissued in 1997, and reissued in 2008. The 2008 reissue included a redelineation of Zone AE floodplains but did not include updates to the hydraulic models. Neither digital nor paper copies of the effective hydrologic models for tributaries to Brushy Creek were available from the FEMA library. FEMA developed preliminary models for a subset of the models presented in this section as part of the Risk MAP study. These models were edited and incorporated per the methodology described below.

5.2 Methodology

5.2.1 Approach

The analysis included an estimation of WSELs for the 1% AEP flood events for specific flood sources. The hydraulic methods used for this analysis included HEC-RAS for riverine modeling. Cross-sections and field survey data were used to prepare the hydraulic analyses.

In general, the analysis performed included the following tasks:

- Streamlines from the watershed area were assigned to models per the organization shown in Figure 5-1.
- Survey data for structures were incorporated into the models. Figure 3-3 depicts locations of structures included in the model and those not included.
- Cross-sections were sited per FEMA guidelines using spacing guidance provided in Section 3.
- Model cross-section geometries were initially developed from 2012 LIDAR data where 2012 LIDAR data were available. Elsewhere, model cross-section geometries were initially developed from 2006 LIDAR data. For selected model areas where individual cross-sections traversed the boundary between older (2006) and newer (2012) LIDAR datasets, engineering judgment was used to choose between which dataset to use to define a consistent full cross-section.
- Cross-section field surveys were used to adjust cross-section geometry.
- Ineffective flow areas were added at structures and within overbanks of individual cross-sections as needed.
- The flows were added to cross-sections for each flow scenario modeled.
- Models underwent internal quality assurance (QA) procedures (detail checks and independent technical reviews).
- Independent technical review comments relevant to model results were addressed.
- Results presented in this section were prepared.

5.2.2 Model and Computer Tools Used

WSELs were determined using detailed methods described in this section. Hydraulic analyses were carried out using HEC-RAS Version 4.1. Cross-sections were cut from the available topographic data using HEC-GeoRAS 10.1, within an ESRI ArcMap GIS Version 10.1 platform.

5.2.3 Topographic Data

The following data were collected and included in the preparation of this section:

- **2006 LIDAR Data.** Data were obtained from CAPCOG and reflect ground conditions between July 27, 2006 and August 4, 2006. Sanborn was contracted by CAPCOG in the spring of 2006 to provide LIDAR data acquisition and processing services covering Williamson County, Texas. The source data units are in meters and use coordinate system North American Data (NAD) 83, projection Universal Transverse Mercator (UTM) Zone 14. Coverage includes entire Upper Brushy Creek watershed (see Figure 5-1).
- **2012 LIDAR Data.** Data were obtained from the City of Austin and City of Round Rock. These data only partially covered the watershed (see Figure 5-1).

Data analyses performed for this section included:

- **Processing of 2006 LIDAR.** First, the 2006 LIDAR tiles were grouped into quarter-quads for easier processing and projected into State Plane, Texas Central FIPS 4203 feet. ArcGIS Terrain Extension LP 360 was then used to extract ground elevation values (in feet) to derive a 5-by-5-foot Digital Elevation Model (DEM) for each quarter-quad. These DEMs were then merged into a seamless elevation surface using the ArcGIS tool, Mosaic to New Raster. To ensure a smooth surface, the mosaic operator type was set to "Mean" so that overlapping areas were merged by taking the average value of the overlapping cells. The resulting surface was then clipped to the UBC watershed boundary.
- **Processing of 2012 LIDAR.** The 2012 LIDAR data were processed into a 5-by-5 foot DEM using the same methodology described above for the 2006 LIDAR data, with the exception that the 2012 data did not need projecting as it already was in State Plane coordinates. Because the 2012 layer only covered a portion of the watershed, it was clipped 20 feet inward from its original extent to eliminate skewed data along its edges.
- **Creating a Combined Topographic Surface.** The 2012 LIDAR covers approximately 80% of the District study area. "Bare Earth" surfaces were extracted from the two LIDAR sets. The two "Bare Earth" datasets were merged so that the gaps in the 2012 surface were filled by the 2006 Surface.

No "transition" or "blend" was applied to the seams where the two datasets meet. A GIS "2012 Extents" file was created delineating the extent of the 2012 LIDAR. This GIS "2012 Extents" file is used with the resulting merged 2012/2006 surface to define the limits of analysis and modeling. This extents file was referenced by modelers when modeling in the vicinity of LIDAR data boundary. The file was used to explain discontinuities in cross-section geometry cut on the combined surface, and as the basis of the engineering judgment as to which topographic data set (2006, 2012) governed for that dataset.

5.2.4 Cross-Section Generation

Cross-sections were generated using the procedure described in Section 3. Details concerning the method (Visual Basic script) used to incorporate field-surveyed cross-sections are provided in Exhibit L to this memo.

5.2.5 Parameter Estimation

5.2.5.1 Manning's "n" Values

Manning's "n" values for both the channel and overbanks were derived per the method described in Section 3. These values were entered into the hydraulic model to represent the values that were viewed as part of the field reconnaissance and estimated from available aerial photography.

5.2.5.2 Expansion and Contraction Coefficients

Expansion and contraction loss coefficients were applied to all crossing structures within the HEC-RAS model to account for the additional energy losses. Expansion and contraction loss coefficients were applied between cross-sections to account for losses to the changing width of the channel in accordance with commonly accepted practices. Table 5-2 provides the loss coefficients that were used for most of the HEC-RAS modeling. In a few cases, abrupt contractions and expansions were modeled with slightly higher loss coefficients.

Table 5-2. Expansion and Contraction Coefficients

Location	Contraction Loss Coefficient	Expansion Loss Coefficient
Natural Cross-Sections	0.1	0.3
Bridge/Culvert	0.3	0.5
Abrupt Transitions	0.4	0.6

5.2.5.3 Ineffective Areas and Obstructions

The expansion ratios at structures were derived based upon Table 5-1 of the *HEC-RAS V4.1 User's Manual* as a function of stream slope, ratio of overbank to channel roughness, and ratio of bridge opening to approximate width of 1% AEP floodplain.

Ineffective areas delineated within cross-sections not associated with structures were delineated by hand based upon review of cross-section geometry and upstream and downstream conditions.

5.2.6 Structures

Structures were modeled per the procedures described in Section 3. A brief overview of those procedures is provided herein. Structures located along the study area consist of concrete box culverts with concrete wingwalls, culvert crossings, bridges, earthen dams, concrete in-line structures, and non-standard structures designed to maintain local amenity ponds and other features. Where possible, structure dimensions and invert elevations were based on field survey.

In limited circumstances where survey data were not available, these parameters were estimated based on the available topographic data, aerial photography, and field reconnaissance.

Several in-line dams operated by the District are located within the study area. Some dams were located at the upstream end of individual reaches and some were located at the downstream ends of individual reaches. Several of the dams were also included in the middle of the study reaches. For the dams existing within the middle of the study reaches, the reaches were broken into two disconnected reach segments (upstream of dam and downstream of dam) with the actual dam not included in the hydraulic model. The effects of these dams were included in Section 4. WSELs calculated in the hydrologic model were used to plot WSELs (backwater) for the upstream sections of applicable study reaches.

5.2.7 Peak Flow Insertion Points

Peak flows were inserted per the methodology described in Section 3. A detailed description of the methodology used is provided in Exhibit M.

5.2.8 Starting Conditions

Boundary conditions were set per the assumptions presented in Section 3.

5.2.9 Model Calibration

Model calibration was performed to confirm that the hydraulic and hydrologic models provided results consistent with measured high water marks from recent flood events. This calibration is documented in Exhibit P.

5.3 Analysis and Results

Given the large size of the models (over 3,500 cross-sections in the full watershed model), results are presented as follows:

- HEC-RAS summary output tables by Table 5-1 model designation are provided in Exhibit N.
- Floodplains for each Table 5-1 model extent are scaled to 11x17 and provided in Exhibit O.

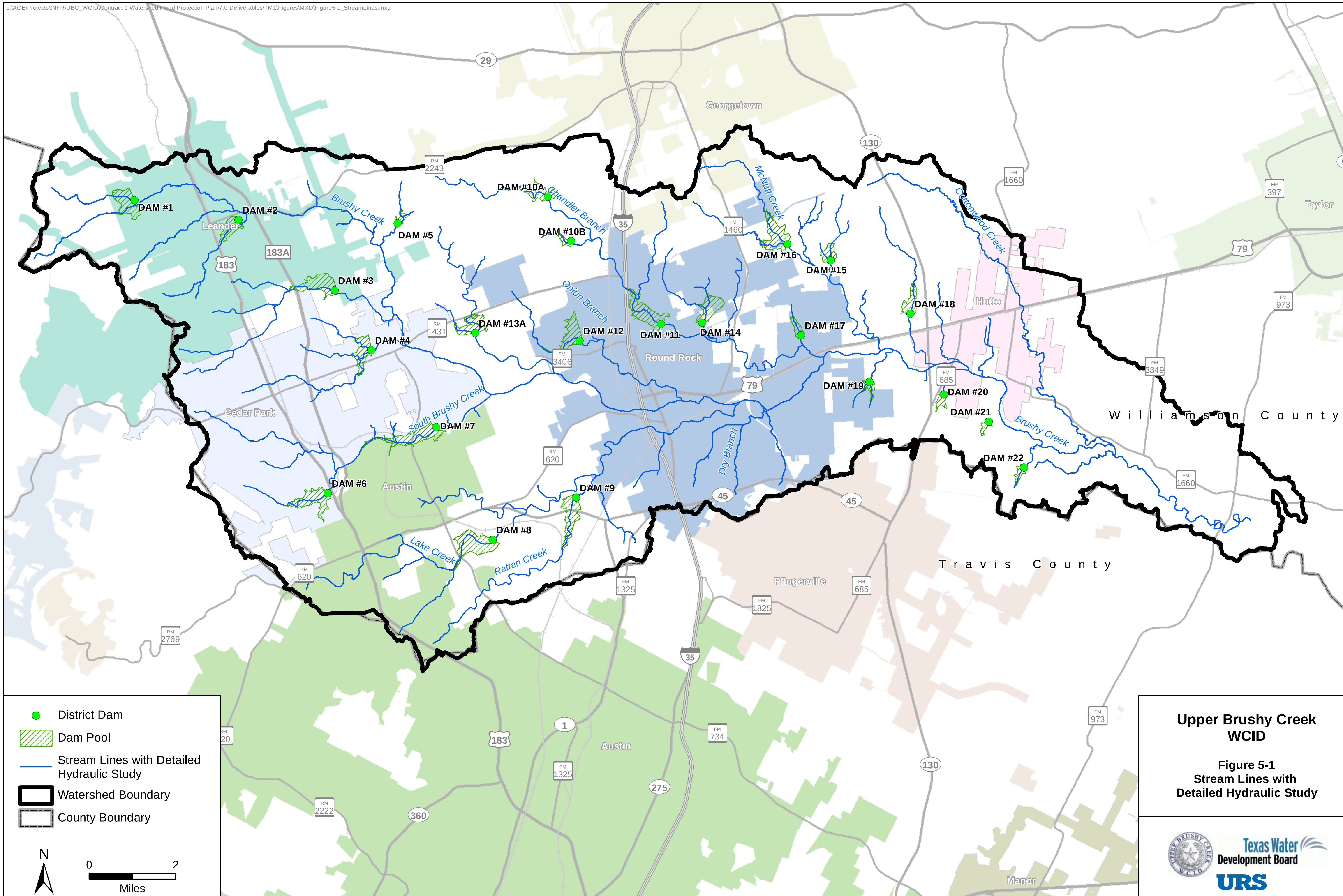
5.4 References

Federal Emergency Management Agency (FEMA), 2009. *Guidelines and Specifications for Flood Hazard Mapping Partners*, as amended. Washington, DC.

FEMA. Flood Insurance Study, Williamson County, Texas, and Incorporated Areas. Washington, DC, September 26, 2008.

FEMA. Flood Insurance Rate Maps, Williamson County, Texas, and Incorporated Areas. Washington, DC, September 26, 2008.

U.S. Army Corps of Engineers (USACE). Hydrologic Engineering Center-HECRAS River Analysis System, Hydraulic Reference Manual (HEC-RAS), Version 4.1. January 2010.



Upper Brushy Creek WCID

Figure 5-1
Stream Lines with Detailed Hydraulic Study

6.0 FLOOD HAZARD ASSESSMENT

6.1 Task Summary

A prime purpose of the FPP is to quantify flood risk using detailed hydrologic and hydraulic models to support the development of a flood mitigation plan. Section 5 details the flood hazard assessment process and results.

In June 2013, a TAC meeting was held to identify methodologies that could be used to quantify flood risk. Representatives from the City of Austin presented methods previously developed that could be tailored to the FPP. The URS project team reviewed all the available regional risk assessment methods and developed an approach that leverages the City's methodology, details from the hydraulic models developed for the FPP, and previous URS experience. This section details the methodology developed to assess flood risk as it pertains to inline transit structures (roadways, rail lines) and habitable structures (residential, commercial, etc.). This section also details how the results of this analysis were used to select PAs for flood mitigation.

Section 5:

- Provides a description of the overall task methodology;
- Provides a description of the risk assessment methodology for habitable structures;
- Provides a description of the risk assessment methodology for inline transit structures;
- Provides risk assessment results; and
- Selects PAs for development of flood mitigation.

The risk assessments presented in this section address the 50%, 10%, 4%, 2%, 1%, and 0.2% annual-chance (2-year, 10-year, 25-year, 50-year, 100-year, and 500-year return periods) flood events. The hydraulic models used in this analysis have been documented in Section 5 and are for planning purposes only.

6.2 Data Collection

URS developed geospatial databases for habitable structures and inline transit structures that served as the foundation for the flood risk assessment. Listed below are the larger datasets used to build the databases for this analysis.

Hydraulic Models – The hydraulic models developed for the UBC FPP, as detailed in Section 4, were used to estimate WSELs along the riverine system. The models were developed in compliance with FEMA's Appendix C (2009). The models have undergone two iterations of review by URS' FEMA review team. Comments that could potentially impact flood risk have been resolved. The unresolved comments at the time of this report pertain to those that are specific to FEMA regulatory models and do not significantly affect planning. These comments will be addressed once additional FEMA funding is made available. These models include the 10%, 4%, 2%, 1%, 1% future, and 0.2% annual-chance flood events.

Structures – The structure footprint shapefile provided by the Williamson County GIS Department was used as the base file for identifying structure footprints. This file was supplemented where gaps were found with data provided by the City of Round Rock and the City of Austin. Further comparison between the most current orthophotography (2012) and the footprint shapefiles identified structures that were not included in the dataset. Those structures were digitized into the footprint dataset. The classification of each structure (multi-family, single-family, non-residential) was estimated by visual inspection using the ESRI World Imagery base map. Additionally, smaller structures including sheds, pools, and garages were eliminated from the dataset (per the City of Austin's flood scoring methodology).

Inline Transit Structures – Inline transit structures were identified in Section 2 as part of the hydraulic modeling methodology. This point shapefile was updated to include the type of transit structure (highway, major arterial, minor arterial, single access, major collector, local, and rail). The roadway designation datasets used in the classification were provided by City of Austin, City of Round Rock, and the City of Georgetown.

In addition to the hydraulic models, other existing information was gathered and reviewed to complete the risk assessment. This information included:

- 2012 LiDAR/ 2006 LiDAR;
- 2012 Orthophotography; and
- Streamlines.

6.3 Software

Various software were used to build and develop both the structure and inline transit structure database. The multiple software used for this analysis are listed below.

- ArcGIS Desktop 10.1;
- HEC-RAS, Version 4.1.0; and
- HEC-Geo-RAS for ArcGIS 10.

6.4 Methodology

The methodology used for risk assessment in the FPP was developed over a series of workshops involving the District Board or TAC (including TWDB and District staff and Board members). These included:

- A TAC meeting on June 6, 2013 in which the City of Austin presented a risk assessment method they used.
- A District Board workshop on August 17, 2013. In this workshop, URS received input from the District on: 1) the hydraulic model-based method used for estimating flood risk for habitable structures (commercial buildings, residences); 2) the hydraulic model-based method used for estimating flood risk for in-line structures (road crossings of streams); and 3) qualitative factors to consider in estimating flood risk.

- A TAC workshop on October 1, 2013 in which the issues from the August meeting were addressed with the full TAC. Consensus methods were defined, with some issues relegated to resolution during the final workshop.
- A final TAC risk assessment workshop on October 11, 2013. In this workshop, final consensus methods were developed. Risk scores were finalized within the workshop, and priority areas were identified for development of flood mitigation measures.

This section provides the following:

- A brief summary of the City of Austin flood risk assessment methodology. This method provided a basic strategy that was followed in the FPP risk assessment methodology.
- A description of the methodology used for assessing flood risk associated with habitable structures. This description is of the final method employed, per the final plan workshop.
- A description of the methodology used for assessing flood risk associated with inline structures. This description is of the final method employed, per the final plan workshop.

6.4.1 Review of City of Austin Risk Assessment

The City of Austin presented a risk assessment method to the TAC on June 6, 2013. The presentation detailed the process that the City of Austin had developed to quantify flood risk based on flood depth at both habitable structures and inline transit structures. The method known as Creek Flood Hazard Mitigation (CFHM) uses depth of flooding associated with a range of flood events and the characteristics of each structure at risk to determine the Flood Score (FS). The process was readily applied for the FPP because it used spatial output datasets from hydraulic models including depth grids and velocity grids. In the case of habitable structures, FS for each structure can be aggregated based on geography and proximity to other structures to produce damage centers. The FS of each structure within the damage center are summed to quantify the FS for the damage center. This process allows for quantification of flood risk based on output datasets from detailed hydraulic models. This approach provided the basic outline of the approach developed for the FPP.

6.4.2 Risk Assessment Method Applied to Habitable Structures

In basic outline, the risk assessment for habitable structures included these basic tasks:

- Completion of watershed hydrologic and hydraulic models (documented in Sections 4 and 5);
- Application of the hydraulic models to estimate depth of flooding at each habitable structure (residences, commercial buildings, etc.) for a range of floods of varying return probability (from frequent to extremely rare);
- Classification of each flooded structure as a type of structure per a list of types;
- Development of a flood depth-related risk score for each flooded structure per a FS algorithm;

- Aggregation of individual structures within close proximity to each other (e.g., flooded structures within the same subdivision) into clusters, designated as Habitable Structure Damage Centers (HSDCs);
- Assignment of HSDCs into 13 Priority Areas;
- Application of qualitative risk factors to each HSDC per a workshop-developed procedure;
- Relative weighting of flood depth-related risk score to qualitative factors; this task was performed during the October 11 workshop;
- Ranking of HSDCs per an aggregate scoring scheme; and
- Selection of PAs that the FPP will address with proposed mitigation measures.

6.4.2.1 Estimation of Depth of Flooding at Structures

The hydraulic models documented in Section 5 were run to generate depth rasters (spatial, pixel by pixel, estimates of flood depth within the floodplain) for the following floods:

- 2% AEP flood, sometimes referred to as the flood with an average expected return period of 50 years ("50-year flood");
- 1% AEP flood (100-year flood); and
- 0.2% AEP flood (500-year flood).

The depth of flooding at each habitable structure was estimated by intersecting the structure footprint with the depth grid datasets for each storm event analyzed. The average depth of flooding at the structure was calculated by averaging the range of depths intersected by the structure footprint. The final depth was calculated by subtracting 6 inches from the average depth of flooding over the structure. The 6-inch subtraction represents the height adjustment from ground elevation to the finish floor elevation. This adjustment was estimated to be conservative and is consistent with what was used in the City of Austin risk scoring process.

6.4.2.2 Classification of Habitable Structure Types

A resource value was assigned to each structure within the database. The purpose of the assignment was to differentiate high occupancy/emergency service provider public facilities (hospitals, schools, etc.) from residences. The resource value is tied to the type of facility. Each structure was manually reviewed using orthophotography for accuracy, and the public facilities were identified individually in the workshops. Structures that are considered critical have a higher resource value than those that are considered less critical. All structures identified as sheds, pools, or residential car ports were eliminated from the analysis. Table 6-1 details the values assigned to each resource. These values were developed through multiple discussions in the TAC meetings described above.

Table 6-1. Structure Resource Values

Description	Resource Value	Number of Structures within 500-Year Flood Depth Grid Extent in Full Plan Area
Commercial	60	83
Single-Family Residential	60	824
Multi-Family Residential	80	10
Public Facility	100	10

6.4.2.3 Habitable Structure Flood Score Algorithm

The FS for each habitable structure was quantified by the equation:

$$FS_{\text{habitable structure}} = RV * (1/50D_{50} + 1/100D_{100} + 1/500D_{500})$$

RV = Resource Value, indicates type of structure (see Table 6-1);
D_{50} = Flood inundation depth over finished floor elevation for the 50-year storm event;
D_{100} = Flood inundation depth over finished floor elevation for the 100-year storm event; and
D_{500} = Flood inundation depth over finished floor elevation for the 500-year storm event.

The structure database which included the resource values was intersected with the depth grids from the 2%, 1%, and 0.2% AEP (50-year, 100-year, and 500-year) flood events. The algorithm shown above was applied to each structure, and the resulting FS was estimated for each.

6.4.2.4 Creation and Scoring of Habitable Structure Damage Centers

As noted in Table 6-1, over 900 structures within the FPP study area were assigned FS. A clustering procedure was applied to structures, similar to City of Austin procedures, to better identify contiguous areas of high flood risk. The method for developing these HSDCs is as follows.

A buffer was applied to the structure based on the FS rating. The rating of each structure determined the extent of their buffer and ability to merge with another buffer. The buffer widths versus FS are shown in Table 6-2. These are consistent with the City of Austin method.

Table 6-2. Flood Score Buffers

Rating	Flood Score	Buffer Applied
1	0	70 ft
2	0>FS>1	90 ft
3	1>FS>4	105 ft
4	4>FS>8	120 ft
5	8>FS>100	ft

Groups of structures adjacent to one another were combined using the dissolve ArcGIS tool to create clusters (HSDCs). Figure 6-1 illustrates the clustering process. FS were assigned to damage centers by summing the FS of all structures within the damage centers. The composite FS is the damage center FS. Figure 6-2 provides a watershed-wide overview of the location of the HSDCs with the highest FS. Table 6-3 provides a summary of the 41 HSDCs with the highest aggregate FS.

Table 6-3. 41 HSDCs with Highest Aggregate Flood Scores

HSDC ID	Model	Total Flood Score	# of Structures in 500-Year Floodplain	Priority Area
C201	Blockhouse	74.0	64	2
C65	Blockhouse	56.4	72	6
C14	Brushy Creek	49.2	6	3
C20	Brushy Creek	30.7	8	13
C58	Blockhouse	28.2	14	6
C55	Blockhouse	26.7	27	6
C194	Brushy Creek	23.8	9	10
C167	Brushy Creek	23.6	16	9
C29	Blockhouse	20.7	34	7
C83	Blockhouse	19.4	7	6
C47	Blockhouse	17.8	1	6
C188	Brushy Creek	15.0	5	9
C142	Brushy Creek	12.8	1	11
C145	Brushy Creek	12.2	1	11
C186	Brushy Creek	11.9	1	9
C100	Lake Creek	11.3	30	8
C139	Brushy Creek	11.0	2	4
C42	Blockhouse	9.3	4	13
C16	Brushy Creek	8.8	1	13
C189	Brushy Creek	8.5	6	9
C54	Blockhouse	7.5	1	11
C15	Blockhouse	7.4	1	13
C112	Lake Creek	7.0	12	4
C140	Brushy Creek	6.3	10	11
C242	Brushy Creek	6.1	1	1
C102	Lake Creek	5.6	3	9
C170	Brushy Creek	5.6	2	10
C199	Brushy Creek	5.3	2	10
C96	Blockhouse	5.1	2	8
C37	Blockhouse	4.5	1	13
C63	Blockhouse	4.5	24	11
C180	Brushy Creek	4.3	1	9

HSDC ID	Model	Total Flood Score	# of Structures in 500-Year Floodplain	Priority Area
C51	Blockhouse	4.2	16	13
C35	Blockhouse	4.1	12	6
C202	Cottonwood	4.0	27	12
C197	Brushy Creek	3.9	4	9
C187	Brushy Creek	3.6	1	9
C240	Brushy Creek	3.4	2	1
C196	Brushy Creek	3.1	2	10
C40	Blockhouse	3.1	1	11
C4	Blockhouse	2.9	18	5

6.4.2.5 Assignment of HSDCs to Priority Areas

Many of the HSDCs were located within the same reach of stream (i.e., along a reach between significant tributary inflows). The major projects envisioned for mitigation measures to address the HSDCs would likely improve all HSDCs within a single reach by roughly the same amount. For example, if a major detention facility were added to Davis Spring upstream of the junction with Lake Creek (see Figure 6-3), there would likely be significant lowering of flood levels for all the HSDCs downstream along Lake Creek. There would also be improvement to flood levels for HSDCs along Brushy Creek downstream of the junction of Lake Creek with Brushy Creek, but the improvement would be significantly less. To better understand the number of areas that could potentially be addressed by major projects, the 41 highest risk HSDCs were further aggregated into PAs, where "Priority Area" is loosely defined as a set of HSDCs with risks that are likely to be addressed by a common flood mitigation project or series of projects. In Lake Creek, for example, 6 HSDCs were aggregated into PA6.

Figure 6-3 provides a watershed-wide figure showing locations of PAs with their associated HSDCs. Table 6-3 shows which HSDCs are included within which PA. Exhibit Q includes a figure for each PA showing HSDC locations.

6.4.2.6 Development and Application of Qualitative Risk Factors

During the series of workshops, there was general consensus among TAC members that the ranking of PAs in terms of need for flood mitigation should not be based purely upon depth of flooding, and that other more judgment-based factors needed to be considered in addition to the FS factor detailed above. The basic sequence in the development of qualitative risk factors was as follows:

- TAC members, notably City of Round Rock staff, provided qualitative ranking procedures in use within their jurisdiction. These factors were typically applied to ranking of capital projects rather than ranking of risk areas.
- A series of qualitative factors and proposals for consideration of the factors were considered by TAC during June and October workshops. The method described in this section is the consensus method that was applied.

Qualitative factors were considered in planning by:

- Developing through consensus in TAC meetings the list of qualitative factors;
- Developing through consensus in TAC meetings a method by which to assign a value of 0 through 5 to each identified qualitative factor;
- Developing through consensus in the TAC meetings a means of weighting each qualitative factor score with the FS (per Section 6.4.2.3); and
- Aggregating the weighted scores.

The qualitative risk factors included in risk scoring are described below. Table 6-4 provides a summary of the scoring method used for each factor.

Risk of structural failure of any habitable structure within a damage center. If the estimated finished floor elevation of any habitable typical residential structure within a HSDC were inundated in excess of 4 feet, or a mobile home were inundated in excess of 1 foot, the structure would be at risk of collapse. This added risk is not considered by the estimation of FS per Section 6.4.2.3 and is included as a qualitative factor.

Public facility at risk. The identified damage centers included five with public facilities that were potentially at risk, including Grisham Middle School, Cedar Park Regional Clinic, Water Treatment Plant of Brushy Creek, Wastewater Treatment Plant further US on Brushy Creek, and a Cedar Park Pump station (in the backwater of Dam 4). These facilities were individually discussed in the TAC meeting and assigned risk values within the meeting. All other damage centers received a value of 0 for this factor.

Risk of loss of access to damage center in flood. Each damage center was reviewed and an estimate made as to which level of flood potentially cut off access to the damage center (e.g., by inundating a road that provided sole access). Damage centers whose access was severed for the statistically higher probability floods were assigned a higher value for this qualitative factor.

Likelihood of occupancy during flood. Damage centers were individually reviewed and a qualitative judgment made, based upon type of structure (residential, commercial, park facility, etc.), as to the likelihood that the structure would be occupied during a major flood.

Likelihood of damage center being addressed by flood mitigation project. The next planning following the risk assessment was to develop regional flood mitigation strategies that would significantly lower flood risk for the damage centers with the highest risk. There was the potential that some of the highest risk damage centers could not effectively be addressed by regional improvements. This qualitative factor provided a higher score to damage centers which, per initial analyses, were likely to be readily addressed by regional flood improvements. In general, the analyses performed included:

Table 6-4. Summary of Scoring Methods

Qualitative Factor	Qualitative Factor Value					
	5	**4**	**3**	**2**	**1**	**0**
Risk of Structural Failure for Any Inhabited Structure in DC	Risk of structural failure in 25-year flood	Risk of structural failure in 50-year flood	Risk of structural failure in 100-year flood	Risk of structural failure in 500-year flood		No risk of structural failure at 500-year flood or less
Public Facility at Risk	Judgment-based, based on relative significance of facility (there are so few that they can reviewed individually by group for a consensus decision)					
Risk of Loss of Access to Damage Center in Flood	Loss of access in 10-year flood	Loss of access in 25-year flood	Loss of access in 50-year flood	Loss of access in 100-year flood		No loss of access at 100-year flood or less
Likelihood of Occupancy During Flood	Occupancy is expected	Occupancy is very likely	Occupancy is likely	Occupancy is not likely	Occupancy is questionable	Occupancy is not possible
Likelihood of DC Being Addressed by Flood Mitigation Project	FS reduced by > 90%	FS reduced by > 70%	FS reduced by > 50%	FS reduced by > 25%	FS reduced by > 10%	FS not reduced
Large Commercial Developments	Judgment-based, based on relative significance of development (there are so few that they can reviewed individually by group for a consensus decision)					
Liklihood FFE Estimate Erroneously Raises FS	Highly Likely, Entire DC	Highly Likely, Half of DC	Highly Likely, Small part of DC	Highly Likely, one structure in DC	Indeterminate	Unlikely

- Review of hydraulic model profiles to identify damage centers located within the backwater of a downstream bridge/culvert, where bridge modification could potentially reduce upstream flooding. At identified sites, the potential effect of bridge modification on FS were estimated.
- Review of HEC-HMS model results to identify Brushy Creek tributaries that lacked flood detention structures (i.e., those stream lines not controlled by District dams). For each of these tributaries:
    - The topography was reviewed for a potential flood-retarding structure site;
    - The approximate maximum flood detention volume for that site was estimated;
    - The effect of this detention on watershed flood flows was estimated; and
    - Approximate changes to FS of damage centers were estimated.

Large commercial developments. There was recognition by TAC that large commercial developments at risk should be identified and given qualitative consideration because of the concentration of high property damage associated with inundation. Out of the 41 HSDCs, only four were identified as involving risk to commercial developments. These damage centers were reviewed and assigned scores for this qualitative factor in the TAC meeting. This factor ultimately had little influence on PA selection, as the highest ranked of these four HSDCs was 21st out of 41 HSDCs.

Likelihood Finished Floor Elevation (FFE) estimate erroneously raises the FS. The purpose for this qualitative factor was to allow for consideration that selected HSDCs were sited on steep terrain at the edge of floodplains, where the approximate method used for estimation of FFE could lead to overestimation of risk. This factor allowed for consideration of engineer's judgment that the estimated FS risk was inflated by the method used for estimating FFE. The judgment included an estimate of what percentage of the HSDC's risk was associated with the method used for FFE estimates.

Table 6-5 provides a summary of the scoring of qualitative factors by HSDC, using the method presented in Table 6-4.

6.4.2.7 Aggregation of Flood Risk Score and Qualitative Factors

The method used for aggregating FS (estimated quantitatively using flood depth from the hydraulic models) and the qualitative factor scores (estimated qualitatively per consensus method) for each HSDC followed the general procedure used by the City of Round Rock for ranking of capital projects. This procedure was modified and tailored during TAC discussions to fit the needs of the UBC FPP. This modification included use of Logical Decisions software to present aggregate results of TAC weighting preferences to allow for immediate discussion and development of a consensus during the TAC meeting. The method included the following steps.

Table 6-5. Summary of Scoring for Qualitative Factors by HSDC

CID	Category, Description	Number of Structures Impacted	Model	Total Flood Score	Priority Area	Structural Failure	Public Facility	Loss of Access	Occupancy	Reduction in FS	Commercial Development	Erroneous FFE
C100	A-numerous homes, shallow flooding	30	Brushy Creek	11.3	8	0	0	0	5	1	0	4
C102	E-few homes, residence questionable	2	Brushy Creek	5.6	9	0	0	2	5	1	0	5
C112	A-Numerous homes, shallow flooding	12	Brushy Creek	7.0	4	0	0	0	5	1	0	5
C139	C-Commercial property	2	Brushy Creek	11.0	4	0	0	0	2	1	3	4
C14	D-Combination-Public facility	6	South Brushy	49.2	3	2	4	4	5	2	0	5
C140	F-Single house	1	Brushy Creek	6.3	11	0	0	0	5	2	0	0
C142	F-Single house	1	Brushy Creek	12.8	11	0	0	5	5	2	0	4
C145	F-Single house	1	Brushy Creek	12.2	11	0	0	5	3	2	0	5
C15	F-Single house	1	Brushy Creek	7.4	13	0	0	4	5	2	0	5
C16	F-Single house	1	Brushy Creek	8.8	13	0	0	5	5	3	0	4
C167	C-Commercial-potentially need to change RV	5	Brushy Creek	23.6	9	0	5	0	1	2	0	5
C170	F-Single House	1	Brushy Creek	5.6	10	0	0	4	5	3	0	4
C180	A-numerous homes, shallow flooding	24	Brushy Creek	4.3	9	0	0	2	5	2	0	1
C186	F-Single house	1	Brushy Creek	11.9	9	2	0	5	5	1	0	0
C187	C-Commercial buildings	4	Brushy Creek	3.6	9	0	0	0	2	2	5	5
C188	F-Single house	1	Brushy Creek	15.0	9	2	0	5	5	2	0	5
C189	C-Commercial	6	Brushy Creek	8.5	9	0	0	0	2	2	5	5
C194	E-Few homes, deep flooding	9	Brushy Creek	23.8	10	0	0	5	5	2	0	3
C196	F-Single House	2	Brushy Creek	3.1	10	0	0	0	5	2	0	4
C197	A-numerous houses, shallow flooding	27	Brushy Creek	3.9	9	0	0	0	5	2	0	5
C199	A-Numerous homes, shallow flooding	17	Brushy Creek	5.3	10	0	0	2	5	0	0	4
C20	E-Cluster of mixed use struct, floods in 2yr	8	Brushy Creek	30.7	13	0	0	5	3	0	0	5
C201	B-Numerous homes, >1 foot 100year flood	64	Blockhouse	74.0	2	5	0	5	5	0	0	5
C202	B-numerous homes, deep flooding	12	Cottonwood	4.0	12	0	0	4	5	0	0	5

CID	Category, Description	Number of Structures Impacted	Model	Total Flood Score	Priority Area	Structural Failure	Public Facility	Loss of Access	Occupancy	Reduction in FS	Commercial Development	Erroneous FFE
C240	C-Commercial	1	Brushy Creek	3.4	1	0	0	0	1	0	5	5
C242	E-cluster of mixed use struct	10	Brushy Creek	6.1	1	0	0	0	5	0	0	5
C29	A-numerous homes, shallow flooding	34	Lake Creek	20.7	7	0	0	0	5	0	0	5
C35	A-numerous homes, shallow flooding	16	Lake Creek	4.1	6	0	0	0	5	4	0	1
C37	F-Single house	2	Brushy Creek	4.5	13	0	0	5	5	5	0	4
C4	D-Combination houses, commercial	3	Lake Creek	2.9	5	0	0	0	5	5	0	1
C40	F-Single house	1	Brushy Creek	3.1	11	0	0	3	5	5	0	5
C42	E-few homes	4	Brushy Creek	9.3	13	0	0	5	5	5	0	4
C47	B-Numerous homes, >1 foot 100year flood	16	Lake Creek	17.8	6	0	0	2	5	5	0	2
C51	F-single house-flooded in the 2yr	1	Brushy Creek	4.2	13	0	0	2	1	5	0	4
C54	F-Single house	1	Brushy Creek	7.5	11	0	0	4	5	5	0	4
C55	B-Numerous homes, >1 foot 100year flood	27	Lake Creek	26.7	6	0	0	4	5	5	0	2
C58	B-Numerous homes, >1 foot 100year flood	14	Lake Creek	28.2	6	0	0	4	5	5	0	2
C63	F-Single House	1	Brushy Creek	4.5	11	0	0	4	5	5	0	4
C65	B-Numerous homes, >1 foot 100year flood	72	Lake Creek	56.4	6	0	0	4	5	5	0	5
C83	E-few homes, deep flooding	7	Lake Creek	19.4	6	0	0	4	5	4	0	5
C96	D-Public Facility	3	Brushy Creek	5.1	8	0	5	0	0	0	0	5

Pairwise comparison. The FS and each qualitative factor were arrayed as shown in Figure 6-4. TAC members were asked to fill in each unshaded cell of the table, by estimating the relative importance of the two factors associated with each cell. An example estimate for a single cell is shown in Figure 6-5 (this is an example with random entries, not associated with any TAC member input). Once all the comparisons are made in the full table, the numbers within each row are summed, and then divided by the total of all rows to estimate a relative weight between each factor, as shown in Figure 6-6. In the example provided, FS would have a weight of 0 versus a weight of 4 for "Likelihood of Occupancy" during a flood (this is not an actual evaluation sheet).

Consensus development of weighting factors and final results. Following the initial pairwise comparison, results were shown to the full TAC, and the effects of the weighting on ranking of the 41 HSDCs (and associated Priority Areas) in Table 6-3 were presented. The rankings were based upon applying the weights to normalized values of each factor, i.e., the range of values for each factor were divided by the maximum value to constrain the range of values from 0 to 1. During further meeting discussions, Logical Decisions software was used to test the effect of alternative weights for each considered factor on rankings of HSDCs and Priority Areas. The consensus final weights for each factor are shown in Table 6-6.

Table 6-6. Final Weights for Each Factor

HSDC ID		C140
Priority Area		11
Aggregate Risk Score (Sum of Scores X Weights)		0.174
Factor	**Factor Weight**	**Normalized Score (no weight applied)**
Flood Score	0.130	0.05
Risk of Structural Failure for Any Inhabited Structure in DC	0.160	0.00
Critical Public Facility at Risk	0.160	0.00
Risk of Loss of Access to Damage Center in Flood	0.130	0.00
Likelihood of Occupancy During Flood	0.120	1.00
Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or Bridge Modification	0.120	0.40
Large Commercial Developments	0.100	0.00
Likelihood that FFE Estimate Erroneously Raises FS	0.080	0.00

6.4.2.8 Ranking of Priority Areas for HSDCs

The aggregate ranking score for each of the 41 HSDCs with high FS, sorted by score value, is presented in Table 6-7. The final ranking of PAs from highest to lowest per this table is 3, 2, 6, 9, 13, 11, 10, 12, 5, 8, 7, 4, and 1. Exhibit Q to this section provides a figure depicting each Priority Area.

Table 6-7. Aggregate Ranking Scores for HSDCs

HSDC ID	Priority Area	Aggregate Risk Score (Sum of Scores X Weights)	Factor: Flood Score	Risk of Structural Failure for Any Inhabited Structure in DC	Critical Public Facility at Risk	Risk of Loss of Access to Damage Center in Flood	Likelihood of Occupancy During Flood	Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or Bridge Modification	Large Commercial Developments	Likelihood that FFE Estimate Erroneously Raises FS
		Factor Weight	0.130	0.160	0.160	0.130	0.120	0.120	0.100	0.080
		Normalized Score (no weight applied)								
C14	3	0.629	0.65	0.40	0.80	0.80	1.00	0.40	0.00	1.00
C201	2	0.620	1.00	1.00	0.00	1.00	1.00	0.00	0.00	1.00
C65	6	0.522	0.75	0.00	0.00	0.80	1.00	1.00	0.00	1.00
C188	9	0.464	0.17	0.40	0.00	1.00	1.00	0.40	0.00	1.00
C42	13	0.446	0.09	0.00	0.00	1.00	1.00	1.00	0.00	0.80
C37	13	0.437	0.02	0.00	0.00	1.00	1.00	1.00	0.00	0.80
C83	6	0.430	0.23	0.00	0.00	0.80	1.00	0.80	0.00	1.00
C58	6	0.422	0.36	0.00	0.00	0.80	1.00	1.00	0.00	0.40
C55	6	0.419	0.33	0.00	0.00	0.80	1.00	1.00	0.00	0.40
C54	11	0.416	0.06	0.00	0.00	0.80	1.00	1.00	0.00	0.80
C63	11	0.411	0.02	0.00	0.00	0.80	1.00	1.00	0.00	0.80
C40	11	0.398	0.00	0.00	0.00	0.60	1.00	1.00	0.00	1.00
C16	13	0.397	0.08	0.00	0.00	1.00	1.00	0.60	0.00	0.80
C194	10	0.384	0.29	0.00	0.00	1.00	1.00	0.40	0.00	0.60
C142	11	0.380	0.14	0.00	0.00	1.00	1.00	0.40	0.00	0.80
C170	10	0.365	0.04	0.00	0.00	0.80	1.00	0.60	0.00	0.80
C15	13	0.360	0.06	0.00	0.00	0.80	1.00	0.40	0.00	1.00
C186	9	0.354	0.13	0.40	0.00	1.00	1.00	0.20	0.00	0.00
C47	6	0.351	0.21	0.00	0.00	0.40	1.00	1.00	0.00	0.40
C167	9	0.350	0.29	0.00	1.00	0.00	0.20	0.40	0.00	1.00
C145	11	0.347	0.13	0.00	0.00	1.00	0.60	0.40	0.00	1.00
C20	13	0.333	0.39	0.00	0.00	1.00	0.60	0.00	0.00	1.00
C202	12	0.306	0.02	0.00	0.00	0.80	1.00	0.00	0.00	1.00
C189	9	0.286	0.08	0.00	0.00	0.00	0.40	0.40	1.00	1.00
C102	9	0.281	0.04	0.00	0.00	0.40	1.00	0.20	0.00	1.00
C187	9	0.277	0.01	0.00	0.00	0.00	0.40	0.40	1.00	1.00
C51	13	0.262	0.02	0.00	0.00	0.40	0.20	1.00	0.00	0.80
C4	5	0.256	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.20
C197	9	0.250	0.01	0.00	0.00	0.00	1.00	0.40	0.00	1.00
C96	8	0.244	0.03	0.00	1.00	0.00	0.00	0.00	0.00	1.00
C199	10	0.240	0.03	0.00	0.00	0.40	1.00	0.00	0.00	0.80
C180	9	0.238	0.02	0.00	0.00	0.40	1.00	0.40	0.00	0.20
C35	6	0.234	0.02	0.00	0.00	0.00	1.00	0.80	0.00	0.20
C29	7	0.232	0.25	0.00	0.00	0.00	1.00	0.00	0.00	1.00
C196	10	0.232	0.00	0.00	0.00	0.00	1.00	0.40	0.00	0.80
C112	4	0.231	0.06	0.00	0.00	0.00	1.00	0.20	0.00	1.00
C100	8	0.223	0.12	0.00	0.00	0.00	1.00	0.20	0.00	0.80
C139	4	0.211	0.11	0.00	0.00	0.00	0.40	0.20	0.60	0.80
C242	1	0.206	0.05	0.00	0.00	0.00	1.00	0.00	0.00	1.00
C240	1	0.205	0.01	0.00	0.00	0.00	0.20	0.00	1.00	1.00
C140	11	0.174	0.05	0.00	0.00	0.00	1.00	0.40	0.00	0.00

Shading indicates first occurrence of Priority Area.

A sensitivity analysis (see Exhibit R) was performed to estimate the effect of alternative weighting scenarios on PA ranking. This analysis considered eight separate scenarios and provided results of ranking deriving from each. In general, PAs within the original (base scenario per Table 6-6) top seven (out of 13) rankings moved up or down within the ranking by a maximum of one position. The ranking of some PAs within the original scenario's bottom six positions changed more significantly over the span of alternative scenario results. None of the lower six PAs rose higher in rank than position 8, i.e., all the changes involved shuffling within the bottom six positions.

A later review of PA5 found that this area had FFE that were above the estimated flood elevations per hydraulic modeling, and this PA was removed from further consideration.

6.4.3 Risk Assessment Method Applied to Inline Structure Damage Centers

In basic outline, the risk assessment for inline structures (bridges, culverts spanning floodplains – see Figures 6-7A and 6-7B) included these basic tasks, similar to those applied for habitable structures:

- Completion of watershed hydrologic and hydraulic models (documented in Sections 4 and 5);
- Application of the hydraulic models to estimate depth of flooding at each inline structure spanning a floodplain for a range of floods of varying return probability (from frequent to extremely rare);
- Classification of each flooded structure as a type of structure per a list of types;
- Development of a flood depth-related risk score for each flooded structure per a FS algorithm; and
- Ranking of in-line structures per risk score.

Flooded structures were referred to as inline structure damage centers (ISDCs), consistent with terminology used by the City of Austin. The ranking of ISDCs did not include consideration of qualitative factors, as TAC considered that improvement designs associated with undersized bridges and culverts would be led by the governing TAC member rather than the District.

6.4.3.1 Estimation of Depth of Flooding and Velocity at Inline Structure

The hydraulic models documented in Section 5 were run to generate depth of flooding and velocity at each inline structure for each of the following floods:

- 2% AEP flood (50-year flood);
- 1% AEP flood (100-year flood); and
- 0.2% AEP flood (500-year flood).

6.4.3.2 Classification of Inline Structure Types

A resource value was assigned to each inline structure within the database. The purpose of the assignment was to differentiate high traffic major highways from roadways of lesser traffic and utility for evacuation. The resource value is tied to the type of roadway. Table 6-8 details the values assigned to each resource. These values were developed through multiple discussions in the TAC meetings described above.

Table 6-8. Inline Transit Structure Resource Values

Description	Resource Value
Highway	100
Railroad	100
Major Arterial	95
Minor Arterial	90
Single Access Road	90
Major Collector	85
Minor Collector	85
Local	20
Single Access Driveway	0
Low Water Crossing	0
Park Road	0

The assignment of a roadway description per Table 6-8 to each ISDC was reviewed individually by TAC members and adjusted per TAC consensus in TAC meetings. Table 6-9 provides a summary of roadways that overtopped in the 50-year flood with their respective assigned resource values, flood depths, and velocities.

6.4.3.3 Inline Structure Flood Score Algorithm

Per consensus of the TAC, the FS for each ISDC was quantified by the equation:

$$FT_{crossing} = RV * (1/50D_{50}\ V_{50} + 1/100D_{100}\ V_{100} + 1/500D_{500}\ V_{500})$$

RV = Resource Value, indicates type of structure (see Table 6-7);
D_{50} = Flood inundation depth for the 50-year storm event, taken as depth of weir flow from the culvert/bridge summary table in HEC-RAS; and
V_{50} = Channel velocity for the 50-year storm event, taken as weir flow rate divided by weir flow area from the culvert/bridge summary table in HEC-RAS (where weir flow defined by HECRAS; where not, average velocity between upstream and downstream cross-sections was used).

6.4.3.4 Flood Score Results, Inline Damage Centers

Table 6-9 provides a summary of the FS for each ISDC per the method described in Sections 5.3.2 and 5.3.3. In the final TAC meeting, there was no final consensus on the method for estimation of velocity to use in the FS, in particular for the condition where

Table 6-9. Roadways Overtopped in 50-Year Flood

ISID	Roadway Name	Location	Type	Total Flood Score	Flood Depth 50-Year	Flood Depth 100-Year	Flood Depth 500-Year	Velocity 50-Year	Velocity 100-Year	Velocity 500-Year
City of Austin										
IS372	Mellow Meadows	Lake Creek R2	Single Access Road	6.1	0.8	1.4	2.8	1.9	2.6	3.5
IS371	San Felipe Blvd	Rattan Creek	Minor Collector	8.2	0.8	1.5	2.9	2.1	3.1	4.1
City of Cedar Park										
IS360	Cardinal Ln	Cluck Creek	Single Access Road	19.9	1.5	1.8	2.6	2.7	3.0	3.6
IS357	Cedar Park Dr	Cluck Creek	Minor Collector	21.9	1.6	1.9	2.4	2.7	2.9	3.4
IS354	RR 1431/W Whitestone Blvd	Cluck Creek	Major Arterial	21.8	1.4	1.5	1.8	2.5	2.6	2.8
City of Hutto										
IS68	Coyote Trail	Brushy Creek Trib9	Local	7.9	2.0	2.3	2.8	3.0	3.1	3.4
IS66	CR 110	McNutt Creek Trib3	Minor Arterial	40.6	2.1	2.5	3.0	3.3	3.6	3.8
IS65	CR 110	McNutt Creek Trib3	Minor Arterial	24.6	1.6	1.8	2.1	2.6	2.7	3.0
IS63	CR 110	McNutt Creek Trib2 R2	Minor Arterial	16.6	1.2	1.4	1.8	2.5	2.7	3.0
IS62	CR 112	McNutt Creek Trib1	Minor Collector	10.5	0.9	1.3	1.9	2.3	2.7	3.3
IS69	CR 135	Brushy Creek Trib9	Single Access Road	10.6	1.2	2.1	3.0	2.2	3.0	3.6
IS169	CR 199	Cottonwood	Local	9.3	5.3	6.1	5.6	1.3	1.3	2.3
City of Leander										
IS39	Emerald Isle Dr	Blockhouse Trib2	Minor Collector	6.9	0.7	0.8	1.0	1.8	2.0	2.2
IS249	FM 2243	S Fork Brushy	Major Arterial	7.7	1.1	1.4	1.8	2.2	2.2	2.5
IS54	Los Vista Dr	Mason Creek Trib1	Minor Collector	11.5	1.0	1.1	1.3	2.2	2.3	2.6
IS252	Ridgmar Rd	Brushy Creek	Local	56.8	7.8	8.7	11.0	5.6	5.7	5.8
IS251	RR 2243	Brushy Creek	Major Arterial	37.1	2.3	2.5	3.3	2.9	3.2	3.8
City of Round Rock										
IS158	A W Grimes Blvd Northbound	Brushy Creek	Major Arterial	128.1	5.7	7.6	11.5	4.5	5.2	6.4
IS318	Burnet St S	Lake Creek R1	Local	5.6	1.8	3.4	7.1	2.9	4.2	5.8
IS254	Chisholm Trail Rd	Brushy Creek	Minor Collector	176.8	6.1	7.1	10.6	5.8	6.3	6.5
IS377	Deep Wood Dr	Lake Creek R1	Minor Collector	85.4	4.2	6.5	9.5	4.3	3.8	4.5
IS7	Greenlawn Blvd	Dry Branch Trib1	Major Arterial	15.6	1.3	1.5	2.0	2.1	2.4	2.8
IS64	Harrell Pkwy	Chandler Branch Trib5 R1	Local	4.7	1.5	1.7	2.1	2.5	2.7	3.0
IS15	Nash St W	Lake Creek Trib6	Local	12.2	2.9	3.2	3.7	3.3	3.5	3.9
IS375	Oak Ridge Dr	Lake Creek R1	Minor Collector	34.9	2.2	4.2	8.1	3.4	4.7	4.9

ISID	Roadway Name	Location	Type	Total Flood Score	Flood Depth			Velocity		
					50-Year	100-Year	500-Year	50-Year	100-Year	500-Year
IS4	Oxford Blvd	Dry Branch Trib1	Local	5.2	1.5	2.1	2.9	2.9	3.3	3.5
IS10	Purple Sage	Lake Creek Trib6	Local	6.5	1.8	2.1	2.5	2.8	3.0	3.4
IS274	Railroad Crossing	Onion Branch R1	Railroad	25.3	1.6	2.0	2.7	2.7	3.0	3.2
IS159	Red Bud Ln	Brushy Creek	Major Arterial	13.9	1.4	2.2	6.7	2.6	3.3	5.6
IS376	Round Rock W Dr	Lake Creek R1	Minor Collector	24.7	1.7	4.1	8.1	3.3	4.4	6.3
IS48	Twin Ridge Pkwy	Brushy Creek Trib5A	Minor Collector	6.6	0.8	1.3	1.8	2.0	2.5	2.9
Williamson County										
IS304	Brushy Bend	Brushy Creek	Local	82.1	10.7	12.0	15.1	6.1	6.1	5.9
IS310	CR 110	McNutt Creek R1	Minor Arterial	63.0	3.0	4.0	5.9	3.7	4.3	5.3
IS173	CR 110	McNutt Creek Trib2A	Minor Arterial	43.8	2.3	2.6	3.1	3.3	3.5	3.7
IS83	CR 129	Brushy Creek	Local	19.8	4.0	5.0	7.0	4.2	4.7	5.8
IS162	CR 137	Brushy Creek	Minor Arterial	108.0	4.4	6.1	9.5	5.0	5.8	7.1
IS125	CR 176	Brushy Creek Trib4 R2	Local	11.2	2.9	3.0	3.5	3.0	3.2	3.5
IS217	CR 177	Brushy Creek	Local	38.6	10.4	11.0	12.5	2.8	2.9	3.4
IS277	CR 179	Brushy Creek	Minor Collector	230.7	7.3	8.0	10.2	6.0	6.2	6.4
IS117	FM 1325	Rattan Creek Trib1 R2	Major Arterial	23.6	1.6	2.1	2.9	2.5	3.1	3.8
IS308	FM 1660	Cottonwood	Major Arterial	19.7	1.5	1.9	2.5	2.4	2.9	3.4
IS89	Hairy Man Rd	Brushy Creek	Major Arterial	73.2	5.7	6.8	9.9	4.3	4.2	5.5
IS130	Lemens Ave	Dam 18 R2	Local	6.6	1.8	2.0	2.4	2.8	3.0	3.0
IS248	Mesa Rd	N Fork Brushy R1	Single Access Road	6.7	0.7	0.7	0.9	1.8	1.8	2.0
IS306	Old TX 180 Dirt Road	Post Oak	Local	5.5	1.8	2.0	2.5	2.6	2.7	3.1
IS313	Railroad Crossing	Chandler Branch R3	Railroad	41.4	2.1	2.3	2.8	3.1	3.3	3.6
IS334	Railroad Crossing	Blockhouse R2	Railroad	6.3	1.0	1.3	1.8	1.5	1.8	2.3
IS365	Skyview St	Spanish Oak R2	Single Access Road	70.0	3.1	3.4	4.3	3.9	4.1	4.5
IS155	Spanish Oak Trail	Brushy Creek	Local	52.4	9.3	10.4	13.6	4.4	4.4	4.4
IS186	Tonkawa Trail	Dry Fork	Local	4.8	1.6	1.8	2.3	2.4	2.6	3.1

HECRAS did not provide a weir flow rate and flow area. Table 6-9 is therefore provided as a resource for use by TAC members, to be modified as needed to fit the needs of each TAC member. Figure 6-8 provides the location of 50 ISDCs with relatively high FS.

6.4.4 Summary

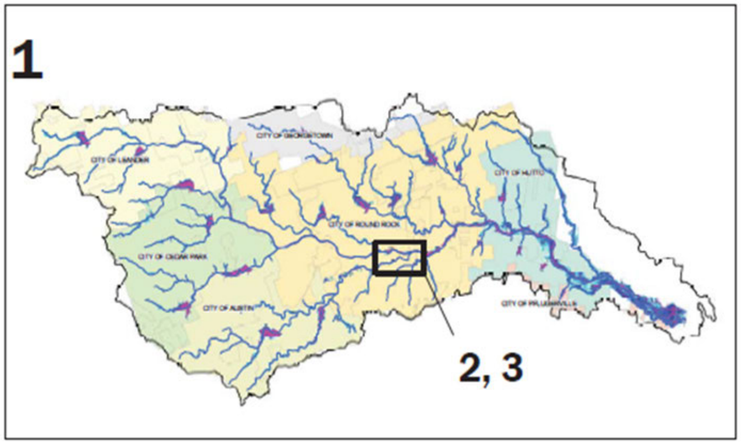
This section provides the results of the flood hazard assessment for the FPP for Upper Brushy Creek Watershed. Table 6-7 provides a ranking in terms of flood hazard of 13 PAs (habitable structures) identified through watershed modeling and confirmed through interaction with the study TAC. Table 6-9 provides a summary of FS associated with individual inline structures, per the method documented in this report.

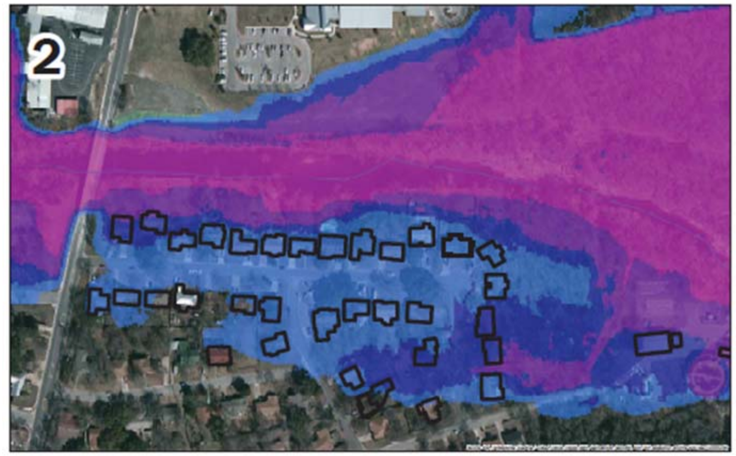
The application of the ranking of the PAs per Table 6-7 is:

- The number of PAs (13) identified for consideration of flood improvements was within the expected range of plan areas to be addressed. The plan proceeded with development of alternatives to address all 13 areas.
- The ranking of PAs per Table 6-7 will likely be considered in the final ranking of planned flood mitigation efforts District-wide.

The application of the FS for ISDCs per Table 6-9 is:

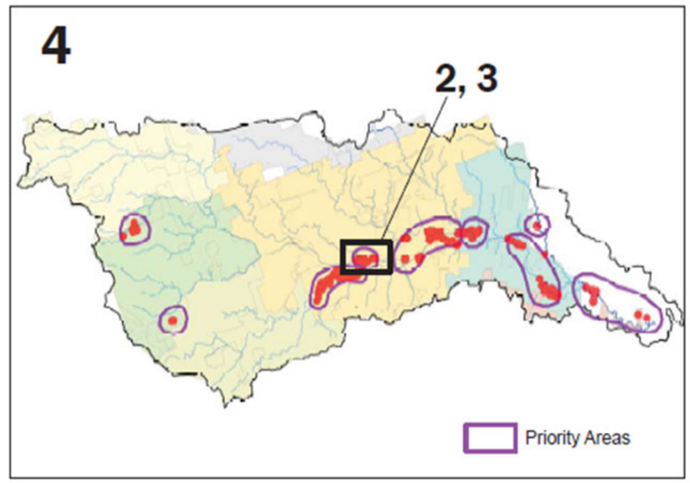
- Individual TAC members can use this information as pertains to ongoing transportation planning within their individual jurisdictions; and
- The information may be considered in the final plan proposed flood improvement ranking if improvement of an ISDC is planned as part of a solution to address a habitable structure PA.





Depth grids were generated from HECRAS models that show depth of flooding from the 2-year to the 500-year floodplain.

Damage centers were created based on the composite Flood Risks of each structure.



Depth of flooding was evaluated at each habitable structure to quantify the Flood Risk value based on likelihood and depth of flooding.

After ranking all damage centers based on qualitative and quantitative factors, as well as input from the communities, 9 Priority Areas were chosen for further evaluation.

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Figure 6-1. Selecting Priority Areas

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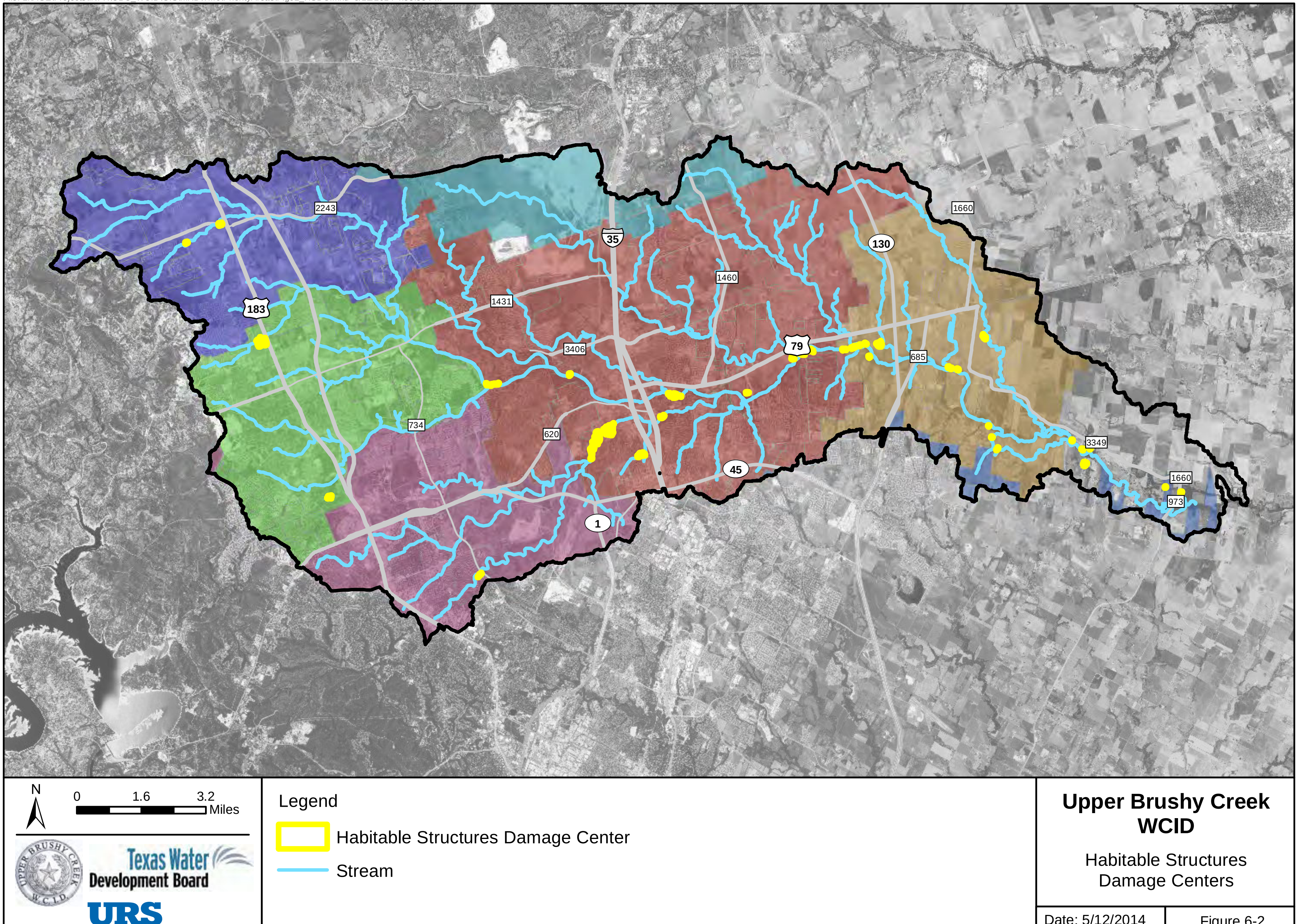

Legend

Habitable Structures Damage Center

Stream

Upper Brushy Creek WCID

Habitable Structures Damage Centers

Date: 5/12/2014

Figure 6-2

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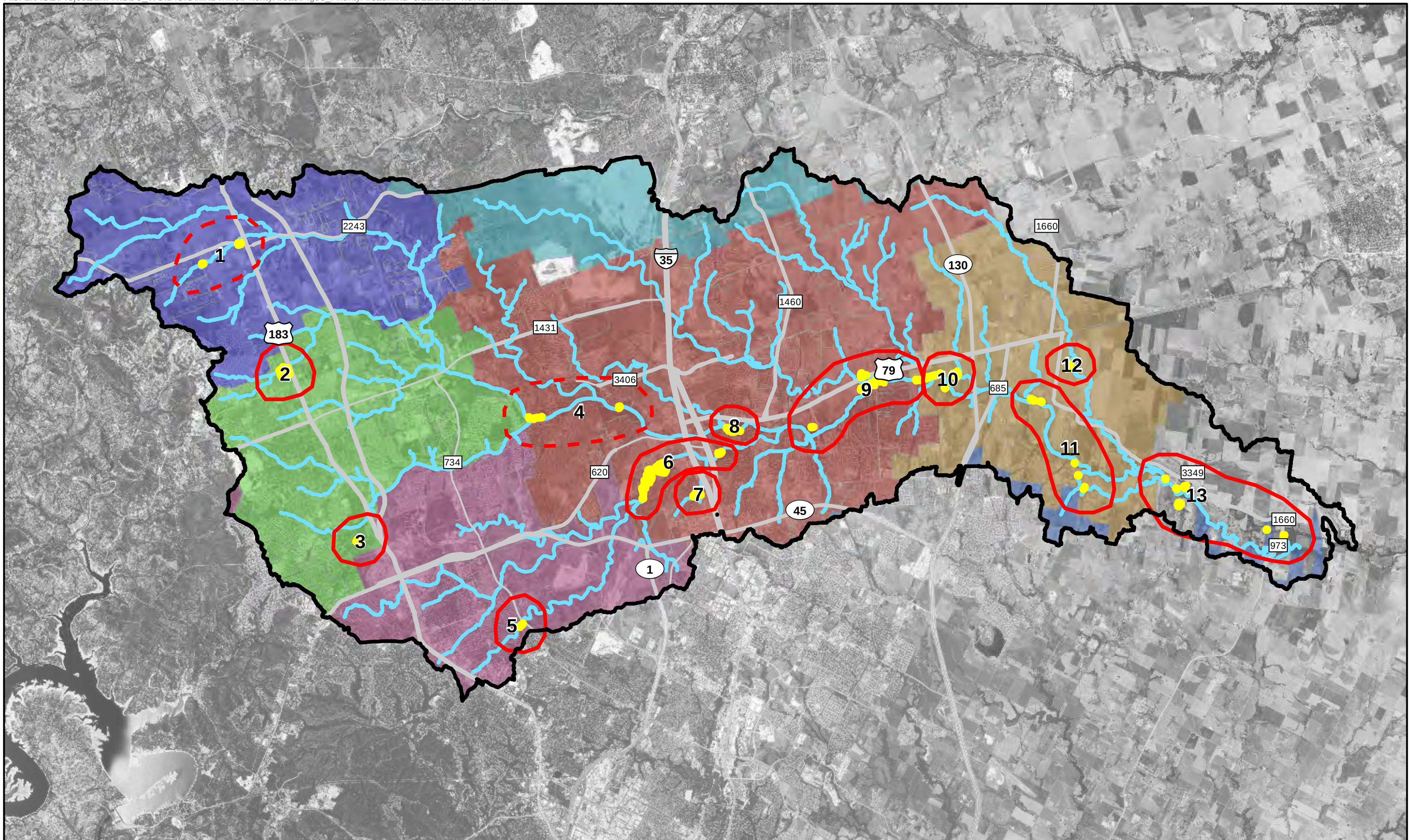

N

0 1.6 3.2 Miles

Texas Water Development Board

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Legend

Priority Areas (higher priority)

Priority Areas (lower priority)

Habitable Structures Damage Center

Stream

Upper Brushy Creek WCID

Priority Areas

Date: 5/12/2014

Figure 6-3

Pairwise Evaluation

Criteria	Flood Score	Qualitative Factors						Sum	Weight
		Risk of Structural Failure for Any Inhabited Structure in DC	Public Facility at Risk	Large Commercial Developments	Risk of Loss of Access to Damage Center in Flood	Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or bridge Modification	Likelihood that FFE Estimate Erroneously Raises FS	Likelihood of Occupancy During Flood		
Flood Score										
Risk of Structural Failure for Any Inhabited Structure in DC										
Public Facility at Risk										
Large Commercial Developments										
Risk of Loss of Access to Damage Center in Flood										
Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or bridge Modification										
Likelihood that FFE Estimate Erroneously Raises FS										
Likelihood of Occupancy During Flood										

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Figure 6-4. Pairwise Evaluation Form

The flood score factor was assigned a score of 1 out of 4 relative to the likelihood that the FFE estimate erroneously raised the flood score factor.

Pairwise Evaluation

Criteria	Flood Score	Qualitative Factors							Sum	Weight
		Risk of Structural Failure for Any Inhabited Structure in DC	Public Facility at Risk	Large Commercial Developments	Risk of Loss of Access to Damage Center in Flood	Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or bridge Modification	Likelihood that FFE Estimate Erroneously Raises FS	Likelihood of Occupancy During Flood		
Flood Score							1			
Risk of Structural Failure for Any Inhabited Structure in DC										
Public Facility at Risk										
Large Commercial Developments										
Risk of Loss of Access to Damage Center in Flood										
Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or bridge Modification										
Likelihood that FFE Estimate Erroneously Raises FS	3									
Likelihood of Occupancy During Flood										

The score for the likelihood that the FFE estimate erroneously raised the flood score factor was calcuated as 4 minus 1, based on the score of 1 assigned to the flood score factor.

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Figure 6-5. Pairwise Evaluation Form with Sample Entry

Scores are assigned to each factor in the first column.

The scores are summed for each factor.

Pairwise Evaluation

Criteria	Flood Score	Qualitative Factors							Sum	Weight
		Risk of Structural Failure for Any Inhabited Structure in DC	Public Facility at Risk	Large Commercial Developments	Risk of Loss of Access to Damage Center in Flood	Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or bridge Modification	Likelihood that FFE Estimate Erroneously Raises FS	Likelihood of Occupancy During Flood		
Flood Score		1	2	3	2	1	1	0	10	0.089
Risk of Structural Failure for Any Inhabited Structure in DC	3		4	4	3	3	4	1	22	0.196
Public Facility at Risk	2	0		3	3	2	3	1	14	0.125
Large Commercial Developments	1	0	1		1	1	1	0	5	0.045
Risk of Loss of Access to Damage Center in Flood	2	1	1	3		2	1	0	10	0.089
Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or bridge Modification	3	1	2	3	2		2	1	14	0.125
Likelihood that FFE Estimate Erroneously Raises FS	3	0	1	3	3	2		0	12	0.107
Likelihood of Occupancy During Flood	4	3	3	4	4	3	4		25	0.223

Reciprocal scores are calculated based on the assigned scores.

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Figure 6-6. Completed Sample Pairwise Evaluation Form

Legend

- Inline Structure
- Road
- Stream
- UBC WCID Boundary
- County Boundary

Upper Brushy Creek WCID

Inline Structures

Date: 5/13/2014	Figure 6-7A

Texas Water Development Board

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Legend

- Inline Structure
- Road
- Stream
- UBC WCID Boundary
- County Boundary

N

0 2,750 5,500 Feet

Upper Brushy Creek WCID

Inline Structures

Date: 5/13/2014

Figure 6-7B

Texas Water Development Board

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Factor	Evaluation 1	2	3	4	5	6	7	8	9	10	11	Total Score	Factor Weight
	Score												
Flood Score	10	9	10	16	14	25	20	15	14	11	13	157	0.13
Risk of Structural Failure for Any Inhabited Structure in DC	22	23	17	12	15	20	16	21	18	18	21	203	0.16
Public Facility at Risk	14	16	23	19	15	12	18	21	19	20	17	194	0.16
Large Commercial Developments	5	14	4	14	17	16	9	6	7	12	14	118	0.10
Risk of Loss of Access to Damage Center in Flood	10	13	22	13	13	16	16	12	13	18	17	163	0.13
Feasibility of DC Being Addressed by Existing Dam Pool Alteration,	14	11	14	10	14	12	18	14	19	11	13	150	0.12
Likelihood that FFE Estimate Erroneously Raises FS	12	10	4	16	11	7	6	10	8	6	5	95	0.08
Likelihood of Occupancy During Flood	25	16	18	12	13	4	9	13	14	16	12	152	0.12

Upper Brushy Creek W.C.I.D. | Texas Water Development Board | URS

Figure 6-8. Summary of 11 Separate Pairwise Evaluation Forms

7.0 FLOOD MITIGATION ALTERNATIVES

7.1 Task Summary

Previous sections have addressed:

- Hydrologic modeling;
- Hydraulic modeling; and
- Risk assessment/ identification of PAs to be addressed by future flood mitigation measures.

The FPP goals, as noted in Section 1, include identification of flood mitigation measures that address priority flooding issues within the watershed. This plan focuses on structural improvements (dams, channels, bridge crossings) which can be included in stakeholder (city, county) capital improvement plans. This section includes information which can be used by these stakeholders to prioritize and budget for these improvements within the larger context of their project funding. This section also demonstrates benefits associated with each project in terms of mitigation within regional flood concern PAs. This will facilitate coordination and cooperation between stakeholders when benefits of a flood mitigation measure are substantial within multiple jurisdictional boundaries, or when achieving the desired benefit means a flood mitigation measure needs to be built in an upstream jurisdiction to mitigate flooding concerns in a downstream jurisdiction.

This FPP does not address non-structural improvements (public education, refinements in providing early warning, regulatory changes, etc.). The District and TWDB recognize the importance of these measures, and local stakeholders are encouraged to consider such measures in the context of stormwater planning within each of their relevant individual jurisdictions. The District has been very proactive in facilitating early warning of floods within the District boundaries by: 1) having installed real-time stage and rainfall gages on 22 District dams and several flow gages on streams within the District, and 2) posting gage readings in real time on the District website.

Section 7 details development and assessment of structural flood mitigation alternatives within the study watershed. The tasks documented within this section include:

- Development of alternatives to address flooding in PAs;
- Sizing and costing of each alternative;
- Estimation of benefits in terms of a FS reduction for each alternative and combination of alternatives; and
- Prioritization of alternatives.

7.2 Development of Alternatives

This section describes the development of regional or local structural alternatives for the mitigation of flooding within the 13 PAs. Non-structural alternatives (e.g., home buyouts) or structure-specific measures (e.g., house-specific finished floor raises or floodproofing) are not addressed here.

Flooding within the Upper Brushy Creek Watershed is largely controlled by existing dams maintained by the District (see Figure 7-1). These dams, all located on tributaries to the Brushy Creek main stem, each perform a major function: each dam detains most (if not all) of the 1% AEP flood (100-year flood) within its flood pool, reducing peak floods entering the flood pool to minor flow levels passed through a low level outlet. The flooding within 13 PAs identified in the flood risk assessment analysis (see Figure 7-1) can all be mitigated by one of more of the following regional or local projects:

- Construction of in-line detention (i.e., the full stream line is intercepted) within a watershed not currently controlled by a District dam;
- Improvement of undersized or inefficient drainage structures at a road crossing;
- Construction of off-channel detention to reduce peak flows within an adjacent stream line; or
- Channel improvements and construction of diversion channels.

Opportunities for siting these types of structures were identified, per the following method.

7.2.1 Identification of Undersized/ Inefficient Road Crossing Drainage Structures

Hydraulic model profiles identify PA damage centers located within the backwater of a downstream bridge/culvert, where bridge/culvert modification could potentially reduce upstream flooding. Three structures appeared to potentially negatively impact flood levels in PAs in a substantive manner: U.S. 183 and Peach Tree Lane crossings of Blockhouse Creek (PA2 in Figure 7-1) and Red Bud Lane crossing of Brushy Creek (PA10 in Figure 7-1).

7.2.2 Identification of Potential Sites for In-Line Detention

The watershed HEC-HMS model results were reviewed to identify Brushy Creek tributaries that lacked flood detention structures (i.e., those stream lines not controlled by District dams). Figure 7-2 provides a summary of 100-year (existing condition) flow rate increases along roughly 32 miles of creek length through the study area. This figure shows:

- 100-year flow increasing from 5,600 cfs to over 56,000 cfs through this creek length; and
- For each major tributary, there is an incremental jump in peak flow rate as each tributary adds flows to the main stem. The larger incremental jumps (from upstream to downstream) are associated with Onion Branch (2,400 cfs); Lake Creek (6,000 cfs); Dry Branch (4,000 cfs); Chandler Branch (6,000 cfs), McNutt Creek (5,000 cfs), and Cottonwood Creek (9,000 cfs)

Figures 7-3, 7-4, and 7-5 provide similar diagrams of 100-year flows within Chandler Branch, McNutt Creek, and Lake Creek, each of which are partially controlled by District dams.

For each of these tributaries:

- The topography was reviewed for a potential flood-retarding structure site on a stream line (i.e., a state-regulated dam would be built across the stream, configured in a manner similar to existing District dams);
- The approximate maximum flood detention volume for that site was estimated;
- The effect of this detention on watershed flood flows was estimated; and
- If the available detention was found to significantly reduce flood flows, the site was retained for presentation to and consideration by the District and TAC stakeholders.

Figures 7-2 through 7-5 show the reductions initially estimated to be potentially achievable with construction of detention along these uncontrolled tributaries.

7.2.3 Identification of Potential Sites for Off-Channel Flood Detention

In certain subbasins of the watershed, e.g., where the watershed is highly urbanized or where there are no apparent opportunities for significant flood reduction by interception of tributary flow, off-channel detention was considered. Off-channel detention differs from "Regional Detention" (on-channel) described above in that:

- A stream line is not completely blocked by a dam;
- A low, non-regulatory, three-sided embankment basin is built adjacent to the stream, with flood pool storage augmented by excavation; and
- A diversion channel from the stream to the basin has the channel engaging (i.e., intercepting flow) only in major floods.

This type of structure has the advantage of scalping peak flows significantly in the immediate area downstream of the point of diversion and storage, with a relatively small flood pool. The significant cost associated with controlling the state regulatory dam safety flood is avoided. The structures, however, yield progressively less significant reductions in flow peak as flow proceeds downstream. Benefits from structures sited adjacent to the upper reaches of Brushy Creek (where a small off-channel basin can significantly reduce peaks) are insignificant in the lower reaches of the main stem.

Three PAs were identified to have very limited options for flood mitigation by regional detention, and off-channel detention sites were investigated for each:

- PA1 (Leander);
- PA2 (Cedar Park); and
- PA4 (Round Rock).

7.2.4 Identification of Potential Sites for Mitigation Channels

The hydraulic model flood profiles for the channel adjacent to and immediately downstream of PAs were reviewed to look for opportunities where channel improvements or diversions could potentially lower flood WSELs. In particular, these situations were noted:

- Channels that had been narrowed historically by substantial fills into the natural floodplain;
- PAs located on the outer bank of a channel bend, with undeveloped land within the area adjacent to the inner bank: i.e., an opportunity for diversion of a portion of high-stage flows across the bend; and
- Locations where a short diversion channel could divert flood flows into the flood pool of an existing District dam. This option was only considered where substantive 100-year flood pool capacity was available at the existing dam (i.e., the 100-year flood level was well below the dam's auxiliary spillway).

7.2.5 Selection of Sites for Analysis

The tentatively identified sites for stream crossing improvements, regional detention, and off-channel detention were presented to stakeholders in a series of individual meetings with each stakeholder (City of Round Rock, City of Austin, City of Hutto, City of Leander, City of Cedar Park, Williamson County) during the period October 16 to 25, 2013. Each of these meetings included a review of each site, with the rationale for site selection and a description of potential benefits of the site for flood mitigation. Sites were deleted, added, or generally relocated per discussions with stakeholders. Sites selected for analysis during these meetings were not intended to reflect exact structure locations, but were intended to be representative locations, which under analysis, would result in representative structure sizes, costs, and associated flood mitigation benefits of a structure in the vicinity of the selected site.

The sites selected for analysis during these meetings are presented in Figure 7-6 and are summarized in Table 7-1.

7.3 Description of Alternatives Development Methodology

The detailed methodology for development of alternatives varied by type of mitigation method considered. Each method included these general tasks:

- Identification of site constraints (e.g., maximum elevations of dam backwaters that would not impinge on existing structures);
- Sizing of structure to achieve maximum flood mitigation benefit within site constraints;
- Layout of basic structure configuration on existing topography to estimate rough materials quantities; and
- Concept design-level cost estimation.

7.3.1 In-Line Detention Structures

7.3.1.1 Estimation of Constraints

The types of constraints that were estimated varied depending on the type of project being analyzed. In all, the constraints included:

- *Total runoff volume during the 1% AEP storm.* This volume was estimated by use of the existing HEC-HMS watershed model. The existing model subwatershed was truncated to the location of the dam site and run to estimate this volume. This volume was the preferred flood pool volume for the site.
- *Upstream storage structures.* In some cases, alternative sizes for proposed detention upstream/downstream on the same tributary (e.g., proposed sites A-16 and A-17, and proposed sites A-29 and A-30) were considered to identify the best combination of structure sizes.
- *Thalweg elevation at proposed dam sites.* This elevation determined, once the dam elevation for needed storage was estimated, whether the dam would be regulated per TCEQ dam safety regulations.
- *Primary maximum WSEL allowable before structural or roadway flooding.* This elevation set the maximum allowable 100-year WSEL in the dam backwater (with or without flow through the auxiliary spillway).
- *Secondary and tertiary maximum WSELs allowable before structural or roadway flooding.* These are alternative constraints should the primary constraint be addressed by flood protection, relocation, buyout, etc.
- Potential flood pool volume for the primary through tertiary elevation constraints were each estimated and compared to preferred flood pool volume.

The constraints for each in-line structure site are shown in Table 7-2.

7.3.1.2 Sizing of In-line Structures

The siting and sizing of the embankments and associated spillways were performed using a simplified design methodology for all sites except sites A-16 and A-17. For these two sites, a more detailed analysis of each site and sizing of spillways was performed.

Simplified Concept Design

In the simplified design, the following procedures were followed, and basic design assumptions were made:

- A dam embankment trace was sited consistent with site topography.
- An elevation-volume relationship for the storage volume impounded by the dam embankment was developed from most current LiDAR.
- The sediment pool (and associated principal spillway elevation) was estimated using engineering judgment at each site, depending on site topography. In each case, the principal spillway was several feet above the toe of the upstream embankment.
- The principal spillway was sized to be a 30-inch- or 60-inch-diameter pipe, whichever size best fit site performance goals.

- The auxiliary spillway elevation and width were set such that the 100-year flood elevation (with or without auxiliary spillway flow) stayed below the defined site constraining elevation in Table 7-2.
- The top of dam was set at the auxiliary spillway elevation plus 5 feet to provide an emergency pool for safe passage of the dam safety regulatory flood. This is a conservative (i.e., high estimate) differential for small watershed dams. In some cases, where top of dam elevation was constrained, initial PMF analyses were performed that allowed the top of dam to be set at a lower elevation.
- SITES (small watershed dam design software) was run to set final spillway elevations and dimensions.
- The resulting embankment configuration was laid out in Civil 3D with assumed upstream and downstream embankment slopes of 3 horizontal to 1 vertical. Materials quantities were derived from this analysis.

In particular, an assumption was made that for these small watershed structures, auxiliary spillway channels would be sufficiently wide and flat to preclude breach of the grass surface and subsequent headcutting though the auxiliary spillway crest, leading to dam failure. This condition would require a major (costly) structure (sheetpile wall, drilled piers) to prevent this occurrence. As existing, similar or larger district dams lack such structures, this appears to be a reasonable assumption.

Concept Design of Sites A-16 and A-17

Sites A-16 and A-17 required significantly more detail in concept design than the other sites, for the following reasons:

- The watershed to be controlled by these new structures was substantially larger (over 10 square miles) than other proposed sites;
- The site constraints greatly restrained design, as existing structures and environmental concerns limited flood pool volume to significantly less than the preferred 100-year flood volume;
- The two sites and their associated flood backwaters are primarily located within the property of a single landowner, and as an incentive to the landowner, the flood pools were sized to include added runoff from upstream development; and
- Because of the close proximity of the impounded creek (Lake Creek) and an adjacent creek (Rattan Creek), the hydrologies of the two creeks were intertwined in the state dam safety flood, with auxiliary spillway discharge from the existing Dam 9 spilling into Lake Creek, while auxiliary spillway discharge from the proposed A-17 discharges into Rattan Creek.

These two sites required more detailed analyses than were performed for the other sites, notably:

- The HEC-HMS model was adjusted to assume "ultimate development" (per the City of Austin definition) of the site owner's full property extent upstream of the dam sites;

- A wide variety of principal spillway sizes and configurations and auxiliary spillway sizes and configurations were considered in the analysis of each dam; and alternatives were considered for construction of one dam or both dams;
- A detailed PMF analysis was performed; and
- Sizing of a labyrinth weir was estimated using current methods, the projected PMF flows, and identified site constraints.

Dam A-17 is presented in Exhibit S in two variations, as a smaller dam (A-17) intended to be constructed in tandem with Dam A-16, and as "Site A-17 Expanded," which is be constructed without Dam A-16.

7.3.1.3 Estimated Construction Cost of In-Line Structures

The estimated costs for each in-line structure were based upon the following methods and assumptions:

- Materials quantities for cuts and fill for the embankment and concrete volume for the labyrinth spillways were developed, as noted above, in Civil 3D. Unit costs for structural concrete were per a recent rehabilitation design performed by URS for Calaveras Creek Site 10 (Bexar County). Unit costs for excavation and embankment fill were taken from the 12-month moving average low bid values provided by TxDOT, updated March 31, 2014.
- Costs for principal spillway installation and other project elements were average costs per URS' recent NRCS structure design experience.
- The following contingency costs were added based upon initial construction costs: 30% for construction contingency, 10% for design contingency, 5% for permitting, 8% for construction oversight, and 5% for geotechnical work.
- The latter four contingencies were applied to construction cost after application of the 30% construction contingency.
- Land cost is not included.

7.3.2 Off-Channel Detention Structures

7.3.2.1 Estimation of Constraints

The primary constraints at each site were: 1) the available surface area for the off-channel detention, 2) the lowest feasible bottom elevation, and 3) the maximum allowable water surface elevation (set by the need to have a positive slope from the point of diversion). These three allowed for estimation of the maximum storage volume available at each site. Table 7-3 provides these factors for the proposed off-channel detention structures and for the project to expand in-line detention within the existing Leander High School (LHS) ponds, which was designed in a similar manner as the off-channel structures, because this design also involved an embankment of non-regulatory height.

7.3.2.2 Sizing of Off-Channel Structures

These structures were sized per the following method:

- A hydrograph was developed from the watershed plan HEC-HMS model for the point of diversion into the storage;
- A stage-discharge relation for the HEC-RAS cross-section at the point of diversion was extracted from the watershed plan HEC-RAS model;
- A spreadsheet estimating flow into a lateral weir adjacent to the stream was developed;
- The weir elevation and length were varied by trial and error until the volume of flood water withdrawn from the peak of the stream flow hydrograph equaled the available storage volume at the off channel site; and
- The off-channel storage was assumed to have a low-level outlet for costing purposes, but flow from this outlet was assumed to be too minor to add back into the stream hydrograph downstream of the storage. A high-flow bypass spillway would be needed to control return of extreme flood flows back to the stream.

7.3.2.3 Construction Costs

The estimated costs for each off-channel structure (and the LHS pond expansion) were based upon similar methods to those described for in-line structures. Cost for the lateral weir returning flow to the stream is not included in the estimate.

7.3.3 Road Crossing Improvements

The project constraints, concept design methodology, and cost estimation for construction for road crossing improvements necessarily had to be tailored specifically to each of the three project sites. These are discussed in the individual project descriptions in Exhibit S.

A common methodology was used for all three sites within alternatives analysis for estimating flood depths at structures upstream of each crossing, and this method is described below.

Estimating Finished Floor Elevations (FFEs). FFEs were estimated using the spatial analyst tool to calculate the average 2012 LiDAR elevation under each structure's footprint. These average elevations were then increased by 0.5 foot to account for an average foundation thickness, yielding a final FFE for each habitable structure included in the analysis. If modifications to a bridge produced water surface elevations below this FFE estimate, the habitable structure was considered removed from the floodplain.

Interpolating Depths at Structures. Rather than generate a new flood depth grid for each modification, the HEC-RAS cross-section output elevations were used to interpolate water surface elevations at structures between cross sections. To interpolate the water surface elevation at each habitable structure, the stationing of each structure was estimated along the stream line. This station was used to linearly interpolate the water surface elevation between bounding cross sections for the 2-, 10-, 25-, 50-, 100-, and 500-year storm events. The estimated

FFE was then subtracted from this water surface elevation to estimate the depth of flooding and the FS for each habitable structure.

7.3.4 Channel Improvements and New Diversions

The project constraints, concept design methodology and cost estimation for construction of improved and new channels necessarily had to be tailored specifically to each of the three project sites. These are discussed in the individual project descriptions in Exhibit S.

7.4 Summary of Alternatives Designs

7.4.1 In-Line Detention Structures

Table 7-4 provides a summary of the basic dimensions and estimated costs for the new in-line detention structure alternatives. A description and site layout for each of these structures is provided in Exhibit S.

7.4.2 Off-Channel Detention Structures

Table 7-5 provides a summary of the basic dimensions and estimated costs for the new off-channel detention structure alternatives. A description and site layout for each of these structures is provided in Exhibit S.

7.4.3 Road Crossing Improvements

Table 7-6 provides a summary of the basic dimensions and estimated costs for the new road improvement alternatives. A description and site layout for each of these structures is provided in Exhibit S.

7.4.4 Channel Improvements/New Diversions

Table 7-7 provides a summary of the basic dimensions and estimated costs for the channel improvement alternatives. A description and site layout for each of these structures is provided in Exhibit S.

7.5 Summary of Benefits Analysis

7.5.1 Procedure for Estimating Project Benefits

Benefits provided by projects were estimated as either reduction in Habitable Structure Flood Score, or prevention of a priority In-line Structure Damage Center (ISDC, i.e. road crossing) from overtopping.

7.5.1.1 Procedure for Estimating Changes in Flood Score Due to Projects

To estimate improvements in the FS associated with the construction of each of the projects, the following tasks were performed:

- Each structure within the existing condition 0.2% AEP (500-year) flood was assigned an FFE. This task was performed in the risk assessment process described in Section 6.
- Each structure was assigned to the nearest HEC-RAS cross-section.
- Each structure, per the FPP hydraulic analysis performed for Section 6, has a depth over FFE versus flow rate for 2-, 5-, 10-, 25-, 50-, 100-, and 500-year existing floods and 100-year ultimate flood. These were based upon depth grids that account for topographic changes between cross-sections. This provides a rating curve (depth of flooding above FFE versus flow) at each structure.
- Given the above, a revised FS associated with a particular alternative would be estimated by:
    - Estimating the flow changes throughout the watershed HEC-HMS model associated with the flood improvement alternative;
    - Assigning changed flows to each hydraulic model cross-section per the method described in Section 5;
    - Each structure would be assigned the flow rates associated with its assigned HEC-RAS cross-section;
    - The revised FS at each structure would be estimated by:
        - Taking the new 50-, 100-, and 500-year flow rates and using the structure-specific rating curve to get revised depth of flooding over FFE at each structure; and
        - Using the FS equation documented in Section 6 to estimate a revised FS; and
    - The total reduction in FS associated with each alternative would be aggregated by summing the watershed-wide improvements in FS associated with each structure.

7.5.1.2 Procedure for Estimating Benefits to In-Line Structure Damage Centers

As part of the procedure to estimate flood risks associated with ISDCs, Table 6-9 was developed with 100 priority ISDCs (road crossings). For each of these ISDCs, the flow overtopping the crossing during the 50-year (2% AEP) and 100-year (1% AEP) floods were extracted from HEC-RAS model results. Given this table, the procedure to estimate when an alternative lowered flows below an overtopping threshold is as follows:

- The overtopping flow for each event for each ISDC was subtracted from the total flow at each ISDC for each event to estimate the "threshold" flow at which the ISDC would not overtop for each event;
- Predicted 50- and 100-year flood flows associated with each alternative were assigned to each ISDC; and
- If the predicted flow at an ISDC for an alternative was less than the threshold flow for an event, the alternative was credited with preventing overtopping of that ISDC during that event.

7.5.2 Benefits Associated with Combinations of Detention Structures

The in-line structures are designed to detain most if not all of the 1% AEP (100-year) flood and are expected to have measurable benefits for a significant reach downstream, to include, when built together with other projects, the Brushy Creek main stem. A series of combinations of alternatives were modeled and FS estimated. These combinations were chosen from the large number of potential combinations, using the following insights:

- PA6 along Lake Creek was unique within the District in that it had large numbers of structures at risk (i.e., had a large FS) and was associated with a tributary that lacked regional detention on a significant portion of the watershed. One or two projects had the ability to significantly reduce FS.
- Other PAs with large FS sited along the main stem of Brushy Creek could not have the FS feasibly reduced to the same extent as PA6 because of the lack of available sites that would control as significant a portion of the uncontrolled full Brushy Creek watershed. The necessary strategy for addressing these PAs is to add detention at multiple sites where smaller tributaries are currently uncontrolled.
- Detention sited to address PAs located well upstream along tributaries (e.g., PA2 along Blockhouse Creek, PA7 along Lake Creek Tributary 6) are located so far upstream from the PAs along the Brushy Creek main stem as to have minimal benefits as part of a regional plan to reduce flows in Brushy Creek. Detention to address these isolated upstream PAs are evaluated individually and discussed in the next section.

The conclusion from these insights was that the few projects that addressed PA6 were clearly going to have the greatest impact in FS reduction. Since these projects also potentially provided significant reduction to flow in Brushy Creek below the Lake Creek junction, these projects serve to reduce FS at PAs below the junction.

The logic for the assembly of regional detention structure combinations therefore followed this logic:

- The Lake Creek detention projects would be constructed first;
- The next detention sites would be constructed along the furthest upstream tributaries within the watershed, since the benefits of each were expected to extend downstream through the full length of the Brushy Creek main stem (further upstream stream projects had the greater length of benefits along Brushy Creek). For this reason, projects were added to alternatives in this order:
    - Projects on tributaries of Chandler Creek;
    - Projects on tributaries of McNutt Creek; and
    - Projects on tributaries of Cottonwood Creek.

Table 7-8 provides a summary of each alternative considered, the projects that make up each alternative, and the tributary watershed with increased detention associated with each alternative. The reductions in flow profile associated with the alternatives in Table 7-8 are presented in

Figures 7-7 through 7-11 for Lake Creek, Chandler Branch, McNutt Creek, Cottonwood Creek, and Brushy Creek main stem, respectively. These alternatives and the associated FS are summarized in Table 7-9 for both the entire watershed and individual PAs.

The aggregate numbers of structures with floodplain improvements are provided for the individual scenarios in Table 7-10, for the three floods used in calculating FS. For instance, Alternative 1, in the 100-year flood, reduces the base flood elevation of 44 structures by over a foot.

The numbers of structures in 50-, 100-, and 500-year flood plains are shown in Table 7-11, for each of the modeled scenarios. The structures are counted in the entire watershed and within the individual PAs.

7.5.3 Benefits Associated with Other Alternatives

Table 7-12 shows the FS for Blockhouse Creek (PA2) under existing conditions and with the proposed detention projects affecting that creek. Table 7-12 also shows that the proposed project for South Brushy Creek (PA3) provides minimal improvement in FS.

Table 7-13 shows flood depth reductions associated with proposed projects on Blockhouse Creek for three different flood levels. Table 7-14, in comparison to Table 7-13, provides a summary for Blockhouse Creek of the numbers of structures currently within the floodplain adjacent to the creek.

The channel alternatives A5, A25, and A31 were found to have FS reductions of 36, 0.5, and 3.4, respectively. The channel alternative A23 was found to have minimal benefits.

The road crossing project A2 was found to have a FS reduction of 32.7.

7.5.4 Benefits associated with Flood Improvements at Road Crossings

Table 7-15 provides a summary of the results of the analysis described in Section 7.5.1.2. The suite of plan alternatives addresses overtopping at these structures for these events.

For the 50-year flood, Oak Drive (Lake Creek) is removed from the floodplain by A17 expanded alone. Alternatives 1 through 8 remove Red Bud Lane (Brushy Creek) and Burnet St. South (Lake Creek) from the floodplain. Alternatives 1, 7, and 8 remove CR164 (Cottonwood Creek) from the floodplain. Alternative 8 removes FM 2243 (South Brushy Creek) from the floodplain.

For the 100-year flood, Oak Drive (Lake Creek) is removed from the floodplain by A17 expanded with either Dam 9 Diversion project. Alternatives 1, 7, and 8 remove CR164 (Cottonwood Creek) and Hwy 79 (Cottonwood Creek) from the floodplain. Alternative 8 removes FM 2243 (South Brushy Creek) from the floodplain.

7.6 Project Prioritization

The projects presented in this plan, if implemented, will be funded and implemented under a wide variety of mechanisms. It is expected that individual projects will be incorporated into capital improvement planning of the individual stakeholders (five cities, one county). In this section, a common approach is applied to prioritizing all projects within the planning region. This approach has not been defined to conform to capital project prioritization methods used by the individual stakeholders.

Benefits in terms of FS reduction have been estimated by project in Section 7.5, and cost per project is documented in Exhibit T. Given this information, projects are prioritized generally by a common yardstick: the cost per unit FS reduction, or the cost of the project divided by the difference between the current condition FS minus the post-project condition FS. This yardstick is applied somewhat differently between: 1) the series of detention projects that are conceived to work in tandem to reduce flooding on lower creek main stems, and 2) the remaining projects that are targeted to address flooding issues in the immediate vicinity of each project.

Table 7-16 provides a summary of costs by project used in prioritization. The documentation for these costs is provided in Exhibit T.

7.6.1 Prioritization of Detention Projects

The cost per unit reduction in FS for each alternative is shown in Table 7-17. Note that the alternatives were designed to progressively add detention from upstream to downstream within the Brushy Creek Watershed. Table 7-17 also provides a cost per unit reduction in FS for the incremental new FS reduction associated with the addition of new detention relative to a defined "base" case. For example, when Site A-16 is added to the Dam 9 Diversion project (Option 1), the cost per unit FS reduction for the two projects combined is $202,000 per unit reduction, while the cost per unit FS reduction for the incremental reduction associated with the addition of Site A-16 is $376,000. This allows for prioritization of competing projects that control the same watershed. Results per watershed are discussed below.

7.6.1.1 Controls in Lake Creek Watershed

The choice between the two options for the Dam 9 Diversion project hinges on this discussion:

- Option 1 (which diverts more flow into the Dam 9 flood pool) reduced peak flow in Rattan Creek by 200 to 300 cfs more than Option 2, with associated additional reductions in FS; and
- Option 2 (which avoids construction of a costly additional diversion channel into the Dam 9 flood pool) is much more cost effective ($79,000 per unit FS reduction versus $92,000 per FS reduction).

Given that the added diversion channel (C5) associated with Option 1 has potential significant issues affecting feasibility (see Exhibit S), Option 2 appears to be the most favorable of the two options.

The choice between the options for control of Davis Spring (A16, A17, A16 and A17, or A17 Expanded) is relatively straightforward, with A17 Expanded providing equivalent benefits for less cost.

The choice between which of the two major improvements to construct first and whether to construct the second improvement after the first hinges on this discussion:

- Dam 9 Diversion Option 2 (hereafter just called Dam 9 Diversion) is much less expensive than A17 Expanded and is sited with fewer environmental permitting and cost uncertainties. The project appears feasible to design and construct in the short term, while the cost of A17 and its site complexities make it more feasible in the long term.
- Dam 9 Diversion resolves a long-standing drainage issue where existing flood protection is provided by temporary structures (quarry and temporary levee).
- A17 Expanded alone (per Table 7-10) appears to have very similar benefits in terms of numbers of houses with flood depths that are lowered as the same project with the Dam 9 Diversion added. Per Table 7-11, however, following construction of A17, 33 houses remain in the 100-year floodplain. This number is reduced to 14 with the addition of the Dam 9 Diversion. The depth reductions associated with the 19 houses removed by the addition of the Dam 9 Diversion range from less than 0.1 foot (for 10 houses) to between 0.1 and 0.4 foot (for nine houses).
- Per Table 7-15, the two projects (A17 Expanded and Dam 9 Diversion) are required to remove Oak Creek Blvd. from overtopping during the 100-year flood.

7.6.1.2 Controls in Chandler Branch Watershed

Alternatives 2 and 3 address new controls in the Chandler Branch Watershed. Both achieve the same incremental additional FS reduction, but Alternative 2 is more cost effective.

7.6.1.3 Controls in McNutt Creek Watershed

Alternatives 4, 5,and 6 address new controls in the McNutt Creek Watershed. Alternatives 5 and 6, which add on to Alternative 4, provide minimal new reduction in FS and have very high incremental costs.

7.6.1.4 Controls in Cottonwood Creek Watershed

Alternative 1 adds new controls in the Cottonwood Creek Watershed. Alternative 7, which adds new controls for McNutt Creek to Alternative 1, has a very high incremental cost for minor improvement.

7.6.1.5 Controls in Upper Brushy Creek Main Stem

Alternative 8 is the only alternative that addresses FS above the junction of Lake Creek with Brushy Creek. The alternative results in a small FS reduction at an incremental cost similar to Alternative 1 or 4.

7.6.1.6 Summary

Per the discussion above, the most cost-effective prioritizing of alternatives associated with combined regional detention are, in order:

- Site A-17 Expanded with or without Dam 9 Diversion and associated project elements (Site B-1), with construction of Dam 9 Diversion preceding A17 by several years;
- Alternative 2 (Sites A-14 and A-32);
- Alternative 4 (Site A-13); and
- Alternative 1 (Site A-21).

Table 7-18 provides a prioritization of regional projects per the discussion above.

7.6.2 Prioritization of Other Projects

The cost per unit reduction in FS for alternatives not associated with region-wide combined detention is shown in Table 7-19. Each of these projects is concept designed to perform alone. In terms of cost effectiveness, these projects can be prioritized as follows:

- Site A-2 is clearly the most effective improvement to Blockhouse Creek flooding within PA2.
- Site A-15 achieves significant reduction in FS, but the cost is not yet estimated.
- Site A-11 is also designed to improve flooding in PA2. The site may provide significant incremental added reduction in FS above that provided by Site A-2, but these two projects have not been assessed in combination.

The other projects in Table 7-19 appear to have high costs for minor improvements or high relative costs when compared to competing projects.

Table 7-20 provides a prioritization of standalone projects per the discussion above.

Table 7-1. Identified Potential Mitigation Actions

ID	Actions	Priority Areas to be Mitigated
A-1	Off-channel detention	2
A-2	Bridge crossing improvement	2
A-3	Expansion of existing detention storage	2
A-4	Secondary Spillway at Dam 6	3
A-5	Channel improvement	2
A-6	Bridge crossing improvement	2
A-7	Bridge crossing improvement	1
A-8	New in-line storage	4, 8, 9, 10, 11,13
A-9	Off channel storage US of CR177	4, 8, 9, 10, 11,14
A-11	Expansion of existing detention storage	2
A-12	Off-channel detention	1
A-13	New in-line storage	10, 11
A-14	New in-line storage	9, 10
A-15	New in-line storage	7
A-16	New in-line storage	6
A-17	New in-line storage	6
A-19	New in-line storage	6
A-20	Bridge crossing improvement	9
A-21	New in-line storage	12
A-22	New in-line storage	11
A-23	New diversion channel	12
A-24	Off-channel detention	10, 11
A-25	Channel expansion	10, 11
A-26	Upgrade existing dam	11, 13
A-27	New in-line storage	9, 10
A-28	New in-line storage	10, 11
A-29	New in-line storage	10, 11
A-30	New in-line storage	2
A-31	Channel Improvement	8
A-32	New diversion channel	9, 10

Table 7-2. Summary of Site Constraints

New Dam	1% AEP (100-Year) Water Surface Elevation Constraint	Top-of-Dam Elevation Constraint	
	Constraint	Constraint	Constraint Elevation (ft-msl)
A-13	None	Unnamed Road to West	725
A-14	None	None	
A-16	TX 45 West Frontage	TX 45 West	808
A-17	Saddle at SE flood pool	Quarry to NE	775
A-17 Expanded	None	Dam 9 Aux Spillway	786
A-21	House	None	
A-27	None	AW Grimes Blvd	
A-28	CR-110	CR-110	
A-29	None	None	
A-30	None	Ridgeline Blvd/Houses	947

Table 7-3. Constraints

Alternative	Description	Drainage Area (acres)	Total Runoff Volume (acre-ft)	Approx Detention Area (acres)	Lowest Bottom Elevation	Bottom Constraint	Max. WSEL	Max. WSEL Constraint	Max. Water Depth (ft)
Constraints for Off-Channel Detention									
A-1	New Blockhouse and Trib 1 Detention	1428	763	7.3	975.0	DS stream bed elevation	986.0	S Bagdad Rd.	11
A-3	Existing LISD Detention Expansion:								
	a) Maintain existing detention volume on channel.	201	113	1.4	1010.0	Existing outlet structure	1017.0	N Lakeline Blvd	7
	b) Add new off channel storage.		113	2.6	1010.0		1021.0	Parking lot to west	11
A-12	New Broade Street Detention	1035	404	17.1	980.0	DS stream bed elevation	995.0	1 House to west	15
Constraints for Improvements to In-Line Detention									
A-11	Modify Leander HS Ponds: a) Maintain existing US pond. b) Modify existing DS pond.	345	194	11.0	994.0	Invert elevation at existing culvert	1001.9	Outlet of existing upstream detention	7.9

Table 7-4. Data Summary for In-Line Detention

New Dam	Dam			Watershed Above New Dam		Principal Spillway (PS)		Auxiliary Spillway (AS)				Flood Pool			
	Thalweg at Dam (ft-msl)	Top-of-Dam Elevation (ft-msl)	Height of Dam (ft)	Total Area (acres)	Uncontrolled Area (acre)	Crest Elevation (ft-msl)	Conduit Size	Elevation	Type	Dimensions	100 yr WSEL over AS Crest (ft)	100 yr WSEL (ft-msl)	Storage at PS (ac-ft)	Storage Volume at AS (ac-ft)	Area of Flood Pool at 100-Year WSEL (ac)
A-13	698.8	725	26.2	1130	1130	707	60	720.2	Earthen	Width: 400'	0	720.2	8	363	59
A-14	688.1	706.4	18.3	408	408	695	60	703	Earthen	Width: 200'	0	703.0	5	99	25
A-16	782.7	808	25.3	8009	2641	788	60 x (4)	803	Labyrinth	Cycles: 10, Magnification: 4.95	0	802.7	5	425	65
A-17	751.2	774	22.81	8912	903	756	60 x (4)	770.1	Labyrinth	Cycles: 13, Magnification: 4.95	0	770.1	10	338	82
A-17 Expanded	751.2	786	34.81	8912	3544	756	60 x (3)	775.2	Concrete	525'	0	775.1	10	744	101
A-21	672.2	701	28.8	1800	1800	678	60	696	Earthen	Width: 300'	0	696.0	1	642	88
A-27	730.1	750.6	20.5	442	442	740	30	747.5	Earthen	Width: 200'	0	747.5	30	214	34
A-28	637.2	660.3	23.1	786	786	642	60	655.3	Concrete	Width: 250'	1.53	656.8	1	101	22
A-29	719.7	735.7	16	185	185	728	30	733.4	Earthen	Width: 200'	0	733.2	17	79	17
A-30	920.4	946.7	26.3	69.8	69.8	926	60	938.2	Concrete	Width: 100'	2.55	940.8	0	48	12

Table 7-5. Data Summary for Off-Channel Detention

Alternative	Description	Drainage Area (acres)	Detention Area (acres)	Lowest Bottom Elevation	Bottom Constraint	Top-of-Dam Constraint Elevation	Top-of-Dam Constraint	Max. Water Depth (ft)	Max Volume Estimate (acre-ft)	Inlet Description	Inlet Dimensions	Outlet Description	Note
A-1	New Blockhouse and Trib 1 Detention	1428	7	977.0	DS stream bed elevation	986.0	S Bagdad Rd.	9.0	63	1) Weir on south stream. 2) Weir on north stream.	1) Weir width: 20', Crest elevation: 982.4' 2) Weir width: 20', Crest elevation: 982.4'	Outlet located west past confluence. Needs flap gate.	Not regulated by TCEQ
A-3	Existing LISD Detention Expansion	201											No PMF. Existing outlet could be lower, allowing for the bottom of the pond to be lowered as well. Existing inlet west of pond may need to be relocated.
	a) Maintain existing detention volume on channel (3a).		1	1009.7	Existing outlet structure	1017.5	N Lakeline Blvd	7.8	11	Existing inlet structure	Inlet invert: 1013.83'	Existing outlet structure, new weir to off channel detention (3b).	
	b) Add new off channel storage (3b).		4	1009.0	Connection to existing outlet	1020.0	Parking lot to west	11	40	Weir from on channel detention (3a)	Weir width: 20', Crest elevation: 1014.5'	New outlet to on channel detention (a). Flag gate needed.	
A-12	New Broade Street Detention	1035	17	980.0	DS stream bed elevation	996.0	1 House to west	16	274	Weir on south side	Weir width: 20', Crest elevation: 990.4'	Outlet downstream	Not regulated by TCEQ
A-22	Trib 7 Pond	64											
A-24	Off-Channel Storage near Dam 18	1847											

Table 7-6. Summary of Road Improvements

Alternative	Description	Recommended Solution	Cost
A-2 U.S. 183	U.S. 183 causes significant flooding upstream. Recommended to lower and widen the channel with addition of two 8'x10' box culverts.	Two concrete box culverts (10 ft x 8 ft)	$ 1,669.52
		Structural excavation (box)	$ 3,495.85
		Cutting and restoring pavement	$ 3,517.36
		Channel excavation	$ 9,205.95
A-2 Peach Tree Lane	Removing low-water crossing does not improve local flooding. No proposed action.	NA	NA
A-20 Red Bud Lane	Considered alternatives do little to lower the 500-yr floodplain, causing high flood scores. No proposed action.	NA	NA

Table 7-7. Data Summary for Channel Improvements

Description	Length (ft)	Bottom Width (ft)	US Invert (ft-msl)	DS Invert (ft-msl)	Slope (ft/ft)	Excavate (cy)	Fill (cy)	Net Excavation (cy)	Cost Estimate	Notes
Blockhouse Channel Improvement	1,400	150	972	965.04	0.5%	16,300	200	16,100	$1,478,000	Requires the buy-out of houses.
Cottonwood Channel Improvement	630	70	629	626	0.6%	1,600	100	1,500	$336,000	
Dam 18 Channel Modification	2,000	20	619.7	610.1	0.4%	5,600	100	5,500	$446,000	
Chandler Branch Trib 4 Diversion	1,750	20	737.2	733.67	0.2%	1,700	7	1,694	$855,000	Requires riprap basin at DS end.

Table 7-8. Summary of Combined In-Line Detention Alternatives

	D9 Div	A16	A17	A17 Exp	A14	A27	A13	A29	A28	A21	A32	A12	Added Controls on Creek:			
													Lake Creek	McNutt Creek	Chandler Branch	Cottonwood Creek
Existing Conditions																
Dam 9 Div, Opt 1	X												X			
Dam 9 Div, Opt 2	X												X			
A17 Expanded				X									X			
A16, Dam 9 Div, Opt 1	X	X											X			
A16, A17, Dam 9 Div, Opt 1	X	X	X										X			
A17 Expanded, Dam 9 Div, Opt 1	X			X									X			
Alternative 2	X	X	X		X						X		X		X	
Alternative 3	X	X	X		X	X							X		X	
Alternative 4	X	X	X		X	X	X						X	X	X	
Alternative 5	X	X	X		X	X	X	X					X	X	X	
Alternative 6	X	X	X		X	X	X	X	X				X	X	X	
Alternative 1	X	X	X		X	X	X			X			X	X	X	X
Alternative 7	X	X	X		X	X	X	X	X	X			X	X	X	X
Alternative 8	X	X	X		X	X	X			X		X	X	X	X	

Table 7-9. Reductions in Flood Score by Alternative

	D9 Div	A16	A17	A17 Exp	A14	A27	A13	A29	A28	A21	A32	A12	Flood Score Per TM6									
													Entire Watershed	**PA 1**	**PA 4**	**PA 6**	**PA 8**	**PA 9**	**PA 10**	**PA 11**	**PA 12**	**PA 13**
Existing Conditions													**509***	**4.5**	**18.8**	**167.3**	**10.4**	**76.5**	**40.8**	**38.3**	**3.6**	**53.3**
Dam 9 Div, Opt 1	X												426	4.5	18.8	88.4	10.4	76.5	40.9	38.3	3.6	53.3
Dam 9 Div, Opt 2	X												444	4.5	18.8	103.6	10.4	77.0	41.0	38.4	3.6	53.4
A17 Expanded			X										364	4.5	18.8	34.9	10.4	73.9	39.9	38.0	3.6	52.4
A16, Dam 9 Div, Opt 1	X	X											374	4.5	18.8	39.7	10.4	76.1	40.6	38.2	3.6	53.1
A16, A17, Dam 9 Div, Opt 1	X	X	X										349	4.5	18.8	19.8	10.4	74.1	40.0	38.1	3.6	52.6
A17 Expanded, Dam 9 Div, Opt 1	X			X									350	4.5	18.8	20.7	10.4	74.1	40.1	38.1	3.6	52.6
Alternative 2	X	X	X		X						X		339	4.5	18.8	19.8	10.4	71.8	38.0	37.2	3.6	51.2
Alternative 3	X	X	X		X	X							338	4.5	18.8	19.8	10.4	71.6	37.9	37.1	3.6	51.0
Alternative 4	X	X	X		X	X	X						331	4.5	18.8	19.8	10.4	71.6	34.8	35.8	3.6	48.9
Alternative 5	X	X	X		X	X	X	X					329	4.5	18.8	19.8	10.4	71.6	34.2	35.5	3.6	48.3
Alternative 6	X	X	X		X	X	X	X	X				328	4.5	18.8	19.8	10.4	71.6	33.8	35.3	3.6	47.7
Alternative 1	X	X	X		X	X	X			X			320	4.5	18.8	19.8	10.4	71.6	34.8	35.8	1.0	47.0
Alternative 7	X	X	X		X	X	X	X	X	X			317	4.5	18.8	19.8	10.4	71.6	33.8	35.2	1.0	45.8
Alternative 8	X	X	X		X	X	X			X		X	314	0.7	18.1	19.8	10.4	71.5	34.7	35.8	1.0	47.0

Table 7-10. Flood Depth Reductions by Alternative and Flood Return Period

		Dam 9 Div, Opt 1	Dam 9 Div, Opt 2	A17 Expanded Only	Dam A16 and Dam 9 Div Only, Opt 1	Dam A16, A17, and Dam 9 Div, Opt 1	Dam A17 Expanded and Dam 9 Div, Opt 1	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
50-year	0.01	36	36	47	36	49	47	76	69	69	70	70	70	76	89
	0.25*	26	26	28	28*	28	28	41	28	30	38	38	38	46	43
	0.5	17	17	20	19	20	20	20	20	20	20	22	22	22	20
	0.75	8	8	12	11	12	12	12	12	12	12	12	12	12	12
	1	2	2	9	8	9	9	9	9	9	9	9	9	9	9
	1.25	1	1	4	3	4	4	4	4	4	4	4	4	4	4
	1.5	0	0	3	2	3	3	3	3	3	3	3	3	3	3
100-year	0.01	76	74	156	127	155	156	190	160	160	161	161	161	190	223
	0.25	60	56	67	67	67	67	108	78	80	91	91	102	111	113
	0.5	45	43	55	55	55	55	65	55	55	60	61	62	67	69
	0.75	39	29	49	49	50	50	52	50	50	50	50	51	53	53
	1	28	13	43	43	43	43	44	43	43	43	43	43	44	44
	1.25	13	3	41	39	41	41	42	41	41	41	41	41	42	42
	1.5	3	0	32	32	32	32	33	32	32	32	32	32	33	33
	1.75	0	0	29	29	30	30	30	30	30	30	30	30	30	30
	2	0	0	27	27	27	27	27	27	27	27	27	27	27	27
	2.25	0	0	18	17	23	23	23	23	23	23	23	23	23	23
	2.5	0	0	12	11	14	14	14	14	14	14	14	14	14	14
	2.75	0	0	8	7	10	10	10	10	10	10	10	10	10	10
	3	0	0	6	4	7	8	7	7	7	7	7	7	7	7
	3.25	0	0	2	1	6	6	6	6	6	6	6	6	6	6
	3.5	0	0	1	0	3	3	3	3	3	3	3	3	3	3
	3.75	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	4	0	0	0	0	1	1	1	1	1	1	1	1	1	1

* 28 houses have 50-year flood depths reduced by over 0.25 foot.

Table 7-11. Numbers of Structures in Floodplains by Return Period

	No Projects	Dam 9 Div, Opt 1	Dam 9 Div, Opt 2	Dam A17 Only	Dam A16 and Dam 9 Div, Opt 1 Only	Dam A16, A17, and Dam 9 Div, Opt 1	Dam A17 Expanded and Dam 9 Div, Opt 1	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	A1	A3	A11
2% AEP (50-year) Flood																		
Entire Watershed	124	124	124	89	101	91	87	87	91	91	91	91	91	87	81			
PA1	6	6	6	6	6	6	6	6	6	6	6	6	6	6	1			
PA2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	45	45
PA3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5			
PA5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA6	36	35	35	7	13	9	5	9	9	9	9	9	9	9	9			
PA7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
PA9	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7			
PA10	10	10	10	8	10	8	8	8	8	8	8	8	8	8	8			
PA11	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5			
PA12	3	3	3	3	3	3	3	1	3	3	3	3	3	1	1			
PA13	13	13	13	11	13	11	11	11	11	11	11	11	11	11	11			
1% AEP (100-year) Flood																		
Entire Watershed	324	318	324	238	280	220	220	189	219	219	219	219	219	189	173			
PA1	8	8	8	8	8	8	8	8	8	8	8	8	8	8	5			
PA2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	53	45
PA3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA4	13	13	13	13	13	13	13	13	13	13	13	13	13	13	5			
PA5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA6	69	69	69	33	34	14	14	14	14	14	14	14	14	14	14			
PA7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA8	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23			
PA9	39	39	39	15	38	15	15	15	15	15	15	15	15	15	15			
PA10	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10			
PA11	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6			
PA12	7	7	7	7	7	7	7	3	7	7	7	7	7	3	3			
PA13	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15			
0.2% AEP (500-year) Flood																		
Entire Watershed	634	634	634	619	619	530	530	508	530	530	528	528	528	508	507			
PA1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9			
PA2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	72	72
PA3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA4	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14			
PA5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA6	149	149	149	136	136	68	68	68	68	68	68	68	68	68	68			
PA7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
PA8	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24			
PA9	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45			
PA10	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13			
PA11	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6			
PA12	10	10	10	10	10	10	10	8	10	10	10	10	10	8	8			
PA13	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18			

Table 7-12. Summary of Other Alternatives

	A1	A3	A11	A30	Flood Scores per Section 5		
					Blockhouse Watershed	PA2	PA3
Blockhouse Creek Existing Condition					81.5	76.3	
A1	X				81.0	75.7	
A3		X			78.8	73.8	
A11			X		57.4	52.2	
South Brushy Creek Existing Condition					38.6		38.6
A30				X	38.5		38.5

Table 7-13. Flood Depth Reductions by Alternative and Flood Return Period, Block House Creek

	Depth Reduction (ft)	A1	A3	A11
50-year	0.01	19	45	45
	0.25	0	0	18
	0.5	0	0	0
100-year	0.01	49	52	53
	0.25	0	0	31
	0.5	0	0	0
500-year	0.01	20	74	73
	0.25	0	0	65
	0.5	0	0	32
	0.75	0	0	4
	1	0	0	0

Table 7-14. Summary of Structures within Floodplains for Priority Area 2

PA	50-yr	100-yr	500-yr
2	45	53	72
Outside PAs	3	3	9
Total	**48**	**56**	**81**

Table 7-15. Benefits of Alternatives Versus In-Line Damage Centers

Alternative	Bridges and Culverts That Are Prevented from Overtopping in the Listed Flood			
	50-year (2% AEP) Flood		100-year (1% AEP) Flood	
	Crossing	Model	Crossing	Model
A16	Burnet St S	Lake Creek R1		
	Oak Ridge Dr	Lake Creek R1		
A16 D9	Oak Ridge Dr	Lake Creek R1		
A17 expanded	Oak Ridge Dr	Lake Creek R2		
A16, A17, and D9 Opt 1	Burnet St S	Lake Creek R1	Oak Ridge Dr	Lake Creek R1
	Oak Ridge Dr	Lake Creek R1		
D9 Option 1 or Option 2	Oak Ridge Dr	Lake Creek R1		
A17 expanded and D9 Option 1 or Option 2	Oak Ridge Dr	Lake Creek R1	Oak Ridge Dr	Lake Creek R1
Alt 1	Burnet St S	Lake Creek R1	Oak Ridge Dr	Lake Creek R1
	Oak Ridge Dr	Lake Creek R1	HWY 79	Cottonwood
	CR 164/Limmer Loop	Cottonwood	CR 164/Limmer Loop	Cottonwood
	Red Bud Ln	Brushy Creek		
Alt 2	Red Bud Ln	Brushy Creek	Oak Ridge Dr	Lake Creek R1
	Burnet St S	Lake Creek R1		
	Oak Ridge Dr	Lake Creek R1		
Alt 3	Red Bud Ln	Brushy Creek	Oak Ridge Dr	Lake Creek R1
	Burnet St S	Lake Creek R1		
	Oak Ridge Dr	Lake Creek R1		
Alt 4	Red Bud Ln	Brushy Creek	Oak Ridge Dr	Lake Creek R1
	Burnet St S	Lake Creek R1		
	Oak Ridge Dr	Lake Creek R1		
Alt 5	Red Bud Ln	Brushy Creek	Oak Ridge Dr	Lake Creek R1
	Burnet St S	Lake Creek R1		
	Oak Ridge Dr	Lake Creek R1		
Alt 6	Red Bud Ln	Brushy Creek	Oak Ridge Dr	Lake Creek R1
	Burnet St S	Lake Creek R1		
	Oak Ridge Dr	Lake Creek R1		
Alt 7	Burnet St S	Lake Creek R1	Oak Ridge Dr	Lake Creek R1
	Oak Ridge Dr	Lake Creek R1	HWY 79	Cottonwood
	CR 164/Limmer Loop	Cottonwood	CR 164/Limmer Loop	Cottonwood
	Red Bud Ln	Brushy Creek		
Alt 8	Burnet St S	Lake Creek R1	Oak Ridge Dr	Lake Creek R1
	Oak Ridge Dr	Lake Creek R1	HWY 79	Cottonwood
	CR 164/Limmer Loop	Cottonwood	CR 164/Limmer Loop	Cottonwood
	Red Bud Ln	Brushy Creek		
	FM2243	S Brushy Creek		

Table 7-16. Summary of Total Costs per Project (Includes Contingencies)

Project	Construction Cost (Including Contingencies)	Total Estimated Cost*
A-1	$1,061,733	$1,360,000
A-2 and A-6	$25,200	$57,000
A-3	$660,754	$846,000
A-5	$339,024	$434,000
A-11	$1,575,356	$2,017,000
A-12	$4,759,661	$6,093,000
A-13	$3,277,386	$4,196,000
A-14	$1,217,304	$1,559,000
A-16	$15,388,216	$19,697,000
A-17	$15,058,585	$19,275,000
A-17 Expanded	$17,483,492	$20,194,000
A-19	$332,634	$554,000
A-21	$4,925,037	$6,305,000
A-23	$109,546	$141,000
A-25	$148,650	$191,000
A-27	$2,278,637	$2,917,000
A-28	$5,076,553	$6,498,000
A-29	$1,669,143	$2,137,000
A-30	$1,585,667	$2,030,000
A-31	$1,215,024	$1,556,000
A-32	$316,391	$405,000
Dam 9 Diversion Alternative Option 1		
B-1 Regulatory	$2,095,131	$3,071,000
C-5	$3,165,849	$4,053,000
C-2	$375,799	$482,000
Dam 9 Spillway Widening	$328,718	$421,000
Dam 9 Diversion Total	$5,965,497	$7,596,000
Dam 9 Diversion Alternative Option 2		
B-1 Regulatory	$3,443,649	$4,339,000
C-2	$375,799	$482,000
Dam 9 Spillway Widening	$269,896	$346,000
Dam 9 Diversion Total	$4,089,344	$5,167,000

*Does not include land use costs.

Table 7-17. Summary of Cost per Unit Flood Score Reduction – Detention Sites

	D9 Div	A16	A17	A17 Exp	A14	A27	A13	A29	A28	A21	A32	A12	Reduction in FS	Total Cost	Cost per FS Reduction	Base	Incremental FS Reduction Above Base	Total Incremental Cost Above Base	Incremental Cost per FS Reduction
Existing Conditions													0						
Dam 9 Div, Option 1	X												83	$7,596,000	$92,000				
Dam 9 Div, Option 2	X												65	$5,167,000	$79,000				
A17 Expanded			X										145	$20,194,000	$139,000				
A16, Dam 9 Div, Opt 1	X	X											135	$27,293,000	$202,000	Dam 9 Div Opt1	52	$19,697,000	$376,000
A16, A17, Dam 9 Div, Opt 1	X	X	X										160	$46,568,000	$291,000	Dam 9 Div Opt1	78	$38,972,000	$503,000
A17 Expanded, Dam 9 Div, Opt 1	X			X									159	$27,790,000	$174,000	Dam 9 Div Opt1	77	$20,194,000	$264,000
A17 Expanded, Dam 9 Div, Opt 2	X			X									155	$25,361,000	$164,000	Dam 9 Div Opt2	90	$20,194,000	$225,000
Alternative 2	X			X	X						X		170	$29,349,000	$173,000	A17 Expanded, Dam 9 Div	11	$1,559,000	$145,000
Alternative 3	X			X	X	X							171	$30,707,000	$180,000	A17 Expanded, Dam 9 Div	12	$2,917,000	$254,000
Alternative 4	X			X	X	X	X						178	$34,903,000	$196,000	Alt 3	8	$4,196,000	$548,000
Alternative 5	X			X	X	X	X	X					180	$37,040,000	$206,000	Alt 4	2	$2,137,000	$1,313,000
Alternative 6	X			X	X	X	X	X	X				181	$43,538,000	$240,000	Alt 5	1	$6,498,000	$4,727,000
Alternative 1	X			X	X	X	X			X			189	$41,208,000	$218,000	Alt 4	9	$4,168,000	$463,000
Alternative 7	X			X	X	X	X	X	X	X			192	$49,843,000	$260,000	Alt 1	3	$8,635,000	$2,736,000
Alternative 8	X			X	X	X	X			X		X	195	$40,996,000	$211,000	Alt 4	15	$6,093,000	$406,000

Table 7-18. Summary Prioritization of Regional Detention Projects

	Priority	Upstream Location	Reduction in FS	Notes	Program Total Cost	Project Cost	Incremental Cost per FS Reduction
Dam 9 Div, Opt 2	1	1	65	Most cost-effective solution reducing highest FS	$5,167,000		$79,000
A17 Expanded	1	1	155	Most cost-effective solution for next highest reduction in FS	$25,361,000	$20,194,000	$225,000
Add A32	3	2	163	Lowest cost portion of Alternative 2, best control option on Chandler Branch	$25,766,000	$405,000	$536,900
Add A14	4	2	170	Other project in Alternative 2, best control option on Chandler Branch	$27,325,000	$1,559,000	$536,900
Add A13	5	3	178	Best control option on McNutt Creek	$31,521,000	$4,196,000	$547,600
Add A21	6	4	189	Best control option on Cottonwood Creek	$37,826,000	$6,305,000	$616,100
Add A12	7		195	Best control option in upper Brushy Creek headwaters	$43,919,000	$6,093,000	$773,200
Add A29	8	2		Added control on McNutt Creek, least cost of two additions	$46,056,000	$2,137,000	
Add A28	9	2		Added control on McNutt Creek	$52,554,000	$6,498,000	
Alternatives to the Project Above							
A16		1		Alternative to A17 Expanded, less FS reduction, similar incremental cost		$12,000,000	$204,000
A16 and A17		1		Alternative to A17 Expanded, same FS reduction, higher incremental cost		$21,000,000	$250,000
A27		2		Alternative to A32 in Chandler Branch watershed		$2,917,000	$719,300

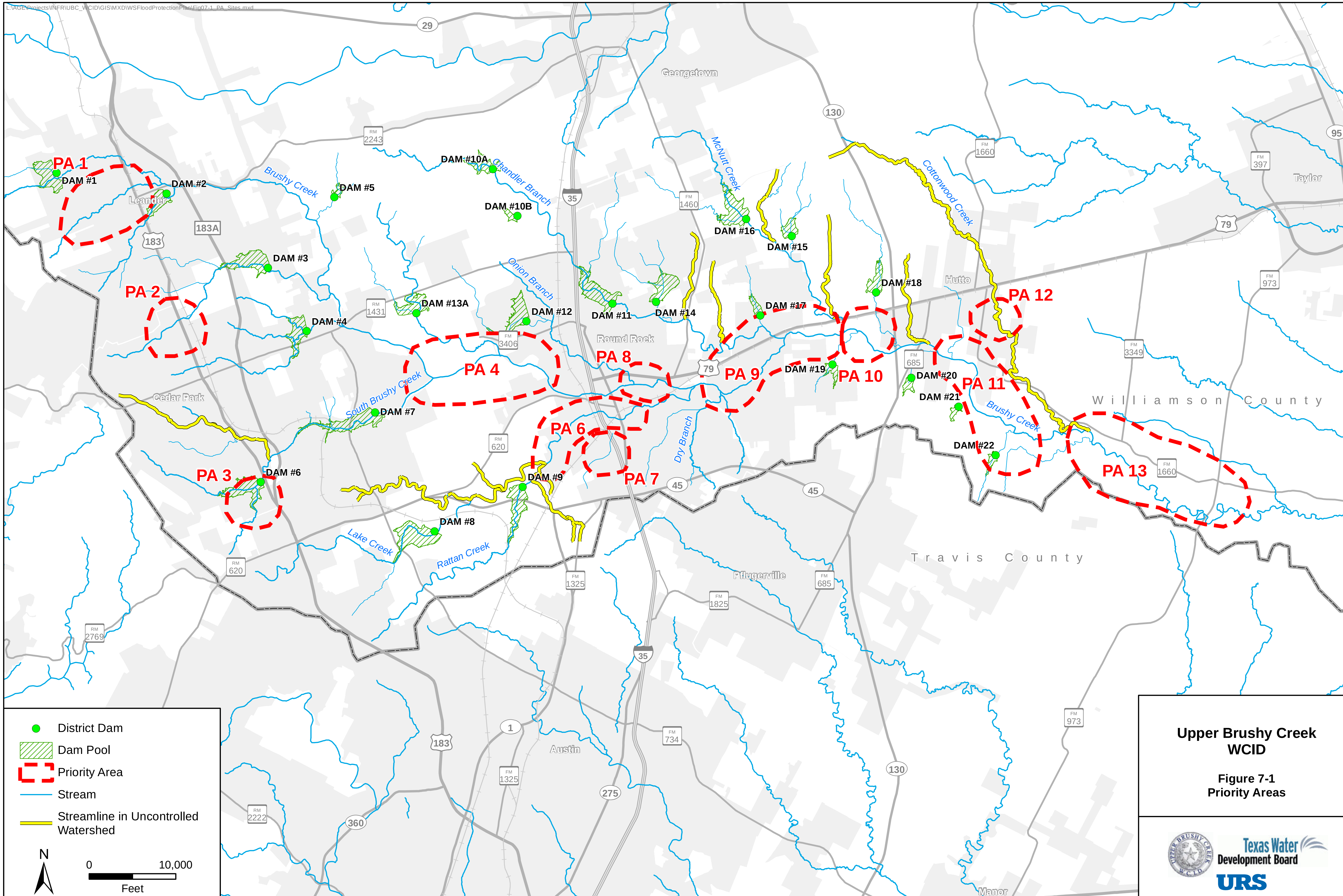
*1 = the most upstream location in the watershed of the Brushy Creek main stem.

Table 7-19. Summary of Cost per Unit Flood Score Reduction – Other Sites

	A1	A2	A3	A11	A15	A30	A5	A23	A25	A31	Reduction in FS	Total Cost	Cost per Unit of FS Reduction
Blockhouse Control											0		
A1	X										0.5	$1,360,000	$2,725,600
A2		X									32.7	$57,000	$1,700
A3			X								2.6	$846,000	$321,700
A11				X							24.0	$2,017,000	$83,900
South Brushy Control											0		
A30						X					0.03	$2,030,000	Low benefit
Lake Creek Trib 6													
A15					X						24.4	$-	TBD
Channel Modifications													
A5							X				36	$434,000	$12,100
A23								X			0	$141,000	No benefit
A25									X		0.5	$191,000	$353,700
A31										X	3.4	$1,556,000	$460,400

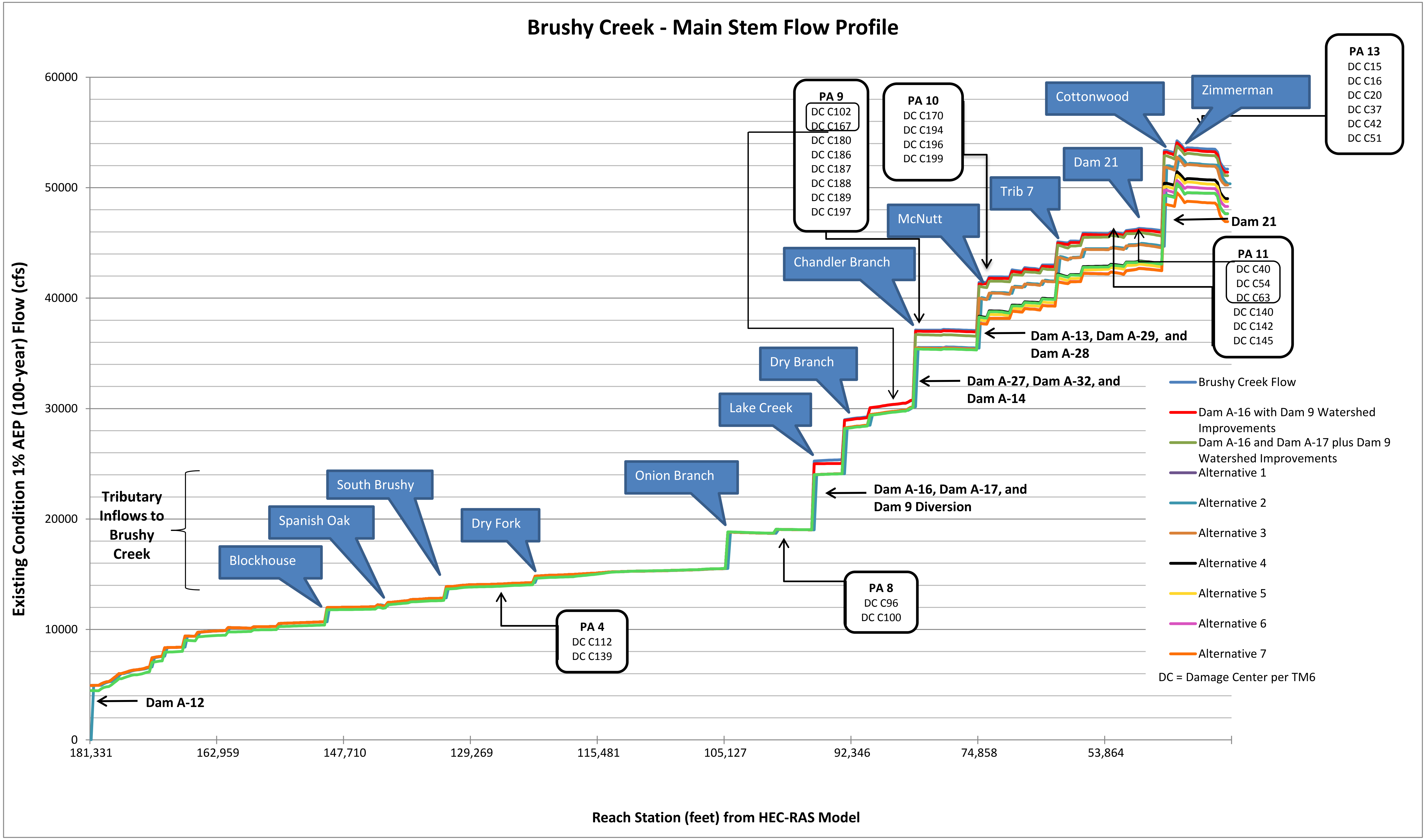
Table 7-20. Summary Prioritization of Standalone Projects

Project	Priority	Reduction in FS	Total Cost	Cost per Unit of FS Reduction	Note
Most Cost-Effective Projects in Addressing Local PAs					
A2	1	32.7	$57,000	$1,700	Most cost-effective control on Blockhouse Creek
A11	2	24.0	$2,017,000	$83,900	Potentially cost-effective addition to A2 for Blockhouse Creek
A31	3	3.4	$1,556,000	$460,400	Only project that benefits PA8 on Brushy Creek main stem
A15	??	24.4	??	??	Control on Lake Creek Tributary 6
Alternatives to Projects Above					
A1		0.5	$1,360,000	$2,725,600	Alternative to A2, A11 on Blockhouse Creek
A3		2.6	$846,000	$321,700	Alternative to A2, A11 on Blockhouse Creek
A5		36	$434,000	$12,100	Appears cost-effective control to Blockhouse Creek, but requires buyouts
Rejected Alternatives					
A30		0.03	$2,030,000	Low benefit	South Brushy Creek, no benefit
A25		0.5	$191,000	$353,700	Dam 18 Tributary Channel mod, no benefit to main stem
A23		0			Cottonwood Creek diversion channel, no benefit



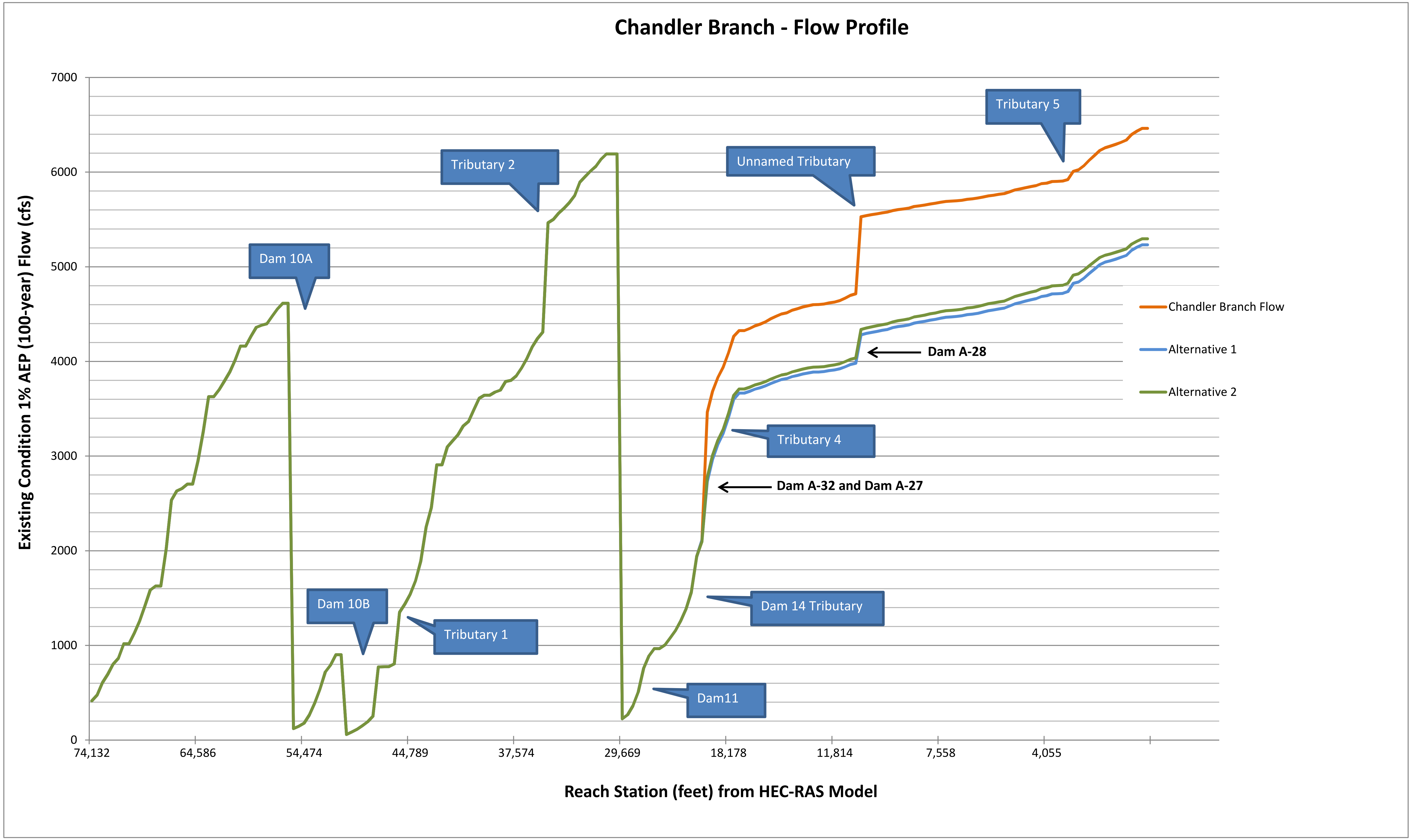
Upper Brushy Creek WCID

Figure 7-1
Priority Areas



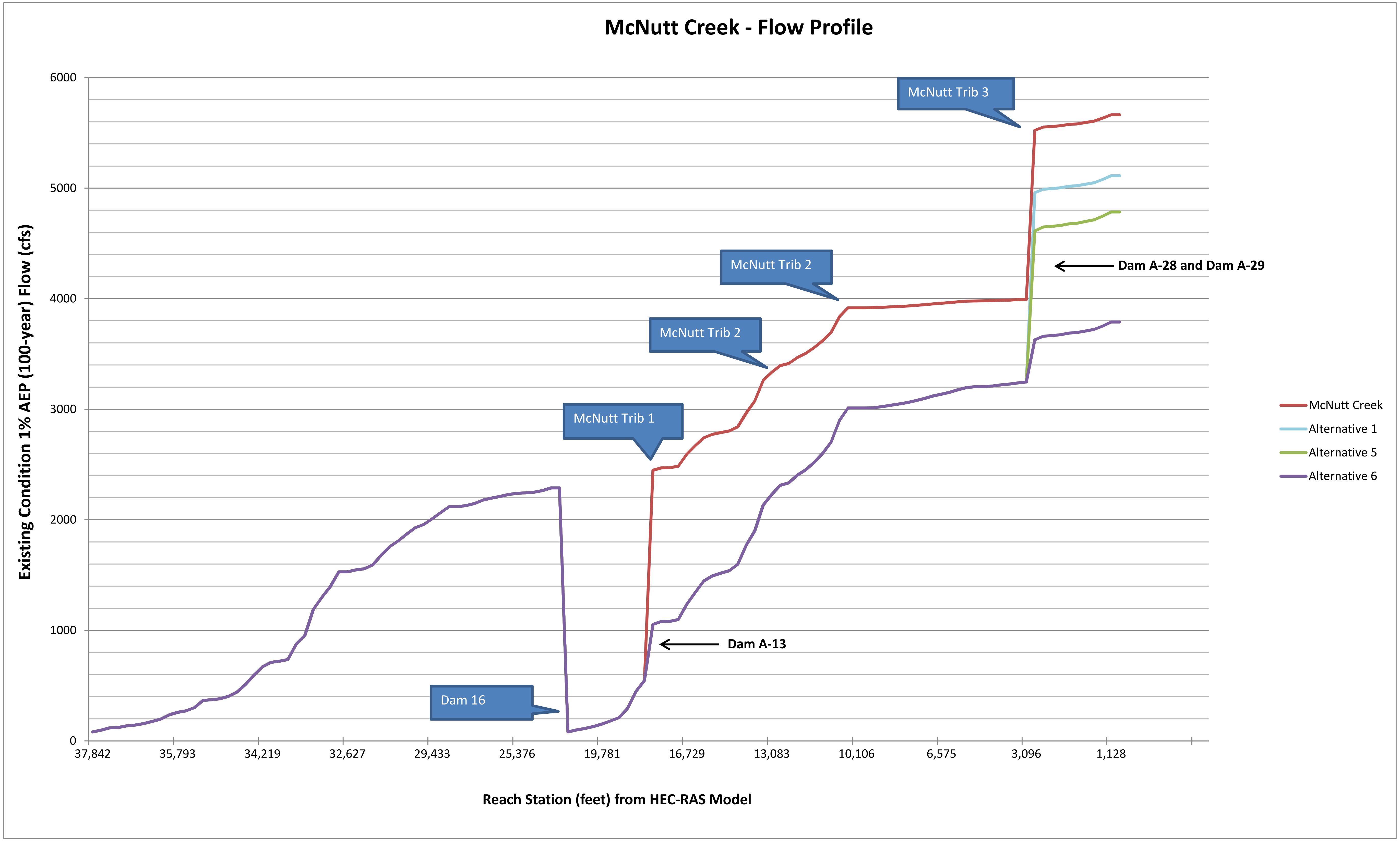
Texas Water Development Board URS

Figure 7-2. Brushy Creek Main Stem Flow Profile



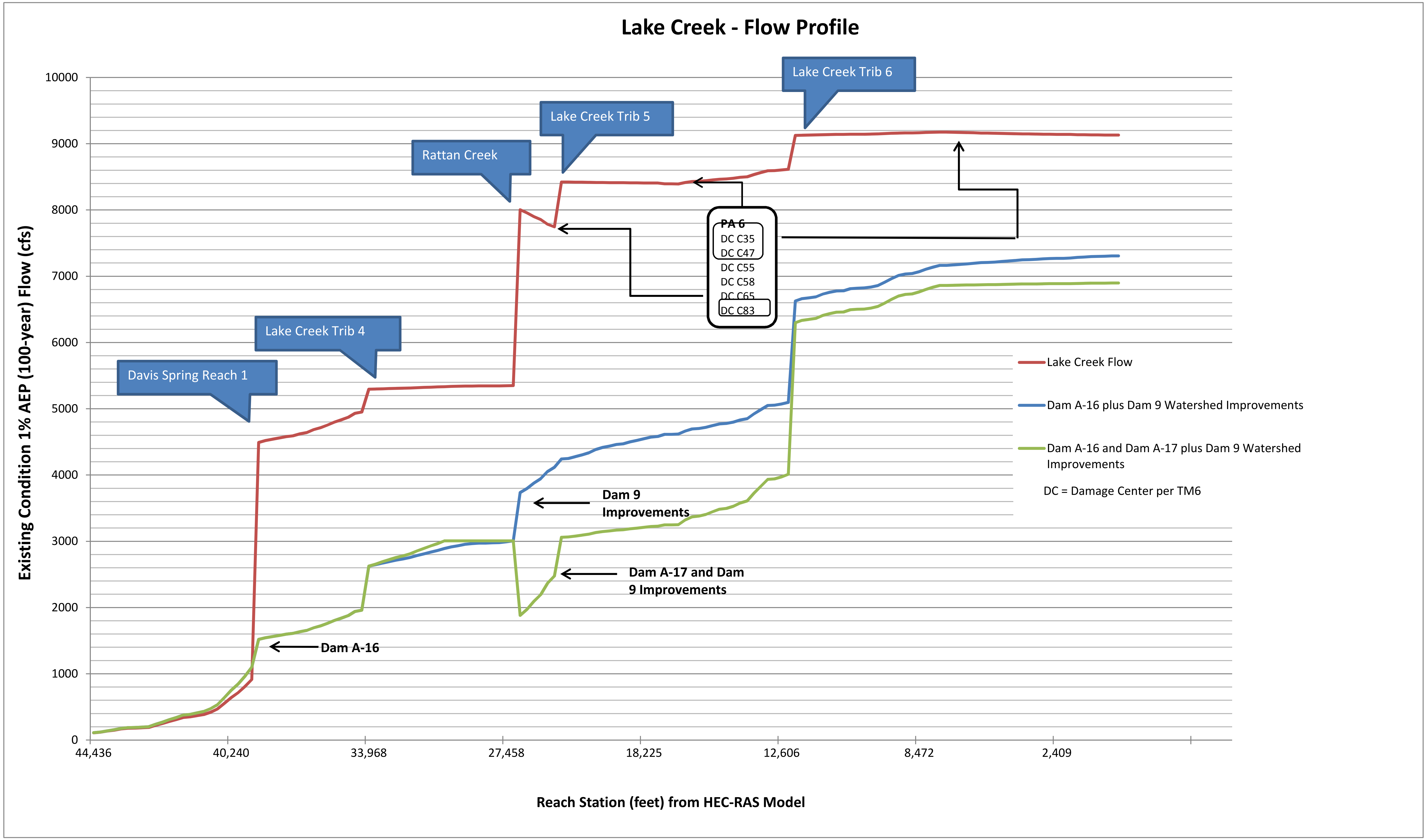
Texas Water Development Board URS

Figure 7-3. Chandler Branch Flow Profile



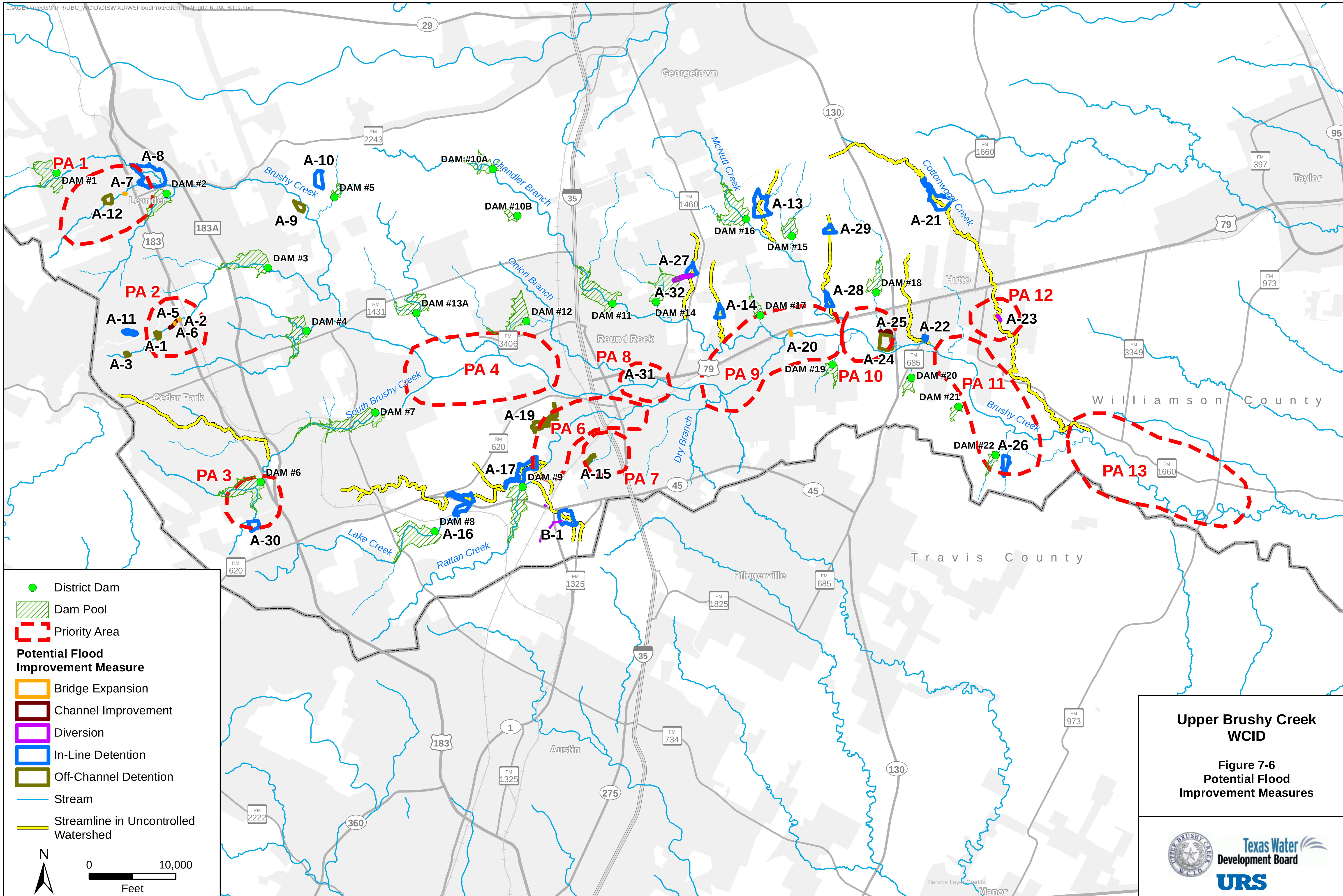
Texas Water Development Board URS

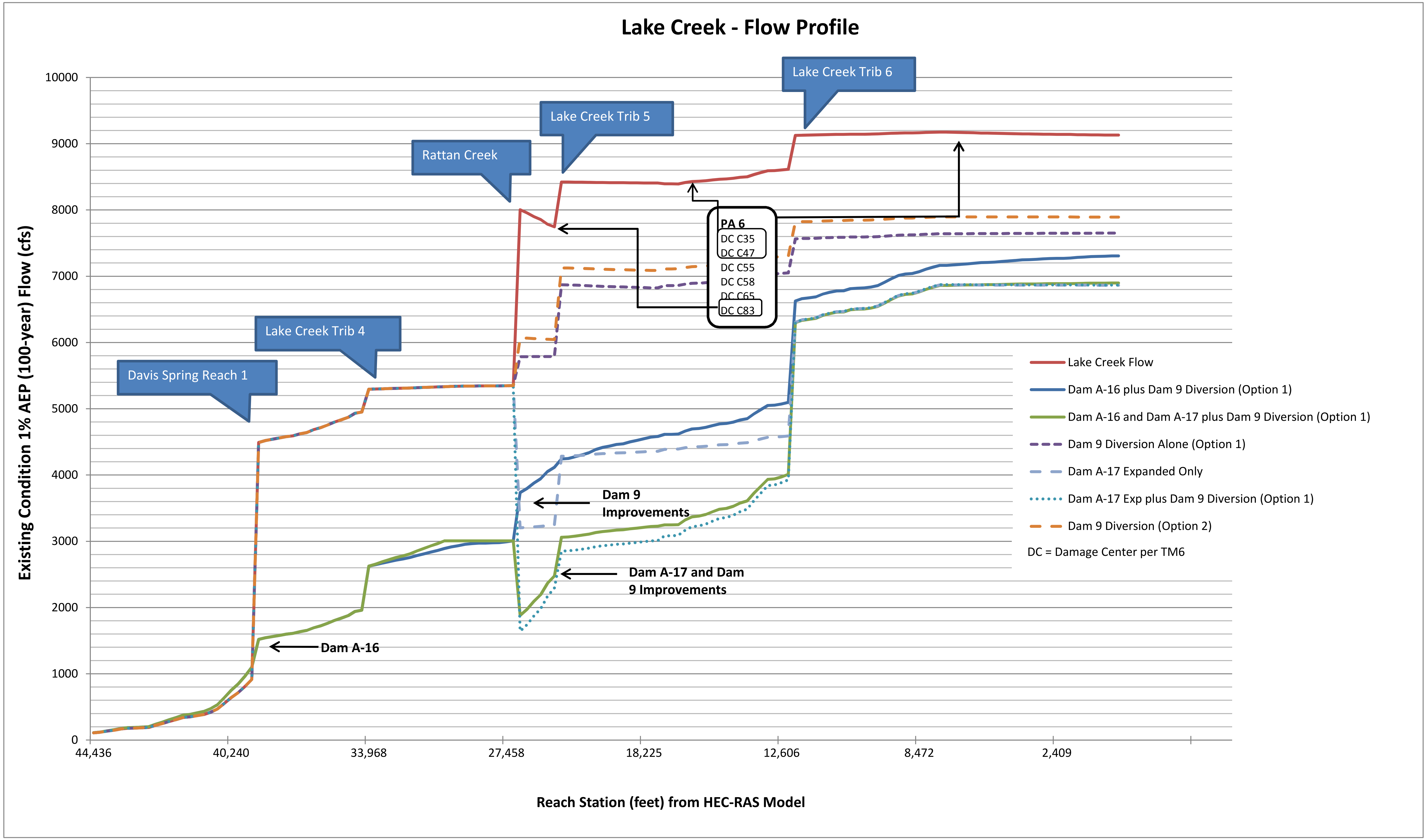
Figure 7-4. McNutt Creek Flow Profile



Texas Water Development Board URS

Figure 7-5. Lake Creek Flow Profile


Upper Brushy Creek WCID
Figure 7-6
Potential Flood Improvement Measures
District Dam
Dam Pool
Priority Area
Potential Flood Improvement Measure
Bridge Expansion
Channel Improvement
Diversion
In-Line Detention
Off-Channel Detention
Stream
Streamline in Uncontrolled Watershed
N
0
10,000
Feet
PA 1
PA 2
PA 3
PA 4
PA 6
PA 7
PA 8
PA 9
PA 10
PA 11
PA 12
PA 13
A-1
A-2
A-3
A-5
A-6
A-7
A-8
A-9
A-10
A-11
A-12
A-13
A-14
A-15
A-16
A-17
A-19
A-20
A-21
A-22
A-23
A-24
A-25
A-26
A-27
A-28
A-29
A-30
A-31
A-32
B-1
DAM #1
DAM #2
DAM #3
DAM #4
DAM #5
DAM #6
DAM #7
DAM #8
DAM #9
DAM #10A
DAM #10B
DAM #11
DAM #12
DAM #13A
DAM #14
DAM #15
DAM #16
DAM #17
DAM #18
DAM #19
DAM #20
DAM #21
DAM #22
Brushy Creek
South Brushy Creek
Chandler Branch
Onion Branch
McNutt Creek
Cottonwood Creek
Dry Branch
Lake Creek
Rattan Creek
Georgetown
Leander
Cedar Park
Round Rock
Hutto
Taylor
Pflugerville
Austin
Manor
Williamson County
Travis County
Texas Water Development Board
URS



Texas Water Development Board URS

Figure 7-7. Lake Creek Flow Profile, Effect of Improvements

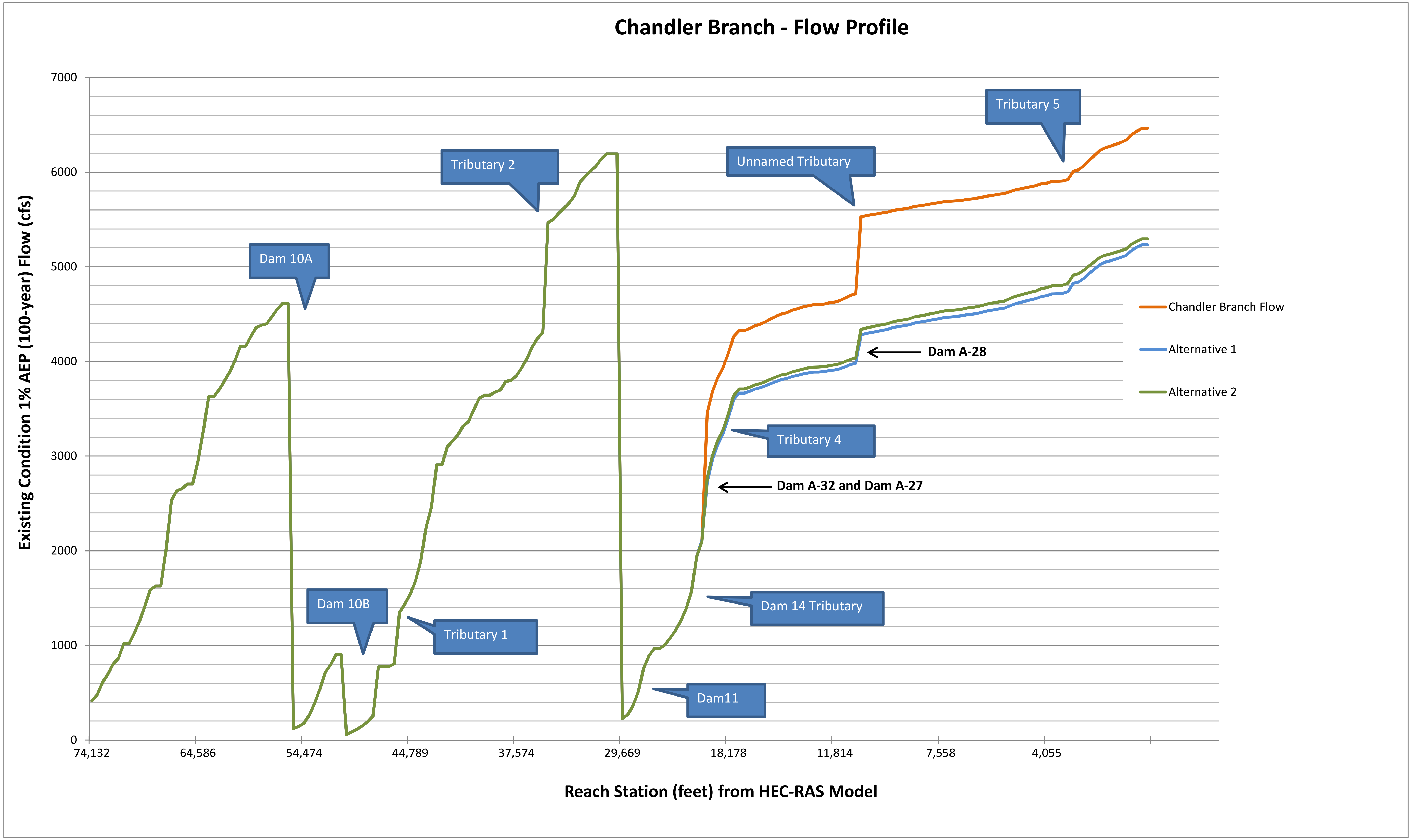


Figure 7-8. Chandler Branch Flow Profile, Effect of Improvements

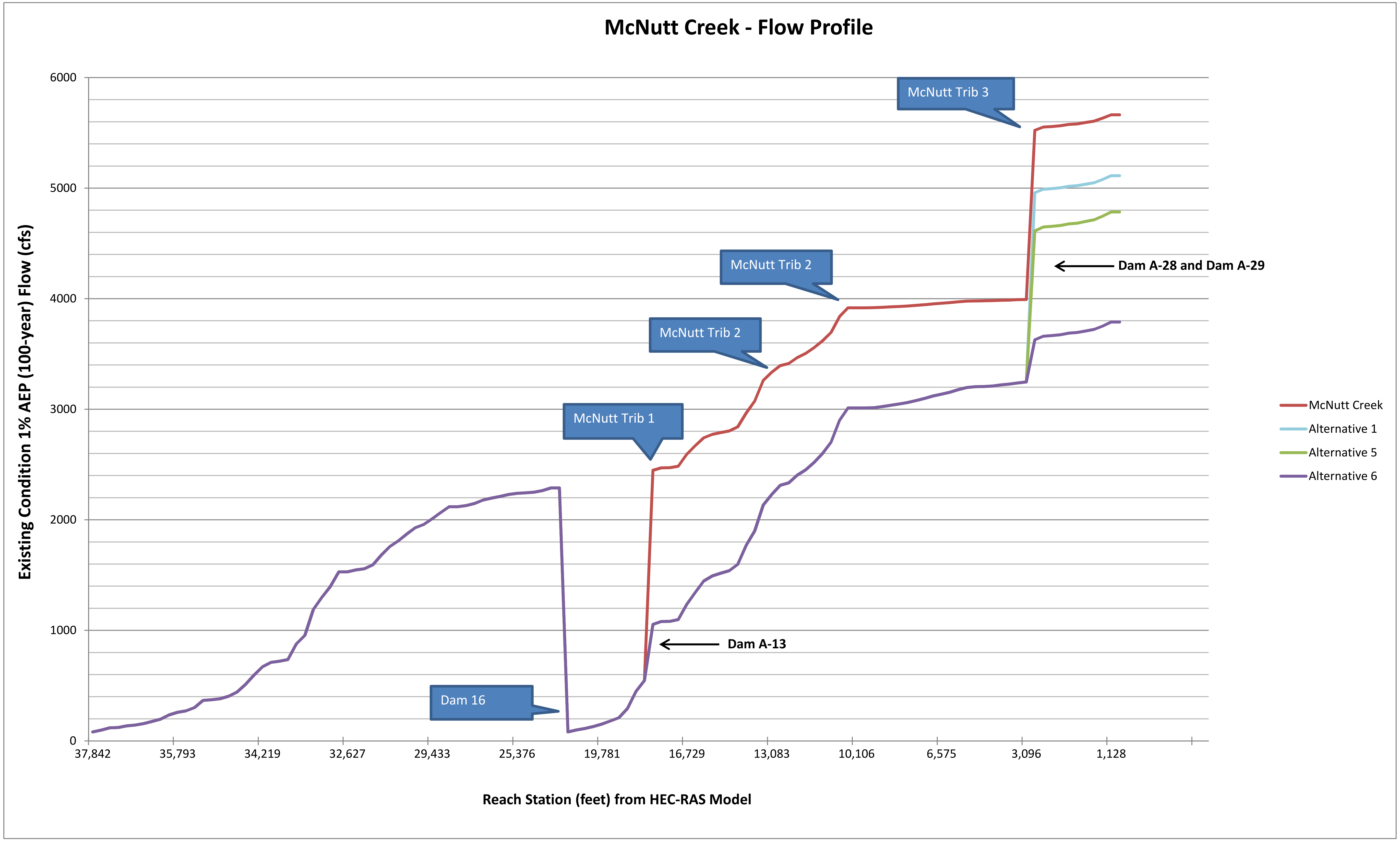


Figure 7-9. McNutt Creek Flow Profile, Effect of Improvements

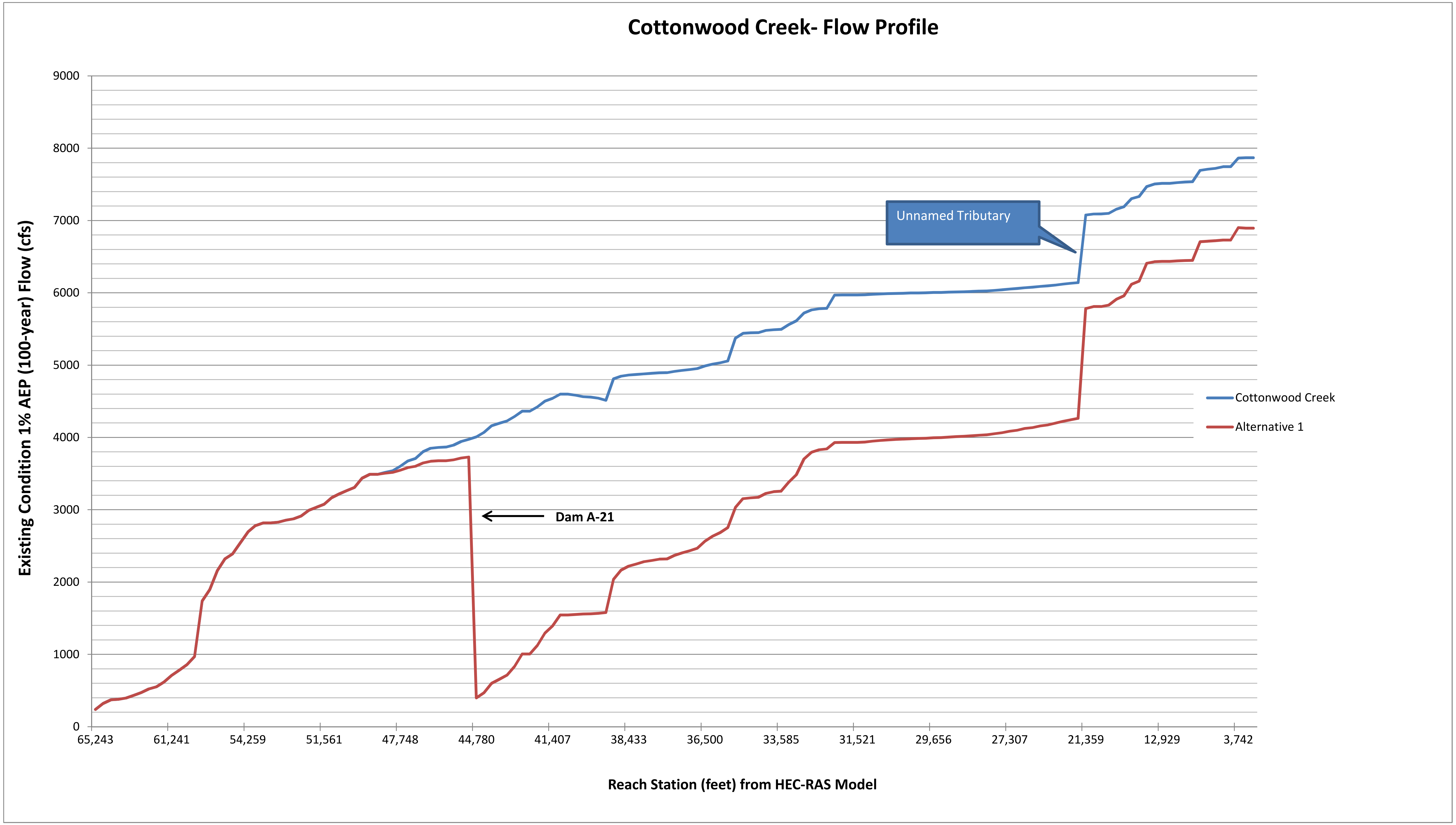
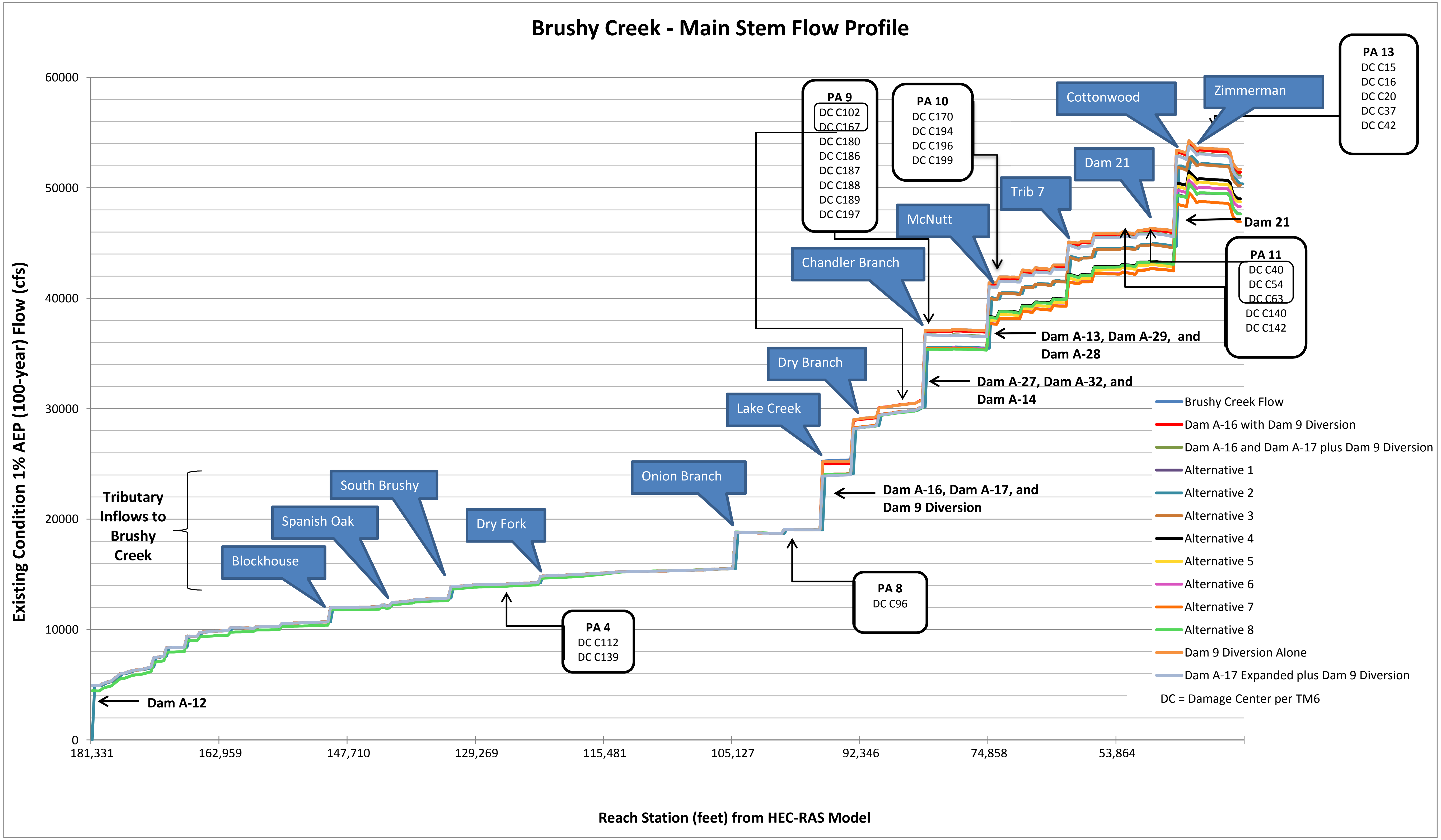


Figure 7-10. Cottonwood Creek Flow Profile, Effect of Improvements



Texas Water Development Board URS

Figure 7-11. Brushy Creek Main Stem Flow Profile,Effect of Improvements

Exhibit A
Summary of Hydrologic Methods
per TAC Consensus

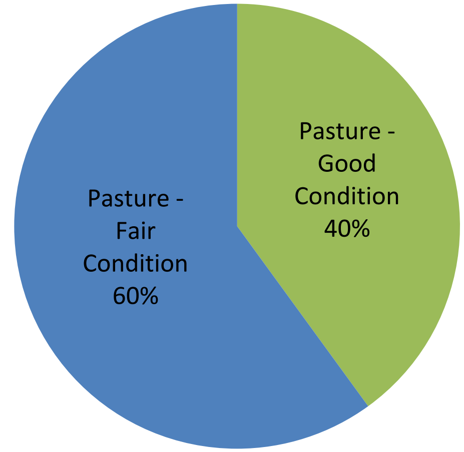
Exhibit A. Method Summary

Parameters		City of Austin	City of Cedar Park	City of Hutto	City of Leander	City of Round Rock	Williamson County	Risk Map/FEMA Models	Selected
Drainage Area	Topo	2006 LiDAR	"There is hereby adopted by the City of Cedar Park for the purpose of establishing rules and regulations for the design, development, construction, alteration, enlargement, repair, conversion, equipment, use, height, area and maintenance of drainage improvements, that certain codes recommended by the **City of Austin Drainage Criteria Manual**, being the most current edition thereof, and the whole thereof, as amended from time to time, including later editions, except such portions as are hereinafter amended, deleted or modified by the City of Cedar Park. One (1) copy of said code is now on file in the office of the city secretary, and the same is hereby adopted and incorporated as fully as if set out at length herein, and the same shall be controlling in the design, development, and construction of all drainage improvements within the city limits and extraterritorial jurisdiction of the City of Cedar Park, Texas."	"All drainage systems shall be designed in accordance with the **City of Round Rock Drainage Criteria Manual** (Jan. 2005), City of Hutto Standard Details, and TCEQ Design Criteria in the Texas Administrative Code, as amended. Drainage systems shall be constructed in accordance with the City of Georgetown Specifications and City of Hutto Standard Details. Where a City of Hutto detail does not exist, use the applicable Georgetown detail. If there is a conflict between Hutto city ordinance and manual content, Hutto ordinances will prevail."	"The City of Leander has adopted both the Austin Transportation Criteria Manual and the **Austin Drainage Criteria Manual** to provide design criteria for site development. The criteria shall be implemented with reliance on sound engineering and planning judgment."	2006 LiDAR	Per subdivision regulations: City of Austin DCM or equivalent	2006 LiDAR	2006 LiDAR
	Watershed size							Larger upstream, smaller adjacent to study reach	< 1 sq mi
	Roads/ Railroads							Per LiDAR, aerial photo search for cross-drainage structure	Per LiDAR, aerial photo search for cross-drainage structure
	Storm Drains Considered?					Yes		No	Stakeholder input, otherwise no
Rainfall	24 Hour/1 day 100-Year Depth	10.2 inches				1-day depths not provided.		Varies (9.0-9.9) USGS SIR 2004-5041	Create surface from (9.0-9.9)- USGS SIR 2004-5041 and select point at center of drainage area for each major tributary.
	Temporal Distribution	SCS 24-hour Type III				SCS 24-hour Type III		SCS 24-hour Type III	SCS 24-hour Type III
Infiltration and Loss	Impervious Area	Per TR55 Tabulation for existing, per max allowable in ultimate				Per TR55 Tabulation		Per TR55 Tabulation, other (Table 3, TSDN)	Per analysis of multispectral image
	Antecedent Moisture	Average (II)				Average (II)		Average (II)	Average (II) for precalibration; revisited prior to planning
	Initial abstraction	Per NEH-4				Per NEH-4		Per NEH-4	Per NEH-4
	Losses after initial abstraction	SCS Curve Number (TR-55)				SCS Curve Number (TR-55)		SCS Curve Number (TR-55)	SCS Curve Number (TR-55)
Reach Routing	Method	Modified Puls				Muskingum-Cunge Acceptable		Muskingum-Cunge	Muskingum-Cunge
Time of Concentration/ Lag Method	Method	SCS Method: Overland flow + Shallow Concentrated flow + channel flow				SCS Method: Overland flow + Shallow Concentrated flow + channel flow		SCS Method: Overland flow + Shallow Concentrated flow + channel flow	SCS Method: Overland flow + Shallow Concentrated flow + channel flow
	max overland flow length	100 feet				urban: 150 feet; undeveloped 300 feet		100 feet	100 feet, adjusted during calibration
	Channel velocity	Bankfull condition, normal depth				Bankfull condition, normal depth		If mapped channel: HECRAS velocity; if unmapped: bankfull and normal depth	If mapped channel: HECRAS velocity; if unmapped: bankfull and normal depth
Existing Condition		Existing land use "2008 Land Use Detailed" and "2008 Land Use General" GIS layers available	Existing "Zoning" layer package available	Zoning Shapefile available	?	"RR_Landuse" land use shapefile available	?	Modified from combination of City of Austin, Cedar Park, Hutto and Round Rock data. Data reclassed into TSDN Table 3 categories	Define % impervious per analysis of multispectral image; use TR55 value for pasture for undeveloped CN in urban area; use survey results for rural areas
Ultimate Condition		"flum_combined" future land use shapefile available	Future "Land use" Layer Package Available. Zoning categories combined into less detailed categories.	Zoning Shapefile available	?	"RR_Future_Landuse_Adoption_2010" future land use shapefile available Maximum Percent Impervious Cover from Building Code	?	Used City of Round Rock data. Watersheds upstream of Round Rock were assumed fully developed with mixed commercial and residential. Used Impervious Cover % from TR-55. Used paved condition for new development shallow concentrated flow. All area outside ETJ assumed developed per predominant development type	Utilize ultimate land use/zoning data provided by each city. Use paved condition for shallow concentrated flow.
Model Time Step and Run Duration		--	--	--	--	--	--	15 min, 48 hrs; except where > 0.28 * lag time = 10 minutes	15 min, 48 hrs; except where > 0.28 * lag time = 10 minutes
WCID Flood Control Structure Modeling (all modeled)	Model Initial Condition	--	--	--	--	--	--	WSE at lowest opening on Principal Spillway	WSE at lowest opening on Principal Spillway
	E-S-Q Curve	--	--	--	--	--	--	FNI SITES and other, see status discussion	SITES per FNI adjusted per review/ survey
Detention/ Retention Ponds	Choice of dams to model	--	--	--	--	--	--	per stakeholder input	per stakeholder input
	Model Initial Condition	--	--	--	--	--	--	per stakeholder provided normal pool	per stakeholder provided normal pool
	E-S-Q Curve	--	--	--	--	--	--	stakeholder provided	stakeholder provided
Other Dam Modeling	Choice of dams to model	--	--	--	--	--	--	not modeled	per size, flood/emergency pool; stakeholder input
	Model Initial Condition	--	--	--	--	--	--	not modeled	Best available data for normal pool
	E-S-Q Curve	--	--	--	--	--	--	not modeled	Best available data: LiDAR, aerial, survey?

Exhibit B
Curve Number Survey

Land Cover Type 1

Selected Cover Type



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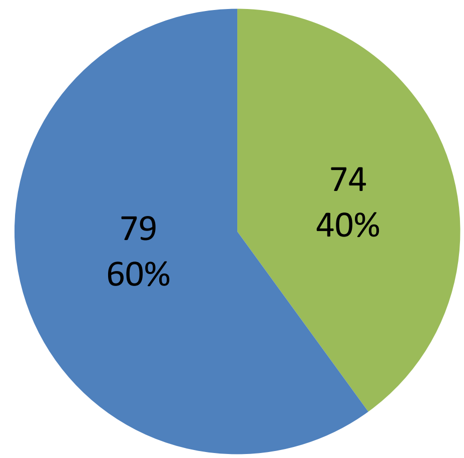
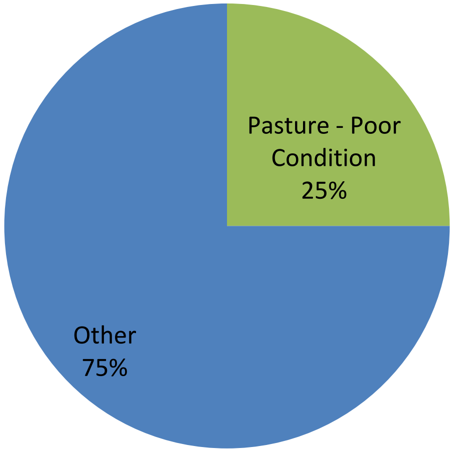


Land Cover Type 2

Selected Cover Type



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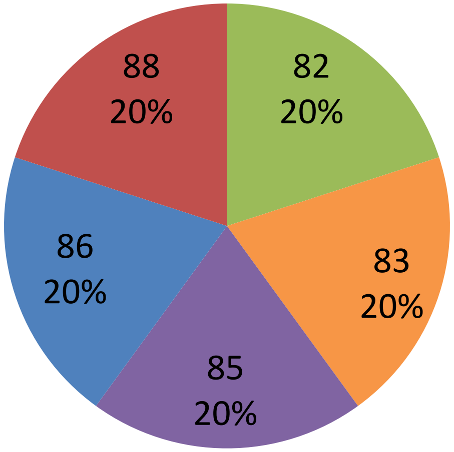
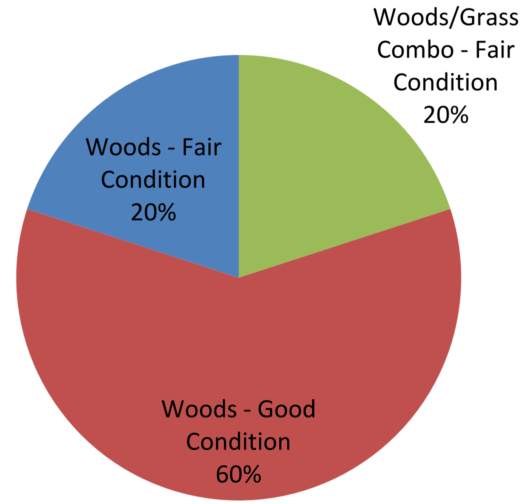


Land Cover Type 3

Selected Cover Type



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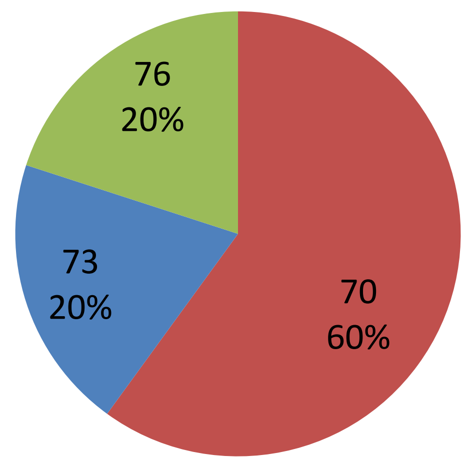

Land Cover Type 4

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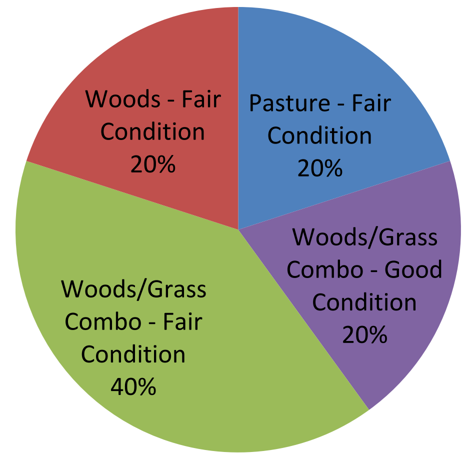

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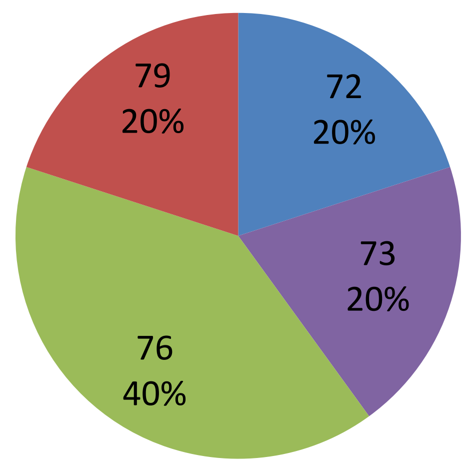
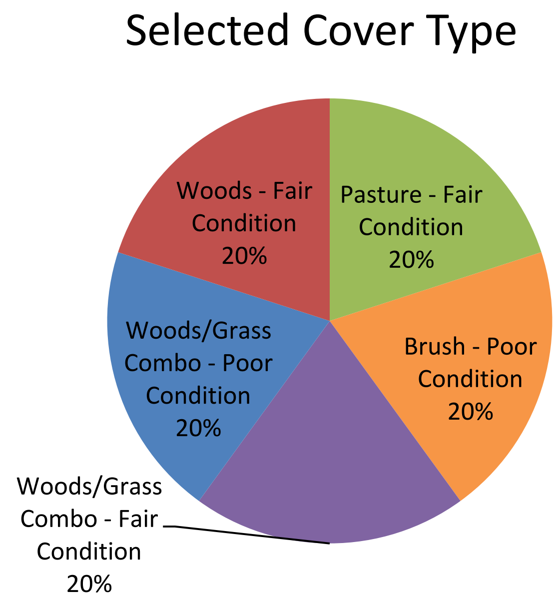


Land Cover Type 5



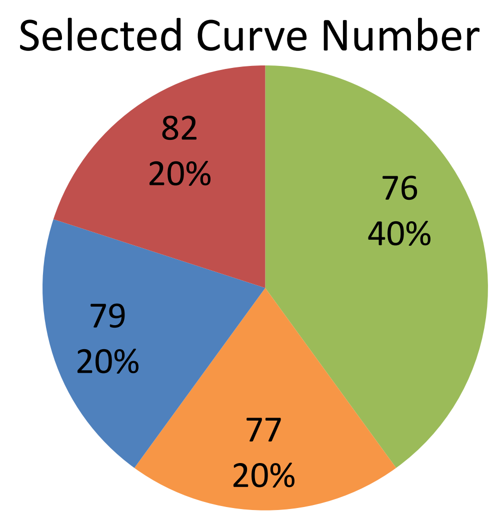


Exhibit C
Manning's n Values

Exhibit C

Table 3-1 Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
A. *Natural Streams*			
1. **Main Channels**			
a. Clean, straight, full, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as "d" but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy. deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stands of timber and brush	0.070	0.100	0.150
2. **Flood Plains**			
a. Pasture no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
2. Same as above, but heavy sprouts	0.050	0.060	0.080
3. Heavy stand of timber, few down trees, little undergrowth, flow below branches	0.080	0.100	0.120
4. Same as above, but with flow into branches	0.100	0.120	0.160
5. Dense willows, summer, straight	0.110	0.150	0.200

Type of Channel and Description	Minimum	Normal	Maximum
3. **Mountain Streams, no vegetation in channel, banks usually steep, with trees and brush on banks submerged**			
a. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
b. Bottom: cobbles with large boulders	0.040	0.050	0.070

Exhibit C

Table 3-1 (Continued) Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
B. *Lined or Built-Up Channels*			
1. **Concrete**			
a. Trowel finish	0.011	0.013	0.015
b. Float Finish	0.013	0.015	0.016
c. Finished, with gravel bottom	0.015	0.017	0.020
d. Unfinished	0.014	0.017	0.020
e. Gunite, good section	0.016	0.019	0.023
f. Gunite, wavy section	0.018	0.022	0.025
g. On good excavated rock	0.017	0.020	
h. On irregular excavated rock	0.022	0.027	
2. **Concrete bottom float finished with sides of:**			
a. Dressed stone in mortar	0.015	0.017	0.020
b. Random stone in mortar	0.017	0.020	0.024
c. Cement rubble masonry, plastered	0.016	0.020	0.024
d. Cement rubble masonry	0.020	0.025	0.030
e. Dry rubble on riprap	0.020	0.030	0.035
3. **Gravel bottom with sides of:**			
a. Formed concrete	0.017	0.020	0.025
b. Random stone in mortar	0.020	0.023	0.026
c. Dry rubble or riprap	0.023	0.033	0.036
4. **Brick**			
a. Glazed	0.011	0.013	0.015
b. In cement mortar	0.012	0.015	0.018
5. **Metal**			
a. Smooth steel surfaces	0.011	0.012	0.014
b. Corrugated metal	0.021	0.025	0.030
6. **Asphalt**			
a. Smooth	0.013	0.013	
b. Rough	0.016	0.016	
7. **Vegetal lining**	0.030		0.500

Exhibit C

Table 3-1 (Continued) Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
C. *Excavated or Dredged Channels*			
1. **Earth, straight and uniform**			
a. Clean, recently completed	0.016	0.018	0.020
b. Clean, after weathering	0.018	0.022	0.025
c. Gravel, uniform section, clean	0.022	0.025	0.030
d. With short grass, few weeds	0.022	0.027	0.033
2. **Earth, winding and sluggish**			
a. No vegetation	0.023	0.025	0.030
b. Grass, some weeds	0.025	0.030	0.033
c. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
d. Earth bottom and rubble side	0.028	0.030	0.035
e. Stony bottom and weedy banks	0.025	0.035	0.040
f. Cobble bottom and clean sides	0.030	0.040	0.050
3. **Dragline-excavated or dredged**			
a. No vegetation	0.025	0.028	0.033
b. Light brush on banks	0.035	0.050	0.060
4. **Rock cuts**			
a. Smooth and uniform	0.025	0.035	0.040
b. Jagged and irregular	0.035	0.040	0.050
5. **Channels not maintained, weeds and brush**			
a. Clean bottom, brush on sides	0.040	0.050	0.080
b. Same as above, highest stage of flow	0.045	0.070	0.110
c. Dense weeds, high as flow depth	0.050	0.080	0.120
d. Dense brush, high stage	0.080	0.100	0.140

Other sources that include pictures of selected streams as a guide to n value determination are available (Fasken, 1963; Barnes, 1967; and Hicks and Mason, 1991). In general, these references provide color photos with tables of calibrated n values for a range of flows.

Although there are many factors that affect the selection of the n value for the channel, some of the most important factors are the type and size of materials that compose the bed and banks of a channel, and the shape of the channel. Cowan (1956) developed a procedure for estimating the effects of these factors to determine the value of Manning's n of a channel. In Cowan's procedure, the value of n is computed by the following equation:

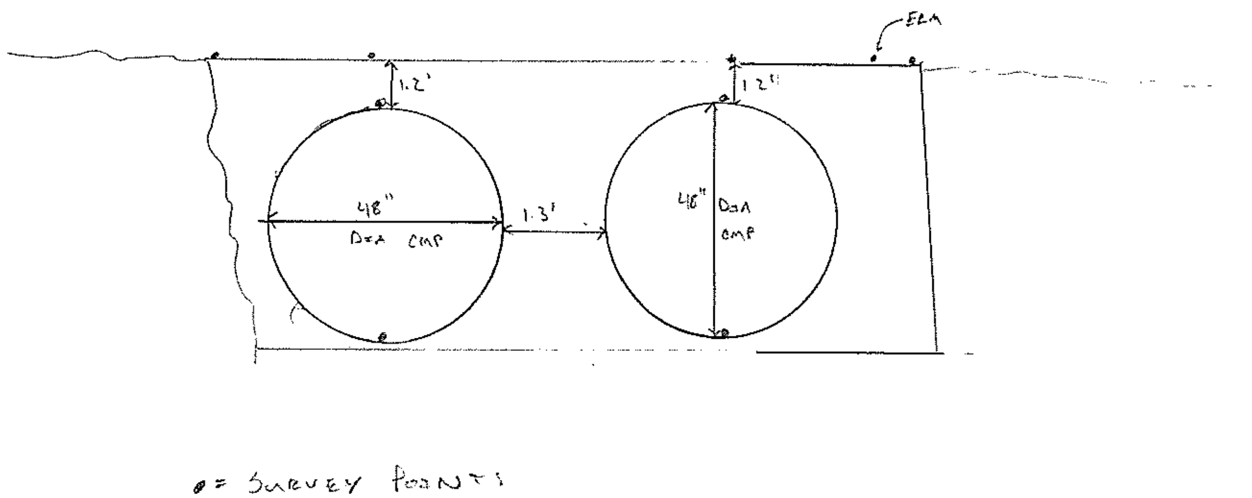
Exhibit D
Example Survey Data

2011 UPPER BRUSHY CREEK WATERSHED
WILLIAMSON COUNTY, TEXAS

SKETCH: ☐ BRIDGE ☒ CULVERT ☐ ROAD CROSSING ☐ CROSS-SECTION

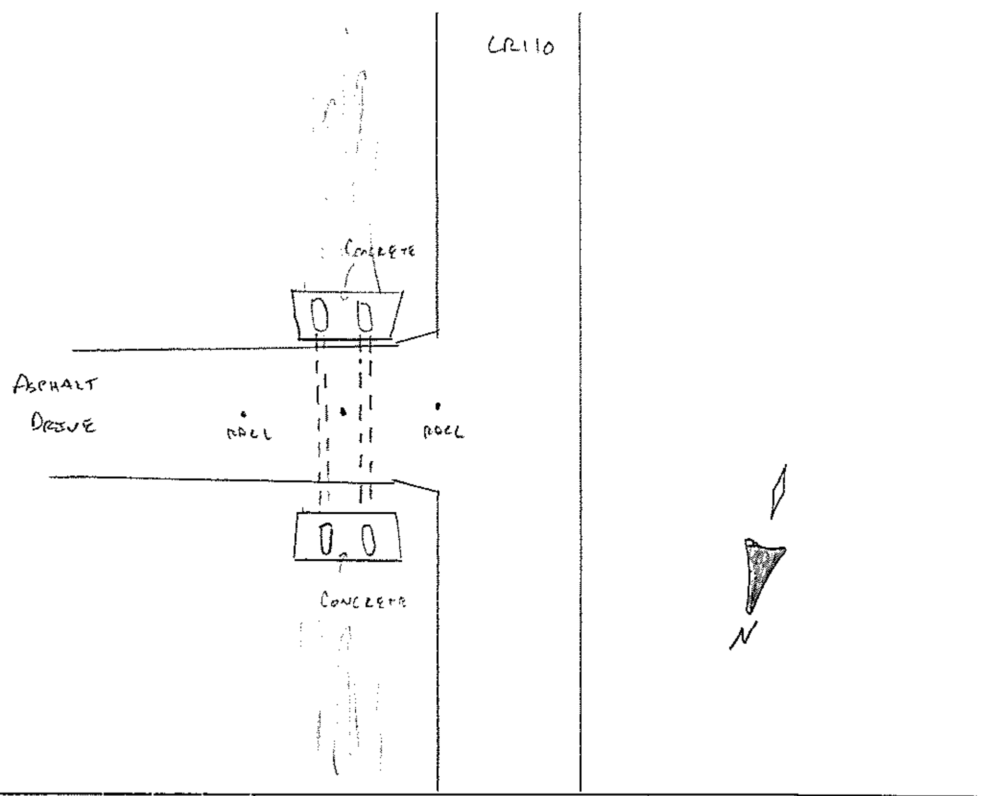
ID NO. McN-D-003 DATE 11-1-11 CREW CR NUMBER PHOTOS 4 COMMENT

PROFILE VIEW



SPANS____ BARRELS 2 HEIGHT 48" WIDTH 48" ☒ GPS ☐ CONV. ☐ H2O ☐ SEDIMENT

PLAN VIEW



LENGTH____ WIDTH____

CLIENT WCID & URS JOB NO.____

NOTES____

BAKER-AICKLEN & ASSOCIATES, INC.
ENGINEERS | SURVEYORS | GIS | PLANNERS | LANDSCAPE ARCHITECTS
ROUND ROCK - CEDAR PARK

405 BRUSHY CREEK ROAD
CEDAR PARK, TEXAS 78613
(512) 260-3700
ENGINEERING FIRM # F45
SURVEY FIRM #100231-0 TBAE #1787

MCN_D_003_USF.JPG

Title: Upper Brushy Creek Watershed Study

Attributes	
Description	
Comment	Baker-Aicklen Field Survey Crews
File Name	MCN_D_003_USF.JPG
Latitude	N 30° 34' 31"
Longitude	W 97° 36' 38"
Elevation	650 ft
Time Stamp	8:40:17 AM
Date Stamp	11/1/2011
Photo Direction	164° SSE
Measure Mode	3D

MCN_D_003_USC.JPG

Title: Upper Brushy Creek Watershed Study

Attributes	
Description	
Comment	Baker-Aicklen Field Survey Crews
File Name	MCN_D_003_USC.JPG
Latitude	N 30° 34' 31"
Longitude	W 97° 36' 38"
Elevation	651 ft
Time Stamp	8:40:26 AM
Date Stamp	11/1/2011
Photo Direction	324° NW
Measure Mode	3D

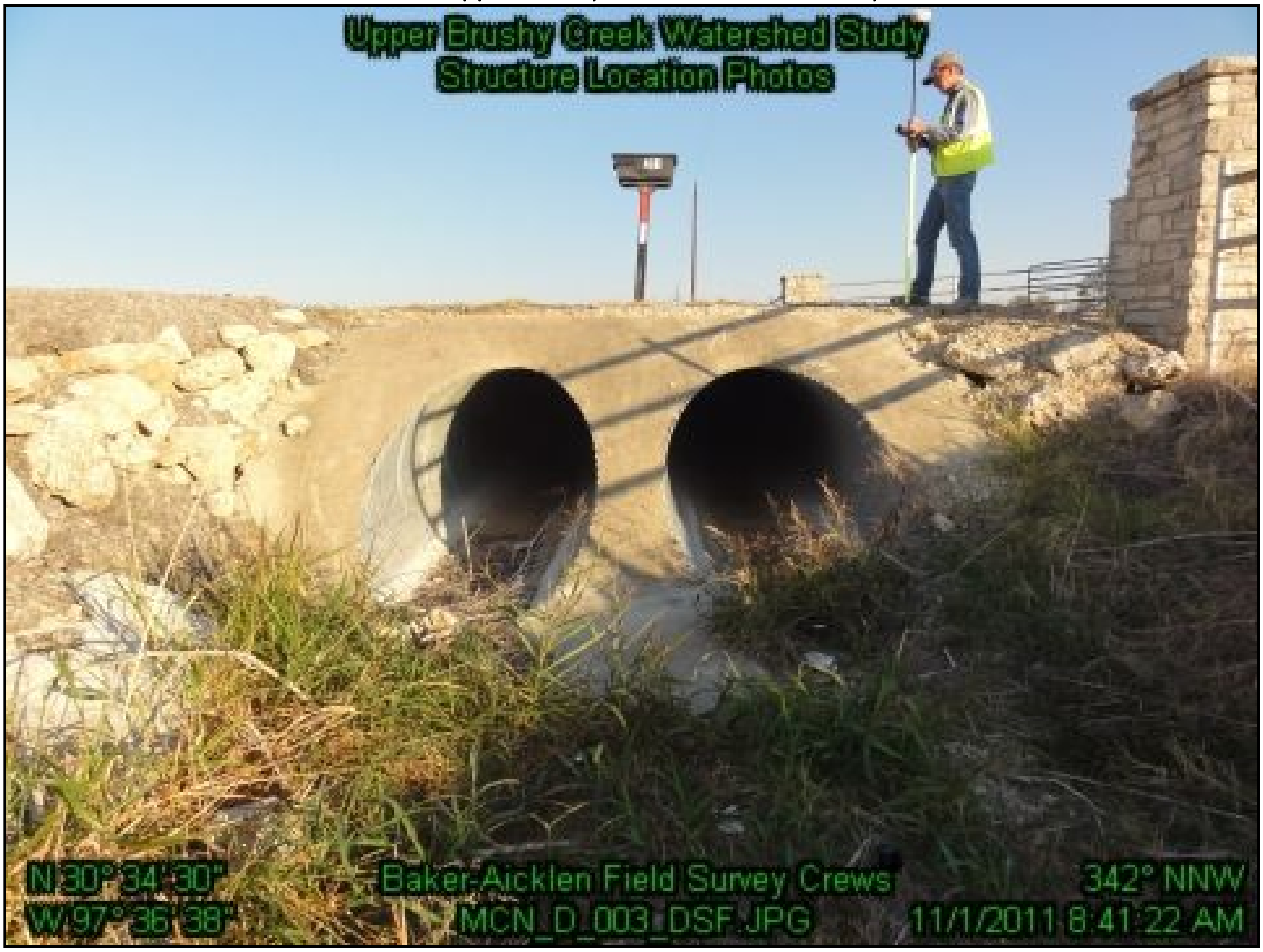
MCN_D_003_DSC.JPG

Title: Upper Brushy Creek Watershed Study

Attributes	
Description	
Comment	Baker-Aicklen Field Survey Crews
File Name	MCN_D_003_DSC.JPG
Latitude	N 30° 34' 30"
Longitude	W 97° 36' 38"
Elevation	656 ft
Time Stamp	8:41:08 AM
Date Stamp	11/1/2011
Photo Direction	177° S
Measure Mode	3D

MCN_D_003_DSF.JPG

Title: Upper Brushy Creek Watershed Study



Attributes	
Description	
Comment	Baker-Aicklen Field Survey Crews
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Longitude	W 97° 36' 38"
Elevation	659 ft
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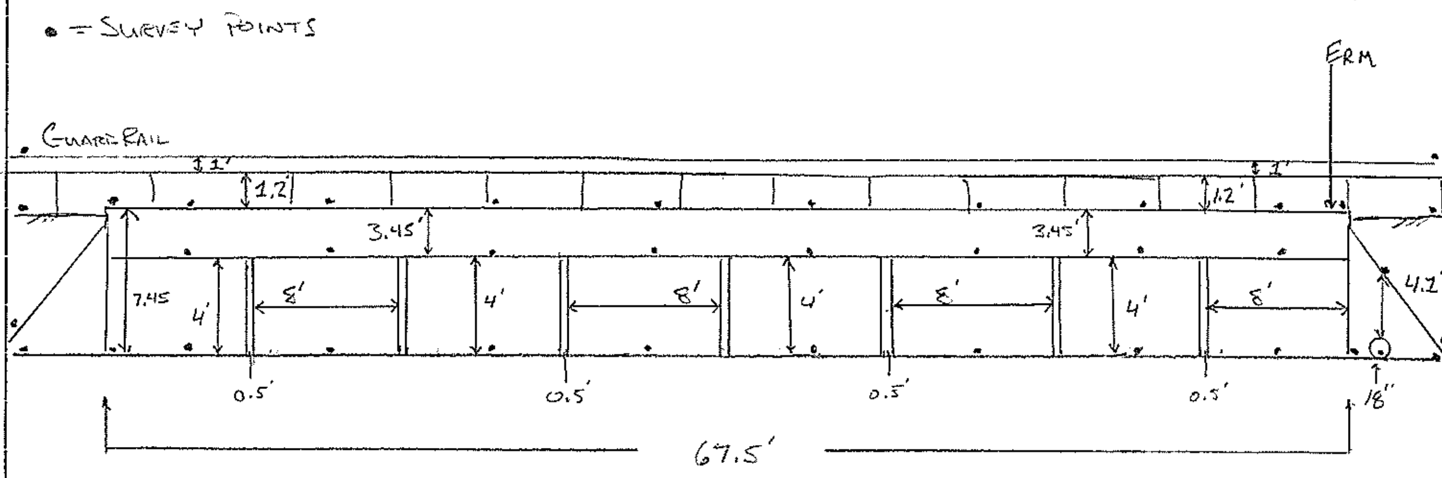
Date Stamp	11/1/2011
Photo Direction	342° NNW
Measure Mode	3D

2011 UPPER BRUSHY CREEK WATERSHED
WILLIAMSON COUNTY, TEXAS

SKETCH: ☒ BRIDGE ☐ CULVERT ☐ ROAD CROSSING ☐ CROSS-SECTION

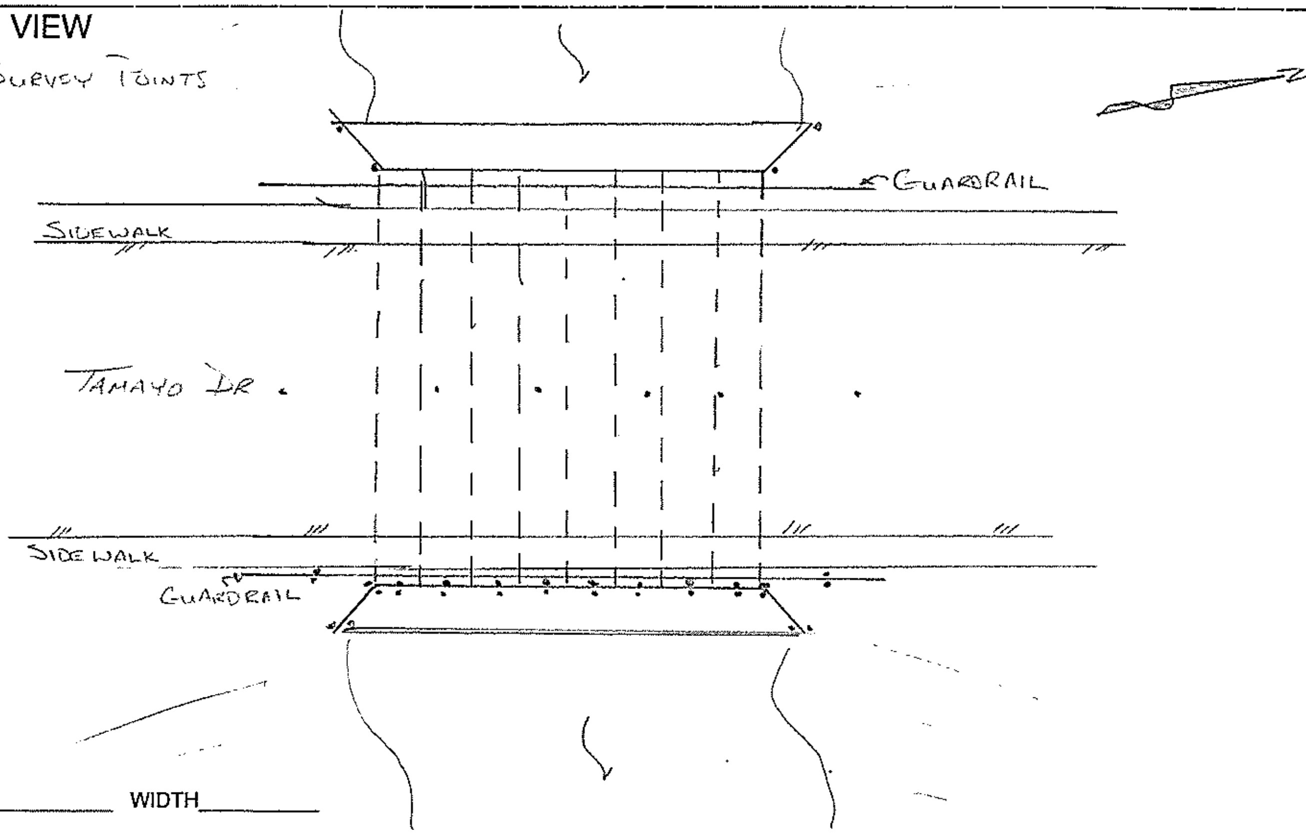
ID NO. RAT-A-011 DATE 10/4/11 CREW TP NUMBER PHOTOS 4 COMMENT

PROFILE VIEW



SPANS 8 BARRELS ______ HEIGHT 4' WIDTH 8' ☒ GPS ☐ CONV. ☒ H2O ☐ SEDIMENT

PLAN VIEW



LENGTH ______ WIDTH ______

CLIENT WCID & URS JOB NO. ______

NOTES ______

BAKER-AICKLEN & ASSOCIATES, INC.
ENGINEERS | SURVEYORS | GIS | PLANNERS | LANDSCAPE ARCHITECTS
ROUND ROCK - CEDAR PARK
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(512) 260-3700
ENGINEERING FIRM # F-45
SURVEY FIRM #100231-0 TBAE #1787

RAT_A_011_USF.JPG

Title: Upper Brushy Creek Watershed Study

Attributes	
Description	
Comment	Baker-Aicklen Field Survey Crews
File Name	RAT_A_011_USF.JPG
Latitude	N 30° 26' 48"
Longitude	W 97° 45' 27"
Elevation	873 ft
Time Stamp	1:57:20 PM
Date Stamp	10/4/2011
Photo Direction	0° N
Measure Mode	3D

RAT_A_011_USC.JPG

Title: Upper Brushy Creek Watershed Study

Attributes	
Description	
Comment	Baker-Aicklen Field Survey Crews
File Name	RAT_A_011_USC.JPG
Latitude	N 30° 26' 48"
Longitude	W 97° 45' 27"
Elevation	868 ft
Time Stamp	1:57:41 PM
Date Stamp	10/4/2011
Photo Direction	234° SW
Measure Mode	3D

RAT_A_011_DSC.JPG

Title: Upper Brushy Creek Watershed Study

Attributes	
Description	
Comment	Baker-Aicklen Field Survey Crews
File Name	RAT_A_011_DSC.JPG
Latitude	N 30° 26' 48"
Longitude	W 97° 45' 26"
Elevation	874 ft
Time Stamp	1:59:15 PM
Date Stamp	10/4/2011
Photo Direction	56° NE
Measure Mode	3D

RAT_A_011_DSF.JPG

Title: Upper Brushy Creek Watershed Study

Attributes	
Description	
Comment	Baker-Aicklen Field Survey Crews
File Name	RAT_A_011_DSF.JPG
Latitude	N 30° 26' 49"
Longitude	W 97° 45' 25"
Elevation	872 ft
Time Stamp	2:00:28 PM
Date Stamp	10/4/2011
Photo Direction	245° WSW
Measure Mode	3D

Exhibit E
Hydrologic Model Results

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	1	J_NFBC_040	0.57	1,102	1,312
	2	J_NFBC_050	1.20	1,912	2,328
	3	J_NFBC_60_70	1.13	1,528	1,810
	4	J_NFBC_050_060_070	2.33	3,415	4,138
	5	J_NFBC_010_020	1.12	1,677	1,943
	6	J_NFBC_30	1.80	2,584	2,950
	7	J_NFBC_90	0.78	1,013	1,185
	8	J_NFBC_030_080_090	5.07	6,723	8,362
	9	J_NFBC_100	5.81	962	1,050
	10	J_NFBC_110	6.58	1,760	1,991
	11	J_NFBC_120	7.59	2,073	2,377
	12	J_SFBC_010_020	0.95	1,350	1,500
	13	J_SFBC_030	1.53	1,975	2,172
	14	J_SFBC_040	0.58	998	1,063
	15	J_SFBC_030_040	2.11	2,912	3,176
	16	J_SFBC_050	2.50	3,459	3,762
	17	J_NFBC_120_&_SFBC_050	10.09	5,192	5,880
	18	J_BRC_010	10.16	5,194	5,866
	19	J_MAC_010	0.68	520	622
	20	J_MAN_020_1	1.18	986	1,135
	21	J_MACT1_010	0.20	295	304
	22	J_MAC_020	1.38	1,173	1,330
	23	J_MAC_030	1.76	1,487	1,674
	24	J_MAC_040	2.63	2,647	2,882
	25	J_MAC_050	3.13	2,999	3,271
	26	J_MAC_060	3.33	479	562
	27	J_BRC_010_&_MAC_060	13.49	5,325	6,061
	28	J_BRC_020	14.38	6,300	7,215
	29	J_BRC_030	15.20	6,945	7,963
	30	J_BRC_040	0.74	905	1,079
	31	J_BRC_030_040	15.94	7,810	8,986
	32	J_BRC_050	16.30	7,937	9,187
	33	J_BRCT1_010	0.68	853	1,004
	34	J_BRC_050_&_BRCT1_010	16.98	8,733	10,119
	35	J_BRC_060	17.11	8,818	10,125
	36	J_BRC_070_080	1.37	2,126	2,546
	37	J_BRC_060_070_080	18.48	9,850	11,488
	38	J_BRC_090	18.57	9,775	11,357
	39	J_BRCT2_010	0.32	694	788
	40	J_BRCT2_020	0.52	896	1,036
	41	J_BRC_090_BRCT2_020	19.10	10,113	11,729
	42	J_BRC_100	19.55	10,256	12,005
	43	J_BRCT3_010	0.37	529	639
	44	J_BRC_100_&_BRCT3_010	19.92	10,529	12,362
	45	J_BRC_110	20.31	10,548	12,380
	46	J_BRCT4_010_&_BRCT4_020	0.90	1,472	1,783
	47	J_BRCT4_030	1.00	1,631	1,960

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	48	J_BRCT4_040	1.24	406	471
	49	J_BRC_110_&_BRCT4_040	21.55	10,641	12,494
	50	J_BRC_120	21.89	10,668	12,643
	51	J_BRC_130	0.70	1,281	1,407
	52	J_BRC_120_130	22.59	10,925	12,981
	53	J_BRC_140B	23.47	11,069	13,178
	54	J_BLH_040	0.52	780	796
	55	J_BLH_010	0.17	296	296
	56	J_BLH_020	0.32	568	568
	57	J_BLH_030	0.39	367	367
	58	J_BLH_030_040	0.91	1,138	1,155
	59	J_BLH_050	1.33	1,752	1,796
	60	J_BLHT1_010	0.90	1,515	1,515
	61	J_BLH_050_&_BLHT1_010	2.23	3,217	3,260
	62	J_BLH_060	2.46	3,470	3,516
	63	J_BLH_070	2.75	3,762	3,813
	64	J_BLH_080	3.02	4,026	4,127
	65	J_BLH_090	3.47	4,451	4,561
	66	J_BLHT2_010	0.73	1,678	1,732
	67	J_BLHT2_020	0.81	1,712	1,793
	68	J_BLHT2_030	1.08	2,082	2,164
	69	J_BLH_090_030	4.54	5,498	5,663
	70	J_BLH_100	4.78	5,558	5,712
	71	J_BLHT3_003	0.00	87	87
	72	J_BLHT3_006	0.09	251	251
	73	J_BLHT3_006_Div_Crystal_Fall	0.36	748	748
	74	J_BLHT3_010	0.57	1,151	1,151
	75	J_BLHT3_030	0.71	1,258	1,259
	76	J_BLHT3_030_&_BLH_100	5.49	6,438	6,616
	77	J_BLH_110B	5.83	6,708	6,893
	78	J_BLHT3_020	0.55	960	1,025
	79	J_BLH_110C	0.55	885	945
	80	J_BLH_110_BLHT3_020	6.38	7,543	7,777
	81	J_BLH_120	7.42	8,674	9,121
	82	J_BLH_130	8.01	9,238	9,859
	83	J_BLH_140	8.86	1,186	1,411
	84	J_BLH_160	9.54	1,655	2,026
	85	J_BLH_150	0.38	602	770
	86	J_BLH_150_160	9.93	2,129	2,671
	87	J_BLH_170	9.98	2,106	2,659
	88	J_BRC_140_BLH_170	33.45	12,160	14,640
	89	J_BRC_150	33.88	12,250	14,826
	90	J_SPAO_010	0.18	500	500
	91	J_SPAO_020	0.45	847	877
	92	J_SPAO_030	0.53	901	938
	93	J_SPAO_040	0.77	1,260	1,360
	94	J_SPAO_050	1.02	1,725	1,849

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	95	J_SPAO_060	1.16	2,016	2,145
	96	J_SPAO_070	1.27	2,229	2,390
	97	J_SPAO_080B	1.38	2,293	2,463
	98	J_SPAOT1_010	0.99	1,354	1,402
	99	J_SPAO_080	2.38	3,471	3,689
	100	J_SPAO_090	2.84	3,926	4,184
	101	J_SPAO_100	0.15	311	312
	102	J_SPAO_090_100	2.99	4,040	4,333
	103	J_SPAO_110	3.39	4,313	4,643
	104	J_CWC_010	0.48	772	948
	105	J_CWC_030	0.79	1,256	1,534
	106	J_CWC_020	1.16	1,410	1,766
	107	J_CWC_020_&_SPAO_120	4.55	5,658	6,338
	108	J_SPAO_120B	4.64	5,702	6,386
	109	J_POC_010	0.16	369	423
	110	J_POC_020	0.59	821	993
	111	J_POC_030	0.79	772	956
	112	J_SPAO_120	5.43	6,347	7,161
	113	J_SPAO_130	5.73	432	638
	114	J_BRC_150_&_SPAO_130	39.61	12,286	14,937
	115	J_BRC_160	39.68	12,149	14,795
	116	J_BRC_170	39.90	12,194	14,863
	117	J_BRC_180	0.97	2,118	2,308
	118	J_BRC_170_180	40.87	12,460	15,156
	119	J_BRC_190	41.75	12,631	15,383
	120	J_BRC_200	0.28	485	559
	121	J_BRC_190_200	42.03	12,715	15,482
	122	J_BRC_220	0.43	800	862
	123	J_BRC_210	42.46	12,770	15,534
	124	J_BRC_240B	42.84	12,830	15,621
	125	J_BRC_230	0.12	177	215
	126	J_BRC_230_210	42.97	12,863	15,660
	127	J_BRC_240	42.98	12,853	15,654
	128	J_BUT_010	0.93	1,408	1,428
	129	J_BUT_020	1.35	1,667	1,686
	130	J_BUT_030	0.54	1,024	1,024
	131	J_BUT_020_030	1.90	2,572	2,590
	132	J_BUT_040	2.03	2,558	2,592
	133	J_BUT_050	2.06	2,525	2,558
	134	J_BUT_060	0.79	1,394	1,409
	135	J_BUT_070	1.28	2,271	2,295
	136	J_BUT_080	1.36	2,257	2,280
	137	J_BUT_050_080	3.43	4,702	4,756
	138	J_BUT_090	4.13	5,157	5,267
	139	J_BUT_100	1.02	1,964	2,090
	140	J_BUT_110	0.21	518	573
	141	J_BUT_100_110	1.24	2,359	2,523

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	142	J_BUT_120	1.64	2,529	2,717
	143	J_BUT_090_120	5.76	7,440	7,739
	144	J_BUT_130	6.25	997	1,095
	145	J_CLK_010	0.05	104	109
	146	J_CLK_020	0.41	722	825
	147	J_CLK_030	0.82	1,320	1,468
	148	J_CLK_040	1.15	1,609	1,830
	149	J_CLK_050	1.60	1,936	2,234
	150	J_CLK_060	2.30	2,250	2,572
	151	J_CLK_070	0.97	1,460	1,486
	152	J_CLK_060_070	3.28	3,363	3,750
	153	J_CLK_080	3.60	3,494	3,896
	154	J_CLKT1_010	0.20	373	393
	155	J_CLK_080_&_CLKT1_010	3.80	3,668	4,047
	156	J_CLK_090	4.12	3,896	4,335
	157	J_CLK_090_&_BUT_130	10.38	4,372	4,861
	158	J_SBR_010	10.95	4,570	5,067
	159	J_SBR_020	11.70	4,884	5,389
	160	J_SBRT1_010	0.60	1,233	1,281
	161	J_SBR_020_SBRT1_010	12.30	5,358	5,994
	162	J_SBR_030	12.77	5,895	6,625
	163	J_SBR_040	1.14	1,553	1,793
	164	J_SBRT2_010_020	0.27	523	561
	165	J_SBRT2_030	0.32	569	620
	166	J_SBR_030_040_&_SBRT2_030	14.23	7,843	8,799
	167	J_SBR_050	0.31	661	698
	168	J_SBR_060B	0.63	1,206	1,261
	169	J_SBR_060	14.85	8,520	9,491
	170	J_SBR_070	15.85	10,048	11,038
	171	J_SBR_080	16.53	1,171	1,303
	172	J_SBRT3_140	0.15	345	358
	173	J_SBR_080_SBRT3_010	16.68	1,414	1,556
	174	J_SBR_090	17.36	2,494	2,712
	175	J_SBR_100	17.66	2,873	3,173
	176	J_SBRT4_010	0.56	907	940
	177	J_SBR_100_&_SBRT4_010	18.22	3,716	4,048
	178	J_SBR_110	18.44	3,965	4,319
	179	J_BRC_240_&_SBR_110	61.42	13,748	16,685
	180	J_BRC_250	62.08	13,887	16,868
	181	J_BRC_260	63.06	14,099	17,148
	182	J_HONT1_010	0.29	393	448
	183	J_HON_010	0.24	307	357
	184	J_HON_010_&_HONT1_010	0.53	699	805
	185	J_HON_020	1.37	1,469	1,690
	186	J_HONT2_010	0.44	810	845
	187	J_HON_020_&_HONT2_010	1.81	2,158	2,410
	188	J_HON_030	2.36	2,950	3,198

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	189	J_HON_040	2.77	3,290	3,545
	190	J_DRYFT1_010	1.08	1,527	1,669
	191	J_DRYFT1_020	1.20	1,656	1,797
	192	J_DRYFT1_020_&_HON_040	3.97	4,908	5,321
	193	J_DRYF_010	4.68	1,011	1,133
	194	J_DRYF_020	5.20	1,627	1,822
	195	J_BRC_260_&_DRYF_020	68.26	14,643	17,804
	196	J_BRC_270	69.12	14,809	18,018
	197	J_BRC_280	70.14	15,085	18,688
	198	J_BRC_290	70.92	15,329	19,033
	199	J_ONI_010	0.19	444	454
	200	J_ONI_015	0.49	1,109	1,175
	201	J_ONI_020	1.07	1,871	1,938
	202	J_ONI_030	1.27	2,153	2,230
	203	J_ONI_040	0.34	589	604
	204	J_ONI_030_040	1.61	2,741	2,837
	205	J_ONI_050	1.82	2,982	3,104
	206	J_ONI_060	2.18	3,292	3,437
	207	J_ONI_080	0.52	876	992
	208	J_ONIT1_010	1.17	1,812	2,038
	209	J_ONIT1_010_&_ONI_060	3.35	5,074	5,425
	210	J_ONI_070	3.48	273	281
	211	J_ONIT1_020	0.13	291	294
	212	J_ONIT1_020_&_ONI_070	3.60	544	558
	213	J_ONI_090	4.42	1,751	1,838
	214	J_ONI_100	5.43	3,213	3,394
	215	J_ONI_110	5.87	3,890	4,087
	216	J_ONI_120	0.15	324	324
	217	J_ONI_110_120	6.01	4,067	4,263
	218	J_ONI_130	6.56	4,679	4,883
	219	J_BRC_290_&_ONI_140	77.49	18,582	22,475
	220	J_BRC_310	77.65	18,488	22,330
	221	J_BRC_320	0.43	884	884
	222	J_BRC_300	0.22	477	477
	223	J_BRC_300_310_320	78.30	18,857	22,728
	224	J_BRC_330	78.49	18,803	22,758
	225	J_LAK_010	0.26	532	544
	226	J_LAK_020	0.48	969	992
	227	J_LAK_030	0.87	1,824	1,867
	228	J_LAK_040	1.53	2,801	2,859
	229	J_LAK_060	1.79	3,229	3,292
	230	J_LAK_060_050	2.19	3,809	3,883
	231	J_LAK_070	2.40	3,844	3,922
	232	J_LAK_080	2.60	4,057	4,136
	233	J_LAKT1_010	0.92	1,331	1,503
	234	J_LAK_090	0.95	1,298	1,465
	235	J_LAK_080_090	3.55	5,286	5,551

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	236	J_LAK_100	3.72	5,315	5,572
	237	J_LAKT2_010	0.45	1,162	1,172
	238	J_LAKT2_020	1.11	2,472	2,474
	239	J_LAKT2_020_&_LAK_100	4.83	6,749	7,014
	240	J_LAK_110	5.35	7,291	7,516
	241	J_LAKT3_010	0.82	1,858	1,858
	242	J_LAKT3_020	1.60	3,112	3,112
	243	J_LAK_110_LAKT3_020	6.96	10,261	10,530
	244	J_LAK_130	7.37	10,663	10,884
	245	J_LAK_140	8.21	10,700	11,076
	246	J_LAK_120	0.17	333	352
	247	J_LAK_140B	0.17	294	312
	248	J_LAK_140_120	8.39	10,992	11,385
	249	J_LAK_150	9.08	948	1,283
	250	J_DAVT1_010	0.46	761	947
	251	J_DAV_020	0.58	879	1,086
	252	J_DAV_030	1.09	1,559	1,956
	253	J_DAV_040_050	1.87	2,096	2,536
	254	J_DAV_060	2.14	2,427	2,983
	255	J_DAV_070	2.57	2,983	3,625
	256	J_DAV_080	3.25	3,746	4,423
	257	J_DAV_080_&_LAK_150	12.33	4,521	5,662
	258	J_LAK_160	13.00	4,980	6,284
	259	J_LAKT4_010	0.43	823	902
	260	J_LAK_160_&_LAKT4_010	13.43	5,320	6,659
	261	J_LAK_170	13.95	5,451	6,753
	262	J_RAT_010	0.27	583	583
	263	J_RAT_020	0.64	1,388	1,388
	264	J_RAT_030	0.77	1,666	1,676
	265	J_RAT_040	1.11	2,271	2,300
	266	J_RAT_050	1.64	3,257	3,300
	267	J_RAT_060	1.89	3,662	3,720
	268	J_RAT_070	2.89	4,755	5,200
	269	J_RAT_080	3.55	5,316	6,008
	270	J_RAT_090	0.34	386	583
	271	J_RAT_080_090	3.89	5,701	6,590
	272	J_RAT_100B	4.62	5,968	6,962
	273	J_Quarry_SH_45_Div2	0.00	348	555
	274	J_RAT_100B_&_SH_45_Div2	4.62	6,299	7,539
	275	J_RAT_110	4.69	169	174
	276	J_RATT2_010	0.36	836	910
	277	J_RATT2_020	0.59	1,260	1,366
	278	J_RATT2_030	0.10	245	283
	279	J_RATT2_020_030	0.70	1,449	1,580
	280	J_RATT2_040	1.04	1,971	2,248
	281	J_RATT1_010	1.96	3,280	3,994
	282	J_Quarry_SH_45_Bypass	2.13	2,689	3,195

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	283	J_RATT1_020	2.27	2,640	3,269
	284	J_RAT_110_&_RATT1_020	6.97	2,709	3,360
	285	J_RAT_120	7.01	2,704	3,368
	286	J_RATT2_050	0.11	215	249
	287	J_Quarry_SH_45_Div1	0.00	340	461
	288	J_RATT2_050_&_SH_45_Div1	0.11	428	591
	289	J_RATT2_060	0.23	512	746
	290	J_RAT_120_&_RATT2_060	7.25	3,206	4,108
	291	J_RAT_130	7.30	3,095	3,993
	292	J_LAK_170_&_RAT_130	21.25	8,107	10,324
	293	J_LAK_180	21.80	7,835	10,238
	294	J_LAKT5_010	0.89	1,730	1,733
	295	J_LAKT5_020	1.78	2,969	3,306
	296	J_LAK_190	0.76	1,349	1,562
	297	J_LAK_190_&_LAKT5_020	2.54	4,267	4,869
	298	J_Quarry_FM620_Bypass	2.54	1,098	2,399
	299	J_LAKT5_030	0.10	229	275
	300	J_LAKT5_030_&_LAK_180	24.44	8,478	12,625
	301	J_LAK_200	24.99	8,454	12,550
	302	J_Quarry_FM620_Div1	0.00	36	125
	303	J_LAK_210	0.13	316	316
	304	J_LAK_210_&_LAK_200	25.11	8,419	12,588
	305	J_LAK_220	25.83	8,620	12,775
	306	J_LAKT6_010	0.13	69	72
	307	J_LAKT6_020	0.52	864	864
	308	J_LAKT6_030	0.17	63	63
	309	J_LAKT6_040	0.33	575	575
	310	J_LAKT6_020_040	0.85	1,344	1,344
	311	J_LAKT6_050	1.47	2,813	2,813
	312	J_LAK_220_&_LAKT6_050	27.30	9,135	13,404
	313	J_LAK_230	27.80	9,172	13,332
	314	J_LAK_240	28.19	9,144	13,242
	315	J_LAK_240_&_BRC_330	106.69	25,025	31,823
	316	J_BRC_340	107.10	25,167	31,986
	317	J_DRYT1_010	0.73	1,571	1,571
	318	J_DRYT1_020	0.49	1,138	1,138
	319	J_DRYT1_010_020	1.22	2,709	2,709
	320	J_DRYT1_030	2.02	3,955	3,955
	321	J_DRY_010	0.92	1,897	2,126
	322	J_DRY_020	1.61	3,017	3,221
	323	J_DRYT1_030_&_DRY_020	3.63	6,842	7,052
	324	J_DRY_030	4.10	7,086	7,318
	325	J_DYB_010	0.76	1,651	1,826
	326	J_DYB_020	1.49	2,957	3,243
	327	J_DYB_020_BRC_340_DRY_030	112.68	28,887	35,341
	328	J_BRC_350	113.22	29,169	35,678
	329	J_BRC_360	0.20	479	479

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	330	J_BRC_360_370	0.53	1,004	1,004
	331	J_BRC_380	1.15	1,962	1,962
	332	J_BRC_350_380	114.37	30,016	36,519
	333	J_BRC_390	115.20	30,386	36,958
	334	J_BRC_400	115.76	30,675	37,206
	335	J_CHB_010	0.89	1,094	1,305
	336	J_CHB_020	1.47	1,747	2,108
	337	J_CHB_030	2.29	2,926	3,545
	338	J_CHB_040	3.04	3,942	4,806
	339	J_CHB_050	3.58	4,530	5,571
	340	J_CHB_060	4.18	5,048	6,247
	341	J_CHB_070A	4.68	982	1,197
	342	J_CHB_070C	0.26	178	209
	343	J_CHB_070D	5.05	273	301
	344	J_CHBT1_010B	1.12	1,508	1,803
	345	J_CHBT1_010_QRY	1.12	101	114
	346	J_CHBT1_020	1.81	1,128	1,353
	347	J_CHBT1_030A	0.27	233	234
	348	J_CHBT1_030B	0.44	320	321
	349	J_CHBT1_030C	0.30	0	0
	350	J_NRCS_DAM_10B_DS	2.56	305	315
	351	J_CHBT1_040	2.76	619	646
	352	J_CHB_070_&_CHBT1_040	7.81	853	897
	353	J_CHB_080	7.87	889	938
	354	J_CHB_090	0.54	644	900
	355	J_CHB_080_090	8.41	1,502	1,803
	356	J_CHB_100	9.41	3,201	3,595
	357	J_CHB_110	10.13	3,957	4,479
	358	J_CHB_120	10.61	4,669	5,285
	359	J_CHBT2_010	0.62	1,093	1,199
	360	J_CHBT2_020	0.36	729	844
	361	J_CHBT2_010_020	0.98	1,791	1,993
	362	J_CHBT2_030	1.39	2,321	3,235
	363	J_CHBT2_040	1.94	1,494	1,652
	364	J_CHB_110_CHBT2_040	12.54	5,914	6,667
	365	J_CHB_130	13.31	6,770	7,659
	366	J_CHB_140	13.92	1,042	1,137
	367	J_CHB_150	14.45	1,686	1,798
	368	J_CHBT3_010	0.18	369	369
	369	J_CHBT3_020	0.64	993	1,085
	370	J_CHBT3_030	1.19	1,569	1,742
	371	J_CHBT3_060	0.41	860	940
	372	J_CHBT3_040	0.23	582	582
	373	J_CHBT3_050	0.09	214	214
	374	J_CHBT3_060_50_40	0.74	1,628	1,718
	375	J_CHBT3_070	0.27	465	554
	376	J_CHBT3_030_070	2.20	3,515	3,858

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	377	J_CHBT3_080	2.46	4,005	4,379
	378	J_CHBT3_090	2.65	490	501
	379	J_CHBT3_090_&_CHB_150	17.10	2,092	2,216
	380	J_CHB_160	17.21	2,246	2,352
	381	J_CHBT4_010	1.09	1,703	2,194
	382	J_CHB_160_&_CHBT4_010	18.29	3,754	4,401
	383	J_CHB_170	18.95	4,681	5,336
	384	J_CHB_180	19.43	5,115	5,817
	385	J_CHB_190	0.75	1,075	1,413
	386	J_CHB_180_190	20.18	6,006	7,007
	387	J_CHB_200	20.92	6,537	7,660
	388	J_CHBT5_010	0.68	1,108	1,334
	389	J_CHBT5_020	1.17	1,883	2,134
	390	J_CHBT5_030	1.24	222	235
	391	J_CHB_200_CHBT5_030	22.15	6,634	7,762
	392	J_CHB_210	22.93	7,057	8,159
	393	J_BRC_410	0.19	408	408
	394	J_CHB_210_BRC_400_410	138.88	36,920	44,285
	395	J_BRC_430	138.97	36,916	44,228
	396	J_BRC_420	0.16	358	374
	397	J_BRC_430_420	139.13	36,988	44,301
	398	J_BRC_440	139.95	36,923	44,238
	399	J_MCNF_010	0.63	1,097	1,317
	400	J_MCNF_020	1.33	2,255	2,739
	401	J_MCNF_030	0.78	1,294	1,649
	402	J_MCNF_040	0.29	501	566
	403	J_MCNF_030_040	2.40	3,798	4,699
	404	J_MCNF_050	3.04	4,523	5,606
	405	J_MCNF_060	3.45	4,720	5,692
	406	J_MCN_010	1.00	1,772	1,855
	407	J_MCN_020	1.57	2,502	2,734
	408	J_MCN_030	2.22	2,697	2,967
	409	J_MCNF_060_&_MCN_030	5.67	7,356	8,656
	410	J_MCN_040	5.99	639	814
	411	J_MCNT1_010	0.74	1,156	1,305
	412	J_MCNT1_020	0.94	1,327	1,503
	413	J_MCNT1_030_040	0.61	1,009	1,193
	414	J_MCNT1_050	0.02	45	50
	415	J_MCNT1_020_&_MCNT1_050	1.57	2,207	2,552
	416	J_MCNT1_060	1.92	2,566	2,990
	417	J_MCN_040_&_MCNT1_060	7.92	2,875	3,482
	418	J_MCN_050	8.29	3,328	3,986
	419	J_MCNT2_010_020	0.75	1,590	1,793
	420	J_MCNT2_030	1.12	2,321	2,606
	421	J_MCNT2_040	0.16	328	363
	422	J_MCNT2_030_040	1.29	2,649	2,968
	423	J_MCNT2_050	1.38	215	257

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	424	J_MCN_050_&_MCNT2_050	9.67	3,496	4,159
	425	J_MCN_060	10.03	3,943	4,658
	426	J_MCN_070	10.56	4,567	5,397
	427	J_MCN_080	11.06	4,600	5,461
	428	J_MCNT3_010	0.77	1,449	1,606
	429	J_MCNT3_020	1.07	1,825	2,025
	430	J_MCNT3_030	1.31	2,095	2,304
	431	J_MCN_080_&_MCNT3_030	12.37	6,293	7,321
	432	J_MCN_090	12.56	6,455	7,484
	433	J_BRC_440_&_MCN_090	152.51	41,220	49,334
	434	J_BRC_460	152.61	41,241	49,349
	435	J_BRCT5_010	0.87	1,631	1,641
	436	J_BRCT5_020	1.38	2,543	2,556
	437	J_BRCT5_030	0.30	779	779
	438	J_BRCT5_030_020	1.67	2,919	2,932
	439	J_BRCT5_040	1.89	440	500
	440	J_BRCT5_050	2.00	618	717
	441	J_BRC_450	0.46	655	724
	442	J_BRC_460_&_BRCT5_050	155.07	41,827	49,975
	443	J_BRC_470	155.13	41,796	49,911
	444	J_BRC_480	0.87	1,036	1,160
	445	J_BRC_470_480	156.00	42,476	50,669
	446	J_BRC_490	156.17	42,364	50,566
	447	J_BRC_500	0.87	1,665	1,857
	448	J_BRC_490_500	157.04	42,722	50,948
	449	J_BRC_510	157.11	42,556	50,799
	450	J_D18_010	0.63	1,055	1,189
	451	J_BRCT7_010	0.10	219	238
	452	J_D18_020	0.43	669	745
	453	J_D18_010_020	1.06	1,642	1,851
	454	J_D18_030	1.27	1,839	2,082
	455	J_D18_040	2.29	3,137	3,563
	456	J_D18_050	2.67	825	880
	457	J_D18_060	3.03	1,295	1,459
	458	J_D18_070	3.27	1,645	1,877
	459	J_D18_070_BRC_510	160.39	43,044	51,324
	460	J_BRC_520	160.67	43,044	51,307
	461	J_BRCT7_020	0.44	719	831
	462	J_BRCT7_030	0.67	1,103	1,267
	463	J_BRCT7_040	1.44	2,302	2,632
	464	J_BRCT7_060	0.68	637	676
	465	J_BRCT7_040_060	2.12	2,822	3,189
	466	J_BRCT7_050	2.52	3,060	3,485
	467	J_BRCT9_010	0.12	225	254
	468	J_BRC_530	0.21	342	375
	469	J_BRC_540	0.18	629	641
	470	J_BRC_550	0.34	875	883

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	471	J_BRC_520_550_BRCT7_050	163.53	45,120	53,629
	472	J_BRC_560	163.62	45,018	53,479
	473	J_BRCT8_010	0.48	866	929
	474	J_BRCT8_020	0.91	1,616	1,765
	475	J_BRCT8_030	1.22	612	681
	476	J_BRCT8_040	1.45	1,041	1,157
	477	J_BRC_550_&_BRCT8_040	165.07	45,240	53,721
	478	J_BRC_570	165.31	45,236	53,759
	479	J_BRCT9_020	0.40	647	668
	480	J_BRCT9_030	0.81	1,294	1,316
	481	J_BRCT9_040	0.12	307	307
	482	J_BRCT9_030_040	0.93	1,542	1,560
	483	J_BRCT9_050	1.19	1,994	2,052
	484	J_BRCT9_060	0.14	319	319
	485	J_BRCT9_050_060	1.33	2,269	2,328
	486	J_BRCT9_070	1.35	2,280	2,344
	487	J_BRC_570__BRCT9_070	166.66	46,006	54,549
	488	J_BRC_580	167.18	45,967	54,591
	489	J_BRC_600	0.91	1,687	1,955
	490	J_BRC_610	0.97	149	324
	491	J_BRC_590	0.35	372	485
	492	J_BRC_580_610_590	168.50	46,183	54,885
	493	J_BRC_630	168.67	45,989	54,753
	494	J_BRC_620	0.48	363	495
	495	J_BRC_640	0.34	750	868
	496	J_BRC_630_620	169.49	46,333	55,193
	497	J_BRC_650	169.90	46,448	55,249
	498	J_D22_010	0.71	1,385	1,603
	499	J_D22_020	1.08	764	925
	500	J_BRC_650_D22_020	170.98	46,572	55,386
	501	J_BRC_670	171.56	46,390	55,166
	502	J_COT_010	0.14	336	404
	503	J_COT_030	0.53	944	1,115
	504	J_COT_020	0.22	460	519
	505	J_COT_040	0.17	347	395
	506	J_COT_030_040	0.92	1,691	1,996
	507	J_COT_050	1.74	2,740	3,278
	508	J_COT_060	2.37	3,411	4,072
	509	J_COT_070	3.19	4,264	5,065
	510	J_COT_080	3.55	4,497	5,305
	511	J_COT_100	3.64	4,413	5,305
	512	J_COT_090	0.29	455	500
	513	J_COT_100_090	3.93	4,718	5,635
	514	J_COT_110	4.09	4,778	5,722
	515	J_COT_130	4.50	4,965	5,864
	516	J_COT_120	0.21	273	306
	517	J_COT_130_120	4.72	5,230	6,160

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	518	J_COT_150	5.31	5,694	6,715
	519	J_COT_140	0.28	233	255
	520	J_COT_160_150	5.59	5,880	6,923
	521	J_COT_160	6.23	6,080	7,158
	522	J_COT_180	0.27	387	420
	523	J_COT_190	0.98	1,417	1,574
	524	J_COT_170	0.44	808	930
	525	J_COT_190_170	7.66	7,049	8,235
	526	J_COT_200	7.74	7,076	8,319
	527	J_COT_210	8.45	7,341	8,590
	528	J_COT_220	0.37	613	724
	529	J_COT_210_220	8.82	7,493	8,775
	530	J_COT_230	8.97	7,542	8,811
	531	J_COT_240	9.13	7,567	8,863
	532	J_COT_250	0.39	640	739
	533	J_COT_240_250	9.52	7,747	9,059
	534	J_COT_260	9.77	7,802	9,123
	535	J_COT_270	0.17	234	269
	536	J_COT_260_270	9.94	7,925	9,264
	537	J_COT_280	9.99	7,931	9,273
	538	J_COT_300	10.07	7,760	9,110
	539	J_COT_290	0.13	185	227
	540	J_COT_300_&_BRC_670	181.76	52,989	63,114
	541	J_BRCT10_010	0.37	632	694
	542	J_BRCT10_020	0.69	1,053	1,178
	543	J_BRCT10_030	0.29	736	835
	544	J_BRCT10_040	0.54	1,221	1,387
	545	J_BRCT10_020_040	1.23	2,067	2,339
	546	J_BRCT10_050	2.21	2,865	3,347
	547	J_BRC_690	0.04	70	99
	548	J_BRCT10_050_690	184.01	53,768	63,976
	549	J_BRC_700	184.20	53,522	63,751
	550	J_BRCT11_010	0.34	568	656
	551	J_BRCT11_020	0.94	1,176	1,347
	552	J_BRCT11_030	0.35	537	617
	553	J_BRCT11_010_020	1.29	1,694	1,936
	554	J_BRCT11_040	1.60	2,111	2,411
	555	J_BRCT11_050	2.10	2,737	3,150
	556	J_BRCT11_060	2.48	3,139	3,638
	557	J_BRC_680	0.09	167	192
	558	J_BRCT11_070	0.18	279	349
	559	J_BRC_700_&_BRCT11_070	186.87	54,734	65,237
	560	J_BRC_720	186.96	53,975	64,414
	561	J_BRC_710	0.60	971	1,166
	562	J_BRC_720_710	187.56	54,117	64,570
	563	J_BRC_770	188.44	53,996	64,581
	564	J_BRC_790	188.69	52,214	62,809

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
	565	J_BRC_800	0.43	888	1,023
	566	J_BRC_790_800	189.12	52,297	62,902
	567	J_BRC_900	189.54	52,251	62,859
	568	J_BRC_740	0.97	1,124	1,447
	569	J_BRC_750	0.34	356	537
	570	J_BRC_740_750	1.30	1,454	1,937
	571	J_BRC_760	2.09	2,381	3,156
	572	J_BRC_780	2.80	3,148	4,144
	573	J_BRC_780_900	192.34	52,820	63,537
	574	J_QRY_010_020	2.30	1,215	1,775
1		BLH_010	0.17	296	296
2		BLH_020	0.16	404	404
3		BLH_030	0.07	193	195
4		BLH_040	0.52	780	796
5		BLH_050	0.42	737	765
6		BLH_060	0.23	542	544
7		BLH_070	0.28	644	652
8		BLH_080	0.27	436	540
9		BLH_090	0.45	602	614
10		BLH_100	0.23	508	508
11		BLH_110	0.34	730	730
12		BLH_120	1.04	1,581	1,815
13		BLH_130	0.59	1,028	1,179
14		BLH_140	0.85	1,127	1,352
15		BLH_150	0.38	602	770
16		BLH_160	0.69	982	1,228
17		BLH_170	0.05	105	118
18		BLHT1_010	0.90	1,515	1,515
19		BLHT2_010	0.73	1,678	1,732
20		BLHT2_020	0.08	172	212
21		BLHT2_030	0.27	456	456
22		BLHT3_003	0.27	586	586
23		BLHT3_006	0.09	202	202
24		BLHT3_010	0.21	405	405
25		BLHT3_020	0.55	960	1,025
26		BLHT3_030	0.14	363	366
27		BRC_010	0.07	125	140
28		BRC_020	0.89	1,457	1,568
29		BRC_030	0.82	1,314	1,510
30		BRC_040	0.74	905	1,079
31		BRC_050	0.36	626	753
32		BRC_060	0.14	176	212
33		BRC_070	0.49	697	830
34		BRC_080	0.88	1,485	1,767
35		BRC_090	0.09	143	193
36		BRC_100	0.46	706	871
37		BRC_110	0.40	609	747

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
38		BRC_120	0.34	457	587
39		BRC_130	0.70	1,281	1,407
40		BRC_140	0.88	947	1,300
41		BRC_150	0.43	500	751
42		BRC_160	0.07	132	155
43		BRC_170	0.22	386	530
44		BRC_180	0.97	2,118	2,308
45		BRC_190	0.87	1,366	1,808
46		BRC_200	0.28	485	559
47		BRC_210	0.39	578	690
48		BRC_220	0.43	800	862
49		BRC_230	0.12	177	215
50		BRC_240	0.01	24	32
51		BRC_250	0.66	1,308	1,326
52		BRC_260	0.98	1,704	1,726
53		BRC_270	0.86	1,805	1,826
54		BRC_280	1.02	1,721	1,744
55		BRC_290	0.78	1,633	1,852
56		BRC_300	0.22	477	477
57		BRC_310	0.16	282	327
58		BRC_320	0.43	884	884
59		BRC_330	0.20	442	466
60		BRC_340	0.41	706	859
61		BRC_350	0.54	731	958
62		BRC_360	0.20	547	547
63		BRC_370	0.32	909	909
64		BRC_380	0.62	1,456	1,456
65		BRC_390	0.84	1,130	1,545
66		BRC_400	0.56	865	912
67		BRC_410	0.19	408	408
68		BRC_420	0.16	358	374
69		BRC_430	0.09	121	121
70		BRC_440	0.82	1,532	1,710
71		BRC_450	0.46	655	724
72		BRC_460	0.10	139	194
73		BRC_470	0.05	63	100
74		BRC_480	0.87	1,036	1,160
75		BRC_490	0.17	245	361
76		BRC_500	0.87	1,665	1,857
77		BRC_510	0.08	138	160
78		BRC_520	0.28	381	492
79		BRC_530	0.09	167	167
80		BRC_540	0.18	502	502
81		BRC_550	0.16	419	419
82		BRC_560	0.09	164	212
83		BRC_570	0.24	395	503
84		BRC_580	0.53	754	917

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
85		BRC_590	0.35	372	485
86		BRC_600	0.91	1,687	1,955
87		BRC_610	0.06	127	154
88		BRC_620	0.48	420	540
89		BRC_630	0.17	311	413
90		BRC_640	0.34	750	868
91		BRC_650	0.42	475	599
92		BRC_670	0.58	537	726
93		BRC_680	0.09	167	192
94		BRC_690	0.04	70	99
95		BRC_700	0.20	347	458
96		BRC_710	0.60	971	1,166
97		BRC_720	0.09	62	120
98		BRC_740	0.97	1,124	1,447
99		BRC_750	0.34	356	537
100		BRC_760	0.78	1,004	1,275
101		BRC_770	0.88	1,279	1,604
102		BRC_780	0.72	771	998
103		BRC_790	0.25	323	434
104		BRC_800	0.43	888	1,023
105		BRC_900	0.42	697	874
106		BRCT1_010	0.68	853	1,004
107		BRCT10_010	0.37	632	694
108		BRCT10_020	0.32	615	695
109		BRCT10_030	0.29	736	835
110		BRCT10_040	0.25	559	618
111		BRCT10_050	0.97	964	1,197
112		BRCT11_010	0.34	568	656
113		BRCT11_020	0.60	714	808
114		BRCT11_030	0.35	537	617
115		BRCT11_040	0.31	458	515
116		BRCT11_050	0.51	834	948
117		BRCT11_060	0.38	523	634
118		BRCT11_070	0.09	143	194
119		BRCT2_010	0.32	694	788
120		BRCT2_020	0.20	414	475
121		BRCT3_010	0.37	529	639
122		BRCT4_010	0.52	821	1,018
123		BRCT4_020	0.38	729	852
124		BRCT4_030	0.10	166	196
125		BRCT4_040	0.23	401	462
126		BRCT5_010	0.87	1,631	1,641
127		BRCT5_020	0.50	1,030	1,030
128		BRCT5_030	0.30	779	779
129		BRCT5_040	0.21	416	476
130		BRCT5_050	0.12	244	296
131		BRCT7_010	0.10	219	238

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
132		BRCT7_020	0.44	719	831
133		BRCT7_030	0.23	456	518
134		BRCT7_040	0.77	1,514	1,717
135		BRCT7_050	0.40	757	898
136		BRCT7_060	0.47	637	676
137		BRCT8_010	0.48	866	929
138		BRCT8_020	0.43	826	920
139		BRCT8_030	0.31	608	675
140		BRCT8_040	0.23	432	478
141		BRCT9_010	0.12	225	254
142		BRCT9_020	0.40	647	668
143		BRCT9_030	0.41	930	930
144		BRCT9_040	0.12	307	307
145		BRCT9_050	0.25	467	509
146		BRCT9_060	0.14	319	319
147		BRCT9_070	0.03	43	60
148		BUT_010	0.93	1,408	1,428
149		BUT_020	0.43	939	939
150		BUT_030	0.54	1,024	1,024
151		BUT_040	0.13	274	307
152		BUT_050	0.04	88	90
153		BUT_060	0.79	1,394	1,409
154		BUT_070	0.49	1,088	1,099
155		BUT_080	0.08	231	267
156		BUT_090	0.70	1,436	1,575
157		BUT_100	1.02	1,964	2,090
158		BUT_110	0.21	518	573
159		BUT_120	0.40	1,006	1,123
160		BUT_130	0.49	956	1,057
161		CHB_010	0.89	1,094	1,305
162		CHB_020	0.58	982	1,174
163		CHB_030	0.83	1,234	1,498
164		CHB_040	0.75	1,240	1,519
165		CHB_050	0.53	967	1,179
166		CHB_060	0.61	1,264	1,522
167		CHB_070A	0.50	1,000	1,229
168		CHB_070B	0.19	328	433
169		CHB_070C	0.06	178	209
170		CHB_070D	0.12	280	311
171		CHB_080	0.06	93	96
172		CHB_090	0.54	644	900
173		CHB_100	1.00	1,763	1,852
174		CHB_110	0.72	1,276	1,540
175		CHB_120	0.48	870	967
176		CHB_130	0.77	1,094	1,178
177		CHB_140	0.60	1,039	1,082
178		CHB_150	0.54	1,344	1,344

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
179		CHB_160	0.10	251	251
180		CHB_170	0.65	1,277	1,277
181		CHB_180	0.48	792	866
182		CHB_190	0.75	1,115	1,453
183		CHB_200	0.73	1,025	1,084
184		CHB_210	0.78	1,483	1,483
185		CHBT1_010A	0.96	1,458	1,669
186		CHBT1_010B	0.17	185	190
187		CHBT1_020	0.69	1,128	1,342
188		CHBT1_030A	0.27	223	232
189		CHBT1_030B	0.17	300	308
190		CHBT1_030C	0.30	432	444
191		CHBT1_040	0.20	457	479
192		CHBT2_010	0.62	1,093	1,199
193		CHBT2_020	0.36	729	844
194		CHBT2_030	0.41	981	981
195		CHBT2_040	0.55	1,180	1,274
196		CHBT3_010	0.18	369	369
197		CHBT3_020	0.46	885	994
198		CHBT3_030	0.55	1,307	1,385
199		CHBT3_040	0.23	582	582
200		CHBT3_050	0.09	214	214
201		CHBT3_060	0.41	860	940
202		CHBT3_070	0.27	465	554
203		CHBT3_080	0.26	496	528
204		CHBT3_090	0.19	477	483
205		CHBT4_010	1.09	1,703	2,194
206		CHBT5_010	0.68	1,108	1,334
207		CHBT5_020	0.49	923	945
208		CHBT5_030	0.07	172	172
209		CLK_010	0.05	104	109
210		CLK_020	0.36	715	817
211		CLK_030	0.41	888	959
212		CLK_040	0.33	503	630
213		CLK_050	0.45	857	915
214		CLK_060	0.70	1,323	1,370
215		CLK_070	0.97	1,460	1,486
216		CLK_080	0.33	709	854
217		CLK_090	0.32	273	326
218		CLKT1_010	0.20	373	393
219		COT_010	0.14	336	404
220		COT_020	0.22	460	519
221		COT_030	0.40	647	771
222		COT_040	0.17	347	395
223		COT_050	0.82	1,357	1,674
224		COT_060	0.63	967	1,088
225		COT_070	0.82	1,165	1,355

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
226		COT_080	0.36	723	802
227		COT_090	0.29	455	500
228		COT_100	0.09	190	227
229		COT_110	0.16	319	328
230		COT_120	0.21	273	306
231		COT_130	0.41	914	1,024
232		COT_140	0.28	233	255
233		COT_150	0.60	927	1,018
234		COT_160	0.65	1,436	1,545
235		COT_170	0.44	808	930
236		COT_180	0.27	387	420
237		COT_190	0.71	1,239	1,395
238		COT_200	0.08	76	96
239		COT_210	0.71	1,266	1,415
240		COT_220	0.37	613	724
241		COT_230	0.15	250	297
242		COT_240	0.15	269	324
243		COT_250	0.39	640	739
244		COT_260	0.25	510	594
245		COT_270	0.17	234	269
246		COT_280	0.05	91	126
247		COT_290	0.13	185	227
248		COT_300	0.08	93	150
249		CWC_010	0.48	772	948
250		CWC_020	0.37	662	810
251		CWC_030	0.31	587	669
252		D18_010	0.63	1,055	1,189
253		D18_020	0.33	467	531
254		D18_030	0.21	455	528
255		D18_040	1.02	1,349	1,534
256		D18_050	0.38	823	877
257		D18_060	0.36	535	658
258		D18_070	0.24	418	473
259		D22_010	0.71	1,385	1,603
260		D22_020	0.36	761	919
261		DAV_010	0.26	365	498
262		DAV_020	0.11	250	293
263		DAV_030	0.51	936	1,099
264		DAV_040	0.43	877	947
265		DAV_050	0.34	644	798
266		DAV_060	0.27	392	487
267		DAV_070	0.43	770	846
268		DAV_080	0.68	802	866
269		DAVT1_010	0.21	412	451
270		DRY_010	0.92	1,897	2,126
271		DRY_020	0.70	1,662	1,699
272		DRY_030	0.46	1,108	1,164

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
273		DRYF_010	0.71	965	1,087
274		DRYF_020	0.52	855	937
275		DRYFT1_010	1.08	1,527	1,669
276		DRYFT1_020	0.12	155	161
277		DRYT1_010	0.73	1,571	1,571
278		DRYT1_020	0.49	1,138	1,138
279		DRYT1_030	0.81	1,366	1,366
280		DYB_010	0.76	1,651	1,826
281		DYB_020	0.72	1,456	1,543
282		HON_010	0.24	307	357
283		HON_020	0.84	1,212	1,316
284		HON_030	0.55	908	917
285		HON_040	0.41	911	946
286		HONT1_010	0.29	393	448
287		HONT2_010	0.44	810	845
288		LAK_010	0.26	532	544
289		LAK_020	0.22	532	545
290		LAK_030	0.39	902	923
291		LAK_040	0.66	1,177	1,188
292		LAK_050	0.40	810	825
293		LAK_060	0.26	591	596
294		LAK_070	0.21	682	695
295		LAK_080	0.19	373	389
296		LAK_090	0.03	89	93
297		LAK_100	0.17	315	323
298		LAK_110	0.53	1,015	1,034
299		LAK_120	0.17	333	352
300		LAK_130	0.42	758	809
301		LAK_140	0.84	1,432	1,862
302		LAK_150	0.69	903	1,232
303		LAK_160	0.67	1,089	1,410
304		LAK_170	0.52	892	1,147
305		LAK_180	0.56	976	1,130
306		LAK_190	0.76	1,349	1,562
307		LAK_200	0.54	1,019	1,044
308		LAK_210	0.13	320	320
309		LAK_220	0.72	1,604	1,604
310		LAK_230	0.50	1,021	1,050
311		LAK_240	0.39	814	888
312		LAKT1_010	0.92	1,331	1,503
313		LAKT2_010	0.45	1,162	1,172
314		LAKT2_020	0.66	1,347	1,347
315		LAKT3_010	0.82	1,858	1,858
316		LAKT3_020	0.78	1,349	1,349
317		LAKT4_010	0.43	823	902
318		LAKT5_010	0.89	1,730	1,733
319		LAKT5_020	0.89	1,611	2,046

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
320		LAKT5_030	0.10	229	275
321		LAKT6_010	0.13	366	371
322		LAKT6_020	0.39	864	864
323		LAKT6_030	0.17	596	596
324		LAKT6_040	0.16	539	539
325		LAKT6_050	0.62	1,575	1,575
326		MAC_010	0.68	520	622
327		MAC_020	0.50	524	570
328		MAC_030	0.38	579	640
329		MAC_040	0.87	1,284	1,334
330		MAC_050	0.49	967	1,103
331		MAC_060	0.21	463	543
332		MACT1_010	0.20	295	304
333		MCN_010	1.00	1,772	1,855
334		MCN_020	0.58	1,075	1,317
335		MCN_030	0.65	1,273	1,535
336		MCN_040	0.32	647	812
337		MCN_050	0.37	763	834
338		MCN_060	0.36	740	799
339		MCN_070	0.53	1,077	1,209
340		MCN_080	0.50	762	1,156
341		MCN_090	0.19	354	363
342		MCNF_010	0.63	1,097	1,317
343		MCNF_020	0.70	1,255	1,503
344		MCNF_030	0.78	1,294	1,649
345		MCNF_040	0.29	501	566
346		MCNF_050	0.64	859	1,068
347		MCNF_060	0.41	858	930
348		MCNT1_010	0.74	1,156	1,305
349		MCNT1_020	0.20	495	552
350		MCNT1_030	0.43	702	843
351		MCNT1_040	0.18	421	477
352		MCNT1_050	0.02	45	50
353		MCNT1_060	0.35	594	693
354		MCNT2_010	0.34	682	766
355		MCNT2_020	0.41	979	1,093
356		MCNT2_030	0.38	794	882
357		MCNT2_040	0.16	328	363
358		MCNT2_050	0.09	204	220
359		MCNT3_010	0.77	1,449	1,606
360		MCNT3_020	0.30	753	827
361		MCNT3_030	0.24	539	570
362		NFBC_010	0.90	1,350	1,571
363		NFBC_020	0.21	401	471
364		NFBC_030	0.68	1,080	1,269
365		NFBC_040	0.57	1,102	1,312
366		NFBC_050	0.63	986	1,168

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
367		NFBC_060	0.86	1,289	1,518
368		NFBC_070	0.27	302	357
369		NFBC_080	0.15	280	322
370		NFBC_090	0.78	1,013	1,185
371		NFBC_100	0.74	925	1,010
372		NFBC_110	0.77	884	1,050
373		NFBC_120	1.01	1,537	1,770
374		ONI_010	0.19	444	454
375		ONI_015	0.30	714	781
376		ONI_020	0.59	1,014	1,038
377		ONI_030	0.20	411	423
378		ONI_040	0.34	589	604
379		ONI_050	0.20	453	463
380		ONI_060	0.37	745	755
381		ONI_070	0.12	255	258
382		ONI_080	0.52	876	992
383		ONI_090	0.82	1,255	1,310
384		ONI_100	1.01	1,834	1,936
385		ONI_110	0.44	803	803
386		ONI_120	0.15	324	324
387		ONI_130	0.55	1,060	1,080
388		ONIT1_010	0.65	1,045	1,140
389		ONIT1_020	0.13	291	294
390		POC_010	0.16	369	423
391		POC_020	0.43	758	914
392		POC_030	0.20	321	402
393		QRY_010	1.04	634	848
394		QRY_020	1.26	584	923
395		QRY_030	0.20	148	242
396		QRY_040	0.11	43	144
397		RAT_010	0.27	583	583
398		RAT_020	0.37	1,019	1,019
399		RAT_030	0.13	307	316
400		RAT_040	0.34	697	715
401		RAT_050	0.53	1,293	1,293
402		RAT_060	0.25	579	615
403		RAT_070	1.00	1,506	2,062
404		RAT_080	0.66	1,083	1,449
405		RAT_090	0.34	386	583
406		RAT_100A	0.17	220	321
407		RAT_100B	0.73	1,393	1,682
408		RAT_110	0.07	130	132
409		RAT_120	0.05	70	90
410		RAT_130	0.05	112	126
411		RATT1_010	0.92	1,314	1,780
412		RATT1_020	0.14	308	332
413		RATT2_010	0.36	836	910

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
414		RATT2_020	0.23	464	491
415		RATT2_030	0.10	245	283
416		RATT2_040	0.35	656	787
417		RATT2_050	0.11	215	249
418		RATT2_060	0.13	234	267
419		SBR_010	0.57	1,040	1,207
420		SBR_020	0.75	1,495	1,517
421		SBR_030	0.47	772	856
422		SBR_040	1.14	1,553	1,793
423		SBR_050	0.31	661	698
424		SBR_060	0.31	710	733
425		SBR_070	1.00	1,759	1,842
426		SBR_080	0.68	1,104	1,254
427		SBR_090	0.68	1,236	1,351
428		SBR_100	0.30	471	583
429		SBR_110	0.22	376	397
430		SBRT1_010	0.60	1,233	1,281
431		SBRT2_010	0.12	281	288
432		SBRT2_020	0.15	271	302
433		SBRT2_030	0.05	66	88
434		SBRT3_010	0.15	345	358
435		SBRT4_010	0.56	907	940
436		SFBC_010	0.65	890	1,032
437		SFBC_020	0.30	472	481
438		SFBC_030	0.58	1,106	1,168
439		SFBC_040	0.58	998	1,063
440		SFBC_050	0.39	712	754
441		SPAO_010	0.18	500	500
442		SPAO_020	0.27	557	587
443		SPAO_030	0.08	181	199
444		SPAO_040	0.24	578	658
445		SPAO_050	0.25	651	651
446		SPAO_060	0.14	291	299
447		SPAO_070	0.12	283	321
448		SPAO_080	0.11	219	252
449		SPAO_090	0.46	698	754
450		SPAO_100	0.15	311	312
451		SPAO_110	0.40	501	605
452		SPAO_120	0.09	176	205
453		SPAO_130	0.30	382	545
454		SPAOT1_010	0.99	1,354	1,402
		Bagdad Pond	0.18	303	303
		Cedar Park Medical Center	0.79	1,184	1,458
		D_CHBT1_010A	0.96	1,381	1,623
		D_CHBT1_010B	1.12	0	0
		D_Quarry_FM620_Div1	2.54	1,124	2,433
		D_Quarry_SH_45_Div1	2.13	3,037	3,749

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
		D_Quarry_SH_45_Div2	2.13	2,689	3,195
		D_Storage_CHBT1_030C	0.30	0	0
		Div_Crystal_Falls	0.27	500	500
		Eagle Ridge	0.64	1,151	1,147
		Horizon Park Gateway	0.57	1,166	1,166
		La Frontera	0.17	63	63
		La Frontera 2	0.13	69	72
		Lake Forest	0.20	479	479
		LISD Block House Creek	0.32	341	341
		North Branch Pond	0.92	1,291	1,455
		NRCS_DAM_1	5.07	46	83
		NRCS_DAM_10A	4.18	196	687
		NRCS_DAM_10B	1.81	10	11
		NRCS_DAM_11	13.31	153	428
		NRCS_DAM_12	3.35	36	36
		NRCS_DAM_13A	3.97	133	207
		NRCS_DAM_14	2.46	55	56
		NRCS_DAM_15	1.29	50	51
		NRCS_DAM_16	5.67	62	320
		NRCS_DAM_17	1.17	108	222
		NRCS_DAM_18	2.29	110	246
		NRCS_DAM_19	1.67	318	326
		NRCS_DAM_2	3.13	34	125
		NRCS_DAM_20	0.91	27	60
		NRCS_DAM_21	0.91	141	309
		NRCS_DAM_22	0.71	13	69
		NRCS_DAM_3	8.01	73	73
		NRCS_DAM_4	5.43	274	609
		NRCS_DAM_5	1	14	15
		NRCS_DAM_6	5.76	193	294
		NRCS_DAM_7	15.85	131	184
		NRCS_DAM_8	8.39	114	245
		NRCS_DAM_9	4.62	51	155
		Onion Branch at 1431	0.49	880	923
		QRY_010	1.04	634	848
		QRY_020	1.26	584	923
		QRY_030	0.2	148	242
		QRY_040	0.11	43	144
		Quarry_FM_620	2.54	1,162	2,561
		Quarry_SH_45	2.13	3,377	4,210
		Randalls Town Center	0.92	1,778	1,979
		S_QRY_010_&_020	2.3	1,215	1,775
		S_QRY_030	0.2	148	242
		S_QRY_040	0.11	40	138
		SH45 US183 Pond	0.4	633	643
		Sink_CHBT1_030C	0	432	444
		Storage_CHB_070A	4.68	0	0

Table E-1. 100-Year Peak Flows

Watershed ID per Figures 4-2 to 4-6	Junction ID per Figures 4-20 to 4-24	Element - see Table E-4 for stream names	Drainage Area (sq. mi)	Existing Conditions 100-Year Peak Discharge (cfs)	Ultimate Conditions 100-Year Peak Discharge (cfs)
		Storage_CHB_070B	0.19	11	87
		Storage_CHB_070C	0.26	0	0
		Storage_CHBT1_010A	0.96	1,482	1,737
		Storage_CHBT1_010B	1.12	0	0
		Storage_CHBT1_030A	0.27	102	108
		Teravista C1	1.39	1,036	1,259
		Teravista C2	1.39	1,935	2,888
		Teravista C3	0.98	1,978	3,103
		Teravista S1	0.18	258	258
		Twin Lakes	6.25	567	637
		Walmart Pond	0.45	792	821

Table E-2. 100-Year Flow Comparisons at Select Locations

Flooding Source and Location	Junction Per Figures 4-20 to 4-24	Junction Name per TM4 HECHMS Model (Jan, 2014)	Drainage Area (sq. mi) per Current FIS (TR20)	Drainage Area (sq. mi) per TM4 HECHMS Model (Jan, 2014)	1% Annual Exceedance Probability Flood (cfs)		
					FEMA Preliminary (April, 2012)	Current FIS (TR-20)	TM4 HECHMS Model (Jan, 2014)
BLOCK HOUSE CREEK1							
Downstream of SCS Site 3		NRCS_DAM_3	7.97	8.01	73	38	73
Upstream of SCS Site 3	82	J_BLH_130	7.97	8.01	10,847	8,688	9,238
At County Route 278	59	J_BLH_050	1.03	1.33	1,660	1,481	1,752
At U.S. Route 183	66	J_BLHT2_010	0.68	0.73		1,423	1,678
BRUSHY CREEK1							
At County Route 405	573	J_BRC_780_900	195.43	192.34		42,662	52,820
At FM 973	563	J_BRC_770	187.89	188.44		41,222	53,996
At County Route 129	559	J_BRC_700_&_BRCT11_070	184.33	186.87		42,426	54,734
At County Route 137	492	J_BRC_580_610_590	166.12	168.50		38,870	46,183
At State Route 685	471	J_BRC_520_550_BRCT7_050	160.56	163.53		37,214	45,120
At County Route 123	442	J_BRC_460_&_BRCT5_050	152.66	155.07		34,215	41,827
At County Route 122	395	J_BRC_430	137.11	138.97		30,084	36,916
At confluence of Lake Creek	315	J_LAK_240_&_BRC_330	104.17	106.69		22,395	25,025
At North Mays Street	198	J_BRC_290	70.53	70.92		13,494	15,329
At Great Oaks Drive	180	J_BRC_250	62.51	62.08		11,632	13,887
At County Route 179	49	J_BRC_110_&_BRCT4_040	21.65	21.55		8,590	10,641
At FM 2243	17	J_NFBC_120_&_SFBC_050	10.17	10.09		2,913	5,192
At U.S. Route 183	10	J_NFBC_110	6.38	6.58		1,256	1,760
Downstream of SCS Site 1		NRCS_DAM_1	5.1	5.07		33	46
Upstream of SCS Site 1	8	J_NFBC_030_080_090	5.1	5.07		4,575	6,723
BRUSHY CREEK TRIBUTARY 8							
At Confl. With Brushy Creek	476	J_BRCT8_040	1.32	1.45	813		1,041
Downstream of SCS Site 20		NRCS_DAM_20	0.87	0.91	106		27
Upstream of SCS Site 20	474	J_BRCT8_020	0.87	0.91	2,023		1,616

Table E-2. 100-Year Flow Comparisons at Select Locations

Flooding Source and Location	Junction Per Figures 4-20 to 4-24	Junction Name per TM4 HECHMS Model (Jan, 2014)	Drainage Area (sq. mi) per Current FIS (TR20)	Drainage Area (sq. mi) per TM4 HECHMS Model (Jan, 2014)	1% Annual Exceedance Probability Flood (cfs)		
					FEMA Preliminary (April, 2012)	Current FIS (TR-20)	TM4 HECHMS Model (Jan, 2014)
BUTTERCUP CREEK1							
Downstream of SCS Site 6		NRCS_DAM_6	5.73	5.76	549	201	193
Upstream of SCS Site 6	143	J_BUT_090_120	5.73	5.76	8,480	5,176	7,440
At Cypress Creek Road	131	J_BUT_020_030	1.94	1.90	2,715	1,953	2,572
CHANDLER BRANCH1							
At FM 1460	382	J_CHB_160_&_CHBT4_010	18.38	18.29	3,418	3,155	3,754
Downstream of SCS Site 11		NRCS_DAM_11	13.13	13.31	1,695	621	153
Upstream of SCS Site 11	365	J_CHB_130	13.13	13.31	8,334	4,730	6,770
At Interstate Route 35	357	J_CHB_110	9.94	10.13		2,888	3,957
Downstream of SCS Site 10A		NRCS_DAM_10A	4.46	4.18	773	379	196
Upstream of SCS Site 10A	340	J_CHB_060	4.46	4.18	3,758	3,304	5,048
CHANDLER BRANCH TRIBUTARY 1							
Downstream of SCS Site 14		NRCS_DAM_14	2.46	2.46	88		55
Upstream of SCS Site 14	377	J_CHBT3_080	2.46	2.46	3,135		4,005
At Confluence with Chandler Branch	378	J_CHBT3_090	2.65	2.65	473		490
CLUCK CREEK							
At U.S. Route 183	152	J_CLK_060_070	3.32	3.28	5,647	5,294	3,363
At Buttercup Creek Boulevard	150	J_CLK_060	2.21	2.30		3,892	2,250
At West Park Street	148	J_CLK_040	1.69	1.15	3,040	3,179	1,609
At Cedar Park Drive	147	J_CLK_030	0.9	0.82		2,127	1,320
COTTONWOOD CREEK1							
At FM 1660	533	J_COT_240_250	9.07	9.52		5,779	7,747
At U.S. Route 79	520	J_COT_160_150	5.28	5.59		4,032	5,880
At County Route 136	517	J_COT_130_120	4.74	4.72		3,856	5,230

Table E-2. 100-Year Flow Comparisons at Select Locations

Flooding Source and Location	Junction Per Figures 4-20 to 4-24	Junction Name per TM4 HECHMS Model (Jan, 2014)	Drainage Area (sq. mi) per Current FIS (TR20)	Drainage Area (sq. mi) per TM4 HECHMS Model (Jan, 2014)	1% Annual Exceedance Probability Flood (cfs)		
					FEMA Preliminary (April, 2012)	Current FIS (TR-20)	TM4 HECHMS Model (Jan, 2014)
DAVIS SPRING BRANCH							
At FM 620	255	J_DAV_070	2.25	2.57		3,103	2,983
DRY BRANCH							
At Gattis School Road	321	J_DRY_010	0.99	0.92		2,449	1,897
DRY BRANCH TRIBUTARY 1							
At Gattis School Road	319	J_DRYT1_010_020	1.4	1.22		2,608	2,709
At Greenlawn Boulevard	317	J_DRYT1_010	0.83	0.73		1,761	1,571
DYER BRANCH							
At Gattis School Road	325	J_DYB_010	0.99	0.76		2449	1,651
DRY FORK							
At Confl. With Brushy Creek	194	J_DRYF_020	5.27	5.20	2,048		1,627
Downstream of SCS Site 13A		NRCS_DAM_13A	3.97	3.97	474		133
Upstream of SCS Site 13A	192	J_DRYFT1_020_&_HON_040	3.97	3.97	3,404		4,908
LAKE CREEK1							
At Oakridge Drive	300	J_LAKT5_030_&_LAK_180	22.65	24.44	5,532	9,421	8,478
Downstream of SCS Site 8		NRCS_DAM_8	8.51	8.39	790	606	114
Upstream of SCS Site 8	248	J_LAK_140_120	8.51	8.39	9,357	7,756	10,992
At U.S. Route 183	230	J_LAK_060_050	1.99	2.19	2,966	3,344	3,809
At School House Lane	227	J_LAK_030	0.9	0.87		2,403	1,824
LAKE CREEK TRIBUTARY 1							
At confluence with Lake Creek	311	J_LAKT6_050	1.6	1.47		1,921	2,813
At Yucca Drive	310	J_LAKT6_020_040	0.98	0.85		1,293	1,344
At Wagongap Drive	307	J_LAKT6_020	0.49	0.52		1,250	864

Table E-2. 100-Year Flow Comparisons at Select Locations

Flooding Source and Location	Junction Per Figures 4-20 to 4-24	Junction Name per TM4 HECHMS Model (Jan, 2014)	Drainage Area (sq. mi) per Current FIS (TR20)	Drainage Area (sq. mi) per TM4 HECHMS Model (Jan, 2014)	1% Annual Exceedance Probability Flood (cfs)		
					FEMA Preliminary (April, 2012)	Current FIS (TR-20)	TM4 HECHMS Model (Jan, 2014)
LAKE CREEK TRIBUTARY 2							
At Briar Hollow Drive	238	J_LAKT2_020	1.24	1.11		1,989	2,472
MASON CREEK							
Downstream of SCS Site 2		NRCS_DAM_2	3.07	3.13		87	34
Upstream of SCS Site 2	25	J_MAC_050	3.07	3.13		2,995	2,999
At U.S. Route 183	24	J_MAC_040	2.59	2.63		2,417	2,647
McNUTT CREEK1							
At County Route 122	425	J_MCN_060	10.35	10.03		3,487	3,943
Downstream of SCS Site 16		NRCS_DAM_16	5.5	5.67		541	62
Upstream of SCS Site 16	409	J_MCNF_060_&_MCN_030	5.5	5.67		5,648	7,356
ONION BRANCH1							
At U.S. Route 79	218	J_ONI_130	6.44	6.56	3,175	3,609	4,679
At U.S. Route 81	215	J_ONI_110	5.75	5.87	2,923	3,105	3,890
At FM 3406	213	J_ONI_090	4.67	4.42	1,664	2,068	1,751
Downstream of SCS Site 12		NRCS_DAM_12	3.57	3.35	58	24	36
Upstream of SCS Site 12	209	J_ONIT1_010_&_ONI_060	3.57	3.35	5,479	649	5,074
RATTAN CREEK							
At Lake Creek	291	J_RAT_130		7.30	2,987		3,095
Downstream of SCS Site 9		NRCS_DAM_9		4.62	53		51
Upstream of SCS Site 9	274	J_RAT_100B_&_SH_45_Div2		4.62	6,126		6,299
At West Parmer Lane	266	J_RAT_050		1.64	2,809		3,257
RATTAN CREEK TRIBUTARY 1							
At Quanah Drive	289	J_RATT2_060	1.2	0.23	2,477	2,005	512
At McNeil Road	286	J_RATT2_050	1.1	0.11	2,306	1,853	215

Table E-2. 100-Year Flow Comparisons at Select Locations

Flooding Source and Location	Junction Per Figures 4-20 to 4-24	Junction Name per TM4 HECHMS Model (Jan, 2014)	Drainage Area (sq. mi) per Current FIS (TR20)	Drainage Area (sq. mi) per TM4 HECHMS Model (Jan, 2014)	1% Annual Exceedance Probability Flood (cfs)		
					FEMA Preliminary (April, 2012)	Current FIS (TR-20)	TM4 HECHMS Model (Jan, 2014)
SOUTH BRUSHY CREEK1							
Downstream of SCS Site 7		NRCS_DAM_7	15.79	15.85	1,267	194	131
Upstream of SCS Site 7	170	J_SBR_070	15.79	15.85	13,772	7,322	10,048
SPANISH OAK CREEK1							
Downstream of SCS Site 4		NRCS_DAM_4	5.59	5.43	938	203	274
Upstream of SCS Site 4	112	J_SPAO_120	5.59	5.43	6,602	6,055	6,347
At Skyview Drive	100	J_SPAO_090	2.69	2.84	4,638	3,568	3,926
At Southern Pacific Railroad	93	J_SPAO_040	0.66	0.77	1,418	1,599	1,260
Downstream of Century Lane	91	J_SPAO_020	0.45	0.45		1,045	847

Table E-3. 1% Annual Exceedance Probability Peak Pond Elevations

Dam Name	PS Elevation (ft)	Auxiliary Elevation (ft)	Top of Dam Elevation (ft) [a]	Peak 1% AEP flood per TM4 HECHMS Model (Jan, 2014)		TR20 Peak 1% AEP flood elevation
				WSE Elevation (ft)	Depth above Aux Spillway (ft)	
District Dams						
Dam No. 1	1011.5	1026.3	1034.5	1024.4	0	1025.4
Dam No. 2	948.3	962.8	971.3	962.4	0	962.2
Dam No. 3	872.8	901.2	912.7	897.9	0	898.7
Dam No. 4	838.3	859.0	868.8	859.7	0.6	859.5
Dam No. 5	886.6	903.3	910.9	899.8	0	902.8
Dam No. 6	888.5	907.2	918.0	907.7	0.5	
Dam No. 7	805.0	829.0	836.5	827.7	0	
Dam No. 8	825.5	847.1	851.8	847.1	0	
Dam No. 9	771.1	786.9	792.5	785.4	0	
Dam No. 10A	811.7	830.9	841.1	830.9	0	
Dam No. 10B	797.4	813.4	823.4	805.3	0	
Dam No. 11	722.1	736.8	748.6	736.6	0	
Dam No. 12	768.0	782.3	789.5	781.4	0	779.9
Dam No. 13A	829.4	841.8	850.3	841.7	0	841.9
Dam No. 14	714.3	723.3	730.8	722.2	0	
Dam No. 15	698.9	709.0	714.4	706.8	0	
Dam No. 16	714.3	729.6	739.5	728.8	0	
Dam No. 17	670.8	680.6	687.1	681.0	0.4	
Dam No. 18	659.2	670.8	678.9	671.3	0.5	
Dam No. 19	660.7	676.1	685.1	677.2	1.1	
Dam No. 20	649.3	661.2	667.9	661.4	0.2	
Dam No. 21	618.7	630.1	639.8	631.2	1.1	
Dam No. 22	600.0	609.5	615.6	609.5	0	
Public Private Detention Structures					**Overtopped?**	
Eagle Ridge Pond	746.0	--	750.0	750 +	Yes	--
La Frontera	805.4	--	825.0	819.1	--	--
La Frontera 2	813.0	--	819.0	816.7	--	--
Lake Forest Detention Pond 1 (or Pond A)	760.0	--	765.0	764.9	--	--
Randalls' Town Centre	713.0	--	727.0	724.6	--	--
Onion Branch at 1431	830.0	--	854.0	842.7	--	--
TeraVista, Chandler Pond C1	765.0	--	771.0	770.2	--	--
TeraVista, Chandler Pond C2	769.5	--	778.0	778 +	Yes	--
TeraVista, Chandler Pond C3	775.0	--	782.0	782 +	Yes	--
TeraVista, Sunshine Pond S1	766.2	--	774.0	772.9	--	--
Horizon Park/Gateway	943.0	--	952.0	952 +	Yes	--
Twin Lakes	863.0	--	870.0	866.8	--	--
Bagdad Pond	997.0	--	1007.0	1005.0	--	--
LISD Pond	1009.0	--	1018.0	1016.5	--	--
Wal Mart Pond	966.0	--	983.0	970.6	--	--
Cedar Park Medical Center Pond	896.0	--	907.4	903.8	--	--
North Branch Pond	886.0	--	896.0	890.8	--	--
SH45/US183 Interchange - Main Pond	917.0	--	928.0	924.6	--	--

a) For all NRCS Dams, the top of dam elevation provided is from the as-built information. For the Public/Private Detention structures, the top of dam elevation provided is the highest elevation in the elevation-discharge-storage curve located in Appendix G.

Table E-4. Naming Convention

Naming Prefix	River System
BLH	Block House Creek
BLHT1	Block House Creek
BLHT2	Block House Creek
BLHT3	Block House Creek
BRC	Brushy Creek
BRCT1	Brushy Creek
BRCT10	Brushy Creek
BRCT11	Brushy Creek
BRCT2	Brushy Creek
BRCT3	Brushy Creek
BRCT4	Brushy Creek
BRCT5	Brushy Creek
BRCT7	Brushy Creek
BRCT8	Brushy Creek
BRCT9	Brushy Creek
BUT	Buttercup Creek
CHB	Chandler Branch
CHBT1	Chandler Branch
CHBT2	Chandler Branch
CHBT3	Chandler Branch
CHBT4	Chandler Branch
CHBT5	Chandler Branch
CLK	Cluck Creek
CLKT1	Cluck Creek
COT	Cottonwood Creek
CWC	Cottonwood Creek
DAV	Davis Creek
DAVT1	Davis Creek
DRY	Dry Fork
DRYF	Dry Fork
DRYFT1	Dry Fork
DRYT1	Dry Fork
DYB	Dyer Branch

Naming Prefix	River System
HON	Honey Bear Creek
HONT1	Honey Bear Creek
HONT2	Honey Bear Creek
LAK	Lake Creek
LAKT1	Lake Creek
LAKT2	Lake Creek
LAKT3	Lake Creek
LAKT4	Lake Creek
LAKT5	Lake Creek
LAKT6	Lake Creek
MAC	Mason Creek
MACT1	Mason Creek
MAN	Mason Creek
MCN	McNutt Creek
MCNF	McNutt Creek
MCNT1	McNutt Creek
MCNT2	McNutt Creek
MCNT3	McNutt Creek
NFBC	North Fork Brushy Creek
ONI	Onion Branch
ONIT1	Onion Branch
POC	Post Oak Creek
QRY	Quarry
RAT	Rattan Creek
RATT1	Rattan Creek
RATT2	Rattan Creek
SBR	South Brushy Creek
SBRT1	South Brushy Creek
SBRT2	South Brushy Creek
SBRT3	South Brushy Creek
SBRT4	South Brushy Creek
SFBC	South Fork Brushy Creek
SPAO	Spanish Oak

Exhibit F
Hydrologic Model
Input Parameters

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
1	BLH_010	0.165	44.6	65.0	34.4	
2	BLH_020	0.157	41.7	65.0	11.2	
3	BLH_030	0.066	41.2	65.0	7.5	
4	BLH_040	0.518	33.6	65.0	42.9	
5	BLH_050	0.420	39.2	65.0	33.8	
6	BLH_060	0.234	34.4	65.0	16.7	
7	BLH_070	0.283	36.0	64.9	17.8	
8	BLH_080	0.269	16.7	64.6	29.8	
9	BLH_090	0.451	33.1	63.2	50.0	
10	BLH_100	0.232	47.4	62.6	20.6	
11	BLH_110	0.338	43.1	64.3	20.9	
12	BLH_120	1.040	15.7	64.5	34.4	
13	BLH_130	0.586	5.9	66.9	25.4	
14	BLH_140	0.850	12.3	63.3	39.8	
15	BLH_150	0.385	9.4	65.9	31.5	
16	BLH_160	0.687	8.8	61.8	30.2	
17	BLH_170	0.048	21.2	54.3	5.9	
18	BLHT1_010	0.905	41.6	65.0	38.2	
19	BLHT2_010	0.730	29.9	65.0	15.8	
20	BLHT2_020	0.078	13.5	65.0	11.0	
21	BLHT2_030	0.271	50.5	64.7	40.6	
22	BLHT3_003	0.267	42.0	65.0	20.5	
23	BLHT3_006	0.092	23.8	65.0	16.3	
24	BLHT3_010	0.212	40.5	65.0	28.7	
25	BLHT3_020	0.551	24.0	65.0	28.9	
26	BLHT3_030	0.143	31.2	64.8	10.1	
27	BRC_010	0.071	17.7	61.7	21.7	
28	BRC_020	0.888	21.4	65.8	32.9	
29	BRC_030	0.818	13.0	63.9	28.5	
30	BRC_040	0.740	3.3	66.8	48.8	
31	BRC_050	0.362	5.4	64.3	20.8	
32	BRC_060	0.136	11.1	60.4	36.4	
33	BRC_070	0.489	5.1	65.1	35.4	
34	BRC_080	0.877	2.5	66.2	25.4	
35	BRC_090	0.095	0.1	59.0	18.6	
36	BRC_100	0.455	1.0	64.3	26.9	
37	BRC_110	0.398	5.0	62.5	26.4	
38	BRC_120	0.338	3.4	60.6	29.0	
39	BRC_130	0.704	15.3	64.1	21.5	
40	BRC_140	0.879	1.9	55.1	31.6	
41	BRC_150	0.433	9.2	58.3	38.6	
42	BRC_160	0.069	25.6	54.8	12.6	
43	BRC_170	0.215	7.7	63.9	19.8	
44	BRC_180	0.973	33.4	64.3	19.0	
45	BRC_190	0.875	5.9	61.2	25.2	
46	BRC_200	0.283	9.8	63.4	24.7	

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
47	BRC_210	0.386	12.6	57.2	24.5	
48	BRC_220	0.430	22.5	64.0	25.8	
49	BRC_230	0.122	10.7	58.5	27.7	
50	BRC_240	0.015	9.8	51.9	10.0	
51	BRC_250	0.660	34.6	62.9	25.8	
52	BRC_260	0.976	32.2	63.5	33.2	
53	BRC_270	0.862	30.0	63.1	20.8	
54	BRC_280	1.020	36.6	62.9	38.5	
55	BRC_290	0.780	45.7	60.3	26.4	
56	BRC_300	0.220	49.3	63.0	27.9	
57	BRC_310	0.161	29.7	56.5	27.6	
58	BRC_320	0.426	44.7	63.6	29.3	
59	BRC_330	0.198	30.0	56.2	13.6	
60	BRC_340	0.412	27.2	59.0	30.8	
61	BRC_350	0.537	14.4	58.2	39.2	
62	BRC_360	0.204	38.2	62.7	14.0	
63	BRC_370	0.323	47.0	63.7	14.8	
64	BRC_380	0.620	45.1	62.4	22.5	
65	BRC_390	0.838	11.1	57.6	38.0	
66	BRC_400	0.559	21.5	60.5	38.6	
67	BRC_410	0.193	45.4	59.6	26.6	
68	BRC_420	0.159	49.0	58.2	22.0	
69	BRC_430	0.087	32.7	53.4	41.5	
70	BRC_440	0.819	21.2	56.9	22.2	
71	BRC_450	0.461	15.2	63.7	46.8	
72	BRC_460	0.097	8.0	49.6	17.7	
73	BRC_470	0.054	7.3	44.5	17.1	
74	BRC_480	0.874	15.9	61.1	60.4	
75	BRC_490	0.167	0.3	51.8	17.3	
76	BRC_500	0.868	17.0	61.6	26.3	
77	BRC_510	0.077	17.7	55.4	21.0	
78	BRC_520	0.278	1.2	58.7	34.7	
79	BRC_530	0.089	38.3	66.0	37.3	
80	BRC_540	0.179	44.4	64.9	14.7	
81	BRC_550	0.163	38.3	61.2	15.9	
82	BRC_560	0.092	9.9	51.6	11.3	
83	BRC_570	0.238	11.8	52.4	18.6	
84	BRC_580	0.527	12.6	54.7	31.8	
85	BRC_590	0.345	1.4	58.0	53.0	
86	BRC_600	0.907	4.1	66.5	29.5	
87	BRC_610	0.063	10.8	56.9	15.5	
88	BRC_620	0.477	6.6	56.2	72.1	
89	BRC_630	0.167	5.4	54.5	10.9	
90	BRC_640	0.344	7.3	64.5	19.1	
91	BRC_650	0.415	0.7	61.0	55.0	
92	BRC_670	0.580	0.4	56.6	62.0	

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
93	BRC_680	0.092	1.4	67.7	32.9	
94	BRC_690	0.043	0.8	52.8	15.4	
95	BRC_700	0.196	1.0	57.3	17.9	
96	BRC_710	0.603	2.6	63.0	33.7	
97	BRC_720	0.086	0.3	42.6	30.7	
98	BRC_740	0.968	1.9	58.8	48.6	
99	BRC_750	0.336	0.0	50.8	33.5	
100	BRC_760	0.782	1.7	59.0	41.5	
101	BRC_770	0.877	3.0	59.3	34.0	
102	BRC_780	0.718	1.6	58.7	55.2	
103	BRC_790	0.253	1.6	55.8	34.9	
104	BRC_800	0.430	2.3	66.5	23.2	
105	BRC_900	0.415	0.4	61.0	26.8	
106	BRCT1_010	0.676	5.6	66.4	46.9	
107	BRCT10_010	0.370	6.9	71.4	43.7	
108	BRCT10_020	0.322	9.4	66.3	29.3	
109	BRCT10_030	0.291	1.2	68.8	15.3	
110	BRCT10_040	0.252	6.9	69.5	24.0	
111	BRCT10_050	0.973	1.2	62.1	73.0	
112	BRCT11_010	0.343	0.9	68.7	38.4	
113	BRCT11_020	0.600	2.6	70.3	74.5	
114	BRCT11_030	0.347	0.1	69.3	45.9	
115	BRCT11_040	0.307	0.0	71.6	53.5	
116	BRCT11_050	0.506	0.0	69.8	41.3	
117	BRCT11_060	0.382	0.6	64.1	46.5	
118	BRCT11_070	0.093	5.7	53.1	19.4	
119	BRCT2_010	0.324	10.5	65.2	13.0	
120	BRCT2_020	0.196	8.5	65.0	12.6	
121	BRCT3_010	0.366	1.9	65.1	32.9	
122	BRCT4_010	0.523	0.9	63.6	25.3	
123	BRCT4_020	0.376	4.7	64.8	17.1	
124	BRCT4_030	0.103	2.4	67.5	29.3	
125	BRCT4_040	0.234	9.3	65.2	25.5	
126	BRCT5_010	0.872	38.2	62.1	35.4	
127	BRCT5_020	0.504	37.4	63.1	29.6	
128	BRCT5_030	0.296	31.7	63.2	12.2	
129	BRCT5_040	0.213	3.8	66.0	25.7	
130	BRCT5_050	0.118	1.3	63.2	17.9	
131	BRCT7_010	0.104	15.3	66.8	21.2	
132	BRCT7_020	0.440	3.6	67.6	36.4	
133	BRCT7_030	0.231	6.7	66.9	25.8	
134	BRCT7_040	0.766	5.3	68.2	26.8	
135	BRCT7_050	0.401	4.7	62.2	21.6	
136	BRCT7_060	0.472	23.9	65.9	58.7	
137	BRCT8_010	0.478	21.9	63.9	34.3	
138	BRCT8_020	0.429	14.3	64.7	28.5	

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
139	BRCT8_030	0.310	18.6	60.0	23.4	
140	BRCT8_040	0.235	21.4	58.0	26.1	
141	BRCT9_010	0.117	6.2	68.8	28.9	
142	BRCT9_020	0.402	29.5	65.0	44.7	
143	BRCT9_030	0.410	38.3	65.0	25.1	
144	BRCT9_040	0.121	42.2	64.9	19.6	
145	BRCT9_050	0.252	18.6	65.1	30.8	
146	BRCT9_060	0.139	37.6	65.2	24.4	
147	BRCT9_070	0.025	6.6	51.3	10.3	
148	BUT_010	0.929	23.2	64.9	38.0	
149	BUT_020	0.426	36.6	65.0	19.3	
150	BUT_030	0.544	40.1	65.0	29.4	
151	BUT_040	0.127	30.8	63.1	17.7	
152	BUT_050	0.038	41.3	59.6	14.2	
153	BUT_060	0.787	42.0	65.0	35.2	
154	BUT_070	0.494	50.3	65.0	23.3	
155	BUT_080	0.082	35.1	64.4	7.3	
156	BUT_090	0.699	24.9	65.2	20.2	
157	BUT_100	1.023	31.1	65.0	27.2	
158	BUT_110	0.213	31.8	65.0	13.3	
159	BUT_120	0.400	20.6	66.2	9.8	
160	BUT_130	0.490	20.9	65.5	21.8	
161	CHB_010	0.886	3.8	66.1	47.1	
162	CHB_020	0.583	2.4	65.7	25.0	
163	CHB_030	0.826	3.1	64.6	30.9	
164	CHB_040	0.747	0.5	65.6	25.8	
165	CHB_050	0.534	0.1	66.8	20.9	
166	CHB_060	0.606	0.0	66.6	15.0	
167	CHB_070A	0.499	0.1	66.6	18.0	
168	CHB_070B	0.193	0.0	61.7	18.9	
169	CHB_070C	0.063	0.0	68.9	5.0	
170	CHB_070D	0.116	0.2	67.8	9.6	
171	CHB_080	0.062	2.0	67.0	37.2	
172	CHB_090	0.544	8.2	50.8	25.1	
173	CHB_100	0.999	31.6	65.7	34.9	
174	CHB_110	0.715	3.9	65.6	25.4	
175	CHB_120	0.477	35.4	64.8	32.9	
176	CHB_130	0.770	24.4	66.3	50.5	
177	CHB_140	0.601	36.5	64.9	38.8	
178	CHB_150	0.537	45.2	61.2	17.2	
179	CHB_160	0.102	27.9	64.3	15.8	
180	CHB_170	0.653	39.6	62.1	30.1	
181	CHB_180	0.482	24.8	57.2	29.6	
182	CHB_190	0.753	6.6	63.8	38.1	
183	CHB_200	0.733	10.8	62.7	44.5	
184	CHB_210	0.777	37.4	60.3	30.0	

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
185	CHBT1_010A	0.955	6.4	70.3	40.1	
186	CHBT1_010B	0.167	0.0	55.0	28.7	
187	CHBT1_020	0.688	0.2	66.0	27.2	
188	CHBT1_030A	0.273	0.0	50.1	36.6	
189	CHBT1_030B	0.171	0.0	60.4	16.4	
190	CHBT1_030C	0.302	0.0	62.3	29.8	
191	CHBT1_040	0.203	0.1	66.0	9.9	
192	CHBT2_010	0.621	15.8	64.3	28.6	
193	CHBT2_020	0.360	7.0	66.0	19.6	
194	CHBT2_030	0.410	34.9	65.1	18.1	
195	CHBT2_040	0.548	42.3	64.5	25.6	
196	CHBT3_010	0.177	28.1	63.3	20.8	
197	CHBT3_020	0.461	24.2	64.9	27.3	
198	CHBT3_030	0.550	33.9	63.5	17.4	
199	CHBT3_040	0.233	50.7	63.8	19.6	
200	CHBT3_050	0.095	49.2	64.6	25.4	
201	CHBT3_060	0.413	25.0	64.2	21.7	
202	CHBT3_070	0.268	15.0	67.1	34.5	
203	CHBT3_080	0.260	9.0	72.3	32.4	
204	CHBT3_090	0.195	30.1	64.0	16.1	
205	CHBT4_010	1.087	15.6	63.4	37.5	
206	CHBT5_010	0.678	21.2	63.1	37.4	
207	CHBT5_020	0.491	12.9	65.0	27.6	
208	CHBT5_030	0.067	34.2	62.9	15.0	
209	CLK_010	0.045	27.5	64.2	12.4	
210	CLK_020	0.365	27.4	62.2	20.0	
211	CLK_030	0.414	35.1	59.3	16.3	
212	CLK_040	0.325	13.6	57.8	22.2	
213	CLK_050	0.455	19.6	65.0	22.5	
214	CLK_060	0.699	35.6	65.0	27.9	
215	CLK_070	0.973	35.3	63.9	42.5	
216	CLK_080	0.327	23.2	63.3	15.5	
217	CLK_090	0.323	22.0	60.9	87.3	
218	CLKT1_010	0.198	33.2	61.7	24.4	
219	COT_010	0.137	9.7	70.1	16.3	
220	COT_020	0.220	6.7	69.7	23.0	
221	COT_030	0.397	12.6	68.0	38.6	
222	COT_040	0.169	3.2	69.0	22.0	
223	COT_050	0.822	2.3	67.2	33.3	
224	COT_060	0.629	8.3	67.8	42.5	
225	COT_070	0.817	0.3	68.9	47.4	
226	COT_080	0.360	12.0	67.1	26.3	
227	COT_090	0.291	14.4	67.3	42.8	
228	COT_100	0.087	1.9	63.4	13.9	
229	COT_110	0.162	30.5	64.1	29.2	
230	COT_120	0.215	7.6	69.4	63.6	

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
231	COT_130	0.410	10.2	67.3	19.5	
232	COT_140	0.276	16.0	67.4	118.5	
233	COT_150	0.597	15.5	66.3	43.5	
234	COT_160	0.647	20.2	66.4	21.2	
235	COT_170	0.444	3.8	67.7	30.6	
236	COT_180	0.270	15.1	69.4	54.9	
237	COT_190	0.713	2.9	70.7	38.5	
238	COT_200	0.079	0.4	61.2	72.8	
239	COT_210	0.714	15.9	62.5	30.8	
240	COT_220	0.366	0.1	66.0	34.8	
241	COT_230	0.151	1.7	64.2	33.3	
242	COT_240	0.154	1.6	64.0	29.2	
243	COT_250	0.391	2.7	67.8	39.5	
244	COT_260	0.250	1.0	66.0	22.5	
245	COT_270	0.172	0.1	69.5	58.1	
246	COT_280	0.049	0.3	55.2	10.2	
247	COT_290	0.127	0.9	62.8	38.9	
248	COT_300	0.082	2.6	46.7	20.0	
249	CWC_010	0.478	19.8	65.0	32.2	
250	CWC_020	0.374	19.3	65.0	26.7	
251	CWC_030	0.308	35.2	65.0	27.5	
252	D18_010	0.631	4.1	68.6	36.7	
253	D18_020	0.327	10.3	66.2	46.8	
254	D18_030	0.212	5.6	65.5	18.8	
255	D18_040	1.017	6.9	67.6	56.0	
256	D18_050	0.383	22.6	64.0	22.1	
257	D18_060	0.359	15.5	51.5	24.9	
258	D18_070	0.242	18.4	58.6	27.9	
259	D22_010	0.715	3.0	66.7	27.5	
260	D22_020	0.365	5.4	60.8	16.9	
261	DAV_010	0.257	12.9	65.0	31.6	2.08
262	DAV_020	0.114	28.1	65.0	13.8	2.08
263	DAV_030	0.514	25.9	65.2	24.2	2.07
264	DAV_040	0.435	27.7	65.3	19.0	2.06
265	DAV_050	0.344	3.6	65.6	14.8	2.05
266	DAV_060	0.267	6.4	66.8	30.0	1.99
267	DAV_070	0.430	25.2	66.6	27.1	2
268	DAV_080	0.684	27.1	65.8	58.8	2.04
269	DAVT1_010	0.206	39.7	65.0	22.8	2.08
270	DRY_010	0.916	32.5	62.5	27.1	
271	DRY_020	0.696	40.7	61.3	19.6	
272	DRY_030	0.464	32.5	57.4	12.3	
273	DRYF_010	0.709	12.9	65.0	45.0	
274	DRYF_020	0.519	17.8	64.9	32.5	
275	DRYFT1_010	1.079	18.1	65.9	43.3	
276	DRYFT1_020	0.124	1.6	68.6	50.8	

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
277	DRYT1_010	0.730	59.8	61.3	31.3	
278	DRYT1_020	0.487	56.1	61.9	26.1	
279	DRYT1_030	0.806	40.8	62.0	41.0	
280	DYB_010	0.763	25.9	62.3	21.9	
281	DYB_020	0.723	27.7	62.3	26.4	
282	HON_010	0.236	2.1	63.7	37.7	
283	HON_020	0.843	2.2	63.5	30.0	
284	HON_030	0.548	23.8	64.6	32.1	
285	HON_040	0.413	13.7	66.1	15.9	
286	HONT1_010	0.294	4.8	64.6	38.7	
287	HONT2_010	0.438	26.4	64.9	27.7	
288	LAK_010	0.265	45.3	65.0	24.8	2.08
289	LAK_020	0.216	44.6	65.0	11.5	2.08
290	LAK_030	0.390	46.4	65.0	17.7	2.08
291	LAK_040	0.656	42.4	65.0	30.4	2.08
292	LAK_050	0.402	65.6	65.0	31.6	2.08
293	LAK_060	0.261	57.1	65.0	21.4	2.08
294	LAK_070	0.215	60.2	63.1	6.2	2.17
295	LAK_080	0.191	38.1	63.1	22.5	2.17
296	LAK_090	0.033	40.1	65.0	9.1	2.08
297	LAK_100	0.173	34.2	62.2	24.5	2.22
298	LAK_110	0.529	27.8	63.2	19.6	2.16
299	LAK_120	0.174	33.0	65.0	24.9	2.08
300	LAK_130	0.415	28.3	63.6	24.0	2.14
301	LAK_140	0.843	3.2	66.3	19.6	2.02
302	LAK_150	0.692	1.2	67.0	37.6	1.99
303	LAK_160	0.672	8.1	66.0	26.2	2.03
304	LAK_170	0.517	5.5	65.3	19.5	2.06
305	LAK_180	0.557	18.9	65.7	26.8	2.04
306	LAK_190	0.760	21.4	65.9	25.9	2.03
307	LAK_200	0.545	31.4	65.0	26.5	2.08
308	LAK_210	0.127	45.1	64.0	11.8	2.13
309	LAK_220	0.722	50.6	62.3	21.1	2.21
310	LAK_230	0.497	33.0	59.7	22.1	
311	LAK_240	0.393	27.1	57.3	18.6	
312	LAKT1_010	0.919	38.6	65.0	43.9	2.08
313	LAKT2_010	0.449	53.9	65.0	14.7	2.08
314	LAKT2_020	0.656	40.5	64.2	21.4	2.12
315	LAKT3_010	0.823	47.9	65.0	20.1	2.08
316	LAKT3_020	0.779	38.1	64.2	32.6	2.12
317	LAKT4_010	0.430	23.6	65.8	20.5	2.04
318	LAKT5_010	0.887	40.6	65.0	26.1	2.08
319	LAKT5_020	0.888	14.4	66.1	20.7	2.03
320	LAKT5_030	0.103	8.9	65.7	9.0	2.04
321	LAKT6_010	0.126	51.6	64.7	9.9	2.09
322	LAKT6_020	0.392	40.4	65.2	20.4	2.07

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
323	LAKT6_030	0.165	85.2	63.5	9.2	2.15
324	LAKT6_040	0.163	63.5	64.4	8.2	2.11
325	LAKT6_050	0.624	54.7	63.7	20.4	
326	MAC_010	0.680	6.1	65.1	99.0	
327	MAC_020	0.497	21.2	64.9	69.2	
328	MAC_030	0.381	17.6	65.1	36.1	
329	MAC_040	0.874	28.7	65.1	42.9	
330	MAC_050	0.492	11.3	66.0	19.1	
331	MAC_060	0.208	8.4	64.9	10.1	
332	MACT1_010	0.203	30.2	65.0	44.4	
333	MCN_010	0.995	21.3	62.8	28.8	
334	MCN_020	0.580	15.2	64.5	27.4	
335	MCN_030	0.646	1.2	66.8	21.8	
336	MCN_040	0.322	2.6	66.5	21.6	
337	MCN_050	0.375	12.0	65.4	22.9	
338	MCN_060	0.361	13.3	66.7	24.8	
339	MCN_070	0.527	15.7	63.4	20.6	
340	MCN_080	0.502	6.3	56.8	26.9	
341	MCN_090	0.190	32.7	55.2	25.8	
342	MCNF_010	0.629	5.4	62.0	22.8	
343	MCNF_020	0.700	1.6	64.6	23.1	
344	MCNF_030	0.778	5.3	63.8	28.6	
345	MCNF_040	0.294	1.8	70.0	35.8	
346	MCNF_050	0.641	1.3	67.6	49.1	
347	MCNF_060	0.407	2.3	69.4	21.8	
348	MCNT1_010	0.738	0.4	70.1	40.6	
349	MCNT1_020	0.205	3.0	68.6	15.2	
350	MCNT1_030	0.431	4.9	69.7	38.7	
351	MCNT1_040	0.184	1.5	69.8	17.9	
352	MCNT1_050	0.016	0.2	69.0	8.6	
353	MCNT1_060	0.350	1.0	65.5	29.3	
354	MCNT2_010	0.337	4.1	70.3	25.7	
355	MCNT2_020	0.412	0.7	69.9	17.0	
356	MCNT2_030	0.375	1.8	69.6	21.2	
357	MCNT2_040	0.163	0.8	67.5	22.0	
358	MCNT2_050	0.091	12.8	66.2	19.0	
359	MCNT3_010	0.772	6.1	69.5	30.9	
360	MCNT3_020	0.301	3.8	69.1	14.9	
361	MCNT3_030	0.241	19.0	65.3	20.2	
362	NFBC_010	0.904	6.1	66.8	35.4	
363	NFBC_020	0.213	0.0	69.0	21.1	
364	NFBC_030	0.684	0.2	68.2	31.2	
365	NFBC_040	0.570	3.2	66.1	18.1	
366	NFBC_050	0.633	0.0	67.6	31.1	
367	NFBC_060	0.859	0.9	68.4	35.8	
368	NFBC_070	0.269	0.6	68.6	59.3	

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
369	NFBC_080	0.153	0.5	70.9	26.6	
370	NFBC_090	0.781	6.2	66.4	45.2	
371	NFBC_100	0.744	19.7	65.4	53.3	
372	NFBC_110	0.772	5.9	65.1	52.7	
373	NFBC_120	1.005	9.8	65.0	32.0	
374	ONI_010	0.190	44.2	65.0	19.4	
375	ONI_015	0.296	24.3	65.0	11.1	
376	ONI_020	0.586	24.3	65.5	30.9	
377	ONI_030	0.203	28.2	65.1	22.2	
378	ONI_040	0.339	32.1	65.0	34.4	
379	ONI_050	0.202	49.0	65.0	23.0	
380	ONI_060	0.366	20.2	66.2	22.1	
381	ONI_070	0.122	34.6	65.0	24.4	
382	ONI_080	0.521	2.8	64.4	25.8	
383	ONI_090	0.818	26.5	65.0	42.4	
384	ONI_100	1.008	33.6	64.9	33.1	
385	ONI_110	0.439	62.9	64.1	43.0	
386	ONI_120	0.147	35.9	62.3	20.3	
387	ONI_130	0.551	35.9	60.4	27.9	
388	ONIT1_010	0.651	10.2	65.6	32.8	
389	ONIT1_020	0.126	38.6	65.0	19.7	
390	POC_010	0.159	24.6	65.0	11.4	
391	POC_020	0.427	8.0	64.9	21.6	
392	POC_030	0.203	2.3	65.4	27.9	
393	QRY_010	1.039	0.2	61.0	117.1	
394	QRY_020	1.259	0.0	53.3	112.9	
395	QRY_030	0.196	1.3	52.8	50.0	
396	QRY_040	0.108	8.9	36.1	18.9	4.54
397	RAT_010	0.269	58.8	65.0	27.4	2.08
398	RAT_020	0.368	53.2	65.0	11.2	2.08
399	RAT_030	0.134	34.4	65.0	16.6	2.08
400	RAT_040	0.339	36.8	65.0	22.6	2.08
401	RAT_050	0.533	36.7	65.0	13.2	2.08
402	RAT_060	0.250	25.7	65.5	13.4	2.05
403	RAT_070	0.997	1.3	65.8	27.3	2.04
404	RAT_080	0.655	2.7	65.2	22.3	2.07
405	RAT_090	0.340	0.0	67.0	47.3	1.99
406	RAT_100A	0.169	1.4	66.5	38.1	2.01
407	RAT_100B	0.734	5.6	65.3	16.9	2.06
408	RAT_110	0.074	4.2	64.7	18.1	2.09
409	RAT_120	0.048	0.3	64.5	25.9	2.1
410	RAT_130	0.048	18.9	64.6	9.3	2.1
411	RATT1_010	0.918	10.2	65.2	34.6	2.07
412	RATT1_020	0.143	9.1	66.9	12.3	1.99
413	RATT2_010	0.359	29.6	64.6	15.3	2.1
414	RATT2_020	0.234	27.6	66.5	24.9	2.01

Table F-1. Watershed Parameters

Watershed ID per Figures 4-2 to 4-6	SubBasin Name (associated stream name is provided in Table F-3)	Area (sq-mi)	Impervious (%)	Curve Number	Lag Time (min)	Initial Abstraction (in)
415	RATT2_030	0.104	23.9	65.9	13.2	2.03
416	RATT2_040	0.345	11.6	67.0	20.9	1.99
417	RATT2_050	0.106	19.3	67.0	20.2	1.99
418	RATT2_060	0.126	17.2	65.1	21.7	2.07
419	SBR_010	0.572	24.4	58.5	19.8	
420	SBR_020	0.750	47.0	64.4	28.7	
421	SBR_030	0.470	30.3	60.9	30.8	
422	SBR_040	1.145	18.8	64.8	46.8	
423	SBR_050	0.314	29.8	65.0	21.0	
424	SBR_060	0.312	29.9	60.5	11.5	
425	SBR_070	0.998	28.9	65.7	32.4	
426	SBR_080	0.676	23.8	64.3	33.6	
427	SBR_090	0.682	22.3	63.6	27.4	
428	SBR_100	0.296	8.6	60.1	24.5	
429	SBR_110	0.218	25.2	60.1	27.5	
430	SBRT1_010	0.598	36.2	64.7	21.6	
431	SBRT2_010	0.122	31.1	64.8	17.0	
432	SBRT2_020	0.152	15.3	64.7	25.8	
433	SBRT2_030	0.045	9.4	57.8	26.0	
434	SBRT3_010	0.151	34.2	63.3	17.5	
435	SBRT4_010	0.564	28.5	65.7	40.5	
436	SFBC_010	0.654	6.2	66.9	42.2	
437	SFBC_020	0.297	32.5	65.2	38.7	
438	SFBC_030	0.576	25.3	65.1	23.8	
439	SFBC_040	0.584	24.8	65.0	30.0	
440	SFBC_050	0.390	25.1	65.0	26.8	
441	SPAO_010	0.181	39.4	65.0	8.9	
442	SPAO_020	0.270	46.3	64.2	25.5	
443	SPAO_030	0.076	39.3	64.5	16.2	
444	SPAO_040	0.243	33.7	64.7	13.8	
445	SPAO_050	0.252	51.1	65.0	14.4	
446	SPAO_060	0.137	42.9	65.0	22.1	
447	SPAO_070	0.116	38.7	65.0	13.7	
448	SPAO_080	0.108	34.6	65.0	22.7	
449	SPAO_090	0.464	40.0	65.1	46.1	

Table F-2. Reach Parameters

Reach (associated stream name is provided in Table F-3)	Length (ft)	Slope (ft/ft)	LoB Roughness	Channel Roughness	RoB Roughness
R_BLH_020	1963	0.0046	0.035	0.035	0.035
R_BLH_030	1204	0.0033	0.05	0.05	0.05
R_BLH_050	3583	0.0031	0.035	0.035	0.035
R_BLH_060	1230	0.0048	0.035	0.035	0.035
R_BLH_070	1315	0.0048	0.035	0.035	0.035
R_BLH_080	2574	0.0023	0.035	0.035	0.035
R_BLH_090	3842	0.003	0.1	0.1	0.1
R_BLH_100	2534	0.002	0.05	0.05	0.05
R_BLH_110	3929	0.0019	0.05	0.05	0.05
R_BLH_110B	725	0.0027	0.035	0.035	0.035
R_BLH_120	2916	0.0052	0.05	0.05	0.05
R_BLH_140	3550	0.0028	0.05	0.05	0.05
R_BLH_160	5304	0.0037	0.1	0.1	0.1
R_BLH_170	1043	0.0016	0.05	0.05	0.05
R_BLHT2_020	4047	0.0057	0.035	0.035	0.035
R_BLHT2_030	782	0.0033	0.035	0.035	0.035
R_BLHT3_006	1360	0.0091	0.035	0.035	0.035
R_BLHT3_010	2648	0.0082	0.035	0.035	0.035
R_BLHT3_030	3760	0.0025	0.035	0.035	0.035
R_BRC_010	1456	0.0066	0.05	0.05	0.05
R_BRC_020	3255	0.0048	0.1	0.1	0.1
R_BRC_030	4424	0.0129	0.1	0.1	0.1
R_BRC_050	1607	0.0092	0.05	0.05	0.05
R_BRC_060	2999	0.0124	0.1	0.1	0.1
R_BRC_090	2239	0.0045	0.1	0.1	0.1
R_BRC_100	3159	0.0042	0.05	0.05	0.05
R_BRC_110	2476	0.0014	0.05	0.05	0.05
R_BRC_120	3556	0.0021	0.035	0.035	0.035
R_BRC_140	7375	0.0054	0.1	0.1	0.1
R_BRC_150	4125	0.0022	0.05	0.05	0.05
R_BRC_160	1410	0.0012	0.05	0.05	0.05
R_BRC_170	639	0.0121	0.05	0.05	0.05
R_BRC_190	4981	0.003	0.05	0.05	0.05
R_BRC_210	2445	0.0033	0.05	0.05	0.05
R_BRC_210B	2603	0.0033	0.05	0.05	0.05
R_BRC_240	610	0.0242	0.05	0.05	0.05
R_BRC_250	2072	0.0072	0.05	0.05	0.05
R_BRC_260	6340	0.004	0.05	0.05	0.05
R_BRC_270	4199	0.0068	0.05	0.05	0.05
R_BRC_280	7308	0.0064	0.05	0.05	0.05
R_BRC_290	6779	0.008	0.05	0.05	0.05
R_BRC_310	3980	0.0068	0.05	0.05	0.05
R_BRC_330	4003	0.0052	0.05	0.05	0.05

Table F-2. Reach Parameters

Reach (associated stream name is provided in Table F-3)	Length (ft)	Slope (ft/ft)	LoB Roughness	Channel Roughness	RoB Roughness
R_BRC_340	3336	0.0081	0.05	0.05	0.05
R_BRC_350	3669	0.0163	0.05	0.05	0.05
R_BRC_370	3034	0.0066	0.1	0.1	0.1
R_BRC_380	5485	0.0044	0.1	0.1	0.1
R_BRC_390	5483	0.0094	0.05	0.05	0.05
R_BRC_400	2137	0.0052	0.05	0.05	0.05
R_BRC_430	2182	0.0042	0.05	0.05	0.05
R_BRC_440	5495	0.0019	0.05	0.05	0.05
R_BRC_460	1470	0.0099	0.035	0.035	0.035
R_BRC_460B	2684	0.0058	0.05	0.05	0.05
R_BRC_470	2585	0.0067	0.05	0.05	0.05
R_BRC_490	2830	0.0072	0.05	0.05	0.05
R_BRC_510	1300	0.0048	0.05	0.05	0.05
R_BRC_520	2253	0.0124	0.05	0.05	0.05
R_BRC_530	2601	0.0012	0.035	0.035	0.035
R_BRC_550	3380	0.0014	0.05	0.05	0.05
R_BRC_560	2224	0.0048	0.05	0.05	0.05
R_BRC_570	1855	0.0065	0.05	0.05	0.05
R_BRC_580	6642	0.0064	0.05	0.05	0.05
R_BRC_610	2068	0.0071	0.05	0.05	0.05
R_BRC_630	3814	0.0063	0.05	0.05	0.05
R_BRC_650	3183	0.0056	0.05	0.05	0.05
R_BRC_670	10592	0.0041	0.05	0.05	0.05
R_BRC_690	1295	0.0044	0.05	0.05	0.05
R_BRC_700	3667	0.0037	0.05	0.05	0.05
R_BRC_720	4507	0.0015	0.05	0.05	0.05
R_BRC_760	3155	0.0037	0.035	0.035	0.035
R_BRC_770	17028	0.0112	0.035	0.035	0.035
R_BRC_780	6717	0.0162	0.035	0.035	0.035
R_BRC_790	8103	0.001	0.05	0.05	0.05
R_BRC_900	6515	0.0048	0.05	0.05	0.05
R_BRCT10_020	5467	0.0133	0.035	0.035	0.035
R_BRCT10_040	1052	0.0098	0.035	0.035	0.035
R_BRCT10_050	8625	0.0056	0.035	0.035	0.035
R_BRCT11_020	3580	0.0116	0.035	0.035	0.035
R_BRCT11_040	2680	0.0038	0.035	0.035	0.035
R_BRCT11_050	824	0.0042	0.035	0.035	0.035
R_BRCT11_060	4014	0.0035	0.035	0.035	0.035
R_BRCT11_070	2371	0.0005	0.035	0.035	0.035
R_BRCT11_070B	3103	0.0141	0.035	0.035	0.035
R_BRCT2_020	2771	0.0051	0.1	0.1	0.1
R_BRCT4_030	1211	0.0044	0.035	0.035	0.035
R_BRCT4_040	4103	0.0052	0.05	0.05	0.05

Table F-2. Reach Parameters

Reach (associated stream name is provided in Table F-3)	Length (ft)	Slope (ft/ft)	LoB Roughness	Channel Roughness	RoB Roughness
R_BRCT5_020	5253	0.0076	0.05	0.05	0.05
R_BRCT5_040	2604	0.0067	0.05	0.05	0.05
R_BRCT5_050	3148	0.0058	0.035	0.035	0.035
R_BRCT7_030	2162	0.0156	0.035	0.035	0.035
R_BRCT7_040	7898	0.0055	0.035	0.035	0.035
R_BRCT7_050	6035	0.0043	0.05	0.05	0.05
R_BRCT7_060	2604	0.0107	0.035	0.035	0.035
R_BRCT8_020	1947	0.0067	0.05	0.05	0.05
R_BRCT8_030	5277	0.0025	0.05	0.05	0.05
R_BRCT8_040	748	0.0079	0.013	0.013	0.013
R_BRCT9_030	4116	0.0028	0.035	0.035	0.035
R_BRCT9_050	3542	0.0169	0.035	0.035	0.035
R_BRCT9_070	1919	0.006	0.05	0.05	0.05
R_BUT_020	3977	0.002	0.05	0.05	0.05
R_BUT_040	1423	0.0006	0.035	0.035	0.035
R_BUT_050	1405	0.0014	0.05	0.05	0.05
R_BUT_070	1385	0.0039	0.035	0.035	0.035
R_BUT_080	2333	0.0011	0.035	0.035	0.035
R_BUT_090	5276	0.0024	0.035	0.035	0.035
R_BUT_120	3154	0.0036	0.1	0.1	0.1
R_BUT_130	4474	0.0008	0.035	0.035	0.035
R_CHB_020	2468	0.01002	0.065	0.035	0.065
R_CHB_030	2479	0.01002	0.065	0.035	0.065
R_CHB_040	2538	0.01002	0.055	0.035	0.05
R_CHB_050	3483	0.01002	0.05	0.035	0.05
R_CHB_060	3002	0.01002	0.05	0.035	0.05
R_CHB_070A	5288	0.00325	0.08	0.035	0.065
R_CHB_070D1	3132	0.00638	0.06	0.035	0.06
R_CHB_070D2	1562	0.00638	0.06	0.035	0.06
R_CHB_080	1476	0.00638	0.07	0.035	0.06
R_CHB_100	3893	0.00638	0.06	0.035	0.06
R_CHB_100	3893	0.00638	0.06	0.035	0.06
R_CHB_120	2081	0.00638	0.07	0.035	0.07
R_CHB_130	7272	0.00638	0.075	0.035	0.05
R_CHB_140	4104	0.00297	0.09	0.035	0.09
R_CHB_150	4373	0.00297	0.09	0.035	0.09
R_CHB_160	1935	0.00297	0.08	0.035	0.09
R_CHB_170	3260	0.00297	0.09	0.035	0.07
R_CHB_180	6735	0.00297	0.09	0.035	0.05
R_CHB_200	7095	0.00297	0.06	0.035	0.05
R_CHB_210	3101	0.00297	0.09	0.035	0.05
R_CHBT1_040	3038	0.00569	0.06	0.035	0.07
R_CHBT2_030	1862	0.01256	0.07	0.035	0.055

Table F-2. Reach Parameters

Reach (associated stream name is provided in Table F-3)	Length (ft)	Slope (ft/ft)	LoB Roughness	Channel Roughness	RoB Roughness
R_CHBT2_040	6983	0.01256	0.04	0.035	0.04
R_CHBT3_020	4108	0.00971	0.05	0.035	0.04
R_CHBT3_030	5119	0.00971	0.05	0.035	0.05
R_CHBT3_070	2393	0.00577	0.04	0.035	0.09
R_CHBT3_090	4342	0.0051	0.06	0.04	0.07
R_CHBT5_020	2756	0.00775	0.04	0.035	0.04
R_CHBT5_030	1390	0.00882	0.085	0.035	0.06
R_CLK_020	4294	0.0027	0.1	0.1	0.1
R_CLK_030	2299	0.0012	0.05	0.05	0.05
R_CLK_040	2204	0.0014	0.05	0.05	0.05
R_CLK_050	3342	0.0048	0.1	0.1	0.1
R_CLK_060	5248	0.0035	0.1	0.1	0.1
R_CLK_080	2358	0.0032	0.1	0.1	0.1
R_CLK_090	3603	0.0037	0.05	0.05	0.05
R_COT_030A	4303	0.0136	0.035	0.035	0.035
R_COT_030B	4914	0.0045	0.035	0.035	0.035
R_COT_050	5857	0.0043	0.05	0.05	0.05
R_COT_060	4605	0.0026	0.05	0.05	0.05
R_COT_070	5802	0.0031	0.035	0.035	0.035
R_COT_080	1289	0.0031	0.035	0.035	0.035
R_COT_100	1619	0.0028	0.05	0.05	0.05
R_COT_110	1433	0.0071	0.035	0.035	0.035
R_COT_130A	2954	0.0082	0.035	0.035	0.035
R_COT_130B	2575	0.006	0.035	0.035	0.035
R_COT_150A	3027	0.0123	0.035	0.035	0.035
R_COT_150B	3191	0.0079	0.035	0.035	0.035
R_COT_160	9614	0.0105	0.05	0.05	0.05
R_COT_190	7893	0.0063	0.035	0.035	0.035
R_COT_200	2514	0.0086	0.05	0.05	0.05
R_COT_210	4368	0.0051	0.05	0.05	0.05
R_COT_230	1859	0.0067	0.05	0.05	0.05
R_COT_240	2685	0.0039	0.035	0.035	0.035
R_COT_260	4538	0.0037	0.05	0.05	0.05
R_COT_280	3072	0.0034	0.05	0.05	0.05
R_COT_280B	2205	0.0281	0.05	0.05	0.05
R_COT_300	2876	0.0035	0.035	0.035	0.035
R_CWC_020	2268	0.0032	0.1	0.1	0.1
R_CWC_030	4445	0.0125	0.035	0.035	0.035
R_D18_020	4640	0.008	0.1	0.1	0.1
R_D18_030	1812	0.0086	0.05	0.05	0.05
R_D18_040	8654	0.011	0.035	0.035	0.035
R_D18_050	2539	0.0095	0.035	0.035	0.035
R_D18_060	4262	0.0178	0.035	0.035	0.035

Table F-2. Reach Parameters

Reach (associated stream name is provided in Table F-3)	Length (ft)	Slope (ft/ft)	LoB Roughness	Channel Roughness	RoB Roughness
R_D18_070	2359	0.0047	0.05	0.05	0.05
R_D22_020	3981	0.0057	0.035	0.035	0.035
R_DAV_020	1150	0.0065	0.1	0.1	0.1
R_DAV_030	3092	0.0179	0.1	0.1	0.1
R_DAV_040	4435	0.0031	0.05	0.05	0.05
R_DAV_060	2845	0.005	0.05	0.05	0.05
R_DAV_070	3844	0.0065	0.035	0.035	0.035
R_DAV_080	3407	0.0061	0.035	0.035	0.035
R_DRY_020	4677	0.0067	0.035	0.035	0.035
R_DRY_030	4372	0.0055	0.035	0.035	0.035
R_DRYF_010	6423	0.0107	0.05	0.05	0.05
R_DRYF_020	8503	0.0367	0.05	0.05	0.05
R_DRYFT1_010	2567	0.0033	0.035	0.035	0.035
R_DRYT1_030	6905	0.0038	0.035	0.035	0.035
R_DYB_020	6378	0.0127	0.05	0.05	0.05
R_HON_020	6980	0.0056	0.05	0.05	0.05
R_HON_030	5773	0.0052	0.035	0.035	0.035
R_HON_040	1950	0.0081	0.035	0.035	0.035
R_LAK_020	1360	0.0063	0.035	0.035	0.035
R_LAK_030	1955	0.0081	0.035	0.035	0.035
R_LAK_040	3722	0.002	0.05	0.05	0.05
R_LAK_060	2528	0.0046	0.035	0.035	0.035
R_LAK_070	2642	0.0033	0.035	0.035	0.035
R_LAK_080	3072	0.0033	0.035	0.035	0.035
R_LAK_090	1041	0.0024	0.035	0.035	0.035
R_LAK_100	3057	0.002	0.035	0.035	0.035
R_LAK_110	4321	0.0032	0.035	0.035	0.035
R_LAK_130	1825	0.0051	0.1	0.1	0.1
R_LAK_140	4054	0.002	0.05	0.05	0.05
R_LAK_140B	5877	0.0028	0.05	0.05	0.05
R_LAK_150	6772	0.0028	0.05	0.05	0.05
R_LAK_160	5520	0.0058	0.05	0.05	0.05
R_LAK_170	7510	0.0039	0.05	0.05	0.05
R_LAK_180	2911	0.001	0.05	0.05	0.05
R_LAK_190	4184	0.0029	0.035	0.035	0.035
R_LAK_200	6182	0.003	0.05	0.05	0.05
R_LAK_210B	1198	0.0073	0.035	0.035	0.035
R_LAK_220	4123	0.0048	0.035	0.035	0.035
R_LAK_230	4897	0.0026	0.035	0.035	0.035
R_LAK_240	7239	0.0033	0.05	0.05	0.05
R_LAKT2_020	6727	0.0105	0.035	0.035	0.035
R_LAKT3_020	5131	0.0022	0.035	0.035	0.035
R_LAKT5_020	5146	0.0057	0.035	0.035	0.035

Table F-2. Reach Parameters

Reach (associated stream name is provided in Table F-3)	Length (ft)	Slope (ft/ft)	LoB Roughness	Channel Roughness	RoB Roughness
R_LAKT6_020	5844	0.0043	0.035	0.035	0.035
R_LAKT6_040	2377	0.0033	0.035	0.035	0.035
R_LAKT6_050	4799	0.0052	0.035	0.035	0.035
R_MAC_020	1875	0.0107	0.035	0.035	0.035
R_MAC_030	4162	0.008	0.05	0.05	0.05
R_MAC_040	1904	0.0043	0.035	0.035	0.035
R_MAC_050	3112	0.0074	0.035	0.035	0.035
R_MAC_060	1328	0.0058	0.1	0.1	0.1
R_MCN_020	4236	0.0031	0.035	0.035	0.035
R_MCN_030	6798	0.0031	0.05	0.05	0.05
R_MCN_040	3944	0.0019	0.05	0.05	0.05
R_MCN_050	3592	0.0049	0.05	0.05	0.05
R_MCN_060	1303	0.007	0.05	0.05	0.05
R_MCN_070	2688	0.0079	0.05	0.05	0.05
R_MCN_080	7528	0.0026	0.05	0.05	0.05
R_MCN_090	2197	0.031	0.035	0.035	0.035
R_MCNF_020	2661	0.0034	0.035	0.035	0.035
R_MCNF_030	2961	0.0033	0.05	0.05	0.05
R_MCNF_050	3801	0.0047	0.035	0.035	0.035
R_MCNF_060	4289	0.0027	0.035	0.035	0.035
R_MCNT1_020	3591	0.0079	0.035	0.035	0.035
R_MCNT1_060	5383	0.0046	0.035	0.035	0.035
R_MCNT2_030	4258	0.0035	0.035	0.035	0.035
R_MCNT2_050	3232	0.0042	0.05	0.05	0.05
R_MCNT3_020	4486	0.0107	0.035	0.035	0.035
R_MCNT3_030	5526	0.0122	0.035	0.035	0.035
R_NFBC_030	6940	0.0066	0.035	0.035	0.035
R_NFBC_050	8064	0.0113	0.035	0.035	0.035
R_NFBC_100	4019	0.0057	0.05	0.05	0.05
R_NFBC_110	4309	0.0051	0.05	0.05	0.05
R_NFBC_120	7555	0.0011	0.035	0.035	0.035
R_ONI_015	1299	0.027	0.05	0.05	0.05
R_ONI_020	3561	0.0088	0.05	0.05	0.05
R_ONI_030	2560	0.0077	0.035	0.035	0.035
R_ONI_050	2736	0.0043	0.035	0.035	0.035
R_ONI_060	5289	0.0067	0.05	0.05	0.05
R_ONI_090	3027	0.0091	0.05	0.05	0.05
R_ONI_090	3027	0.0091	0.05	0.05	0.05
R_ONI_100	6800	0.0167	0.05	0.05	0.05
R_ONI_110	2887	0.0101	0.035	0.035	0.035
R_ONI_130	5123	0.0071	0.035	0.035	0.035
R_ONIT1_010	4406	0.0083	0.05	0.05	0.05
R_POC_020	4727	0.0036	0.1	0.1	0.1

Table F-2. Reach Parameters

Reach (associated stream name is provided in Table F-3)	Length (ft)	Slope (ft/ft)	LoB Roughness	Channel Roughness	RoB Roughness
R_POC_030	3015	0.0007	0.1	0.1	0.1
R_Quarry_SH_45_Div1	1395	0.0109	0.035	0.035	0.035
R_Quarry_SH_45_Div2	3257	0.0108	0.05	0.05	0.05
R_RAT_020	3284	0.01	0.035	0.035	0.035
R_RAT_030	889	0.0063	0.05	0.05	0.05
R_RAT_040	2268	0.0369	0.035	0.035	0.035
R_RAT_050	3655	0.0102	0.035	0.035	0.035
R_RAT_060	2501	0.0114	0.05	0.05	0.05
R_RAT_070	7434	0.0066	0.05	0.05	0.05
R_RAT_080	5137	0.0096	0.05	0.05	0.05
R_RAT_100B	6147	0.0085	0.05	0.05	0.05
R_RAT_110	1363	0.0083	0.05	0.05	0.05
R_RAT_120	1339	0.0033	0.05	0.05	0.05
R_RAT_130	1255	0.0023	0.05	0.05	0.05
R_RATT1_010	3116	0.0084	0.035	0.035	0.035
R_RATT1_020	3593	0.0113	0.05	0.05	0.05
R_RATT2_020	2796	0.0055	0.035	0.035	0.035
R_RATT2_040	2054	0.009	0.035	0.035	0.035
R_RATT2_060	3871	0.0048	0.035	0.035	0.035
R_SBR_010	5710	0.002	0.05	0.05	0.05
R_SBR_020	930	0.0004	0.1	0.1	0.1
R_SBR_030	2969	0.0085	0.05	0.05	0.05
R_SBR_060	1830	0.0084	0.035	0.035	0.035
R_SBR_060A	3450	0.0084	0.035	0.035	0.035
R_SBR_070	1502	0.0154	0.03	0.03	0.03
R_SBR_080	1545	0.0008	0.1	0.1	0.1
R_SBR_090	2547	0.0122	0.09	0.09	0.09
R_SBR_100	1878	0.0084	0.05	0.05	0.05
R_SBR_110	2692	0.0184	0.05	0.05	0.05
R_SBRT2_030	1754	0.0062	0.1	0.1	0.1
R_SFBC_030	7736	0.0134	0.05	0.05	0.05
R_SFBC_050	4306	0.007	0.035	0.035	0.035
R_SPAO_020	3376	0.0191	0.035	0.035	0.035
R_SPAO_040	1027	0.0124	0.035	0.035	0.035
R_SPAO_050	1423	0.0005	0.013	0.013	0.013
R_SPAO_070	805	0.0033	0.035	0.035	0.035
R_SPAO_080	2553	0.0015	0.05	0.05	0.05
R_SPAO_090	5530	0.0023	0.05	0.05	0.05

Table F-3. Naming Convention

Naming Prefix	River System
BLH	Block House Creek
BLHT1	Block House Creek
BLHT2	Block House Creek
BLHT3	Block House Creek
BRC	Brushy Creek
BRCT1	Brushy Creek
BRCT10	Brushy Creek
BRCT11	Brushy Creek
BRCT2	Brushy Creek
BRCT3	Brushy Creek
BRCT4	Brushy Creek
BRCT5	Brushy Creek
BRCT7	Brushy Creek
BRCT8	Brushy Creek
BRCT9	Brushy Creek
BUT	Buttercup Creek
CHB	Chandler Branch
CHBT1	Chandler Branch
CHBT2	Chandler Branch
CHBT3	Chandler Branch
CHBT4	Chandler Branch
CHBT5	Chandler Branch
CLK	Cluck Creek
CLKT1	Cluck Creek
COT	Cottonwood Creek
CWC	Cottonwood Creek
DAV	Davis Creek
DAVT1	Davis Creek
DRY	Dry Fork
DRYF	Dry Fork
DRYFT1	Dry Fork
DRYT1	Dry Fork
DYB	Dyer Branch

Naming Prefix	River System
HON	Honey Bear Creek
HONT1	Honey Bear Creek
HONT2	Honey Bear Creek
LAK	Lake Creek
LAKT1	Lake Creek
LAKT2	Lake Creek
LAKT3	Lake Creek
LAKT4	Lake Creek
LAKT5	Lake Creek
LAKT6	Lake Creek
MAC	Mason Creek
MACT1	Mason Creek
MAN	Mason Creek
MCN	McNutt Creek
MCNF	McNutt Creek
MCNT1	McNutt Creek
MCNT2	McNutt Creek
MCNT3	McNutt Creek
NFBC	North Fork Brushy Creek
ONI	Onion Branch
ONIT1	Onion Branch
POC	Post Oak Creek
QRY	Quarry
RAT	Rattan Creek
RATT1	Rattan Creek
RATT2	Rattan Creek
SBR	South Brushy Creek
SBRT1	South Brushy Creek
SBRT2	South Brushy Creek
SBRT3	South Brushy Creek
SBRT4	South Brushy Creek
SFBC	South Fork Brushy Creek
SPAO	Spanish Oak

Exhibit G
Rainfall Depths Used
in Hydrologic Modeling

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
1	J_NFBC_040	0.570	3.260	5.643	6.577	8.000	9.000	12.000
2	J_NFBC_050	1.203	3.264	5.634	6.592	8.000	9.000	12.000
3	J_NFBC_60_70	1.128	3.257	5.625	6.592	8.000	9.000	12.000
4	J_NFBC_050_060_070	2.331	3.261	5.629	6.592	8.000	9.000	12.000
5	J_NFBC_010_020	1.117	3.271	5.636	6.621	8.000	9.000	12.000
6	J_NFBC_30	1.802	3.270	5.629	6.625	8.000	9.000	12.000
7	J_NFBC_90	0.781	3.287	5.618	6.647	8.000	9.000	12.000
8	J_NFBC_030_080_090	5.066	3.268	5.627	6.613	8.000	9.000	12.000
9	J_NFBC_100	5.810	3.269	5.624	6.613	8.000	9.000	12.000
10	J_NFBC_110	6.582	3.270	5.622	6.615	8.000	9.000	12.000
11	J_NFBC_120	7.587	3.273	5.618	6.620	8.000	9.000	12.000
12	J_SFBC_010_020	0.952	3.287	5.594	6.647	8.000	9.000	12.000
13	J_SFBC_030	1.528	3.290	5.596	6.649	8.000	9.000	12.000
14	J_SFBC_040	0.584	3.289	5.594	6.650	8.000	9.000	12.000
15	J_SFBC_030_040	2.112	3.288	5.597	6.648	8.000	9.000	12.000
16	J_SFBC_050	2.502	3.284	5.599	6.643	8.000	9.000	12.000
17	_NFBC_120_&_SFBC_05	10.089	3.234	5.539	6.541	7.896	8.883	11.844
18	J_BRC_010	10.160	3.234	5.539	6.541	7.896	8.883	11.844
19	J_MAC_010	0.680	3.305	5.592	6.674	8.000	9.000	12.000
20	J_MAN_020_1	1.177	3.305	5.592	6.685	8.000	9.000	12.000
21	J_MACT1_010	0.203	3.305	5.573	6.697	8.000	9.000	12.000
22	J_MAC_020	1.379	3.305	5.589	6.687	8.000	9.000	12.000
23	J_MAC_030	1.760	3.303	5.586	6.685	8.000	9.000	12.000
24	J_MAC_040	2.634	3.300	5.584	6.684	8.000	9.000	12.000
25	J_MAC_050	3.126	3.302	5.584	6.684	8.000	9.000	12.000
26	J_MAC_060	3.334	3.302	5.582	6.683	8.000	9.000	12.000
27	J_BRC_010_&_MAC_060	13.494	3.227	5.509	6.529	7.864	8.847	11.796
28	J_BRC_020	14.383	3.225	5.501	6.524	7.856	8.838	11.784
29	J_BRC_030	15.200	3.223	5.494	6.520	7.848	8.829	11.772
30	J_BRC_040	0.740	3.305	5.570	6.679	8.000	9.000	12.000
31	J_BRC_030_040	15.941	3.221	5.487	6.515	7.840	8.820	11.760
32	J_BRC_050	16.302	3.221	5.485	6.516	7.840	8.820	11.760
33	J_BRCT1_010	0.676	3.305	5.551	6.695	8.000	9.000	12.000
34	_BRC_050_&_BRCT1_01	16.978	3.218	5.478	6.511	7.832	8.811	11.748
35	J_BRC_060	17.114	3.219	5.478	6.512	7.832	8.811	11.748
36	J_BRC_070_080	1.366	3.314	5.540	6.715	8.000	9.000	12.000
37	J_BRC_060_070_080	18.480	3.217	5.468	6.509	7.824	8.802	11.736
38	J_BRC_090	18.575	3.217	5.468	6.510	7.824	8.802	11.736
39	J_BRCT2_010	0.324	3.325	5.544	6.721	8.000	9.000	12.000
40	J_BRCT2_020	0.520	3.325	5.544	6.724	8.000	9.000	12.000
41	J_BRC_090_BRCT2_020	19.095	3.215	5.461	6.505	7.816	8.793	11.724
42	J_BRC_100	19.550	3.213	5.454	6.500	7.808	8.784	11.712
43	J_BRCT3_010	0.366	3.327	5.526	6.735	8.000	9.000	12.000
44	_BRC_100_&_BRCT3_01	19.916	3.213	5.453	6.501	7.808	8.784	11.712
45	J_BRC_110	20.314	3.214	5.452	6.503	7.808	8.784	11.712
46	BRCT4_010_&_BRCT4_0	0.900	3.337	5.522	6.757	8.000	9.000	12.036
47	J_BRCT4_030	1.003	3.337	5.523	6.757	8.000	9.000	12.032
48	J_BRCT4_040	1.237	3.337	5.523	6.754	8.000	9.000	12.026
49	_BRC_110_&_BRCT4_04	21.550	3.210	5.437	6.495	7.792	8.766	11.689

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
50	J_BRC_120	21.889	3.210	5.436	6.496	7.792	8.766	11.689
51	J_BRC_130	0.704	3.341	5.526	6.768	8.000	9.000	12.000
52	J_BRC_120_130	22.592	3.208	5.429	6.493	7.784	8.757	11.677
53	J_BRC_140B	23.471	3.210	5.427	6.496	7.784	8.757	11.679
54	J_BLH_040	0.518	3.327	5.552	6.743	8.000	9.000	12.000
55	J_BLH_010	0.165	3.327	5.580	6.731	8.000	9.000	12.000
56	J_BLH_020	0.322	3.327	5.572	6.729	8.000	9.000	12.000
57	J_BLH_030	0.388	3.327	5.571	6.729	8.000	9.000	12.000
58	J_BLH_030_040	0.906	3.327	5.560	6.737	8.000	9.000	12.000
59	J_BLH_050	1.326	3.330	5.561	6.734	8.000	9.000	12.000
60	J_BLHT1_010	0.905	3.327	5.564	6.712	8.000	9.000	12.000
61	_BLH_050_&_BLHT1_01	2.231	3.329	5.562	6.725	8.000	9.000	12.000
62	J_BLH_060	2.465	3.330	5.561	6.724	8.000	9.000	12.000
63	J_BLH_070	2.747	3.331	5.560	6.724	8.000	9.000	12.000
64	J_BLH_080	3.016	3.332	5.558	6.724	8.000	9.000	12.000
65	J_BLH_090	3.467	3.332	5.557	6.725	8.000	9.000	12.000
66	J_BLHT2_010	0.730	3.313	5.573	6.712	8.000	9.000	12.000
67	J_BLHT2_020	0.807	3.314	5.571	6.713	8.000	9.000	12.000
68	J_BLHT2_030	1.078	3.316	5.567	6.712	8.000	9.000	12.000
69	J_BLH_090_030	4.545	3.328	5.559	6.722	8.000	9.000	12.000
70	J_BLH_100	4.777	3.328	5.559	6.722	8.000	9.000	12.000
71	J_BLHT3_003	0.000	3.321	5.555	6.681	8.000	9.000	12.000
72	J_BLHT3_006	0.092	3.321	5.555	6.681	8.000	9.000	12.000
73	BLHT3_006_Div_Crystal_F	0.359	3.321	5.555	6.681	8.000	9.000	12.000
74	J_BLHT3_010	0.570	3.321	5.555	6.681	8.000	9.000	12.000
75	J_BLHT3_030	0.714	3.321	5.555	6.689	8.000	9.000	12.000
76	_BLHT3_030_&_BLH_10	5.491	3.327	5.559	6.718	8.000	9.000	12.000
77	J_BLH_110B	5.829	3.327	5.558	6.718	8.000	9.000	12.000
78	J_BLHT3_020	0.551	3.310	5.562	6.693	8.000	9.000	12.000
79	J_BLH_110C	0.551	3.310	5.562	6.693	8.000	9.000	12.000
80	J_BLH_110_BLHT3_020	6.380	3.326	5.559	6.716	8.000	9.000	12.000
81	J_BLH_120	7.420	3.324	5.558	6.717	8.000	9.000	12.000
82	J_BLH_130	8.006	3.325	5.557	6.717	8.000	9.000	12.000
83	J_BLH_140	8.856	3.326	5.555	6.720	8.000	9.000	12.000
84	J_BLH_160	9.543	3.327	5.552	6.723	8.000	9.000	12.000
85	J_BLH_150	0.385	3.347	5.511	6.770	8.000	9.000	12.000
86	J_BLH_150_160	9.927	3.328	5.550	6.725	8.000	9.000	12.000
87	J_BLH_170	9.975	3.328	5.550	6.725	8.000	9.000	12.001
88	J_BRC_140_BLH_170	33.447	3.186	5.363	6.443	7.704	8.667	11.558
89	J_BRC_150	33.880	3.186	5.362	6.444	7.704	8.667	11.560
90	J_SPAO_010	0.181	3.354	5.552	6.743	8.000	9.000	12.000
91	J_SPAO_020	0.451	3.347	5.542	6.750	8.000	9.000	12.000
92	J_SPAO_030	0.527	3.347	5.541	6.752	8.000	9.000	12.000
93	J_SPAO_040	0.770	3.345	5.543	6.751	8.000	9.000	12.000
94	J_SPAO_050	1.021	3.347	5.544	6.751	8.000	9.000	12.000
95	J_SPAO_060	1.158	3.347	5.545	6.752	8.000	9.000	12.000
96	J_SPAO_070	1.274	3.348	5.545	6.755	8.000	9.000	12.000
97	J_SPAO_080B	1.382	3.349	5.543	6.756	8.000	9.000	12.000
98	J_SPAOT1_010	0.995	3.362	5.536	6.793	8.000	9.000	12.000

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
99	J_SPAO_080	2.376	3.354	5.540	6.772	8.000	9.000	12.000
100	J_SPAO_090	2.840	3.355	5.536	6.772	8.000	9.000	12.010
101	J_SPAO_100	0.155	3.369	5.519	6.804	8.000	9.028	12.064
102	J_SPAO_090_100	2.995	3.355	5.536	6.774	8.000	9.001	12.013
103	J_SPAO_110	3.394	3.356	5.533	6.777	8.000	9.001	12.019
104	J_CWC_010	0.478	3.351	5.547	6.746	8.000	9.000	12.000
105	J_CWC_030	0.786	3.351	5.540	6.752	8.000	9.000	12.000
106	J_CWC_020	1.160	3.353	5.537	6.759	8.000	9.000	12.021
107	J_CWC_020_&_SPAO_120	4.554	3.355	5.534	6.773	8.000	9.001	12.020
108	J_SPAO_120B	4.644	3.355	5.533	6.773	8.000	9.001	12.020
109	J_POC_010	0.159	3.340	5.529	6.746	8.000	9.000	12.000
110	J_POC_020	0.585	3.345	5.529	6.746	8.000	9.000	12.000
111	J_POC_030	0.789	3.349	5.525	6.753	8.000	9.000	12.000
112	J_SPAO_120	5.432	3.354	5.532	6.770	8.000	9.001	12.017
113	J_SPAO_130	5.733	3.355	5.531	6.770	8.000	9.003	12.022
114	J_BRC_150_&_SPAO_130	39.613	3.173	5.324	6.415	7.656	8.613	11.490
115	J_BRC_160	39.682	3.173	5.324	6.415	7.656	8.613	11.490
116	J_BRC_170	39.898	3.173	5.323	6.416	7.656	8.613	11.492
117	J_BRC_180	0.973	3.374	5.511	6.800	8.000	9.044	12.184
118	J_BRC_170_180	40.871	3.171	5.317	6.411	7.648	8.605	11.484
119	J_BRC_190	41.746	3.172	5.316	6.413	7.648	8.608	11.490
120	J_BRC_200	0.283	3.382	5.521	6.817	8.000	9.137	12.253
121	J_BRC_190_200	42.029	3.173	5.316	6.414	7.648	8.609	11.491
122	J_BRC_220	0.430	3.382	5.544	6.835	8.000	9.215	12.319
123	J_BRC_210	42.459	3.170	5.310	6.408	7.640	8.602	11.482
124	J_BRC_240B	42.845	3.171	5.310	6.409	7.640	8.603	11.486
125	J_BRC_230	0.122	3.393	5.594	6.835	8.000	9.215	12.461
126	J_BRC_230_210	42.966	3.171	5.310	6.410	7.640	8.604	11.487
127	J_BRC_240	42.981	3.171	5.310	6.410	7.640	8.604	11.487
128	J_BUT_010	0.929	3.357	5.541	6.789	8.000	9.000	12.000
129	J_BUT_020	1.355	3.363	5.535	6.793	8.000	9.000	12.000
130	J_BUT_030	0.544	3.387	5.512	6.804	8.000	9.000	12.000
131	J_BUT_020_030	1.898	3.370	5.529	6.796	8.000	9.000	12.000
132	J_BUT_040	2.025	3.370	5.528	6.798	8.000	9.000	12.000
133	J_BUT_050	2.063	3.370	5.528	6.798	8.000	9.000	12.002
134	J_BUT_060	0.787	3.387	5.512	6.831	8.000	9.075	12.040
135	J_BUT_070	1.282	3.387	5.512	6.830	8.000	9.075	12.040
136	J_BUT_080	1.364	3.387	5.512	6.830	8.000	9.070	12.043
137	J_BUT_050_080	3.427	3.377	5.522	6.811	8.000	9.028	12.018
138	J_BUT_090	4.126	3.378	5.520	6.816	8.000	9.038	12.030
139	J_BUT_100	1.023	3.400	5.501	6.854	8.000	9.168	12.160
140	J_BUT_110	0.213	3.400	5.514	6.854	8.000	9.168	12.280
141	J_BUT_100_110	1.236	3.400	5.503	6.854	8.000	9.168	12.181
142	J_BUT_120	1.635	3.399	5.506	6.850	8.000	9.149	12.176
143	J_BUT_090_120	5.761	3.384	5.516	6.826	8.000	9.070	12.071
144	J_BUT_130	6.251	3.385	5.515	6.827	8.000	9.071	12.082
145	J_CLK_010	0.045	3.338	5.569	6.747	8.000	9.000	12.000
146	J_CLK_020	0.410	3.338	5.554	6.757	8.000	9.000	12.000
147	J_CLK_030	0.824	3.342	5.553	6.758	8.000	9.000	12.000

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
148	J_CLK_040	1.150	3.349	5.550	6.758	8.000	9.000	12.000
149	J_CLK_050	1.605	3.350	5.546	6.761	8.000	9.000	12.000
150	J_CLK_060	2.303	3.357	5.539	6.767	8.000	9.000	12.005
151	J_CLK_070	0.973	3.365	5.524	6.797	8.000	9.000	12.000
152	J_CLK_060_070	3.276	3.359	5.535	6.776	8.000	9.000	12.003
153	J_CLK_080	3.603	3.360	5.532	6.779	8.000	9.001	12.005
154	J_CLKT1_010	0.198	3.373	5.508	6.793	8.000	9.012	12.016
155	_CLK_080_&_CLKT1_01	3.801	3.361	5.531	6.780	8.000	9.002	12.005
156	J_CLK_090	4.124	3.363	5.529	6.782	8.000	9.003	12.015
157	J_CLK_090_&_BUT_130	10.375	3.332	5.449	6.721	7.896	8.926	11.899
158	J_SBR_010	10.947	3.329	5.443	6.714	7.888	8.921	11.891
159	J_SBR_020	11.697	3.325	5.436	6.707	7.880	8.915	11.884
160	J_SBRT1_010	0.598	3.369	5.503	6.816	8.000	9.028	12.064
161	J_SBR_020_SBRT1_010	12.295	3.321	5.430	6.701	7.872	8.905	11.872
162	J_SBR_030	12.765	3.322	5.431	6.701	7.872	8.907	11.879
163	J_SBR_040	1.145	3.399	5.531	6.846	8.000	9.184	12.329
164	J_SBRT2_010_020	0.274	3.381	5.503	6.816	8.000	9.121	12.184
165	J_SBRT2_030	0.319	3.383	5.507	6.816	8.000	9.132	12.194
166	BR_030_040_&_SBRT2_	14.229	3.317	5.420	6.690	7.856	8.901	11.877
167	J_SBR_050	0.314	3.396	5.531	6.858	8.000	9.277	12.329
168	J_SBR_060B	0.625	3.396	5.531	6.850	8.000	9.238	12.293
169	J_SBR_060	14.855	3.318	5.421	6.692	7.856	8.908	11.886
170	J_SBR_070	15.853	3.315	5.419	6.688	7.848	8.907	11.891
171	J_SBR_080	16.529	3.312	5.415	6.681	7.840	8.900	11.887
172	J_SBRT3_140	0.151	3.393	5.544	6.839	8.000	9.215	12.319
173	J_SBR_080_SBRT3_010	16.679	3.312	5.415	6.681	7.840	8.901	11.888
174	J_SBR_090	17.362	3.310	5.412	6.676	7.832	8.900	11.886
175	J_SBR_100	17.658	3.310	5.412	6.677	7.832	8.902	11.889
176	J_SBRT4_010	0.564	3.400	5.645	6.865	8.000	9.386	12.527
177	J_SBR_100_&_SBRT4_01	18.222	3.307	5.410	6.671	7.824	8.902	11.888
178	J_SBR_110	18.440	3.307	5.411	6.672	7.824	8.904	11.892
179	J_BRC_240_&_SBR_110	61.421	3.158	5.252	6.381	7.568	8.550	11.416
180	J_BRC_250	62.081	3.156	5.247	6.375	7.560	8.543	11.408
181	J_BRC_260	63.058	3.157	5.248	6.377	7.560	8.547	11.416
182	J_HONT1_010	0.294	3.349	5.507	6.799	8.000	9.027	12.135
183	J_HON_010	0.236	3.349	5.507	6.784	8.000	9.027	12.135
184	_HON_010_&_HONT1_01	0.530	3.349	5.507	6.792	8.000	9.027	12.135
185	J_HON_020	1.373	3.349	5.507	6.796	8.000	9.027	12.166
186	J_HONT2_010	0.438	3.360	5.551	6.799	8.000	9.158	12.328
187	_HON_020_&_HONT2_01	1.811	3.352	5.518	6.797	8.000	9.059	12.206
188	J_HON_030	2.359	3.354	5.514	6.800	8.000	9.060	12.234
189	J_HON_040	2.772	3.357	5.522	6.802	8.000	9.075	12.258
190	J_DRYFT1_010	1.079	3.352	5.500	6.792	8.000	9.064	12.186
191	J_DRYFT1_020	1.203	3.354	5.503	6.795	8.000	9.064	12.208
192	_DRYFT1_020_&_HON_04	3.974	3.356	5.516	6.800	8.000	9.071	12.243
193	J_DRYF_010	4.684	3.361	5.525	6.804	8.000	9.094	12.276
194	J_DRYF_020	5.203	3.364	5.530	6.809	8.000	9.107	12.309
195	J_BRC_260_&_DRYF_020	68.261	3.152	5.235	6.368	7.544	8.534	11.408
196	J_BRC_270	69.123	3.152	5.236	6.369	7.544	8.538	11.416

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
197	J_BRC_280	70.143	3.153	5.238	6.371	7.544	8.544	11.424
198	J_BRC_290	70.924	3.150	5.234	6.366	7.537	8.540	11.420
199	J_ONI_010	0.190	3.367	5.551	6.824	8.000	9.158	12.328
200	J_ONI_015	0.486	3.367	5.551	6.824	8.000	9.158	12.328
201	J_ONI_020	1.072	3.367	5.551	6.832	8.000	9.158	12.406
202	J_ONI_030	1.275	3.370	5.555	6.835	8.000	9.158	12.427
203	J_ONI_040	0.339	3.378	5.572	6.832	8.000	9.224	12.537
204	J_ONI_030_040	1.613	3.372	5.558	6.834	8.000	9.172	12.450
205	J_ONI_050	1.816	3.375	5.565	6.837	8.000	9.178	12.460
206	J_ONI_060	2.182	3.379	5.575	6.843	8.000	9.200	12.508
207	J_ONI_080	0.521	3.375	5.602	6.855	8.000	9.253	12.613
208	J_ONIT1_010	1.172	3.381	5.614	6.860	8.000	9.253	12.650
209	J_ONIT1_010_&_ONI_060	3.354	3.380	5.589	6.849	8.000	9.219	12.557
210	J_ONI_070	3.476	3.380	5.592	6.849	8.000	9.222	12.562
211	J_ONIT1_020	0.126	3.394	5.674	6.879	8.000	9.310	12.679
212	J_ONIT1_020_&_ONI_070	3.602	3.381	5.594	6.851	8.000	9.225	12.566
213	J_ONI_090	4.420	3.383	5.609	6.856	8.000	9.248	12.587
214	J_ONI_100	5.428	3.386	5.621	6.865	8.001	9.275	12.616
215	J_ONI_110	5.867	3.387	5.625	6.868	8.004	9.290	12.636
216	J_ONI_120	0.147	3.400	5.725	6.920	8.049	9.481	12.887
217	J_ONI_110_120	6.014	3.388	5.627	6.869	8.005	9.295	12.643
218	J_ONI_130	6.565	3.389	5.637	6.874	8.008	9.318	12.673
219	J_BRC_290_&_ONI_140	77.489	3.147	5.229	6.362	7.522	8.542	11.440
220	J_BRC_310	77.649	3.147	5.230	6.362	7.522	8.543	11.441
221	J_BRC_320	0.426	3.400	5.796	6.961	8.038	9.652	13.000
222	J_BRC_300	0.220	3.400	5.745	6.945	8.038	9.652	13.000
223	J_BRC_300_310_320	78.295	3.148	5.231	6.364	7.522	8.547	11.448
224	J_BRC_330	78.493	3.148	5.232	6.364	7.522	8.549	11.450
225	J_LAK_010	0.265	3.400	5.501	6.870	8.000	9.246	12.232
226	J_LAK_020	0.480	3.400	5.525	6.870	8.000	9.246	12.232
227	J_LAK_030	0.870	3.400	5.538	6.870	8.000	9.246	12.286
228	J_LAK_040	1.526	3.400	5.545	6.875	8.000	9.286	12.315
229	J_LAK_060	1.786	3.400	5.546	6.876	8.000	9.294	12.320
230	J_LAK_060_050	2.189	3.400	5.548	6.874	8.000	9.288	12.313
231	J_LAK_070	2.404	3.400	5.553	6.875	8.000	9.285	12.321
232	J_LAK_080	2.595	3.400	5.558	6.876	8.000	9.291	12.327
233	J_LAKT1_010	0.919	3.400	5.571	6.862	8.000	9.261	12.401
234	J_LAK_090	0.952	3.400	5.571	6.862	8.000	9.265	12.401
235	J_LAK_080_090	3.547	3.400	5.561	6.872	8.000	9.284	12.347
236	J_LAK_100	3.720	3.400	5.564	6.873	8.000	9.287	12.349
237	J_LAKT2_010	0.449	3.400	5.611	6.893	8.000	9.339	12.473
238	J_LAKT2_020	1.106	3.400	5.611	6.893	8.000	9.395	12.473
239	_LAKT2_020_&_LAK_10	4.826	3.400	5.574	6.877	8.000	9.312	12.377
240	J_LAK_110	5.355	3.400	5.584	6.880	8.000	9.324	12.399
241	J_LAKT3_010	0.823	3.400	5.651	6.920	8.000	9.433	12.545
242	J_LAKT3_020	1.602	3.400	5.659	6.918	8.000	9.478	12.568
243	J_LAK_110_LAKT3_020	6.957	3.400	5.601	6.889	8.000	9.359	12.438
244	J_LAK_130	7.372	3.400	5.605	6.890	8.000	9.364	12.442
245	J_LAK_140	8.214	3.400	5.617	6.892	8.000	9.373	12.465

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
246	J_LAK_120	0.174	3.400	5.628	6.900	8.000	9.448	12.521
247	J_LAK_140B	0.174	3.400	5.628	6.900	8.000	9.448	12.521
248	J_LAK_140_120	8.389	3.400	5.617	6.893	8.000	9.374	12.466
249	J_LAK_150	9.081	3.400	5.623	6.895	8.000	9.387	12.481
250	J_DAVT1_010	0.464	3.400	5.571	6.873	8.000	9.277	12.361
251	J_DAV_020	0.577	3.400	5.582	6.876	8.000	9.277	12.379
252	J_DAV_030	1.091	3.400	5.604	6.880	8.000	9.321	12.413
253	J_DAV_040_050	1.870	3.400	5.608	6.884	8.000	9.342	12.455
254	J_DAV_060	2.136	3.400	5.618	6.885	8.000	9.345	12.472
255	J_DAV_070	2.566	3.400	5.629	6.887	8.000	9.362	12.504
256	J_DAV_080	3.250	3.400	5.632	6.892	8.000	9.384	12.523
257	J_DAV_080_&_LAK_150	12.331	3.346	5.535	6.784	7.872	9.236	12.292
258	J_LAK_160	13.003	3.346	5.538	6.785	7.873	9.244	12.308
259	J_LAKT4_010	0.430	3.400	5.645	6.904	8.014	9.464	12.736
260	_LAK_160_&_LAKT4_01	13.432	3.342	5.533	6.778	7.865	9.237	12.302
261	J_LAK_170	13.950	3.342	5.536	6.779	7.868	9.243	12.316
262	J_RAT_010	0.269	3.400	5.651	6.950	8.000	9.483	12.665
263	J_RAT_020	0.637	3.400	5.684	6.948	8.000	9.535	12.665
264	J_RAT_030	0.771	3.400	5.688	6.948	8.000	9.533	12.665
265	J_RAT_040	1.110	3.400	5.694	6.951	8.000	9.546	12.665
266	J_RAT_050	1.643	3.400	5.685	6.948	8.008	9.539	12.685
267	J_RAT_060	1.893	3.400	5.691	6.945	8.007	9.550	12.691
268	J_RAT_070	2.890	3.400	5.703	6.943	8.022	9.574	12.752
269	J_RAT_080	3.546	3.400	5.717	6.946	8.028	9.582	12.773
270	J_RAT_090	0.340	3.400	5.725	6.935	8.051	9.542	12.802
271	J_RAT_080_090	3.885	3.400	5.718	6.945	8.030	9.579	12.776
272	J_RAT_100B	4.620	3.400	5.719	6.945	8.033	9.581	12.783
273	J_Quarry_SH_45_Div2	0.000	3.400	5.827	6.966	8.133	9.681	12.984
274	_RAT_100B_&_SH_45_Div	4.620	3.400	5.756	6.950	8.072	9.616	12.860
275	J_RAT_110	4.694	3.400	5.719	6.945	8.034	9.581	12.785
276	J_RATT2_010	0.359	3.400	5.839	6.969	8.179	9.728	13.000
277	J_RATT2_020	0.593	3.400	5.823	6.963	8.179	9.728	13.000
278	J_RATT2_030	0.104	3.400	5.839	6.969	8.115	9.728	12.944
279	J_RATT2_020_030	0.697	3.400	5.826	6.964	8.170	9.728	12.992
280	J_RATT2_040	1.042	3.400	5.830	6.966	8.152	9.728	12.976
281	J_RATT1_010	1.960	3.400	5.834	6.969	8.135	9.685	12.987
282	J_Quarry_SH_45_Bypass	2.129	3.400	5.827	6.966	8.133	9.681	12.984
283	J_RATT1_020	2.273	3.400	5.832	6.967	8.131	9.676	12.980
284	_RAT_110_&_RATT1_02	6.967	3.400	5.757	6.952	8.067	9.613	12.851
285	J_RAT_120	7.015	3.400	5.757	6.952	8.067	9.612	12.851
286	J_RATT2_050	0.106	3.400	5.798	6.942	8.078	9.728	12.944
287	J_Quarry_SH_45_Div1	0.000	3.400	5.827	6.966	8.133	9.681	12.984
288	RATT2_050_&_SH_45_Di	0.106	3.400	5.826	6.965	8.130	9.683	12.982
289	J_RATT2_060	0.233	3.400	5.824	6.964	8.128	9.681	12.976
290	_RAT_120_&_RATT2_06	7.247	3.400	5.758	6.952	8.067	9.615	12.853
291	J_RAT_130	7.295	3.400	5.758	6.952	8.067	9.615	12.853
292	J_LAK_170_&_RAT_130	21.245	3.315	5.530	6.741	7.824	9.233	12.317
293	J_LAK_180	21.802	3.312	5.526	6.735	7.817	9.229	12.310
294	J_LAKT5_010	0.887	3.400	5.645	6.888	8.000	9.386	12.670

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
295	J_LAKT5_020	1.775	3.400	5.671	6.894	8.020	9.433	12.741
296	J_LAK_190	0.760	3.400	5.696	6.890	8.041	9.479	12.812
297	_LAK_190_&_LAKT5_02	2.536	3.400	5.678	6.893	8.026	9.447	12.762
298	J_Quarry_FM620_Bypass	2.536	3.400	5.678	6.893	8.026	9.447	12.762
299	J_LAKT5_030	0.103	3.400	5.746	6.900	8.041	9.479	12.812
300	_LAKT5_030_&_LAK_18	24.441	3.305	5.515	6.720	7.801	9.207	12.293
301	J_LAK_200	24.985	3.305	5.517	6.720	7.801	9.209	12.297
302	J_Quarry_FM620_Div1	0.000	3.400	5.678	6.893	8.026	9.447	12.762
303	J_LAK_210	0.127	3.400	5.703	6.895	8.041	9.492	12.812
304	J_LAK_210_&_LAK_200	25.112	3.301	5.512	6.712	7.793	9.200	12.290
305	J_LAK_220	25.834	3.298	5.508	6.706	7.787	9.195	12.286
306	J_LAKT6_010	0.126	3.400	5.798	6.954	8.139	9.650	13.000
307	J_LAKT6_020	0.518	3.400	5.758	6.954	8.139	9.650	13.000
308	J_LAKT6_030	0.165	3.400	5.848	6.954	8.139	9.738	13.000
309	J_LAKT6_040	0.328	3.400	5.822	6.959	8.139	9.738	13.000
310	J_LAKT6_020_040	0.846	3.400	5.783	6.956	8.139	9.684	13.000
311	J_LAKT6_050	1.470	3.400	5.788	6.955	8.120	9.671	13.000
312	_LAK_220_&_LAKT6_05	27.304	3.295	5.508	6.701	7.784	9.196	12.291
313	J_LAK_230	27.801	3.291	5.505	6.695	7.777	9.189	12.284
314	J_LAK_240	28.193	3.291	5.506	6.696	7.778	9.193	12.288
315	J_LAK_240_&_BRC_330	106.686	3.130	5.211	6.339	7.458	8.564	11.464
316	J_BRC_340	107.098	3.130	5.212	6.339	7.458	8.566	11.467
317	J_DRYT1_010	0.730	3.400	5.848	6.979	8.121	9.823	13.000
318	J_DRYT1_020	0.487	3.400	5.845	6.995	8.121	9.823	13.000
319	J_DRYT1_010_020	1.217	3.400	5.847	6.985	8.121	9.823	13.000
320	J_DRYT1_030	2.022	3.400	5.846	6.982	8.103	9.789	13.000
321	J_DRY_010	0.916	3.400	5.897	6.995	8.104	9.909	13.000
322	J_DRY_020	1.612	3.400	5.875	6.991	8.089	9.872	13.000
323	_DRYT1_030_&_DRY_02	3.634	3.400	5.859	6.986	8.097	9.826	13.000
324	J_DRY_030	4.098	3.400	5.857	6.986	8.094	9.825	13.000
325	J_DYB_010	0.763	3.400	5.894	7.047	8.100	9.994	13.000
326	J_DYB_020	1.486	3.400	5.894	7.036	8.085	9.911	13.000
327	YB_020_BRC_340_DRY_	112.683	3.129	5.219	6.341	7.454	8.587	11.486
328	J_BRC_350	113.220	3.129	5.220	6.342	7.454	8.589	11.489
329	J_BRC_360	0.204	3.400	5.894	7.087	8.079	9.909	13.000
330	J_BRC_360_370	0.527	3.400	5.924	7.074	8.079	9.909	13.000
331	J_BRC_380	1.147	3.400	5.908	7.058	8.079	9.909	13.000
332	J_BRC_350_380	114.367	3.129	5.222	6.344	7.455	8.595	11.495
333	J_BRC_390	115.205	3.126	5.218	6.339	7.447	8.590	11.487
334	J_BRC_400	115.764	3.126	5.220	6.340	7.447	8.593	11.490
335	J_CHB_010	0.886	3.346	5.515	6.757	8.000	9.000	12.086
336	J_CHB_020	1.469	3.346	5.515	6.767	8.000	9.000	12.142
337	J_CHB_030	2.295	3.346	5.520	6.775	8.000	9.031	12.191
338	J_CHB_040	3.041	3.348	5.518	6.779	8.000	9.044	12.200
339	J_CHB_050	3.575	3.349	5.517	6.784	8.000	9.050	12.225
340	J_CHB_060	4.181	3.352	5.523	6.790	8.000	9.055	12.246
341	J_CHB_070A	4.681	3.353	5.530	6.795	8.000	9.072	12.280
342	J_CHB_070C	0.256	3.366	5.582	6.838	8.000	9.216	12.561
343	J_CHB_070D	5.052	3.354	5.534	6.798	8.000	9.083	12.301

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
344	J_CHBT1_010B	1.122	3.359	5.531	6.830	8.000	9.122	12.419
345	J_CHBT1_010_QRY	1.122	3.359	5.531	6.830	8.000	9.122	12.419
346	J_CHBT1_020	1.810	3.362	5.549	6.836	8.000	9.122	12.419
347	J_CHBT1_030A	0.273	3.400	5.704	6.928	8.023	9.442	12.963
348	J_CHBT1_030B	0.443	3.400	5.704	6.928	8.023	9.442	12.963
349	J_CHBT1_030C	0.302	3.400	5.704	6.928	8.023	9.442	12.963
350	J_NRCS_DAM_10B_DS	2.555	3.362	5.549	6.836	8.000	9.122	12.419
351	J_CHBT1_040	2.756	3.371	5.598	6.846	8.000	9.245	12.601
352	_CHB_070_&_CHBT1_04(	7.808	3.358	5.545	6.813	8.000	9.111	12.364
353	J_CHB_080	7.870	3.358	5.544	6.812	8.000	9.108	12.356
354	J_CHB_090	0.544	3.385	5.633	6.870	8.000	9.311	12.561
355	J_CHB_080_090	8.414	3.360	5.550	6.816	8.000	9.121	12.370
356	J_CHB_100	9.414	3.363	5.559	6.823	8.000	9.142	12.391
357	J_CHB_110	10.129	3.321	5.494	6.738	7.896	9.038	12.246
358	J_CHB_120	10.606	3.319	5.492	6.734	7.888	9.038	12.249
359	J_CHBT2_010	0.621	3.395	5.684	6.886	8.019	9.405	12.845
360	J_CHBT2_020	0.360	3.395	5.684	6.870	8.000	9.405	12.703
361	J_CHBT2_010_020	0.981	3.395	5.684	6.880	8.012	9.405	12.793
362	J_CHBT2_030	1.392	3.396	5.684	6.880	8.009	9.405	12.767
363	J_CHBT2_040	1.939	3.397	5.675	6.879	8.008	9.416	12.763
364	J_CHB_110_CHBT2_040	12.545	3.317	5.497	6.728	7.873	9.059	12.278
365	J_CHB_130	13.314	3.315	5.497	6.725	7.866	9.063	12.286
366	J_CHB_140	13.916	3.317	5.503	6.728	7.867	9.075	12.300
367	J_CHB_150	14.452	3.314	5.502	6.724	7.860	9.078	12.305
368	J_CHBT3_010	0.177	3.398	5.684	6.894	8.023	9.405	12.845
369	J_CHBT3_020	0.638	3.399	5.699	6.894	8.023	9.432	12.883
370	J_CHBT3_030	1.188	3.400	5.701	6.910	8.023	9.437	12.920
371	J_CHBT3_060	0.413	3.400	5.755	6.927	8.023	9.537	12.897
372	J_CHBT3_040	0.233	3.400	5.704	6.911	8.023	9.537	12.897
373	J_CHBT3_050	0.095	3.400	5.704	6.919	8.023	9.537	12.897
374	J_CHBT3_060_50_40	0.740	3.400	5.733	6.921	8.023	9.537	12.897
375	J_CHBT3_070	0.268	3.400	5.755	6.935	8.023	9.537	12.897
376	J_CHBT3_030_070	2.197	3.400	5.718	6.917	8.023	9.483	12.909
377	J_CHBT3_080	2.457	3.400	5.725	6.919	8.024	9.488	12.915
378	J_CHBT3_090	2.652	3.400	5.728	6.921	8.024	9.495	12.919
379	_CHBT3_090_&_CHB_15(	17.104	3.308	5.505	6.715	7.839	9.089	12.328
380	J_CHB_160	17.206	3.304	5.486	6.705	7.836	9.053	12.271
381	J_CHBT4_010	1.087	3.400	5.755	6.935	8.023	9.632	13.000
382	_CHB_160_&_CHBT4_01(	18.294	3.306	5.508	6.713	7.832	9.102	12.342
383	J_CHB_170	18.947	3.303	5.507	6.710	7.825	9.105	12.342
384	J_CHB_180	19.429	3.304	5.510	6.712	7.826	9.114	12.351
385	J_CHB_190	0.753	3.322	5.643	6.800	7.863	9.410	12.701
386	J_CHB_180_190	20.183	3.301	5.510	6.708	7.819	9.116	12.352
387	J_CHB_200	20.916	3.302	5.516	6.712	7.820	9.131	12.364
388	J_CHBT5_010	0.678	3.400	5.806	6.967	8.063	9.726	13.000
389	J_CHBT5_020	1.168	3.400	5.815	6.971	8.065	9.726	13.000
390	J_CHBT5_030	1.235	3.400	5.815	6.972	8.065	9.728	13.000
391	J_CHB_200_CHBT5_030	22.152	3.296	5.514	6.704	7.807	9.133	12.357
392	J_CHB_210	22.929	3.296	5.519	6.707	7.809	9.146	12.367

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
393	J_BRC_410	0.193	3.400	5.878	6.992	8.087	9.763	13.000
394	J_CHB_210_BRC_400_410	138.885	3.116	5.205	6.322	7.415	8.577	11.491
395	J_BRC_430	138.972	3.116	5.205	6.322	7.416	8.578	11.491
396	J_BRC_420	0.159	3.400	5.878	7.001	8.087	9.763	13.000
397	J_BRC_430_420	139.131	3.116	5.205	6.323	7.416	8.578	11.492
398	J_BRC_440	139.950	3.116	5.207	6.324	7.416	8.582	11.495
399	J_MCNF_010	0.629	3.400	5.693	6.901	8.014	9.463	12.943
400	J_MCNF_020	1.329	3.400	5.693	6.909	8.024	9.429	12.918
401	J_MCNF_030	0.778	3.400	5.735	6.909	8.034	9.530	12.943
402	J_MCNF_040	0.294	3.400	5.704	6.933	8.034	9.530	13.000
403	J_MCNF_030_040	2.401	3.400	5.708	6.912	8.029	9.474	12.936
404	J_MCNF_050	3.042	3.400	5.720	6.917	8.031	9.486	12.950
405	J_MCNF_060	3.449	3.400	5.725	6.922	8.032	9.505	12.956
406	J_MCN_010	0.995	3.400	5.735	6.918	8.019	9.500	12.845
407	J_MCN_020	1.575	3.400	5.735	6.921	8.026	9.535	12.899
408	J_MCN_030	2.221	3.400	5.735	6.927	8.031	9.552	12.928
409	_MCNF_060_&_MCN_03	5.670	3.400	5.729	6.924	8.031	9.524	12.945
410	J_MCN_040	5.991	3.400	5.733	6.927	8.033	9.534	12.948
411	J_MCNT1_010	0.738	3.400	5.704	6.958	8.054	9.516	13.000
412	J_MCNT1_020	0.943	3.400	5.765	6.966	8.058	9.647	13.000
413	J_MCNT1_030_040	0.615	3.400	5.777	6.960	8.072	9.516	13.000
414	J_MCNT1_050	0.016	3.400	5.765	6.975	8.058	9.647	13.000
415	MCNT1_020_&_MCNT1_0	1.574	3.400	5.741	6.960	8.062	9.535	13.000
416	J_MCNT1_060	1.924	3.400	5.746	6.963	8.062	9.555	13.000
417	_MCN_040_&_MCNT1_06	7.916	3.400	5.736	6.935	8.040	9.539	12.961
418	J_MCN_050	8.291	3.400	5.741	6.938	8.041	9.548	12.962
419	J_MCNT2_010_020	0.750	3.400	5.777	6.982	8.078	9.581	13.000
420	J_MCNT2_030	1.125	3.400	5.777	6.980	8.080	9.603	13.000
421	J_MCNT2_040	0.163	3.400	5.777	6.975	8.063	9.647	13.000
422	J_MCNT2_030_040	1.288	3.400	5.777	6.979	8.078	9.608	13.000
423	J_MCNT2_050	1.379	3.400	5.781	6.979	8.078	9.616	13.000
424	_MCN_050_&_MCNT2_05	9.669	3.400	5.747	6.943	8.046	9.558	12.968
425	J_MCN_060	10.030	3.356	5.675	6.855	7.943	9.439	12.800
426	J_MCN_070	10.557	3.352	5.674	6.852	7.937	9.438	12.789
427	J_MCN_080	11.059	3.352	5.679	6.855	7.938	9.451	12.790
428	J_MCNT3_010	0.772	3.400	5.838	7.017	8.083	9.764	13.000
429	J_MCNT3_020	1.073	3.400	5.838	7.029	8.083	9.764	13.000
430	J_MCNT3_030	1.314	3.400	5.845	7.035	8.084	9.782	13.000
431	_MCN_080_&_MCNT3_03	12.373	3.346	5.677	6.850	7.926	9.452	12.767
432	J_MCN_090	12.563	3.346	5.678	6.851	7.926	9.456	12.768
433	J_BRC_440_&_MCN_090	152.512	3.108	5.201	6.313	7.395	8.579	11.500
434	J_BRC_460	152.609	3.108	5.201	6.313	7.395	8.580	11.500
435	J_BRCT5_010	0.872	3.400	5.944	7.106	8.097	9.909	13.000
436	J_BRCT5_020	1.376	3.400	5.927	7.113	8.097	9.909	13.000
437	J_BRCT5_030	0.296	3.400	5.898	7.084	8.097	9.909	13.000
438	J_BRCT5_030_020	1.673	3.400	5.922	7.108	8.097	9.909	13.000
439	J_BRCT5_040	1.886	3.400	5.919	7.107	8.096	9.909	13.000
440	J_BRCT5_050	2.004	3.400	5.917	7.107	8.096	9.906	13.000
441	J_BRC_450	0.461	3.400	5.910	7.060	8.083	9.764	13.000

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
442	J_BRC_460_&_BRCT5_050	155.074	3.109	5.205	6.317	7.396	8.588	11.508
443	J_BRC_470	155.128	3.109	5.205	6.317	7.396	8.588	11.508
444	J_BRC_480	0.874	3.400	5.949	7.125	8.097	9.909	13.000
445	J_BRC_470_480	156.002	3.109	5.206	6.318	7.396	8.591	11.511
446	J_BRC_490	156.169	3.109	5.207	6.319	7.396	8.592	11.511
447	J_BRC_500	0.868	3.404	5.949	7.125	8.116	10.000	13.000
448	J_BRC_490_500	157.037	3.109	5.208	6.320	7.397	8.596	11.514
449	J_BRC_510	157.114	3.109	5.208	6.320	7.397	8.596	11.514
450	J_D18_010	0.631	3.400	5.777	6.998	8.078	9.633	13.000
451	J_BRCT7_010	0.104	3.400	5.789	6.998	8.098	9.620	13.000
452	J_D18_020	0.431	3.400	5.789	6.998	8.098	9.620	13.000
453	J_D18_010_020	1.062	3.400	5.782	6.998	8.086	9.628	13.000
454	J_D18_030	1.274	3.400	5.783	7.001	8.089	9.648	13.000
455	J_D18_040	2.291	3.400	5.812	7.036	8.095	9.694	13.000
456	J_D18_050	2.674	3.400	5.826	7.039	8.097	9.721	13.000
457	J_D18_060	3.033	3.400	5.836	7.044	8.099	9.740	13.000
458	J_D18_070	3.275	3.400	5.842	7.050	8.099	9.750	13.000
459	J_D18_070_BRC_510	160.389	3.109	5.212	6.324	7.398	8.604	11.524
460	J_BRC_520	160.667	3.109	5.212	6.324	7.399	8.605	11.525
461	J_BRCT7_020	0.440	3.400	5.789	7.058	8.103	9.620	13.000
462	J_BRCT7_030	0.671	3.400	5.814	7.072	8.103	9.665	13.000
463	J_BRCT7_040	1.437	3.400	5.839	7.109	8.103	9.711	13.000
464	J_BRCT7_060	0.678	3.400	5.869	7.178	8.123	9.737	13.000
465	J_BRCT7_040_060	2.115	3.400	5.849	7.131	8.109	9.719	13.000
466	J_BRCT7_050	2.517	3.401	5.860	7.136	8.112	9.743	13.000
467	J_BRCT9_010	0.117	3.401	5.861	7.160	8.123	9.737	13.000
468	J_BRC_530	0.206	3.401	5.888	7.170	8.124	9.737	13.000
469	J_BRC_540	0.179	3.404	5.922	7.182	8.127	9.868	13.000
470	J_BRC_550	0.342	3.404	5.922	7.192	8.129	9.868	13.000
471	_BRC_520_550_BRCT7_05	163.526	3.107	5.210	6.322	7.392	8.602	11.520
472	J_BRC_560	163.617	3.107	5.210	6.322	7.392	8.603	11.521
473	J_BRCT8_010	0.478	3.408	5.993	7.165	8.116	10.000	13.000
474	J_BRCT8_020	0.906	3.406	5.996	7.185	8.126	10.000	13.000
475	J_BRCT8_030	1.216	3.405	5.993	7.190	8.127	10.000	13.000
476	J_BRCT8_040	1.451	3.406	5.991	7.199	8.129	10.000	13.000
477	J_BRC_550_&_BRCT8_040	165.068	3.107	5.213	6.325	7.393	8.608	11.525
478	J_BRC_570	165.306	3.107	5.214	6.325	7.393	8.609	11.525
479	J_BRCT9_020	0.402	3.401	5.873	7.182	8.123	9.737	13.000
480	J_BRCT9_030	0.813	3.405	5.904	7.182	8.125	9.796	13.000
481	J_BRCT9_040	0.121	3.408	5.934	7.182	8.127	9.868	13.000
482	J_BRCT9_030_040	0.934	3.405	5.908	7.182	8.125	9.805	13.000
483	J_BRCT9_050	1.186	3.406	5.913	7.186	8.127	9.816	13.000
484	J_BRCT9_060	0.139	3.408	5.934	7.203	8.132	9.868	13.000
485	J_BRCT9_050_060	1.325	3.406	5.915	7.188	8.127	9.821	13.000
486	J_BRCT9_070	1.350	3.406	5.917	7.189	8.127	9.825	13.000
487	J_BRC_570__BRCT9_070	166.656	3.107	5.216	6.328	7.394	8.613	11.529
488	J_BRC_580	167.184	3.107	5.216	6.329	7.394	8.614	11.530
489	J_BRC_600	0.907	3.411	6.000	7.268	8.136	10.000	13.000
490	J_BRC_610	0.970	3.412	6.000	7.267	8.136	10.000	13.000

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
491	J_BRC_590	0.345	3.412	5.995	7.246	8.136	9.999	13.000
492	J_BRC_580_610_590	168.499	3.108	5.219	6.332	7.395	8.619	11.534
493	J_BRC_630	168.666	3.108	5.220	6.333	7.395	8.621	11.535
494	J_BRC_620	0.477	3.142	5.521	6.711	7.494	9.196	11.973
495	J_BRC_640	0.344	3.415	6.000	7.290	8.136	10.000	13.000
496	J_BRC_630_620	169.488	3.108	5.221	6.334	7.395	8.623	11.536
497	J_BRC_650	169.903	3.108	5.221	6.335	7.396	8.624	11.537
498	J_D22_010	0.715	3.419	6.000	7.352	8.141	10.000	13.000
499	J_D22_020	1.079	3.419	6.000	7.344	8.146	10.000	13.000
500	J_BRC_650_D22_020	170.982	3.108	5.223	6.338	7.396	8.628	11.540
501	J_BRC_670	171.562	3.108	5.224	6.339	7.397	8.630	11.542
502	J_COT_010	0.137	3.400	5.716	6.981	8.074	9.502	13.000
503	J_COT_030	0.534	3.400	5.736	6.981	8.074	9.502	13.000
504	J_COT_020	0.220	3.400	5.777	6.990	8.074	9.502	13.000
505	J_COT_040	0.169	3.400	5.789	6.990	8.098	9.501	13.000
506	J_COT_030_040	0.923	3.400	5.755	6.985	8.078	9.502	13.000
507	J_COT_050	1.745	3.400	5.771	6.999	8.085	9.502	13.000
508	J_COT_060	2.374	3.400	5.779	7.019	8.094	9.529	13.000
509	J_COT_070	3.191	3.400	5.784	7.050	8.101	9.549	13.000
510	J_COT_080	3.551	3.400	5.792	7.059	8.103	9.568	13.000
511	J_COT_100	3.638	3.400	5.794	7.061	8.104	9.572	13.000
512	J_COT_090	0.291	3.400	5.823	7.139	8.123	9.639	13.000
513	J_COT_100_090	3.928	3.400	5.796	7.067	8.105	9.577	13.000
514	J_COT_110	4.091	3.400	5.799	7.071	8.106	9.582	13.000
515	J_COT_130	4.501	3.400	5.806	7.083	8.107	9.595	13.000
516	J_COT_120	0.215	3.401	5.873	7.179	8.142	9.723	13.000
517	J_COT_130_120	4.715	3.400	5.809	7.087	8.109	9.601	13.000
518	J_COT_150	5.312	3.401	5.823	7.102	8.113	9.615	13.000
519	J_COT_140	0.276	3.405	5.873	7.225	8.142	9.713	13.000
520	J_COT_160_150	5.588	3.401	5.826	7.108	8.114	9.620	13.000
521	J_COT_160	6.235	3.402	5.837	7.123	8.118	9.644	13.000
522	J_COT_180	0.270	3.409	5.885	7.244	8.162	9.713	13.000
523	J_COT_190	0.983	3.411	5.929	7.244	8.166	9.805	13.000
524	J_COT_170	0.444	3.408	5.934	7.245	8.147	9.840	13.000
525	J_COT_190_170	7.661	3.404	5.854	7.145	8.125	9.676	13.000
526	J_COT_200	7.741	3.404	5.855	7.147	8.126	9.679	13.000
527	J_COT_210	8.455	3.405	5.867	7.158	8.128	9.705	13.000
528	J_COT_220	0.366	3.412	6.000	7.284	8.152	9.971	13.000
529	J_COT_210_220	8.821	3.405	5.872	7.164	8.129	9.716	13.000
530	J_COT_230	8.972	3.405	5.874	7.166	8.129	9.720	13.000
531	J_COT_240	9.126	3.405	5.877	7.168	8.130	9.725	13.000
532	J_COT_250	0.391	3.419	6.000	7.304	8.171	9.971	13.000
533	J_COT_240_250	9.517	3.406	5.882	7.174	8.132	9.735	13.000
534	J_COT_260	9.767	3.406	5.885	7.178	8.133	9.742	13.000
535	J_COT_270	0.172	3.423	6.000	7.304	8.176	10.000	13.000
536	J_COT_260_270	9.939	3.407	5.887	7.180	8.133	9.746	13.000
537	J_COT_280	9.988	3.407	5.887	7.181	8.134	9.748	13.000
538	J_COT_300	10.070	3.363	5.812	7.089	8.028	9.623	12.831
539	J_COT_290	0.127	3.423	6.000	7.324	8.176	10.000	13.000

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
540	J_COT_300_&_BRC_670	181.758	3.107	5.230	6.348	7.394	8.640	11.553
541	J_BRCT10_010	0.370	3.426	6.000	7.365	8.161	10.000	13.000
542	J_BRCT10_020	0.692	3.425	6.000	7.365	8.161	10.000	13.000
543	J_BRCT10_030	0.291	3.430	6.000	7.364	8.181	10.000	13.000
544	J_BRCT10_040	0.543	3.428	6.000	7.364	8.171	10.000	13.000
545	J_BRCT10_020_040	1.235	3.426	6.000	7.365	8.165	10.000	13.000
546	J_BRCT10_050	2.208	3.426	6.000	7.356	8.172	10.000	13.000
547	J_BRC_690	0.043	3.427	6.000	7.344	8.196	10.000	13.000
548	J_BRCT10_050_690	184.009	3.104	5.228	6.346	7.388	8.638	11.546
549	J_BRC_700	184.205	3.104	5.228	6.347	7.388	8.638	11.546
550	J_BRCT11_010	0.343	3.416	5.946	7.284	8.171	9.840	13.000
551	J_BRCT11_020	0.943	3.418	5.980	7.284	8.171	9.924	13.000
552	J_BRCT11_030	0.347	3.419	6.000	7.284	8.171	9.958	13.000
553	J_BRCT11_010_020	1.290	3.418	5.986	7.284	8.171	9.933	13.000
554	J_BRCT11_040	1.597	3.419	5.988	7.288	8.172	9.946	13.000
555	J_BRCT11_050	2.103	3.420	5.991	7.292	8.177	9.949	13.000
556	J_BRCT11_060	2.484	3.421	5.992	7.296	8.180	9.957	13.000
557	J_BRC_680	0.092	3.427	6.000	7.324	8.196	10.000	13.000
558	J_BRCT11_070	0.185	3.427	6.000	7.333	8.196	10.000	13.000
559	_BRC_700_&_BRCT11_07	186.874	3.104	5.232	6.352	7.390	8.646	11.552
560	J_BRC_720	186.960	3.104	5.232	6.352	7.390	8.646	11.552
561	J_BRC_710	0.603	3.434	6.000	7.363	8.200	10.000	13.000
562	J_BRC_720_710	187.563	3.105	5.233	6.353	7.390	8.648	11.553
563	J_BRC_770	188.440	3.105	5.235	6.355	7.391	8.650	11.555
564	J_BRC_790	188.694	3.105	5.235	6.356	7.391	8.651	11.556
565	J_BRC_800	0.430	3.449	6.000	7.402	8.245	10.000	13.000
566	J_BRC_790_800	189.124	3.105	5.236	6.357	7.392	8.652	11.557
567	J_BRC_900	189.539	3.105	5.236	6.358	7.392	8.653	11.558
568	J_BRC_740	0.968	3.434	6.000	7.363	8.200	10.000	13.000
569	J_BRC_750	0.336	3.442	6.000	7.363	8.220	10.000	13.000
570	J_BRC_740_750	1.304	3.436	6.000	7.363	8.206	10.000	13.000
571	J_BRC_760	2.085	3.438	6.000	7.362	8.211	10.000	13.000
572	J_BRC_780	2.803	3.440	6.000	7.362	8.220	10.000	13.000
573	J_BRC_780_900	192.342	3.106	5.240	6.364	7.394	8.661	11.563
574	J_QRY_010_020	2.299	3.367	5.581	6.827	8.000	9.216	12.512
	Bagdad Pond	0.181	3.354	5.552	6.743	8.000	9.000	12.000
	Cedar Park Medical Center	0.786	3.351	5.540	6.752	8.000	9.000	12.000
	D_CHBT1_010A	0.955	3.359	5.531	6.830	8.000	9.122	12.419
	D_CHBT1_010B	1.122	3.359	5.531	6.830	8.000	9.122	12.419
	D_Quarry_FM620_Div1	2.536	3.400	5.696	6.895	8.041	9.479	12.812
	D_Quarry_SH_45_Div1	2.129	3.400	5.827	6.966	8.133	9.681	12.984
	D_Quarry_SH_45_Div2	2.129	3.400	5.827	6.966	8.133	9.681	12.984
	D_Storage_CHBT1_030C	0.302	3.400	5.704	6.928	8.023	9.442	12.963
	Div_Crystal_Falls	0.267	3.321	5.555	6.681	8.000	9.000	12.000
	Eagle Ridge	0.638	3.399	5.699	6.894	8.023	9.432	12.883
	Horizon Park Gateway	0.570	3.321	5.555	6.681	8.000	9.000	12.000
	La Frontera	0.165	3.400	5.848	6.954	8.139	9.738	13.000
	La Frontera 2	0.126	3.400	5.798	6.954	8.139	9.650	13.000
	Lake Forest	0.204	3.400	5.894	7.087	8.079	9.909	13.000

Table G-1. Rainfall Inputs

Junction ID per Figures 4-20 to 4-24	Element (associated stream name is provided in Table F-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
	LISD Block House Creek	0.322	3.327	5.572	6.729	8.000	9.000	12.000
	North Branch Pond	0.919	3.400	5.571	6.862	8.000	9.261	12.401
	NRCS_DAM_1	5.066	3.268	5.627	6.613	8.000	9.000	12.000
	NRCS_DAM_10A	4.181	3.352	5.523	6.790	8.000	9.055	12.246
	NRCS_DAM_10B	1.810	3.362	5.549	6.836	8.000	9.122	12.419
	NRCS_DAM_11	13.314	3.315	5.497	6.725	7.866	9.063	12.286
	NRCS_DAM_12	3.354	3.380	5.589	6.849	8.000	9.219	12.557
	NRCS_DAM_13A	3.974	3.356	5.516	6.800	8.000	9.071	12.243
	NRCS_DAM_14	2.457	3.400	5.725	6.919	8.024	9.488	12.915
	NRCS_DAM_15	1.288	3.400	5.777	6.979	8.078	9.608	13.000
	NRCS_DAM_16	5.670	3.400	5.729	6.924	8.031	9.524	12.945
	NRCS_DAM_17	1.168	3.400	5.815	6.971	8.065	9.726	13.000
	NRCS_DAM_18	2.291	3.400	5.812	7.036	8.095	9.694	13.000
	NRCS_DAM_19	1.673	3.400	5.922	7.108	8.097	9.909	13.000
	NRCS_DAM_2	3.126	3.302	5.584	6.684	8.000	9.000	12.000
	NRCS_DAM_20	0.906	3.406	5.996	7.185	8.126	10.000	13.000
	NRCS_DAM_21	0.907	3.411	6.000	7.268	8.136	10.000	13.000
	NRCS_DAM_22	0.715	3.419	6.000	7.352	8.141	10.000	13.000
	NRCS_DAM_3	8.006	3.325	5.557	6.717	8.000	9.000	12.000
	NRCS_DAM_4	5.432	3.354	5.532	6.770	8.000	9.001	12.017
	NRCS_DAM_5	1.003	3.337	5.523	6.757	8.000	9.000	12.032
	NRCS_DAM_6	5.761	3.384	5.516	6.826	8.000	9.070	12.071
	NRCS_DAM_7	15.853	3.315	5.419	6.688	7.848	8.907	11.891
	NRCS_DAM_8	8.389	3.400	5.617	6.893	8.000	9.374	12.466
	NRCS_DAM_9	4.620	3.400	5.719	6.945	8.033	9.581	12.783
	Onion Branch at 1431	0.486	3.367	5.551	6.824	8.000	9.158	12.328
	QRY_010	1.039	3.372	5.613	6.837	8.000	9.274	12.512
	QRY_020	1.260	3.363	5.562	6.821	8.000	9.179	12.512
	QRY_030	0.196	3.357	5.541	6.774	8.000	9.000	12.000
	QRY_040	0.108	3.364	5.572	6.810	8.000	9.151	12.341
	Quarry_FM_620	2.536	3.400	5.696	6.895	8.041	9.479	12.812
	Quarry_SH_45	2.129	3.400	5.827	6.966	8.133	9.681	12.984
	Randalls Town Center	0.916	3.400	5.897	6.995	8.104	9.909	13.000
	SH45 US183 Pond	0.402	3.400	5.554	6.866	8.000	9.261	12.280
	Teravista C1	1.392	3.396	5.684	6.880	8.009	9.405	12.767
	Teravista C2	1.392	3.396	5.684	6.880	8.009	9.405	12.767
	Teravista C3	0.981	3.395	5.684	6.880	8.012	9.405	12.793
	Teravista S1	0.177	3.398	5.684	6.894	8.023	9.405	12.845
	Twin Lakes	6.251	3.332	5.449	6.721	7.896	8.926	11.899
	Walmart Pond	0.451	3.347	5.542	6.750	8.000	9.000	12.000

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
1	BLH_010	0.165	3.327	5.580	6.731	8.000	9.000	12.000
2	BLH_020	0.157	3.327	5.564	6.727	8.000	9.000	12.000
3	BLH_030	0.066	3.327	5.564	6.727	8.000	9.000	12.000
4	BLH_040	0.518	3.327	5.552	6.743	8.000	9.000	12.000
5	BLH_050	0.420	3.335	5.564	6.727	8.000	9.000	12.000
6	BLH_060	0.234	3.343	5.547	6.712	8.000	9.000	12.000
7	BLH_070	0.283	3.343	5.547	6.723	8.000	9.000	12.000
8	BLH_080	0.269	3.332	5.547	6.723	8.000	9.000	12.000
9	BLH_090	0.451	3.332	5.547	6.735	8.000	9.000	12.000
10	BLH_100	0.232	3.329	5.555	6.719	8.000	9.000	12.000
11	BLH_110	0.338	3.329	5.555	6.731	8.000	9.000	12.000
12	BLH_120	1.040	3.318	5.555	6.721	8.000	9.000	12.000
13	BLH_130	0.586	3.336	5.537	6.721	8.000	9.000	12.000
14	BLH_140	0.850	3.336	5.537	6.746	8.000	9.000	12.000
15	BLH_150	0.385	3.347	5.511	6.770	8.000	9.000	12.000
16	BLH_160	0.687	3.336	5.518	6.761	8.000	9.000	12.000
17	BLH_170	0.048	3.344	5.511	6.770	8.000	9.000	12.112
18	BLHT1_010	0.905	3.327	5.564	6.712	8.000	9.000	12.000
19	BLHT2_010	0.730	3.313	5.573	6.712	8.000	9.000	12.000
20	BLHT2_020	0.078	3.321	5.547	6.723	8.000	9.000	12.000
21	BLHT2_030	0.271	3.321	5.555	6.708	8.000	9.000	12.000
22	BLHT3_003	0.267	3.321	5.555	6.681	8.000	9.000	12.000
23	BLHT3_006	0.092	3.321	5.555	6.681	8.000	9.000	12.000
24	BLHT3_010	0.212	3.321	5.555	6.681	8.000	9.000	12.000
25	BLHT3_020	0.551	3.310	5.562	6.693	8.000	9.000	12.000
26	BLHT3_030	0.143	3.321	5.555	6.719	8.000	9.000	12.000
27	BRC_010	0.071	3.299	5.562	6.672	8.000	9.000	12.000
28	BRC_020	0.888	3.299	5.570	6.672	8.000	9.000	12.000
29	BRC_030	0.818	3.307	5.562	6.697	8.000	9.000	12.000
30	BRC_040	0.740	3.305	5.570	6.679	8.000	9.000	12.000
31	BRC_050	0.362	3.307	5.544	6.704	8.000	9.000	12.000
32	BRC_060	0.136	3.317	5.544	6.704	8.000	9.000	12.000
33	BRC_070	0.489	3.314	5.551	6.695	8.000	9.000	12.000
34	BRC_080	0.877	3.314	5.533	6.726	8.000	9.000	12.000
35	BRC_090	0.095	3.317	5.544	6.728	8.000	9.000	12.000
36	BRC_100	0.455	3.327	5.526	6.735	8.000	9.000	12.000
37	BRC_110	0.398	3.325	5.526	6.752	8.000	9.000	12.000
38	BRC_120	0.338	3.333	5.526	6.752	8.000	9.000	12.000
39	BRC_130	0.704	3.341	5.526	6.768	8.000	9.000	12.000
40	BRC_140	0.879	3.352	5.518	6.761	8.000	9.000	12.044
41	BRC_150	0.433	3.363	5.511	6.786	8.000	9.000	12.112

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
42	BRC_160	0.069	3.374	5.511	6.786	8.000	9.044	12.112
43	BRC_170	0.215	3.363	5.521	6.801	8.000	9.000	12.253
44	BRC_180	0.973	3.374	5.511	6.800	8.000	9.044	12.184
45	BRC_190	0.875	3.374	5.521	6.810	8.000	9.137	12.319
46	BRC_200	0.283	3.382	5.521	6.817	8.000	9.137	12.253
47	BRC_210	0.386	3.382	5.572	6.826	8.000	9.137	12.461
48	BRC_220	0.430	3.382	5.544	6.835	8.000	9.215	12.319
49	BRC_230	0.122	3.393	5.594	6.835	8.000	9.215	12.461
50	BRC_240	0.015	3.400	5.594	6.850	8.000	9.308	12.461
51	BRC_250	0.660	3.400	5.594	6.862	8.000	9.308	12.461
52	BRC_260	0.976	3.400	5.594	6.875	8.000	9.308	12.603
53	BRC_270	0.862	3.400	5.643	6.881	8.004	9.395	12.745
54	BRC_280	1.020	3.400	5.694	6.906	8.004	9.481	12.745
55	BRC_290	0.780	3.400	5.694	6.921	8.094	9.566	12.887
56	BRC_300	0.220	3.400	5.745	6.945	8.038	9.652	13.000
57	BRC_310	0.161	3.400	5.745	6.953	8.076	9.652	13.000
58	BRC_320	0.426	3.400	5.796	6.961	8.038	9.652	13.000
59	BRC_330	0.198	3.400	5.796	6.969	8.076	9.652	13.000
60	BRC_340	0.412	3.400	5.796	6.969	8.052	9.738	13.000
61	BRC_350	0.537	3.400	5.796	6.985	8.052	9.738	13.000
62	BRC_360	0.204	3.400	5.894	7.087	8.079	9.909	13.000
63	BRC_370	0.323	3.400	5.944	7.066	8.079	9.909	13.000
64	BRC_380	0.620	3.400	5.894	7.044	8.079	9.909	13.000
65	BRC_390	0.838	3.400	5.847	7.044	8.072	9.823	13.000
66	BRC_400	0.559	3.400	5.898	7.044	8.092	9.823	13.000
67	BRC_410	0.193	3.400	5.878	6.992	8.087	9.763	13.000
68	BRC_420	0.159	3.400	5.878	7.001	8.087	9.763	13.000
69	BRC_430	0.087	3.400	5.878	7.001	8.092	9.763	13.000
70	BRC_440	0.819	3.400	5.878	7.063	8.092	9.909	13.000
71	BRC_450	0.461	3.400	5.910	7.060	8.083	9.764	13.000
72	BRC_460	0.097	3.400	5.910	7.082	8.087	9.858	13.000
73	BRC_470	0.054	3.400	5.910	7.082	8.112	9.882	13.000
74	BRC_480	0.874	3.400	5.949	7.125	8.097	9.909	13.000
75	BRC_490	0.167	3.400	5.949	7.144	8.112	9.994	13.000
76	BRC_500	0.868	3.404	5.949	7.125	8.116	10.000	13.000
77	BRC_510	0.077	3.404	5.949	7.144	8.112	9.994	13.000
78	BRC_520	0.278	3.400	5.922	7.184	8.112	9.882	13.000
79	BRC_530	0.089	3.401	5.922	7.182	8.127	9.737	13.000
80	BRC_540	0.179	3.404	5.922	7.182	8.127	9.868	13.000
81	BRC_550	0.163	3.404	5.922	7.203	8.132	9.868	13.000
82	BRC_560	0.092	3.404	5.922	7.225	8.132	9.999	13.000

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
83	BRC_570	0.238	3.412	5.983	7.246	8.132	9.999	13.000
84	BRC_580	0.527	3.412	5.995	7.246	8.132	9.985	13.000
85	BRC_590	0.345	3.412	5.995	7.246	8.136	9.999	13.000
86	BRC_600	0.907	3.411	6.000	7.268	8.136	10.000	13.000
87	BRC_610	0.063	3.415	6.000	7.246	8.136	10.000	13.000
88	BRC_620	0.477	3.412	5.995	7.287	8.136	9.985	13.000
89	BRC_630	0.167	3.415	6.000	7.309	8.136	10.000	13.000
90	BRC_640	0.344	3.415	6.000	7.290	8.136	10.000	13.000
91	BRC_650	0.415	3.419	6.000	7.305	8.156	10.000	13.000
92	BRC_670	0.580	3.419	6.000	7.324	8.156	10.000	13.000
93	BRC_680	0.092	3.427	6.000	7.324	8.196	10.000	13.000
94	BRC_690	0.043	3.427	6.000	7.344	8.196	10.000	13.000
95	BRC_700	0.196	3.430	6.000	7.344	8.200	10.000	13.000
96	BRC_710	0.603	3.434	6.000	7.363	8.200	10.000	13.000
97	BRC_720	0.086	3.434	6.000	7.363	8.200	10.000	13.000
98	BRC_740	0.968	3.434	6.000	7.363	8.200	10.000	13.000
99	BRC_750	0.336	3.442	6.000	7.363	8.220	10.000	13.000
100	BRC_760	0.782	3.442	6.000	7.362	8.220	10.000	13.000
101	BRC_770	0.877	3.438	6.000	7.383	8.225	10.000	13.000
102	BRC_780	0.718	3.446	6.000	7.362	8.245	10.000	13.000
103	BRC_790	0.253	3.445	6.000	7.382	8.245	10.000	13.000
104	BRC_800	0.430	3.449	6.000	7.402	8.245	10.000	13.006
105	BRC_900	0.415	3.449	6.000	7.381	8.245	10.000	13.000
106	BRCT1_010	0.676	3.305	5.551	6.695	8.000	9.000	12.000
107	BRCT10_010	0.370	3.426	6.000	7.365	8.161	10.000	13.000
108	BRCT10_020	0.322	3.423	6.000	7.365	8.161	10.000	13.000
109	BRCT10_030	0.291	3.430	6.000	7.364	8.181	10.000	13.000
110	BRCT10_040	0.252	3.426	6.000	7.364	8.161	10.000	13.000
111	BRCT10_050	0.973	3.427	6.000	7.344	8.181	10.000	13.000
112	BRCT11_010	0.343	3.416	5.946	7.284	8.171	9.840	13.000
113	BRCT11_020	0.600	3.419	6.000	7.284	8.171	9.971	13.000
114	BRCT11_030	0.347	3.419	6.000	7.284	8.171	9.958	13.000
115	BRCT11_040	0.307	3.419	6.000	7.304	8.176	10.000	13.000
116	BRCT11_050	0.506	3.423	6.000	7.304	8.191	9.958	13.000
117	BRCT11_060	0.382	3.427	6.000	7.323	8.196	10.000	13.000
118	BRCT11_070	0.093	3.427	6.000	7.343	8.196	10.000	13.000
119	BRCT2_010	0.324	3.325	5.544	6.721	8.000	9.000	12.000
120	BRCT2_020	0.196	3.325	5.544	6.728	8.000	9.000	12.000
121	BRCT3_010	0.366	3.327	5.526	6.735	8.000	9.000	12.000
122	BRCT4_010	0.523	3.337	5.533	6.750	8.000	9.000	12.000
123	BRCT4_020	0.376	3.337	5.507	6.766	8.000	9.000	12.086

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
124	BRCT4_030	0.103	3.337	5.526	6.759	8.000	9.000	12.000
125	BRCT4_040	0.234	3.341	5.526	6.744	8.000	9.000	12.000
126	BRCT5_010	0.872	3.400	5.944	7.106	8.097	9.909	13.000
127	BRCT5_020	0.504	3.400	5.898	7.125	8.097	9.909	13.000
128	BRCT5_030	0.296	3.400	5.898	7.084	8.097	9.909	13.000
129	BRCT5_040	0.213	3.400	5.898	7.103	8.092	9.909	13.000
130	BRCT5_050	0.118	3.400	5.878	7.103	8.092	9.858	13.000
131	BRCT7_010	0.104	3.400	5.789	6.998	8.098	9.620	13.000
132	BRCT7_020	0.440	3.400	5.789	7.058	8.103	9.620	13.000
133	BRCT7_030	0.231	3.400	5.861	7.098	8.103	9.751	13.000
134	BRCT7_040	0.766	3.400	5.861	7.141	8.103	9.751	13.000
135	BRCT7_050	0.401	3.404	5.922	7.163	8.127	9.868	13.000
136	BRCT7_060	0.472	3.400	5.861	7.182	8.123	9.737	13.000
137	BRCT8_010	0.478	3.408	5.993	7.165	8.116	10.000	13.000
138	BRCT8_020	0.429	3.404	6.000	7.206	8.136	10.000	13.000
139	BRCT8_030	0.310	3.404	5.983	7.206	8.132	9.999	13.000
140	BRCT8_040	0.235	3.408	5.983	7.246	8.136	9.999	13.000
141	BRCT9_010	0.117	3.401	5.861	7.160	8.123	9.737	13.000
142	BRCT9_020	0.402	3.401	5.873	7.182	8.123	9.737	13.000
143	BRCT9_030	0.410	3.408	5.934	7.182	8.127	9.854	13.000
144	BRCT9_040	0.121	3.408	5.934	7.182	8.127	9.868	13.000
145	BRCT9_050	0.252	3.408	5.934	7.203	8.132	9.854	13.000
146	BRCT9_060	0.139	3.408	5.934	7.203	8.132	9.868	13.000
147	BRCT9_070	0.025	3.408	5.995	7.225	8.132	9.999	13.000
148	BUT_010	0.929	3.357	5.541	6.789	8.000	9.000	12.000
149	BUT_020	0.426	3.376	5.524	6.800	8.000	9.000	12.000
150	BUT_030	0.544	3.387	5.512	6.804	8.000	9.000	12.000
151	BUT_040	0.127	3.376	5.512	6.827	8.000	9.000	12.000
152	BUT_050	0.038	3.384	5.512	6.827	8.000	9.000	12.088
153	BUT_060	0.787	3.387	5.512	6.831	8.000	9.075	12.040
154	BUT_070	0.494	3.387	5.512	6.827	8.000	9.075	12.040
155	BUT_080	0.082	3.394	5.512	6.827	8.000	9.000	12.088
156	BUT_090	0.699	3.384	5.512	6.839	8.000	9.090	12.088
157	BUT_100	1.023	3.400	5.501	6.854	8.000	9.168	12.160
158	BUT_110	0.213	3.400	5.514	6.854	8.000	9.168	12.280
159	BUT_120	0.400	3.394	5.514	6.839	8.000	9.090	12.160
160	BUT_130	0.490	3.391	5.508	6.850	8.000	9.090	12.208
161	CHB_010	0.886	3.346	5.515	6.757	8.000	9.000	12.086
162	CHB_020	0.583	3.346	5.515	6.781	8.000	9.000	12.228
163	CHB_030	0.826	3.346	5.531	6.790	8.000	9.085	12.277
164	CHB_040	0.747	3.353	5.511	6.789	8.000	9.085	12.228

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
165	CHB_050	0.534	3.356	5.511	6.813	8.000	9.085	12.370
166	CHB_060	0.606	3.366	5.562	6.829	8.000	9.085	12.370
167	CHB_070A	0.499	3.366	5.582	6.838	8.000	9.216	12.561
168	CHB_070B	0.193	3.366	5.582	6.838	8.000	9.216	12.561
169	CHB_070C	0.063	3.366	5.582	6.838	8.000	9.216	12.561
170	CHB_070D	0.116	3.366	5.582	6.838	8.000	9.216	12.561
171	CHB_080	0.062	3.378	5.633	6.862	8.000	9.311	12.561
172	CHB_090	0.544	3.385	5.633	6.870	8.000	9.311	12.561
173	CHB_100	0.999	3.388	5.633	6.878	8.000	9.311	12.561
174	CHB_110	0.715	3.391	5.653	6.871	8.000	9.348	12.613
175	CHB_120	0.477	3.391	5.653	6.896	8.003	9.348	12.755
176	CHB_130	0.770	3.400	5.674	6.896	8.008	9.442	12.821
177	CHB_140	0.601	3.400	5.725	6.912	8.028	9.481	12.821
178	CHB_150	0.537	3.400	5.725	6.936	8.028	9.574	13.000
179	CHB_160	0.102	3.400	5.776	6.952	8.028	9.574	13.000
180	CHB_170	0.653	3.400	5.776	6.952	8.028	9.668	13.000
181	CHB_180	0.482	3.400	5.776	6.961	8.052	9.668	13.000
182	CHB_190	0.753	3.400	5.776	6.960	8.048	9.632	13.000
183	CHB_200	0.733	3.400	5.827	6.984	8.048	9.763	13.000
184	CHB_210	0.777	3.400	5.827	6.992	8.067	9.763	13.000
185	CHBT1_010A	0.955	3.359	5.531	6.830	8.000	9.122	12.419
186	CHBT1_010B	0.167	3.359	5.531	6.830	8.000	9.122	12.419
187	CHBT1_020	0.688	3.369	5.582	6.846	8.000	9.122	12.419
188	CHBT1_030A	0.273	3.369	5.602	6.846	8.000	9.253	12.613
189	CHBT1_030B	0.171	3.369	5.602	6.846	8.000	9.253	12.613
190	CHBT1_030C	0.302	3.369	5.602	6.846	8.000	9.253	12.613
191	CHBT1_040	0.203	3.378	5.582	6.846	8.000	9.216	12.561
192	CHBT2_010	0.621	3.395	5.684	6.886	8.019	9.405	12.845
193	CHBT2_020	0.360	3.395	5.684	6.870	8.000	9.405	12.703
194	CHBT2_030	0.410	3.398	5.684	6.878	8.003	9.405	12.703
195	CHBT2_040	0.548	3.400	5.653	6.878	8.003	9.442	12.755
196	CHBT3_010	0.177	3.398	5.684	6.894	8.023	9.405	12.845
197	CHBT3_020	0.461	3.400	5.704	6.894	8.023	9.442	12.897
198	CHBT3_030	0.550	3.400	5.704	6.928	8.023	9.442	12.963
199	CHBT3_040	0.233	3.400	5.704	6.911	8.023	9.537	12.897
200	CHBT3_050	0.095	3.400	5.704	6.919	8.023	9.537	12.897
201	CHBT3_060	0.413	3.400	5.755	6.927	8.023	9.537	12.897
202	CHBT3_070	0.268	3.400	5.755	6.935	8.023	9.537	12.897
203	CHBT3_080	0.260	3.400	5.776	6.944	8.028	9.537	12.963
204	CHBT3_090	0.195	3.400	5.776	6.944	8.028	9.574	12.963
205	CHBT4_010	1.087	3.400	5.755	6.935	8.023	9.632	13.000

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
206	CHBT5_010	0.678	3.400	5.806	6.967	8.063	9.726	13.000
207	CHBT5_020	0.491	3.400	5.827	6.976	8.067	9.726	13.000
208	CHBT5_030	0.067	3.400	5.827	6.992	8.067	9.763	13.000
209	CLK_010	0.045	3.338	5.569	6.747	8.000	9.000	12.000
210	CLK_020	0.365	3.338	5.552	6.758	8.000	9.000	12.000
211	CLK_030	0.414	3.346	5.552	6.758	8.000	9.000	12.000
212	CLK_040	0.325	3.365	5.541	6.758	8.000	9.000	12.000
213	CLK_050	0.455	3.354	5.536	6.770	8.000	9.000	12.000
214	CLK_060	0.699	3.373	5.524	6.781	8.000	9.000	12.016
215	CLK_070	0.973	3.365	5.524	6.797	8.000	9.000	12.000
216	CLK_080	0.327	3.373	5.508	6.808	8.000	9.012	12.016
217	CLK_090	0.323	3.380	5.508	6.808	8.000	9.012	12.136
218	CLKT1_010	0.198	3.373	5.508	6.793	8.000	9.012	12.016
219	COT_010	0.137	3.400	5.716	6.981	8.074	9.502	13.000
220	COT_020	0.220	3.400	5.777	6.990	8.074	9.502	13.000
221	COT_030	0.397	3.400	5.743	6.981	8.074	9.501	13.000
222	COT_040	0.169	3.400	5.789	6.990	8.098	9.501	13.000
223	COT_050	0.822	3.400	5.789	7.015	8.093	9.501	13.000
224	COT_060	0.629	3.400	5.800	7.077	8.118	9.606	13.000
225	COT_070	0.817	3.400	5.800	7.139	8.123	9.606	13.000
226	COT_080	0.360	3.400	5.861	7.139	8.123	9.737	13.000
227	COT_090	0.291	3.400	5.823	7.139	8.123	9.639	13.000
228	COT_100	0.087	3.401	5.873	7.139	8.123	9.723	13.000
229	COT_110	0.162	3.400	5.873	7.179	8.123	9.723	13.000
230	COT_120	0.215	3.401	5.873	7.179	8.142	9.723	13.000
231	COT_130	0.410	3.401	5.873	7.201	8.123	9.723	13.000
232	COT_140	0.276	3.405	5.873	7.225	8.142	9.713	13.000
233	COT_150	0.597	3.405	5.934	7.222	8.142	9.723	13.000
234	COT_160	0.647	3.412	5.934	7.244	8.147	9.854	13.000
235	COT_170	0.444	3.408	5.934	7.245	8.147	9.840	13.000
236	COT_180	0.270	3.409	5.885	7.244	8.162	9.713	13.000
237	COT_190	0.713	3.412	5.946	7.244	8.167	9.840	13.000
238	COT_200	0.079	3.412	5.934	7.285	8.152	9.971	13.000
239	COT_210	0.714	3.416	5.995	7.287	8.152	9.985	13.000
240	COT_220	0.366	3.412	6.000	7.284	8.152	9.971	13.000
241	COT_230	0.151	3.416	6.000	7.304	8.156	9.971	13.000
242	COT_240	0.154	3.416	6.000	7.304	8.156	10.000	13.000
243	COT_250	0.391	3.419	6.000	7.304	8.171	9.971	13.000
244	COT_260	0.250	3.423	6.000	7.324	8.176	10.000	13.000
245	COT_270	0.172	3.423	6.000	7.304	8.176	10.000	13.000
246	COT_280	0.049	3.423	6.000	7.324	8.176	10.000	13.000

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
247	COT_290	0.127	3.423	6.000	7.324	8.176	10.000	13.000
248	COT_300	0.082	3.423	6.000	7.324	8.176	10.000	13.000
249	CWC_010	0.478	3.351	5.547	6.746	8.000	9.000	12.000
250	CWC_020	0.374	3.358	5.529	6.773	8.000	9.000	12.064
251	CWC_030	0.308	3.351	5.529	6.762	8.000	9.000	12.000
252	D18_010	0.631	3.400	5.777	6.998	8.078	9.633	13.000
253	D18_020	0.327	3.400	5.789	6.998	8.098	9.620	13.000
254	D18_030	0.212	3.400	5.789	7.017	8.103	9.751	13.000
255	D18_040	1.017	3.400	5.850	7.079	8.103	9.751	13.000
256	D18_050	0.383	3.400	5.910	7.060	8.107	9.882	13.000
257	D18_060	0.359	3.400	5.910	7.082	8.112	9.882	13.000
258	D18_070	0.242	3.400	5.910	7.122	8.107	9.882	13.000
259	D22_010	0.715	3.419	6.000	7.352	8.141	10.000	13.000
260	D22_020	0.365	3.419	6.000	7.330	8.156	10.000	13.000
261	DAV_010	0.257	3.400	5.571	6.873	8.000	9.277	12.329
262	DAV_020	0.114	3.400	5.628	6.885	8.000	9.277	12.452
263	DAV_030	0.514	3.400	5.628	6.885	8.000	9.370	12.452
264	DAV_040	0.435	3.400	5.588	6.896	8.000	9.370	12.452
265	DAV_050	0.344	3.400	5.645	6.881	8.000	9.370	12.594
266	DAV_060	0.267	3.400	5.685	6.896	8.000	9.370	12.594
267	DAV_070	0.430	3.400	5.685	6.896	8.000	9.448	12.660
268	DAV_080	0.684	3.400	5.645	6.908	8.000	9.464	12.594
269	DAVT1_010	0.206	3.400	5.571	6.873	8.000	9.277	12.401
270	DRY_010	0.916	3.400	5.897	6.995	8.104	9.909	13.000
271	DRY_020	0.696	3.400	5.845	6.986	8.069	9.823	13.000
272	DRY_030	0.464	3.400	5.845	6.985	8.069	9.823	13.000
273	DRYF_010	0.709	3.389	5.572	6.826	8.000	9.224	12.461
274	DRYF_020	0.519	3.389	5.572	6.857	8.000	9.224	12.603
275	DRYFT1_010	1.079	3.352	5.500	6.792	8.000	9.064	12.186
276	DRYFT1_020	0.124	3.371	5.521	6.817	8.000	9.064	12.395
277	DRYT1_010	0.730	3.400	5.848	6.979	8.121	9.823	13.000
278	DRYT1_020	0.487	3.400	5.845	6.995	8.121	9.823	13.000
279	DRYT1_030	0.806	3.400	5.845	6.978	8.076	9.738	13.000
280	DYB_010	0.763	3.400	5.894	7.047	8.100	9.994	13.000
281	DYB_020	0.723	3.400	5.894	7.025	8.069	9.823	13.000
282	HON_010	0.236	3.349	5.507	6.784	8.000	9.027	12.135
283	HON_020	0.843	3.349	5.507	6.799	8.000	9.027	12.186
284	HON_030	0.548	3.360	5.500	6.808	8.000	9.064	12.328
285	HON_040	0.413	3.378	5.572	6.817	8.000	9.158	12.395
286	HONT1_010	0.294	3.349	5.507	6.799	8.000	9.027	12.135
287	HONT2_010	0.438	3.360	5.551	6.799	8.000	9.158	12.328

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
288	LAK_010	0.265	3.400	5.501	6.870	8.000	9.246	12.232
289	LAK_020	0.216	3.400	5.554	6.870	8.000	9.246	12.232
290	LAK_030	0.390	3.400	5.554	6.870	8.000	9.246	12.353
291	LAK_040	0.656	3.400	5.554	6.881	8.000	9.339	12.353
292	LAK_050	0.402	3.400	5.554	6.866	8.000	9.261	12.280
293	LAK_060	0.261	3.400	5.554	6.881	8.000	9.339	12.353
294	LAK_070	0.215	3.400	5.611	6.893	8.000	9.261	12.401
295	LAK_080	0.191	3.400	5.611	6.877	8.000	9.355	12.401
296	LAK_090	0.033	3.400	5.571	6.877	8.000	9.355	12.401
297	LAK_100	0.173	3.400	5.611	6.889	8.000	9.355	12.401
298	LAK_110	0.529	3.400	5.668	6.904	8.000	9.433	12.593
299	LAK_120	0.174	3.400	5.628	6.900	8.000	9.448	12.521
300	LAK_130	0.415	3.400	5.668	6.916	8.000	9.448	12.521
301	LAK_140	0.843	3.400	5.725	6.912	8.000	9.448	12.660
302	LAK_150	0.692	3.400	5.685	6.923	8.000	9.542	12.660
303	LAK_160	0.672	3.400	5.685	6.919	8.014	9.542	12.802
304	LAK_170	0.517	3.400	5.696	6.915	8.078	9.557	12.878
305	LAK_180	0.557	3.400	5.746	6.942	8.078	9.650	12.878
306	LAK_190	0.760	3.400	5.696	6.890	8.041	9.479	12.812
307	LAK_200	0.545	3.400	5.746	6.930	8.041	9.566	12.812
308	LAK_210	0.127	3.400	5.746	6.921	8.041	9.566	12.812
309	LAK_220	0.722	3.400	5.746	6.930	8.094	9.652	12.954
310	LAK_230	0.497	3.400	5.795	6.953	8.076	9.652	13.000
311	LAK_240	0.393	3.400	5.796	6.969	8.076	9.738	13.000
312	LAKT1_010	0.919	3.400	5.571	6.862	8.000	9.261	12.401
313	LAKT2_010	0.449	3.400	5.611	6.893	8.000	9.339	12.473
314	LAKT2_020	0.656	3.400	5.611	6.893	8.000	9.433	12.473
315	LAKT3_010	0.823	3.400	5.651	6.920	8.000	9.433	12.545
316	LAKT3_020	0.779	3.400	5.668	6.916	8.000	9.526	12.593
317	LAKT4_010	0.430	3.400	5.645	6.904	8.014	9.464	12.736
318	LAKT5_010	0.887	3.400	5.645	6.888	8.000	9.386	12.670
319	LAKT5_020	0.888	3.400	5.696	6.900	8.041	9.479	12.812
320	LAKT5_030	0.103	3.400	5.746	6.900	8.041	9.479	12.812
321	LAKT6_010	0.126	3.400	5.798	6.954	8.139	9.650	13.000
322	LAKT6_020	0.392	3.400	5.746	6.954	8.139	9.650	13.000
323	LAKT6_030	0.165	3.400	5.848	6.954	8.139	9.738	13.000
324	LAKT6_040	0.163	3.400	5.795	6.965	8.139	9.738	13.000
325	LAKT6_050	0.624	3.400	5.795	6.955	8.094	9.652	13.000
326	MAC_010	0.680	3.305	5.592	6.674	8.000	9.000	12.000
327	MAC_020	0.497	3.305	5.592	6.700	8.000	9.000	12.000
328	MAC_030	0.381	3.295	5.573	6.681	8.000	9.000	12.000

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
329	MAC_040	0.874	3.295	5.581	6.681	8.000	9.000	12.000
330	MAC_050	0.492	3.310	5.581	6.681	8.000	9.000	12.000
331	MAC_060	0.208	3.310	5.562	6.681	8.000	9.000	12.000
332	MACT1_010	0.203	3.305	5.573	6.697	8.000	9.000	12.000
333	MCN_010	0.995	3.400	5.735	6.918	8.019	9.500	12.845
334	MCN_020	0.580	3.400	5.735	6.927	8.038	9.595	12.990
335	MCN_030	0.646	3.400	5.735	6.943	8.043	9.595	13.000
336	MCN_040	0.322	3.400	5.806	6.975	8.063	9.726	13.000
337	MCN_050	0.375	3.400	5.838	6.983	8.063	9.726	13.000
338	MCN_060	0.361	3.400	5.838	6.991	8.083	9.726	13.000
339	MCN_070	0.527	3.400	5.838	7.020	8.083	9.726	13.000
340	MCN_080	0.502	3.400	5.878	7.020	8.087	9.858	13.000
341	MCN_090	0.190	3.400	5.878	7.082	8.087	9.858	13.000
342	MCNF_010	0.629	3.400	5.693	6.901	8.014	9.463	12.943
343	MCNF_020	0.700	3.400	5.693	6.917	8.034	9.399	12.896
344	MCNF_030	0.778	3.400	5.735	6.909	8.034	9.530	12.943
345	MCNF_040	0.294	3.400	5.704	6.933	8.034	9.530	13.000
346	MCNF_050	0.641	3.400	5.765	6.934	8.038	9.530	13.000
347	MCNF_060	0.407	3.400	5.765	6.959	8.038	9.647	13.000
348	MCNT1_010	0.738	3.400	5.704	6.958	8.054	9.516	13.000
349	MCNT1_020	0.205	3.400	5.765	6.966	8.058	9.647	13.000
350	MCNT1_030	0.431	3.400	5.777	6.958	8.078	9.516	13.000
351	MCNT1_040	0.184	3.400	5.777	6.966	8.058	9.516	13.000
352	MCNT1_050	0.016	3.400	5.765	6.975	8.058	9.647	13.000
353	MCNT1_060	0.350	3.400	5.765	6.975	8.063	9.647	13.000
354	MCNT2_010	0.337	3.400	5.777	6.982	8.078	9.516	13.000
355	MCNT2_020	0.412	3.400	5.777	6.982	8.078	9.633	13.000
356	MCNT2_030	0.375	3.400	5.777	6.975	8.083	9.647	13.000
357	MCNT2_040	0.163	3.400	5.777	6.975	8.063	9.647	13.000
358	MCNT2_050	0.091	3.400	5.838	6.975	8.083	9.726	13.000
359	MCNT3_010	0.772	3.400	5.838	7.017	8.083	9.764	13.000
360	MCNT3_020	0.301	3.400	5.838	7.060	8.083	9.764	13.000
361	MCNT3_030	0.241	3.400	5.878	7.060	8.087	9.858	13.000
362	NFBC_010	0.904	3.271	5.636	6.624	8.000	9.000	12.000
363	NFBC_020	0.213	3.268	5.636	6.608	8.000	9.000	12.000
364	NFBC_030	0.684	3.268	5.618	6.631	8.000	9.000	12.000
365	NFBC_040	0.570	3.260	5.643	6.577	8.000	9.000	12.000
366	NFBC_050	0.633	3.268	5.625	6.604	8.000	9.000	12.000
367	NFBC_060	0.859	3.257	5.625	6.589	8.000	9.000	12.000
368	NFBC_070	0.269	3.257	5.625	6.601	8.000	9.000	12.000
369	NFBC_080	0.153	3.276	5.607	6.616	8.000	9.000	12.000

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
370	NFBC_090	0.781	3.287	5.618	6.647	8.000	9.000	12.000
371	NFBC_100	0.744	3.276	5.607	6.617	8.000	9.000	12.000
372	NFBC_110	0.772	3.275	5.607	6.632	8.000	9.000	12.000
373	NFBC_120	1.005	3.291	5.588	6.648	8.000	9.000	12.000
374	ONI_010	0.190	3.367	5.551	6.824	8.000	9.158	12.328
375	ONI_015	0.296	3.367	5.551	6.824	8.000	9.158	12.328
376	ONI_020	0.586	3.367	5.551	6.839	8.000	9.158	12.471
377	ONI_030	0.203	3.386	5.572	6.848	8.000	9.158	12.537
378	ONI_040	0.339	3.378	5.572	6.832	8.000	9.224	12.537
379	ONI_050	0.202	3.397	5.623	6.857	8.000	9.224	12.537
380	ONI_060	0.366	3.397	5.623	6.872	8.000	9.310	12.745
381	ONI_070	0.122	3.400	5.674	6.872	8.000	9.310	12.679
382	ONI_080	0.521	3.375	5.602	6.855	8.000	9.253	12.613
383	ONI_090	0.818	3.394	5.674	6.879	8.000	9.348	12.679
384	ONI_100	1.008	3.400	5.674	6.904	8.004	9.395	12.745
385	ONI_110	0.439	3.400	5.674	6.904	8.049	9.481	12.887
386	ONI_120	0.147	3.400	5.725	6.920	8.049	9.481	12.887
387	ONI_130	0.551	3.400	5.745	6.929	8.038	9.566	13.000
388	ONIT1_010	0.651	3.386	5.623	6.864	8.000	9.253	12.679
389	ONIT1_020	0.126	3.394	5.674	6.879	8.000	9.310	12.679
390	POC_010	0.159	3.340	5.529	6.746	8.000	9.000	12.000
391	POC_020	0.427	3.347	5.529	6.746	8.000	9.000	12.000
392	POC_030	0.203	3.358	5.511	6.770	8.000	9.000	12.000
393	QRY_010	1.039	3.372	5.613	6.837	8.000	9.274	12.512
394	QRY_020	1.259	3.363	5.562	6.821	8.000	9.179	12.512
395	QRY_030	0.196	3.357	5.541	6.774	8.000	9.000	12.000
396	QRY_040	0.108	3.364	5.572	6.810	8.000	9.151	12.341
397	RAT_010	0.269	3.400	5.651	6.950	8.000	9.483	12.665
398	RAT_020	0.368	3.400	5.707	6.946	8.000	9.573	12.665
399	RAT_030	0.134	3.400	5.707	6.946	8.000	9.526	12.665
400	RAT_040	0.339	3.400	5.707	6.958	8.000	9.573	12.665
401	RAT_050	0.533	3.400	5.668	6.943	8.025	9.526	12.726
402	RAT_060	0.250	3.400	5.725	6.927	8.000	9.619	12.726
403	RAT_070	0.997	3.400	5.725	6.939	8.051	9.619	12.868
404	RAT_080	0.655	3.400	5.782	6.962	8.051	9.619	12.868
405	RAT_090	0.340	3.400	5.725	6.935	8.051	9.542	12.802
406	RAT_100A	0.169	3.400	5.742	6.931	8.115	9.635	12.944
407	RAT_100B	0.734	3.400	5.742	6.931	8.115	9.635	12.944
408	RAT_110	0.074	3.400	5.742	6.931	8.078	9.557	12.878
409	RAT_120	0.048	3.400	5.696	6.931	8.078	9.557	12.878
410	RAT_130	0.048	3.400	5.746	6.927	8.078	9.557	12.878

Table G-2 . Watershed Rainfall Inputs

Watershed ID per Figures 4-2 to 4-6	Element (associated stream name is provided in Table G-3)	Contributing Area (sq. mi)	Rainfall Input (in)					
			2 YR	10 YR	25 YR	50 YR	100 YR	500 YR
411	RATT1_010	0.918	3.400	5.839	6.973	8.115	9.635	13.000
412	RATT1_020	0.143	3.400	5.798	6.942	8.078	9.557	12.878
413	RATT2_010	0.359	3.400	5.839	6.969	8.179	9.728	13.000
414	RATT2_020	0.234	3.400	5.798	6.954	8.179	9.728	13.000
415	RATT2_030	0.104	3.400	5.839	6.969	8.115	9.728	12.944
416	RATT2_040	0.345	3.400	5.839	6.969	8.115	9.728	12.944
417	RATT2_050	0.106	3.400	5.798	6.942	8.078	9.728	12.944
418	RATT2_060	0.126	3.400	5.798	6.942	8.078	9.650	12.878
419	SBR_010	0.572	3.380	5.508	6.820	8.000	9.106	12.136
420	SBR_020	0.750	3.369	5.508	6.804	8.000	9.106	12.136
421	SBR_030	0.470	3.388	5.531	6.816	8.000	9.106	12.256
422	SBR_040	1.145	3.399	5.531	6.846	8.000	9.184	12.329
423	SBR_050	0.314	3.396	5.531	6.858	8.000	9.277	12.329
424	SBR_060	0.312	3.396	5.531	6.843	8.000	9.199	12.256
425	SBR_070	0.998	3.396	5.588	6.854	8.000	9.199	12.385
426	SBR_080	0.676	3.385	5.544	6.827	8.000	9.121	12.319
427	SBR_090	0.682	3.400	5.588	6.865	8.000	9.293	12.385
428	SBR_100	0.296	3.393	5.544	6.850	8.000	9.215	12.319
429	SBR_110	0.218	3.393	5.594	6.850	8.000	9.308	12.461
430	SBRT1_010	0.598	3.369	5.503	6.816	8.000	9.028	12.064
431	SBRT2_010	0.122	3.377	5.503	6.816	8.000	9.121	12.184
432	SBRT2_020	0.152	3.385	5.503	6.816	8.000	9.121	12.184
433	SBRT2_030	0.045	3.396	5.531	6.816	8.000	9.199	12.256
434	SBRT3_010	0.151	3.393	5.544	6.839	8.000	9.215	12.319
435	SBRT4_010	0.564	3.400	5.645	6.865	8.000	9.386	12.527
436	SFBC_010	0.654	3.287	5.592	6.647	8.000	9.000	12.000
437	SFBC_020	0.297	3.287	5.599	6.647	8.000	9.000	12.000
438	SFBC_030	0.576	3.295	5.599	6.654	8.000	9.000	12.000
439	SFBC_040	0.584	3.284	5.599	6.643	8.000	9.000	12.000
440	SFBC_050	0.390	3.291	5.581	6.666	8.000	9.000	12.000
441	SPAO_010	0.181	3.354	5.552	6.743	8.000	9.000	12.000
442	SPAO_020	0.270	3.343	5.536	6.754	8.000	9.000	12.000

Table G-3. Naming Convention

Naming Prefix	River System
BLH	Block House Creek
BLHT1	Block House Creek
BLHT2	Block House Creek
BLHT3	Block House Creek
BRC	Brushy Creek
BRCT1	Brushy Creek
BRCT10	Brushy Creek
BRCT11	Brushy Creek
BRCT2	Brushy Creek
BRCT3	Brushy Creek
BRCT4	Brushy Creek
BRCT5	Brushy Creek
BRCT7	Brushy Creek
BRCT8	Brushy Creek
BRCT9	Brushy Creek
BUT	Buttercup Creek
CHB	Chandler Branch
CHBT1	Chandler Branch
CHBT2	Chandler Branch
CHBT3	Chandler Branch
CHBT4	Chandler Branch
CHBT5	Chandler Branch
CLK	Cluck Creek
CLKT1	Cluck Creek
COT	Cottonwood Creek
CWC	Cottonwood Creek
DAV	Davis Creek
DAVT1	Davis Creek
DRY	Dry Fork
DRYF	Dry Fork
DRYFT1	Dry Fork
DRYT1	Dry Fork
DYB	Dyer Branch

Naming Prefix	River System
HON	Honey Bear Creek
HONT1	Honey Bear Creek
HONT2	Honey Bear Creek
LAK	Lake Creek
LAKT1	Lake Creek
LAKT2	Lake Creek
LAKT3	Lake Creek
LAKT4	Lake Creek
LAKT5	Lake Creek
LAKT6	Lake Creek
MAC	Mason Creek
MACT1	Mason Creek
MAN	Mason Creek
MCN	McNutt Creek
MCNF	McNutt Creek
MCNT1	McNutt Creek
MCNT2	McNutt Creek
MCNT3	McNutt Creek
NFBC	North Fork Brushy Creek
ONI	Onion Branch
ONIT1	Onion Branch
POC	Post Oak Creek
QRY	Quarry
RAT	Rattan Creek
RATT1	Rattan Creek
RATT2	Rattan Creek
SBR	South Brushy Creek
SBRT1	South Brushy Creek
SBRT2	South Brushy Creek
SBRT3	South Brushy Creek
SBRT4	South Brushy Creek
SFBC	South Fork Brushy Creek
SPAO	Spanish Oak

Exhibit H
Calibration for Curve Number

URS

Exhibit H

TO: Ruth Haberman, General Manager, Upper Brushy Creek Water Control and Improvement District

FROM: Jeff Irvin, PE, URS Corporation

DATE: June 12, 2012; revised September 14, 2012

RE: Discussion on Selection of Curve Number for Floodplain Modeling

Memorandum Purpose

The purpose of this memorandum is to provide background on the technical issues associated with selection of a curve number (CN) for use in hydrologic modeling within the Upper Brushy Creek watershed. The flows that are the output of the hydrologic model (HEC-HMS) will be used as inputs into the Upper Brushy Creek hydraulic model, which will in turn be used to delineate floodplains for planning purposes, and also, per current intention, for regulatory floodplain use.

Technical Memorandum 2 (TM2) laid out the methods by which CNs were to be estimated for each watershed within the hydrologic model, for Antecedent Runoff Condition (ARC) II. ARCII is described in Chapter 10 of NEH Part 630 (NRCS, 2004) as appropriate for an "average runoff condition." The appropriateness of an assumption of ARCII for the Upper Brushy Creek watershed as a basis for floodplain mapping is a decision that needs to be made by the District, the affected stakeholders (represented by the Technical Advisory Committee [TAC]), the Texas Water Development Board (TWDB), and ultimately (since the floodplains are expected to become the basis of the National Flood Insurance Program [NFIP] regulation), the Federal Emergency Management Agency (FEMA). Per previous discussion with the District and TAC, this decision needs to be made in the context of the climatic and runoff conditions of the Upper Brushy Creek watershed, using best available science and best available relevant local data. The Flood Protection Plan scope of work, for this reason, includes performing calibrations to estimate CNs of watersheds under conditions of major recent historic floods.

This memorandum provides:

- A summary of data sources accessed in development of CN calibration;
- A discussion of each of two historic storms used in CN calibration;
- A discussion of calibration methodology;
- Presentation of calibration results; and
- Recommendation for CN selection.

Summary of Data Sources

In general, the calibration method involved applying event-specific rainfall data to individual dam watersheds and performing a water balance at each dam. This procedure required data on each watershed, each dam, and each storm for which a calibration was performed.

Watershed Data

The watershed data that were used were consistent with the values derived for the HEC-HMS model and included:

- Watershed area. Watershed area (in square miles) for each dam was delineated using current Light Detection and Ranging (LiDAR) topographic data.
- Impervious area (percent of watershed area). Impervious area was delineated within each watershed using current multispectral imagery and ERDAS Imagine.
- ARC II CN. These values were taken from the HEC-HMS model (USACE, 2010) and were developed using the procedures documented in TM2.

District dam watersheds are depicted on Figure H-1. Watersheds for Dam 11 and Dam 6 have been truncated because portions of their upstream watersheds each drain into large depressions formed by quarries. The watersheds of Dam 10A and Dam 10B, which each have no functioning low level outlet, were also removed from the watershed of Dam 11, for calibration purposes only. These watersheds are included in the watershed HECHMS model.

Dam Data

The dam data used were obtained from the District and included elevation-volume-discharge curves for each dam. The elevation-volume relationship derives from the original as-builts; and the elevation-discharge relationship derives from modeling with the Natural Resources Conservation Service (NRCS) hydrologic model SITES (NRCS, 2007).

Event Data

The events chosen for calibration included storms that occurred on June 25-29, 2007 and September 7-9, 2010 (Tropical Storm [TS] Hermine). These storms were chosen as the largest events that occurred during the period of stage and rainfall measurements by the District. These events were also independently identified as the most severe recent floods during meetings with TAC stakeholders. The specific datasets that were assembled and considered included:

- District stage data. These data were collected at selected dams during each of these two events at 5-minute intervals. In 2007, some gages had not been installed; and in 2010, several stage gages malfunctioned.
- District rainfall data. These data were collected at selected dams during each of these two events at 5-minute intervals.

- Rainfall data from the National Oceanic and Atmospheric Administration's (NOAA) City of Round Rock gage.
- Rainfall data from the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) precipitation gages. These data are collected in partnership with NOAA and are available through the federal National Climatic Data Center (NCDC).
- Rainfall data from Weather Underground (WU). These datasets are available from the WU website on-line and are a less reliable source than the other listed rainfall data sources.

Discussion of Storms Used in Calibration

June 2007 Storm

Spatial Variation

The spatial variation of rainfall data for the June 2007 storm (total event) is depicted on Figure H-2. Data from all available gages in the Upper Brushy Creek Watershed were assembled for the 2007 event to include all sources listed in the previous section (District, NOAA, CoCoRaHS, and WU). Outliers with obvious data errors were removed by hand. Event rainfall totals were interpolated to create a surface of rainfall distribution using the method known as kriging, which is a purely statistical interpolation scheme designed to handle spatial fluctuations and standard error in data. The figure only shows gages within or near the study area; the rainfall contours in the figure were derived using gages throughout the figure area.

ARC Variation

Figure H-3 depicts rainfall measured by the Dam 13A rain gage during the period prior to the June 2007 storm. About 2.26 inches of rainfall fell in the 2 weeks prior to the June 2007 event. Dam 13A was selected because the watershed for this dam is located within a high rainfall volume area for both calibration storms.

Rainfall Intensity Variation

Figure H-4 depicts a running 1-hour average of rainfall measured at Dam 13A. The rainfall is shown on a timescale from start-of-storm to allow for comparison versus storm shape between this storm, the September 2010 storm, and the storm (NRCS Type III) to be used in deriving flows for regulatory floodplain delineation. In general, a large majority of rainfall from this storm fell within 2 hours, giving this storm a similar shape to the regulatory storm.

Annual Exceedance Probability (AEP)

The AEP for a storm within a region varies by storm duration. Within the Capitol Area, a 6-inch rain within 24 hours has an AEP of 0.1 (or an estimated return period of 10 years), while the same rain within 1 hour has an AEP of 0.02 (or an estimated average return period of 500 years). Table H-1 shows the variation in rainfall depth and return period per City of Austin drainage criteria. Table H-2 shows the analyses performed using data collected at each District dam that collected rain data during the June 2007 storm. The upper half of this table shows the maximum rainfall measured during this storm within a set duration, e.g., at Dam 13A, the maximum rainfall depth measured during a continuous 1-hour period during the storm was 2.9 inches. The lower half of the table estimates the statistical return period for each rainfall depth depicted in the upper half, e.g., the estimated return period for 2.9 inches of rain in 1 hour would be about 16 years. The table shows that there was considerable variation in storm return period by duration and location within the watershed. In general, the storm was most severe when considering a 2-hour duration in the northern half of the Upper Brushy Creek watershed. The storm had a return period for a 2- to 3-hour duration of between 40 to 80 years (0.025 to 0.0125 AEP) in the north and 5 to 15 years in the south.

Table H-1. Rainfall Depth-Duration-Frequency

Recurrence Interval (years)	Depth of Precipitation (in inches)								
	5 min*	15 min	30 min	1 hr	2 hrs	3 hrs	6 hrs	12 hrs	24 hrs
2	0.48	0.98	1.32	1.72	2.16	2.32	2.67	3.06	3.44
5	0.62	1.26	1.71	2.28	2.89	3.13	3.56	4.07	4.99
10	0.71	1.47	1.98	2.68	3.42	3.71	4.21	4.81	6.1
25	0.84	1.76	2.36	3.28	4.2	4.55	5.14	5.9	7.64
50	0.94	2.01	2.68	3.79	4.88	5.28	5.94	6.86	8.87
100	1.05	2.29	3.04	4.37	5.66	6.11	6.85	7.96	10.2
250	1.21	2.73	3.57	5.26	6.86	7.38	8.24	9.67	12
500	1.33	3.11	4.02	6.06	7.94	8.51	9.47	11.2	13.5

*From Table 2-4, Depth-Duration-Frequency Table for Austin and Travis County (COA, 2009).

Table H-2. Summary of Rainfall from September 2007 Storm per Gages at District Dams

Duration	Dam 1	Dam 2	Dam 3	Dam 4	Dam 5	Dam 7	Dam 8	Dam 11	Dam 12	Dam 13A	Dam 14	Dam 16	Dam 17
	Maximum Rainfall Depths Within Duration (Inches)												
5 min	0.5	0.6	0.5	0.5	0.4	0.2	0.4	0.2	0.5	0.4	0.4	0.4	0.4
15 min	1.3	1.4	1.2	1.2	1.2	0.4	0.8	0.4	1.2	0.8	1.1	1.0	0.9
1 hrs	3.1	3.9	3.0	3.1	2.9	0.9	2.0	0.9	2.7	2.9	3.0	3.1	2.7
2 hrs	4.5	4.8	3.2	4.2	3.3	1.0	2.2	1.2	2.9	5.4	4.7	4.2	5.0
3 hrs	4.5	4.8	3.3	4.4	3.3	1.2	2.8	1.3	3.1	5.6	4.9	4.8	5.2
6 hrs	4.9	5.0	3.3	4.4	3.4	1.2	2.8	1.3	3.3	5.6	4.9	4.8	5.3
12 hrs	5.1	5.1	3.4	4.4	3.5	1.2	2.8	1.3	3.3	5.8	4.9	4.8	5.4
24 hrs	5.2	5.1	4.4	6.2	4.3	1.7	3.1	1.4	3.5	6.0	5.1	5.2	5.6

Duration	Dam 1	Dam 2	Dam 3	Dam 4	Dam 5	Dam 7	Dam 8	Dam 11	Dam 12	Dam 13A	Dam 14	Dam 16	Dam 17
	Return Period of Maximum Rainfall Depths (Years)												
5 min	2	2	2	2	2	1	1	1	2	1	2	2	2
15 min	5	8	4	5	4	1	2	1	4	2	3	2	2
1 hrs	20	56	19	22	16	1	3	1	10	16	17	20	11
2 hrs	37	49	8	24	9	1	2	1	5	80	43	24	58
3 hrs	25	35	6	23	7	1	4	1	5	66	36	35	49
6 hrs	21	22	4	14	5	1	3	1	4	38	21	20	30
12 hrs	14	14	3	8	3	1	2	1	3	23	11	10	17
24 hrs	6	6	4	11	4	1	2	1	2	9	5	6	8

TS Hermine, September 2010

Spatial Variation

The spatial variation of rainfall data for TS Hermine (total event) is depicted on Figure H-5, which was derived in the same manner as Figure H-2.

ARC Variation

Figure H-6 depicts rainfall measured by the Dam 13A rain gage during the period prior to the storm. About 1.26 inches of rainfall fell in the 60 days prior to this event (compared to 2.28 inches in 2 weeks prior to the 2007 event). Watershed soils were much drier in late September 2010 than in late June 2007.

Rainfall Intensity Variation

Figure H-7 depicts a running 1-hour average of rainfall measured at Dam 13A. The TS data records from two dams are shown on this figure, to depict the variation in storm shape across the watershed. Rainfall measured at Dam 13A (mid-watershed) was much more intense than rainfall measured at Dam 1 (western watershed).

AEP

Table H-3 shows the analyses performed using rain data collected at each District dam which collected data during the TS. The table shows information in the same format as Table H-2. A glance at the table shows there was considerable variation in storm return period by duration and location within the watershed. In general, this storm included a large volume of rainfall in the central to western portion of the watershed and a much reduced volume in the eastern portion. In the west and central, the event exceeded a 100-year return period (0.01 AEP) for durations

Table H-3. Summary of Rainfall from TS Hermine per Gages at District Dams

Duration	Dam 1	Dam 2	Dam 3	Dam 4	Dam 5	Dam 7	Dam 8	Dam 11	Dam 12	Dam 13A	Dam 14	Dam 16	Dam 17	Dam 19	Dam 21
	Maximum Rainfall Depths Within Duration (Inches)														
5 min	0.4	0.4	0.2	0.2	0.4	0.4	0.4	0.3	0.4	0.5	0.3	0.4	0.2	0.2	0.1
15 min	0.9	1.0	0.6	0.6	0.9	1.0	1.1	0.8	1.0	1.2	0.7	0.7	0.6	0.5	0.3
1 hrs	2.0	2.3	1.9	1.8	2.7	3.6	2.9	1.9	3.1	4.1	1.6	1.4	1.4	0.9	0.6
2 hrs	2.8	2.8	2.8	3.2	4.1	5.3	4.8	2.3	4.4	6.3	2.2	1.7	1.8	1.1	0.6
3 hrs	3.7	3.5	3.9	4.8	5.8	6.9	6.2	2.5	5.1	7.7	2.2	1.8	1.9	1.3	0.8
6 hrs	6.2	5.3	6.3	7.6	8.5	8.0	7.7	4.6	7.6	9.1	3.6	2.6	2.6	1.8	1.4
12 hrs	8.5	8.5	8.9	9.6	10.9	9.4	9.3	5.7	9.3	10.7	5.2	4.2	4.3	3.3	2.4
24 hrs	9.8	9.8	10.7	10.9	12.4	10.8	11.3	7.1	10.9	12.3	7.0	5.5	5.6	4.8	3.7
Duration	Dam 1	Dam 2	Dam 3	Dam 4	Dam 5	Dam 7	Dam 8	Dam 11	Dam 12	Dam 13A	Dam 14	Dam 16	Dam 17	Dam 19	Dam 21
	Return Period of Maximum Rainfall Depths (Years)														
5 min	1	2	1	1	2	2	2	1	2	2	1	1	1	1	0
15 min	2	2	1	1	2	2	3	2	2	5	1	1	1	1	1
1 hrs	4	5	3	2	11	42	16	3	21	73	2	2	2	1	1
2 hrs	5	4	4	8	24	78	47	3	34	175	2	2	2	1	1
3 hrs	10	9	14	32	83	187	108	3	44	316	2	2	2	1	1
6 hrs	65	30	68	185	312	227	189	16	185	424	5	2	2	1	1
12 hrs	148	144	179	241	452	227	220	23	217	420	16	6	6	3	2
24 hrs	87	87	140	159	323	149	188	20	162	297	18	7	8	5	3

ranging from 2 hours to 24 hours, and in most cases, between 3 hours and 6 hours. In the east, the event was relatively minor, with a return period varying from 3 to 10 years for durations of 12 hours and above.

Comparison of the Two Storms

Table H-4 provides a summary comparison of the two storms using the points noted in each section above. The primary difference between the two storms relevant to CNs is the difference in ARC. The June 2007 storm occurred when the watershed had had recent sizable rains; the September 2010 storm came after a prolonged period of very little rain.

Table H-4. Comparison of Calibration Storms

Point of Comparison	June 2007 Storm	TS Hermine	Comment
Spatial Variation	High intensity rainfall in northern county and Leander	Extreme rainfall throughout west and central watershed, to include Leander, Cedar Park, and Austin	Both storms much less intense in eastern watershed.
ARC	Moderate: substantial rains within 2 weeks of main event	Very dry: very little rain over previous 2 months	Should expect a calibrated CN for 2007 to be about an ARCII condition, and for 2010, on or about an ARCI condition.
Return Period, Rainfall Durations ≤ 1 hr	On the order of 20- to 50-year return period storm in main area of storm	On the order of 2- to 5-year storm in main area of storm	A storm similar to the 2007 storm would be expected to stress small to medium watershed (approx. 1 hr lag time) local drainage: storm drains, road conveyance. The 2010 storm would have less severe effect.
Return Period, Rainfall Durations 2 hrs	On the order of 20- to 50-year return period storm in main area of storm	Varies within main storm area: part has 5- to 10-year return period, part has 20- to 175-year return period	Both storms similar for this duration.
Return Period, Rainfall Durations 3 hrs to 24 hrs	Return period diminishing with increase in duration	Return period increasing with increase in duration, up to 300+ years for 24 hours	Downstream main stem (with large watershed with longer lag time) expected to have much worse flooding in 2010 than 2007.
Return Period, Rainfall Durations 24 hrs	5- to 10-year return period, much less than design storm for flood pools of dams	90- to 320-year return period, equal to much greater than design storm for flood pools of dams	District dams provided designed flood protection in 2007, capacity (to contain regulatory flood) exceeded in 2010.

Methodology for Calibration of CNs

General

A hydrologic model of a single watershed above a point of discharge uses a temporal distribution of rainfall as an input and estimates the temporal distribution of runoff (hydrograph) at that point of discharge. In standard hydrologic methods, including the NRCS method used for Upper Brushy Creek modeling, two different watershed parameters are used to define the hydrograph: the CN and the lag time. The CN defines the total area under the hydrograph (total watershed runoff volume), while the lag time defines the temporal shape of that runoff (rate of rise in flow, time of flow peak, rate of drop of inflow following the peak).

The CN is used to estimate the average depth of runoff (e.g., in inches) given an average depth of rainfall (e.g., in inches). The relationship between these parameters, per the NRCS method, is given by the following set of equations:

$$Q = \frac{(P - I_A)^2}{P - I_A + S}\text{; where } S = \frac{1000}{CN} - 10\text{; and the default value of } I_A = 0.2S$$

Where:

- Q = Depth of runoff in inches;
- I_A = Initial abstraction (roughly the amount of rainfall needed to produce runoff);
- P = Depth of rainfall in inches;
- CN = Curve number; and
- S = factor that is an inverse function of CN.

From the nature of the equations, if rainfall depth and CN are known, runoff depth can be estimated.

The method being used for the Upper Brushy Creek watershed essentially divides each watershed into two different areas: an impervious area (where 100% of rainfall is estimated to be converted to runoff) and a pervious area with a CN. In this case, total runoff $Q_{tot} = Q_{CN} + Q_{imp}$, where:

Q_{tot} = Total watershed runoff.

Q_{CN} = Runoff from the portion of the watershed defined by a CN.

Q_{imp}= Runoff from the impervious portion of the watershed.

For a given rainfall event over a District dam watershed, the following data are available for analysis:

- Rainfall (P) over the watershed. There are various alternatives for use of available data, discussed in the following section.
- Stage data (reservoir elevation versus time at 5-minute intervals) for the dam reservoir. These data can be converted to total watershed runoff (Q_{tot}) as described in the following section.
- Percent impervious. The percent of each watershed that is paved (impervious) has been measured using multispectral imagery. The runoff from the impervious area (Q_{imp}) is estimated multiplying the impervious area times the rainfall depth (P).

Given these data-based measurements for Q_{tot}, P, and Q_{imp}, the CN for a watershed can be estimated as follows:

- The remaining percentage of watershed after the impervious area is removed is the portion of the watershed where runoff volume is defined by a CN. The runoff from the pervious area (Q_{CN}) is estimated by subtracting the volume of runoff from the impervious area (Q_{imp}) from the total watershed runoff (Q_{tot})
- Given Q_{CN}, an assumed relationship between I_A and CN, and a value for P, the CN can be estimated.

Application to Upper Brushy Creek Watershed for 2007 and 2010 Storm Events

This section describes how the above basic theory was applied to the Upper Brushy Creek watershed using data available from the two selected storm events.

Estimation of Watershed Rainfall

Three different sets of rainfall data were used to estimate rainfall over each watershed studied:

- Rainfall data collected by the District gage at/near the dam embankment.
- NEXRAD radar-based spatial rainfall estimates. These estimates are available from NOAA at a 60-minute interval on a 4-km grid. These estimates at the time of the 2007 and 2010 storms did not consider data from the District rain gages. District and NEXRAD rainfall data for the same location can differ substantially. Ultimately, NEXRAD rainfall estimates for this watershed were rejected for this reason.
- Rainfall data from all point sources (District, NOAA, CoCoRaHS, and WU), edited to remove obvious outliers, were converted to a rainfall surface using statistical kriging. Average total event rainfall depth over the watershed was estimated from this surface.

Estimation of Total Watershed Runoff

Total watershed runoff was estimated using stage data collected at District dams during the selected storm events. Not all dams were considered in each event, for the following reasons:

- In 2007, only selected dams had gages installed; and
- In 2010, the gages at several dams (including Dam 7 and Dam 2 per FNI, 2012) malfunctioned and did not provide reliable data.

The data from two dams (Dam 4 and Dam 9) were rejected following analysis, as results pointed to inconsistencies between the elevation-volume curves for these reservoirs and the elevation discharge curves. The explanations for this issue range from a poor as-built survey to unexplained significant losses from the reservoirs due to karst features. Note that none of the District dams have regional flood control structures (i.e., designed with a 100-year flood pool) upstream in the watershed, except Dam 7, for which data were rejected, and Dam 11, which has Dams 10A and 10B upstream within the watershed. For Dam 11, an assumption was made that runoff from the watersheds of Dams 10A and 10B were entirely retained.

For each dam for which reliable data were estimated to be available, incremental reservoir inflow volume for each storm event was estimated at 5-minute intervals (the frequency of stage data collection) as a simple water balance:

> Inflow volume in the 5-minute span = change in storage volume during the previous timestep (estimated by the measured change in stage versus the elevation-volume curve) + volume of flow discharged through dam spillways (principal and/or auxiliary spillways) estimated by flow through the spillways at the average timestep stage per the elevation-discharge curve

This simple water balance was used in lieu of the modified Puls method because the near continuous, 5-minute data made further water balance refinement unnecessary.

The result of the application of a water balance to the stage data set was an inflow hydrograph to each dam, starting from time of start of rainfall and extending well past peak reservoir stage. This hydrograph was divided into two parts (direct runoff and interflow) using standard hydrograph separation techniques described in *Water Resources Engineering* (Linsley and Franzini, 1978). Direct runoff, per this reference, was estimated to stop at a time equal to $A^{0.2}$ days after the measured time of peak, where A is the basin area in square miles. There was no appreciable base flow prior to either storm event at any dam. The area under the portion of the hydrograph (flow times time = volume) attributable to direct runoff was the estimated total watershed runoff.

Estimation of Runoff from Impervious Area

Runoff volume from watershed impervious area was estimated as watershed impervious area times the depth of rainfall.

Estimation of Runoff from Pervious Area

Runoff volume from watershed pervious area was estimated as total watershed runoff minus runoff from impervious area.

Estimation of CN

The formulas presented above were used to estimate the CN, given the measured watershed rainfall and watershed runoff from pervious area. Given that a large portion of this watershed is within the Edwards Formation, it was expected that initial abstractions would likely exceed the default value estimated by the formula IA = 0.2S. A series of CNs were calculated based upon a wide range of initial abstractions, and it was found that an assumption of IA = 0.2S produced consistent and reasonable results.

Adjusting for Differences in ARC

As noted in the descriptions of the two studied storm events, the watershed was much drier prior to the 2010 TS Hermine event than prior to the June 2007 event. To adjust for this difference, the watershed prior to the TS Hermine event was assumed to be in ARCI, and the watershed prior to the June 2007 event was assumed to be in ARCII. The estimated CNs from the Hermine analysis were converted from ARCI values to ARCII values using Table 10-1 from NEH Part 630 (NRCS, 2004), reproduced here as Table H-5.

Table H-5. CNs Versus ARC

ARC I	ARC II	ARC III
100	100	100
97	99	100
94	98	99
91	97	99
89	96	99
87	95	98
85	94	98
83	93	98
81	92	97
80	91	97
78	90	96
76	89	96
75	88	95
73	87	95
72	86	94
70	85	94
68	84	93
67	83	93
66	82	92

ARC I	ARC II	ARC III
41	61	78
40	60	78
39	59	77
38	58	76
37	57	75
36	56	75
35	55	74
34	54	73
33	53	72
32	52	71
31	51	70
31	50	70
30	49	69
29	48	68
28	47	67
27	46	66
26	45	65
25	44	64
25	43	63

ARC I	ARC II	ARC III
64	81	92
63	80	91
62	79	91
60	78	90
59	77	89
58	76	89
57	75	88
55	74	88
54	73	87
53	72	86
52	71	86
51	70	85
50	69	84
48	68	84
47	67	83
46	66	82
45	65	82
44	64	81
43	63	80
42	62	79

From NEH, Part 630 (NRCS, 2004).

ARC I	ARC II	ARC III
24	42	62
23	41	61
22	40	60
21	39	59
21	38	58
20	37	57
19	36	56
18	35	55
18	34	54
17	33	53
16	32	52
16	31	51
15	30	50
12	25	43
9	20	37
6	15	30
4	10	22
2	5	13
0	0	0

Adjusting for Climate per 2011 TXDOT Hydraulic Design Manual

In October 2011, the Texas Department of Transportation (TXDOT) issued a revision to its Hydraulic Design Manual (TXDOT, 2011). This version included a revised Chapter 4 (Hydrology). In a subsection of Chapter 4 titled "Climatic Adjustment of CN," TXDOT presents a method whereby CN "may be adjusted to account for the variation of climate within Texas." The method involves:

- Adjusting the standard CN (C_{pred}, developed by methods similar to those used for TM2) by subtracting an adjustment factor (15 for the Upper Brushy Creek watershed within Williamson County) taken from Figure 4-21 to estimate a CN_{obs} (CN adjusted for climate);
- Comparing CN_{obs} to locally derived values (as this TM does for the 2007 and 2010 storm events); and
- "The result should be a range of values that are reasonable for a particular site."

TXDOT puts the lower bound on CN to be used as the ARCI value or a value of 60, whichever is greater. Both the CN per TM2 and the CN_{obs} per the 2011 TXDOT methodology are presented for comparison purposes in the calibration results.

CN Calibration Results

Table H-6 provides a summary of CN calibration results. The table includes:

- "Computed values" of ARCII CN per the methods of TM2, with and without CN adjustment per the 2011 TXDOT Hydraulics Manual.
- Calibrated ARCII CNs using rain data from each District dam as estimated watershed average rainfall for the watershed of that dam.
- Calibrated ARCII CNs using spatial rain data from NEXRAD to estimate watershed average rainfall using GIS techniques.
- Calibrated ARCII CNs using an average of spatially varying rain data across each dam watershed per kriging of rain data from all available point sources within the watershed.

The CNs shown for the TS Hermine event have been converted from ARCI to ARCII.

Table H-6. CN Calibration Summary

			CNs Derived per Calibration					
	Computed Values per TM2		Using District Gage Precip		Using NEXRAD Precip		Using Kriging Precip	
Watershed	No Adjustment	Adjusted per TXDOT, 2011	2007 Event	TS Hermine†	2007 Event	TS Hermine†	2007 Event	TS Hermine†
Dam 1	82.52	67.52	72.2	63.4	90.0	67.0	81.6	64.1
Dam 2	80.19	65.19	64.9	*	85.5	*	79.5	*
Dam 3	79.83	64.83	66.7	60.3	81.5	76.0	80.0	71.5
Dam 5	79.48	64.48	60.0	60.1	63.4	64.4	60.2	66.2
Dam 6	80	65	*	**	*	62.9	*	63.6
Dam 11	78.2	63.2	60.7	70.6	73.1	35.3	72.5	50.2
Dam 12	80.25	65.25	58.9	57.0	58.7	48.1	57.0	61.8
Dam 13A	80	65	61.6	66.4	67.5	66.3	65.9	72.8
Dam 14	80.53	65.53	84.8	41.4	93.3	18.7	93.1	44.4
Dam 16	80.08	65.08	-	66.6	-	41.4	-	51.0
Dam 19	77.58	62.58	-	69.3	-	75.8	-	69.2
Average (excluding Dam 14)	79.88	64.88	63.6	64.2	74.2	59.7	71.0	63.4

- Gage not installed.
* Unreliable stage data from gage.
** Unreliable precipitation data from gage.
† Calculated CN for TS Hermine were increased from ARCI values to ARCII values using Table H-5.

Discussion of Calibration Results

A review of the calibration results leads to the following discussion:

- There is little variation in computed values for CN. This is indicative of little variation within undeveloped land within the watershed in land use, vegetation, and hydrologic soil type. The primary source of variation in predicted runoff using CNs with such little variation in value will be generated by differences in watershed impervious area.
- Dam 14 results are inconsistent with results of all other dams: the estimated ARCII CN from the 2007 event is much higher (more than double) than the estimated CN from TS Hermine.
- The NEXRAD CN calibration results include several anomalies in the TS Hermine results relative to the other two sets of calibrated CNs, notably the results for Dam 11 (low), Dam 12 (low), and Dam 16 (low). The NEXRAD data are known to be inconsistent with the more precise District gage data.
- The kriging-based rain data shows more variation in predicted CN between the two events than is present in results derived from District rain data. The kriging procedure includes results from numerous rain gages of unknown reliability.
- If Dam 14 results are removed, CNs derived using the District rain data show a remarkable consistency between the two events and between relatively wet and dry areas within each event.
- The results for Dam 13A, which has a watershed within the highest rainfall zones of both storms, shows a remarkably consistent CN across all the various forms of rainfall considered. This CN is very consistent with the CN derived using TM2 procedures and adjusted per the TXDOT Hydraulics Manual.
- The CNs derived from District rain data are generally consistent with and slightly lower than the CNs derived using TM2 procedures and adjusted per the TXDOT Hydraulics Manual.

Recommendation for CN Selection

The choice of CN to be used in hydrologic modeling is essentially between using a CN adjusted from ARCII conditions per the 2011 TXDOT methodology (which is supported by multiple model calibrations within the watershed for each of two storms), or a CN based upon ARCII conditions (which is the default method proposed in TM2).

First, the CN calibration and preceding TM2 watershed analysis show that there is little variation within the dam watersheds in terms of CN for undeveloped land. ARCII CN values computed per TM2 vary only between values of 77.5 and 82.5. The calibrated values of CN using District rain data also have a reasonably tight range: most values are between 60 and 66, with isolated values slightly outside this range. Calibrated CN values seem to generally track with the variation in computed CN values, particularly when considering the 2007 event. There does not appear to be justification to abandon the TM2-computed CNs and use a separate method to relate calibration results to the full watershed. The calibration results confirm the basic consistency across the watershed predicted by the TM2-based CN estimations.

If the TXDOT methodology CNs are used, then regulatory risk is defined with an ARC equivalent to that prior to the 2007 storm: about 1.8 to 2.2 inches of rainfall within the previous 2 weeks. This already considers a watershed condition much wetter than existed prior to TS Hermine.

If the ARC II CNs are used, then regulatory risk is defined as being commensurate with an ARC significantly higher than that prior to the 2007 storm (e.g., the ARCII CN for Dam 1 is 82.5; per the 2007 storm calibration, the CN is 72.2; therefore, the antecedent moisture condition prior to the 2007 storm was less than ARCII).

Table H-7 provides a comparison for selected District dam watersheds of the CN per the current FEMA regulatory hydrologic model (from 1991), and CN values per the TM2 and TXDOT methodologies.

Table H-7. CN Comparisons for Selected Dams

Watershed	FEMA Current Regulatory Model (1991)		CN per ARCII (TM2)	CN per TXDOT 2011
	Low CN	High CN		
Dam 1	61	61	82.52	67.52
Dam 2	61	63	80.19	65.19
Dam 4	63	71	79.48	64.48
Dam 5	61	61	79.48	64.48
Dam 12	61	61	80.25	65.25
Dam 13A	61	61	80	65

Given that: 1) the TXDOT methodology is based upon extensive model calibrations to gaged storms and floods in Texas over several decades; and 2) calibration results from two of the most extreme and most extensively gaged floods within the study area are consistent with results from use of the TXDOT methodology; it is clear that use of the TXDOT methodology is strongly supported by a significant body of statewide and local data.

Therefore, use of the TXDOT methodology for derivation of watershed CNs appears the most technically appropriate for use in study modeling.

References

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Natural Resources Conservation Service (NRCS), October 2007. *SITES 2005 Water Resource Site Analysis Computer Program, User Guide*, U.S. Dept. of Agriculture.

NRCS, July 2004. "Chapter 10, Estimation of Direct Runoff from Storm Rainfall," Part 630, Hydrology, *National Engineering Handbook*, 210-VI-NEH, U.S. Dept. of Agriculture.

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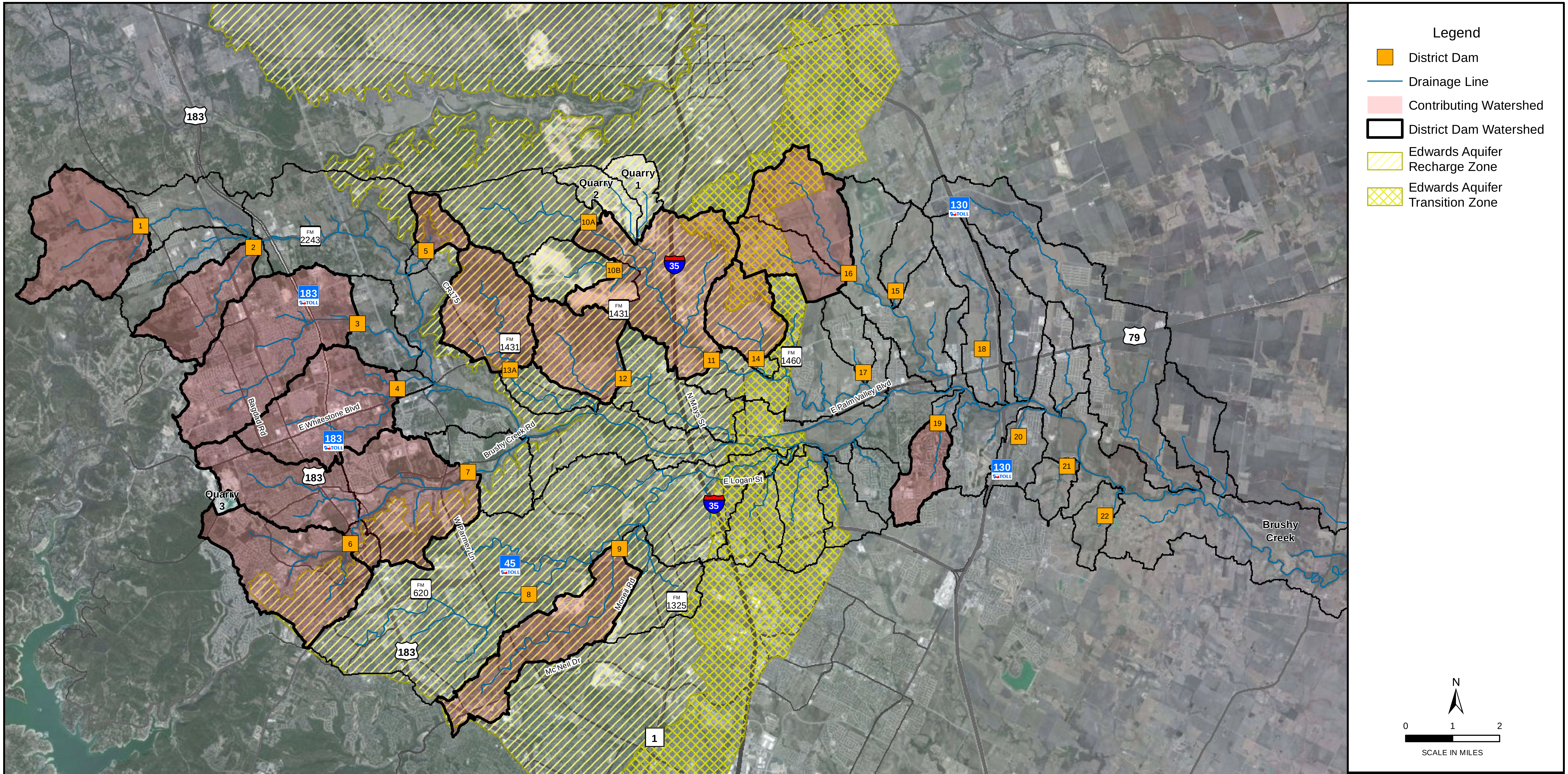
FIGURES



Upper Brushy Creek WCID

Uncontrolled Portion of Contributing Watersheds

Date: 6/12/2012 | Figure H-1

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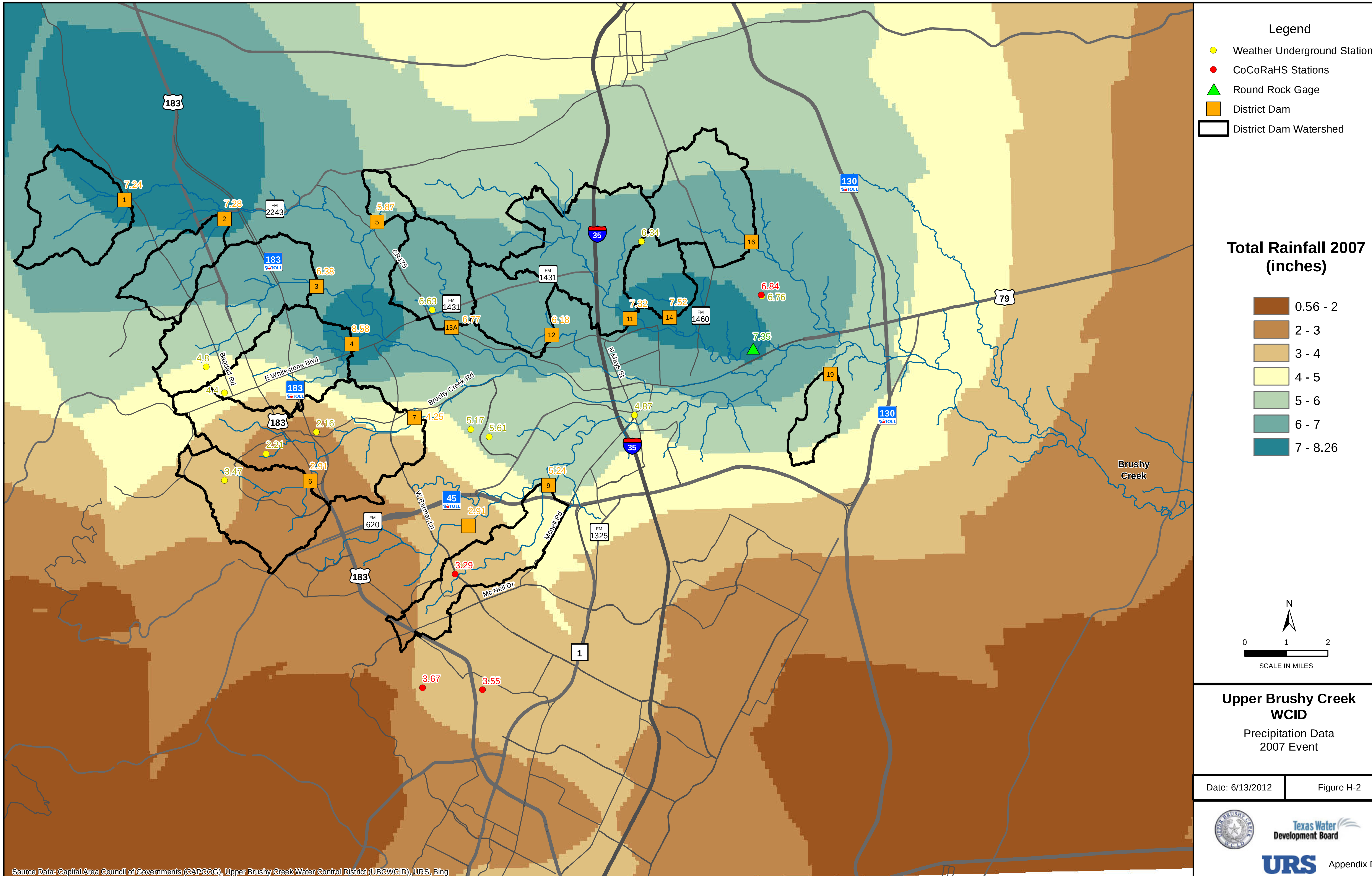
Appendix D



Upper Brushy Creek WCID

Precipitation Data
2007 Event

Date: 6/13/2012	Figure H-2

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Appendix D

Figure H-3: Antecedent Rainfall June 2007 Event

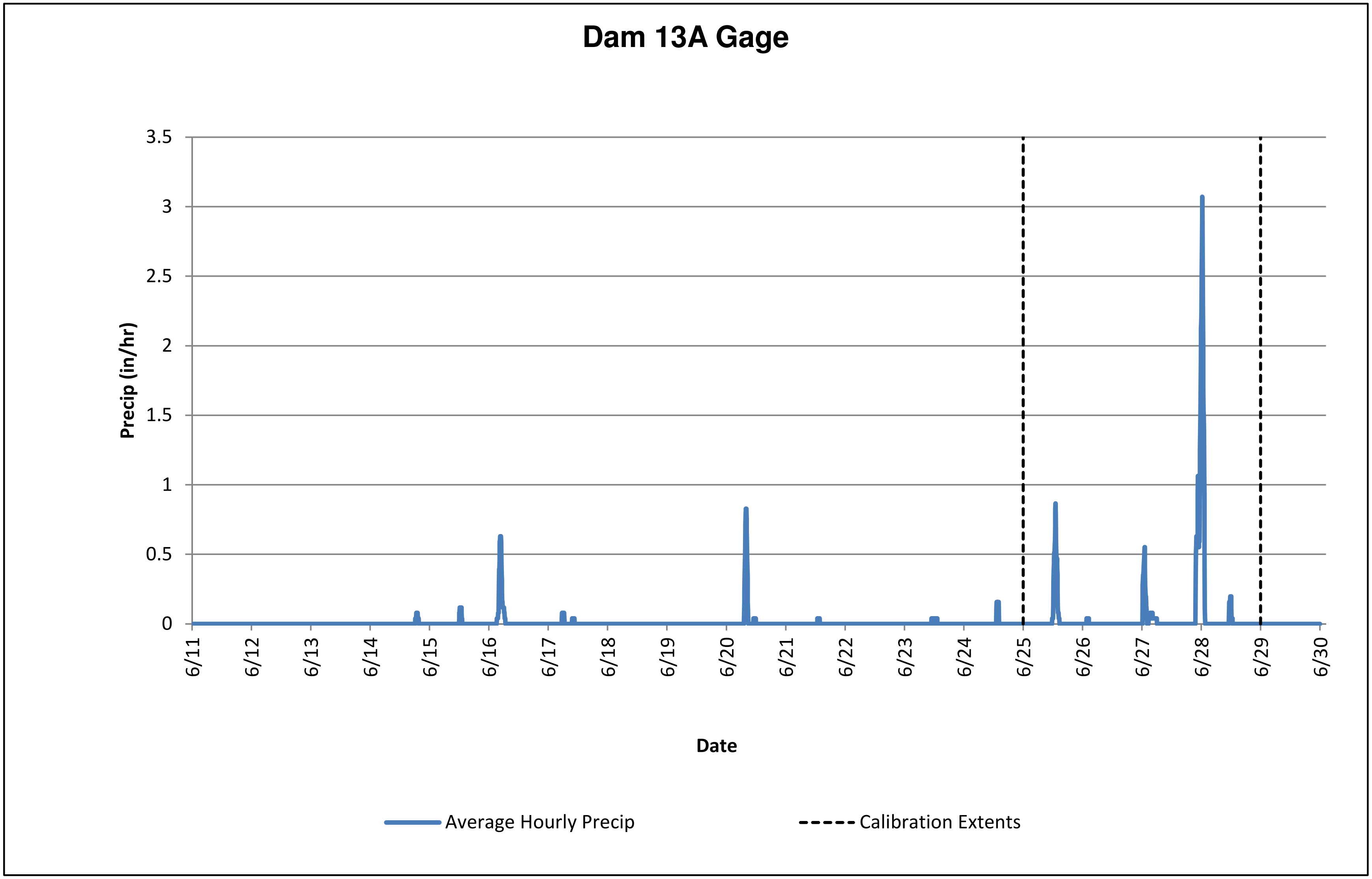
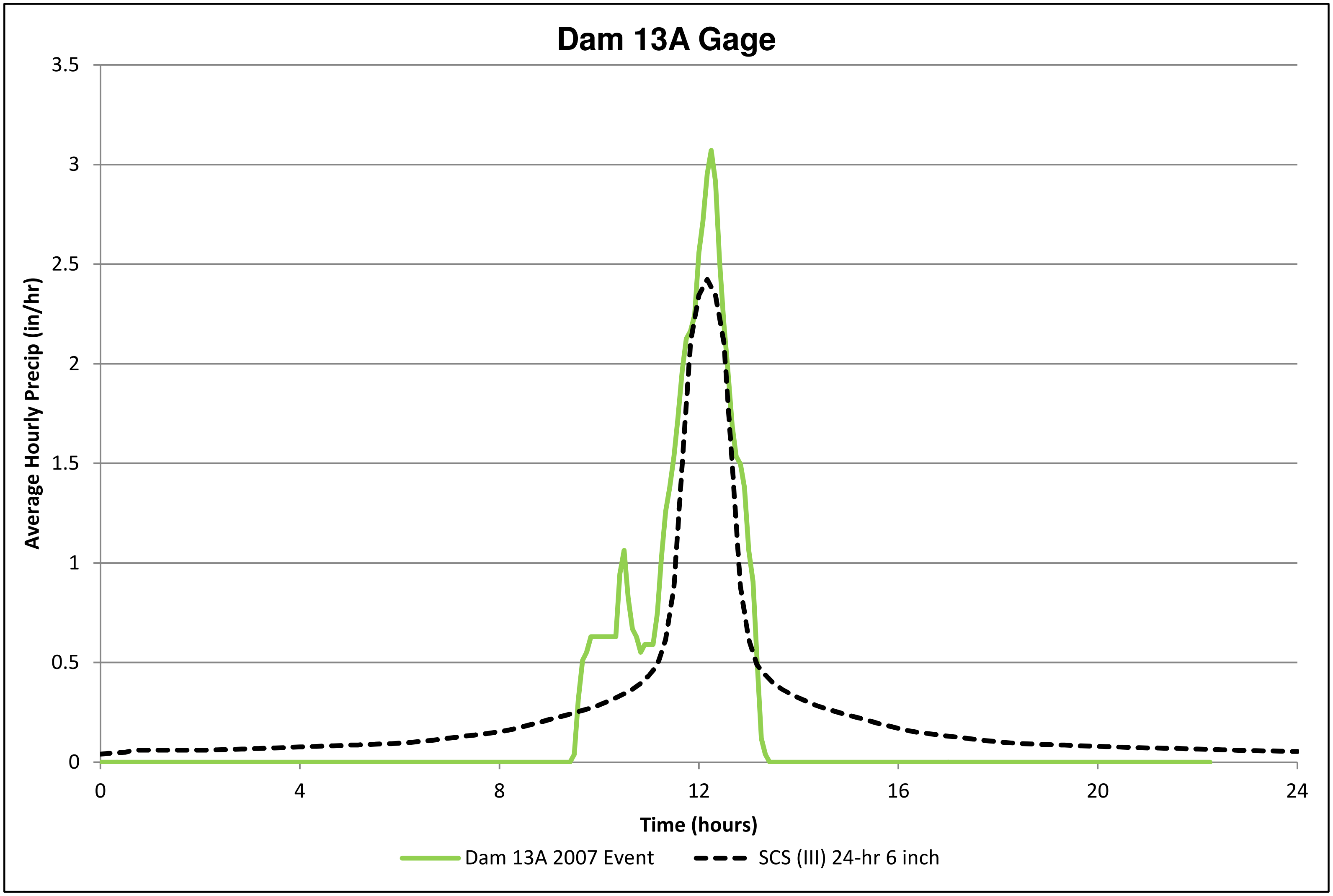
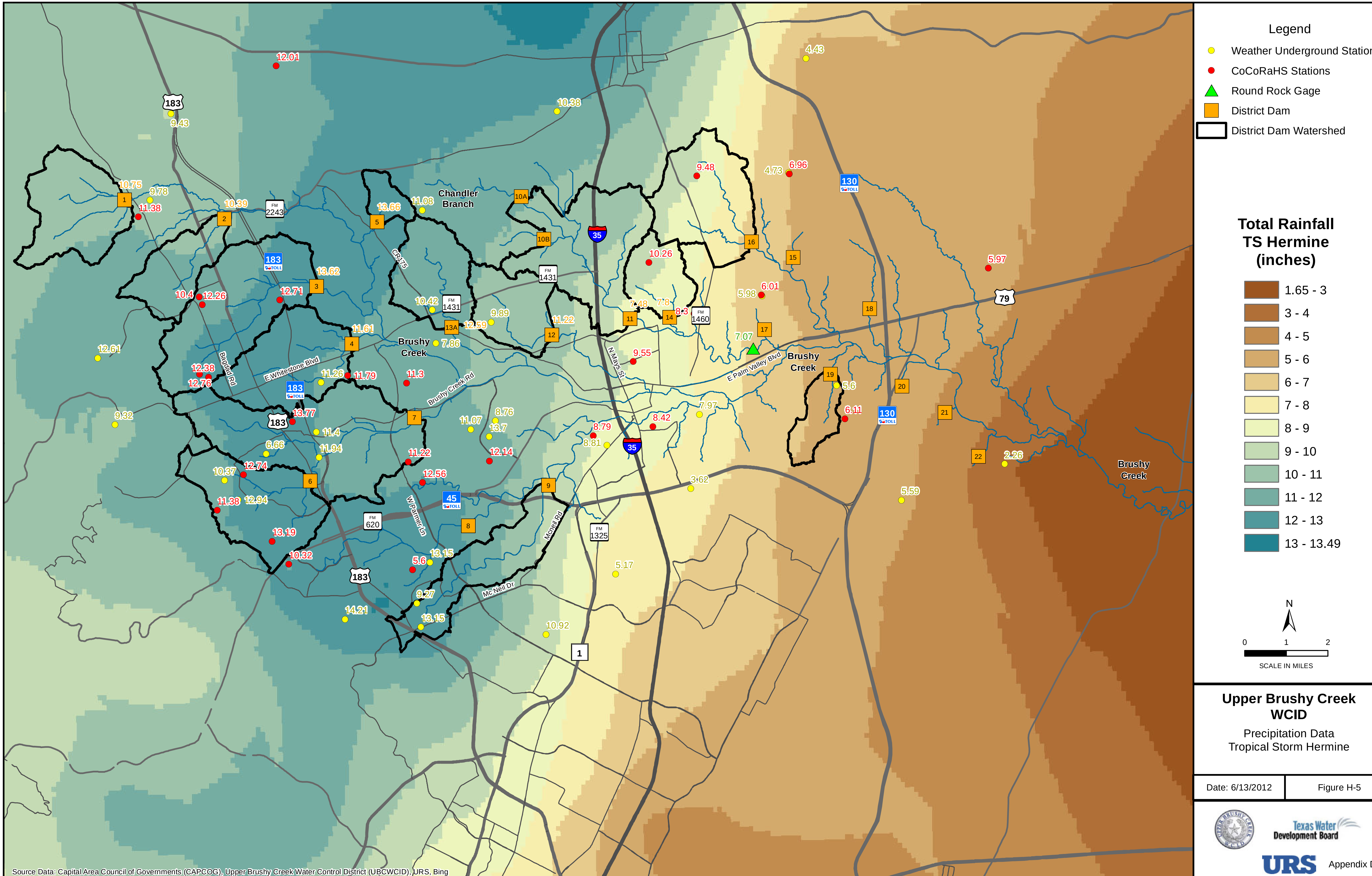


Figure H-4. Comparison of 2007 Storm Temporal Shape to SCS Type III Storm





Upper Brushy Creek WCID

Precipitation Data
Tropical Storm Hermine

Date: 6/13/2012	Figure H-5

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Appendix D

Figure H-6: Antecedent Rainfall Tropical Storm Hermine (2010)

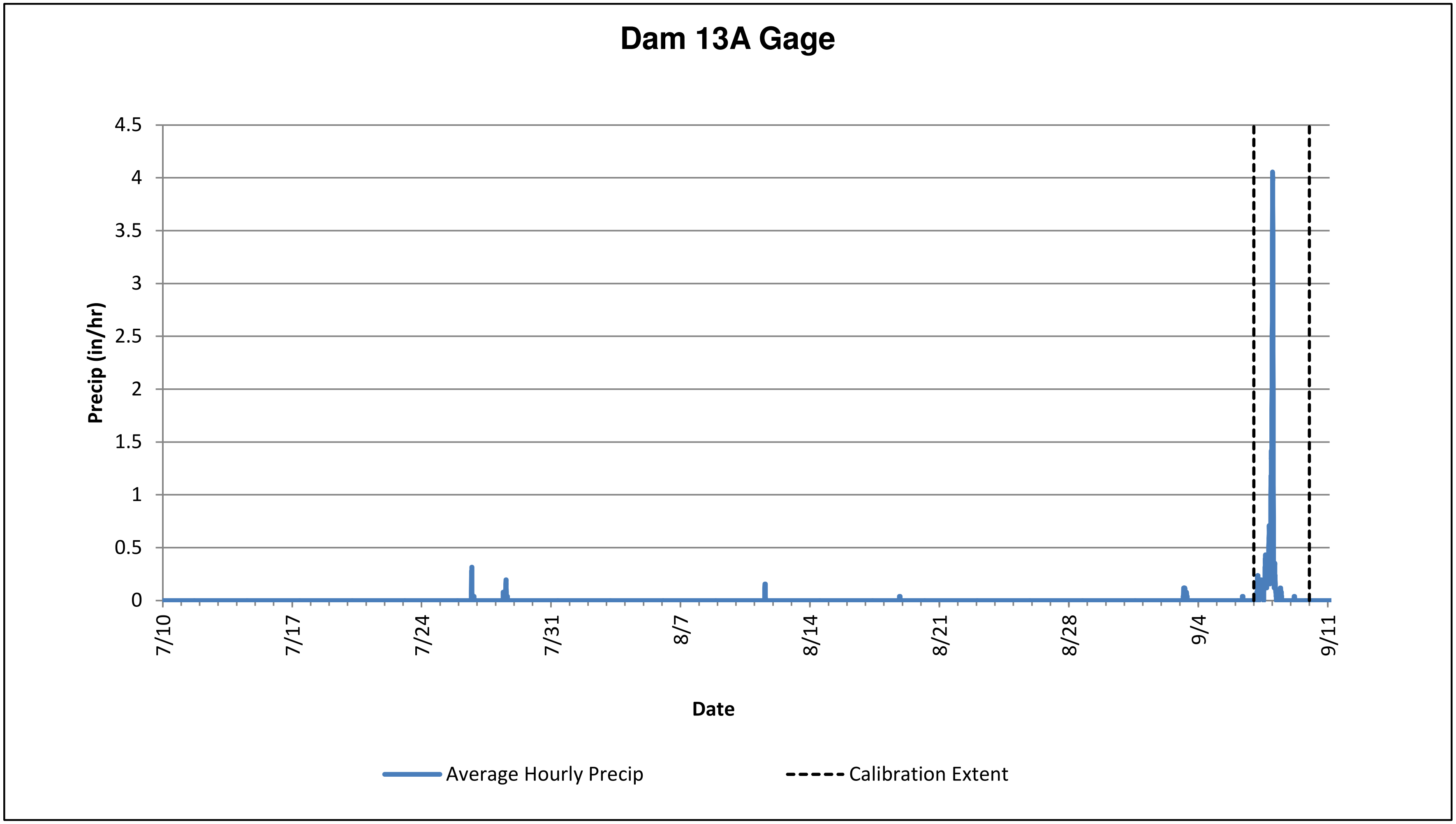


Figure H-7. Comparison of TS Hermine Temporal Shape to SCS Type III Storm

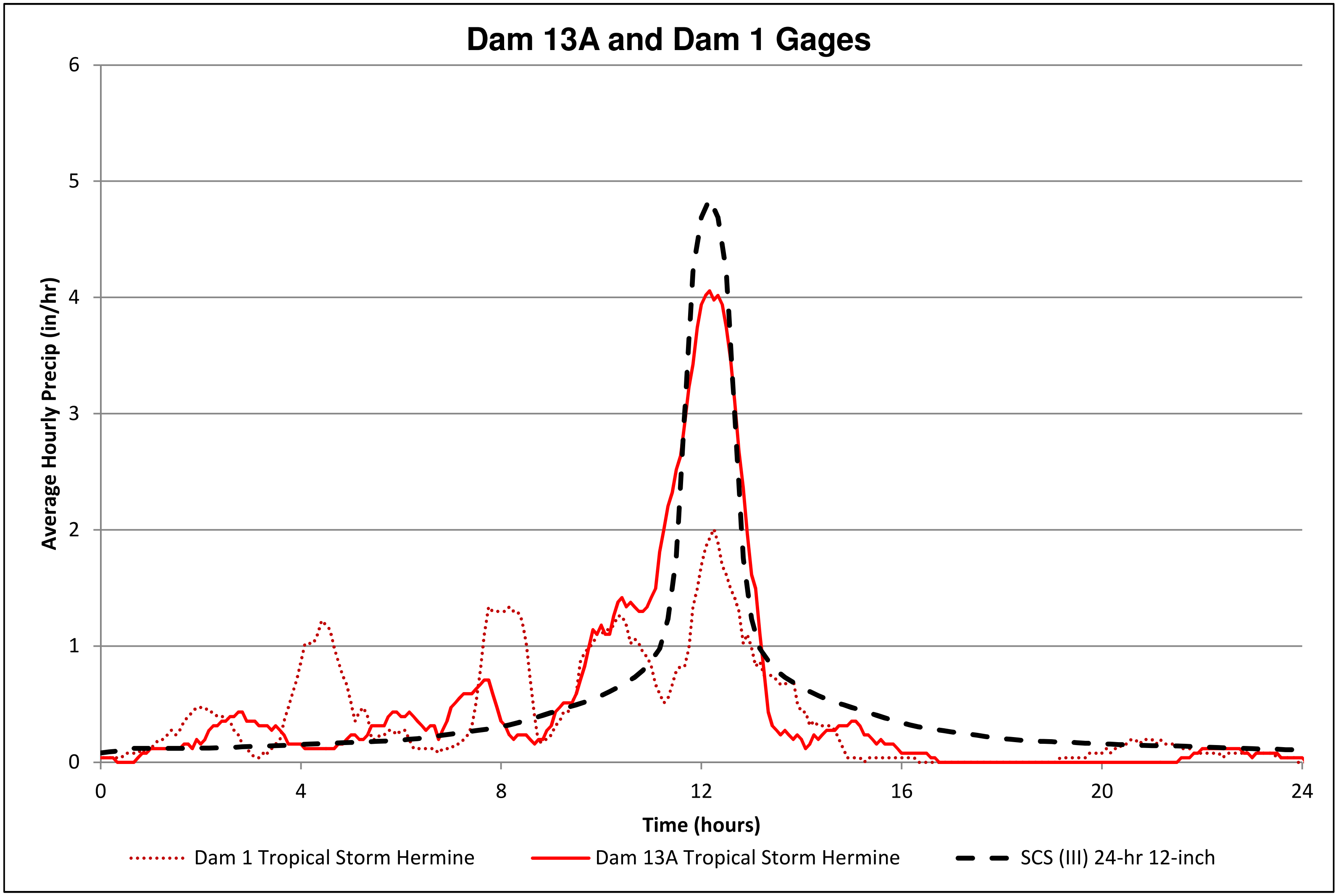


Exhibit I
Calibration of Lag Times

TO: Ruth Haberman, General Manager, Upper Brushy Creek Water Control and Improvement District

FROM: Jeff Irvin, PE, URS Corporation

DATE: June 19, 2012

RE: Discussion on Estimation of Lag Times for Floodplain Modeling

Memorandum Purpose

The purpose of this memorandum is to provide background on the technical issues associated with the estimation of a Lag Time for use in hydrologic modeling within the Upper Brushy Creek watershed. The flows that are the output of the hydrologic model (HEC-HMS) will be used as inputs into the Upper Brushy Creek hydraulic model, which will in turn be used to delineate floodplains for planning purposes, and also, per current intention, for regulatory floodplain use.

Technical Memorandum 2 (TM2) laid out the methods by which Lag Times were to be estimated for each watershed within the hydrologic model, per *TR-55: Urban Hydrology for Small Watersheds* (NRCS) (TR-55) methodology. The TR-55 methodology separates the time of concentration into three components: overland flow, shallow concentrated flow, and channel flow. The overland flow component is the most sensitive to parameter variation and was adjusted during lag time calibration by varying the length of the overland flow segment from 100 feet to 400 feet.

This memorandum provides:

- A summary of data sources accessed in development of lag time calibration;
- A brief discussion of the historic storm used in lag time calibration (detailed description in CN Calibration Memo);
- A discussion of calibration methodology;
- Presentation of calibration results; and
- Recommendation for lag time estimation.

Summary of Data Sources

In general, the calibration method involved applying event-specific rainfall data to individual dam watersheds, varying the sub-watershed lag time characteristics, and comparing the modeled dam inflow to the actual gage dam inflow. The calibrated curve numbers were used for each dam watershed modeled. This procedure required data on each watershed, each dam, and the storm for which the calibration was performed. Only dam watersheds with adequate gage data for the 2007 storm and no significant upstream detention were selected for lag time calibration.

Watershed Data

The watershed data that were used were consistent with the values derived for the HEC-HMS model and included:

- Watershed area. Watershed area (in square miles) for each dam was delineated using current Light Detection and Ranging (LiDAR) topographic data.
- Impervious area (percent of watershed area). Impervious area was delineated within each watershed using current multispectral imagery and ERDAS Imagine.
- Calibrated CN. These values were taken from the Curve Number Calibration Memorandum and are provided in Table I-1 for the dams selected for lag time calibration.

Table I-1. Calibrated Curve Numbers for Dams with 2007 Gage Data

NRCS Dam Number	Calibrated Curve Number
1	72.2
2	64.9
3	66.7
5	60.0
12	61.2
13A	61.6

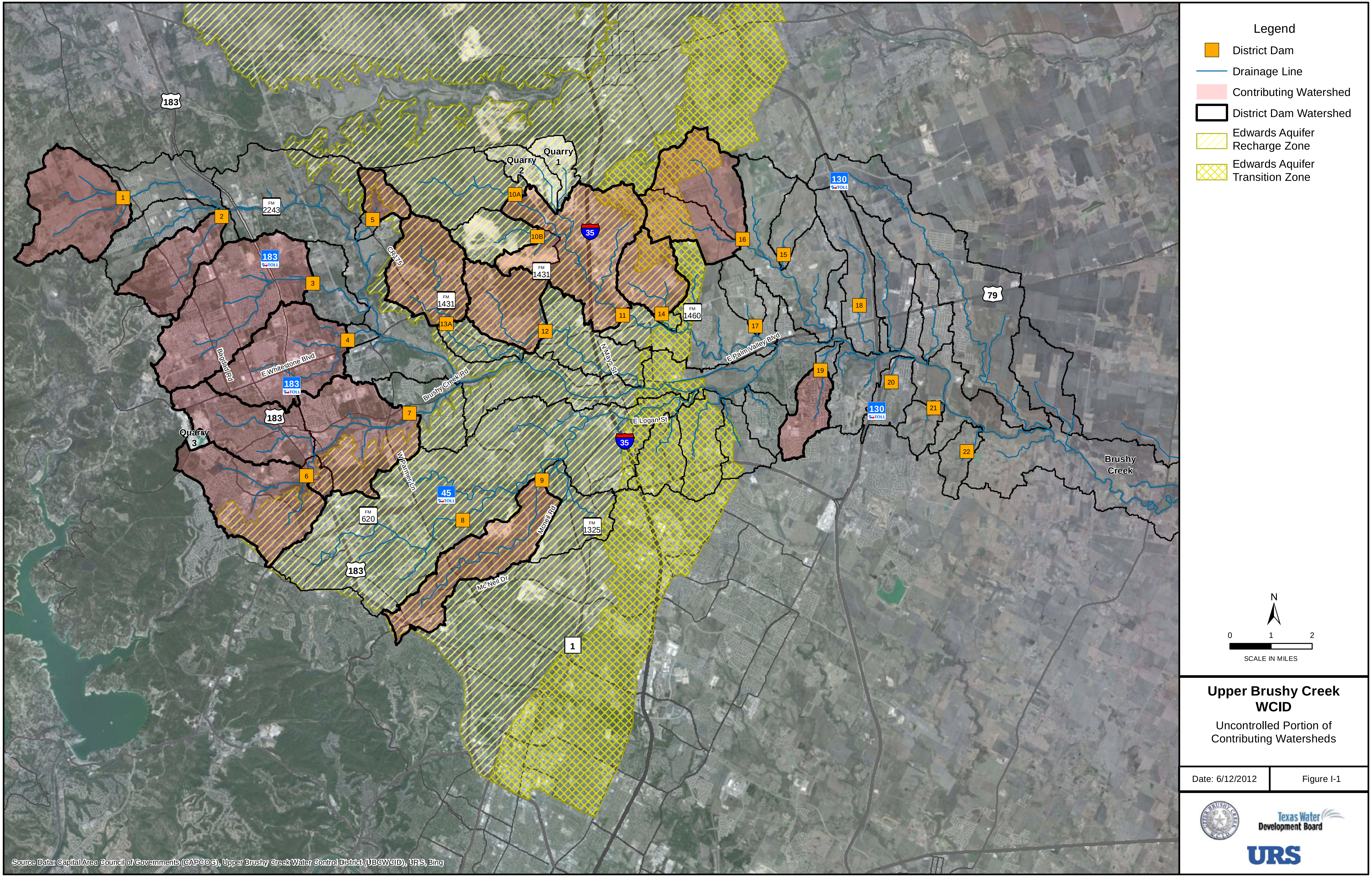
These dams were selected because:

1. They have reliable 2007 rainfall and stage gage readings at the dam.
2. Their contributing watersheds do not have significant upstream storage structures or additional upstream NRCS detention structures.

The District dam watersheds are depicted on Figure I-1.

Dam Data

The dam data used were obtained from the District and included elevation-volume-discharge curves for each dam. The elevation-volume relationship was derived from the original as-builts; and the elevation-discharge relationship was derived from modeling with the Natural Resources Conservation Service (NRCS) hydrologic model SITES (NRCS, 2007).


Legend
District Dam
Drainage Line
Contributing Watershed
District Dam Watershed
Edwards Aquifer Recharge Zone
Edwards Aquifer Transition Zone
N
0
1
2
SCALE IN MILES
Upper Brushy Creek WCID
Uncontrolled Portion of Contributing Watersheds
Date: 6/12/2012
Figure I-1
Texas Water Development Board
URS
Quarry 1
Quarry 2
Quarry 3
1
2
3
4
5
6
7
8
9
10A
10B
11
12
13A
14
15
16
17
18
19
20
21
22
183
FM 2243
FM 1431
FM 1460
FM 620
FM 1325
35
45
79
130
CR 175
Bagdad Rd
E Whitestone Blvd
Brushy Creek Rd
N Mays St
E Palm Valley Blvd
E Logan St
W Parmer Ln
Mcneil Rd
Mc Neil Dr
Brushy Creek
Source Data: Capital Area Council of Governments (CAPCOG), Upper Brushy Creek Water Control District (UBCWCID), URS, Bing

Event Data

The ideal shape of a rainfall event to use for lag time calibration is short duration, very intense (high rate of rainfall), and isolated (no other significant rainfall immediately before or after the intense rainfall period). The event selected for calibration occurred on June 25-29, 2007. This storm meets the “ideal shape” criteria, except that there were small, short rainfall events about one day preceding and following the main events. This storm was the largest event that occurred during the period of stage and rainfall measurements by the District with the exception of Tropical Storm Hermine. Tropical Storm Hermine was not utilized in lag time calibration because the multi-day distribution of the storm complicates interpretation of actual lag times. As such, only the 2007 storm event was utilized in Lag Time Calibration. This event was also independently identified as one of the most severe recent floods during meetings with TAC stakeholders. The specific datasets that were assembled and considered included:

- District stage data. These data were collected at selected dams during this event at 5-minute intervals. In 2007, some gages had not been installed.
- District rainfall data. These data were collected at selected dams during this event at 5-minute intervals.
- Rainfall data from the National Oceanic and Atmospheric Administration's (NOAA) City of Round Rock gage.
- Rainfall data from the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) precipitation gages. These data are collected in partnership with NOAA and are available through the federal National Climatic Data Center (NCDC).
- Rainfall data from Weather Underground (WU). These datasets are available from the WU website on-line and are a less reliable source than the other listed rainfall data sources.

Routing Cross-Section Data

The watersheds for each dam have been subdivided into subwatersheds of average 0.4 square mile area. The Muskingum-Cunge method of routing was selected for reach routing within the watershed. An eight-point cross-section was estimated for each reach based on current LiDAR topographic data. Channel and overbank roughness for each cross-section were estimated based upon review of cross-sections imposed upon aerial photography. Average reach slope was measured along the streamline within each routing reach.

Methodology for Calibration of Lag Times

General

A hydrologic model of a single watershed above a point of discharge uses a temporal distribution of rainfall as an input and estimates the temporal distribution of runoff (hydrograph) at that point of discharge. In standard hydrologic methods, including the NRCS method used for Upper

Brushy Creek modeling, two different watershed parameters are used to define the hydrograph: the CN and the lag time. The CN defines the total area under the hydrograph (total watershed runoff volume), while the lag time defines the temporal shape of that runoff (rate of rise in flow, time of flow peak, and rate of drop of inflow following the peak).

The time of concentration is the time it takes for a drop of water falling at the furthest upstream point in a watershed to reach the watershed outlet. The lag time is approximated as 0.6 * (time of concentration) when modeling the Upper Brushy Creek watershed. The time of concentration is a combination of three run-off components: overland flow (sheet flow), shallow concentrated flow, and channel flow. The equations to calculate each of these are presented below (TR-55: Urban Hydrology for Small Watersheds, USDA, 1986).

Sheet Flow:

$$T_t = \frac{\left(0.007 * (nL)^{0.8}\right)}{(P_2)^{0.5} * s^{0.4}}$$

Where: T_t = travel time (hr);
n = Manning’s roughness coefficient;
L = flow length
P_2 = 2-year, 24-hour rainfall (in); and
s = slope of hydraulic grade line (land slope, ft/ft).

Shallow Concentrated Flow:

$$T_t = \left(\frac{L_{unpaved}}{V_{unpaved}} + \frac{L_{paved}}{V_{paved}}\right) * \frac{1}{60}$$

$$V_{paved} = 16.1345 * s^{0.5}$$

$$V_{unpaved} = 20.3282 * s^{0.5}$$

Where: T_t = travel time (min);
$L_{unpaved}$ = length of unpaved portion of shallow concentrated length (ft);
L_{paved} = length of paved portion of shallow concentrated length (ft);
$V_{unpaved}$ = velocity of runoff over unpaved length (ft/s); and
V_{paved} = velocity of runoff over paved length (ft/s).

Channel Flow:

$$T_t = \left(\frac{L_{channel}}{V_{channel}}\right) * \frac{1}{60}$$

Where: T_t = travel time (min);
$L_{channel}$ = Length of channel flow (ft); and
$V_{channel}$ = Velocity of channel flow (ft/s).

The total time of concentration is found by adding the results of the above equations and the resulting lag time is estimate as 0.6 * (total time of concentration).

Four sets of lag time values were estimated corresponding to overland flow lengths of 100-, 200-, 300-, and 400-feet. Table I-2 (as an example to show the relative importance of overland flow time total time of concentration) provides the average estimated lag times across the Upper Brushy Creek watershed for these given flow lengths. The average sub-watershed size is 0.4 square miles.

Table I-2. Average Sub-Watershed Lag Time Results

Overland Flow Length (ft)	Overland Flow Time (hours)	Total Tc (hours)
100	0.26	0.83
200	0.45	1.00
300	0.62	1.16
400	0.77	1.30

The HEC-HMS model was then run for the 2007 calibration rainfall obtained from the gage at each target dam for each of the four lag time data sets, and the HEC-HMS dam inflow hydrograph was compared to dam inflow hydrograph derived from actual stage gage data from the target dam.

Lag Time Calibration Results

A review of the calibration results leads to the following discussion:

- The timing of the main storm peak approximately matches between the HEC-HMS model results and inflow gage hydrograph for the range of lag times. This confirms the basic validity of the lag time estimation method and the method of reach routing.
- Variance in flood peak value (as opposed to flood peak timing) is due to variation in allocations of runoff to the small rain events that preceded and came after the main event. The focus of this calibration is on confirming model lag time (and peak timing).

For the majority of the dams analyzed (with the exception of Dams 1 and 12), the overland flow length of 100 feet resulted in a time of peak closest to the time of actual peak (see Table I-3). Note that the HEC-HMS model time step used in calibration (and to be used in final model runs) is 10 minutes.

Table I-3. Difference in Modeled Peak and Actual Storm Peak*

Overland Flow Length (ft)	Dam 1 (min)	Dam 2 (min)	Dam 3 (min)	Dam 5 (min)	Dam 12 (min)	Dam 13A (min)
100	15	0	10	10	10	10
200	10	5	15	15	10	15
300	5	20	20	20	5	25
400	0	35	20	25	0	30

*Modeled peak always occurred after actual peak with the exception of Dam 1 and 12.

Figures I-2 through I-7 provide a comparison of the HEC-HMS inflow hydrographs for the range of lag times to the inflow hydrographs obtained from the dam gage.

Recommendation for Lag Time Estimation

The choice of lag time estimation method and overland flow length to be used in hydrologic modeling is a decision to be made by the District in conference with the TAC. The choice of lag time will affect peak flow timing, and in conjunction with choices for curve number, will determine flow peaks used in hydraulic modeling to set regulatory base flood elevations. This section will provide some discussion on a calibration application that the District and TAC might consider.

Due to variations in the rainfall over each dam watershed and the simplifying assumptions necessary to model the watershed rainfall in HEC-HMS, there are discrepancies between the modeled inflow hydrographs and gage inflow hydrographs. As discussed in the previous section, those discrepancies are largest for Dams 2, 5, and 13A. However, the overall shape of the hydrographs are similar, and for the three dams (1, 3, and 12) which are the most consistent between model and gage results, the overland flow length of 100 feet seems to be an appropriate choice for lag time modeling and results closest agreement between model and gage results. This is consistent with the method employed during the preparation of FEMA 2012 preliminary HEC-HMS models and is the most conservative choice of overland flow lengths. As such, URS would recommend utilizing a 100-foot overland flow length in estimation of lag times over the Upper Brushy Creek watershed.

Figure I-2. Dam 1 Lag Time Results

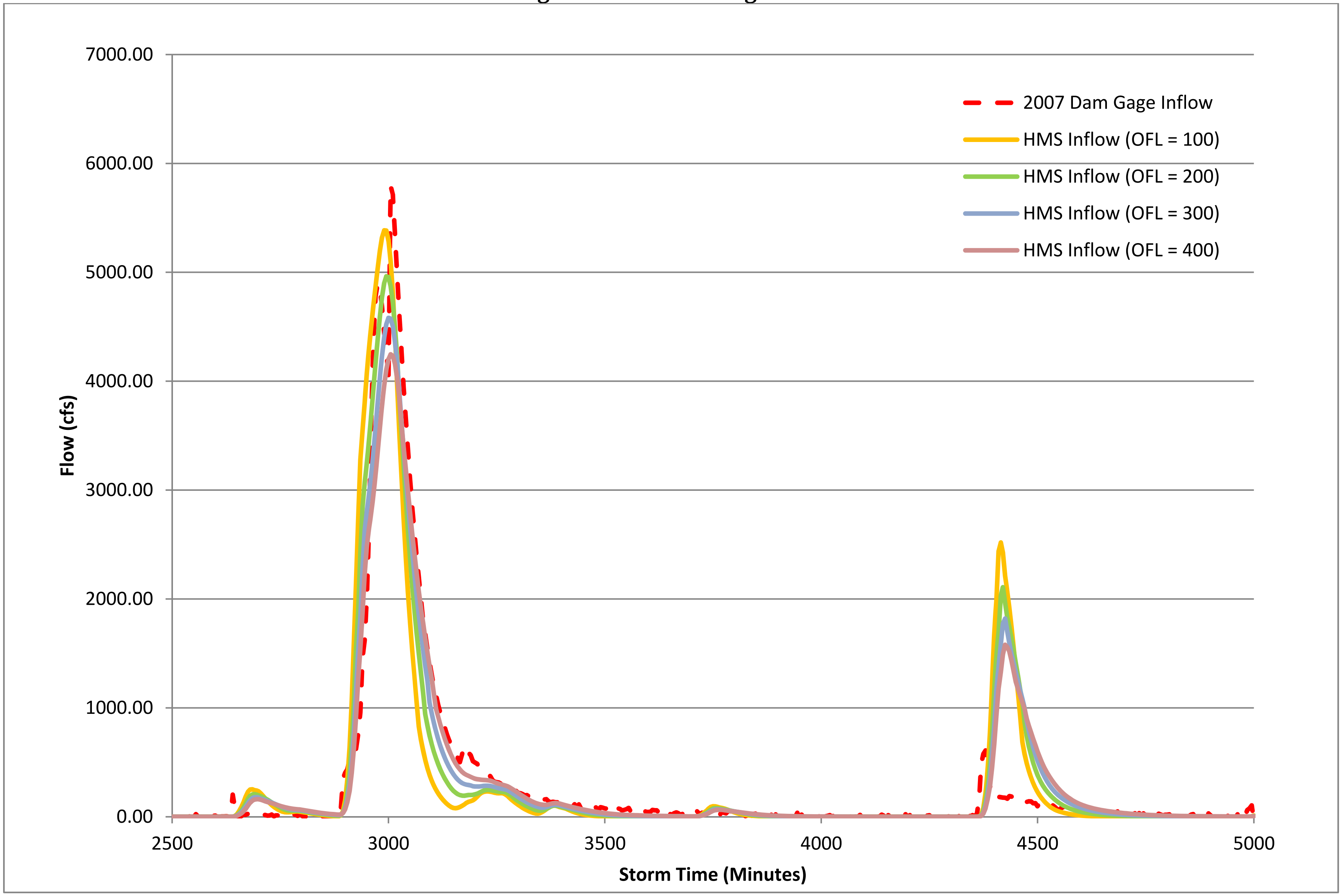


Figure I-3. Dam 2 Lag Time Results

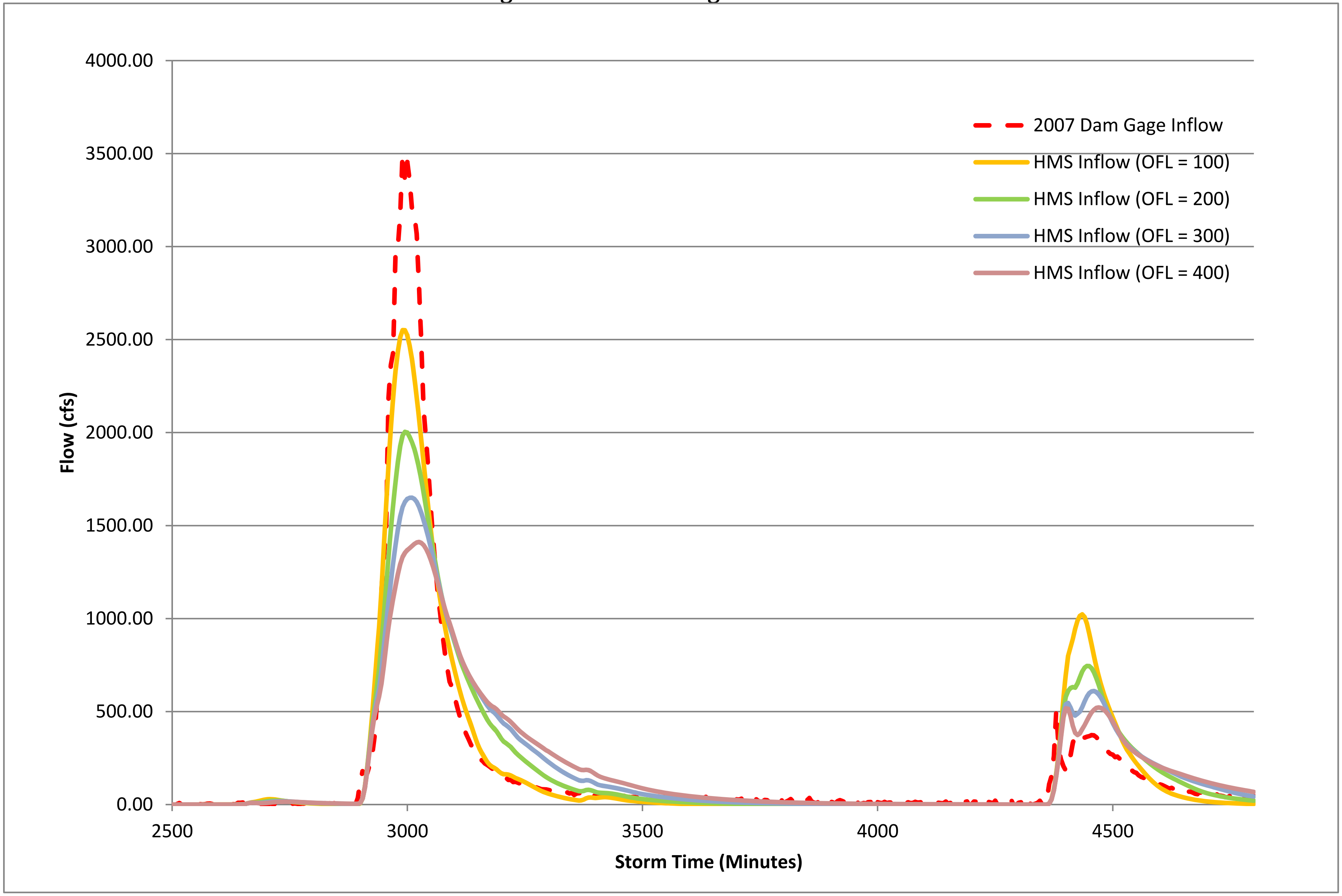


Figure I-4. Dam 3 Lag Time Results

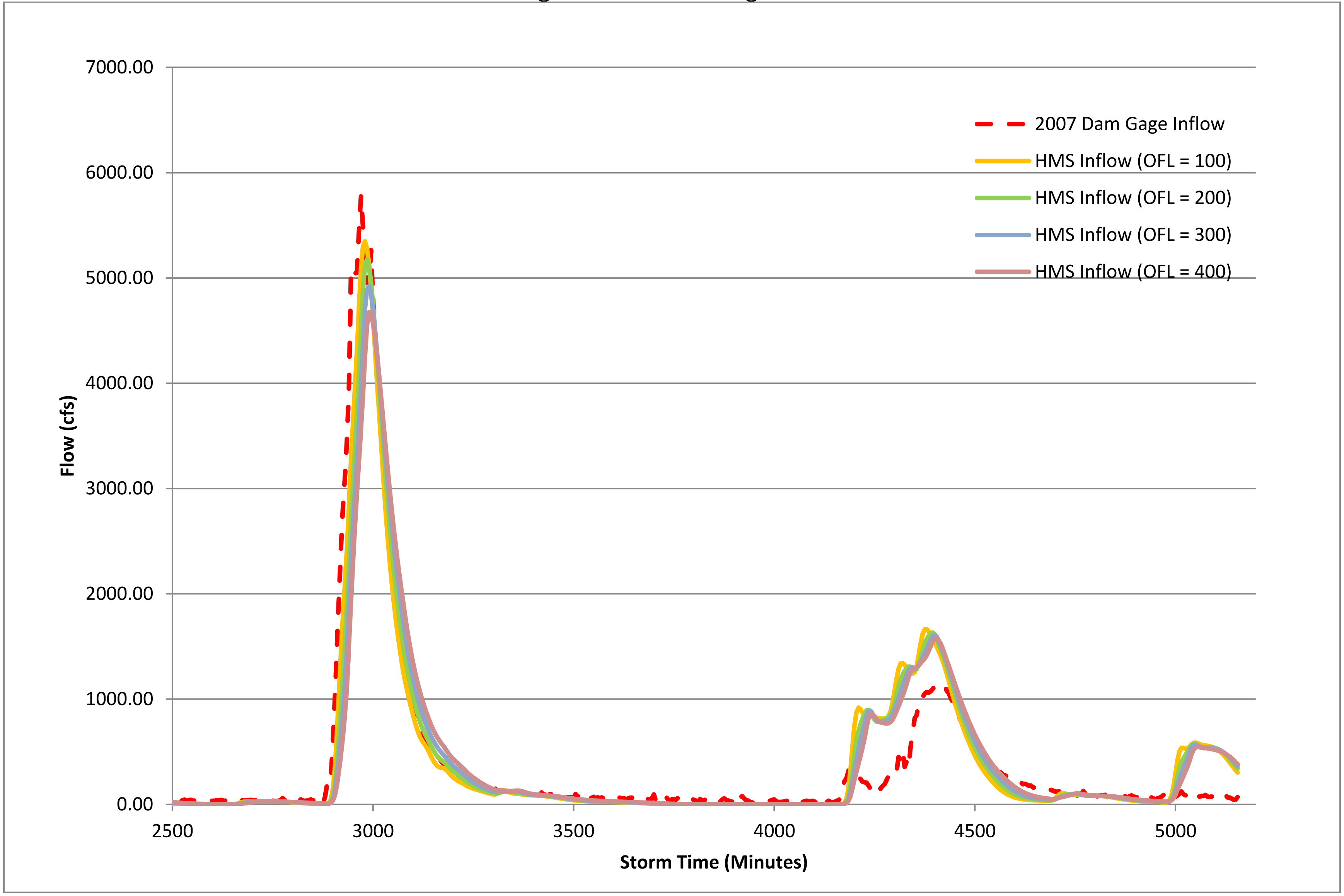


Figure I-5. Dam 5 Lag Time Results

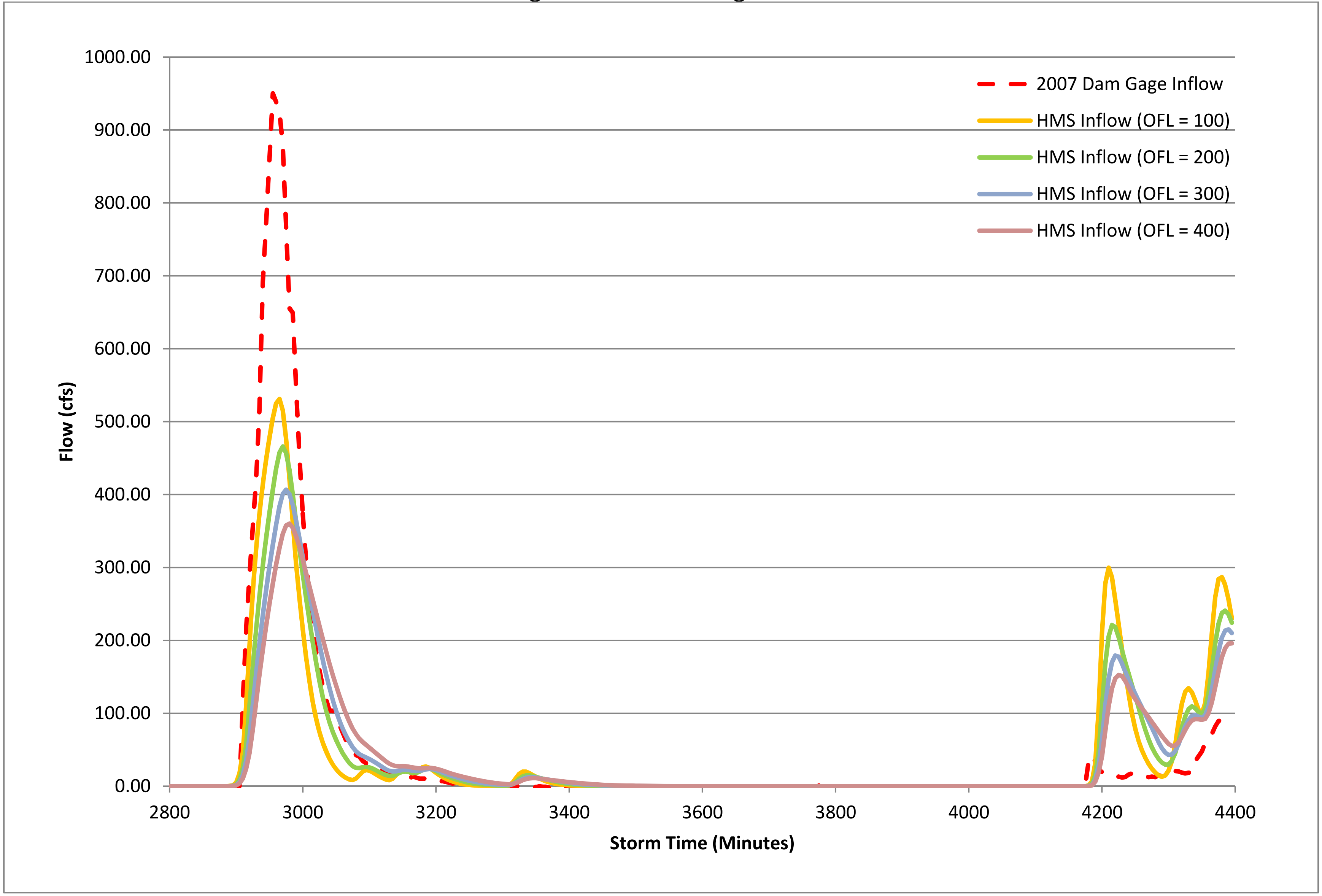


Figure I-6. Dam 12 Lag Time Results

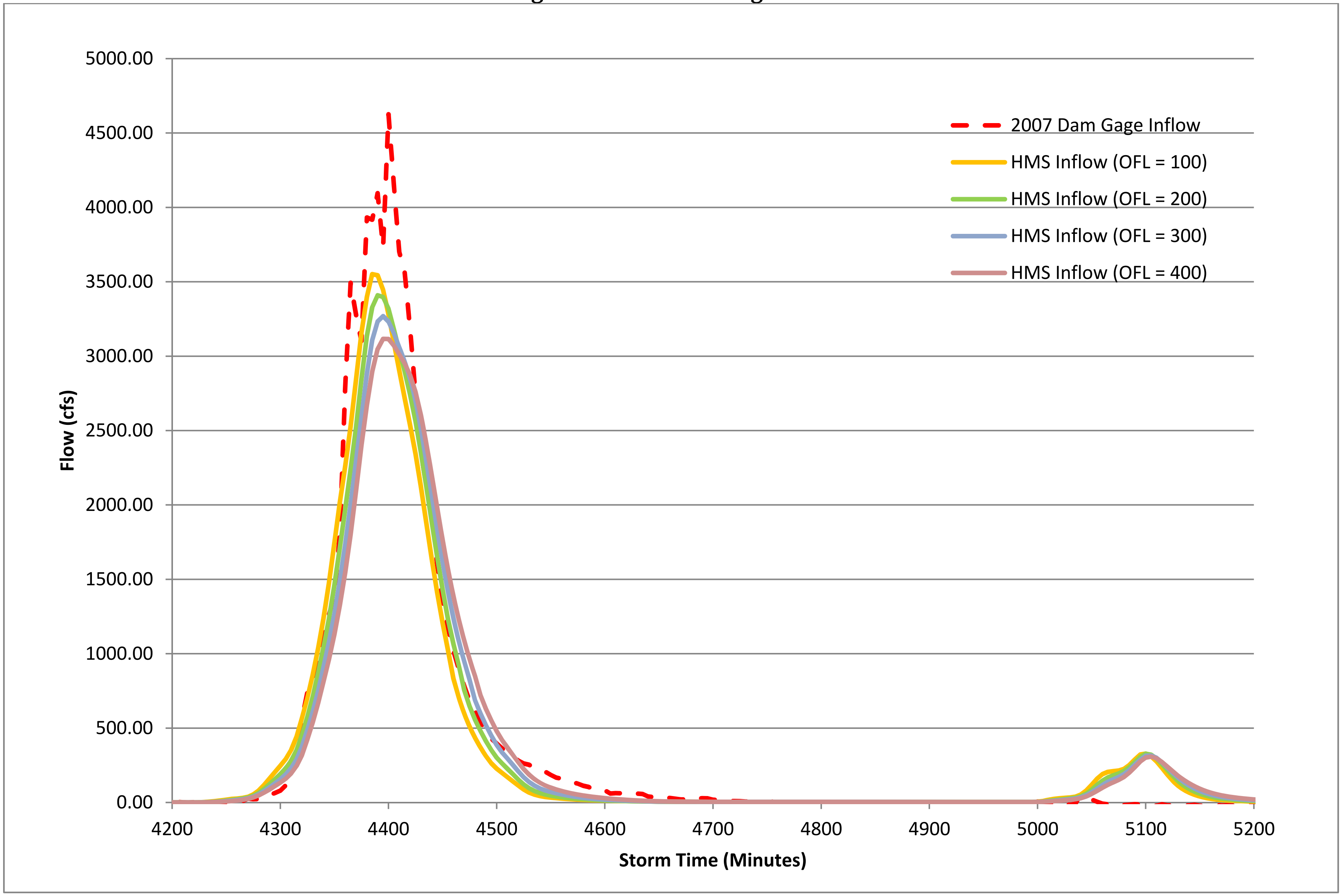
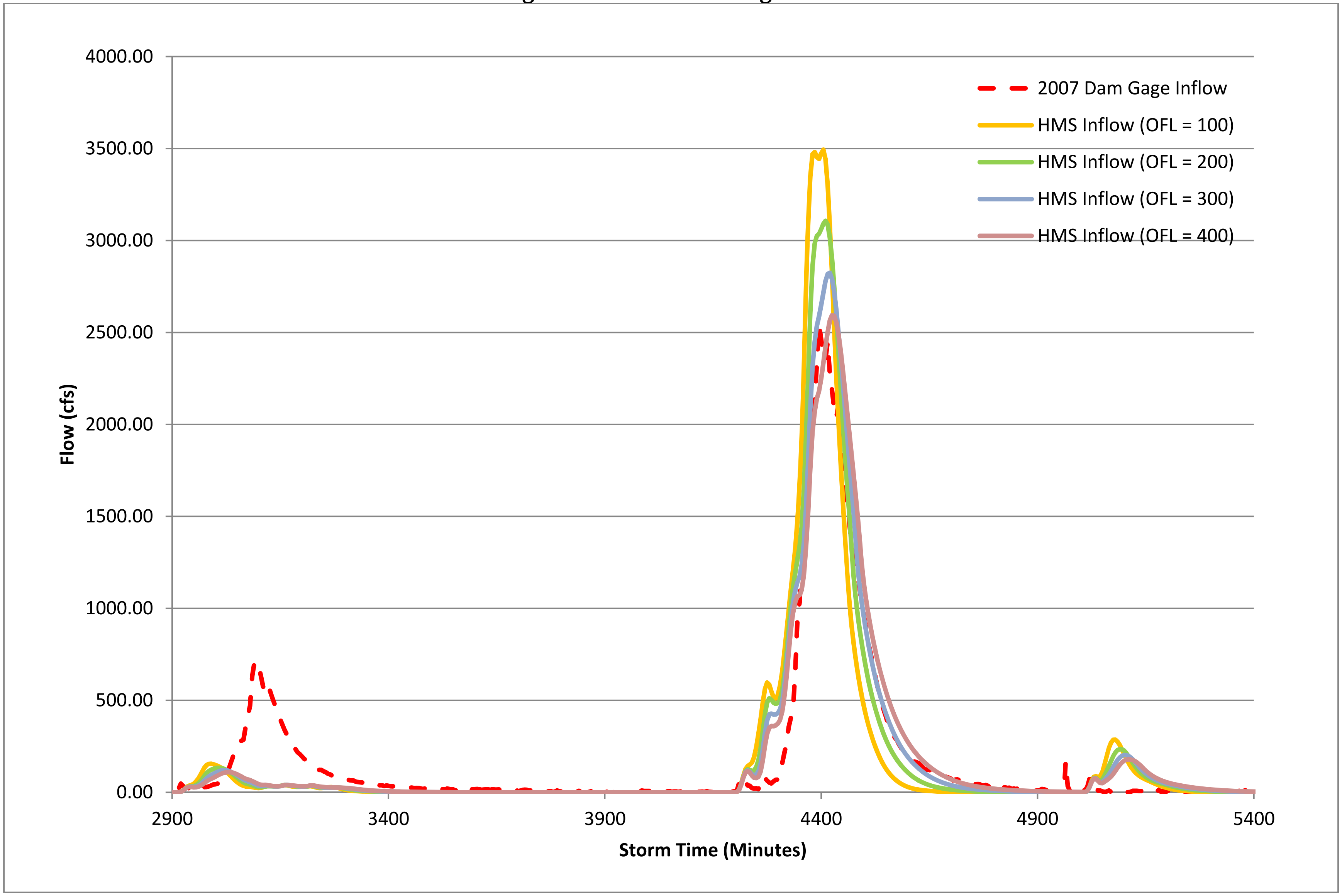


Figure I-7. Dam 13A Lag Time Results



Example of Application of Revised Lag Times and CNs to Example Watersheds

Figures I-8 and I-9 provide a comparison of hydrographs for two selected dams using the RiskMap parameters, the existing TR-20 model parameters, the URS-derived parameters with CN alternative A (Unadjusted AMC II), and the URS-derived parameters with CN alternative B (TXDOT Adjustment). These two dams were selected for comparison because they represent the only dams included in the calibration that were modeled by both TR-20 and the FEMA 2012 preliminary HEC-HMS models. An approximate 100-year rainfall depth (9 inches) coupled with the NRCS Type III distribution was utilized for this comparison. The rainfall depth used in modeling will vary geographically across the watershed in the final Upper Brushy Creek hydrologic model.

In the Dam 12 case (Figure I-8), the Alternative B CN (65.2) is slightly more than the TR20 CN (61). The large difference in apparent flood volume between Alternative B and TR20 results is due to the HEC-HMS model considering impervious area (21%), while the TR20 model does not. The HEC-HMS model assumes 100% runoff from impervious area. The difference in flood peak is increased substantially due to the differences between TR20 and HEC-HMS lag time.

In the Dam 13 case (Figure I-9), the same factors affect the differences between the TR20 results and HECHMS results (watershed impervious area is 13.5%). The difference in time to peak between results from the FEMA preliminary 2012 model and results from the Alternative A and B models is due to the FEMA model being based upon a single watershed (3.97 square miles). The Alternative A and Alternative B models have the same area broken up into 8 subwatersheds. Again, the calibrations to the 2007 storm shown in Figures I-2 to I-7 included these subwatersheds.

References

Freese and Nichols, January 2012. Memorandum – "Flood Monitoring System Data and Observations," Jay Scanlon, P.E., CFM, Jan. 20, 2012, Project BKW10423, Austin, TX.

Natural Resources Conservation Service (NRCS), October 2007. *SITES 2005 Water Resource Site Analysis Computer Program, User Guide*, U.S. Dept. of Agriculture.

Natural Resources Conservation Service (NRCS), June 1986. *TR-55: Urban Hydrology for Small Watersheds*, U.S. Dept. of Agriculture.

U.S. Army Corps of Engineers (USACE), August 2010. *Hydrologic Modeling System HEC-HMS, User's Manual*, Version 3.5, CPD-74A.

U.S. Department of Agriculture (USDA), 2005. *SITES 2005 Water Resource Site Analysis Computer Program*, *User Guide*, U.S. Dept. of Agriculture.

Figure I-8. Dam 12 Parameter Comparison

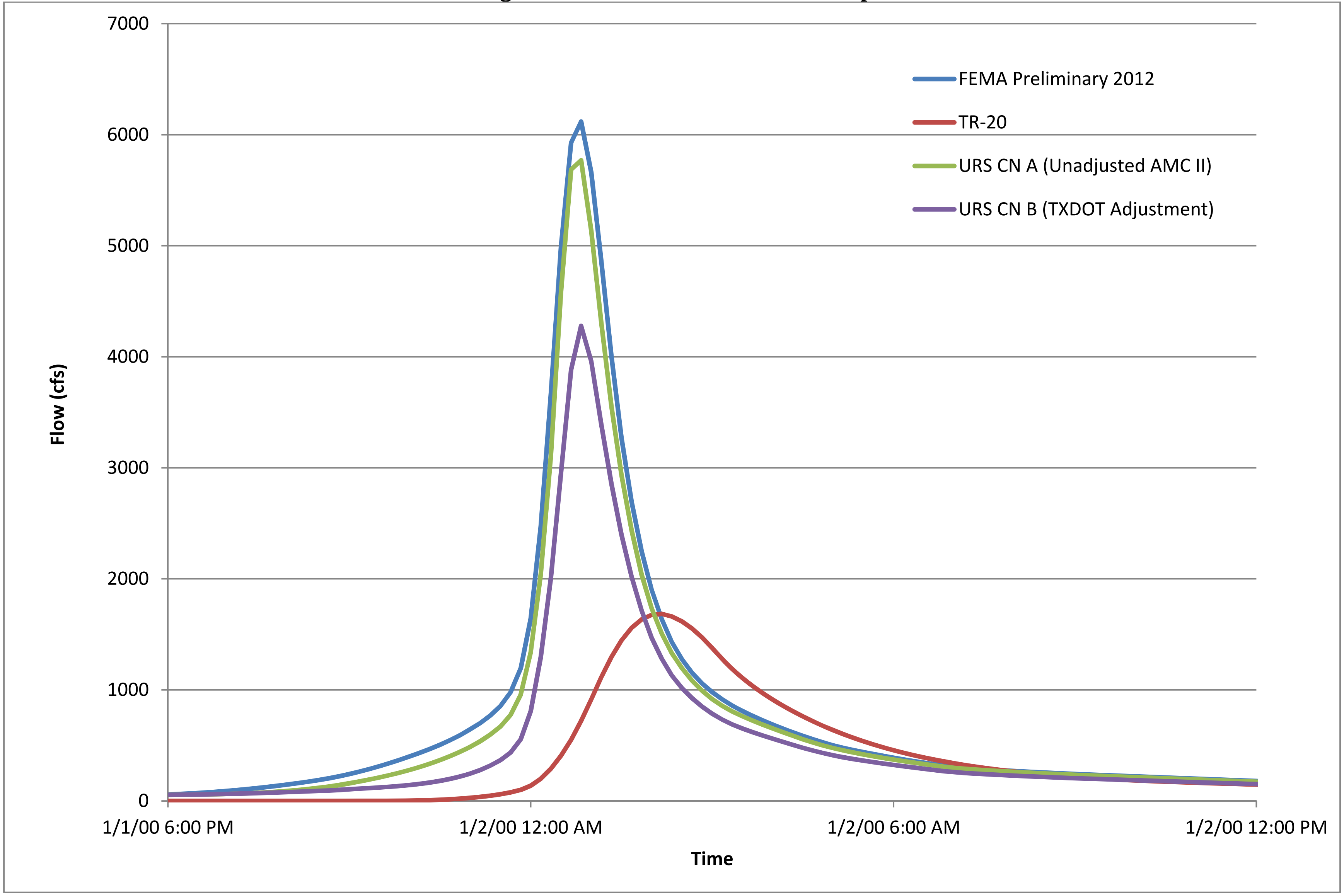


Figure I-9. Dam 13A Parameter Comparison

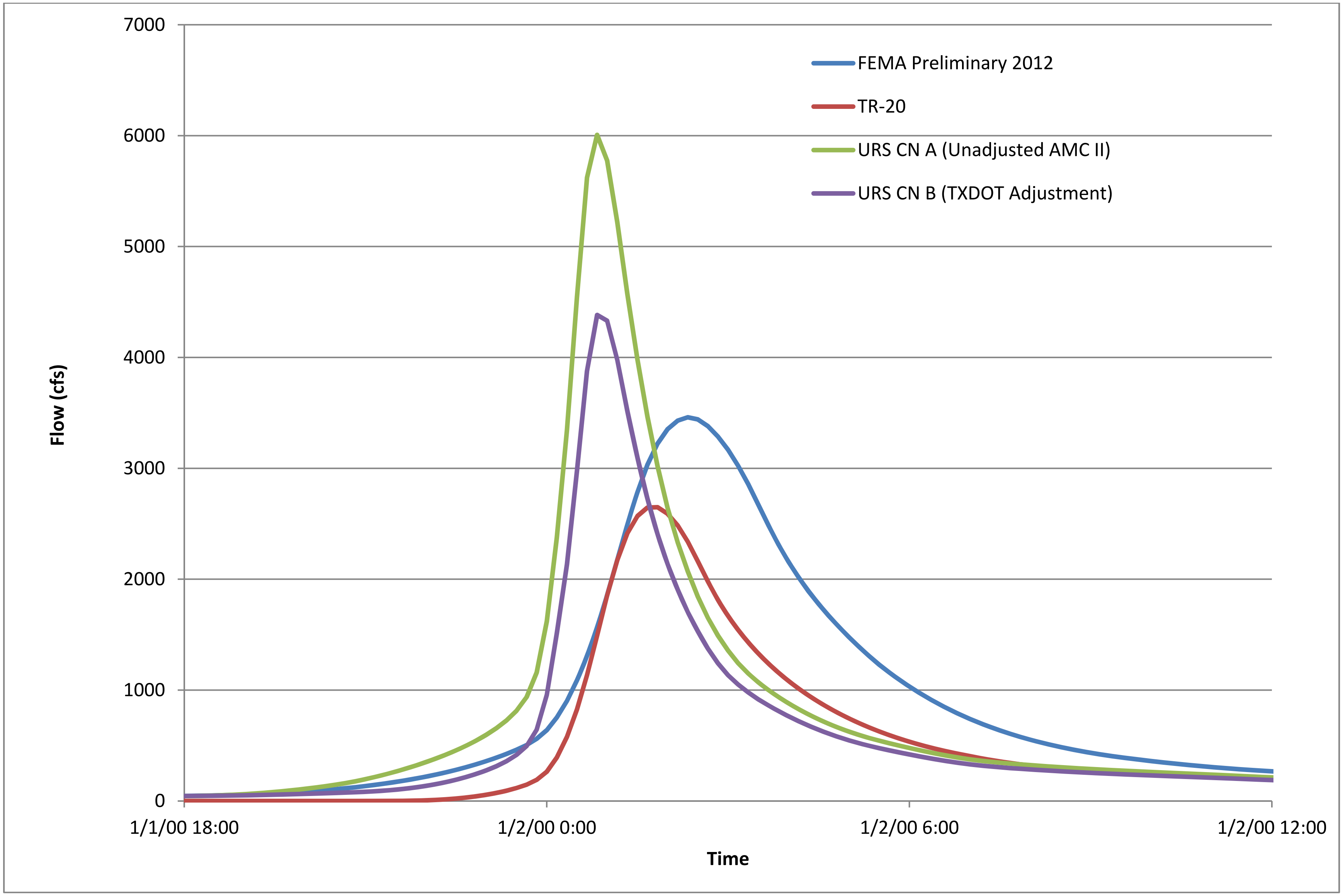


Exhibit J
HMS Model Tree Diagrams

Exhibit J

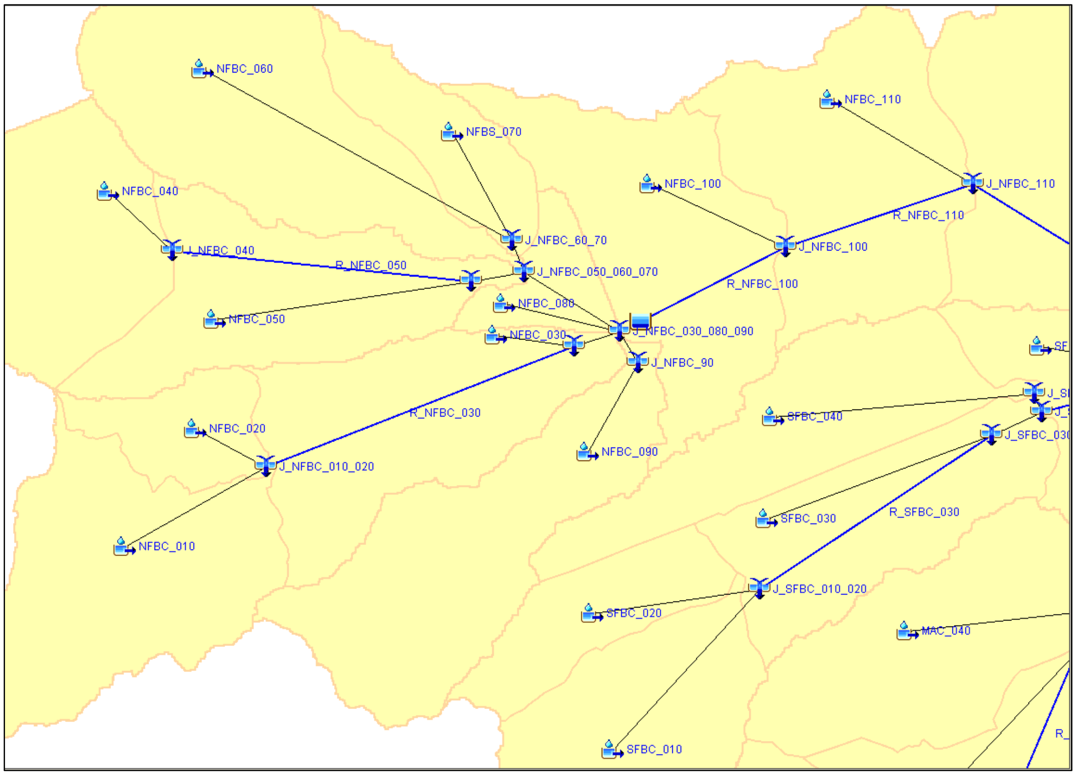


Figure J-1. Upper Brushy Creek 1.1

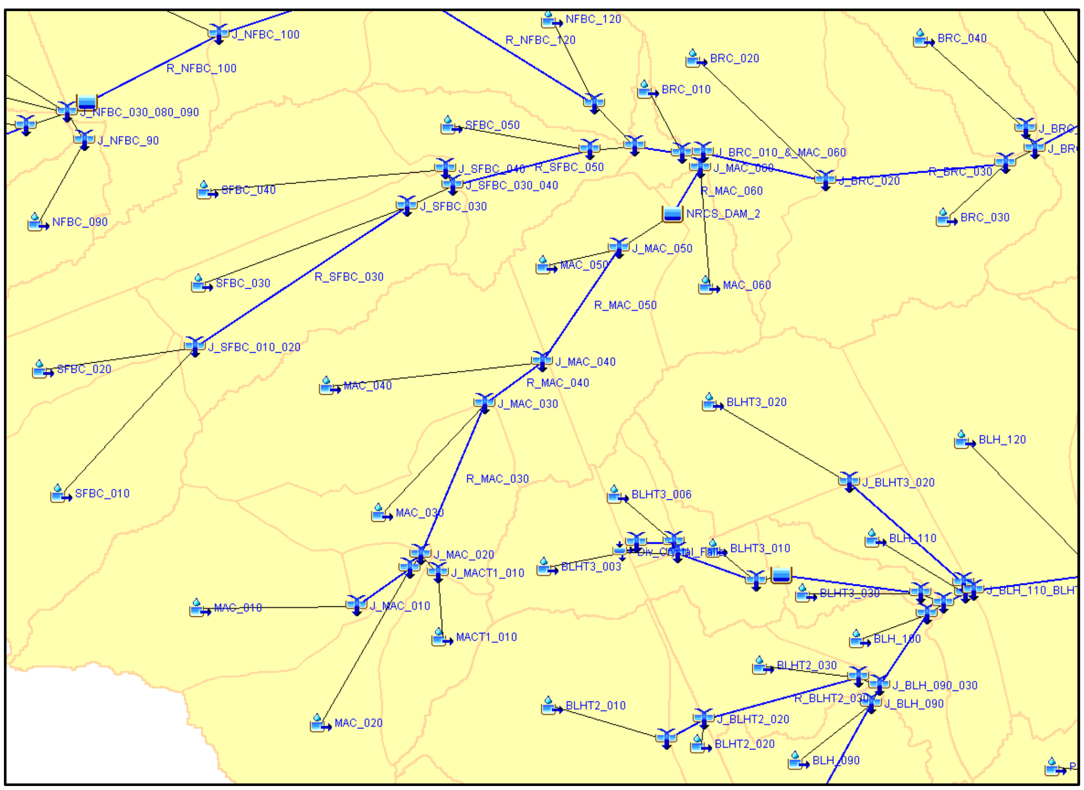


Figure J-2. Upper Brushy Creek 1.2

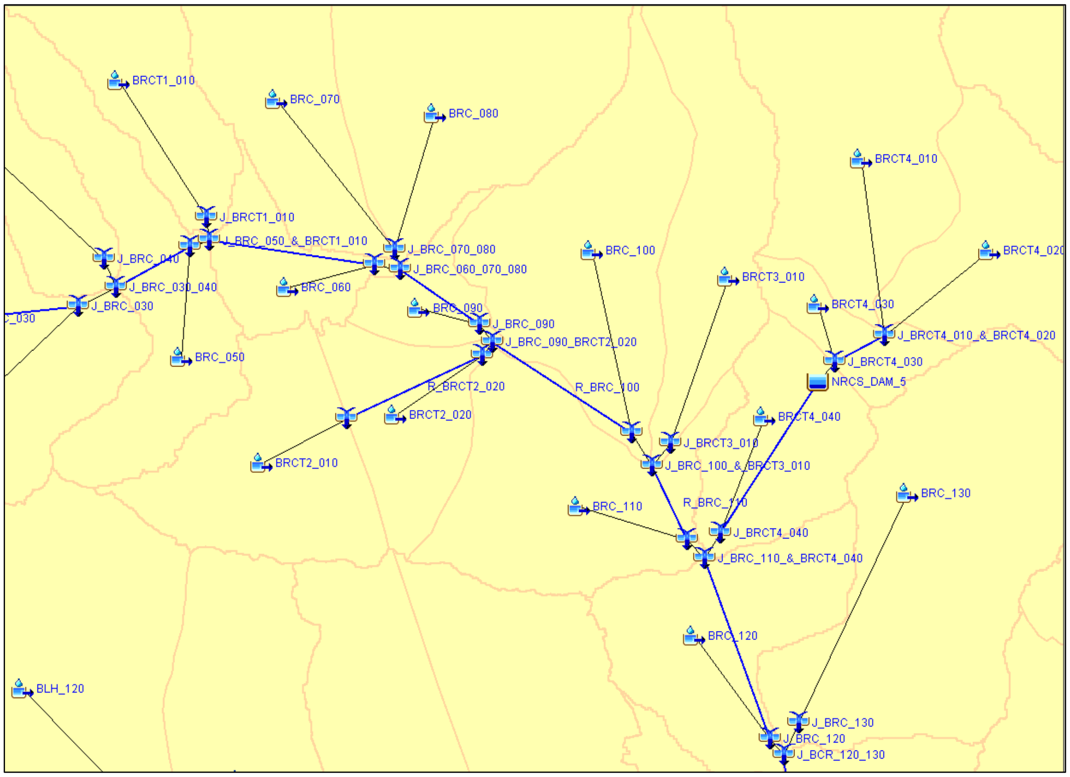


Figure J-3. Upper Brushy Creek 1.3

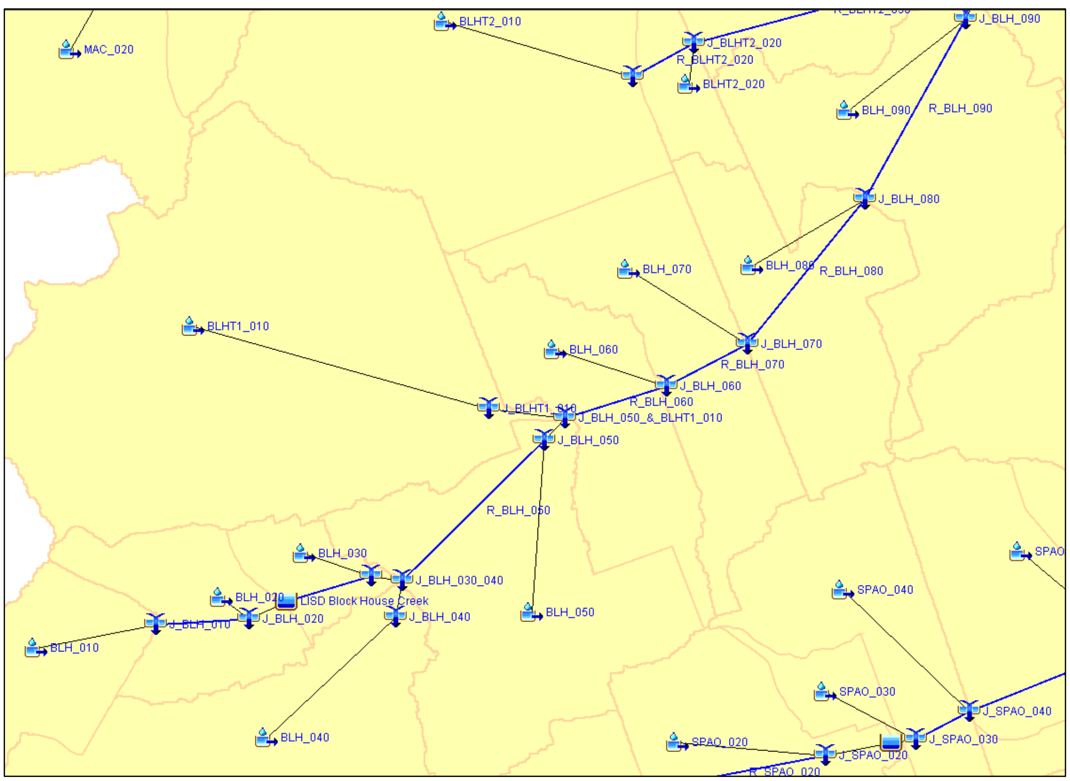


Figure J-4. Block House Creek 1.1

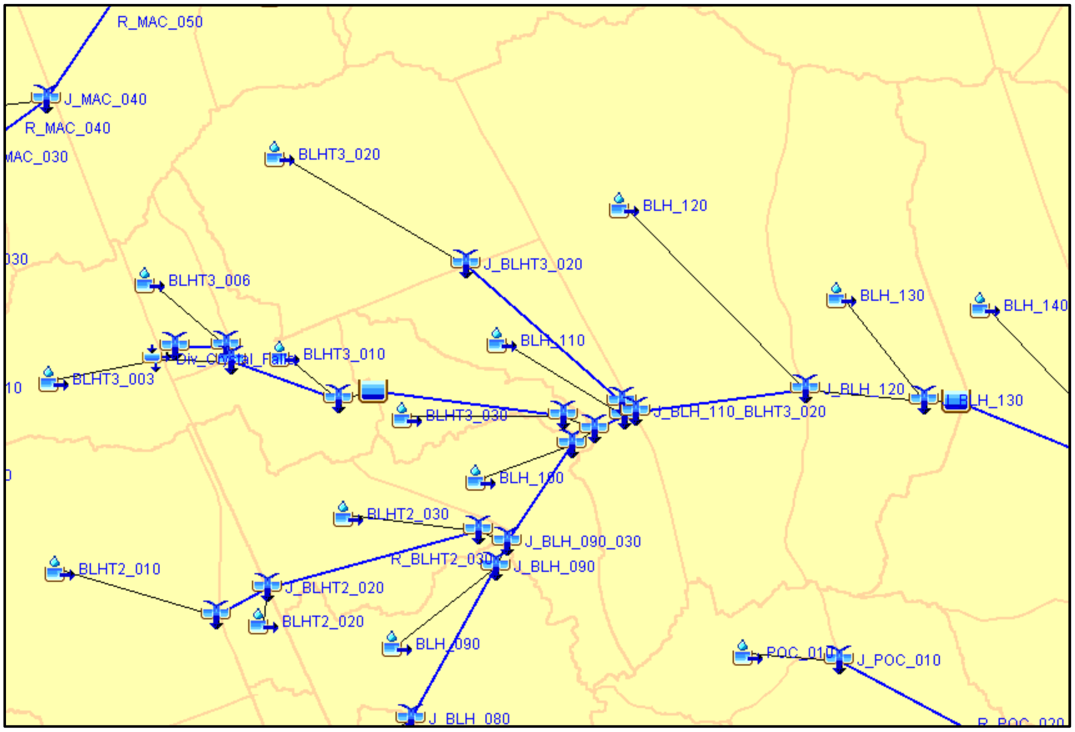


Figure J-5. Block House Creek 1.2

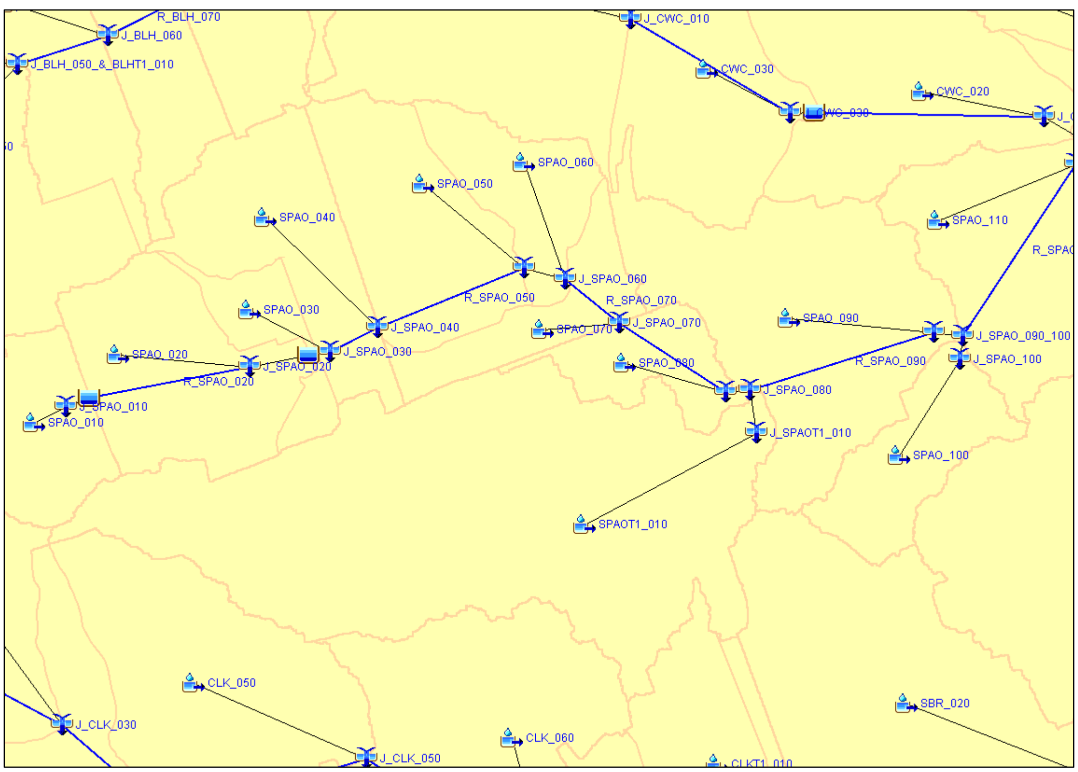


Figure J-6. Spanish Oak 1.1

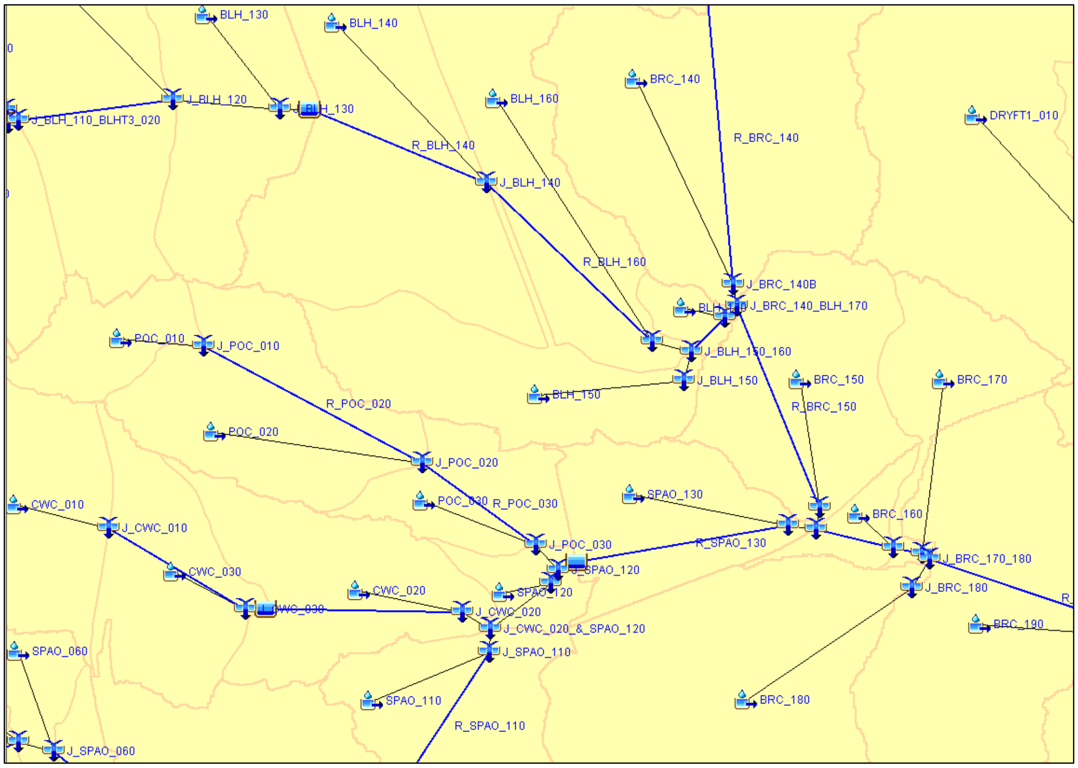


Figure J-7. Spanish Oak 1.2

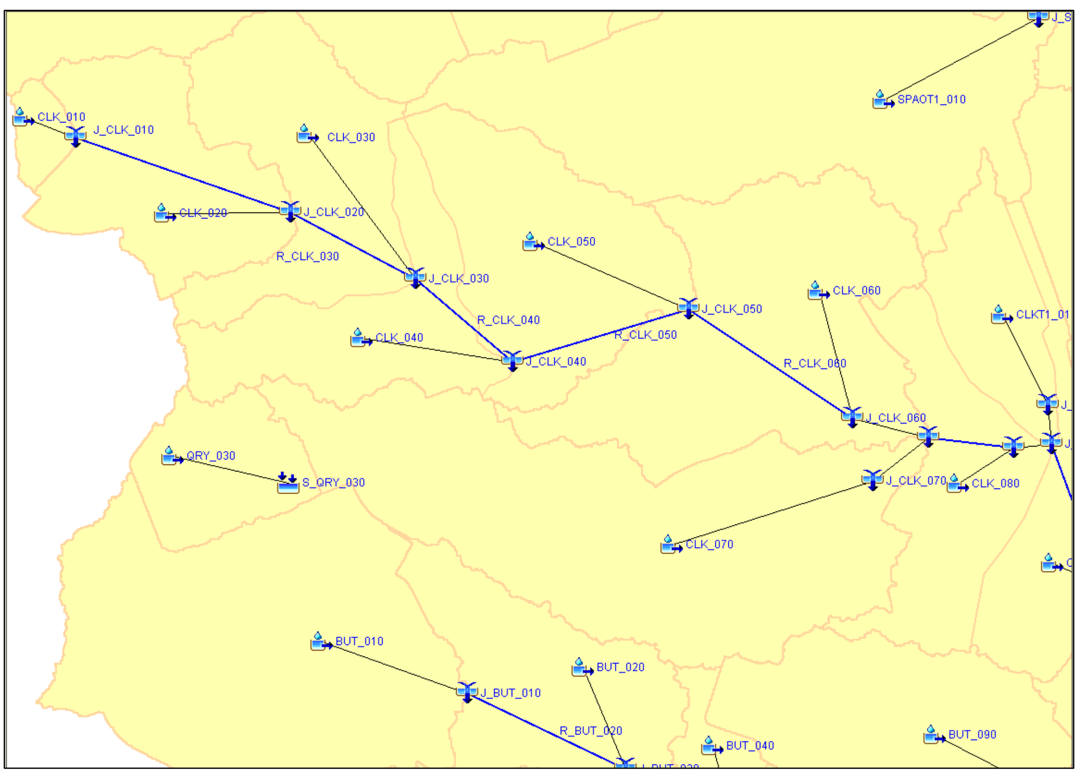


Figure J-8. Cluck Creek

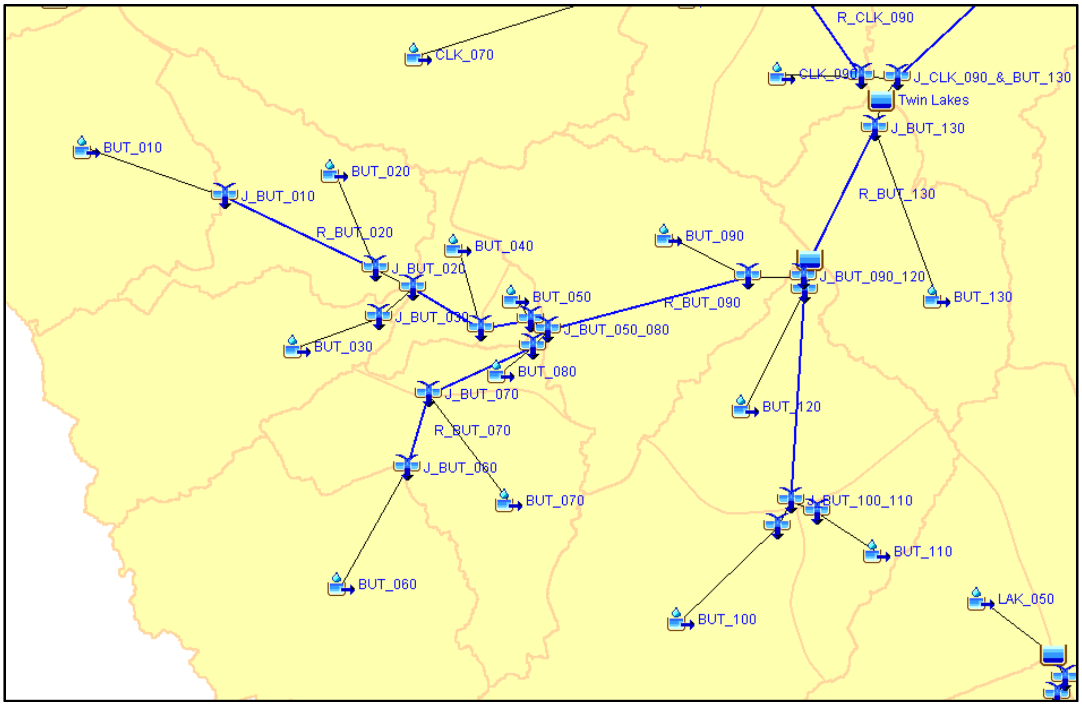


Figure J-9. Buttercup Creek

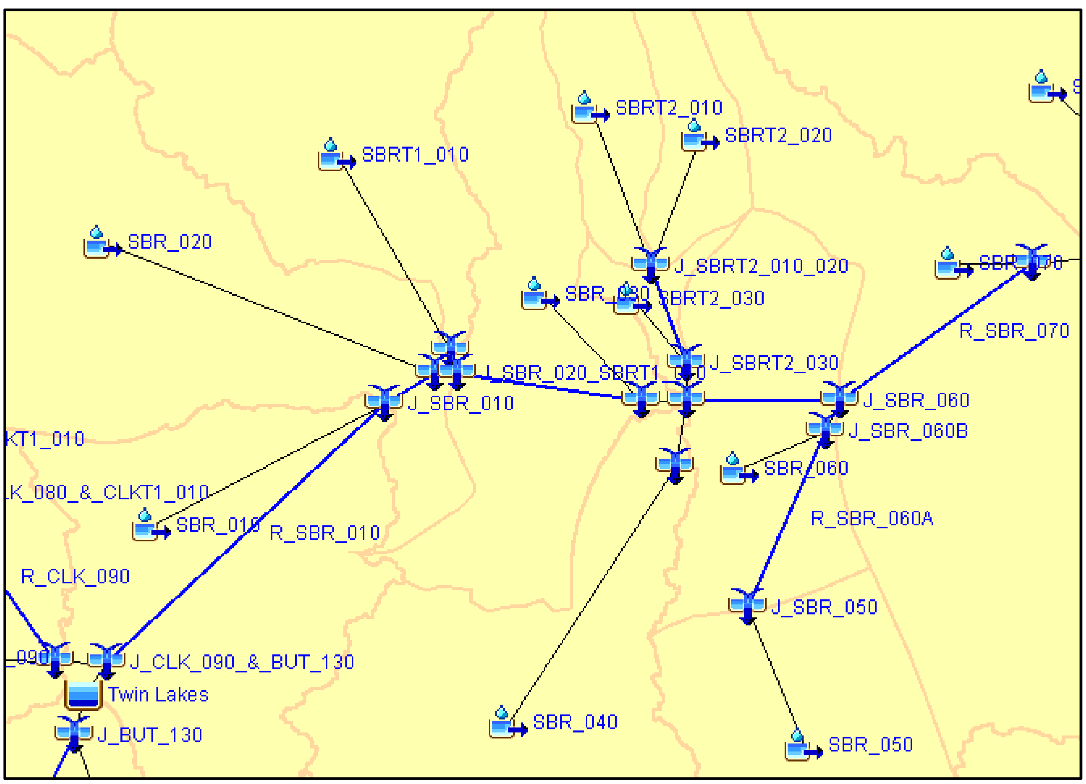


Figure J-10. South Brushy Creek 1.1

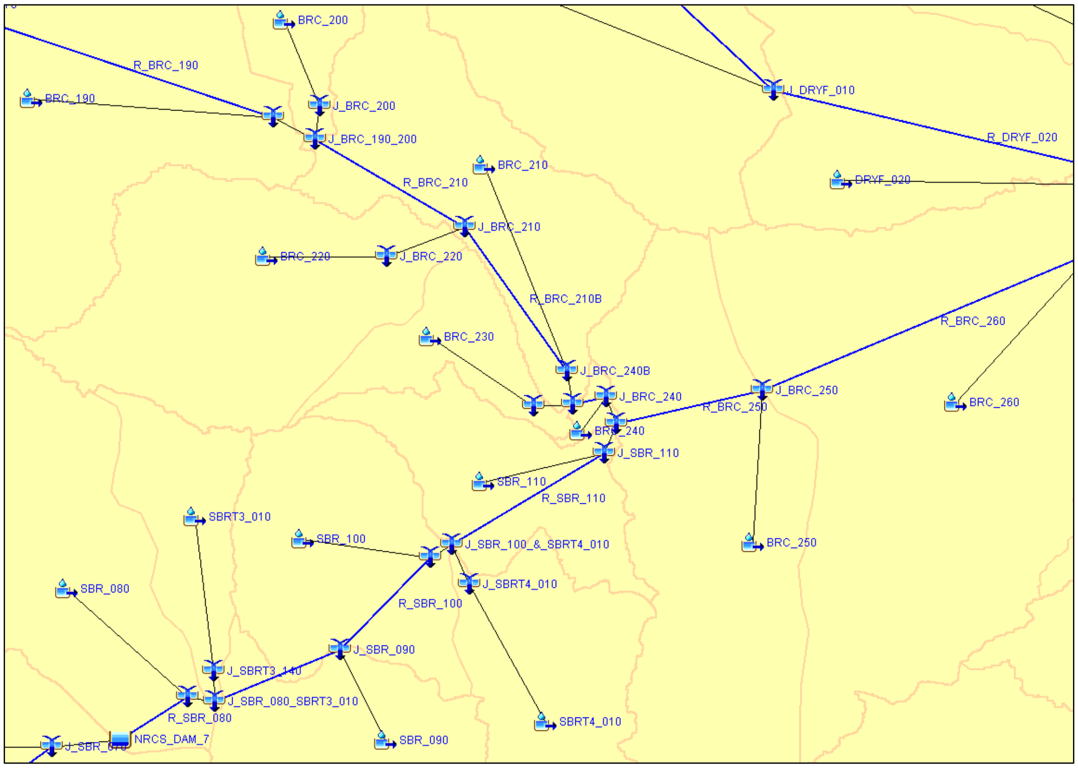


Figure J-11. South Brushy Creek 1.2

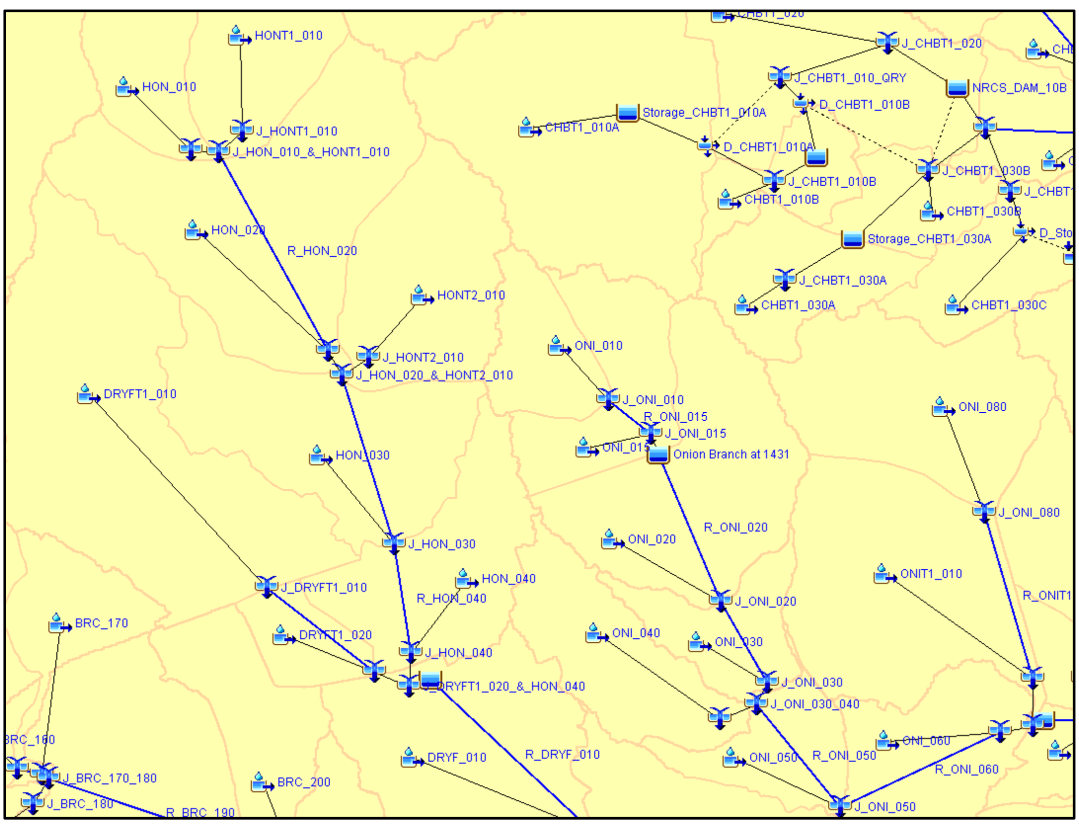


Figure J-12. Dry Fork 1.1

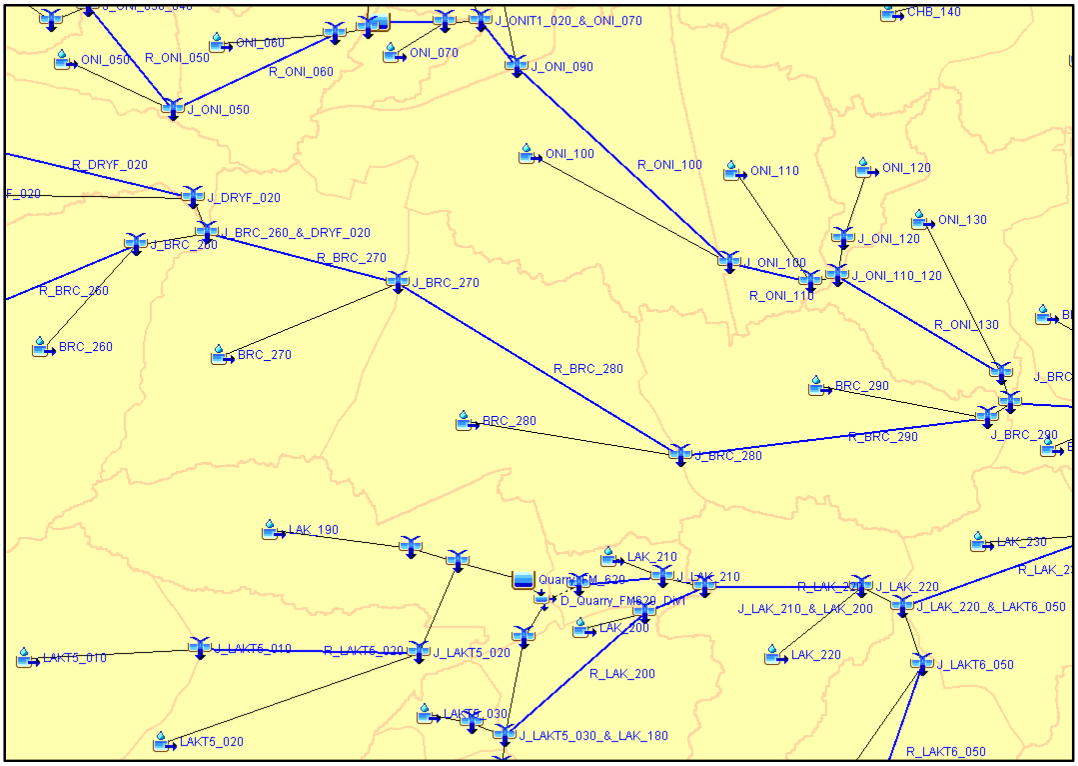


Figure J-13. Dry Fork 1.2

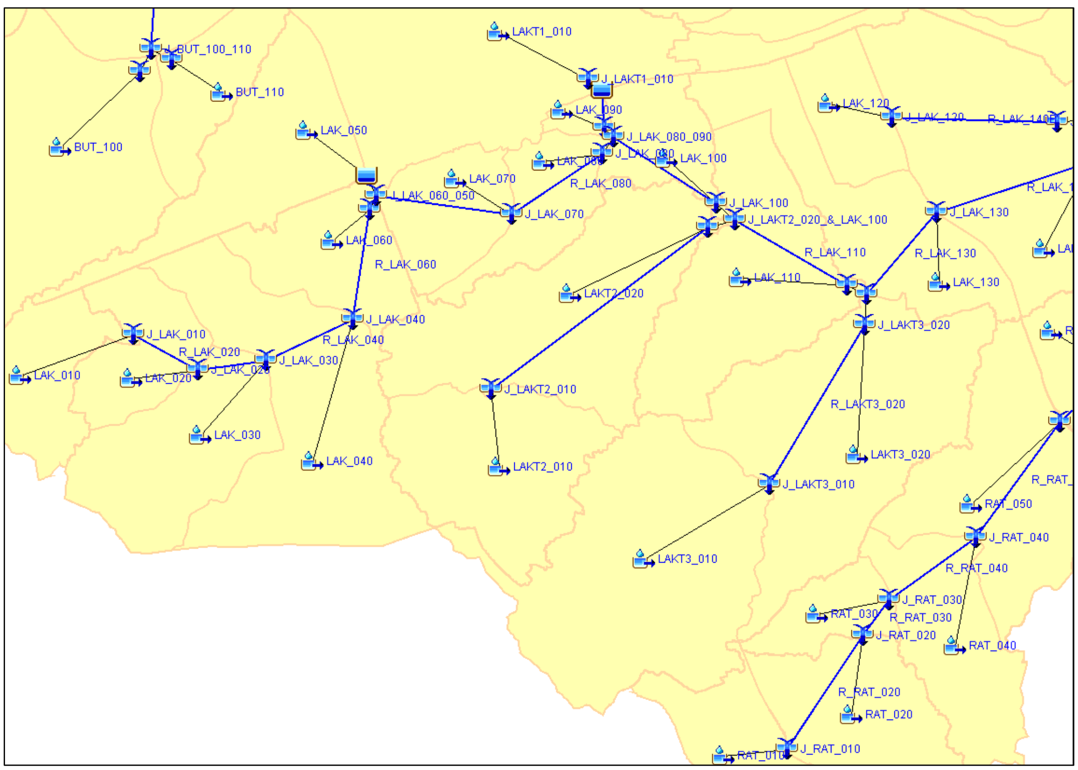


Figure J-14. Lake Creek 1.1

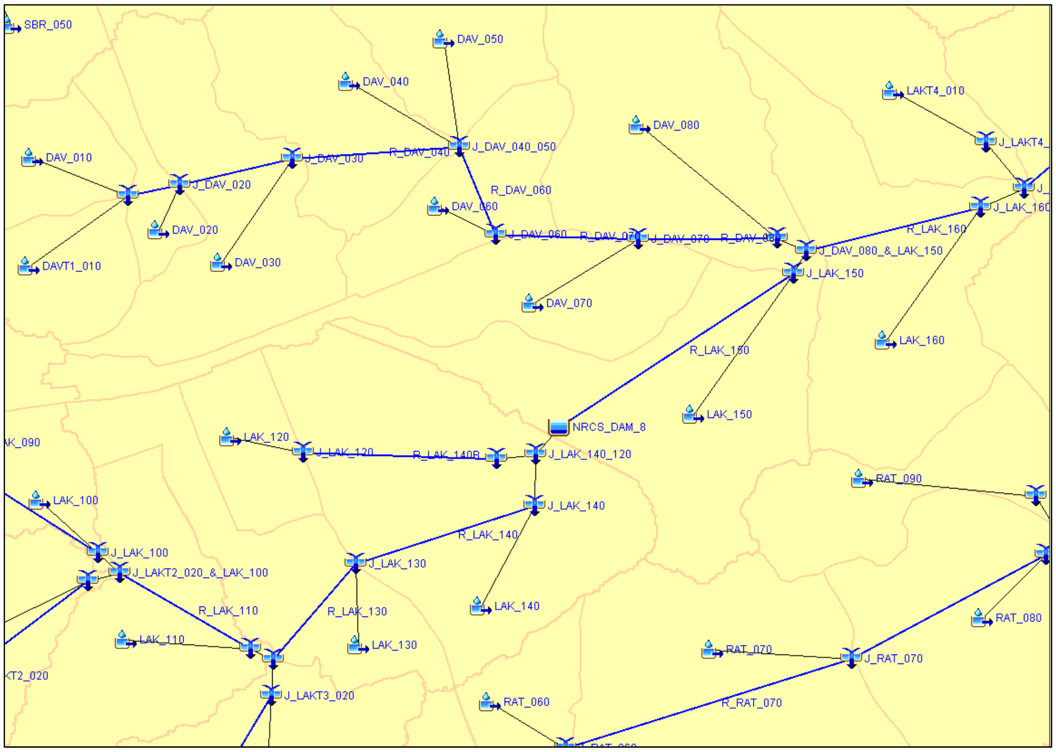


Figure J-15. Lake Creek 1.2

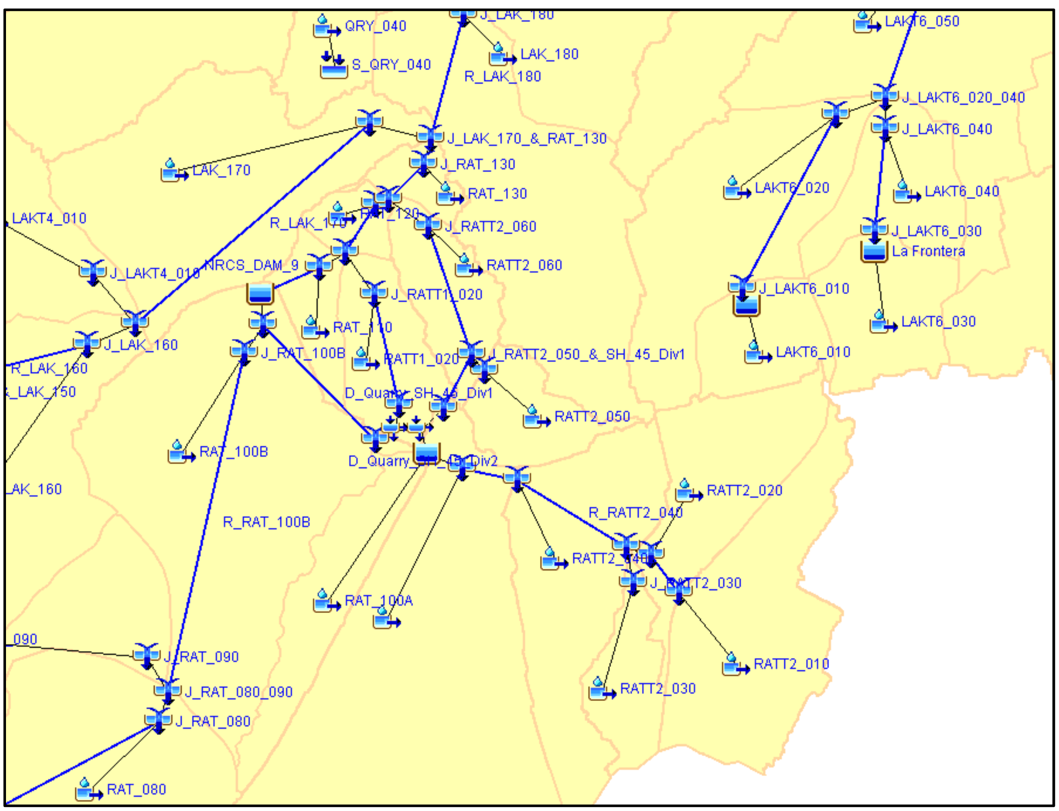


Figure J-16. Lake Creek 1.3

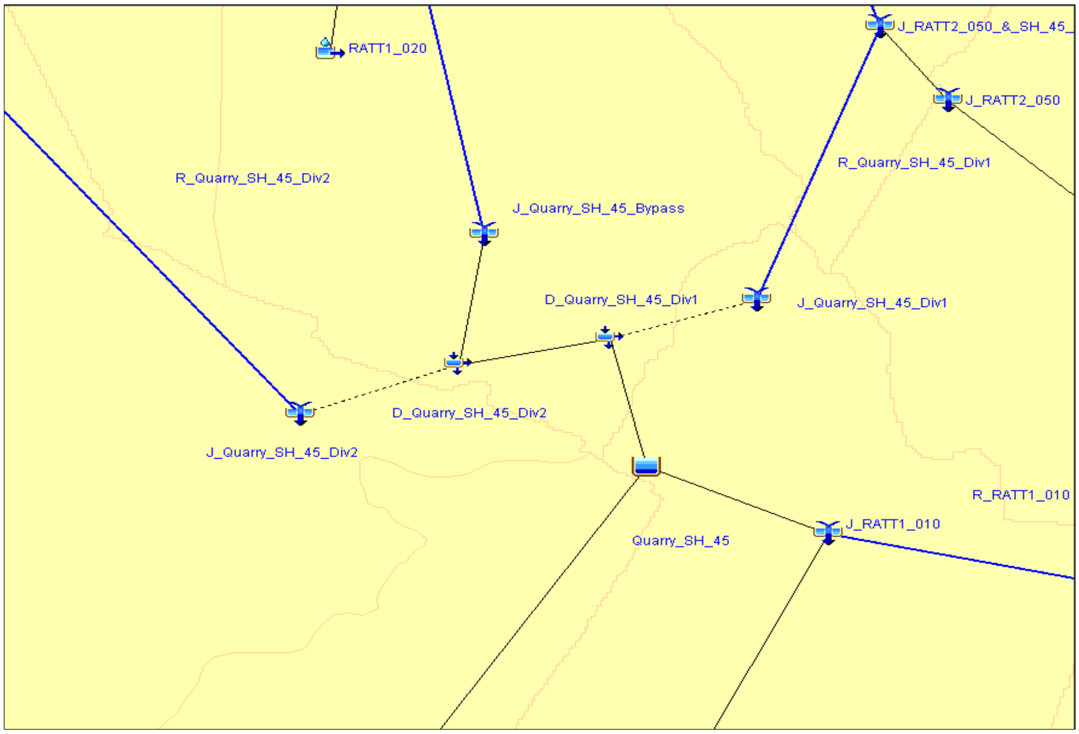


Figure J-17. Quarry_SH_45

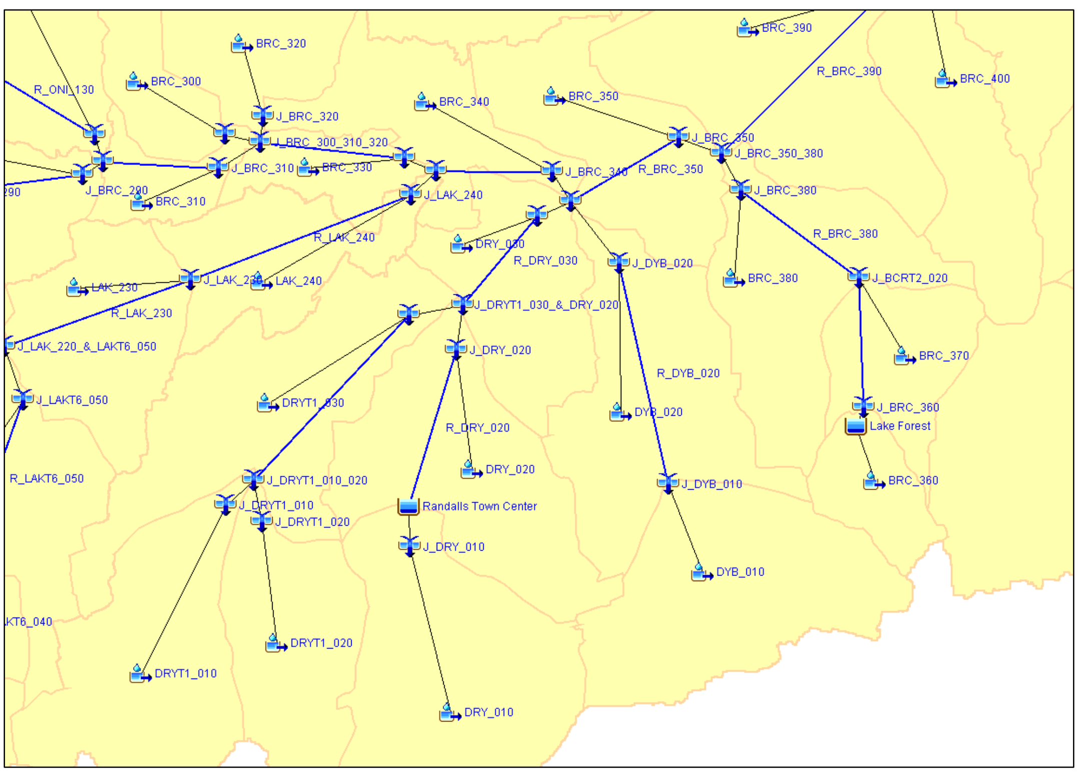


Figure J-18. Lake Creek 1.4

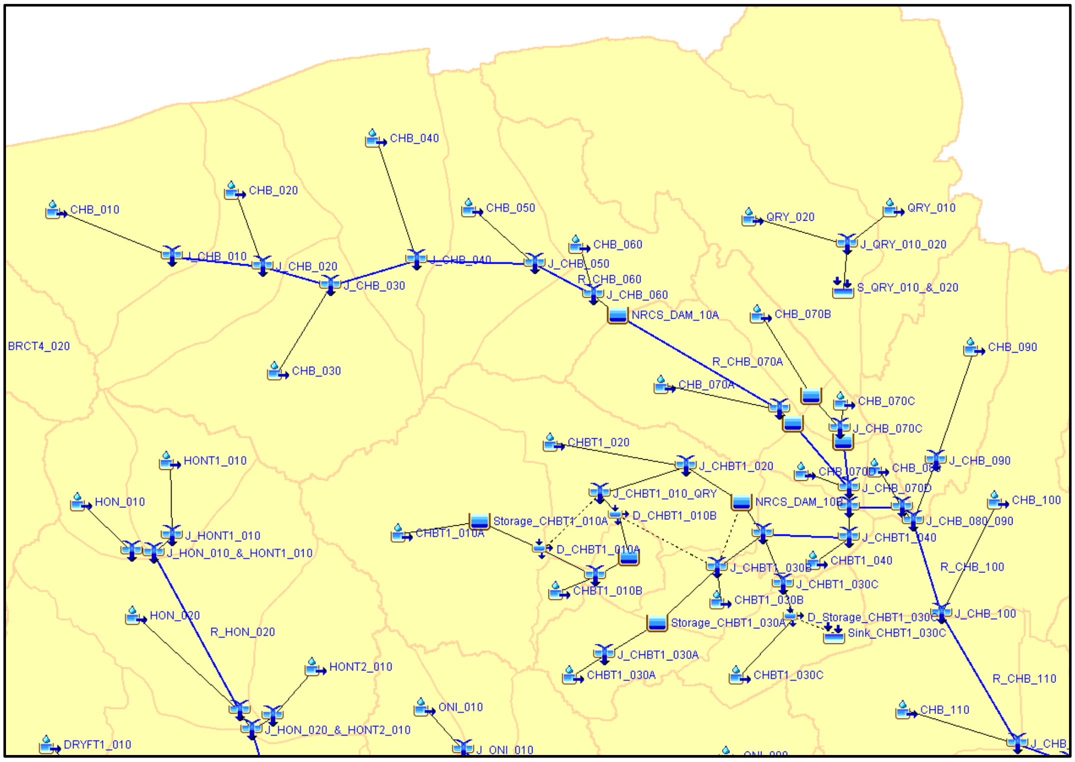


Figure J-19. Chandler Branch 1.1

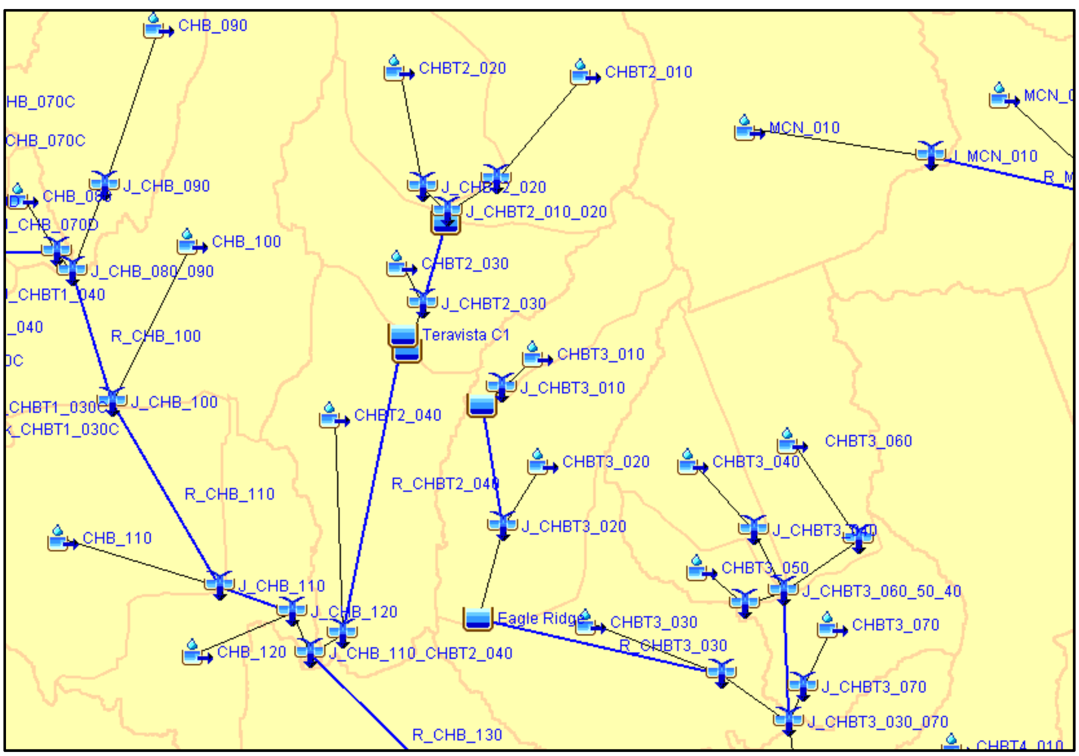


Figure J-20. Chandler Branch 1.2

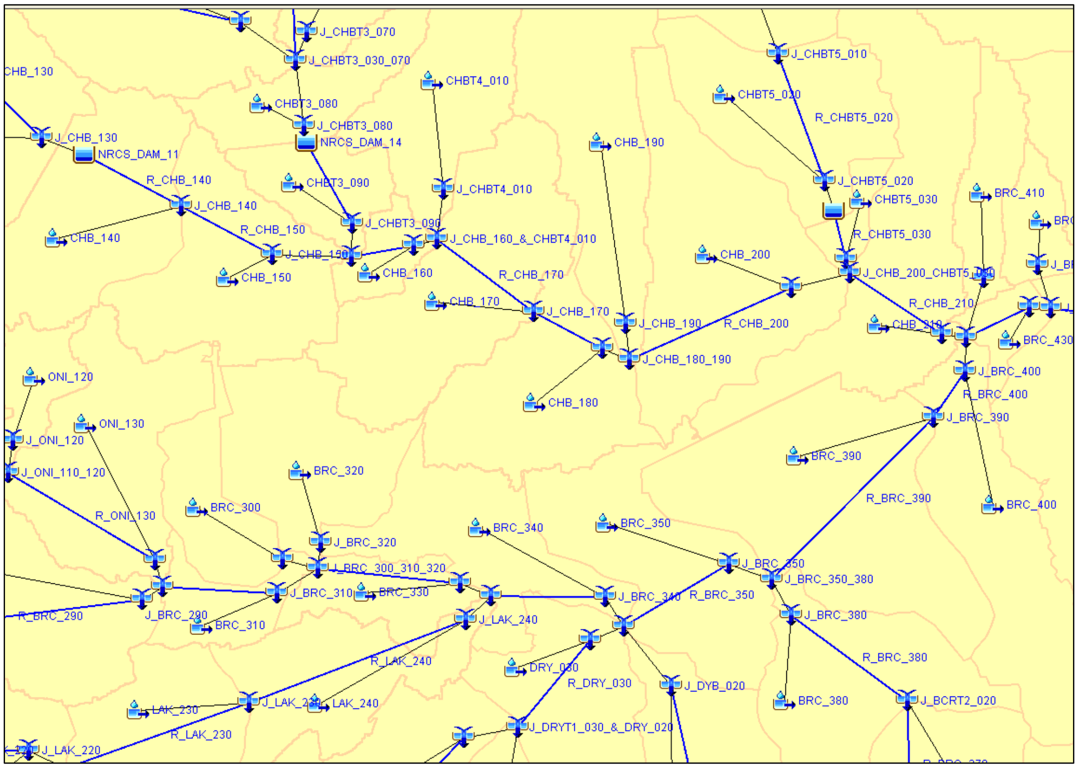


Figure J-21. Chandler Branch 1.3

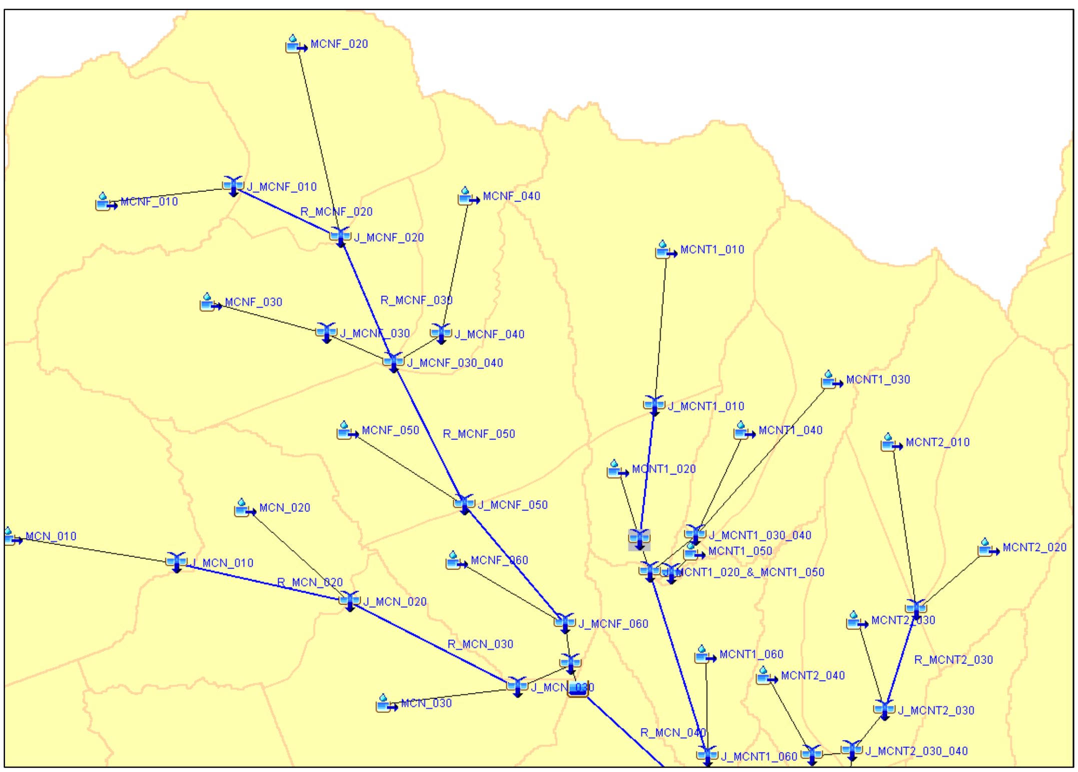


Figure J-22. McNutt Creek 1.1

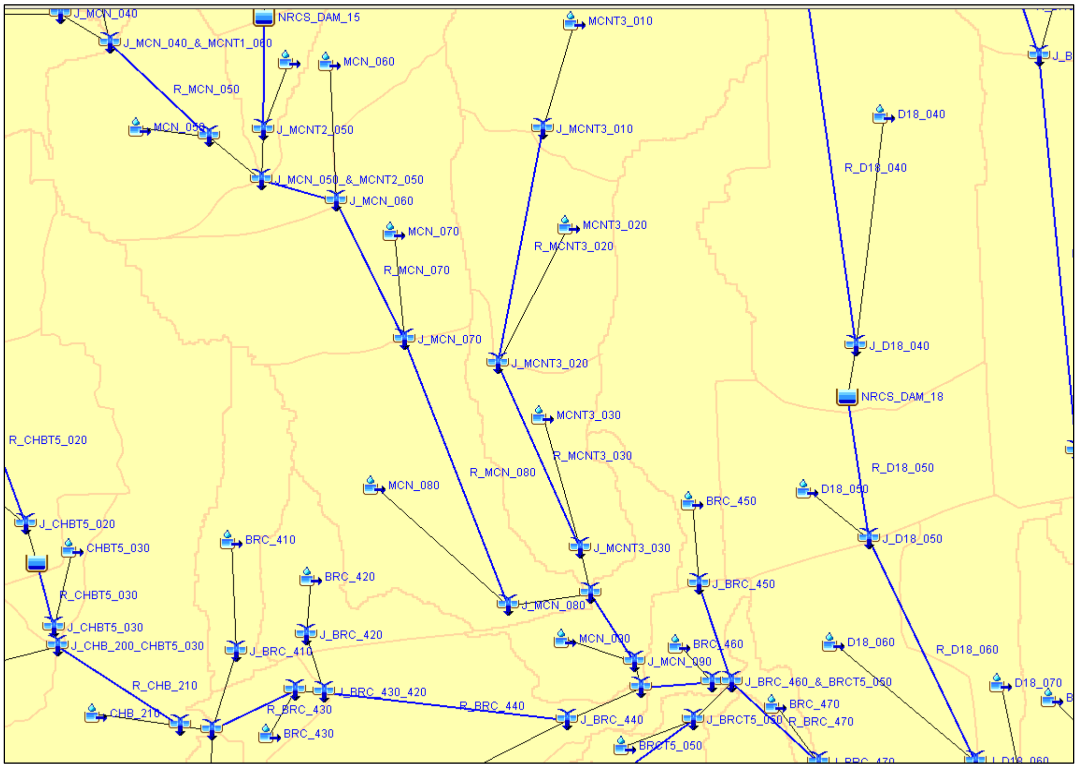


Figure J-23. McNutt Creek 1.2

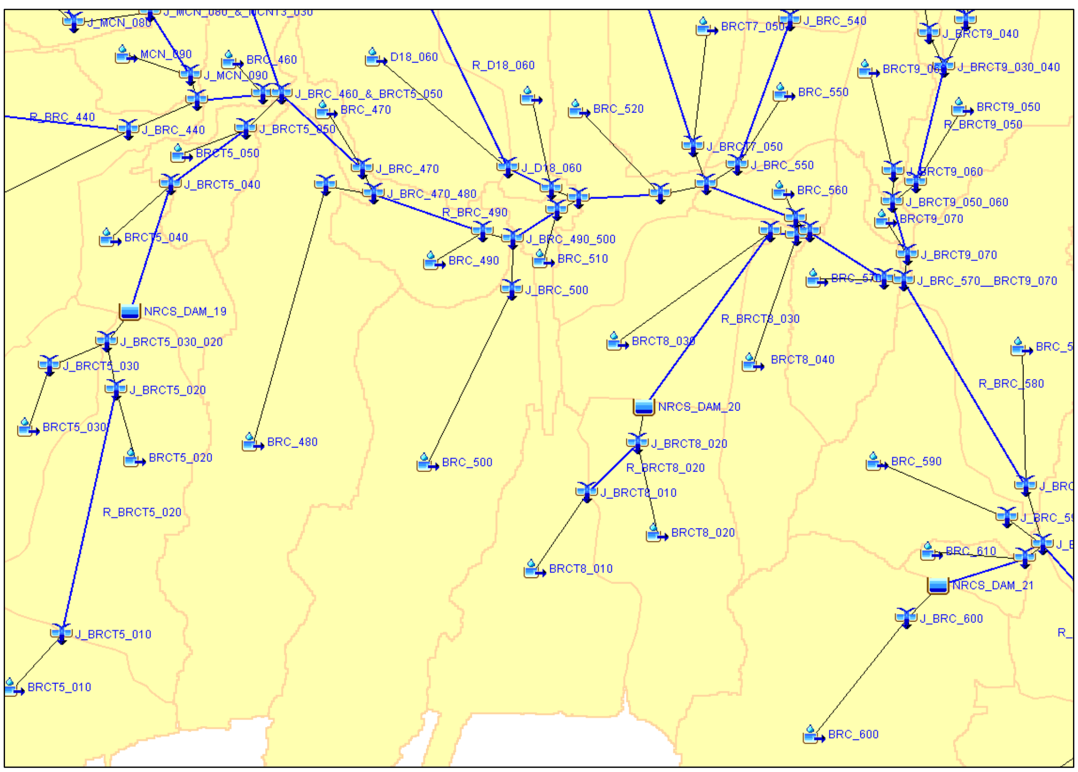


Figure J-24. McNutt Creek 1.3

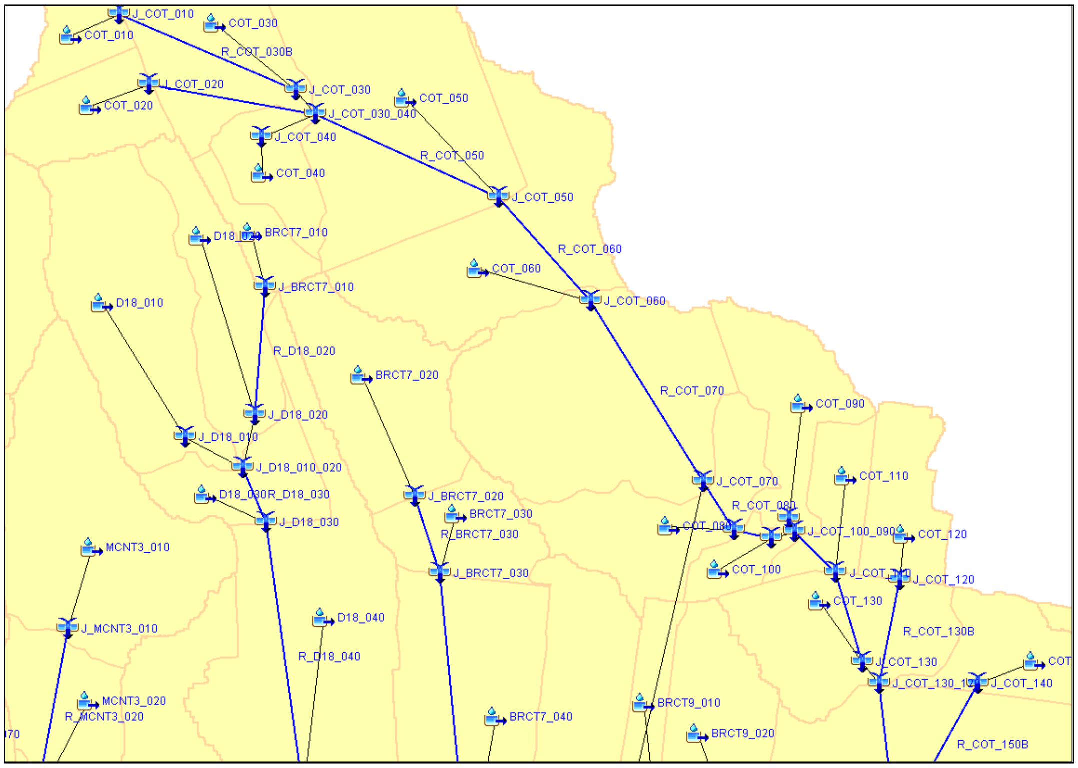


Figure J-25. Cottonwood Creek 1.1

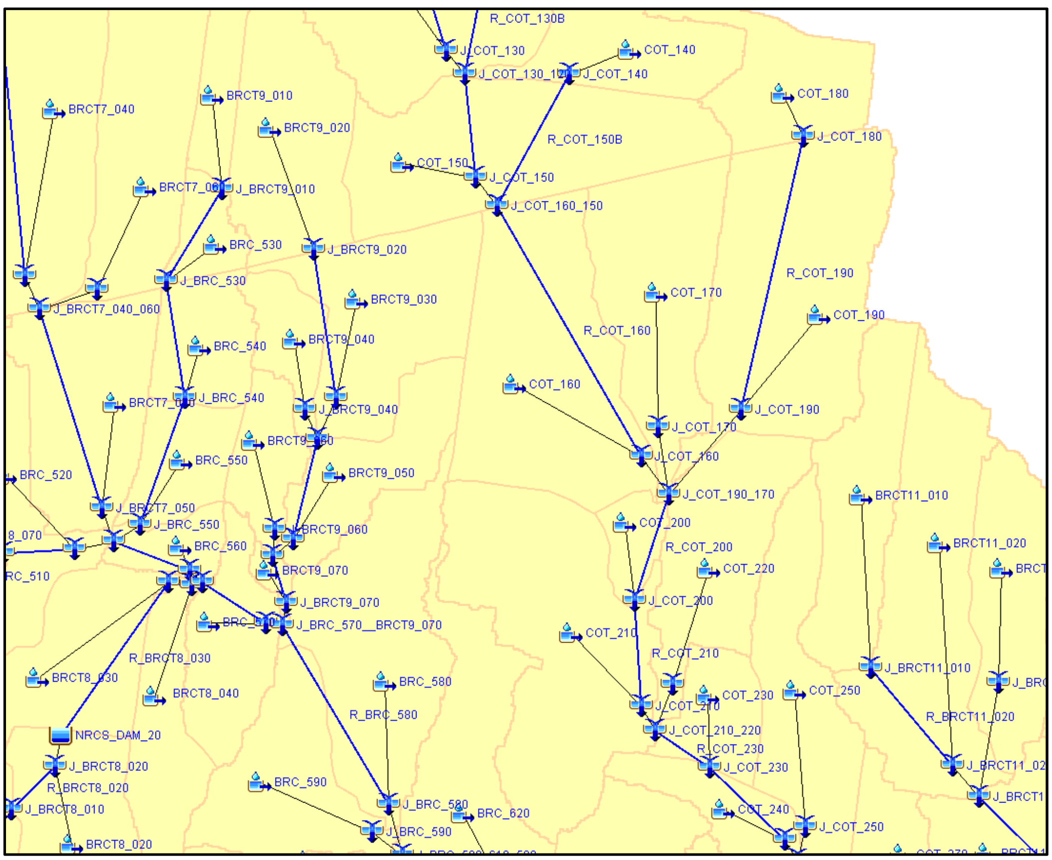


Figure J-26. Cottonwood Creek 1.2

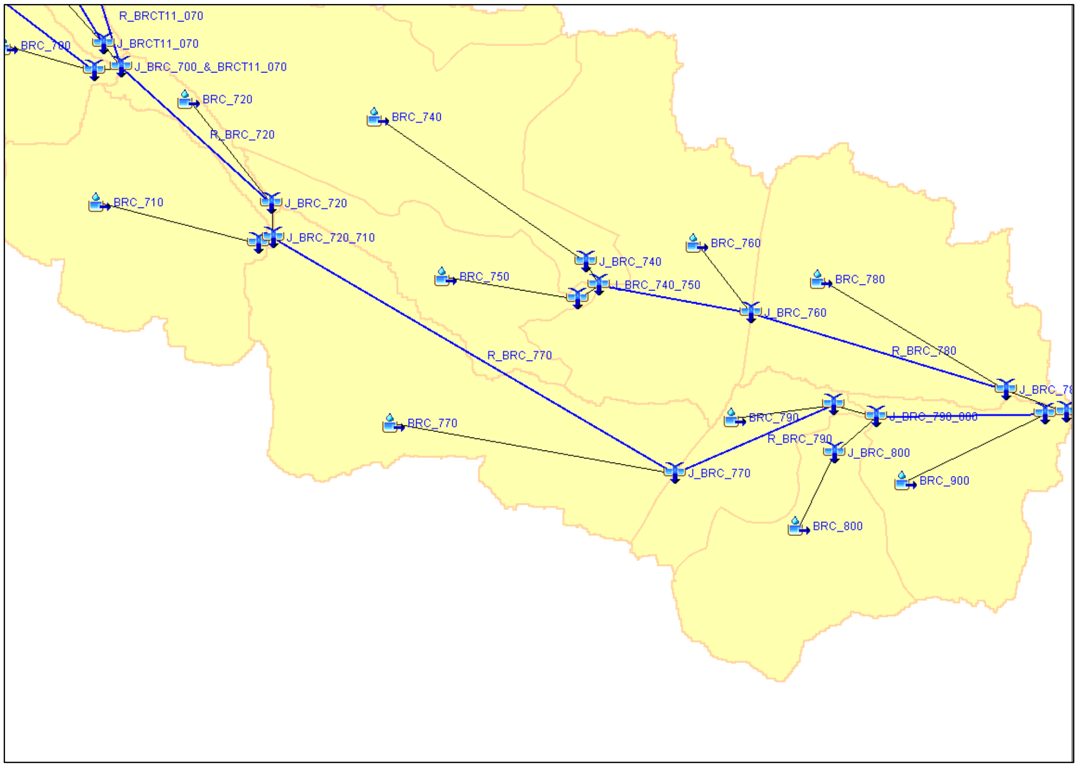


Figure J-27. Brushy Creek

Exhibit K
NRCS and Public/Private Detention Structures
Rating Curves

Table K-1. Elevation-Discharge-Storage Curves for Upper Brushy Creek NRCS Dams

Dam No. 1			Dam No. 2			Dam No. 3			Dam No. 4			Dam No. 5		
Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)
1011.45	0.00	208.21	948.30	0.00	0.00	872.80	0.00	0.00	838.30	0	0.0	886.61	0	0.0
1011.58	0.24	213.78	949.51	9.43	25.55	875.17	26.35	84.92	840.02	41.9	46.9	888.00	4.5	12.5
1011.71	0.69	219.36	950.72	13.89	58.24	877.53	46.86	191.38	841.75	45.7	102.5	889.40	6.3	27.8
1011.84	1.26	224.94	951.93	17.16	103.80	879.90	57.04	319.31	843.47	49.5	158.0	890.79	7.8	45.0
1012.17	3.34	241.01	953.15	19.83	160.70	882.27	59.68	481.80	845.20	52.1	227.3	892.18	9.1	64.2
1012.50	4.55	258.88	954.36	22.18	224.87	884.63	62.22	670.90	846.92	53.7	311.8	893.58	10.1	87.5
1012.83	5.50	276.75	955.57	24.30	295.97	887.00	64.66	897.36	848.65	55.2	415.3	894.97	11.1	114.8
1013.05	11.12	288.58	956.78	26.25	378.25	889.37	67.02	1156.40	850.37	56.6	535.4	896.36	12.0	145.2
1013.27	20.89	300.42	957.99	28.07	467.50	891.73	69.27	1468.25	852.10	58.1	670.5	897.76	12.8	179.9
1013.49	33.36	312.25	959.21	29.78	566.54	894.10	71.48	1799.40	853.82	59.5	826.5	899.15	13.6	219.4
1017.75	38.85	639.37	960.42	31.39	675.65	896.47	72.46	2189.14	855.55	60.8	1009.8	900.54	14.3	262.3
1022.02	43.63	1145.87	961.63	32.92	791.67	898.83	72.69	2614.81	857.27	61.7	1211.7	901.94	15.0	309.1
1026.28 *	47.94	1869.77	962.84 *	34.39	920.08	901.20 *	72.80	3110.85	859.00 *	61.8	1431.6	903.33 *	15.7	361.2
1026.97	311.00	2011.06	963.40	154.18	981.95	901.84	249.72	3263.48	859.65	270.7	1520.4	903.86	59.7	381.3
1027.65	870.27	2152.32	963.96	396.31	1044.90	902.48	640.75	3416.09	860.30	697.5	1613.4	904.40	153.4	403.8
1028.89	2450.81	2432.72	964.96	1106.30	1166.83	903.63	1837.78	3690.81	861.47	1837.8	1789.5	905.36	446.9	445.9
1030.40	5071.73	2801.38	966.19	2390.42	1320.90	905.04	3978.10	4026.59	862.90	3731.6	2018.3	906.53	985.5	500.5
1033.14	11859.69	3587.08	968.42	6009.55	1621.69	907.60	9815.12	4750.60	864.00	5863.3	2210.2	908.66	2513.1	611.4
1036.57	23099.43	4794.91	971.21	12228.65	2060.17	910.80	19376.61	5799.02	865.50	10156.0	2472.0	911.33	5135.5	771.1
1040.00	37297.57	6276.90	974.00	20540.37	2566.50	914.00	31471.98	6967.40	868.75	29363.2	3119.7	914.00	8636.8	951.6
									872.00	65167.2	3858.1			

Note A: The first elevation in all of the NRCS rating curves represents the elevation of the principal spillway.
Note B: The elevation marked with an * in the NRCS rating curves represents the elevation of the auxiliary spillway.
Dam No. 1 Source: SITES Table 2 Output from FNI SITES Modeling
Dam No. 2 Source: SITES Table 2 Output from FNI SITES Modeling
Dam No. 3 Source: SITES Table 2 Output from FNI SITES Modeling, which matches Draft FEMA HEC-HMS Model April 2012, Block House Creek
Dam No. 4 Source: 11-9-10 memo from FNI to RiskMAP team, provided to URS Dec 6 2011. Data matches Draft FEMA HEC-HMS Model April 2012, Spanish Oak Creek
Dam No. 5 Source: SITES Table 2 Output from FNI SITES Modeling

Table K-1. Elevation-Discharge-Storage Curves for Upper Brushy Creek NRCS Dams

Dam No. 6			Dam No. 7			Dam No. 8			Dam No. 9			Dam No. 10A		
Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage
(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)
888.50	0.00	0.00	805.00	0.00	0.00	825.50	0.00	0.00	771.05	0.00	170.96	811.70	0.00	113.43
890.06	36.00	68.10	807.00	94.57	109.22	827.30	36.40	64.80	771.29	4.48	180.64	813.30	4.68	146.40
891.62	42.00	144.20	809.00	98.89	238.13	829.10	69.30	151.90	771.54	12.68	190.31	814.90	7.77	186.58
893.18	43.10	221.20	811.00	102.83	385.61	830.90	73.00	247.20	771.78	23.29	199.99	816.49	9.63	232.38
894.75	44.20	298.20	813.00	106.61	561.82	832.70	76.50	365.00	772.03	35.85	209.66	818.09	11.16	288.94
896.31	45.80	405.30	815.00	110.29	772.75	834.50	79.80	510.20	773.88	38.30	291.30	819.69	12.53	350.47
897.87	47.30	538.40	817.00	113.80	1031.46	836.30	83.00	699.70	775.74	40.57	398.32	821.29	13.71	426.53
899.43	48.80	671.60	819.00	117.22	1307.01	838.09	86.10	922.00	777.59	42.72	530.78	822.89	14.84	506.06
900.99	50.30	828.30	821.00	120.57	1608.38	839.89	89.10	1174.20	779.45	44.77	691.47	824.49	15.84	604.74
902.55	51.70	1007.90	823.00	123.81	1967.20	841.69	92.00	1466.00	781.30	46.73	883.24	826.08	16.83	706.19
904.12	53.10	1207.00	825.00	126.97	2353.04	843.49	94.80	1811.90	783.16	48.61	1109.35	827.68	17.72	831.24
905.68	54.40	1433.30	827.00	130.05	2775.92	845.29	97.50	2193.10	785.01	50.42	1372.25	829.28	18.60	961.74
907.24 *	54.70	1686.40	829.00 *	133.07	3243.88	847.09 *	100.20	2608.10	786.87 *	52.16	1678.11	830.88 *	19.43	1117.73
907.82	211.20	1784.90	829.75	387.16	3430.94	847.84	330.80	2791.40	787.02	79.33	1703.39	831.14	56.88	1142.71
908.39	547.50	1887.60	830.50	922.26	3631.02	848.58	859.30	2990.00	787.16	106.05	1730.18	831.39	124.30	1167.70
909.43	1519.90	2089.00	831.85	2486.81	4002.88	849.92	2379.20	3355.20	787.43	253.72	1778.38	831.85	327.02	1212.67
910.69	3199.00	2345.30	833.50	5186.03	4501.40	851.56	5027.40	3850.30	787.75	532.90	1837.30	832.42	667.53	1275.08
912.99	7597.60	2863.30	836.50	14100.09	5510.77	854.55	25616.20	4875.00	788.33	1343.82	1948.27	833.44	1600.93	1393.36
915.87	14659.60	3604.00	840.25	81641.54	7008.94	858.27	135330.50	6386.40	789.07	2453.95	2091.41	834.72	3147.54	1552.73
918.75	23467.20	4436.50	844.00	201496.45	8692.70	862.00	309829.50	8177.00	789.80	3771.99	2242.41	836.00	5140.04	1721.05

Note A: The first elevation in all of the NRCS rating curves represents the elevation of the principal spillway.
Note B: The elevation marked with an * in the NRCS rating curves represents the elevation of the auxiliary spillway.
Dam No. 6 Source: SITES Table 2 Output from FNI SITES Modeling which matches Draft FEMA HEC-HMS Model April 2012, South Brushy Creek
Dam No. 7 Source: Rating curve based on existing conditions provided by FNI 11/30/11
Dam No. 8 Source: Rating curve based on existing conditions provided by FNI 11/30/11
Dam No. 9 Source: SITES modeling performed by URS June 2012, Table 2 Output . Used LIDAR Elevation-Storage and auxiliary spillway profile as well as surveyed PS elevaitons
Dam No. 10A Source: SITES modeling performed by URS June 2012, Table 2 Output . Used LIDAR Elevation-Storage and auxiliary spillway profile as well as surveyed PS elevaitons

Table K-1. Elevation-Discharge-Storage Curves for Upper Brushy Creek NRCS Dams

Dam No. 10B			Dam No. 11			Dam No. 12			Dam No. 13A			Dam No. 14		
Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)
797.40	0.00	85.10	722.10	0.00	197.71	767.83	0.00	80.50	829.40	0.00	0.00	714.26	0.00	0.00
798.73	3.66	105.65	723.33	26.36	256.15	769.03	10.38	105.87	830.43	38.90	23.71	715.01	7.85	41.40
800.07	5.57	130.06	724.55	44.85	318.72	770.24	14.38	140.52	831.47	52.80	60.62	715.77	16.14	83.00
801.40	6.92	157.25	725.78	84.48	388.44	771.44	18.37	175.17	832.50	67.20	106.64	716.52	20.63	138.70
802.74	8.01	188.65	727.01	108.14	485.39	772.64	21.32	224.18	833.53	82.30	162.39	717.28	31.06	200.30
804.07	8.94	226.27	728.24	116.91	588.21	773.85	23.85	280.72	834.57	93.60	226.89	718.03	38.46	266.30
805.40	9.81	267.91	729.46	124.79	703.12	775.05	26.13	360.83	835.60	100.30	302.02	718.78	43.73	343.90
806.74	10.60	315.27	730.69	129.48	863.48	776.25	28.22	452.10	836.63	106.60	387.95	719.54	47.14	430.10
808.07	11.33	370.01	731.92	134.16	1023.85	777.46	30.17	565.91	837.67	112.50	484.01	720.29	49.94	518.30
809.41	12.03	429.56	733.15	138.85	1184.21	778.66	32.01	700.22	838.70	118.00	593.84	721.05	52.66	607.40
810.74	12.68	495.94	734.37	143.53	1404.96	779.86	33.74	849.01	839.73	123.30	713.62	721.80	54.12	709.70
812.08	13.30	571.89	735.60	148.21	1637.66	781.07	35.38	1029.62	840.77	128.40	850.24	722.56	55.57	812.00
813.41 *	13.89	654.44	736.83 *	152.90	1870.36	782.27 *	36.96	1222.52	841.80 *	133.30	996.11	723.31 *	57.03	914.20
813.66	30.29	672.03	737.55	646.80	2029.08	782.76	135.42	1312.21	842.51	318.60	1111.40	723.94	199.92	1010.20
813.92	59.22	689.63	738.27	1548.17	2197.80	783.24	352.81	1401.91	843.22	754.00	1232.58	724.58	419.78	1106.30
814.38	155.35	721.31	739.56	3928.35	2521.28	784.12	1044.58	1567.72	844.50	1973.70	1464.80	725.72	1107.96	1292.20
814.94	329.52	760.02	741.14	7823.09	2943.64	785.19	2338.40	1804.16	846.06	4048.80	1777.06	727.12	2228.34	1556.50
815.95	818.67	839.92	744.02	17838.15	3835.80	787.13	6121.44	2280.30	848.90	9427.30	2432.29	729.65	5206.27	2121.00
817.23	1653.45	942.37	747.61	34009.61	5155.49	789.57	12521.79	2847.60	852.45	18149.40	3385.82	732.83	10151.33	3004.00
818.50	2749.17	1053.10	751.21	54407.88	6735.62	792.00	20898.36	3652.70	856.00	29256.70	4526.41	736.00	16635.55	4064.10

Note A: The first elevation in all of the NRCS rating curves represents the elevation of the principal spillway.
Note B: The elevation marked with an * in the NRCS rating curves represents the elevation of the auxiliary spillway.
Dam No. 10B Source: SITES modeling performed by URS June 2012, Table 2 Output . Used LIDAR Elevation-Storage and auxiliary spillway profile as well as surveyed PS elevaitons
Dam No. 11 Source: 11-9-10 memo from FNI to RiskMAP team, provided to URS Dec 6 2011. Data matches Draft FEMA HEC-HMS Model April 2012, Chandler Creek
Dam No. 12 Source: 11-9-10 memo from FNI to RiskMAP team, provided to URS Dec 6 2011. Data matches Draft FEMA HEC-HMS Model April 2012, Onion Creek
Dam No. 13A Source: SITES Table 2 Output from FNI SITES Modeling AFTER dam modernization, provided by FNI on 11/30/11. Data matches Draft FEMA HEC-HMS Model April 2012, Dry Fork Cree
Dam No. 14 Source: SITES Table 2 Output from FNI SITES Modeling. Data matches Draft FEMA HEC-HMS Model April 2012, Chandler Creek

Table K-1. Elevation-Discharge-Storage Curves for Upper Brushy Creek NRCS Dams

Dam No. 15			Dam No. 16			Dam No. 17			Dam No. 18			Dam No. 19		
Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage
(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)
698.94	0.00	0.00	714.29	0.00	0.00	670.79	0.00	117.26	659.24	0.00	0.00	660.65	0.00	70.04
699.58	5.38	18.08	715.56	8.96	54.84	671.61	17.93	133.21	660.20	19.78	28.97	661.94	19.99	87.38
700.22	15.23	37.74	716.84	14.22	120.96	672.43	43.99	149.77	661.17	20.45	59.80	663.23	20.88	109.02
700.86	27.97	60.42	718.11	18.11	200.46	673.25	48.89	166.41	662.13	21.09	94.21	664.52	21.75	133.43
701.50	43.06	83.10	719.39	22.86	294.48	674.07	53.78	183.06	663.10	21.72	130.93	665.81	22.57	161.67
702.43	44.40	120.30	720.66	34.28	406.66	674.89	56.09	201.91	664.06	22.33	170.49	667.10	23.39	189.90
703.37	45.68	162.05	721.93	40.34	534.83	675.71	57.88	221.96	665.03	22.93	220.02	668.39	24.20	220.02
704.31	46.94	207.20	723.21	45.39	692.43	676.53	59.54	243.37	665.99	23.50	273.03	669.67	24.96	254.57
705.25	48.15	259.26	724.48	49.58	875.66	677.35	60.91	267.15	666.95	24.07	329.15	670.96	25.69	292.59
706.19	49.34	313.46	725.76	53.77	1058.90	678.17	62.03	292.99	667.92	24.62	389.47	672.25	26.41	332.92
707.12	50.50	376.31	727.03	57.60	1268.64	678.99	63.10	320.65	668.88	25.15	459.19	673.54	27.11	377.93
708.06	51.64	439.93	728.31	61.08	1503.70	679.81	64.17	350.49	669.85	25.68	534.11	674.83	27.79	425.99
709.00 *	52.75	514.51	729.58 *	64.56	1738.76	680.63 *	65.21	383.09	670.81 *	26.20	613.54	676.12 *	28.45	476.38
709.55	150.03	558.23	730.30	364.58	1902.28	681.20	127.96	407.54	671.57	163.80	680.74	676.61	86.68	498.09
710.10	393.55	603.31	731.02	939.34	2065.84	681.77	290.46	431.98	672.33	479.42	753.07	677.11	247.63	519.80
711.09	1102.86	695.38	732.32	2418.68	2382.59	682.79	817.26	481.91	673.70	1382.81	895.15	678.00	742.68	558.88
712.30	2299.13	812.11	733.91	4847.72	2810.70	684.04	1797.28	550.18	675.37	2969.44	1090.29	679.08	1491.00	612.40
714.50	5433.23	1055.51	736.79	11194.79	3808.40	686.32	4601.19	684.93	678.41	7489.19	1502.62	681.06	3404.28	716.12
717.25	10510.32	1413.75	740.40	21644.94	5055.88	689.16	9377.40	901.86	682.20	15389.92	2153.29	683.53	6474.01	862.66
720.00	16957.00	1829.00	744.00	35172.45	6653.40	692.00	15698.98	1147.00	686.0	26160.72	2981.80	686.00	10328.79	1029.90

Note A: The first elevation in all of the NRCS rating curves represents the elevation of the principal spillway.
Note B: The elevation marked with an * in the NRCS rating curves represents the elevation of the auxiliary spillway.
Dam No. 15 Source: SITES Table 2 Output from FNI SITES Modeling
Dam No. 16 Source: SITES Table 2 Output from FNI SITES Modeling
Dam No. 17 Source: SITES Table 2 Output from FNI SITES Modeling. Data matches Draft FEMA HEC-HMS Model April 2012
Dam No. 18 Source: SITES Table 2 Output from FNI SITES Modeling
Dam No. 19 Source: SITES Table 2 Output from FNI SITES Modeling

Table K-1. Elevation-Discharge-Storage Curves for Upper Brushy Creek NRCS Dams

Dam No. 20			Dam No. 21			Dam No. 22		
Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage	Elevation	Total Discharge	Storage
(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)	(ft)	(cfs)	(ac-ft)
649.30	0.00	0.00	618.68	0.00	0.00	600.00	0.00	0.00
650.29	3.83	13.46	619.63	5.52	10.89	600.79	3.04	10.87
651.29	5.39	28.37	620.58	6.36	22.38	601.58	4.13	21.81
652.28	6.62	44.14	621.53	7.09	34.39	602.37	5.04	34.56
653.27	7.64	62.17	622.49	7.77	47.45	603.16	5.82	48.60
654.27	8.55	82.07	623.44	8.38	61.50	603.95	6.49	63.15
655.26	9.37	103.37	624.39	8.95	76.23	604.74	7.09	80.75
656.25	10.13	126.29	625.34	9.50	92.28	605.52	7.65	99.35
657.25	10.83	152.51	626.29	10.01	109.32	606.31	8.18	118.42
658.24	11.49	180.86	627.24	10.49	127.27	607.10	8.66	140.34
659.23	12.11	211.44	628.20	10.95	146.43	607.89	9.12	163.26
660.23	12.69	244.92	629.15	11.40	166.70	608.68	9.57	187.59
661.22 *	13.26	281.03	630.10 *	11.82	187.52	609.47 *	9.99	213.82
661.76	59.93	301.26	630.99	94.22	209.35	610.20	87.81	238.87
662.30	169.21	322.72	631.89	285.67	230.93	610.92	296.73	267.92
663.27	532.90	364.36	633.50	875.92	276.11	612.23	844.00	320.66
664.45	1208.63	417.61	635.47	1972.67	338.34	613.83	1804.52	393.70
666.61	3190.08	526.49	639.05	5340.78	475.38	616.74	4623.34	550.76
669.31	6618.92	683.40	643.52	11564.49	686.94	620.37	9710.66	789.07
672.00	11222.37	863.30	648.00	20497.05	950.00	624.00	16942.60	1083.67

Note A: The first elevation in all of the NRCS rating curves represents the elevation of the principal spillway.
Note B: The elevation marked with an * in the NRCS rating curves represents the elevation of the auxiliary spillway.
Dam No. 20 Source: SITES Table 2 Output from FNI SITES Modeling provided 11/30/2011. Data matches Draft FEMA HEC-HMS Model April 2012, Unnamed Tributary to Brushy Creek
Dam No. 21 Source: SITES Table 2 Output from FNI SITES Modeling
Dam No. 22 Source: SITES Table 2 Output from FNI SITES Modeling

Table K-2. Elevation-Discharge-Storage Curves for Public/Private Detention Structures

Round Rock			Round Rock			Round Rock			Round Rock			Round Rock		
Eagle Ridge Pond [A]			La Frontera [B]			Lake Forest, Detention Pond 1 (or Pond A) [C]			Randall's Town Centre [D]			Stone Oak [E]		
Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)
746.0	1.0	0.30	805.4	0.0	0.0	760.0	0.0	0.00	713.0	0.0	0.00	851.0	4.1	0.00
747.0	1.0	1.78	806.0	1.0	1.30	761.0	22.0	2.44	714.0	7.1	0.02	852.0	20.0	0.00
748.0	1.0	5.11	807.0	12.6	3.68	762.0	64.0	5.04	714.8	18.7	0.07	853.0	42.0	0.01
749.0	1.0	9.68	808.0	21.7	6.18	763.0	98.0	7.98	715.8	67.3	0.15	854.0	60.0	0.06
749.5	176.8	12.10	809.0	28.1	8.77	764.0	147.0	11.38	716.0	78.7	0.17	855.0	72.4	0.20
750.0	396.7	14.57	810.0	33.2	11.47	765.0	520.0	15.21	717.1	174.7	0.33	856.0	82.8	0.48
			811.0	37.7	14.28				718.2	307.7	0.49	857.0	92.2	0.91
			812.0	41.6	17.19				719.3	469.1	0.97	858.0	100.6	1.52
			813.0	45.3	20.22				720.0	585.0	1.48	859.0	108.4	2.35
			814.0	48.6	23.36				720.5	665.1	1.99	860.0	115.7	3.41
			815.0	51.8	26.61				721.3	808.2	2.90	861.0	122.5	4.73
			816.0	54.7	29.97				722.3	1066.4	4.62	862.0	128.3	6.31
			817.0	57.5	33.44				723.0	1248.9	6.10	863.0	133.9	8.19
			818.0	60.2	37.03				724.2	1631.1	10.36	864.0	139.2	10.37
			819.0	62.8	40.73				725.2	1993.6	15.42	865.0	144.4	12.91
			820.0	65.2	44.54				725.8	2250.0	19.28	866.0	149.3	15.82
			821.0	67.6	48.47				727.0	2747.3	26.33	867.0	1260.1	18.72
			822.0	69.9	52.51							868.0	3287.0	21.63
			823.0	652.9	56.67							869.0	5910.2	24.53
			825.0	3094.0	65.34									

Note: The first elevation in the above rating curves represents the initial condition elevation for HEC-HMS modeling.

A) Source: S.D. Kallman, L.P. *Eagle Ridge Section Fourteen Major Drainage Improvements Detention Pond Study* prepared for Canterberry Development, LTD. September 2003. The discharge with a tailwater elevation of 749.0 feet was selected over the no tailwater downstream condition.

B) Source: TR-20 output file (identified as Structure 5 Wet Pond) in the *Stormwater Quality and Detention Pond Drainage Report, La Frontera Commerical Development Section I and II, Round Rock, Texas*. Prepared by Raymond Chan & Associates, Inc. for David Berndt Interests, Inc. May 2000.

C) Source: Page 28 of 64 of the *Drainage Report for the Proposed Lake Forest, Section 1 Subdivision, Round Rock, Texas.* The report was prepared by Carter & Burgess, Inc. for Joel Robuck and the City of Round Rock. Revised October 29, 2001. The structure is identified as "Existing Pond with Modified Outlet."

D) Source: Jones & Carter, Inc. *Site Development Plans for Dry Branch Creek Regional Detention Serving +-123 Acres Located at the Southwest Corner of Gattis School Rd. & A.W. Grimes Blvd.*, Sheet 7 of 9, Detention Calculations. Prepared for Provident Realty Advisors. August 2002.

E) Source: *Revised Drainage Report for Preserve at Stone Oak Phase 3, Section 1 Pond A*, June 2001, Prepared by K.C. Engineering, Inc. for Continental Homes of Austin, L.P and City of Round Rock Public Works Department. The Pond Pack Version 5.2 elevation-outflow data was combined with the elevation-volume estimates presented in Plan Set Sheet 38a of 60 (*Preserve at Stone Oak Phase 3 Section 1 Construction Plans for Paving, Drainage, Water & Wastewater Utilities* prepared by K.C. Engineering April 2001) to arrive at the above elevation-discharge-storage relationship.

Table K-2. Elevation-Discharge-Storage Curves for Public/Private Detention Structures

Round Rock			Round Rock			Round Rock			Round Rock			Round Rock		
Onion Branch @ 1431 [F]			TeraVista, Chandler Pond C1 [G]			Teravista, Chandler Pond C2 [G]			Teravista, Chandler Pond C3 [G]			Teravista, Sunshine Pond S1 [G]		
Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)
830.0	0.0	0.00	765.0	0.00	0.00	769.5	0.0	0.00	775.0	0.0	0.00	766.2	0.0	0.00
832.0	55.4	0.01	766.0	0.00	1.67	770.0	13.9	0.01	776.0	39.2	0.29	767.0	1.9	0.76
834.0	156.8	0.47	767.0	118.64	5.57	771.0	72.1	0.43	777.0	111.0	1.12	768.0	17.4	2.45
836.0	288.1	1.54	768.0	332.65	12.29	772.0	155.1	1.88	778.0	203.9	3.25	769.0	41.0	4.40
838.0	443.5	3.61	769.0	611.40	22.32	773.0	256.9	5.07	779.0	313.9	7.06	770.0	70.5	6.53
840.0	619.9	6.99	770.0	945.59	36.11	774.0	374.6	11.24	780.0	438.7	12.89	771.0	115.7	8.86
842.0	814.8	11.94	771.0	1329.06	54.03	775.0	506.1	21.90	781.0	576.7	21.06	772.0	184.0	11.39
844.0	1006.2	18.72				776.0	596.2	37.92	782.0	726.7	32.02	773.0	270.3	14.12
846.0	1130.3	27.40				777.0	807.0	59.80				774.0	381.4	17.05
848.0	1242.0	38.35				778.0	964.8	88.13						
850.0	1344.5	51.86												
852.0	1439.8	68.02												
854.0	1529.1	87.13												

Note: The first elevation in the above rating curves represents the initial condition elevation for HEC-HMS modeling.

F) Source: Elevation-storage relationship derived from 2006 LIDAR using GIS. Obtained outlet elevation and dimensions from survey and computed pond discharge using Bently Culvert Master. Estimated weir flow over top of dam elevation (~866 feet) to account for overtopping flows during large storm events.

G) Source: Obtained elevation and incremental storage data from Table 6 in *Engineer's Report for Outfall Drainage for Teravista Phase 1 and II* prepared by Turner Collie & Braden, Inc. (TCB) for James E. Powell, NNP-Teravista, L.P. July 2000. Converted incremental into cumulative storage values. Obtained outlet elevation and dimensions from Table 5 and computed pond outflow using Bently CulvertMaster. Confirmed pond configurations with plan set *Williamson County Municipal Utility District No. 10 Plans for Rough Cut Construction of Detention Ponds and Mitigation Corridor for Teravista, Williamson County, Texas*, prepared by TCB, June 2000.

Table K-2. Elevation-Discharge-Storage Curves for Public/Private Detention Structures

Cedar Park			Cedar Park			Cedar Park			Cedar Park			Cedar Park		
Twin Lakes [H]			Bagdad Pond [I]			LISD Pond [J]			Wal Mart Pond [K]			Cedar Park Medical Center Pond [L]		
Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)
863.0	0.0	0.00	997.0	0.0	0.00	1009.0	0.0	0.00	964.0	0.0	0.00	896.0	0.0	0.00
864.0	71.9	11.05	998.0	6.8	0.10	1009.6	7.7	0.11	965.0	0.0	0.02	897.0	3.3	0.15
864.4	100.0	15.60	999.0	19.2	0.64	1010.0	17.0	0.18	966.0	0.0	0.74	898.0	9.5	3.94
865.6	300.0	31.03	1000.0	35.3	1.62	1010.2	21.7	0.34	967.0	78.1	2.24	899.0	12.8	8.66
866.0	379.6	35.92	1001.0	54.4	2.87	1010.8	39.8	0.81	968.0	224.5	4.49	899.1	13.0	9.15
866.6	500.0	43.65	1002.0	78.3	4.53	1011.0	47.0	0.97	969.0	413.9	7.12	900.0	77.0	13.53
867.4	700.0	56.09	1003.0	133.5	6.99	1011.4	61.3	1.70	970.0	638.1	9.90	901.0	233.7	18.53
868.0	866.7	65.63	1004.0	209.2	10.10	1012.0	85.7	2.79	971.0	892.0	12.81	902.0	477.7	23.68
868.1	900.0	67.61	1005.0	299.8	13.46	1012.6	112.7	4.64	972.0	1068.4	15.85	903.0	815.0	28.98
868.8	1100.0	78.62	1006.0	403.1	16.94	1013.0	132.2	5.87	973.0	1245.4	19.02	904.0	1252.2	34.42
868.9	1154.2	81.31	1007.0	517.4	20.53	1013.2	142.0	6.71	974.0	1400.3	22.29	905.0	1795.8	40.01
869.1	1221.3	84.05				1013.8	173.5	9.21	975.0	1539.6	25.67	905.4	2044.5	42.31
869.2	1303.0	86.65				1014.0	184.7	10.04	976.0	1667.3	29.10	906.0	2731.2	45.76
869.4	1408.8	89.47				1014.4	207.0	11.90	977.0	1785.9	32.55	907.0	4442.3	51.65
870.0	1867.4	102.25				1015.0	242.5	14.68	978.0	1897.1	36.02	907.4	5270.0	54.01
						1015.6	279.8	17.60	979.0	2002.2	39.50			
						1016.0	305.8	19.55	980.0	2102.0	42.97			
						1016.2	318.8	20.60	981.0	2197.3	46.44			
						1016.8	359.4	23.76	982.0	2288.6	49.92			
						1017.0	373.5	24.81	983.0	2376.4	53.39			
						1017.4	401.7	27.04						
						1018.0	445.5	30.38						

Note: The first elevation in the above rating curves represents the initial condition elevation for HEC-HMS modeling.

H) Source: Baker-Aiklen & Associates, Drainage Study for Twin Lakes Trailhead Parking and YMCA Improvements, Appendix H, 2002

I) Source: Draft FEMA HEC-HMS Model April 2012, Spanish Oak Creek (called Crossing at Carriage Hills in RAMPP model)

J) Source: As-built plan Phase 2 plan set *Lakeline Blvd. - Heritage Park City of Cedar Park, Texas Grading, Street, Drainage, Water, and Wastewater Construction Plans* prepared by Prossner and Associates, Inc., August 15, 2001. The discharge rating curve with a tailwater elevation of 1009.0 (no tailwater) was selected for use. Storage and discharge points were interpolated where necessary.

K) Source: Elevation-storage relationship derived from 2006 LIDAR using GIS, as it was not available in the plan set *Site Development Plans for Wal*Mart Stores, Inc. Supercenter Store No. 2991 Cedar Park, Texas* prepared by Doucet & Associates, Inc., October 2000. Obtained culvert outlet elevation and dimensions from RAMPP survey data for structure SPA-18 (ESP Associates, P.A. for Spanish Oak Creek performed March 30, 2010) and computed pond discharge using Bently Culvert Master.

L) Source: Cottonwood Creek LOMR HEC-HMS modeling for floodplain boundary modification provided by Cedar Park March 2012. Model is called Cottonwood_Channel.hms, Basin model is "Ex & Dev Flows with Endeavor," Pond is identified as CC Pond in model.

Table K-2. Elevation-Discharge-Storage Curves for Public/Private Detention Structures

City of Austin			City of Austin			City of Austin			Leander		
North Branch Pond [M]			North Branch Pond [M]			SH45/US183 Interchange - Main Pond [N]			Horizon Park/Gateway [O]		
Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)	Elevation (ft)	Total Discharge (cfs)	Storage (ac-ft)
886.0	0.0	0.00	892.2	2112.8	29.27	917.0	0.0	0.00	943.0	0.0	0.00
886.1	0.0	0.00	892.4	2114.7	30.88	917.5	6.6	0.03	944.0	3.4	0.03
886.2	3.6	0.00	892.6	2116.6	32.52	918.0	13.2	0.24	945.0	11.6	0.37
886.4	10.7	0.01	892.8	2118.4	34.18	918.5	19.7	0.76	946.0	20.4	1.69
886.6	17.9	0.02	893.0	2120.3	35.86	919.0	26.3	1.55	947.0	25.7	4.00
886.8	25.0	0.06	893.2	2122.2	37.56	919.5	32.9	2.63	948.0	30.2	7.22
887.0	32.1	0.17	893.4	2124.1	39.28	920.0	39.5	3.95	949.0	34.0	11.10
887.2	39.3	0.36	893.5	2125.0	40.15	920.5	46.1	5.57	950.0	37.4	15.09
887.4	46.4	0.68	893.6	2166.0	41.02	921.0	263.2	7.38	951.0	40.3	19.19
887.5	50.0	0.90	893.8	2248.0	42.77	921.5	324.0	9.30	952.0	43.1	23.34
887.6	60.0	1.11	894.0	2330.0	44.55	922.0	371.7	11.25			
887.8	70.0	1.66	894.2	2412.0	46.34	922.5	420.5	13.23			
888.0	80.0	2.32	894.4	2494.0	48.15	923.0	470.0	15.24			
888.2	90.0	3.09	894.6	2578.2	49.97	923.5	521.6	17.29			
888.4	100.0	3.96	894.8	2662.5	51.81	924.0	572.8	19.37			
888.6	150.0	4.92	895.0	2746.7	53.66	924.5	625.7	21.48			
888.8	200.0	5.94	895.2	2830.9	55.53	925.0	677.7	23.63			
889.0	298.8	7.03	895.4	2915.2	57.41	925.5	720.1	25.82			
889.2	397.7	8.18	895.6	2999.4	59.30	926.0	765.4	28.05			
889.4	496.5	9.36	895.8	3083.7	61.20	926.5	835.3	30.32			
889.6	595.3	10.58	896.0	3167.9	63.11	927.0	971.5	32.65			
889.8	694.1	11.84				927.5	1062.4	35.04			
890.0	792.9	13.14				928.0	1139.1	37.39			
890.2	891.8	14.46									
890.4	990.6	15.82									
890.5	1040.0	16.51									
890.6	1114.0	17.21									
890.8	1262.0	18.62									
891.0	1410.0	20.07									
891.2	1558.0	21.54									
891.4	1706.0	23.04									
891.6	1854.0	24.56									
891.8	2002.0	26.10									
891.9	2110.0	26.89									
892.0	2110.9	27.67									

Note: The first elevation in the above rating curves represents the initial condition elevation for HEC-HMS modeling.

M) Source: Plan set prepared by HNTB Corporation for the Texas Department of Transportation Texas Turnpike Authority Division, Hydraulic Data Sheet for the North Branch Detention Pond. February 2003. Plan set full title not available.

O) Source: Plan set prepared by HNTB Corporation for the Texas Department of Transportation Texas Turnpike Authority Division, Hydraulic Data Sheet for the Main Detention Pond. February 2003. Plan set full title not available. Elevation-storage relationship derived from 2006 LIDAR using GIS, as it was not available in the plan set Gateway at Leander, Williamson County, Texas proposed CLOMR Floodplain Amendment prepared by PBS&J for Gateway 2000, L.C, December 2006. Obtained outlet elevation and dimensions from plan set and computed pond discharge using Bently Culvert Master.

Exhibit L
Methodology for Incorporating Survey Cross-Section Data

Exhibit L
Methodology for Incorporating Survey Cross-Section Data

Survey-LiDAR Script

- Pre-Processing;
- Processing; and
- Post-Processing.

<u>Description:</u>

The Survey-LiDAR Script allowed the engineer to superimpose survey data with HEC-RAS geometry that was developed using a generic terrain dataset, such as LiDAR. The VBA script was built into Microsoft Excel and interpolated between surveyed cross-sections and visually placed the interpolated survey cross-section on top of the original HEC-RAS cross-section, and allowed the engineer to easily choose which points from which source they felt was most representative of actual channel conditions. When the engineer was confident they have made the proper point selections, they ran a second script that generated a new HEC-RAS geometry file.

<u>Pre-Processing:</u>

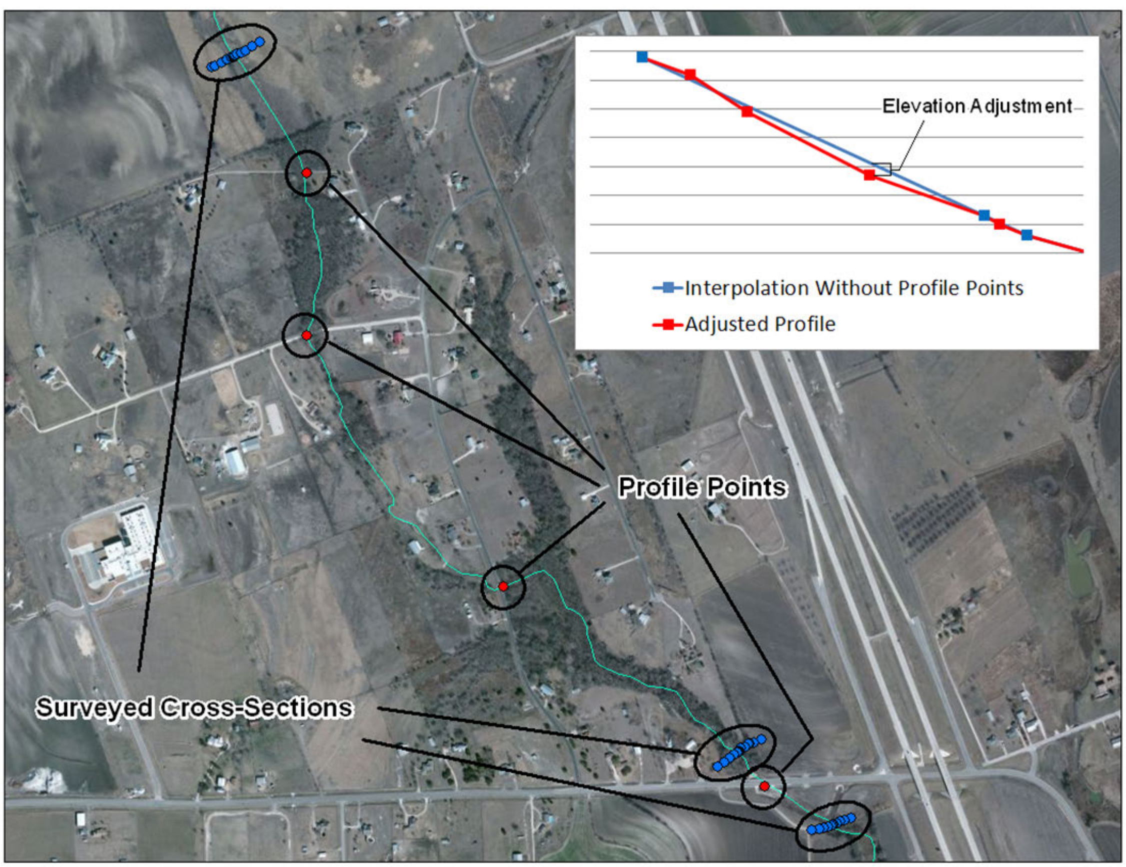
Before running the Survey-LiDAR script, the engineer had to prepare the data properly. The Excel file contains the Survey-LiDAR script came with four tabs, none of which had to be renamed, and each of which had to be filled accurately with the pertinent input data. The "Stationing" tab contains information identifying the location of each surveyed cross-section with respect to the HEC-RAS model. The "Reach_Connectivity" tab identified how all the reaches in the model or series of models were connected to each other in order to allow the script to identify upstream and downstream surveyed cross-sections. The "Surveyed_XSects" tab contains the cross-sections, station and elevation of every survey point. The "Profile_Points" tab contains surveyed elevation reference points that were not associated with a cross-section.

The first thing the engineer had to do was identify the river and reach names along which each surveyed cross-section was located. The engineer then identified the exact station of the surveyed cross-section along the reach. All of this information was placed in the "Stationing" tab. Each surveyed cross-section was given a unique name or identifier, and this identifier matched that in the "Surveyed_XSects" tab.

The "Surveyed_XSects" tab was populated with all the survey points, containing the unique name of the cross-section, with which they were associated, and their corresponding stations and elevations along that cross-section. This was calculated outside of the script using the "Point Angle and Position" tool in ET-GeoWizards. The unique name of each point was unimportant, as was the description, but these attributes were included in the tab for the convenience of the engineer. The bank stations were defined at this point by placing an "X" or any other place-holder in column F. Each cross-section had exactly two X's or bank stations. Only the bank stations and the points between them were included in the interpolation process. It was also important that the points in this tab were sorted by increasing station.

The “Reach_Connectivity” tab contains the upstream and downstream reach name for each reach in the HEC-RAS model, along with the downstream tie-in station in cases where the stationing was not continuous heading into the downstream reach. When the Survey-LiDAR script identified the upstream surveyed cross-sections it needed to know which direction to look whenever it came to a junction. For this reason, it was important that the best upstream reach was selected whenever a reach had more than one upstream reach. The downstream tie-in station had to be filled out whenever there was discontinuity in stationing with the downstream reach, which usually occurred when the current reach ended at station zero. The downstream reach then began a new stationing system and the Survey-LiDAR script had to know what that sudden station-change value was. The downstream tie-in station was the exact station along the downstream reach where the current reach intersected it, based on the downstream reach stationing system. When there was no station change (for instance, if the current reach ended at station 5000 and the downstream reach began at station 5000), the downstream tie-in station was left blank. This helped the script know that no stationing adjustments were needed when looking between these two reaches.

The “Profile_Points” tab contains all the extra survey points that weren’t part of a full or valid cross-section, but which the engineer still wanted to use to help define the low-flow profile of the river.

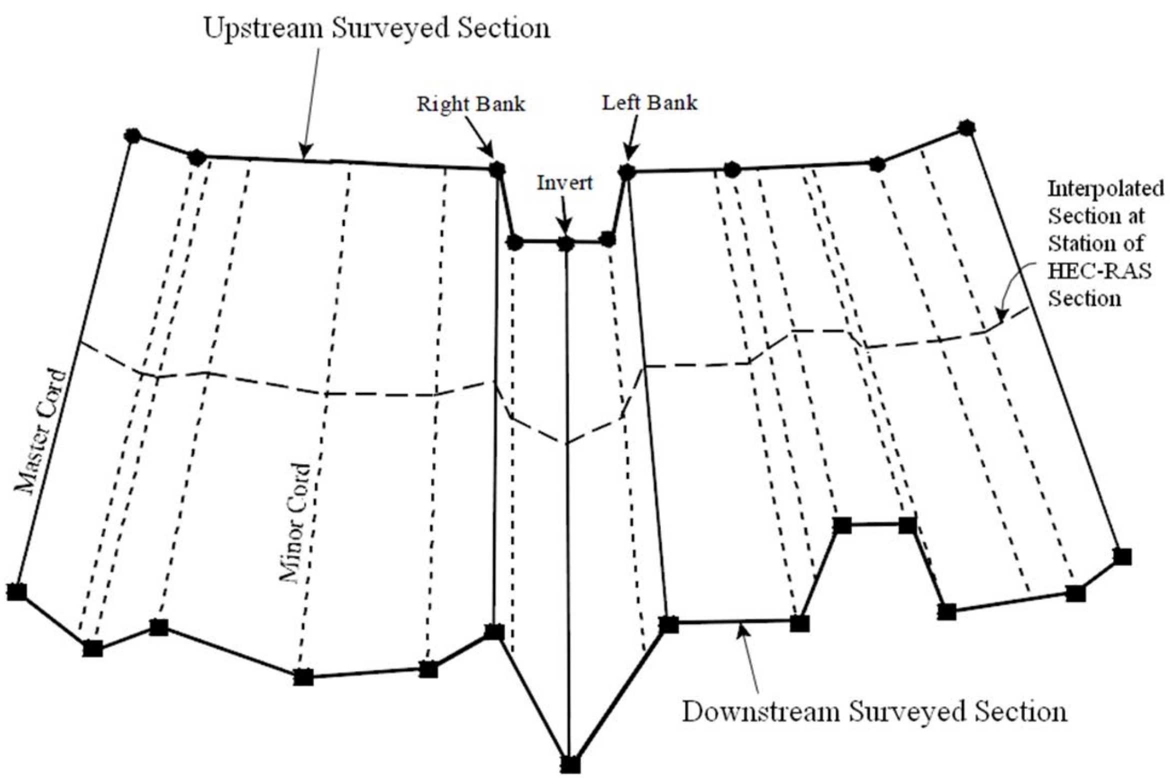


This tab was populated with the river and reach name of each profile point, along with the station along said reach and the elevation of the point. These points represent the actual channel bottom, and were used to define an elevation adjustment at the end of the interpolation process. The difference between the interpolated cross-section based on surveyed cross-sections and the profile of the channel bottom based on both surveyed cross-sections and profile points was known as the elevation adjustment.

Processing:

After the input parameters were correctly placed in their corresponding tabs, the engineer was ready to run the Survey-LiDAR script. The script then created a new tab for each cross-section in the HEC-RAS model, along with an index tab to allow the engineer to quickly navigate between all the other tabs. Each cross-section tab contains a chart showing the original cross-section superimposed by the interpolated survey cross-section, which was generated by the script in the following manner:

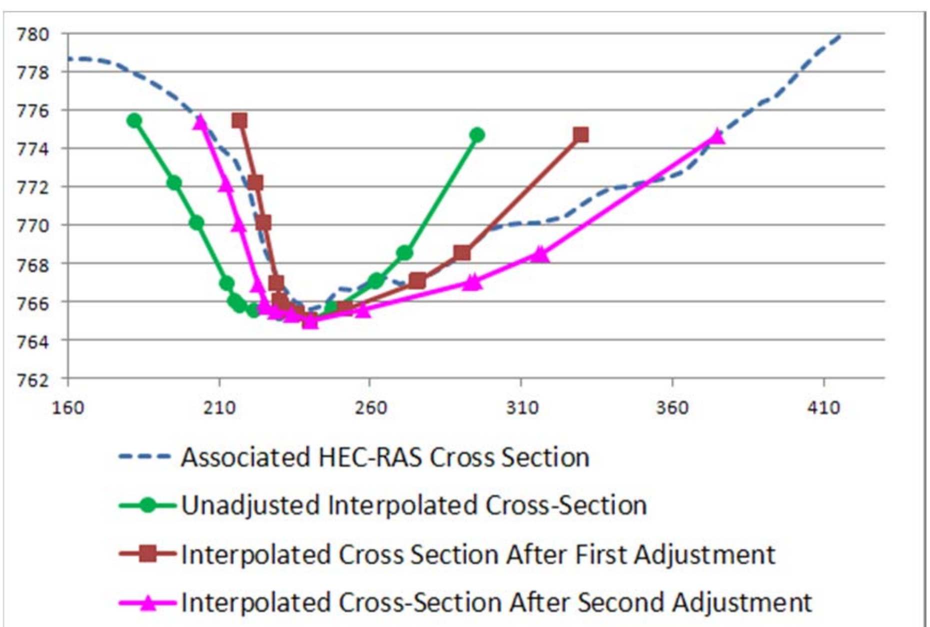
Once the upstream and downstream cross-sections were identified based on the information in the "Stationing" and "Reach_Connectivity" tabs, the interpolated survey cross-section was developed based on the HEC-RAS interpolation method, which is best visualized in the following manner:



Master chords connect bank stations with corresponding bank stations and invert with invert. Minor chords were then drawn for every additional point on both the upstream and downstream cross-section, but rather than tying into other points, they tie into the elevation of the corresponding station at the other cross-section, based on its relative position between the bank point and the invert. As opposed to what is shown in the figure above, the Survey-LiDAR script did not perform any interpolation or calculation outside of the banks. It was assumed that the engineer only wanted the survey to apply within the bank stations.

First the stations of the upstream and downstream surveyed cross-sections were adjusted so that the inverts match the station of the invert of the associated HEC-RAS cross-section (the cross-section we were trying to update in order to include survey data). The survey interpolated cross-sections were then cut perpendicular to the master and minor chords at the station in question as illustrated in the figure above. Due to variation in channel geometry, though, the station of each point in the new cross-section was not likely to match its actual corresponding station in the original HEC-RAS cross-section. To compensate for this the survey-interpolated cross-section shifts the banks to match the banks of the associate cross-section and skews all intermediate points accordingly. For instance, if the distance between the banks of the original interpolated cross-section was 50 feet, but the difference between the banks of the corresponding HEC-RAS cross-section was 100 feet, suggests that the channel was widened between the surveyed cross-sections. Thus, the distance between the banks of the adjusted interpolated cross-section was 100 feet and each interpolated point between the banks was spread out based on their relative positions between the invert and the bank.

A second adjustment was then performed to bring the banks in line with associated cross-section geometry. The banks were moved in or out until they intersected with the associated HEC-RAS geometry, which allowed for a smooth transition between the original HEC-RAS and survey interpolated geometry. See the figure below:



Before the second adjustment was made, however, an elevation adjustment was placed on the interpolated survey cross-section based on proximity to a Profile Point, which was found in the “Profile_Points” tab. All points in the interpolated cross-section were uniformly brought up or down according to the difference between the invert of the interpolated cross-section and the invert based on the new profile of the channel bottom which includes profile point data.

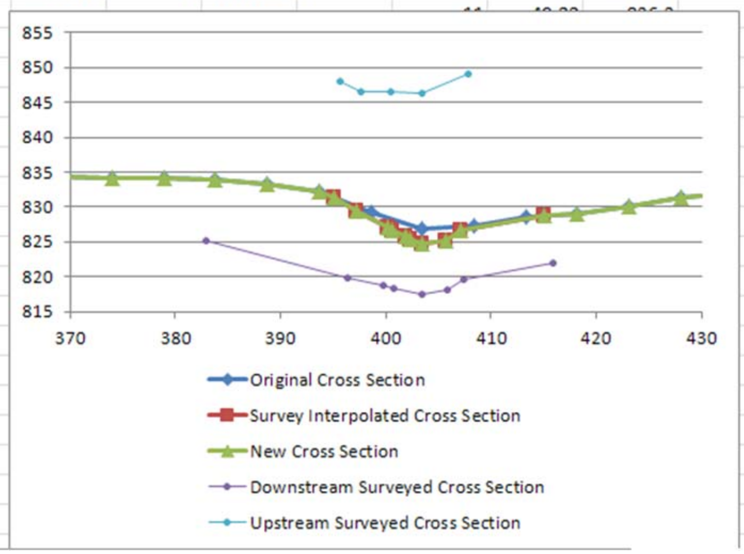
The Survey-LiDAR script created a default new cross-section geometry where only the lowest points between the associated HEC-RAS cross-section and the interpolated survey cross-section were accepted. The engineer then made individual changes to this default as discussed below.

Post-Processing:

The survey LiDAR script was designed to help the engineer make judgments quickly and supplement their work as oppose to replace it.

Checked?	ok		Elev Adj
Left Bank Sta.	395.12		2.41
Low Point Sta.	403.46		
Right Bank Sta.	415	Dist (ft)	Display?
US Survey XSID	CS2070	142	x
DS Survey XSID	SBT2_B_001	713	x

Orig Sta	Orig Elev		Ref Sta	Survey Sta	Survey Elev			New Sta	New Elev
0	838.03	X	384.9771	395.12	831.3421	X	1	0	838.03
4.92	837.61	X	389.6172	397.2138	829.4153	X	2	4.92	837.61
9.84	837.5	X	396.3023	400.2302	826.9819	X	3	9.84	837.5
14.77	837.51	X	397.0433	400.5646	826.7116	X	4	14.77	837.51
19.69	837.41	X	400.088	401.9385	825.7809	X	5	19.69	837.41
24.61	837.24	X	401.0111	402.355	825.3084	X	6	24.61	837.24
29.53	837.08	X	403.46	403.46	824.6884	X	7	29.53	837.08
34.45	836.97	X	405.575	405.6576	825.219	X	8	34.45	836.97
39.37	836.75	X	406.9373	407.0732	826.5638	X	9	39.37	836.75
44.3	836.46	X	414.5661	415	828.7551	X	10	44.3	836.46
49.22	836.3	X							
54.14	836.15	X							
59.06	836.07	X							
63.98	835.99	X							
68.91	835.84	X							
73.83	835.9	X							
78.75	835.83	X							
83.67	835.77	X							
88.59	835.64	X							
93.51	835.52	X							
98.44	835.41	X							
103.36	835.43	X							
108.28	835.58	X							
113.2	835.72	X							
118.12	835.83	X							
123.05	835.71	X							
127.97	835.51	X							
132.89	835.61	X							



With this interface, the engineer was allowed to make a number of changes and have those changes updated live in the chart visualization. The engineer may have changed the bank and invert stations, which updates all the points between them based on relative position. The engineer may have also changed the elevation adjustment, though this change was discouraged without strong justification. The engineer had information and hyperlinks for the upstream and downstream surveyed cross-section upon which to base his/her decisions. The engineer also had the option to include or exclude individual points from either the original or survey-interpolated cross-section by adding and removing X's from the column next to the elevations. It was up to the engineer to decide which points to keep and manage the blending at the transition zone.

When each cross-section had been updated and checked the engineer ran a second script built into the spread that created a new HEC-RAS geometry file based on the information found in the cross section tabs. This second script made an exact duplicate of the existing geometry file in every way except for the geometry as found in the tabs. Ineffective flow areas, structures, manning's roughness coefficients and everything else was not changed. If there was a cross-section in the original geometry file for which there was no tab, that cross-section was copied into the new geometry file with no changes.

Exhibit M
Methodology for Incorporating Flow Data from HEC-HMS

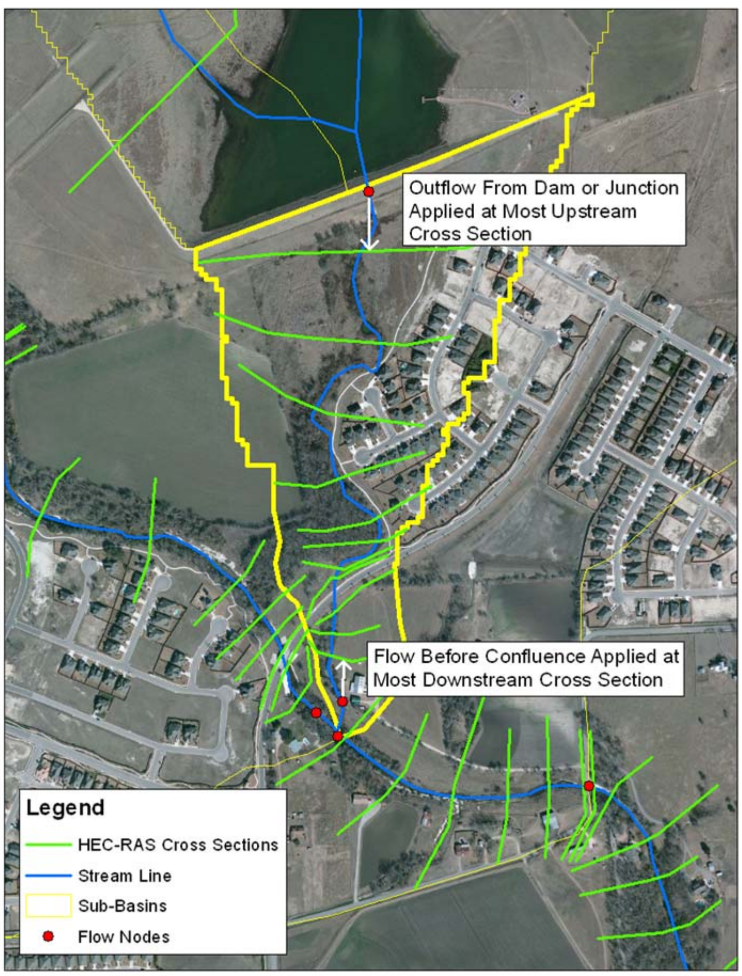
Exhibit M
Methodology for Incorporating Flow Data from HEC-HMS

Overview

The memorandum provides a description of the procedure used to apply peak flows generated in the watershed HEC-HMS model to the cross-sections of the HEC-RAS model. The methodology takes flows at various nodes computed from the watershed HEC-HMS hydrologic model and applies them to each cross-section in each watershed HEC-RAS model using a base-10 logarithmic interpolation, per the type of interpolation used by City of Austin, and approved in TM3. It requires the engineer to define the HEC-RAS station of the hydrologic flows, performs the logarithmic interpolation at every cross-section, and then for the purpose of being conservative it shifts the flows upstream by one cross-section. The details of the TM3 method, which were not provided in TM3, are provided in this memorandum.

Methodology Description

The following figure illustrates how the flows were applied for the Upper Brushy Creek watershed study.



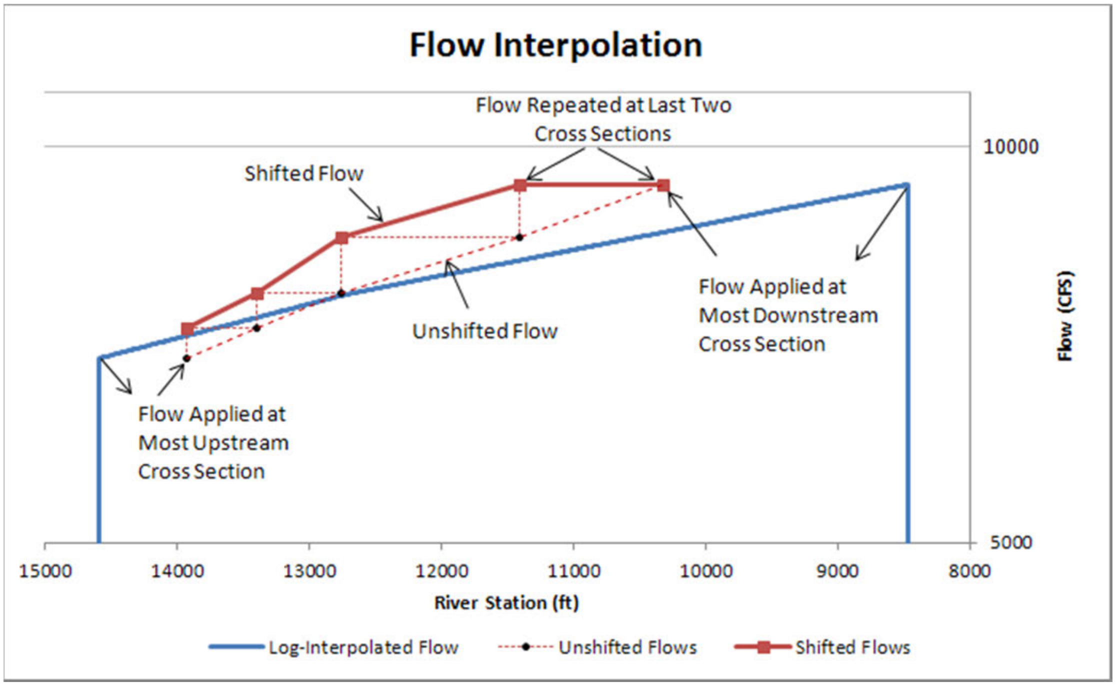
The figure shows the HEC-HMS model flow nodes, where peak flows are predicted. In general, these nodes do not align exactly with HEC-RAS cross-section locations along a streamline. The two nodes to be discussed are the two nodes in the figure with white arrows pointing towards modeled cross-section locations.

The peak flow from the downstream HEC-HMS model node is applied to the next upstream hydraulic cross-section. The peak flow from the upstream model flow node is then initially applied to the next hydraulic model cross-section downstream. The flows for the hydraulic cross-sections between these two cross-sections are then estimated using a base-10 logarithmic interpolation based on relative station between the endpoints, as described in TM3. There are two situations, however, which create a need for a different system.

- **Case 1**. In some cases, there is no upstream flow node. This can occur at the upper ends of the watershed where there is no inflow into a sub-basin from another sub-basin. An interpolation cannot be performed on a single point, and so a different approach is used. In this case, the engineer calculates the contributing area to the top-most cross-section in the sub-basin. The peak flow at this cross-section is estimated based upon the peak flow at the first downstream HEC-HMS model node, multiplied by the ratio of the watershed area of the furthest upstream cross-section, to the watershed area at this HEC-HMS model node. The logarithmic interpolation will then be performed to estimate peak flows at the intervening cross-sections based as discussed above.

- **Case 2**. In this case, the flow at the first downstream HEC-HMS model node is applied to the cross-section.

To ensure flow values applied to cross-sections are conservative relative to the HEC-HMS model, all flows are shifted upstream by one cross-section, or in other words, each cross-section receives the flow of the next cross-section downstream. This addresses the issue of applying the peak flow at the upstream model node to the next cross-section downstream, which is a non-conservative assumption. Peak flow at the most downstream cross-section in each sub-basin does not change, which is a conservative assumption, because the flows are derived from a downstream HEC-HMS model node. The figure below provides a depiction of this flow shift. The blue line in the figure is a straight logarithmic interpolation between the location of the HEC-HMS model nodes (i.e., what the flows would be if these node flows were not reassigned to the adjacent cross-sections, and interpolations were based upon assigning stations to each HEC-HMS model node). When hydraulic calibration was performed, two methods for flow assignment were applied, once per the “blue line” or full reach interpolation scheme in the figure below, and once per the “solid red line” or cross-section-based scheme (the scheme applied in statistical floodplain modeling generally). The results of the calibration were not materially changed.



As a final step, to ensure that flow through a bridge or culvert remains constant, the flow change at the downstream cross-section associate with each bridge or culvert is removed, meaning the flow at the upstream cross-section is applied uniformly throughout the structure. Since this flow has already been shifted up from the downstream cross-section, the value is conservative.

The following figure shows a flow profile for the main stem of South Brushy Creek, and is more representative of a typical comparison.

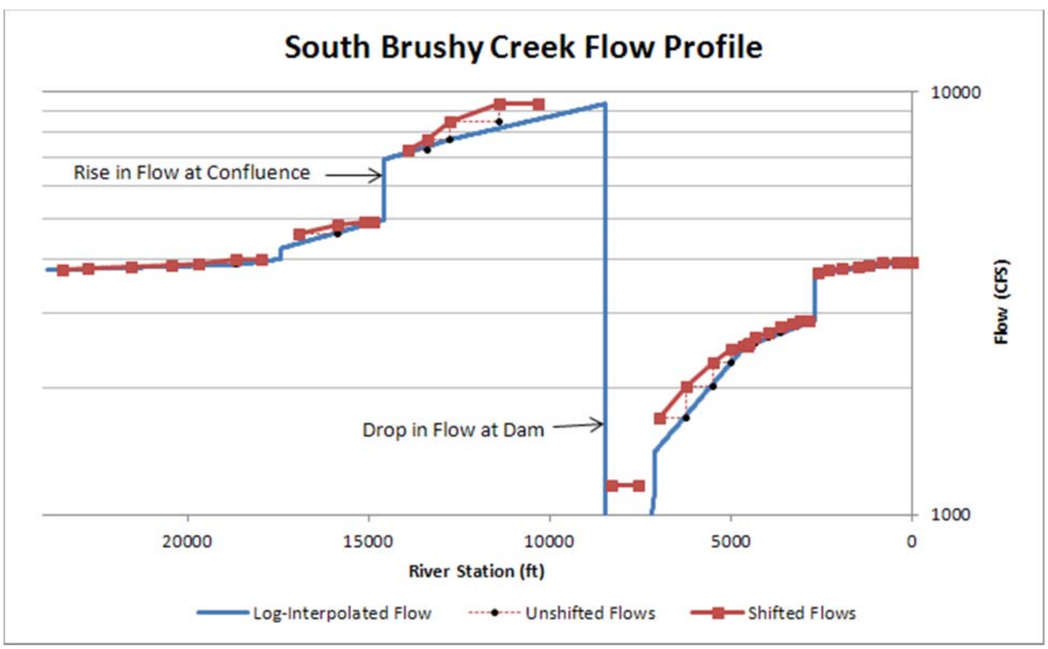


Exhibit N
HEC-RAS Summary Output Data

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Trib4	Reach1	600.8917	582.63	818.03	822.76	822.82	0.00675	2.4	345.47	254.51	0.25
BlockHouse_Trib4	Reach1	482.6573	588.23	816.87	821.02	821.27	0.033941	4.62	179.31	210.37	0.54
BlockHouse_Trib4	Reach1	371.3602	593.37	816.41	819.68	819.85	0.006508	3.75	181.19	202.63	0.61
BlockHouse_Trib4	Reach1	270.064	599.9	810.99	818.88	818.94	0.000288	2.08	416.73	326.94	0.16
BlockHouse_Trib4	Reach1	142.8957	599.9	807.49	818.76	818.86	0.00102	2.85	323.52	551.49	0.26
BlockHouse_Trib4	Reach1	112.8203	Culvert								
BlockHouse_Trib4	Reach1	98.28716	599.9	806.02	816.48	816.57	0.000324	2.49	312.32	103.57	0.17
BlockHouse_Trib3	Reach1	8188.073	497.82	985.1	988.48	988.49	0.000011	0.78	788.78	667.44	0.08
BlockHouse_Trib3	Reach1	8156.817	519.4	983.91	988.48	988.49	0.000008	0.53	929.77	968.53	0.06
BlockHouse_Trib3	Reach1	8107.907	Culvert								
BlockHouse_Trib3	Reach1	8066.31	519.4	980.67	987.4	987.41	0.000002	0.42	1611.52	745.05	0.03
BlockHouse_Trib3	Reach1	7932.62	526.41	980.85	987.4	987.41	0.000014	0.48	1738.4	1054.31	0.04
BlockHouse_Trib3	Reach1	7919.208	Bridge								
BlockHouse_Trib3	Reach1	7895.538	526.41	980.35	983.53	984.37	0.0129	7.47	73.09	140.47	0.94
BlockHouse_Trib3	Reach1	7861.8	540.4	980.44	983.15	983.76	0.011317	6.57	92.57	143.38	0.87
BlockHouse_Trib3	Reach1	7723.254	565.37	980.48	981.88	982.02	0.008411	3.22	191.72	314.56	0.5
BlockHouse_Trib3	Reach1	7484.579	600.3	976.79	980.66	980.79	0.004039	3.66	292.66	553.16	0.51
BlockHouse_Trib3	Reach1	7167.849	649.1	973.92	978.22	979	0.007929	7.09	91.58	92.03	0.82
BlockHouse_Trib3	Reach1	6754.959	666.02	969.7	973.55	974.68	0.014074	8.51	78.24	270.68	1
BlockHouse_Trib3	Reach1	6619.002	722.16	964.84	970.44	970.59	0.000647	3.13	231.04	348.65	0.25
BlockHouse_Trib3	Reach1	6554.695	Culvert								
BlockHouse_Trib3	Reach1	6460.874	722.16	962.2	965.3	965.76	0.004356	5.48	131.87	66.05	0.58
BlockHouse_Trib3	Reach1	6191.413	764.09	961.35	964.1	964.42	0.00507	4.52	169.12	92.09	0.59
BlockHouse_Trib3	Reach1	5893.28	817.77	959.47	961.76	962.4	0.008295	6.42	127.44	74.84	0.87
BlockHouse_Trib3	Reach1	5534.55	848.3	956.09	958.08	958.9	0.011405	7.3	116.24	71.29	1.01
BlockHouse_Trib3	Reach1	5340.871	888.18	954.25	957.15	957.45	0.002668	4.38	202.94	90.21	0.51
BlockHouse_Trib3	Reach1	5098.196	907.28	952.42	957.11	957.19	0.000388	2.29	427.07	197.92	0.21
BlockHouse_Trib3	Reach1	4985.791	930.04	951.69	957	957.13	0.000381	2.86	324.71	127.26	0.22
BlockHouse_Trib3	Reach1	4947.085	Culvert								
BlockHouse_Trib3	Reach1	4908.492	930.04	951.35	955.06	956.26	0.010016	8.81	105.58	43.68	1
BlockHouse_Trib3	Reach1	4854.875	966.6	950.99	953.08	953.57	0.007427	5.59	172.76	114.83	0.8

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Trib3	Reach1	4651.15	1029.61	948.91	950.96	951.56	0.0128	6.26	164.49	139.11	1.01
BlockHouse_Trib3	Reach1	4317.498	1093.65	944.49	949.41	949.42	0.000061	1	1125.85	315.03	0.09
BlockHouse_Trib3	Reach1	3998.682	1102.6	940.82	949.42	949.42	0.000002	0.2	4395.15	934.13	0.02
BlockHouse_Trib3	Reach1	3955.668	1068.58	941.72	949.42	949.42	0.000006	0.35	3037.98	956.88	0.03
BlockHouse_Trib3	Reach1	3935	Culvert								
BlockHouse_Trib3	Reach1	3841.48	1068.58	938.11	941.59	942.7	0.011834	8.46	126.32	56.9	1
BlockHouse_Trib3	Reach1	3662.933	1070.74	934.72	938.76	940.06	0.009395	9.17	116.76	43.17	0.98
BlockHouse_Trib3	Reach1	3549.478	1071.69	933.57	938.66	939.15	0.002566	5.62	190.55	55.37	0.53
BlockHouse_Trib3	Reach1	3499.387	1073.8	933.24	938.62	939	0.001446	4.95	216.94	62.08	0.42
BlockHouse_Trib3	Reach1	3472.759	Culvert								
BlockHouse_Trib3	Reach1	3437.551	1073.8	933.03	937.84	938.33	0.002072	5.62	191.04	60.68	0.5
BlockHouse_Trib3	Reach1	3388.206	1076.32	932.94	937.37	938.1	0.004959	6.9	156.1	54.97	0.72
BlockHouse_Trib3	Reach1	3256.018	1079.43	931.99	936.45	937.37	0.005355	7.69	140.3	43.94	0.76
BlockHouse_Trib3	Reach1	3093.484	1083.4	930.94	934.76	936.17	0.009814	9.53	113.68	40.79	1.01
BlockHouse_Trib3	Reach1	2886.527	1087.21	928.14	932.04	933.49	0.009768	9.65	112.7	38.87	1
BlockHouse_Trib3	Reach1	2688.976	1092.06	925.4	930.05	931.55	0.009768	9.84	110.97	37.42	1.01
BlockHouse_Trib3	Reach1	2437.842	1092.71	923.45	929.19	929.66	0.002075	5.45	200.61	51.51	0.49
BlockHouse_Trib3	Reach1	2404.384	1095.16	923.14	929.18	929.55	0.001445	4.9	223.67	51.05	0.41
BlockHouse_Trib3	Reach1	2367.387	Culvert								
BlockHouse_Trib3	Reach1	2329.99	1095.16	923.08	926.5	927.89	0.009695	9.48	115.56	41.21	1
BlockHouse_Trib3	Reach1	2278.09	1100.28	921.41	925.34	926.7	0.009736	9.37	117.37	43.11	1
BlockHouse_Trib3	Reach1	2015.413	1104.58	918.34	922.64	924.03	0.009883	9.46	116.81	42.57	1.01
BlockHouse_Trib3	Reach1	1795.401	1112.45	916.27	921.49	921.87	0.001906	4.95	224.71	63.52	0.46
BlockHouse_Trib3	Reach1	1760.997	Bridge								
BlockHouse_Trib3	Reach1	1719.34	1112.45	915.92	919.87	920.75	0.006108	7.54	147.63	53.31	0.8
BlockHouse_Trib3	Reach1	1395.216	1116.67	911.66	917.71	917.93	0.010103	3.76	297.16	99.39	0.37
BlockHouse_Trib3	Reach1	1181.641	1119.33	908.85	914.61	915	0.018718	5.14	250.09	160.41	0.5
BlockHouse_Trib3	Reach1	1047.704	1123.02	907.09	912.92	913.1	0.010302	3.89	343.27	143.86	0.37
BlockHouse_Trib3	Reach1	862.2182	1123.02	904.65	911.22	911.43	0.008127	3.65	307.35	86.82	0.34
BlockHouse_Trib3	Reach1	707.9232	1123.02	901.69	907.62	908.64	0.062403	8.18	146.22	159.92	0.88
BlockHouse_Trib2	Reach1	8651.306	391.08	1012.35	1015.37	1015.66	0.022702	4.58	107.69	122.52	0.56

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Trib2	Reach1	8246.122	471.51	1006.17	1009.79	1009.9	0.010217	3.04	208.94	200.64	0.37
BlockHouse_Trib2	Reach1	7813.229	517.45	1000.67	1004.49	1004.64	0.014632	3.79	203.99	204.11	0.45
BlockHouse_Trib2	Reach1	7598.024	554.64	997.54	1001.24	1001.45	0.015154	4.04	165.42	136.07	0.46
BlockHouse_Trib2	Reach1	7437.351	614.84	994.68	1000.62	1000.65	0.002642	1.86	488.64	792.73	0.2
BlockHouse_Trib2	Reach1	7364.573	Culvert								
BlockHouse_Trib2	Reach1	7322.6	614.84	994.12	999.67	999.83	0.010254	3.49	240.29	499.76	0.38
BlockHouse_Trib2	Reach1	7198.835	664	992.96	997.08	997.45	0.037932	5.44	148.72	222.27	0.7
BlockHouse_Trib2	Reach1	7020.811	754.28	991.79	994.35	994.45	0.010341	2.99	302.34	257.42	0.37
BlockHouse_Trib2	Reach1	6725.723	910.16	986.72	991.12	991.3	0.01105	4.33	374.31	562.11	0.42
BlockHouse_Trib2	Reach1	6290.885	1058.99	983.54	984.99	985.26	0.019942	5.17	256.28	455.04	1.02
BlockHouse_Trib2	Reach1	5940.318	1315.46	979.26	982.15	982.44	0.00779	6.08	378.85	517.96	0.74
BlockHouse_Trib2	Reach1	5438.322	1514.86	973.86	978.08	978.5	0.011803	7.09	350.83	341.85	0.74
BlockHouse_Trib2	Reach1	5111.632	1654.61	972.18	975.87	975.89	0.00028	1.63	1304.54	558.72	0.15
BlockHouse_Trib2	Reach1	4907.379	1677.79	969.43	975.83	975.85	0.000153	1.49	1773.21	935.95	0.12
BlockHouse_Trib2	Reach1	4875.171	1678.54	969.07	975.83	975.84	0.000066	0.98	2563.87	1055.44	0.08
BlockHouse_Trib2	Reach1	4836.528	Culvert								
BlockHouse_Trib2	Reach1	4784.811	1678.54	967.18	971.84	972.19	0.003299	5.4	487.47	777.15	0.52
BlockHouse_Trib2	Reach1	4768.592	1688.89	967.04	970.25	971.74	0.012367	9.8	172.42	237.71	1
BlockHouse_Trib2	Reach1	4543.885	1701.91	965.08	970.03	970.19	0.000882	3.2	531.21	590.17	0.28
BlockHouse_Trib2	Reach1	4263.099	1710.46	962.45	970	970.06	0.000204	1.99	858.37	1070.94	0.14
BlockHouse_Trib2	Reach1	4079.939	1711.9	960.97	969.99	970.03	0.000103	1.58	1086.1	1518.74	0.1
BlockHouse_Trib2	Reach1	4049.223	1716.24	960.96	969.95	970.01	0.000179	2.21	877.74	2175.16	0.14
BlockHouse_Trib2	Reach1	4024.661	Bridge								
BlockHouse_Trib2	Reach1	3976.869	1716.24	959.44	964.93	966.4	0.012987	9.72	176.54	589.69	1
BlockHouse_Trib2	Reach1	3934.356	1727.54	959.06	964.76	965.5	0.005226	6.91	251.52	654.2	0.66
BlockHouse_Trib2	Reach1	3824.447	1752.98	957.73	963.84	964.81	0.006278	7.9	229.74	168.64	0.72
BlockHouse_Trib2	Reach1	3579.479	1793.59	954.43	960.75	962.62	0.012162	10.99	163.24	43.26	1
BlockHouse_Trib2	Reach1	3195.646	1839.1	950	958.01	959.26	0.005979	8.95	205.46	60.59	0.71
BlockHouse_Trib2	Reach1	2775.71	1890.85	945.15	953.46	955.6	0.012831	11.75	160.87	37.53	1
BlockHouse_Trib2	Reach1	2310.735	1936.15	941.13	948.03	949.99	0.010885	11.23	172.43	39.65	0.95
BlockHouse_Trib2	Reach1	1913.982	1979.39	937.7	945.37	946.56	0.006243	8.76	225.95	50.62	0.73

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Trib2	Reach1	1543.789	1991.51	934.5	943.43	944.5	0.004835	8.29	240.2	46.96	0.65
BlockHouse_Trib2	Reach1	1441.551	1999.96	933.62	943.69	944.05	0.001329	4.86	411.15	75.76	0.35
BlockHouse_Trib2	Reach1	1370.556	2014	933.01	943.73	943.9	0.000565	3.34	705.77	483.95	0.24
BlockHouse_Trib2	Reach1	1336.658	Bridge								
BlockHouse_Trib2	Reach1	1290.774	2014	932.26	938.87	939.99	0.00604	8.48	237.42	54.82	0.72
BlockHouse_Trib2	Reach1	1253.297	2043.44	931.51	937.56	939.44	0.012344	11.02	185.4	60.15	1
BlockHouse_Trib2	Reach1	1010.162	2082.4	926.64	934.09	935.34	0.007627	9.09	252.05	89.74	0.8
BlockHouse_Trib2	Reach1	693.6918	2082.4	920.3	927.95	929.57	0.086205	10.23	203.55	63.94	1.01
BlockHouse_Trib1	Reach1	7120.63	63.36	1033.72	1034.57	1034.77	0.016516	4.02	26.4	71.02	0.89
BlockHouse_Trib1	Reach1	6998.685	66.71	1030.48	1031.36	1031.66	0.021524	4.45	14.99	24.73	1.01
BlockHouse_Trib1	Reach1	6893.084	68.63	1028	1029.63	1029.79	0.004295	3.31	22.54	23.11	0.51
BlockHouse_Trib1	Reach1	6834.724	71.64	1027.79	1028.94	1029.32	0.01676	5.08	15.09	21.16	0.95
BlockHouse_Trib1	Reach1	6746.417	75.36	1025.01	1026.09	1026.2	0.005633	2.91	28.91	93.07	0.55
BlockHouse_Trib1	Reach1	6697.519	Culvert								
BlockHouse_Trib1	Reach1	6666.263	75.36	1023.26	1024.76	1024.96	0.031182	3.66	21.18	16.2	0.54
BlockHouse_Trib1	Reach1	6642.677	78.33	1022.33	1024.69	1024.72	0.002794	1.32	65.05	108.56	0.17
BlockHouse_Trib1	Reach1	6563.262	79.68	1021.8	1024.08	1024.22	0.018866	3	26.6	16.68	0.42
BlockHouse_Trib1	Reach1	6528.169	85.88	1021.47	1023.43	1023.58	0.017258	3.08	28.2	20.4	0.41
BlockHouse_Trib1	Reach1	6491.236	Culvert								
BlockHouse_Trib1	Reach1	6471.507	85.88	1021.04	1023.41	1023.48	0.006428	2.14	40.85	20.05	0.26
BlockHouse_Trib1	Reach1	6374.367	91.05	1020.27	1022.67	1022.76	0.008434	2.45	38.67	21.01	0.3
BlockHouse_Trib1	Reach1	6254.278	92.72	1019.32	1021.62	1021.7	0.009156	2.34	39.99	22.22	0.3
BlockHouse_Trib1	Reach1	6216.939	102	1019.03	1021	1021.16	0.02174	3.29	31.24	19.02	0.45
BlockHouse_Trib1	Reach1	6185.857	Culvert								
BlockHouse_Trib1	Reach1	6150.776	102	1018.5	1020.91	1021.04	0.00221	2.9	35.22	17.57	0.36
BlockHouse_Trib1	Reach1	6021.033	104.64	1017.38	1020.83	1020.88	0.000484	1.69	61.98	22.32	0.18
BlockHouse_Trib1	Reach1	5968.493	112.25	1015.87	1020.83	1020.85	0.000173	1.09	105.96	51.77	0.11
BlockHouse_Trib1	Reach1	5961.542	Bridge								
BlockHouse_Trib1	Reach1	5952.22	112.25	1015.15	1020.66	1020.69	0.00035	1.39	88.05	56.12	0.16
BlockHouse_Trib1	Reach1	5824.325	122.73	1014.2	1020.67	1020.67	0.000008	0.33	423.35	182.69	0.03
BlockHouse_Trib1	Reach1	5641.023	129.02	1012.85	1020.67	1020.67	0	0.09	1515.38	432.35	0.01

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Trib1	Reach1	5538.486	132.74	1017.63	1020.67	1020.67	0.00005	0.57	290.48	195.43	0.06
BlockHouse_Trib1	Reach1	5480.052	137.27	1019.96	1020.4	1020.59	0.030662	3.73	39.48	126.78	1.1
BlockHouse_Trib1	Reach1	5411.078	152.18	1011.71	1014.52	1015.07	0.018342	5.95	25.59	23.25	1
BlockHouse_Trib1	Reach1	5305.728	Culvert								
BlockHouse_Trib1	Reach1	5276.414	152.18	1011.4	1013.58	1014.28	0.002275	6.73	22.71	22.87	1
BlockHouse_Trib1	Reach1	5199.425	169.23	1010.42	1012.41	1012.92	0.002458	5.77	29.35	47.19	1
BlockHouse_Trib1	Reach1	4981.298	183.59	1007.99	1010.71	1011.29	0.004523	6.15	30.96	67.98	0.96
BlockHouse_Trib1	Reach1	4814.104	211.92	1006.72	1009.22	1009.53	0.001797	5.35	82.81	153.45	0.85
BlockHouse_Trib1	Reach1	4519.406	240.52	1004.55	1007.42	1007.73	0.001315	5.19	99.51	163.35	0.77
BlockHouse_Trib1	Reach1	4259.382	246.75	1002.62	1007.15	1007.19	0.000067	1.98	224.5	401.62	0.2
BlockHouse_Trib1	Reach1	4206.898	269.77	1002.23	1007.13	1007.19	0.000072	1.44	158.46	333.87	0.13
BlockHouse_Trib1	Reach1	4161.746	Culvert								
BlockHouse_Trib1	Reach1	4128.337	269.77	1001.93	1004.87	1005.73	0.015563	7.46	36.18	20.9	1
BlockHouse_Trib1	Reach1	4023.712	302.89	998.64	1001.54	1001.91	0.009842	4.91	61.7	48.61	0.77
BlockHouse_Trib1	Reach1	3785.951	348.32	997.14	999.53	999.86	0.007567	4.57	76.27	55.22	0.68
BlockHouse_Trib1	Reach1	3498.934	357.3	996.11	999.67	999.68	0.000091	0.66	541.13	260.19	0.08
BlockHouse_Trib1	Reach1	3446.694	361.27	995.3	999.57	999.66	0.001016	2.36	153.57	66.43	0.27
BlockHouse_Trib1	Reach1	3423.997	Inl Struct								
BlockHouse_Trib1	Reach1	3413.079	379.76	995.32	998.22	999.28	0.015263	8.25	46.04	22.09	1.01
BlockHouse_Trib1	Reach1	3321.501	430.83	995.21	997.43	997.74	0.006542	4.59	103.33	91.94	0.65
BlockHouse_Trib1	Reach1	3062.377	441.72	993.15	996.81	996.98	0.001544	3.53	143.15	64.37	0.35
BlockHouse_Trib1	Reach1	3011.12	462.94	992.59	996.76	996.9	0.000973	3.09	158.41	212.35	0.29
BlockHouse_Trib1	Reach1	2978.373	Culvert								
BlockHouse_Trib1	Reach1	2948.815	462.94	992.04	995.9	996.21	0.002333	4.54	105.96	110.27	0.44
BlockHouse_Trib1	Reach1	2914.774	497.54	991.83	995.83	996.12	0.002282	4.64	125.05	84.94	0.44
BlockHouse_Trib1	Reach1	2766.761	549.01	990.9	995.33	995.72	0.002757	5.32	118.39	170.35	0.49
BlockHouse_Trib1	Reach1	2564.621	628.27	989.63	993.43	994.6	0.010835	9.12	76.87	138.75	0.92
BlockHouse_Trib1	Reach1	2287.687	786.93	987.9	991.68	992.18	0.004517	6.27	145.32	61.05	0.61
BlockHouse_Trib1	Reach1	1825.313	957.55	984.99	987.91	988.8	0.01183	8.2	133.31	75.01	0.94
BlockHouse_Trib1	Reach1	1422.324	1099.06	982.47	987.98	988.04	0.000298	2.14	590.12	149.76	0.17
BlockHouse_Trib1	Reach1	1139.275	1189.12	980.97	987.95	987.98	0.000116	1.54	891.21	235.8	0.11

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Trib1	Reach1	977.5337	1231.03	980.64	987.94	987.96	0.000113	1.57	1029.54	258.3	0.11
BlockHouse_Trib1	Reach1	906.4042	1358.15	980.19	987.93	987.95	0.000106	1.61	1230.58	320.24	0.11
BlockHouse_Trib1	Reach1	838.0568	Culvert								
BlockHouse_Trib1	Reach1	798.0168	1358.15	980	984.56	986.59	0.011464	11.42	118.91	263.29	1.01
BlockHouse_Trib1	Reach1	704.5984	1515.1	979.21	983.23	983.84	0.004796	6.69	254.48	942.56	0.64
BlockHouse_Trib1	Reach1	480.0402	1515.1	977.99	981.21	982.14	0.010468	8.48	211.63	521.06	0.9
BlockHouse_Creek	Reach6	35258.42	296	1035.51	1038.83	1039.41	0.012796	6.14	48.23	26.16	0.8
BlockHouse_Creek	Reach6	34703.55	296	1032.89	1039.11	1039.11	0.000007	0.23	1468.2	543.14	0.02
BlockHouse_Creek	Reach6	34628.05	Inl Struct								
BlockHouse_Creek	Reach6	34569.36	314.19	1032.2	1035.11	1035.24	0.003711	3.14	121.95	80.38	0.43
BlockHouse_Creek	Reach6	34385.28	380.11	1030.44	1034.55	1034.72	0.002237	3.25	116.94	45.47	0.36
BlockHouse_Creek	Reach6	34305.28	Culvert								
BlockHouse_Creek	Reach6	34180.28	380.11	1027.93	1030.5	1031.3	0.021053	7.18	52.94	33.87	1.01
BlockHouse_Creek	Reach6	33797.53	415.34	1024.47	1027.91	1028.13	0.003493	3.76	110.53	48.65	0.44
BlockHouse_Creek	Reach6	33523.92	465.51	1022.7	1025.13	1026.06	0.019895	7.73	60.23	32.59	1
BlockHouse_Creek	Reach6	33172	491.57	1013.78	1021.13	1021.21	0.000539	2.33	233.75	97.28	0.19
BlockHouse_Creek	Reach6	33124.5	Culvert								
BlockHouse_Creek	Reach6	33077	491.57	1013.55	1018.94	1018.95	0.000195	1.15	623.93	212.36	0.11
BlockHouse_Creek	Reach6	33003.91	546.15	1013.02	1018.94	1018.94	0.000029	0.62	1449.46	311.7	0.05
BlockHouse_Creek	Reach6	32678.99	564.13	1011.01	1018.94	1018.94	0.000002	0.16	3741.37	771.4	0.01
BlockHouse_Creek	Reach6	32578.99	565.18	1009.08	1018.93	1018.94	0.000017	0.59	968.65	115.34	0.04
BlockHouse_Creek	Reach6	32573.24	Inl Struct								
BlockHouse_Creek	Reach6	32558.99	367	1009.08	1013.25	1013.4	0.001797	3.17	115.85	35.71	0.31
BlockHouse_Creek	Reach6	32503.99	Culvert								
BlockHouse_Creek	Reach6	32373.88	367	1007.92	1011.05	1011.22	0.002967	3.27	112.2	83.54	0.37
BlockHouse_Creek	Reach6	31995	367	1006.12	1008.44	1008.87	0.018158	6.29	113.6	156.33	0.79
BlockHouse_Creek	Reach6	31704.36	367	1004.4	1007.4	1007.41	0.000881	1.64	528.74	367.18	0.18
BlockHouse_Creek	Reach6	31674.56	Culvert								
BlockHouse_Creek	Reach6	31634.36	367	1004.4	1007.31	1007.32	0.00073	1.46	610.3	460.11	0.16
BlockHouse_Creek	Reach6	31313.43	1138.2	1002.14	1005.38	1005.83	0.015856	6.8	348.09	732.88	0.76
BlockHouse_Creek	Reach6	30746.1	1307.47	992.8	998.39	998.69	0.005024	5.24	477.45	283.62	0.46

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Creek	Reach6	30029.77	1468.82	988.96	993.37	993.72	0.010041	6.56	494.19	369.42	0.63
BlockHouse_Creek	Reach6	29428.55	1677.53	984.95	988.35	988.64	0.007059	6.77	510.96	182.1	0.67
BlockHouse_Creek	Reach6	28742.13	1677.53	982.39	987.5	987.58	0.000573	2.5	1032.45	694.33	0.2
BlockHouse_Creek	Reach6	28662.13	Culvert								
BlockHouse_Creek	Reach6	28517.13	1677.53	981	983.77	984.86	0.018101	8.4	199.8	541.39	1
BlockHouse_Creek	Reach5	26920.83	3469.8	973.99	978.09	978.28	0.001844	3.51	989.04	301.31	0.34
BlockHouse_Creek	Reach5	26239.55	3469.8	970.53	975.78	976.14	0.006107	7.03	1539.9	983.23	0.64
BlockHouse_Creek	Reach5	26210.05	Inl Struct								
BlockHouse_Creek	Reach5	26149.55	3507.78	970	975.78	976	0.002848	5.46	1932.99	1029.89	0.45
BlockHouse_Creek	Reach5	26004.04	3526.73	968.98	974.43	975.11	0.009684	9.39	1262.16	921.41	0.81
BlockHouse_Creek	Reach5	25932.04	Inl Struct								
BlockHouse_Creek	Reach5	25859.04	3590.12	968.92	974.42	974.7	0.004648	6.4	1730.01	1019.71	0.56
BlockHouse_Creek	Reach5	25694	3620.06	967.49	973.24	973.68	0.006298	7.5	1468.27	928.7	0.66
BlockHouse_Creek	Reach5	25583	Inl Struct								
BlockHouse_Creek	Reach5	25494	3675.64	968.35	973.23	973.36	0.002521	5.04	2536.21	1376.75	0.42
BlockHouse_Creek	Reach5	25379.38	3761.79	966.72	972.81	972.95	0.002131	5.08	2792.62	1512.92	0.39
BlockHouse_Creek	Reach5	25286.88	Bridge								
BlockHouse_Creek	Reach5	25249.38	3761.79	966.73	972.39	972.49	0.001841	4.39	3097.27	1705.3	0.36
BlockHouse_Creek	Reach5	25069.76	3814.78	966.13	970.81	971.66	0.010052	9.15	797.91	1608.85	0.82
BlockHouse_Creek	Reach5	24860.81	Culvert								
BlockHouse_Creek	Reach5	24759.76	3814.78	964.05	967.63	968.96	0.016793	9.25	412.24	154.11	1
BlockHouse_Creek	Reach5	24300.69	3865.82	961.46	967.21	967.25	0.000524	2.22	3338.63	1917.08	0.19
BlockHouse_Creek	Reach5	23864.38	3878.72	960.03	966.75	966.81	0.003128		1946.29	2352.71	0
BlockHouse_Creek	Reach5	23840.38	Mult Open								
BlockHouse_Creek	Reach5	23804.38	3878.72	959.68	961.85	962.04	0.0125	5.43	1162.4	1273.88	0.71
BlockHouse_Creek	Reach5	23755.07	3887.85	955.54	960.19	961.05	0.010967	8.35	695.41	423.05	0.76
BlockHouse_Creek	Reach5	23677.87	3960.97	949.93	956.34	956.88	0.003714	5.88	673.77	133.31	0.46
BlockHouse_Creek	Reach5	23602.87	Culvert								
BlockHouse_Creek	Reach5	23480.42	3960.97	947.92	952.97	954.11	0.015037	8.55	463.19	127.75	0.79
BlockHouse_Creek	Reach5	23066.32	4006.9	940.55	949.2	949.9	0.006804	7.07	705.5	177.14	0.47
BlockHouse_Creek	Reach5	22687.88	4025.7	934.3	946.74	947.47	0.006098	6.87	590.88	87.72	0.45

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Creek	Reach5	22534.28	4025.69	934.25	945.82	946.44	0.009331	6.36	653.65	117.03	0.43
BlockHouse_Creek	Reach5	22239	4091.22	930.42	944.18	944.55	0.004367	4.87	849.02	131.5	0.31
BlockHouse_Creek	Reach5	21743.21	4151.75	931.09	940.9	941.45	0.009477	5.96	696.55	113.8	0.42
BlockHouse_Creek	Reach5	21292.18	4207.73	926.8	937.82	938.2	0.005513	4.94	867.45	140.42	0.33
BlockHouse_Creek	Reach5	20880.86	4256.54	924.17	935.53	935.94	0.005442	5.18	849.48	146.21	0.33
BlockHouse_Creek	Reach5	20526.64	4291.01	920.86	932.29	933.11	0.012287	7.29	588.71	82.63	0.48
BlockHouse_Creek	Reach5	20278.97	4323.25	918.88	930.49	930.95	0.005964	5.48	789.62	101.14	0.35
BlockHouse_Creek	Reach5	20049.1	4373.68	917.35	928.55	929.21	0.009715	6.49	673.49	94.81	0.43
BlockHouse_Creek	Reach5	19692.98	4409.83	915.04	926.45	926.76	0.004758	4.46	989.29	175.36	0.33
BlockHouse_Creek	Reach5	19440.21	4450.89	913.28	925.19	925.55	0.004793	4.81	926.21	128.35	0.32
BlockHouse_Creek	Reach5	19155.55	4450.89	911.02	923.33	923.83	0.007669	5.68	788.05	124.24	0.38
BlockHouse_Creek	Reach4	18517.13	5505.47	907.11	918.27	918.78	0.008164	6.44	1003.93	199.43	0.4
BlockHouse_Creek	Reach4	18292.5	5511.8	905.61	916.58	917.09	0.007432	6.79	1108.94	240.05	0.38
BlockHouse_Creek	Reach4	18097.18	5519.15	904.31	914.92	915.45	0.009827	6.39	974.15	173.97	0.41
BlockHouse_Creek	Reach4	17870.82	5528.05	902.79	913.47	913.76	0.005485	5.5	1453.39	321.03	0.32
BlockHouse_Creek	Reach4	17597.17	5535.34	900.96	911.34	911.86	0.008945	7.17	1099.19	238.26	0.41
BlockHouse_Creek	Reach4	17373.45	5541.48	899.15	910.15	910.49	0.004673	5.35	1275.56	204.83	0.3
BlockHouse_Creek	Reach4	17185.13	5550.8	897.59	908.81	909.27	0.009408	6.08	1085.23	222.99	0.4
BlockHouse_Creek	Reach4	17138.15	Bridge								
BlockHouse_Creek	Reach4	17084.9	5550.8	896.76	907.94	908.27	0.00616	5.09	1277.37	290.74	0.33
BlockHouse_Creek	Reach4	16899.59	5557.89	894.88	907.12	907.34	0.003904	4.08	1561.83	398.41	0.27
BlockHouse_Creek	Reach4	16682.6	5557.89	893.29	905.34	905.95	0.010647	6.82	991.05	322.52	0.43
BlockHouse_Creek	Reach2	9393.88	116.75	848.9	851.44	851.5	0.003555	1.85	63.12	35.07	0.24
BlockHouse_Creek	Reach2	8904.337	151.36	846.21	851.29	851.3	0.000165	0.62	242.46	94.1	0.06
BlockHouse_Creek	Reach2	8636.809	217.98	844.56	851.24	851.25	0.000164	0.64	343.05	93.84	0.06
BlockHouse_Creek	Reach2	8260.928	288.15	842.23	851.22	851.23	0.00004	0.45	653.8	135.12	0.03
BlockHouse_Creek	Reach2	7973.336	295.21	840.45	851.22	851.22	0.000013	0.31	987.81	294.11	0.02
BlockHouse_Creek	Reach2	7948.4	Inl Struct								
BlockHouse_Creek	Reach2	7924.82	362.93	840.15	846.01	846.11	0.003601	2.45	147.84	52.52	0.26
BlockHouse_Creek	Reach2	7735.58	529.63	838.97	845.48	845.54	0.002402	1.92	289.68	143.59	0.21
BlockHouse_Creek	Reach2	7346.09	780.84	837.56	844.2	844.32	0.003713	2.86	272.84	80.88	0.27

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Creek	Reach2	6946.064	1186	836.74	843.13	843.23	0.002292	2.73	466.65	125.5	0.23
BlockHouse_Creek	Reach2	6515.349	1195.49	836.14	841.38	841.6	0.007151	3.74	319.5	104.94	0.38
BlockHouse_Creek	Reach2	6313.965	Culvert								
BlockHouse_Creek	Reach2	6237.746	1195.49	834.37	838.62	839.2	0.020824	6.08	196.69	91.25	0.58
BlockHouse_Creek	Reach2	6118.32	1218.04	829.96	837.67	837.81	0.005714	2.96	411.09	131.4	0.3
BlockHouse_Creek	Reach2	5838.343	1249.06	827.24	836.4	836.55	0.003614	3.12	399.96	82.85	0.25
BlockHouse_Creek	Reach2	5461.593	1265.84	825.26	834.93	835.06	0.004326	2.91	434.28	113.51	0.26
BlockHouse_Creek	Reach2	5261.712	1285.27	824.21	834.02	834.18	0.004493	3.12	412.35	109.97	0.27
BlockHouse_Creek	Reach2	5033.6	1306.84	823.01	832.75	832.97	0.006204	3.78	346.13	79.21	0.32
BlockHouse_Creek	Reach2	4784.266	1330.53	821.7	831.01	831.24	0.007775	3.85	345.19	92.5	0.35
BlockHouse_Creek	Reach2	4515.071	1352.04	820.29	829.58	829.78	0.003988	3.61	406.24	112.73	0.27
BlockHouse_Creek	Reach2	4274.849	1374.8	819.02	828.36	828.62	0.005772	4.14	343.58	95.95	0.32
BlockHouse_Creek	Reach2	4024.799	1395.12	817.71	827.62	827.74	0.002213	2.77	511.76	162.28	0.2
BlockHouse_Creek	Reach2	3804.98	1404.09	816.55	827.36	827.42	0.000912	2.06	793.37	288.66	0.14
BlockHouse_Creek	Reach2	3708.98	1409.96	816.05	827.3	827.35	0.000709	1.99	860.88	396.58	0.12
BlockHouse_Creek	Reach2	3646.519	1415.34	815.81	827.24	827.3	0.000836	2.21	811.18	443.88	0.13
BlockHouse_Creek	Reach2	3589.442	1433.58	815.81	827.16	827.23	0.001309	2.07	753.12	522.7	0.16
BlockHouse_Creek	Reach2	3545.067	Culvert								
BlockHouse_Creek	Reach2	3507.415	1433.58	814.3	824.1	824.25	0.003881	3.12	459	101.07	0.26
BlockHouse_Creek	Reach2	3397.709	1444.65	814.09	822.94	823.45	0.01202	5.74	251.65	49.29	0.45
BlockHouse_Creek	Reach2	3282.444	1455.32	813.73	822.37	822.55	0.00399	3.37	457.2	125.7	0.26
BlockHouse_Creek	Reach2	3172.17	1469.92	812.81	821.93	822.1	0.004149	3.26	450.47	96.43	0.27
BlockHouse_Creek	Reach2	3022.625	1481.2	811.65	820.78	821.13	0.010681	4.76	311.39	98.05	0.41
BlockHouse_Creek	Reach2	2908.136	1497.82	810.97	820.23	820.38	0.003709	3.32	548.77	216.68	0.26
BlockHouse_Creek	Reach2	2741.022	1517.15	810.3	819.48	819.68	0.004718	3.81	482.58	182.05	0.29
BlockHouse_Creek	Reach2	2548.877	1534.4	809.39	818.6	818.78	0.004655	3.67	539.15	294.53	0.29
BlockHouse_Creek	Reach2	2379.531	1574.29	808.58	817.93	818.04	0.003699	2.9	652.79	243.63	0.25
BlockHouse_Creek	Reach2	1995.124	1593.44	806.75	817.26	817.33	0.00121	2.35	888.22	278.61	0.15
BlockHouse_Creek	Reach2	1813.994	1627.08	806.59	817.13	817.17	0.000776	1.9	1052.11	229.75	0.12
BlockHouse_Creek	Reach2	1501.059	1643.43	805.02	816.75	816.86	0.001735	3.08	769.49	260.84	0.19
BlockHouse_Creek	Reach2	1351.287	1655.4	803.69	816.64	816.69	0.000712	2.03	993.57	187.07	0.12

Table N-1. Summary Output - Blockhouse Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BlockHouse_Creek	Reach2	1242.577	1655.4	803.16	816.58	816.62	0.000559	1.82	1146.62	230.83	0.11
BlockHouse_Creek	Reach3	16152.98	6627.44	888.72	901.27	901.66	0.006448	5.94	1615.16	455.28	0.35
BlockHouse_Creek	Reach3	15962	6691.81	887.07	899.53	900.1	0.010252	6.89	1364.43	450.9	0.43
BlockHouse_Creek	Reach3	15848.42	6771.29	886.09	898.56	899.08	0.007535	6.95	1511.44	463.64	0.38
BlockHouse_Creek	Reach3	15709.67	7839.12	884.9	897.49	897.91	0.007679	6.49	1860.26	474.9	0.36
BlockHouse_Creek	Reach3	15667.3	Bridge								
BlockHouse_Creek	Reach3	15610.35	7839.12	884.43	897.09	897.56	0.001304	7.05	1667.43	385.28	0.39
BlockHouse_Creek	Reach3	15552.91	Bridge								
BlockHouse_Creek	Reach3	15495.39	7839.12	884.29	896.95	897.37	0.001074	6.32	1754.17	391.73	0.35
BlockHouse_Creek	Reach3	15459.88	Bridge								
BlockHouse_Creek	Reach3	15403.75	7839.12	884.18	896.9	897.2	0.000736	4.92	1975.99	447.27	0.29
BlockHouse_Creek	Reach3	15359.1	Bridge								
BlockHouse_Creek	Reach3	15311.07	7839.12	883.86	896.46	896.85	0.004111	6.23	1929.79	508.97	0.35
BlockHouse_Creek	Reach3	14972.43	7988.03	881.87	893.77	894.74	0.011373	8.66	1236.25	403.77	0.55
BlockHouse_Creek	Reach3	14573.93	8115.91	879.53	891.09	891.53	0.005714	6.28	1754.61	438.76	0.39
BlockHouse_Creek	Reach3	14237.61	8223.36	878.77	888.71	889.12	0.00775	6.65	1885.65	686.69	0.45
BlockHouse_Creek	Reach3	13959.08	8376.62	876.64	887.66	887.88	0.003311	5	2590.81	781.42	0.3
BlockHouse_Creek	Reach3	13568.06	8532.82	877.02	886.68	886.99	0.005475	6.09	2337.64	806.69	0.38
BlockHouse_Creek	Reach3	13176.82	8532.82	877.36	885.25	885.4	0.002927	3.77	3030.2	896.95	0.27
BlockHouse_Creek	Reach3	12848.12	8532.82	874.4	884.46	884.59	0.002001	3.61	3049.46	614.04	0.23
BlockHouse_Creek	Reach1	990.0462	2126.79	803.78	816.34	816.41	0.001161	2.15	1027.33	200.34	0.15
BlockHouse_Creek	Reach1	911.5703	2119.94	801.97	816.27	816.32	0.000851	1.69	1229.97	427.38	0.12
BlockHouse_Creek	Reach1	864.9165	Culvert								
BlockHouse_Creek	Reach1	806.5767	2119.94	801.51	812.07	812.33	0.011219	4.21	512.26	189.28	0.41
BlockHouse_Creek	Reach1	677.8725	2116.4	800.77	811.13	811.36	0.005371	3.95	550.84	187.97	0.31
BlockHouse_Creek	Reach1	556.6306	2112.34	800.16	810.56	810.75	0.004569	3.49	606.58	264.35	0.28
BlockHouse_Creek	Reach1	417.7111	2109.68	799.43	810.19	810.29	0.002215	2.68	822.17	361.15	0.2
BlockHouse_Creek	Reach1	326.3983	2106	799.69	810.02	810.13	0.00237	2.81	813.37	206.96	0.21
BlockHouse_Creek	Reach1	199.6888	2106	798.78	809.7	809.81	0.002003	2.65	808.19	176.91	0.2

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
S_Fork_Brushy	Reach1	17883.87	164.7	1071.5	1072.66	1072.9	0.02533	4.24	44.99	68.28	0.75
S_Fork_Brushy	Reach1	17145.82	172.88	1063.27	1064.85	1064.94	0.006182	2.71	77.89	82.46	0.4
S_Fork_Brushy	Reach1	17035.25	186.61	1060.79	1062.79	1063.3	0.045884	5.74	32.51	32.64	1.01
S_Fork_Brushy	Reach1	16861.03	198.26	1057.87	1061.4	1061.46	0.001845	1.87	106.01	51.24	0.23
S_Fork_Brushy	Reach1	16722.97	211.21	1055.44	1061.4	1061.41	0.000102	0.64	339.06	102.74	0.06
S_Fork_Brushy	Reach1	16578.73	220.91	1060.06	1061.22	1061.35	0.018756	2.93	77.54	238.97	0.61
S_Fork_Brushy	Reach1	16476.35	287.62	1057.3	1058.72	1058.94	0.024445	4.29	86.01	148.3	0.75
S_Fork_Brushy	Reach1	15874.86	367.11	1050.4	1052.56	1052.87	0.006873	5.38	91.16	141.16	0.88
S_Fork_Brushy	Reach1	15318.56	465.04	1046.8	1048.2	1048.45	0.006638	5.47	133.47	248.21	0.88
S_Fork_Brushy	Reach1	14779.49	590.72	1041.96	1043.16	1043.36	0.011507	3.96	176.24	264.09	0.7
S_Fork_Brushy	Reach1	14234.15	746.96	1036.85	1038.43	1038.55	0.007722	3.12	279.12	322.12	0.48
S_Fork_Brushy	Reach1	13699.19	970.46	1032.5	1034.86	1034.98	0.006166	3.51	401.56	326	0.45
S_Fork_Brushy	Reach1	13102.47	970.46	1027.08	1029.77	1030.14	0.01188	4.98	217.13	196.87	0.64
S_Fork_Brushy	Reach1	12349.98	1350	1018.03	1023.11	1023.4	0.007504	5.05	349.25	177.52	0.55
S_Fork_Brushy	Reach1	11820.69	1385.98	1014.41	1020.09	1020.42	0.004206	5.08	332.25	155.3	0.43
S_Fork_Brushy	Reach1	11331.91	1414.17	1011.86	1018.18	1018.41	0.004135	4.3	511.2	342.32	0.41
S_Fork_Brushy	Reach1	10957.88	1428.26	1009.84	1016.26	1016.52	0.006777	5.15	438.66	437.17	0.51
S_Fork_Brushy	Reach1	10773.62	1446.22	1008.85	1015.69	1015.88	0.001994	3.65	451.35	434.21	0.3
S_Fork_Brushy	Reach1	10713.99	Bridge								
S_Fork_Brushy	Reach1	10671.21	1446.22	1008.3	1014.5	1015.32	0.018545	7.51	212.31	71.34	0.66
S_Fork_Brushy	Reach1	10541.53	1469.84	1007.41	1012.37	1012.78	0.017663	5.64	297.99	163.56	0.48
S_Fork_Brushy	Reach1	10240.55	1507.9	1004.06	1009.88	1010.3	0.004962	6.06	361.78	208.62	0.51
S_Fork_Brushy	Reach1	9765.596	1558.07	999.37	1007.11	1007.38	0.008449	4.57	440.58	287.22	0.38
S_Fork_Brushy	Reach1	9157.467	1587.32	997.73	1003.52	1003.67	0.005436	3.82	542.59	233.12	0.31
S_Fork_Brushy	Reach1	8811.911	1601.9	995.59	1001.68	1001.82	0.005436	3.96	566.12	289.99	0.31
S_Fork_Brushy	Reach1	8642.073	1651.2	994.14	999.26	999.99	0.037062	6.88	251.16	152.54	0.74
S_Fork_Brushy	Reach1	8078.868	1651.23	991.08	997.59	997.64	0.001366	1.67	1010.56	409.77	0.15
S_Fork_Brushy	Reach1	8078.559	1703.89	989.34	995.66	995.9	0.009575	4.06	459.88	200.64	0.39
S_Fork_Brushy	Reach1	7495.231	1761.19	985.29	991.71	991.96	0.004935	3.98	463.14	206.31	0.38
S_Fork_Brushy	Reach1	6880.784	1802.61	981.33	987.14	987.49	0.011605	4.74	380.48	107.67	0.44
S_Fork_Brushy	Reach1	6448.901	1842.73	975.43	983.79	984.08	0.005732	4.77	467.85	120.76	0.33

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
S_Fork_Brushy	Reach1	6039.924	1856.62	971.97	979.8	980.28	0.013918	6.8	391.85	157.39	0.48
S_Fork_Brushy	Reach1	5900.43	1864.99	971.71	979.12	979.31	0.005249	3.45	539.41	267.26	0.3
S_Fork_Brushy	Reach1	5816.838	1891.73	971.56	978.58	978.81	0.00659	4.78	564.45	382.51	0.35
S_Fork_Brushy	Reach1	5801.146	Culvert								
S_Fork_Brushy	Reach1	5783.271	1891.73	970.64	978.68	978.69	0.000576	1.57	1785.02	545.89	0.11
S_Fork_Brushy	Reach1	5552.341	1917.74	969.17	977.24	977.57	0.007884	5.2	467.4	323.33	0.38
S_Fork_Brushy	Reach1	5298.596	1917.78	968.31	976.32	976.4	0.002565	2.13	883.82	405.19	0.2
S_Fork_Brushy	Reach1	5298.287	1934.57	967.72	975.87	975.97	0.002606	3.24	892.67	363.95	0.23
S_Fork_Brushy	Reach1	5136.278	1950.77	967.8	974.79	974.87	0.003784	2.26	908.03	506.05	0.25
S_Fork_Brushy	Reach1	4981.36	1975.2	965.18	974	974.21	0.004136	4.06	706.86	407.36	0.28
S_Fork_Brushy	Reach1	4958.102	Culvert								
S_Fork_Brushy	Reach1	4919.148	1975.2	964.41	971.36	971.46	0.003754	3.33	1028.13	713.54	0.26
S_Fork_Brushy	Reach1	4750.189	2912.2	963.31	970.16	970.34	0.00805	3.82	961.77	632.41	0.35
S_Fork_Brushy	Reach1	4295.877	2955.03	959.43	967.43	967.55	0.005269	3.18	1076.66	519.47	0.28
S_Fork_Brushy	Reach1	3956.026	2980.9	956.54	965.68	965.83	0.004833	4.01	1123.02	577.59	0.32
S_Fork_Brushy	Reach1	3753.165	2998.47	954.81	965.56	965.59	0.000404	1.66	2422.38	603.96	0.1
S_Fork_Brushy	Reach1	3701.532	Culvert								
S_Fork_Brushy	Reach1	3660.418	2998.47	954.01	963.51	964.52	0.017903	8.04	372.82	60.02	0.57
S_Fork_Brushy	Reach1	3616.373	3045.3	953.64	963.8	964.02	0.002997	4.07	839.74	512.55	0.26
S_Fork_Brushy	Reach1	3587.583	Bridge								
S_Fork_Brushy	Reach1	3566.238	3045.3	953.22	961.33	961.51	0.00552	4.29	1065.89	672.46	0.33
S_Fork_Brushy	Reach1	3255.654	3104.2	950.61	958.17	959.01	0.01091	8.65	520.03	397.56	0.69
S_Fork_Brushy	Reach1	2809.754	3188.24	946.88	955.01	955.18	0.003506	3.91	1008.72	700.72	0.32
S_Fork_Brushy	Reach1	2188.01	3274.04	944.03	950.5	951.02	0.038403	7.87	592.88	525.39	0.91
S_Fork_Brushy	Reach1	1569.926	3304.85	939.21	947.29	947.42	0.002753	3.63	1155.56	605.37	0.33
S_Fork_Brushy	Reach1	1351.963	3353.63	938.52	945.75	945.94	0.006838	3.66	963.01	678.36	0.36
S_Fork_Brushy	Reach1	1010.88	3411.37	936.06	943.5	943.72	0.005535	4.93	1025.35	776.26	0.4
S_Fork_Brushy	Reach1	613.6	3458.5	934.26	941.55	941.75	0.004261	4.37	1227.17	578.79	0.36
S_Fork_Brushy	Reach1	294.2512	3458.5	927.27	938.77	939.17	0.021315	5.33	755.62	343.46	0.47
N_Fork_Brushy	Reach1	31758.65	110.44	1107.02	1108.15	1108.16	0.006321	1.16	119.55	179.57	0.21
N_Fork_Brushy	Reach1	31713.48	113.08	1106.13	1108.01	1108.02	0.001884	0.76	178.15	195.67	0.12

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
N_Fork_Brushy	Reach1	31649.34	132.51	1105.89	1107.62	1107.66	0.026875	2.01	83.84	228.47	0.4
N_Fork_Brushy	Reach1	31638.61	Culvert								
N_Fork_Brushy	Reach1	31619.35	132.51	1105.02	1106.25	1106.47	0.048708	3.81	34.79	179.21	0.71
N_Fork_Brushy	Reach1	31219.33	155	1100.08	1101.34	1101.37	0.00669	1.71	117.81	169.76	0.28
N_Fork_Brushy	Reach1	30794.04	190.52	1097.09	1098.35	1098.38	0.00999	1.54	144.18	197.74	0.26
N_Fork_Brushy	Reach1	30234.29	226.98	1092.42	1094.14	1094.16	0.006189	1.35	187.21	184.78	0.21
N_Fork_Brushy	Reach1	29759.14	262.72	1088.4	1090.07	1090.14	0.015753	2.36	124.3	160.9	0.38
N_Fork_Brushy	Reach1	29362.45	315.36	1086.01	1087.54	1087.56	0.004114	1.33	269.99	273.16	0.2
N_Fork_Brushy	Reach1	28867.01	374.88	1082.03	1083.1	1083.37	0.022479	4.73	102.85	221.62	0.86
N_Fork_Brushy	Reach1	28398	453.73	1078.22	1080.34	1080.39	0.002689	2.27	252.3	234.51	0.3
N_Fork_Brushy	Reach1	27880.1	559.89	1075.12	1077.08	1077.38	0.015017	4.85	141.49	154.06	0.69
N_Fork_Brushy	Reach1	27309.77	613.66	1073.67	1076.94	1076.95	0.000209	0.88	882.75	450.97	0.09
N_Fork_Brushy	Reach1	27060.99	690.91	1071.72	1076.92	1076.92	0.000062	0.65	1495.38	578.59	0.05
N_Fork_Brushy	Reach1	27021.2	Culvert								
N_Fork_Brushy	Reach1	26959.77	690.91	1068.55	1072.65	1073.64	0.013809	8.38	87.25	321.41	0.98
N_Fork_Brushy	Reach1	26739.34	832.61	1068.27	1070.92	1071.26	0.008008	5.27	195.99	294.53	0.73
N_Fork_Brushy	Reach1	26233.22	1028.99	1065.19	1068.21	1068.42	0.004325	4.33	319.9	324.61	0.55
N_Fork_Brushy	Reach1	25658.71	1293.49	1062.28	1065.76	1066.02	0.004674	4.44	327.47	272.29	0.51
N_Fork_Brushy	Reach1	25038.09	1664.07	1059.39	1062.96	1063.2	0.004075	4.76	438.68	341.57	0.5
N_Fork_Brushy	Reach1	24354.66	1676.9	1054.97	1059.34	1059.74	0.005269	6.46	399.58	386.82	0.59
N_Fork_Brushy	Reach1	23769.98	1746.22	1051.13	1056.1	1056.56	0.006814	6.16	361.97	362.53	0.64
N_Fork_Brushy	Reach1	23182.46	1801.41	1047.29	1053.35	1053.6	0.002881	5.38	561.52	457.33	0.45
N_Fork_Brushy	Reach1	22731.15	1843.93	1049.31	1051.25	1051.75	0.006492	5.7	323.85	264.81	0.9
N_Fork_Brushy	Reach1	22392.78	1901.09	1043.78	1049.22	1049.57	0.005704	5.24	413.69	313.77	0.51
N_Fork_Brushy	Reach1	21949.98	1979.47	1041.94	1047.2	1047.49	0.004338	4.77	478.8	346.12	0.43
N_Fork_Brushy	Reach1	21364.04	2065.03	1036.91	1044.21	1044.57	0.005225	5.78	522.99	600.47	0.48
N_Fork_Brushy	Reach1	20750.32	2161.37	1035.48	1039.79	1040.15	0.007901	5.28	529.07	566.7	0.55
N_Fork_Brushy	Reach1	20088.98	2267.14	1031	1034.58	1035.08	0.008221	4.55	439.93	322.93	0.54
N_Fork_Brushy	Reach1	19396.02	2383.36	1024.34	1030.1	1030.52	0.005183	6.2	563.11	372.76	0.49
N_Fork_Brushy	Reach1	18670.98	2504.25	1021.02	1025.96	1026.12	0.007369	3.66	842.31	492.78	0.35
N_Fork_Brushy	Reach1	17953.37	2583.9	1016.96	1020.83	1020.97	0.009394	3.8	873.59	475.13	0.38

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
N_Fork_Brushy	Reach1	17499.27	2583.9	1013.85	1017.13	1017.27	0.00896	3.5	877.94	469.15	0.37
N_Fork_Brushy	Reach2	15100.61	55.38	994.74	996.44	996.46	0.002312	1.13	49.01	52.91	0.21
N_Fork_Brushy	Reach2	15003.51	71.32	993.99	995.99	996.06	0.006727	2.05	34.73	33.89	0.36
N_Fork_Brushy	Reach2	14963.87	Culvert								
N_Fork_Brushy	Reach2	14917.26	71.32	993.56	995.84	995.9	0.003441	1.89	40.33	48.33	0.27
N_Fork_Brushy	Reach2	14762.89	82.93	992.63	994.8	994.94	0.011723	2.99	27.78	23.17	0.48
N_Fork_Brushy	Reach2	14619.41	105.88	991.61	994.43	994.45	0.001566	1.3	81.57	53.13	0.18
N_Fork_Brushy	Reach2	14387.17	124.07	989.8	994.09	994.13	0.001293	1.43	86.77	100.09	0.17
N_Fork_Brushy	Reach2	14236.41	175.49	988.63	993.92	993.96	0.001004	1.64	144.38	152.81	0.16
N_Fork_Brushy	Reach2	14229.29	Culvert								
N_Fork_Brushy	Reach2	14212.55	175.49	988.46	993.21	993.24	0.000724	1.36	145.89	110.55	0.14
N_Fork_Brushy	Reach2	13906.68	305.1	988.13	992.71	992.75	0.003118	1.66	209.56	384.03	0.25
N_Fork_Brushy	Reach2	13380.74	506.59	984.15	988.97	989.2	0.013028	3.86	136.91	122.48	0.53
N_Fork_Brushy	Reach2	12898.57	961.5	981.65	986.71	986.82	0.003363	3.16	419.32	426.85	0.31
N_Fork_Brushy	Reach2	12289.23	961.5	978.49	984.16	984.29	0.005973	3.75	384.72	426.96	0.39
N_Fork_Brushy	Reach2	11687.24	1030.81	975.37	981.34	981.46	0.004922	2.88	377.45	301.33	0.34
N_Fork_Brushy	Reach2	11218.98	1048.71	972.94	979.74	979.84	0.002586	2.74	468.05	350.34	0.27
N_Fork_Brushy	Reach2	11103.2	1129.84	972.32	978.74	979.21	0.011865	6.42	246.2	216.44	0.56
N_Fork_Brushy	Reach2	10601.96	1228.94	969.64	976.05	976.42	0.00342	6.01	330.84	289.41	0.53
N_Fork_Brushy	Reach2	10036.44	1337.05	966.62	973.62	974.23	0.005072	7.16	293.04	303.95	0.64
N_Fork_Brushy	Reach2	9469.29	1457.63	963.59	969.91	970.75	0.006823	8	225.01	119.24	0.75
N_Fork_Brushy	Reach2	8888.482	1543.96	960.48	967.76	968.34	0.002878	6.31	273.69	91.61	0.51
N_Fork_Brushy	Reach2	8501.427	1675.86	958.41	966.65	967.06	0.003455	5.37	356.12	177.79	0.53
N_Fork_Brushy	Reach2	7949.998	1759.99	958.41	964.91	965.35	0.002944	5.73	388.22	278.03	0.51
N_Fork_Brushy	Reach2	7620.504	1759.99	956.83	963.82	964.33	0.00327	5.82	338.08	181.92	0.53
N_Fork_Brushy	Reach2	7418.212	1779.73	957.43	961.61	962.89	0.013157	9.07	196.13	96.33	1
N_Fork_Brushy	Reach2	7323.44	Culvert								
N_Fork_Brushy	Reach2	7240.678	1779.73	956.26	961.04	961.18	0.002753	3.06	580.7	219.11	0.33
N_Fork_Brushy	Reach2	6933.846	1784.64	955.07	960.78	960.82	0.000529	1.56	1144.15	1272	0.15
N_Fork_Brushy	Reach2	6814.158	1797.53	956.07	960.26	960.57	0.007067	4.54	399.66	1107.45	0.54
N_Fork_Brushy	Reach2	6737.992	Bridge								

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
N_Fork_Brushy	Reach2	6662.665	1797.53	954.02	959.24	959.51	0.006989	4.52	445.53	539.93	0.54
N_Fork_Brushy	Reach2	6501.623	1815	952.3	958.39	958.49	0.002981	3.1	773.73	1077.25	0.34
N_Fork_Brushy	Reach2	6081.629	1822.81	950.92	957.33	957.44	0.004376	3.54	727.19	1038.49	0.4
N_Fork_Brushy	Reach2	5894.978	1827.73	950.3	956.31	956.45	0.00623	4.33	696.81	944.76	0.47
N_Fork_Brushy	Reach2	5777.859	1834.1	952.12	955.75	955.84	0.00405	2.88	779.01	809.02	0.39
N_Fork_Brushy	Reach2	5626.884	1848.66	951.29	955.33	955.44	0.004928	3.46	730.5	791.55	0.42
N_Fork_Brushy	Reach2	5591.774	Culvert								
N_Fork_Brushy	Reach2	5490.409	1848.66	948.97	955.28	955.37	0.002613	3.42	837.97	682.98	0.34
N_Fork_Brushy	Reach2	5283.475	1876.48	948.15	954.66	954.78	0.003139	3.62	741.71	578.95	0.35
N_Fork_Brushy	Reach2	4634.735	1904.81	945.59	952.75	952.95	0.003343	4.17	611	570.2	0.38
N_Fork_Brushy	Reach2	3983.755	1926.95	943.02	949.47	949.99	0.007242	6.62	435.88	421.54	0.59
N_Fork_Brushy	Reach2	3481.821	1953.54	941.04	947.66	947.81	0.00276	3.67	673.12	398.24	0.36
N_Fork_Brushy	Reach2	2886.589	1973.01	938.69	945.96	946.24	0.003814	4.93	514.17	268.87	0.42
N_Fork_Brushy	Reach2	2455.877	2008.94	936.99	943.9	944.39	0.005038	6.33	417.51	625.78	0.5
N_Fork_Brushy	Reach2	1672.075	2008.95	937.36	942.2	942.33	0.001693	3.2	748.52	428.85	0.31
N_Fork_Brushy	Reach2	1672.007	2026.03	932.96	941.34	941.59	0.002962	4.91	544.98	226.36	0.38
N_Fork_Brushy	Reach2	1304.121	2033.26	932.19	939.48	939.69	0.01324	3.83	578.76	284.43	0.43
N_Fork_Brushy	Reach2	1149.485	2039.94	931.82	939.15	939.18	0.001313	1.65	1409.15	397.67	0.13
N_Fork_Brushy	Reach2	1007.041	2057.63	929.55	938.81	938.91	0.003827	2.68	814.22	209.86	0.21
N_Fork_Brushy	Reach2	632.0792	2073.1	927.62	937.59	937.68	0.004031	3.16	1121.25	520.68	0.22
N_Fork_Brushy	Reach2	306.7893	2073.1	925.95	937.16	937.18	0.000859	1.49	2066.91	638.44	0.1
NFork_Brushy_Tb1	Reach1	12460.15	467.19	1079.03	1079.71	1079.74	0.00166	1.27	348.13	525.7	0.28
NFork_Brushy_Tb1	Reach1	11943.56	688.64	1076.11	1077.49	1077.55	0.009652	1.32	359.93	564.04	0.25
NFork_Brushy_Tb1	Reach1	11437.1	1102.39	1073.07	1075.57	1075.62	0.002527	1.94	660.32	803.58	0.25
NFork_Brushy_Tb1	Reach1	10822.88	1102.39	1070.27	1072.24	1072.7	0.02217	6.98	220.4	302.6	0.94
NFork_Brushy_Tb1	Reach1	10347.45	1166.03	1065.93	1068.15	1068.23	0.005018	3.08	577.3	791.26	0.44
NFork_Brushy_Tb1	Reach1	9560.888	1202.78	1061.89	1064.19	1064.36	0.006722	4.3	471.25	526.24	0.54
NFork_Brushy_Tb1	Reach1	9126.019	1232.98	1058.45	1061.55	1061.75	0.006579	4.45	426.33	383.06	0.54
NFork_Brushy_Tb1	Reach1	8778.396	1279.94	1054.84	1059.35	1059.44	0.006555	2.91	803.16	889.3	0.26
NFork_Brushy_Tb1	Reach1	8254.568	1335.3	1052.64	1056.4	1056.69	0.004923	1.96	355.29	254.69	0.21
NFork_Brushy_Tb1	Reach1	7661.104	1403.98	1049.47	1053.34	1053.59	0.006477	3.41	493.5	418.38	0.34

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
NFork_Brushy_Tb1	Reach1	6958.144	1465.44	1045.68	1048.42	1048.9	0.01161	3.48	303.13	280.12	0.43
NFork_Brushy_Tb1	Reach1	6357.72	1532.63	1040.62	1044.92	1045.46	0.003739	7.04	317.91	280.99	0.75
NFork_Brushy_Tb1	Reach1	5729.434	1598.54	1035.81	1040.63	1041.23	0.00385	7.17	322.43	299.66	0.78
NFork_Brushy_Tb1	Reach1	5139.254	1649.48	1032.61	1037.16	1037.56	0.010822	5.42	340.37	339.56	0.58
NFork_Brushy_Tb1	Reach1	4699.65	1715.27	1031.57	1035.17	1035.25	0.003027	2.37	804.02	632.08	0.29
NFork_Brushy_Tb1	Reach1	4151.482	1786.59	1030.12	1032.23	1032.49	0.012496	4.56	465.98	570.64	0.59
NFork_Brushy_Tb1	Reach1	3580.544	1836.9	1022.56	1027.28	1027.76	0.006521	7.08	502.95	565.32	0.65
NFork_Brushy_Tb1	Reach1	3191.275	1848.97	1022.8	1025.31	1025.37	0.001534	1.61	1087.32	1062.05	0.22
NFork_Brushy_Tb1	Reach1	3099.486	1911.8	1018.56	1023.12	1023.56	0.007547	7.79	518.62	547.44	0.71
NFork_Brushy_Tb1	Reach1	2631.2	1911.8	1017.77	1019.24	1019.43	0.010128	3.82	557.37	671.8	0.66
NFork_Brushy_Tb1	Reach1	2126.227	1911.8	1012.44	1015.29	1015.47	0.006081	4.33	589.05	689	0.56
Mason_Creek	Reach1	1084.807	80.85	929.2	932.54	932.54	0.000389	0.57	144.67	101.55	0.08
Mason_Creek	Reach1	920.9648	157.76	928.83	932.3	932.34	0.003027	2.04	124.48	216.41	0.23
Mason_Creek	Reach1	693.0567	305.98	925.93	929.58	930.07	0.03189	5.59	54.73	29.21	0.72
Mason_Creek	Reach1	467.2051	479	924.04	927.95	928.08	0.004852	2.89	171.79	78.9	0.31
Mason_Creek	Reach1	314.4031	479	922.76	927.63	927.68	0.001504	1.88	310.05	153.86	0.18
Mason_Creek	Reach3	16611.41	297.44	1042.08	1043.74	1043.8	0.009988	2.33	156.89	155.7	0.33
Mason_Creek	Reach3	16286.94	339.97	1037.43	1039.43	1039.51	0.015949	2.82	153.45	204.64	0.41
Mason_Creek	Reach3	15781.71	380.72	1032.13	1034	1034.05	0.00806	1.83	216.5	228.68	0.29
Mason_Creek	Reach3	15353.77	435.93	1028.82	1030.07	1030.12	0.010201	1.64	237.16	301.65	0.3
Mason_Creek	Reach3	14841.8	480.95	1023.58	1026.45	1026.49	0.005874	1.87	344.27	409.61	0.27
Mason_Creek	Reach3	14470.28	480.95	1018.91	1022.75	1023.03	0.014914	4.38	119.18	99.73	0.43
Mason_Creek	Reach3	14177.32	519.7	1016.96	1020.59	1020.68	0.004972	2.43	233	129.53	0.25
Mason_Creek	Reach3	13736.75	584.77	1014.44	1017.9	1018.03	0.007317	2.79	210.55	108.69	0.29
Mason_Creek	Reach3	13432.3	614.88	1011.74	1015.48	1015.62	0.008522	2.95	208.77	78.02	0.32
Mason_Creek	Reach3	13302.74	632.64	1010.82	1014.77	1014.86	0.004165	2.43	264.67	167.04	0.23
Mason_Creek	Reach3	13229.25	710.49	1009.98	1014.56	1014.61	0.00248	1.9	385.83	236.3	0.18
Mason_Creek	Reach3	13152.26	Bridge								
Mason_Creek	Reach3	13082.24	710.49	1008.57	1013.85	1013.9	0.0024	1.84	396.47	248.8	0.17
Mason_Creek	Reach3	12929.75	820.97	1006.87	1012.97	1013.18	0.012943	4.32	265.48	196.64	0.4
Mason_Creek	Reach3	12556.75	897.32	1002.78	1009.38	1009.64	0.008696	4.85	269.98	115.18	0.36

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Mason_Creek	Reach3	12327.25	986.1	1001.97	1007.25	1007.51	0.009881	4.52	257.84	79.36	0.37
Mason_Creek	Reach3	12083.78	986.1	1000.66	1006.13	1006.22	0.003091	2.59	460.8	149.62	0.21
Mason_Creek	Reach2	11830.89	1185.06	999.47	1005.48	1005.56	0.00224	2.27	549.78	164.79	0.18
Mason_Creek	Reach2	11655.81	1212.28	998.42	1004.8	1004.95	0.00569	3.36	398.02	116.36	0.28
Mason_Creek	Reach2	11273.54	1243.58	996.08	1003.23	1003.37	0.00302	3.04	431.94	93.92	0.22
Mason_Creek	Reach2	10844.4	1267.94	993.29	1001.16	1001.43	0.007303	4.4	330.57	110.41	0.34
Mason_Creek	Reach2	10517.79	1301.25	993.85	999.48	999.61	0.004132	3.3	497.49	169.71	0.26
Mason_Creek	Reach2	10081.28	1323.34	988.84	995.45	996.04	0.02274	6.42	228.54	117.69	0.57
Mason_Creek	Reach2	9797.975	1336.4	986.93	993.85	994.02	0.003403	3.71	450.16	158.32	0.3
Mason_Creek	Reach2	9632.602	1359.81	986.33	992.97	993.25	0.007665	4.54	352.65	155.63	0.43
Mason_Creek	Reach2	9340.31	1382.98	982.91	990.16	990.79	0.010327	6.89	252.2	92.93	0.52
Mason_Creek	Reach2	9055.909	1419.13	981.34	988.29	988.6	0.006183	4.73	358.45	153.92	0.4
Mason_Creek	Reach2	8621.533	1425.9	975.85	985.68	986.07	0.006084	5.5	324.44	99.34	0.38
Mason_Creek	Reach2	8541.364	1447.74	975.37	985.47	985.62	0.003562	3.45	478.49	161.81	0.29
Mason_Creek	Reach2	8285.496	1486.89	973.82	983.98	984.34	0.007054	5.82	362.1	177.52	0.38
Mason_Creek	Reach2	7836.32	1486.9	971.11	981.02	981.34	0.006355	5.66	394.51	243.5	0.42
Mason_Creek	Reach2	7722.488	1604.61	970.42	979.9	980.45	0.009257	7.15	324.76	155.14	0.53
Mason_Creek	Reach2	7473.42	1649.75	968.97	974.97	976.87	0.023187	11.47	159.86	47.17	0.92
Mason_Creek	Reach2	7382.725	1778.8	968.37	973.48	973.75	0.003382	4.18	427.95	124.88	0.35
Mason_Creek	Reach2	7338.993	Culvert								
Mason_Creek	Reach2	7303.318	1778.8	968.89	973.09	973.5	0.00736	5.14	346.01	115.77	0.49
Mason_Creek	Reach2	7136.51	1921.51	966.89	972.13	972.5	0.004823	4.92	397.34	103.2	0.42
Mason_Creek	Reach2	6884.229	2117.48	965.36	971.02	971.37	0.004104	4.78	447.94	103.72	0.39
Mason_Creek	Reach2	6566.748	2235.2	963.45	969.89	970.21	0.003263	4.54	499.94	108.57	0.35
Mason_Creek	Reach2	6389.875	2322.26	962.38	969.39	969.67	0.002686	4.29	550.63	111.88	0.32
Mason_Creek	Reach2	6264.957	2459.54	961.63	969.13	969.37	0.002054	3.9	640.66	123.2	0.29
Mason_Creek	Reach2	6077.202	2647.29	960.49	969.02	969.11	0.000744	2.55	1163.34	504.98	0.18
Mason_Creek	Reach2	5836.711	2649.52	959.04	968.86	968.96	0.000572	2.74	1066.93	829.19	0.16
Mason_Creek	Reach2	5773.21	Culvert								
Mason_Creek	Reach2	5735.271	2649.52	958.41	966.61	968.69	0.023625	11.55	229.35	50.64	0.86
Mason_Creek	Reach2	5716.531	2683.19	957.97	966.89	967.97	0.006761	8.55	325.47	1070.29	0.53

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Mason_Creek	Reach2	5688.782	Bridge								
Mason_Creek	Reach2	5636.044	2683.19	956.84	964.29	965.46	0.011626	9.14	334.08	574.93	0.71
Mason_Creek	Reach2	5434.675	2694.35	955.44	962.05	962.78	0.01399	8.07	420	392.23	0.77
Mason_Creek	Reach2	5342.068	2739.65	954.8	962.09	962.21	0.001269	2.34	985.36	423.04	0.23
Mason_Creek	Reach2	4969.974	2793.62	952.21	960.51	961.24	0.006943	7.65	546.3	378.78	0.67
Mason_Creek	Reach2	4534.581	2834.06	949.19	957.86	958.05	0.001554	4.48	1059.09	539.94	0.33
Mason_Creek	Reach2	4213.843	2875.18	946.96	956.92	957.23	0.00541	5.76	855.41	510.78	0.38
Mason_Creek	Reach2	3892.342	2910.94	944.73	956.52	956.57	0.00092	2.24	1738.92	651.43	0.16
Mason_Creek	Reach2	3616.511	2946.88	942.82	956.42	956.43	0.000274	1.44	2838.38	806.81	0.08
Mason_Creek	Reach2	3342.684	2999.09	940.91	956.34	956.36	0.000265	1.79	2848.16	963.26	0.09
Mason_Creek	Reach2	3315.292	Bridge								
Mason_Creek	Reach2	3275.539	2999.09	940.49	949.71	951.7	0.011123	11.48	278.75	255.38	0.87
Mason_Creek	Reach2	2950.673	2999.09	940.82	945.94	946.13	0.002003	3.47	863.63	285.87	0.35
Mason_Ck_Trib1	Reach1	2099.358	131.21	1023.88	1026.51	1026.56	0.006622	1.9	94.8	116.21	0.25
Mason_Ck_Trib1	Reach1	1901.871	138.63	1023.87	1024.51	1024.54	0.016415	1.31	99.12	198.56	0.33
Mason_Ck_Trib1	Reach1	1805.4	146.98	1023.33	1023.99	1024.01	0.00424	0.67	156.38	288.66	0.17
Mason_Ck_Trib1	Reach1	1702.724	166.49	1020.67	1022.89	1023.02	0.014204	2.81	59.24	339.23	0.38
Mason_Ck_Trib1	Reach1	1653.615	Culvert								
Mason_Ck_Trib1	Reach1	1606.29	166.49	1018.86	1020.56	1021.2	0.108878	6.38	26.09	37.85	1
Mason_Ck_Trib1	Reach1	1483.988	179.92	1017.3	1018.64	1018.67	0.006761	1.26	151.24	203.89	0.23
Mason_Ck_Trib1	Reach1	1347.886	179.98	1015.95	1018.35	1018.36	0.001301	0.91	254.9	274.9	0.12
Mason_Ck_Trib1	Reach1	1347.352	189.95	1015.95	1018.01	1018.03	0.003362	1.28	193.44	223.71	0.18
Mason_Ck_Trib1	Reach1	1252.667	198.15	1014.51	1017.46	1017.51	0.009018	1.98	129.62	211.21	0.29
Mason_Ck_Trib1	Reach1	1178.55	207.91	1014.05	1017.09	1017.13	0.003936	1.8	149.71	219.36	0.21
Mason_Ck_Trib1	Reach1	1156.485	Culvert								
Mason_Ck_Trib1	Reach1	1138.125	207.91	1013.4	1016.31	1016.39	0.009854	2.65	112.06	128.63	0.32
Mason_Ck_Trib1	Reach1	1094.166	212.97	1013.19	1015.85	1015.92	0.011203	2.29	111.8	142.52	0.33
Mason_Ck_Trib1	Reach1	1051.96	223.88	1012.38	1015.61	1015.64	0.003554	1.44	201.01	219.8	0.19
Mason_Ck_Trib1	Reach1	964.345	233.46	1011.83	1015.27	1015.29	0.004946	1.31	201.36	218.46	0.21
Mason_Ck_Trib1	Reach1	930.3201	Culvert								
Mason_Ck_Trib1	Reach1	891.3364	233.46	1012.13	1015.18	1015.19	0.002125	1.09	281.68	284.97	0.15

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Mason_Ck_Trib1	Reach1	890.8022	253.19	1012.13	1014.44	1014.49	0.013082	1.88	163.63	252.78	0.33
Mason_Ck_Trib1	Reach1	748.4684	253.62	1010.99	1014.08	1014.09	0.001011	0.89	399.83	352.22	0.11
Mason_Ck_Trib1	Reach1	745.4608	274.68	1011.12	1013.62	1013.67	0.009422	2.24	178.02	272.42	0.31
Mason_Ck_Trib1	Reach1	605.5107	274.68	1009.72	1012.65	1012.67	0.005549	1.61	234.69	304.28	0.23
Mason_Ck_Trib1	Reach1	458.3398	274.68	1007.69	1010.54	1010.83	0.051547	4.49	78.26	177.44	0.69
Brushy_Creek	Reach1	181331.4	5192.39	923.21	935.97	936.08	0.003299	3.66	2313.61	670.69	0.21
Brushy_Creek	Reach1	181108.1	5192.64	922.85	933.09	933.33	0.010066	4.42	1482.89	627.96	0.34
Brushy_Creek	Reach1	180915.8	5193.33	922.54	930.96	931.82	0.004048	8.66	1295.89	793.11	0.63
Brushy_Creek	Reach1	180857.3	Culvert								
Brushy_Creek	Reach1	180799.9	5193.33	922.26	929.91	930.21	0.001339	5.09	1738.81	761.62	0.36
Brushy_Creek	Reach1	180397.1	5193.67	920.19	928.53	929.27	0.004198	7.58	987.31	302.45	0.57
Brushy_Creek	Reach1	180136.5	5193.67	918.85	927.64	928.31	0.002912	8.39	1173.05	284.29	0.55
Brushy_Creek	Reach2	179517.6	5193.67	915.66	923.12	924.84	0.011174	11.88	642.05	190.7	0.91
Brushy_Creek	Reach2	179207.7	5193.67	914.07	921.92	922.7	0.002	6.28	749.06	177.18	0.47
Brushy_Creek	Reach2	179159.8	Bridge								
Brushy_Creek	Reach2	179114.9	5193.67	913.49	921.53	922.1	0.001286	5.31	911.44	266.95	0.37
Brushy_Creek	Reach2	179021.5	5193.67	912.6	921.63	921.86	0.000536	3.64	1346.47	529.21	0.24
Brushy_Creek	Reach2	178936.5	5193.67	911.79	920.87	921.63	0.001795	5.91	765.32	435.57	0.41
Brushy_Creek	Reach2	178887.5	Bridge								
Brushy_Creek	Reach2	178824.2	5193.67	910.19	920.09	920.64	0.001513	6.59	911.91	229.39	0.41
Brushy_Creek	Reach2	178535.5	5193.67	908.38	917.44	919.45	0.005865	12.57	654.1	144.3	0.8
Brushy_Creek	Reach2	177983.2	5193.67	906.13	915.68	916.25	0.003664	6.04	863.92	213.15	0.52
Brushy_Creek	Reach2	177529.8	5193.67	902.05	913.92	914.92	0.00226	8.56	917.6	216.69	0.5
Brushy_Creek	Reach2	177003.5	6299.5	900.06	911.62	913.24	0.0042	11.21	857.21	190.69	0.68
Brushy_Creek	Reach2	176502.2	6377.89	898.06	910.65	911.5	0.002281	8.2	1248.83	255.07	0.46
Brushy_Creek	Reach2	176034.4	6460.83	896.25	910.15	910.52	0.001457	5.47	1742.2	311.8	0.29
Brushy_Creek	Reach2	175545.6	6542.29	894.35	906.59	909.05	0.005602	14.07	759.77	190.78	0.77
Brushy_Creek	Reach2	175071.6	6610.68	892.51	905.65	906.18	0.002822	6.07	1289.51	259.7	0.39
Brushy_Creek	Reach2	174678.2	6659.62	890.99	903.32	904.51	0.006394	8.81	793.94	161.25	0.65
Brushy_Creek	Reach2	174399.2	6664.42	889.9	902.19	902.82	0.004673	6.42	1071.08	245.29	0.5
Brushy_Creek	Reach2	174371.9	6708.24	889.8	902.19	902.7	0.002238	5.75	1184	237.82	0.43

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach2	174124	6747.56	888.84	901.87	902.2	0.001501	4.55	1484.4	246.28	0.32
Brushy_Creek	Reach2	173902.9	6811.43	888.68	901.01	901.6	0.004033	6.15	1112.24	242.14	0.5
Brushy_Creek	Reach2	173885.7	Culvert								
Brushy_Creek	Reach2	173870.4	6811.43	888.82	900.82	901.3	0.003356	5.59	1226	252.92	0.44
Brushy_Creek	Reach2	173546.5	6892.5	886.52	898.74	899.89	0.004239	9.78	1145.83	253.29	0.54
Brushy_Creek	Reach2	173098.9	6892.5	884.68	897.1	898.25	0.003199	9.98	1219.01	245.82	0.59
Brushy_Creek	Reach2	172810.8	7809.91	883.5	896.02	896.84	0.006704	7.98	1259.51	234.89	0.48
Brushy_Creek	Reach2	172293.8	7840.3	881.38	893.6	894.56	0.003018	8.79	1416.78	346.91	0.52
Brushy_Creek	Reach2	171962.8	7881.07	880.02	892.8	893.38	0.004053	7.08	1597.03	317.65	0.41
Brushy_Creek	Reach2	171520.8	7910.75	878.56	891.63	892.11	0.00223	6.13	1737.26	270.73	0.35
Brushy_Creek	Reach2	171200.5	7932.03	877.5	891.06	891.34	0.00208	4.27	1887.37	326.95	0.29
Brushy_Creek	Reach2	170971.6	7932.03	876.74	890.06	890.59	0.004308	6.96	1669.3	315.37	0.39
Brushy_Creek	Reach2	170944.3	Culvert								
Brushy_Creek	Reach2	170915.6	7932.03	876.51	889.89	890.44	0.002874	7.01	1772.29	309.67	0.37
Brushy_Creek	Reach3	170210.4	8750.59	873.19	887.1	887.61	0.005687	6.88	1661.45	287.79	0.41
Brushy_Creek	Reach3	169743	8758.41	870.98	884.96	885.41	0.004131	5.87	1809.05	317.86	0.33
Brushy_Creek	Reach3	169532.8	8765.18	869.98	884.28	884.7	0.002504	5.5	1881.04	321.58	0.34
Brushy_Creek	Reach3	169450.2	Bridge								
Brushy_Creek	Reach3	169401.3	8765.18	869.48	883.51	884.06	0.004313	6.65	1789.48	323.86	0.37
Brushy_Creek	Reach3	169350.9	8778.09	869.52	883.13	883.87	0.00201	7.4	1733.29	312.67	0.41
Brushy_Creek	Reach3	169321.4	Bridge								
Brushy_Creek	Reach3	169169.7	8778.09	868.63	882.79	883.38	0.001627	6.7	1870.38	300.43	0.38
Brushy_Creek	Reach3	169004.5	8790.38	867.57	882.57	882.94	0.002845	5.6	2074.18	303.14	0.3
Brushy_Creek	Reach3	168675.4	8802.64	866.39	881.33	881.86	0.002851	6.72	1814.47	269.12	0.4
Brushy_Creek	Reach3	168347.4	8802.64	865.22	879.86	880.79	0.003406	10.15	1857.77	507.59	0.58
Brushy_Creek	Reach3	167950.3	8802.64	863.8	879.02	879.32	0.003276	5.52	2415.46	502.26	0.31
Brushy_Creek	Reach3	167175.6	9828.46	861.02	876.54	876.88	0.003308	5.84	2380.32	368.77	0.31
Brushy_Creek	Reach3	166782.1	9804.46	859.62	875.03	875.48	0.004174	7.15	2523.74	588.24	0.37
Brushy_Creek	Reach3	166332.3	9787.3	858.01	873.31	873.79	0.004755	6.79	2163.58	411.31	0.37
Brushy_Creek	Reach3	166009.9	9775.42	856.86	871.56	872.31	0.004395	7.63	1868.21	430.3	0.41
Brushy_Creek	Reach3	165786.4	9775.42	855.92	870.49	871.17	0.006093	7.93	1897.58	517.98	0.43

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach4	165274.2	9775.42	853.77	867.68	868.38	0.004858	7.65	1735.92	344.82	0.43
Brushy_Creek	Reach4	164909.1	9775.42	852.23	866.75	867.24	0.001933	7.04	2585.8	500.89	0.37
Brushy_Creek	Reach4	164475	9775.42	850.41	865.28	865.98	0.005544	8.28	1813.07	461.65	0.47
Brushy_Creek	Reach4	164141.2	9775.42	849.01	863.37	864.71	0.002635	10.2	1568.04	412.72	0.55
Brushy_Creek	Reach4	163806.5	9775.42	847.6	862.01	863.62	0.00395	10.84	1272.21	318.82	0.64
Brushy_Creek	Reach4	163445.9	9775.42	846.09	861.46	862.5	0.001926	9	1751.91	451.35	0.47
Brushy_Creek	Reach4	163062	9775.42	844.47	860.91	861.67	0.001972	7.79	2134	688.47	0.43
Brushy_Creek	Reach4	162958.7	9775.42	844.45	859.78	861.33	0.003738	11.47	1667.49	549.37	0.62
Brushy_Creek	Reach4	162759.4	9775.42	844.48	859.4	860.48	0.003385	9.47	1815.41	683.54	0.57
Brushy_Creek	Reach4	162601	9775.42	844.51	859.12	859.82	0.00343	9.37	2094.83	750.59	0.49
Brushy_Creek	Reach4	162452.8	9775.42	844.54	858.76	859.37	0.002512	7.37	2252.81	851.15	0.45
Brushy_Creek	Reach4	162337.3	9775.42	844.56	858.14	859.05	0.002543	9.08	2167.73	803.52	0.51
Brushy_Creek	Reach5	162161.9	9775.42	844.6	858.51	858.68	0.000467	4.31	4667.34	1028.49	0.23
Brushy_Creek	Reach5	162145.6	9775.42	844.6	858.44	858.66	0.000506	4.7	4276.42	995.41	0.25
Brushy_Creek	Reach5	162128.7	Culvert								
Brushy_Creek	Reach5	162118	9775.42	844.59	858.36	858.63	0.000592	5.19	4136.15	911.8	0.27
Brushy_Creek	Reach5	162016.5	9775.42	844.14	856.74	858.17	0.003809	12.08	2097.42	715.47	0.67
Brushy_Creek	Reach5	161921.9	9775.42	843.72	856.17	857.64	0.004908	11.33	1813.97	725.37	0.67
Brushy_Creek	Reach5	161752.9	9775.42	842.98	854.44	856.34	0.007579	12.23	1393.94	588.24	0.81
Brushy_Creek	Reach5	161377.3	9775.42	841.32	853.2	854.11	0.002556	8.73	1996.69	481.61	0.53
Brushy_Creek	Reach5	161161.5	9775.42	840.37	852.94	853.57	0.002137	7.62	2330.72	476.38	0.48
Brushy_Creek	Reach5	160842.4	9775.42	838.76	852.06	852.85	0.002384	8.22	1873.07	358.9	0.5
Brushy_Creek	Reach5	160459.6	9775.42	837.07	849.43	851.68	0.00518	13.65	1074.55	180.43	0.77
Brushy_Creek	Reach5	160071.7	9775.42	835.56	847.12	849.45	0.006572	12.88	965.27	194.58	0.83
Brushy_Creek	Reach6	159518.4	10645.6	834.22	846.47	847.29	0.001862	8.15	1855.85	340.11	0.47
Brushy_Creek	Reach6	159074.6	10649.1	831.75	845.23	846.32	0.002287	9.2	1627.54	243.27	0.52
Brushy_Creek	Reach6	158713.8	10652	830.64	844.53	845.45	0.002218	8.77	1827.68	276.26	0.49
Brushy_Creek	Reach6	158411.1	10653.8	829.71	843.69	844.73	0.002599	9.32	1788.2	280.15	0.51
Brushy_Creek	Reach6	158223.6	10656.3	829.13	843.52	844.29	0.00139	7.51	1945.75	280.76	0.4
Brushy_Creek	Reach6	157965.3	10659.1	828.33	842.59	843.73	0.002264	10.34	1929.71	300.34	0.52
Brushy_Creek	Reach6	157937.1	Culvert								

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	157916.8	10659.1	828.19	842.18	842.97	0.005624	8.65	1891.31	385.99	0.49
Brushy_Creek	Reach6	157675	10662.2	827.58	840.9	841.89	0.003362	8.92	1723.32	288.67	0.52
Brushy_Creek	Reach6	157357.3	10664.7	826.77	838.39	840.25	0.005869	12.65	1416.68	281.08	0.75
Brushy_Creek	Reach6	157091.1	10664.7	826.1	837.82	838.92	0.003072	10.64	1955.99	336.45	0.6
Brushy_Creek	Reach6	156711.9	10925.2	823.89	836.27	837.72	0.003831	10.88	1531.36	245.25	0.62
Brushy_Creek	Reach6	156010.3	10932.3	821.45	835.56	835.97	0.001322	5.65	2677.34	437.9	0.32
Brushy_Creek	Reach6	155663.6	10939.5	819.95	833.85	835.24	0.002706	10.42	1694.31	399.55	0.56
Brushy_Creek	Reach6	155318.7	10947.4	818.46	833.03	833.92	0.004475	8.77	1893.71	410	0.51
Brushy_Creek	Reach6	154931.6	10956.9	816.79	830.34	831.79	0.005941	9.89	1235.19	208.74	0.56
Brushy_Creek	Reach6	154474.3	10965.6	814.82	828.53	829.84	0.00309	9.85	1702.59	579.14	0.61
Brushy_Creek	Reach6	154055.3	10975	813.01	827.06	828.05	0.005782	8.56	1853.57	594.54	0.51
Brushy_Creek	Reach6	153601.1	10985.4	811.39	825.45	826.41	0.002512	8.5	1901.38	375.29	0.53
Brushy_Creek	Reach6	153095.5	10992.3	809.59	824.25	825.26	0.001886	8.25	1668.7	364.33	0.46
Brushy_Creek	Reach6	152765.3	10996.4	808.42	823.49	824.55	0.002541	9.39	1894.01	302.08	0.5
Brushy_Creek	Reach6	152568.1	11005.3	807.72	823.02	824.08	0.001983	9.84	2223.31	368.78	0.49
Brushy_Creek	Reach6	152135.3	11013.3	806.18	820.97	822.86	0.003857	11.73	1496.49	517.19	0.66
Brushy_Creek	Reach6	151751.7	11019.7	804.82	820.4	821.46	0.002633	9.24	2105.01	604.83	0.49
Brushy_Creek	Reach6	151446.5	11027	803.73	817.41	820.12	0.006847	14.04	1172.95	292.8	0.84
Brushy_Creek	Reach6	151093.7	11037.2	802.48	817.4	818.39	0.002378	8.82	2147.12	519.87	0.51
Brushy_Creek	Reach6	150604.5	11046.7	801.31	817.09	817.58	0.001037	6.26	3099.05	663.36	0.33
Brushy_Creek	Reach6	150148.2	11053.3	800.23	815.75	816.88	0.002092	9.11	1742.98	289.62	0.48
Brushy_Creek	Reach6	149828.3	11063.5	799.47	812.66	815.64	0.006351	14.35	1050.17	243.54	0.83
Brushy_Creek	Reach6	149341.4	11063.5	798.32	811.77	813.22	0.002436	10.4	1447.09	215.8	0.54
Brushy_Creek	Reach6	149103	11063.5	797.76	810.61	812.44	0.004401	11.79	1431.95	289.39	0.68
Brushy_Creek	Reach6	148638.7	12163.1	796.66	809.85	810.77	0.0021	8.74	2326.94	420.9	0.49
Brushy_Creek	Reach6	148617.8	Culvert								
Brushy_Creek	Reach6	148595	12163.1	795.97	810.08	810.62	0.000976	6.28	2795	433.51	0.32
Brushy_Creek	Reach6	148506.1	12166.7	795.74	809.68	810.44	0.001586	7.68	2357.16	366.93	0.39
Brushy_Creek	Reach6	148339.8	12169.7	795	809.07	810.08	0.001877	8.24	1810.77	294.94	0.43
Brushy_Creek	Reach6	148199	12174.2	794.18	807.44	809.59	0.004125	12.77	1429.77	244.79	0.68
Brushy_Creek	Reach6	147990.1	12177.5	792.97	807.53	808.73	0.001939	10.02	1946.25	298.94	0.49

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	147834.7	12180.2	792.07	807.52	808.32	0.001655	9.27	2457.23	353.01	0.46
Brushy_Creek	Reach6	147709.5	12181.4	791.34	807.3	808.11	0.001753	9.9	2616.71	370.92	0.46
Brushy_Creek	Reach6	147656.2	12183.2	791.03	807.24	808.01	0.001295	8.38	2694.97	387.7	0.4
Brushy_Creek	Reach6	147641.3	Bridge								
Brushy_Creek	Reach6	147628.5	12183.2	790.88	807.24	807.89	0.00099	7.36	2765.32	381.62	0.35
Brushy_Creek	Reach6	147570.1	12186.6	790.72	806.78	807.73	0.001806	10.04	2324.65	385.06	0.46
Brushy_Creek	Reach6	147414.5	12191.6	790.31	805.26	807.1	0.003425	11.79	1563.45	273.9	0.63
Brushy_Creek	Reach6	147182	12195.5	789.69	805.08	806.26	0.00227	9.66	2106.02	367.63	0.49
Brushy_Creek	Reach6	147002.3	12200.6	789.22	805.03	805.79	0.001665	7.83	2409.25	335.56	0.39
Brushy_Creek	Reach6	146762.9	12206.3	788.58	803.99	805.26	0.002637	10.57	2000.18	290.49	0.54
Brushy_Creek	Reach6	146499.5	12212.7	787.88	803.55	804.45	0.00271	8.32	2001.49	291.69	0.41
Brushy_Creek	Reach6	146203.7	12217	787.09	802.99	803.64	0.002245	6.93	2154.89	317.77	0.37
Brushy_Creek	Reach6	146004.3	12224.2	786.56	801.51	803.07	0.00256	10.82	1629	274.35	0.55
Brushy_Creek	Reach6	145668.5	12231	785.67	801.64	802.13	0.000834	6.46	3112.26	432.36	0.32
Brushy_Creek	Reach6	145638.3	Culvert								
Brushy_Creek	Reach6	145621.2	12231	785.54	801.62	802.03	0.000791	6.05	3314.16	457.76	0.28
Brushy_Creek	Reach6	145353.9	12238.1	785.97	801.43	801.7	0.001047	4.22	2901.18	332.95	0.25
Brushy_Creek	Reach6	145024.6	12238.1	786.05	801.08	801.36	0.001515	4.64	2922.04	539.68	0.22
Brushy_Creek	Reach6	144486.1	12266.8	784.87	800.23	800.46	0.001765	4.05	3213.29	745.45	0.23
Brushy_Creek	Reach6	144381.3	Mult Open								
Brushy_Creek	Reach6	144286.5	12266.8	784.85	796.67	797.34	0.001663	8.51	1959.75	383.3	0.45
Brushy_Creek	Reach6	144155.3	12230.9	783.37	796.38	797.07	0.002493	7.32	2036.27	388.27	0.39
Brushy_Creek	Reach6	143901.6	12230.9	781.72	795.55	796.31	0.004014	7.76	1947.55	384.55	0.44
Brushy_Creek	Reach6	143316.1	12230.9	779.24	794.14	794.84	0.001791	7.24	2186.56	288.49	0.38
Brushy_Creek	Reach6	142696.2	12230.9	778.37	792.96	793.43	0.002712	6.19	2588.36	417.94	0.34
Brushy_Creek	Reach6	142137.3	12465.7	776.81	791.37	792.23	0.001666	7.89	2010.98	256.1	0.42
Brushy_Creek	Reach6	141965.9	12491	776.27	790.42	791.79	0.003067	10.64	1698.88	244.2	0.55
Brushy_Creek	Reach6	141274.4	12511.8	774.08	788.3	789.23	0.004046	8.03	1751.45	226.94	0.43
Brushy_Creek	Reach6	140706	12533.3	772.28	787.24	788.04	0.001231	7.94	2319.05	337.83	0.4
Brushy_Creek	Reach6	140121.2	12554.5	770.43	786.58	787.33	0.001205	7.83	2290.5	245.68	0.39
Brushy_Creek	Reach6	139544.3	12582.3	768.6	785.76	786.26	0.002819	5.69	2213.01	229.01	0.32

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	138789.9	12605.3	767.71	784.63	785.04	0.001015	5.12	2460.84	267.33	0.3
Brushy_Creek	Reach6	138167.3	12631.2	766.99	783.66	784.07	0.00269	5.24	2663.48	372.93	0.3
Brushy_Creek	Reach6	137468.4	12714.4	766.17	781.6	781.97	0.003324	4.86	2622.25	326.23	0.29
Brushy_Creek	Reach6	136879.7	12730.6	765.48	779.91	780.46	0.002003	5.91	2158	311.94	0.37
Brushy_Creek	Reach6	136209.8	12735.3	764.71	779.11	779.47	0.00096	5.1	3130.44	493.01	0.29
Brushy_Creek	Reach6	136189.1	Culvert								
Brushy_Creek	Reach6	136151.2	12735.3	764.46	779	779.29	0.000762	4.6	3363.49	447.7	0.25
Brushy_Creek	Reach6	136018.2	12742.4	763.68	778.87	779.17	0.000933	4.73	3292.45	389.37	0.24
Brushy_Creek	Reach6	135722.2	12755.6	763.26	778.3	778.71	0.002423	5.2	2575.63	358.35	0.29
Brushy_Creek	Reach6	135178.5	12772.1	762.5	776.45	777.06	0.003829	6.45	2202.97	308.93	0.36
Brushy_Creek	Reach6	134499.7	12787.4	761.56	774.46	775.2	0.002047	6.92	1848.31	247.57	0.45
Brushy_Creek	Reach6	133872.3	12801	760.69	773.09	773.79	0.002453	6.77	1977.37	411.82	0.44
Brushy_Creek	Reach6	133313	12807.2	759.91	772.26	772.77	0.001258	5.91	2469.87	563.12	0.38
Brushy_Creek	Reach6	133057.1	12809.1	759.56	772.03	772.47	0.001019	5.53	2687.83	577.82	0.35
Brushy_Creek	Reach6	132977.7	Inl Struct								
Brushy_Creek	Reach6	132941.1	12819.8	755.92	768.28	768.81	0.002099	5.89	2181.4	248.22	0.33
Brushy_Creek	Reach6	132542.1	12819.8	753.59	767.56	768.04	0.001673	5.56	2353.46	349.21	0.33
Brushy_Creek	Reach6	132118.9	12819.8	752.71	766.85	767.44	0.001176	6.45	2380.09	406.5	0.34
Brushy_Creek	Reach6	131616.4	12819.8	752.2	766.18	766.85	0.00114	7.6	2879.25	712.53	0.38
Brushy_Creek	Reach6	131297.8	13750.8	750.98	765.5	766.43	0.00133	8.06	2149.74	338.78	0.41
Brushy_Creek	Reach6	131239.9	13757	750.83	765.36	766.33	0.001789	9.17	2141.61	346.35	0.44
Brushy_Creek	Reach6	131220.2	Culvert								
Brushy_Creek	Reach6	131196	13757	750.72	765.41	766.11	0.002332	7.1	2406.6	361.06	0.35
Brushy_Creek	Reach6	131149.7	13773.5	750.6	765.12	765.95	0.00283	7.78	2208.44	333.11	0.38
Brushy_Creek	Reach6	130906.9	13789	749.99	764.55	765.24	0.002748	7.29	2447.48	334.51	0.35
Brushy_Creek	Reach6	130680.7	13813.9	749.42	764.15	764.74	0.001687	6.79	2693.76	348.26	0.33
Brushy_Creek	Reach6	130316.5	13837	748.5	763.53	763.97	0.002272	6.16	2933.31	388.03	0.3
Brushy_Creek	Reach6	129978.7	13859.7	747.65	762.75	763.29	0.001719	6.49	2821.62	458.84	0.31
Brushy_Creek	Reach6	129647.7	13870.4	746.81	762.08	762.53	0.003025	6.03	2985.53	514.81	0.3
Brushy_Creek	Reach6	129491.8	13885.8	746.42	761.67	762.08	0.002816	5.74	3051.93	526.9	0.29
Brushy_Creek	Reach6	129268.6	13885.8	745.76	761	761.4	0.00349	5.68	2966.76	523.55	0.29

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	128888.7	13897.3	744.65	760	760.51	0.001669	6.38	3140.37	534.06	0.31
Brushy_Creek	Reach6	128573.1	13905.2	743.73	759.61	760.05	0.001199	5.77	2955.49	422.99	0.29
Brushy_Creek	Reach6	128356.9	13913.3	743.1	759.42	759.79	0.001071	5.24	3080.16	434.04	0.27
Brushy_Creek	Reach6	128135.8	13917.2	742.45	759.24	759.54	0.001135	4.86	3423.38	476.68	0.24
Brushy_Creek	Reach6	128032	13919.7	742.15	759.13	759.39	0.001144	4.42	3627.64	523.74	0.22
Brushy_Creek	Reach6	127961.5	13924.1	741.94	759.05	759.31	0.001191	4.55	3673.59	520.48	0.21
Brushy_Creek	Reach6	127933.8	Bridge								
Brushy_Creek	Reach6	127900.3	13924.1	741.76	758.37	758.64	0.001359	4.4	3454.01	490.26	0.22
Brushy_Creek	Reach6	127842.6	13928.4	741.56	758.3	758.55	0.001487	4.09	3577.57	545.07	0.21
Brushy_Creek	Reach6	127725.9	13935.8	741.18	757.9	758.28	0.002723	5.44	3339.36	532.59	0.26
Brushy_Creek	Reach6	127524.3	13944.5	740.51	757.44	757.77	0.00244	5.08	3529.65	561.34	0.24
Brushy_Creek	Reach6	127287.6	13957.5	739.54	756.76	757.18	0.002503	5.93	3421.96	605.34	0.28
Brushy_Creek	Reach6	126933.5	13963	738.55	755.9	756.3	0.002074	5.89	3369.86	438.1	0.26
Brushy_Creek	Reach6	126782.2	13969.9	738.23	755.58	756.02	0.001974	6.07	3242.4	413.41	0.28
Brushy_Creek	Reach6	126594.3	13984.8	737.83	755.17	755.59	0.002526	5.97	3194.35	394.27	0.27
Brushy_Creek	Reach6	126190.8	13998	736.98	754.22	754.61	0.002385	5.78	3302.32	399.06	0.27
Brushy_Creek	Reach6	125833.4	14011	736.22	753.3	753.72	0.002529	5.82	3166.83	422.02	0.28
Brushy_Creek	Reach6	125478.8	14024.9	735.47	751.92	752.74	0.003079	8.2	2627.32	477.26	0.4
Brushy_Creek	Reach6	125103	14035.7	734.68	750.78	751.85	0.001948	9.34	2660.57	429.43	0.44
Brushy_Creek	Reach6	124809.9	14040.5	734.06	750.43	751.07	0.002909	7.53	2954.64	469.01	0.37
Brushy_Creek	Reach6	124680	14046.2	733.79	749.8	750.62	0.002532	8.12	2663.59	417.92	0.39
Brushy_Creek	Reach6	124525.9	14056	733.26	749.45	750.21	0.002535	7.71	2568.42	398.94	0.38
Brushy_Creek	Reach6	124262.3	14069.6	732.35	748.69	749.43	0.00356	7.4	2454.26	404.3	0.38
Brushy_Creek	Reach6	123893.4	14081.8	731.07	747.62	748.29	0.002423	7.8	2803.6	444.83	0.36
Brushy_Creek	Reach6	123564.8	14089.4	729.93	746.88	747.41	0.002788	6.86	2872.1	470.91	0.34
Brushy_Creek	Reach6	123359.9	14089.4	729.22	745.95	746.71	0.004171	8.21	2522.61	438.34	0.4
Brushy_Creek	Reach6	123138	14642	728.45	744.9	746.07	0.002669	10.06	2570.42	481.71	0.47
Brushy_Creek	Reach6	122773.4	14659.2	727.19	744.7	745.21	0.001109	7.05	3106.22	411.63	0.33
Brushy_Creek	Reach6	122369.3	14675.2	725.79	744.24	744.63	0.001875	6.26	3646.16	476.88	0.31
Brushy_Creek	Reach6	121993.2	14688.5	724.48	743.35	743.82	0.003672	6.56	3152.61	440.91	0.32
Brushy_Creek	Reach6	121680.1	14704.8	723.4	742.51	743.1	0.002535	7.34	3206.94	439.48	0.33

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	121298.1	14717.6	722.07	741.12	741.81	0.002697	7.78	2904.38	359.09	0.33
Brushy_Creek	Reach6	120996	14732.2	721.41	740.19	740.9	0.003263	7.41	2723.21	389.3	0.34
Brushy_Creek	Reach6	120654.5	14735.6	720.66	739.82	740.43	0.000695	7.41	4025	529.16	0.31
Brushy_Creek	Reach6	120574.3	14739.3	720.48	739.44	740.27	0.001039	8.11	3514.21	734.57	0.36
Brushy_Creek	Reach6	120552.1	Bridge								
Brushy_Creek	Reach6	120515.6	14739.3	720.35	737.37	738.42	0.002817	8.73	2496.49	599.08	0.41
Brushy_Creek	Reach6	120489.5	14743.9	720.28	737.55	738.1	0.00156	7.62	4017.79	774.28	0.34
Brushy_Creek	Reach6	120480.3	Culvert								
Brushy_Creek	Reach6	120467.8	14743.9	720.22	737.63	738.02	0.001282	6.08	4494.75	785.62	0.27
Brushy_Creek	Reach6	120379.9	14761.2	720	737.58	737.86	0.001317	5.47	4718.65	759.55	0.25
Brushy_Creek	Reach6	119975.1	14772.1	718.96	736.74	737.27	0.002069	6.44	3049.27	385.02	0.3
Brushy_Creek	Reach6	119720.3	14780.5	718.3	736.09	736.75	0.002189	7	2665.63	303.18	0.32
Brushy_Creek	Reach6	119525.9	14791.3	717.8	735.38	736.27	0.002491	8.61	2491.24	289.24	0.39
Brushy_Creek	Reach6	119273.8	14807.1	717.16	734.81	735.57	0.00294	8.21	2725.08	337.16	0.37
Brushy_Creek	Reach6	118905	14807.1	716.21	733.59	734.39	0.003856	7.73	2357.06	265.03	0.37
Brushy_Creek	Reach6	118576.9	14826.3	715.37	732.36	733.39	0.002383	9.18	2402.72	276.22	0.42
Brushy_Creek	Reach6	118084.5	14841.5	714.1	730.41	731.56	0.006329	9.36	1985.99	245.7	0.46
Brushy_Creek	Reach6	117693.3	14851.7	713.09	728.14	729.86	0.002987	10.91	1674.67	206.31	0.55
Brushy_Creek	Reach6	117434.2	14866.7	712.43	727.49	728.92	0.003755	10.04	1810.65	211.08	0.51
Brushy_Creek	Reach6	117050.1	14879.1	711.44	726.04	727.53	0.003393	10.11	1711.07	244.76	0.56
Brushy_Creek	Reach6	116731.4	14893.6	710.62	725.46	726.39	0.002771	8.02	2136.98	305.26	0.42
Brushy_Creek	Reach6	116363.4	14904.1	709.68	725.15	725.46	0.001613	5.13	3774.94	430.71	0.26
Brushy_Creek	Reach6	116094.4	14917.3	708.99	724.8	725.15	0.000957	5.1	3564.97	429.7	0.28
Brushy_Creek	Reach6	115758.4	14928.2	708.12	724.01	724.73	0.00135	8.24	3063.79	365.79	0.4
Brushy_Creek	Reach6	115481.2	14944.1	707.41	723.64	724.19	0.002504	6.12	2795.5	326.05	0.29
Brushy_Creek	Reach6	115075.3	14963.1	706.37	722.56	723.29	0.001907	7.07	2394.17	223.15	0.34
Brushy_Creek	Reach6	114591.9	14978.9	705.51	720.72	721.9	0.004637	10.34	2108.22	213.41	0.49
Brushy_Creek	Reach6	114190.9	14999.8	704.8	719.97	720.83	0.001646	7.75	2362.23	240.17	0.38
Brushy_Creek	Reach6	113661.9	15015.8	703.86	718.93	719.82	0.002415	8.52	2506.57	268.82	0.41
Brushy_Creek	Reach6	113254.6	15034	703.14	718.04	718.6	0.00275	6.78	2864.49	317.31	0.33
Brushy_Creek	Reach6	112794.5	15043.8	702.33	716.39	717.07	0.004402	7.95	2644.41	336.43	0.4

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	112546.5	15048.1	701.89	715.27	716.06	0.004851	8.1	2448.71	323.37	0.42
Brushy_Creek	Reach6	112439.4	15052.8	701.7	714.89	715.62	0.003038	7.45	2575.16	330.84	0.39
Brushy_Creek	Reach6	112320.6	15061.2	701.49	714.17	715.23	0.002917	8.94	2235.5	278.08	0.47
Brushy_Creek	Reach6	112107.5	15065.7	701.11	713.39	714.46	0.004942	10.07	2434.18	359.07	0.55
Brushy_Creek	Reach6	111995.4	15073	700.91	712.95	713.71	0.004494	8.32	2581.48	399.22	0.46
Brushy_Creek	Reach6	111811.4	15083.2	699.9	712.39	713.14	0.002856	7.83	2555.47	356.35	0.42
Brushy_Creek	Reach6	111554.3	15083.2	698.47	711.34	712.27	0.00422	7.95	2056.45	334.79	0.48
Brushy_Creek	Reach6	111281.2	15092.2	696.95	709.41	711.09	0.004026	10.91	1756.95	289.77	0.6
Brushy_Creek	Reach6	111045.4	15096.3	695.63	709.4	710.21	0.001864	7.56	2392.17	426.84	0.42
Brushy_Creek	Reach6	110937.4	15097.8	695.03	708.89	709.94	0.002665	10.25	2411.66	414.71	0.54
Brushy_Creek	Reach6	110898.4	15102.5	694.81	708.89	709.74	0.002386	8.58	2523.54	400.97	0.46
Brushy_Creek	Reach6	110880.7	Bridge								
Brushy_Creek	Reach6	110851.7	15102.5	694.62	708.56	709.18	0.002094	7.28	2790.88	416.45	0.39
Brushy_Creek	Reach6	110775.3	15105.8	694.63	707.89	708.88	0.002098	9.83	2564.6	422.06	0.51
Brushy_Creek	Reach6	110688.8	15110.8	694.63	707.77	708.52	0.002976	8.16	2530.36	398.32	0.43
Brushy_Creek	Reach6	110670.5	Culvert								
Brushy_Creek	Reach6	110637.5	15110.8	694.6	707.09	708.21	0.003773	9.67	2316.03	333.37	0.52
Brushy_Creek	Reach6	110559.1	15113.5	694.26	706.84	707.91	0.003203	9.43	2309.25	294.61	0.49
Brushy_Creek	Reach6	110488.3	15119.6	693.95	706.78	707.53	0.002835	7.23	2420.4	295.11	0.4
Brushy_Creek	Reach6	110328.6	15125.9	693.25	706.37	707.14	0.002154	7.54	2536.54	309.32	0.41
Brushy_Creek	Reach6	110164.5	15129.1	692.54	706.22	706.8	0.001333	6.58	2976.69	332.69	0.35
Brushy_Creek	Reach6	110079.9	15129.6	692.17	706.05	706.69	0.001161	7.25	2819.44	355.12	0.37
Brushy_Creek	Reach6	110068.4	15133.8	692.12	705.99	706.66	0.00118	7.69	2853.82	361.87	0.38
Brushy_Creek	Reach6	110022.9	Bridge								
Brushy_Creek	Reach6	109970.6	15133.8	691.69	705.55	706.41	0.00319	6.32	2191.77	291.92	0.35
Brushy_Creek	Reach6	109957.9	15140.6	691.66	705.65	706.27	0.001027	6.94	2616.48	393.24	0.36
Brushy_Creek	Reach6	109886.5	Bridge								
Brushy_Creek	Reach6	109789.6	15140.6	691.34	705.27	705.93	0.00111	7.57	2546.3	392.79	0.38
Brushy_Creek	Reach6	109780	15147	691.31	705.27	705.9	0.001046	7.39	2583.03	393.91	0.36
Brushy_Creek	Reach6	109742.8	Bridge								
Brushy_Creek	Reach6	109690.1	15147	691.02	704.95	705.6	0.00105	7.35	2499.41	373.26	0.37

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	109612.7	15152.7	690.82	703.25	705.11	0.003337	12.29	1895.87	282.27	0.64
Brushy_Creek	Reach6	109465.7	15162.4	690.43	703.12	704.38	0.002783	9.66	2153.32	300.3	0.51
Brushy_Creek	Reach6	109212.5	15165.7	689.77	702.83	703.8	0.001623	8.7	2733.2	409.6	0.45
Brushy_Creek	Reach6	109126.9	15171.7	689.68	702.92	703.51	0.001062	7.03	2820.93	422.48	0.36
Brushy_Creek	Reach6	109108.3	Culvert								
Brushy_Creek	Reach6	109080.3	15171.7	689.82	702.79	703.3	0.000863	6.44	2949.56	439.87	0.33
Brushy_Creek	Reach6	108969.6	15177.4	689.38	701.86	702.96	0.001867	8.97	2036.15	362.92	0.47
Brushy_Creek	Reach6	108822.5	15182.6	688.8	701.83	702.54	0.001211	6.98	2478.42	381.73	0.37
Brushy_Creek	Reach6	108687	15191.1	688.26	701.91	702.32	0.000703	5.9	3319.52	473.72	0.3
Brushy_Creek	Reach6	108465.7	15200.1	687.39	700.92	702.05	0.002121	9.79	2560.04	380.95	0.5
Brushy_Creek	Reach6	108233.2	15208.9	686.47	700.83	701.57	0.001318	7.1	2561.95	340.07	0.37
Brushy_Creek	Reach6	108003.9	15212.4	685.56	700.48	701.19	0.002126	6.99	2488.95	271.19	0.36
Brushy_Creek	Reach6	107912.1	15214.7	685.19	700.34	700.96	0.002252	6.37	2493.03	277.97	0.34
Brushy_Creek	Reach6	107852.8	15221.8	684.96	700.24	700.8	0.002108	6.03	2591.71	272.67	0.32
Brushy_Creek	Reach6	107777.1	Bridge								
Brushy_Creek	Reach6	107722.6	15221.8	684.45	699.61	700.19	0.004246	6.1	2507.31	280.01	0.35
Brushy_Creek	Reach6	107670.1	15231	684.28	699.26	699.95	0.003705	6.7	2381.86	291.22	0.36
Brushy_Creek	Reach6	107429.6	15250.2	683.48	698.36	699.04	0.003798	6.61	2339.39	343.65	0.41
Brushy_Creek	Reach6	106932.9	15265.2	681.83	696.93	697.59	0.002303	6.54	2422	326.17	0.38
Brushy_Creek	Reach6	106545.8	15278.4	680.54	696.43	696.81	0.001448	5.1	3360.54	445.47	0.28
Brushy_Creek	Reach6	106204.3	15282	679.4	696.18	696.44	0.000691	4.1	3862.42	416.43	0.21
Brushy_Creek	Reach6	106110	15291.3	679.09	696.11	696.39	0.000403	4.25	3798.14	421.76	0.22
Brushy_Creek	Reach6	105870.3	15294.9	678.66	695.9	696.27	0.000527	4.86	3171.42	342.96	0.26
Brushy_Creek	Reach6	105777.1	Inl Struct								
Brushy_Creek	Reach6	105724	15307.7	678.93	691.1	691.92	0.001684	7.37	2242.31	243	0.39
Brushy_Creek	Reach6	105448.2	15320.1	676.2	690.18	691.26	0.00273	9.61	2394.86	320.94	0.49
Brushy_Creek	Reach6	105127	15320.1	671.06	689.26	690.57	0.001784	10.13	2349.68	352.18	0.45
Brushy_Creek	Reach6	104938.9	18580.3	669.52	689.03	690	0.00339	8.02	2631.11	354.51	0.38
Brushy_Creek	Reach6	104671.7	18578.1	667.32	688.19	689.03	0.00356	7.83	2821.87	378.28	0.36
Brushy_Creek	Reach6	104586.1	18575.1	665.66	687.64	688.71	0.002576	8.66	2554.91	408.35	0.38
Brushy_Creek	Reach6	104552.6	Bridge								

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	104510.3	18575.1	664.63	687.15	688.37	0.001914	9.2	2479.87	239.5	0.39
Brushy_Creek	Reach6	104464	18570.2	664.77	687.08	688.27	0.002023	9.12	2432.09	292	0.4
Brushy_Creek	Reach6	104264.7	18563	665.39	686.15	687.66	0.003293	10.43	2320.68	311.52	0.45
Brushy_Creek	Reach6	103974.6	18556.7	666.29	686.04	686.74	0.001757	7.15	3291.36	382.66	0.31
Brushy_Creek	Reach6	103723.6	18546.1	667.06	685.44	686.13	0.003666	7.23	3014.41	544.67	0.35
Brushy_Creek	Reach6	103294	18538.8	668.39	684.21	684.5	0.002961	5.27	4894.17	843.35	0.26
Brushy_Creek	Reach6	103001.3	18534.1	669.21	683.74	683.96	0.00115	5.29	6708.94	966.54	0.27
Brushy_Creek	Reach6	102810.4	18528.7	668.35	683.66	683.75	0.000805	3.09	8589.52	1123.55	0.15
Brushy_Creek	Reach6	102593.5	18519.7	666.99	683.49	683.59	0.000997	3.33	7724.23	907.64	0.16
Brushy_Creek	Reach6	102229.1	18514.1	665.73	683.2	683.37	0.001422	4.49	5951.04	659.09	0.2
Brushy_Creek	Reach6	102002.2	18510.2	664.71	682.68	682.95	0.002151	5.85	5089.31	604.34	0.26
Brushy_Creek	Reach6	101847.1	18502.6	664.01	682.24	682.7	0.001997	7.79	4542.34	493.72	0.34
Brushy_Creek	Reach6	101540.6	18499	662.63	682	682.3	0.00181	6.27	4992.69	470.71	0.27
Brushy_Creek	Reach6	101395.7	18494.3	661.98	681.46	682.11	0.001297	9.12	4490.97	397.87	0.41
Brushy_Creek	Reach6	101202.3	18493	661.11	680.85	681.89	0.001241	9.79	3704.33	352.04	0.41
Brushy_Creek	Reach6	101152.6	18490.8	660.88	680.92	681.71	0.001201	9.72	3567.98	345	0.41
Brushy_Creek	Reach6	101122.8	Culvert								
Brushy_Creek	Reach6	101096.7	18490.8	660.63	680.78	681.49	0.000911	8.75	3351.89	341.09	0.36
Brushy_Creek	Reach6	101060.3	18490.8	660.47	680.71	681.44	0.001355	7.65	3318.85	297.53	0.32
Brushy_Creek	Reach6	100861.4	18490.8	659.57	680.54	681.04	0.001355	6.17	3471.19	316.3	0.26
Brushy_Creek	Reach6	100600.9	18848.2	658.39	679.87	680.59	0.00205	7.73	3117.52	341.14	0.32
Brushy_Creek	Reach6	100127.2	18841.1	656.25	679.43	680.04	0.000714	8.23	4464.58	347.92	0.32
Brushy_Creek	Reach6	99664.65	18835.2	654.65	679.16	679.71	0.000677	7.59	4863.79	385.96	0.3
Brushy_Creek	Reach6	99278.1	18831	653.33	678.97	679.37	0.000866	6.48	5028.42	409.38	0.26
Brushy_Creek	Reach6	99007.13	18827.8	652.41	678.77	679.18	0.000713	6.16	5142.49	437.62	0.24
Brushy_Creek	Reach6	98799.99	18826.8	651.7	678.71	679.08	0.000276	5.6	5939.63	507.5	0.2
Brushy_Creek	Reach6	98734.43	18825.1	652.56	678.68	679.04	0.001194	5.54	4383.16	404.22	0.21
Brushy_Creek	Reach6	98693.35	Bridge								
Brushy_Creek	Reach6	98640.63	18825.1	653.79	677.04	677.4	0.000627	5.38	4409.58	443.12	0.21
Brushy_Creek	Reach6	98620.27	18822.1	653.83	676.97	677.38	0.000526	5.65	4373	418.62	0.22
Brushy_Creek	Reach6	98580.03	Bridge								

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	98528.34	18822.1	653.95	676.12	676.69	0.000562	7.16	4140.26	386.98	0.29
Brushy_Creek	Reach6	98425.21	18818.2	653.74	676.17	676.46	0.00124	4.57	4574.97	467.14	0.19
Brushy_Creek	Reach6	98171.63	18813.1	653.22	675.21	675.92	0.002138	7.67	3620.12	441.12	0.3
Brushy_Creek	Reach6	97837.41	18809.9	652.54	674.71	675.31	0.001537	7.05	4008.27	551.06	0.28
Brushy_Creek	Reach6	97628.63	18806.8	652.12	674.25	674.91	0.002077	7.23	3683.43	560.1	0.3
Brushy_Creek	Reach6	97424	18803.8	651.7	674.07	674.58	0.001041	6.37	4197.25	561.82	0.25
Brushy_Creek	Reach6	97226.66	18803.8	651.3	674.05	674.36	0.000667	4.95	4979.24	584.65	0.21
Brushy_Creek	Reach6	97094.49	26714.3	651.03	673.45	674.17	0.001877	7.4	4774.2	589.39	0.31
Brushy_Creek	Reach6	96690.8	26728.1	650.14	672.97	673.38	0.001687	5.44	5394.79	561.61	0.23
Brushy_Creek	Reach6	96412.28	26743.6	649.57	672.03	672.76	0.002745	7.21	4553.51	465.87	0.3
Brushy_Creek	Reach6	96098.12	26761.8	648.85	670.82	671.72	0.003906	7.84	3921.1	391.39	0.34
Brushy_Creek	Reach6	95730.94	26780.2	648.04	669.46	670.3	0.003656	7.99	4288.95	474.9	0.34
Brushy_Creek	Reach6	95359.27	26802.3	647.23	668.34	669.35	0.001746	10.19	4342.74	471.96	0.42
Brushy_Creek	Reach6	94915.04	26813.4	646.26	666.11	668.18	0.00364	14.84	3861.05	437.44	0.61
Brushy_Creek	Reach6	94690.98	26823.3	645.77	665.66	667.43	0.002458	11.7	3687.73	426.59	0.48
Brushy_Creek	Reach6	94491.27	26832.5	645.33	664.51	666.83	0.00323	15.36	3298.34	392.42	0.66
Brushy_Creek	Reach6	94305.7	26840.1	644.93	664.42	666.18	0.002387	13.43	3743.2	382.71	0.57
Brushy_Creek	Reach6	94152.46	26854.8	644.59	664.06	665.84	0.002248	13.32	3999.07	431.62	0.56
Brushy_Creek	Reach6	93856.71	26854.8	643.94	664.19	665.12	0.001212	9.9	5780.55	540.64	0.41
Brushy_Creek	Reach6	93566.95	30492.6	644.22	663.98	664.67	0.001526	10.1	7343.48	672.72	0.43
Brushy_Creek	Reach6	93234.43	30536.5	642.58	663.95	664.1	0.001097	4.6	11081.74	1183.05	0.2
Brushy_Creek	Reach6	92720.84	30568.5	641.46	663.33	663.71	0.000782	7.82	11088.8	1125.6	0.32
Brushy_Creek	Reach6	92346.28	30602.9	640.64	663.32	663.41	0.000396	3.31	13241.69	1196.03	0.14
Brushy_Creek	Reach6	91944.66	30643.4	639.76	663.17	663.3	0.00022	4.69	13613.92	1165.1	0.19
Brushy_Creek	Reach6	91472.23	30673.8	638.72	662.93	663.14	0.00047	4.94	9363.31	811.12	0.21
Brushy_Creek	Reach6	91117.9	30684.1	637.95	662.81	662.96	0.000489	4.28	10995.56	931.09	0.17
Brushy_Creek	Reach6	90997.39	30718.8	637.77	662.3	662.84	0.000817	7.87	7485.28	819.64	0.31
Brushy_Creek	Reach6	90593.53	30749	637.17	661.73	662.36	0.001884	7.76	5896.94	736.12	0.31
Brushy_Creek	Reach6	90243.1	30778.1	636.64	660.62	661.62	0.002086	9.58	6069.24	824.17	0.39
Brushy_Creek	Reach6	89904.68	30778.1	636.14	660.29	661.03	0.001146	8.43	7505.61	890.16	0.34
Brushy_Creek	Reach6	89548.77	31655.2	635.61	660.03	660.45	0.001788	7.03	8503.53	1046.77	0.29

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	89131.33	31682.9	634.98	658.47	659.55	0.002643	10.23	5673.33	621.9	0.42
Brushy_Creek	Reach6	88743.98	31704.5	634.4	657.43	658.24	0.003442	8.76	5368.73	538.5	0.37
Brushy_Creek	Reach6	88441.7	31734.6	633.95	656.68	657.22	0.003063	6.95	5916.93	585.4	0.31
Brushy_Creek	Reach6	88020.07	31776.6	631.32	656.15	656.69	0.000687	6.71	7233.81	586.89	0.27
Brushy_Creek	Reach6	87433.43	31809.2	630.25	655.27	656.19	0.001186	10.67	7665.68	731.01	0.41
Brushy_Creek	Reach6	86978.64	31842.9	629.44	654.75	655.65	0.001313	8.53	5866.91	537.46	0.36
Brushy_Creek	Reach6	86509.85	31867.2	628.61	654.3	654.82	0.001912	6.78	6652.91	629.75	0.28
Brushy_Creek	Reach6	86171.37	31893.1	628.01	653.72	654.22	0.001647	6.97	7276.13	833.31	0.27
Brushy_Creek	Reach6	85811.05	31915.1	627.37	653.32	653.67	0.001224	5.54	7765.23	881.69	0.21
Brushy_Creek	Reach6	85505.58	31937.3	626.83	652.75	653.24	0.001569	7.29	7095.43	690.27	0.28
Brushy_Creek	Reach6	85196.41	31969.8	626.29	652.28	652.73	0.001836	6.44	7099.95	678.2	0.25
Brushy_Creek	Reach6	84746.2	31997.1	625.03	651.33	651.95	0.001941	7.46	6517.77	717.85	0.29
Brushy_Creek	Reach6	84367.13	31997.1	623.95	650.79	651.25	0.001561	6.83	7865.13	981.84	0.26
Brushy_Creek	Reach6	83920.14	32109	622.67	649.91	650.55	0.001244	8.27	7342.62	776.44	0.3
Brushy_Creek	Reach6	83437.31	32248.8	621.3	649.58	650.02	0.000921	7.13	8361.59	835.93	0.26
Brushy_Creek	Reach6	82836.15	32248.8	619.58	649.35	649.64	0.000471	5.31	8450.24	735.09	0.19
Brushy_Creek	Reach6	82613.31	32248.8	618.94	649.09	649.48	0.00137	5.65	7419.91	855.5	0.22
Brushy_Creek	Reach6	82186.27	38539.1	617.72	648.46	648.91	0.001089	6.82	9108.47	1097.94	0.25
Brushy_Creek	Reach6	81974.84	38525.3	617.05	648.22	648.65	0.001355	6.53	8926.98	1019.77	0.24
Brushy_Creek	Reach6	81662.57	38514.4	616.05	647.96	648.26	0.001109	5.52	10270.68	1098.25	0.21
Brushy_Creek	Reach6	81417.16	38510.8	615.27	647.64	648.06	0.00078	6.58	10479.23	1072.64	0.23
Brushy_Creek	Reach6	81333.91	38504.8	615	647.36	647.94	0.000834	7.79	8620.06	885.16	0.27
Brushy_Creek	Reach6	81281.83	Bridge								
Brushy_Creek	Reach6	81214.17	38504.8	614.7	643.49	645.84	0.001938	14.4	4485.1	302.13	0.52
Brushy_Creek	Reach6	81199.12	38499.5	614.77	644.01	645.23	0.00629	11.07	5247.86	605.92	0.39
Brushy_Creek	Reach6	81078.1	38493.5	615.3	644.34	644.71	0.000392	5.08	9450.7	855.54	0.2
Brushy_Creek	Reach6	81066.96	Bridge								
Brushy_Creek	Reach6	81054.49	38493.5	615.37	644.16	644.6	0.00047	5.91	9814.89	852.09	0.21
Brushy_Creek	Reach6	80942.2	38485.1	615.23	643.91	644.49	0.00079	6.4	7418.25	611.5	0.24
Brushy_Creek	Reach6	80753.14	38474.6	614.98	642.76	644.2	0.001553	12.12	6038.66	586.02	0.43
Brushy_Creek	Reach6	80514.44	38455.2	614.68	642.53	643.83	0.001295	11.72	7020.53	771.97	0.43

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	80076.23	38455.2	614.11	641.17	643.11	0.001996	13.29	5852.96	783.76	0.49
Brushy_Creek	Reach6	79647.8	38522.4	613.56	639.99	642.13	0.002788	13.28	4952.65	535.22	0.52
Brushy_Creek	Reach6	79140.95	38520.9	612.83	639.09	640.78	0.002012	10.45	3752.99	260.53	0.46
Brushy_Creek	Reach6	78942.25	38520	612.44	637.49	640.17	0.003458	13.45	3331.12	301.55	0.58
Brushy_Creek	Reach6	78823.24	38517.6	612.21	638.59	639.37	0.001195	8.62	7736.19	818.85	0.35
Brushy_Creek	Reach6	78520.81	38514.7	611.62	637.93	638.82	0.002917	8.41	5865.27	630.56	0.36
Brushy_Creek	Reach6	78135.55	38510.9	610.87	636.9	637.73	0.0028	8.31	6069.43	636.71	0.35
Brushy_Creek	Reach6	77644.98	38507	609.91	635.74	636.49	0.002344	8.39	6529.02	892.83	0.36
Brushy_Creek	Reach6	77141.85	38502.8	608.93	634.78	635.71	0.001085	9.59	7064.54	787.61	0.37
Brushy_Creek	Reach6	76594.52	38500.7	607.86	633.3	634.83	0.002674	11.93	5063.84	613.8	0.48
Brushy_Creek	Reach6	76325.07	38499	607.34	633.33	634.17	0.001139	8.91	6289.83	679.21	0.37
Brushy_Creek	Reach6	76105.01	38496.8	606.96	632.88	633.88	0.001414	9.86	6328.22	687.39	0.38
Brushy_Creek	Reach6	75811.88	38493.6	606.45	632.81	633.4	0.001122	6.84	6866.27	651.17	0.27
Brushy_Creek	Reach6	75401.27	38493.6	605.74	632.45	633.07	0.00064	7.66	7425.93	671.72	0.3
Brushy_Creek	Reach6	74857.73	42982.5	604.8	631.41	632.51	0.001776	9.61	6711.48	931.91	0.44
Brushy_Creek	Reach6	74406.27	42930.5	604.01	631.05	631.82	0.001006	8.24	8719.67	1176.2	0.35
Brushy_Creek	Reach6	73853.93	42874.2	602.93	630.67	631.21	0.000872	7.29	10441.73	1549.74	0.3
Brushy_Creek	Reach6	73256.2	42874.2	601.75	629.21	630.42	0.001438	10.31	6789.47	1158.03	0.42
Brushy_Creek	Reach6	72956.67	43510.6	601.16	629.07	629.91	0.000778	8.45	8319.38	1125.56	0.33
Brushy_Creek	Reach6	72913.7	Bridge								
Brushy_Creek	Reach6	72897.52	43510.6	601.04	629.12	629.66	0.000489	6.24	9158.79	1173.19	0.25
Brushy_Creek	Reach6	72833.16	43509.9	600.94	629.15	629.58	0.000374	6.03	12326.17	1733.36	0.24
Brushy_Creek	Reach6	72800.48	43507.2	600.9	629.05	629.54	0.000493	6.74	11272.5	1689.77	0.26
Brushy_Creek	Reach6	72782.48	Bridge								
Brushy_Creek	Reach6	72768.4	43507.2	600.85	628.81	629.33	0.000448	6.94	11164.02	1634.2	0.25
Brushy_Creek	Reach6	72666.93	43506.7	601.51	628.01	629.1	0.001717	10.27	7699.53	1328.05	0.42
Brushy_Creek	Reach6	72643.56	43505.8	601.68	627.89	629.04	0.001702	10.76	7649.23	1310.09	0.43
Brushy_Creek	Reach6	72636.07	Bridge								
Brushy_Creek	Reach6	72624.68	43505.8	601.82	626.62	628.42	0.002558	12.89	6124.05	1136.83	0.52
Brushy_Creek	Reach6	72602.3	43501.8	601.7	626.13	628.26	0.003128	13.66	5527.02	1066.95	0.57
Brushy_Creek	Reach6	72403.97	43483.3	600.42	626.03	627.48	0.001906	12.01	7976.69	1365.27	0.5

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	71509.27	43468.2	598.78	625.03	626.22	0.001013	9.89	7476.62	745.59	0.37
Brushy_Creek	Reach6	70774.6	43468.2	597.44	624.72	625.34	0.000969	8.25	12639.45	2871.71	0.35
Brushy_Creek	Reach6	70424.41	44140.5	596.81	624.28	625.02	0.000747	8.64	11706.31	2310.54	0.33
Brushy_Creek	Reach6	69949.41	44123.6	595.94	624.26	624.57	0.000741	6.5	13454.56	2354.29	0.25
Brushy_Creek	Reach6	69385.34	44107	594.91	623.99	624.2	0.000843	4.65	13195.62	1928.04	0.18
Brushy_Creek	Reach6	68828.12	44089.2	593.89	623.4	623.7	0.001089	6.27	12533.17	2403.78	0.23
Brushy_Creek	Reach6	68233.93	44074.2	592.81	621.39	622.7	0.002617	11.42	7288.03	1891.87	0.42
Brushy_Creek	Reach6	67729.48	44430.4	591.89	620.1	621.1	0.0037	9.15	6775.65	1986.8	0.37
Brushy_Creek	Reach6	67278.64	44409.9	591.07	619.41	619.97	0.001497	7.59	8415.1	2127.05	0.28
Brushy_Creek	Reach6	67158.77	44383.7	590.85	619.29	619.86	0.000679	8.31	9980.13	1305.63	0.3
Brushy_Creek	Reach6	67115.92	Bridge								
Brushy_Creek	Reach6	67065.58	44383.7	590.69	619.32	619.69	0.000546	5.68	10570.48	1145.93	0.22
Brushy_Creek	Reach6	67005.67	44374.1	590.65	619.21	619.65	0.00033	5.99	10512.48	1304.38	0.22
Brushy_Creek	Reach6	66949.63	44367.2	590.62	619.05	619.6	0.000486	7.15	10060.64	1309.01	0.27
Brushy_Creek	Reach6	66909.19	44328	590.59	619	619.57	0.000671	7.31	9298.62	1160.27	0.29
Brushy_Creek	Reach6	66866.67	Bridge								
Brushy_Creek	Reach6	66828.33	44328	590.55	618.97	619.4	0.000337	6.13	11368.8	1308.53	0.23
Brushy_Creek	Reach6	66680.07	44294.1	590.57	618.84	619.32	0.000617	7	10035.47	1303.66	0.26
Brushy_Creek	Reach6	66481.97	44294.1	590.61	618.82	619.07	0.00074	5.08	12174.38	1510.06	0.2
Brushy_Creek	Reach6	66059.94	44739.7	590.69	617.96	618.58	0.001806	6.82	7807.42	1421.41	0.3
Brushy_Creek	Reach6	65312.87	44694.8	589.33	616.23	617.17	0.001954	9.91	7358.59	1468.7	0.35
Brushy_Creek	Reach6	64523.82	44685.5	587.89	615.54	615.94	0.000814	6.92	12704.22	1349.69	0.25
Brushy_Creek	Reach6	64497.57	Bridge								
Brushy_Creek	Reach6	64460.12	44685.5	587.7	615.51	615.78	0.000757	5.26	13447.42	1457.69	0.19
Brushy_Creek	Reach6	64361.15	44677.1	587.18	615.25	615.66	0.00099	7.04	12303.72	1857.52	0.26
Brushy_Creek	Reach6	64213.45	44666	586.34	615.23	615.42	0.000703	4.56	14974.4	2048.11	0.17
Brushy_Creek	Reach6	64017.54	44666	585.21	615.09	615.27	0.000966	4.23	13561.91	1601.46	0.15
Brushy_Creek	Reach6	63983.72	Bridge								
Brushy_Creek	Reach6	63947.36	44666	584.81	614.35	614.99	0.000519	8.49	12313.05	1535.27	0.29
Brushy_Creek	Reach6	63801.45	46858.7	584.57	614.26	614.89	0.000742	8.33	12669.45	2194.03	0.32
Brushy_Creek	Reach6	63455.27	46804.3	584.01	614.35	614.48	0.000328	3.78	16877.57	1778.19	0.13

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	62977.8	46738.5	583.25	613.84	614.19	0.000995	6.14	10940.72	1273.29	0.21
Brushy_Creek	Reach6	62398.66	46697.1	582.32	612.74	613.51	0.001285	8.39	7564.29	927.7	0.3
Brushy_Creek	Reach6	62034.09	46697.1	581.73	612.4	612.92	0.001683	6.66	8539.36	953.4	0.26
Brushy_Creek	Reach6	61419.61	46923.2	580.77	611.38	612.15	0.001077	8.28	9337.88	979.86	0.32
Brushy_Creek	Reach6	61373.07	46929	580.89	611.13	612.04	0.001274	9.55	9075.53	955.58	0.35
Brushy_Creek	Reach6	61353.38	Bridge								
Brushy_Creek	Reach6	61330	46929	580.93	610.39	611.6	0.001768	10.76	8413.97	822.29	0.4
Brushy_Creek	Reach6	61144.86	46941	580.65	610.25	611.11	0.002243	9.65	8914.24	842.96	0.34
Brushy_Creek	Reach6	60670.62	46955.4	579.92	609.43	610.19	0.002169	10.03	9801.83	1447.05	0.37
Brushy_Creek	Reach6	60103.3	47726.4	579.05	608.3	609.03	0.002032	8.87	9913.37	1897.16	0.35
Brushy_Creek	Reach6	59554.96	47725.1	578.21	607.44	608.11	0.001199	7.86	9973.04	1830.3	0.28
Brushy_Creek	Reach6	58973.82	47723.5	577.31	606.97	607.33	0.001269	6.45	11926.36	2108.29	0.24
Brushy_Creek	Reach6	58202.02	47721.9	576.7	605.35	605.99	0.002412	8.5	10045.14	2311.38	0.32
Brushy_Creek	Reach6	57481.5	47720.2	576.14	603.85	604.77	0.0012	10.05	10328.12	2498.73	0.36
Brushy_Creek	Reach6	56680.07	47718.9	575.51	603.36	603.93	0.001007	7.77	11210.74	2639.73	0.32
Brushy_Creek	Reach6	56073.23	47717.6	575.03	603.09	603.31	0.000908	4.56	13168.62	2717.77	0.18
Brushy_Creek	Reach6	55464.06	47716.1	574.55	602.76	602.97	0.000629	4.74	14449.39	2652.28	0.18
Brushy_Creek	Reach6	54804.77	47714.1	572.55	602.15	602.5	0.001011	5.83	11233.67	2030.91	0.2
Brushy_Creek	Reach6	53864.41	47712.5	569.6	600.73	601.26	0.001832	6.7	9093.04	1088.14	0.26
Brushy_Creek	Reach6	53098.2	47712.5	567.2	599.03	599.69	0.002561	7.78	9029.93	2036.03	0.29
Brushy_Creek	Reach6	52619.79	47931.1	566.24	598.66	598.88	0.000946	4.41	13445.02	1621.55	0.17
Brushy_Creek	Reach6	52059.73	49668.7	565.11	598.05	598.41	0.000998	5.14	10568.51	958.76	0.19
Brushy_Creek	Reach6	51997.41	Bridge								
Brushy_Creek	Reach6	51932.36	49668.7	564.89	594.98	595.72	0.002857	7.37	7294.48	838.22	0.29
Brushy_Creek	Reach6	51245.77	50237.6	564.2	593.45	594.41	0.001149	9.65	8046.24	1059.74	0.37
Brushy_Creek	Reach6	50985.45	51492.6	563.93	593.27	593.79	0.00147	6.93	9214.18	1224.29	0.26
Brushy_Creek	Reach6	50421.43	52794	563.36	591.93	592.85	0.002095	9.31	8149.08	1188.22	0.34
Brushy_Creek	Reach6	49850.91	52794	562.78	590.72	591.81	0.001847	10.05	7515.17	1043.09	0.36
Brushy_Creek	Reach6	48875.23	48081.1	560.44	588.4	590.32	0.001198	11.85	6765.3	901.69	0.42
Brushy_Creek	Reach6	48121.9	48098.6	558.64	587.51	588.69	0.003555	10.21	6911.95	1181.52	0.41
Brushy_Creek	Reach6	47633.98	48115.9	557.47	587.16	587.71	0.000992	6.14	9387.9	1806.35	0.24

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	47154.27	48136.9	556.32	586.38	587.02	0.002261	7.43	9524.56	2075.89	0.29
Brushy_Creek	Reach6	46569.05	48158.2	554.92	584.88	585.66	0.002123	8.47	8488.05	1594.33	0.32
Brushy_Creek	Reach6	45976.66	48283.2	553.89	583.1	584.41	0.002752	11.05	8392.86	1704.18	0.41
Brushy_Creek	Reach6	44556.04	48270.3	551.42	580.58	581.37	0.001624	8.67	10287.41	2819.6	0.32
Brushy_Creek	Reach6	44008.3	48248.3	550.46	579.95	580.4	0.001513	6.76	12446.55	3355.04	0.26
Brushy_Creek	Reach6	43074.42	48214.9	549.06	578.73	579.04	0.001469	5.9	12896.84	3459.4	0.25
Brushy_Creek	Reach6	41656.13	48200.2	546.92	575.56	576.5	0.002322	9.65	9734.57	2773.96	0.37
Brushy_Creek	Reach6	41032.07	48174.9	545.98	573.44	574.95	0.002505	11.96	8318.58	2886.61	0.45
Brushy_Creek	Reach6	39957.86	48147.6	544.15	571.44	572.02	0.001098	8.75	11721.38	2734.86	0.37
Brushy_Creek	Reach6	38797.2	48114.6	542.18	570.83	571.06	0.000746	5.18	15676.8	2407.15	0.21
Brushy_Creek	Reach6	37391.76	48084.5	539.8	569.78	570.04	0.000952	5.3	14208.21	2835.1	0.21
Brushy_Creek	Reach6	36110.91	48084.5	538.4	568.33	568.57	0.001627	5.33	14288.02	2281.79	0.23
Brushy_Creek	Reach6	34718.59	48084.5	536.88	567.07	567.23	0.000653	4.44	17065.94	2594.82	0.17
Brushy_Creek	Reach6	33981.24	48084.5	535.76	566.44	566.74	0.000997	6.08	13902	2322.67	0.24
Brushy_Creek	Reach6	32822.66	55354.5	533.75	565.06	565.61	0.000967	7.98	12717.08	2476.17	0.31
Brushy_Creek	Reach6	31915.64	55294	532.18	562.58	564.46	0.001908	13.97	8946.92	1976.75	0.49
Brushy_Creek	Reach6	31272.02	55194.5	531.06	562.96	563.22	0.000587	5.56	16095.92	2441.5	0.21
Brushy_Creek	Reach6	30213.66	55194.5	529.23	562.31	562.61	0.00069	5.97	16560.34	2595.6	0.21
Brushy_Creek	Reach6	30185.61	Bridge								
Brushy_Creek	Reach6	30152.86	55194.5	529.13	559.33	560.21	0.001345	8.73	11613.12	2283.99	0.3
Brushy_Creek	Reach6	29305.06	56215.8	528.28	558.54	558.88	0.001246	6.41	15751.59	2934.11	0.23
Brushy_Creek	Reach6	28326.17	55987.5	527.3	557.23	557.79	0.001559	8.42	13678.26	2937.81	0.31
Brushy_Creek	Reach6	27136.17	55987.5	526.11	555.03	555.73	0.002163	8.35	10827.72	2377.47	0.3
Brushy_Creek	Reach6	25621.11	55987.5	524.59	551.63	552.45	0.002373	10.78	10186.16	2436.26	0.48
Brushy_Creek	Reach6	24169.37	55832.7	523.14	549.73	550.11	0.001363	6.14	12864	2744.07	0.24
Brushy_Creek	Reach6	23166.58	55820.4	522.13	548.54	548.9	0.001113	7.43	14158.47	2850.33	0.29
Brushy_Creek	Reach6	21690.49	55802.9	520.65	546.79	547.36	0.002228	8.76	12751.06	3291.12	0.38
Brushy_Creek	Reach6	19586.49	55791.4	518.55	544.19	544.68	0.001337	8.06	14760.4	3581.85	0.32
Brushy_Creek	Reach6	18205.87	55760.6	517.16	542.96	543.18	0.001252	5.11	16479.18	3901.03	0.22
Brushy_Creek	Reach6	14497.62	55747.6	513.45	540.38	540.54	0.000899	4.88	19622.04	3076.1	0.2
Brushy_Creek	Reach6	12928.72	55736.5	511.87	539.99	540.06	0.000183	3.82	33267.5	4019.04	0.15

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Creek	Reach6	11599.98	55722.1	510.54	539.92	539.96	0.000099	1.9	38780.31	4940.11	0.07
Brushy_Creek	Reach6	9858.581	55719.2	508.8	539.89	539.91	0.000056	2.13	48810.52	5378.53	0.08
Brushy_Creek	Reach6	9513.753	55709.4	508.45	539.88	539.9	0.000055	1.76	48422.8	4834.88	0.06
Brushy_Creek	Reach6	8333.75	55707.3	507.27	539.85	539.87	0.000056	2.07	46238.52	4660.55	0.08
Brushy_Creek	Reach6	8083.79	55460	507.02	538.87	539.62	0.001147	8.57	9178.89	4482.74	0.31
Brushy_Creek	Reach6	8051.512	Bridge								
Brushy_Creek	Reach6	8022.034	55460	509.93	538.31	538.39	0.000212	3.51	27643.71	3799.92	0.12
Brushy_Creek	Reach6	6902.85	54567.7	510.24	532.51	536.69	0.022017	18.44	3801.57	4628.58	0.9
Brushy_Creek	Reach6	2822.852	54217.5	506.93	532.84	533.21	0.0015	7.75	14905.61	4221.46	0.31
Brushy_Creek	Reach6	1203.396	53990.5	505.91	528.66	530.84	0.002879	14.89	8460.19	3344.96	0.63
Brushy_Creek	Reach6	148.167	53990.5	503.69	523.98	525.19	0.002003	11.6	6931.97	2355.7	0.52
Brushy_Ck_Trib4A	Reach1	1181.43	934.25	902.23	906.09	906.33	0.015429	4.34	248.36	134.82	0.47
Brushy_Ck_Trib4A	Reach1	767.8296	1471.5	897.04	900.73	900.92	0.012055	4.13	441.91	231.12	0.43
Brushy_Ck_Trib4A	Reach1	436.2723	1471.5	892.39	900.68	900.68	0.000173	0.77	1975.06	417.34	0.06
Brushy_Ck_Trib4	Reach3	4348.605	528.9	871.02	877.31	877.43	0.006996	2.8	189.13	84.12	0.31
Brushy_Ck_Trib4	Reach3	4177.357	528.9	869.72	876.18	876.34	0.00591	3.33	186.74	112.42	0.3
Brushy_Ck_Trib4	Reach3	3909.75	528.9	867.68	874.17	874.38	0.009295	3.71	142.55	45.65	0.37
Brushy_Ck_Trib4	Reach3	3692.054	528.9	866.02	872.33	872.51	0.007912	3.4	155.7	51.06	0.34
Brushy_Ck_Trib4	Reach3	3460.37	528.9	864.25	870.78	870.93	0.005849	3.03	175.03	57.71	0.3
Brushy_Ck_Trib4	Reach3	3214.177	528.9	862.38	869.06	869.3	0.007273	3.9	135.68	246.73	0.34
Brushy_Ck_Trib4	Reach3	3176.277	Culvert								
Brushy_Ck_Trib4	Reach3	3141.983	528.9	861.83	868	868.34	0.010405	4.76	115.4	62.57	0.54
Brushy_Ck_Trib4	Reach3	2790.749	528.9	859.15	863.93	864.39	0.012526	5.44	97.26	38.96	0.61
Brushy_Ck_Trib4	Reach3	2554.501	528.9	857.35	862.48	862.65	0.004233	3.33	163.91	76.68	0.36
Brushy_Ck_Trib4	Reach3	2304.929	528.9	855.45	860.23	860.79	0.015467	6.01	88.04	34.84	0.67
Brushy_Ck_Trib4	Reach3	1954.297	528.9	852.77	857.93	858.12	0.004228	3.52	150.38	51.72	0.36
Brushy_Ck_Trib4	Reach3	1745.75	528.9	851.19	856.8	857.07	0.006051	4.29	140.99	91.91	0.43
Brushy_Ck_Trib4	Reach3	1452.11	528.9	848.95	853.77	854.32	0.016054	5.94	89.11	37.4	0.68
Brushy_Ck_Trib4	Reach3	1250.859	528.9	847.39	852.38	852.56	0.004944	3.35	157.8	66.24	0.38
Brushy_Ck_Trib4	Reach3	1032.676	528.9	845.18	851.17	851.36	0.006151	3.47	152.51	71.07	0.42
Brushy_Ck_Trib4	Reach3	618.8967	528.9	840.98	848.05	848.31	0.008906	4.14	128.24	71.26	0.49

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Ck_Trib4	Reach3	410.9243	528.9	838.86	847.88	847.93	0.000621	1.9	340.79	124.47	0.15
Brushy_Ck_Trib4	Reach3	245.856	528.9	837.19	847.89	847.89	0.000067	0.73	746.98	177.18	0.05
Brushy_Ck_Trib4	Reach1	10055.55	528.9	937.51	941.57	942.05	0.024525	5.57	95	34.33	0.59
Brushy_Ck_Trib4	Reach1	9662.981	528.9	931.62	935.35	935.57	0.011624	3.71	142.7	55.92	0.41
Brushy_Ck_Trib4	Reach1	9145.785	528.9	925.95	928.25	928.4	0.016744	3.15	167.72	111.24	0.45
Brushy_Ck_Trib4	Reach1	8599.661	528.9	918.77	920.4	920.46	0.01283	2.15	259.65	287.86	0.37
Brushy_Ck_Trib4	Reach1	8111.514	528.9	911.76	914.69	914.83	0.011332	3.23	192.76	138.61	0.39
Brushy_Ck_Trib4	Reach1	7672.969	528.9	907.23	909.69	909.77	0.012148	2.66	232.46	207.28	0.38
Brushy_Ck_Trib4	Reach1	7287.54	528.9	903.04	905.95	906.04	0.008879	2.77	241.28	198.24	0.34
Brushy_Ck_Trib4	Reach1	7014.853	528.9	900.27	902.67	902.79	0.018531	3.73	204.54	214.17	0.49
Brushy_Ck_Trib4	Reach1	6764.029	528.9	897.24	901.16	901.19	0.00334	1.89	393.1	297.04	0.22
Brushy_Ck_Trib4	Reach1	6734.456	Culvert								
Brushy_Ck_Trib4	Reach1	6694.651	528.9	896.13	900.73	900.73	0.000485	0.79	776.41	396.94	0.08
Brushy_Ck_Trib4	Reach1	6419.208	528.9	892.61	900.69	900.7	0.000067	0.41	1368.05	372.78	0.03
Brushy_Ck_Trib4	Reach1	6105.761	528.9	889.46	900.69	900.69	0.00001	0.21	2740.27	523.85	0.01
Brushy_Ck_Trib4	Reach1	5984.269	528.9	888.66	900.68	900.69	0.000004	0.15	3842.77	607.56	0.01
Brushy_Ck_Trib4	Reach2	5561.687	53990.5	886.49	898.93	900.53	0.016324	10.9	5371.64	624.43	0.61
Brushy_Ck_Trib4	Reach2	5293.457	53990.5	878.04	897.57	898.43	0.004698	7.76	7577.36	624.59	0.35
Brushy_Ck_Trib4	Reach2	4979.471	53990.5	874.16	896.9	897.44	0.002001	6.11	9758.47	682.22	0.24
Brushy_Ck_Trib3	Reach1	2376.021	451.06	884.81	887.04	887.44	0.071798	5.43	89.54	80.49	0.85
Brushy_Ck_Trib3	Reach1	2137.172	460.27	878.45	883.36	883.53	0.008342	3.37	136.43	42.83	0.33
Brushy_Ck_Trib3	Reach1	1917.419	471.47	875.21	879.67	880.23	0.03264	6.04	78.09	27.74	0.63
Brushy_Ck_Trib3	Reach1	1655.857	482.93	869.97	876.34	876.49	0.007707	3.05	158.55	55.07	0.32
Brushy_Ck_Trib3	Reach1	1394.914	491.75	867.5	874	874.2	0.00998	3.58	137.3	44.16	0.36
Brushy_Ck_Trib3	Reach1	1198.067	507.27	865.87	868.78	869.6	0.093592	7.24	70.06	43.96	1.01
Brushy_Ck_Trib3	Reach1	860.2894	517.28	858.69	864	864.12	0.005258	2.86	197.29	70.7	0.27
Brushy_Ck_Trib3	Reach1	647.7759	524.97	856.25	861.96	862.28	0.016819	4.51	116.44	39.46	0.46
Brushy_Ck_Trib3	Reach1	487.3946	528.9	854.67	859.73	860	0.01198	4.18	126.44	41.32	0.42
Brushy_Ck_Trib3	Reach1	406.2728	528.9	852.97	858.61	858.94	0.014326	4.56	115.89	36.69	0.45
Brushy_Ck_Trib2	Reach1	2339.762	721.11	891.76	894.3	894.93	0.041358	7.57	125.13	102.87	0.92
Brushy_Ck_Trib2	Reach1	2034.981	761.06	886.13	889.97	890.23	0.00734	4.26	198.21	85.39	0.42

Table N-2. Summary Output - Brushy Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Ck_Trib2	Reach1	1612.507	799.88	880.86	886.67	886.89	0.008172	4.25	248.27	167.69	0.43
Brushy_Ck_Trib2	Reach1	1222.715	841.14	879.36	881.62	881.95	0.024225	4.48	182.31	262.13	0.66
Brushy_Ck_Trib2	Reach1	828.6903	896.1	875.97	877.71	877.8	0.005686	1.85	375.88	558.71	0.31
Brushy_Ck_Trib2	Reach1	332.7465	896.1	871.69	873.6	873.84	0.01605	6.21	262.48	491.5	0.87
Brushy_Ck_Trib1	Reach1	3441.134	656.66	916.73	920.05	920.37	0.012098	4.98	167.48	149.46	0.59
Brushy_Ck_Trib1	Reach1	3240.246	675.89	914.95	918.09	918.18	0.007167	3.14	314.09	424.91	0.43
Brushy_Ck_Trib1	Reach1	2899.066	700.19	911	914.57	914.85	0.014956	5.26	197.64	217.46	0.65
Brushy_Ck_Trib1	Reach1	2481.451	727.1	905.96	911.04	911.23	0.005833	4.19	253.49	216.53	0.43
Brushy_Ck_Trib1	Reach1	2035.791	750.65	901.27	906.57	907.22	0.016646	7.03	155.94	211.22	0.71
Brushy_Ck_Trib1	Reach1	1658.944	775.74	898.58	902.6	902.91	0.007983	5.19	217.05	174.06	0.51
Brushy_Ck_Trib1	Reach1	1270.313	791.12	892.97	898.43	898.89	0.014484	6.51	193.37	204.04	0.64
Brushy_Ck_Trib1	Reach1	1038.372	816.6	888.49	892.5	893.89	0.034504	9.45	86.4	31.61	1.01
Brushy_Ck_Trib1	Reach1	663.5534	835.45	885.72	891.49	891.61	0.001226	2.81	299.5	179.5	0.22
Brushy_Ck_Trib1	Reach1	624.3975	Culvert								
Brushy_Ck_Trib1	Reach1	598.8764	835.45	885.59	889.73	890.29	0.010483	6.24	145.23	50.29	0.59
Brushy_Ck_Trib1	Reach1	393.8401	842.31	883.58	889.82	889.85	0.000296	1.45	672.68	216.59	0.11
Brushy_Ck_Trib1	Reach1	297.2617	852.5	882.48	889.79	889.81	0.00032	1.68	759.51	230.76	0.12
Brushy_Ck_Trib1	Reach1	276.1519	Culvert								
Brushy_Ck_Trib1	Reach1	259.2716	852.5	880.36	889.77	889.8	0.000275	1.7	792.02	251.87	0.1
Brushy_Ck_Trib1	Reach1	155.0662	852.5	880.14	889.76	889.78	0.000204	1.5	801.95	242.1	0.09

Table N-3. Summary Output - Brushy Creek Tributary 5 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Trib5A	Reach1	4012.25	213.5	721.86	723.49	723.75	0.072384	4.59	57.47	90.05	0.79
Brushy_Trib5A	Reach1	3735.801	232.52	714.32	716.72	716.84	0.013726	2.95	88.99	64.21	0.38
Brushy_Trib5A	Reach1	3555.303	244.49	712.22	714.23	714.32	0.012868	2.64	104.06	99.47	0.36
Brushy_Trib5A	Reach1	3449.076	252.17	707.06	710.52	711.29	0.107912	7.02	35.91	30.28	1
Brushy_Trib5A	Reach1	3383.708	287.7	704.27	709.99	710.03	0.001587	1.88	193.6	119.77	0.15
Brushy_Trib5A	Reach1	3306.07	Culvert								
Brushy_Trib5A	Reach1	3225.014	287.7	701.67	704.34	704.9	0.022537	6.03	47.68	37.54	0.77
Brushy_Trib5A	Reach1	3104.849	306.24	698.34	702.18	702.49	0.016888	4.71	72.32	47.58	0.54
Brushy_Trib5A	Reach1	2972.735	382.36	697.7	700.51	700.77	0.011826	3.87	99.19	61.52	0.46
Brushy_Trib5A	Reach1	2503.2	459.65	690.3	693.63	693.97	0.019555	4.91	108.94	89.52	0.59
Brushy_Trib5A	Reach1	2113.743	558.13	680.14	683.07	683.64	0.03892	6.54	93.75	72.62	0.82
Brushy_Trib5A	Reach1	1703.109	613.57	671.22	674.88	675.79	0.011853	8.17	84.37	48.04	0.93
Brushy_Trib5A	Reach1	1502.809	700.8	667.48	671.6	672.51	0.008899	8.12	103.4	61.87	0.83
Brushy_Trib5A	Reach1	1221.642	723.17	662.33	671.52	671.54	0.000561	1.5	667.09	158.81	0.09
Brushy_Trib5A	Reach1	1155.156	778.87	662.19	671.49	671.51	0.000379	1.2	787.25	210.19	0.08
Brushy_Trib5A	Reach1	1108.262	Culvert								
Brushy_Trib5A	Reach1	1057.044	778.87	660.73	664.92	665.9	0.035013	7.95	97.95	116.67	0.69
Brushy_Trib5A	Reach1	998.2261	778.87	660.93	663.72	664.04	0.020038	4.5	173.07	210.48	0.49
Brushy_Trib5	Reach2	9286.27	1724.58	678.27	685.59	686.06	0.015332	6.59	355.96	113.63	0.48
Brushy_Trib5	Reach2	9059	1802.21	678.07	681.36	682.59	0.015716	9.9	208.69	86.4	0.99
Brushy_Trib5	Reach2	8880.04	1866.87	673.49	679.86	680.54	0.003922	7.6	305.1	78.63	0.55
Brushy_Trib5	Reach2	8736.76	1929.77	670.7	679.05	679.59	0.010962	6.1	327.59	90.55	0.41
Brushy_Trib5	Reach2	8697.26	Culvert								
Brushy_Trib5	Reach2	8646.09	1929.77	670.49	678.52	679.04	0.010149	6.1	332.01	92.92	0.4
Brushy_Trib5	Reach2	8602.08	1987.58	670.37	676.46	678.22	0.009862	11.61	204.91	57.98	0.86
Brushy_Trib5	Reach2	8482.1	2082.61	667.52	675.91	676.52	0.002367	6.89	367.13	76.08	0.44
Brushy_Trib5	Reach2	8292.27	2230.4	664.59	675.18	675.67	0.008973	6.41	451.6	96	0.37
Brushy_Trib5	Reach2	8013.6	2419.65	661.95	672.03	672.65	0.013392	7.02	421.61	134.7	0.45
Brushy_Trib5	Reach2	7682.58	2543.04	659.48	667.8	668.27	0.012803	6.43	512.64	193.39	0.42
Brushy_Trib5	Reach2	7480.42	2543.04	658.82	666.06	666.34	0.008611	4.88	622.78	207.12	0.34
Brushy_Trib5	Reach1	5378.235	335.75	640.22	644.31	644.38	0.000979	2.16	167.44	496.1	0.26

Table N-3. Summary Output - Brushy Creek Tributary 5 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy_Trib5	Reach1	5065.965	359.33	638.08	642.28	643.23	0.094089	7.85	45.75	744.98	1
Brushy_Trib5	Reach1	4669.75	396.43	636.48	638.98	639.79	0.092477	7.19	55.13	1085.32	1
Brushy_Trib5	Reach1	4096.082	410.11	634.19	635.82	635.99	0.013709	1.99	130.79	1079.93	0.36
Brushy_Trib5	Reach1	3898.063	429.94	633.39	635.33	635.37	0.001651	0.67	292.77	863.94	0.12
Brushy_Trib5	Reach1	3622.451	433.05	632.28	634.49	634.5	0.000732	0.6	475.18	555.28	0.09
Brushy_Trib5	Reach1	3580.466	440.36	631.83	634.46	634.47	0.000279	0.34	643.73	614.14	0.05
Brushy_Trib5	Reach1	3568.034	Culvert								
Brushy_Trib5	Reach1	3553.146	440.36	631.37	633.73	633.75	0.001344	0.85	369.09	540.62	0.14
Brushy_Trib5	Reach1	3482.676	454.19	631.24	632.8	632.85	0.004195	1.22	246.17	374.15	0.23
Brushy_Trib5	Reach1	3066.519	464.18	626.6	631.48	631.76	0.004854	4.41	130.28	154.69	0.56
Brushy_Trib5	Reach1	2953.835	496.44	625.01	630.09	630.2	0.006375	3.26	199.81	241.55	0.33
Brushy_Trib5	Reach1	2606.048	542.13	624.03	628.54	628.61	0.00356	2.25	261.37	189.52	0.26
Brushy_Trib5	Reach1	2150.168	569.12	621.57	627.03	627.1	0.003496	2.27	275.86	232.86	0.25
Brushy_Trib5	Reach1	1898.694	617.74	620.56	626.13	626.22	0.004076	2.52	272.85	256.26	0.28
Brushy_Trib5	Reach1	1474.322	617.74	617.56	624.16	624.36	0.005001	3.56	173.56	45.34	0.32

Table N-4. Summary Output - Brushy Creek Tributary 6 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
BrushyCreek Trib6	Reach1	1501.835	1603.46	636.1	640.22	640.7	0.011004	9.49	483.98	311.92	0.93
BrushyCreek Trib6	Reach1	1290.403	1610.61	627.52	632.12	633.44	0.010445	10.75	189.04	75.94	0.95
BrushyCreek Trib6	Reach1	1176.697	1627.62	625.44	630.07	631.33	0.001843	8.99	181.03	72.34	1
BrushyCreek Trib6	Reach1	908.6069	1642.01	623.47	626.42	627.57	0.013601	8.62	190.55	82.42	1
BrushyCreek Trib6	Reach1	683.889	1665	617.43	622.46	622.96	0.011226	6.5	301.24	80.19	0.52
BrushyCreek Trib6	Reach1	329.0169	1665	609.75	616.21	617.53	0.023003	10.24	194.21	48.22	0.75

Table N-5. Summary Output - Brushy Creek Tributary 7 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy Creek Trib 7	Reach1	12784.34	1179.49	670.86	676.11	676.56	0.006657	6.62	260.49	147.56	0.59
Brushy Creek Trib 7	Reach1	12253.35	1259.64	668.08	672.75	673.1	0.005882	6.33	321.95	210.11	0.56
Brushy Creek Trib 7	Reach1	11731.76	1333.71	664.16	669.73	670.29	0.005557	7.1	281.45	151.9	0.56
Brushy Creek Trib 7	Reach1	11278.42	1433.5	662.05	666.6	667.12	0.009544	7.56	272.97	144.86	0.7
Brushy Creek Trib 7	Reach1	10705.97	1504.11	658.57	663.57	663.97	0.00385	5.86	328.05	112.03	0.47
Brushy Creek Trib 7	Reach1	10324.45	1597.24	656.56	662.46	662.77	0.002503	5.23	423.16	177.97	0.39
Brushy Creek Trib 7	Reach1	9847.841	1738.09	654.8	660.48	661.01	0.005577	7.49	358.42	206.06	0.57
Brushy Creek Trib 7	Reach1	9177.315	1866.68	651.51	656.15	656.94	0.008526	8.15	266.96	310.09	0.69
Brushy Creek Trib 7	Reach1	8611.051	2000.98	649.14	653.21	653.58	0.004601	6.74	495.04	355.66	0.63
Brushy Creek Trib 7	Reach1	8059.833	2156.1	646.29	650.33	650.85	0.00573	7.55	488.41	412.21	0.7
Brushy Creek Trib 7	Reach1	7467.442	2265.15	643.67	648.22	648.31	0.001196	3.3	921.67	525.66	0.31
Brushy Creek Trib 7	Reach1	7075.973	2301.72	641.26	648.05	648.11	0.000326	2.47	1188.2	781.02	0.18
Brushy Creek Trib 7	Reach1	6948.898	3080.49	637.77	648.05	648.07	0.000087	1.63	2668.31	925.3	0.1
Brushy Creek Trib 7	Reach1	6904.174	Bridge								
Brushy Creek Trib 7	Reach1	6856.055	3080.49	636.91	646.72	646.99	0.000676	4.14	763.65	128.71	0.27
Brushy Creek Trib 7	Reach1	6824.528	3081.24	636.78	646.79	646.9	0.000351	2.78	1371.29	503.28	0.19
Brushy Creek Trib 7	Reach1	6803.594	3084.89	636.7	646.72	646.88	0.000375	3.42	1196.39	399.43	0.21
Brushy Creek Trib 7	Reach1	6764.049	Bridge								
Brushy Creek Trib 7	Reach1	6719.181	3084.89	636.26	646.09	646.32	0.000569	3.94	835.43	1215.52	0.25
Brushy Creek Trib 7	Reach1	6702.052	3085.45	635.8	646.01	646.29	0.000759	4.59	745.82	685.28	0.29
Brushy Creek Trib 7	Reach1	6686.317	3093.82	635.37	645.77	646.22	0.001106	5.85	593.68	623.06	0.35
Brushy Creek Trib 7	Reach1	6669.856	Bridge								
Brushy Creek Trib 7	Reach1	6630.258	3093.82	634.31	642.81	643.84	0.004093	10.02	510.6	350.62	0.66
Brushy Creek Trib 7	Reach1	6453.604	3103.71	633.16	641.56	642.21	0.016512	8.38	557.86	427.82	0.58
Brushy Creek Trib 7	Reach1	6179.431	3113.14	631.37	640.02	640.21	0.004002	4.06	955.38	434.25	0.29
Brushy Creek Trib 7	Reach1	5918.538	3127.36	629.68	638.52	638.8	0.007088	5.44	843.58	460.79	0.39
Brushy Creek Trib 7	Reach1	5527.056	3141.02	627.13	636.06	636.34	0.006128	5.59	840.38	367.8	0.37
Brushy Creek Trib 7	Reach1	5152.398	3150.48	624.69	633.57	633.97	0.008968	6.48	736.57	339.56	0.44
Brushy Creek Trib 7	Reach1	4894.036	3165.56	623	631.81	632.04	0.005529	4.99	864.83	388.9	0.33
Brushy Creek Trib 7	Reach1	4483.715	3179.5	620.33	627.67	628.39	0.016007	8.15	497.41	195.28	0.58

Table N-5. Summary Output - Brushy Creek Tributary 7 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy Creek Trib 7	Reach1	4106.068	3190.62	617.87	625.06	625.35	0.004785	4.62	786.44	257.19	0.32
Brushy Creek Trib 7	Reach1	3806.064	3207.17	615.04	623.5	623.84	0.005769	5.3	715.09	238.15	0.36
Brushy Creek Trib 7	Reach1	3361.552	3220.61	611.87	620.36	620.87	0.008107	6.09	613.65	180.68	0.42
Brushy Creek Trib 7	Reach1	3002.268	3231.03	609.29	618.08	618.48	0.005921	5.53	671.15	204.86	0.37
Brushy Creek Trib 7	Reach1	2724.494	3246.67	605.94	615.07	616.07	0.014971	8.32	466.52	177.01	0.57
Brushy Creek Trib 7	Reach1	2309.592	3261.51	602.81	612.01	612.28	0.005696	4.14	788.91	179.27	0.34
Brushy Creek Trib 7	Reach1	1917.66	3281.22	598.49	609.54	609.88	0.006563	4.69	710.29	181.17	0.39
Brushy Creek Trib 7	Reach1	1400.031	3294.71	596.69	608.02	608.22	0.001842	3.79	1013.07	897.13	0.22
Brushy Creek Trib 7	Reach1	1047.481	3297.8	594.98	606.98	607.33	0.003609	4.92	848.84	724.13	0.29
Brushy Creek Trib 7	Reach1	966.8574	3297.8	594.66	607.13	607.14	0.000089	0.81	5715.2	927.85	0.05
Brushy Creek Trib 7	Reach1	928.597	Culvert								
Brushy Creek Trib 7	Reach1	892.581	3297.8	593.53	607.13	607.13	0.000046	0.6	7470.06	1044.75	0.03
Brushy Creek Trib 7	Reach1	743.5872	3297.8	592.58	606.6	606.99	0.005878	5.9	855.29	791.28	0.31
Brushy Creek Trib 7	Reach1	268.1543	3297.8	589.43	596.88	599.51	0.074527	13.01	253.54	146.15	1

Table N-6. Summary Output - Brushy Creek Tributary 8 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Brushy Trib 8	Reach1	572	612.18	589.37	607.67	607.68	0.000005	0.43	1661.31	252.08	0.02
Brushy Trib 8	Reach1	325	Mult Open								
Brushy Trib 8	Reach1	130	612.18	584.65	593.61	593.76	0.003704	3.12	196.2	43.92	0.26
Brushy Trib 8	Reach2	5506	73.15	630.65	631.81	631.99	0.014241	3.38	21.67	27.11	0.67
Brushy Trib 8	Reach2	4780	92.08	626.24	627.47	627.51	0.003771	1.71	53.93	69.71	0.34
Brushy Trib 8	Reach2	4341	106.3	622.28	623.06	623.18	0.045221	2.82	37.73	148.36	0.98
Brushy Trib 8	Reach2	4067	138.59	618.89	621.92	621.93	0.000332	0.88	157.24	140.06	0.13
Brushy Trib 8	Reach2	4030	Culvert								
Brushy Trib 8	Reach2	3916	138.59	617.05	618.74	619.06	0.023904	4.59	30.17	39.79	0.75
Brushy Trib 8	Reach2	3561	167.11	616.15	617.31	617.33	0.002044	1.23	156.77	176.89	0.22
Brushy Trib 8	Reach2	3204	230.44	611.97	615.58	615.77	0.009444	3.51	65.7	139	0.46
Brushy Trib 8	Reach2	2591	270.24	607.49	610.43	610.57	0.007727	3.04	89.04	93.38	0.44
Brushy Trib 8	Reach2	2287	485.32	605.45	609.77	609.84	0.001456	2.63	290.22	142.1	0.23
Brushy Trib 8	Reach2	2265	Bridge								
Brushy Trib 8	Reach2	2241	485.32	605.45	609.39	609.59	0.002642	4.05	172.51	92.98	0.37
Brushy Trib 8	Reach2	1170	612.18	604.29	605.36	605.48	0.005346	2.8	220.7	262.64	0.53
Brushy Trib 8	Reach2	727	612.18	599.7	601.64	602.19	0.010706	5.96	102.72	170.25	0.84

Table N-7. Summary Output - Brushy Creek Tributary 9 Model

River	Reach	River Sta	Q Total	Min Ch El	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude #
			(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Trib9A	Reach1	2477.932	135.65	639.69	641.1	641.51	0.013367	5.19	26.7	35.66	0.98
Trib9A	Reach1	2264.042	138.78	637.5	639.71	640.9	0.000956	2.22	66.71	394.38	0.29
Trib9A	Reach1	2224.271	151.72	636.85	639.83	640.82	0.002176	3.33	49.45	477.13	0.44
Trib9A	Reach1	2188.886	Culvert								
Trib9A	Reach1	2155.839	151.72	635.9	638.5	639.34	0.010795	7.23	20.98	126.7	0.97
Trib9A	Reach1	2068.639	176.03	635.7	637.78	638.3	0.009708	6.66	33.24	33.08	0.92
Trib9A	Reach1	1809.333	197.89	633.11		635.66	0.002153	3.53	57.93	35.79	0.45
Trib9A	Reach1	1605.032	230.63	631.85	633.97	634.72	0.010797	7.03	33.85	23.49	0.96
Trib9A	Reach1	1337.821	235.6	630.22		633.75	0.000657	2.58	99.02	48.2	0.26
Trib9A	Reach1	1300.641	270.1	629.5	631.88	633.71	0.000819	3.07	98.65	45.58	0.3
Trib9A	Reach1	1238.007	Culvert								
Trib9A	Reach1	1166.568	270.1	628.36	630.31	632.8	0.000363	2.26	131.52	49.75	0.2
Trib9A	Reach1	1062.111	294.02	628.32		632.75	0.000489	2.69	125.85	49.72	0.24
Trib9A	Reach1	914.0386	307.32	626.77		632.69	0.000224	2.23	181.45	77.15	0.17
Trib9A	Reach1	836.8259	307.32	624.94		632.67	0.000001	0.21	1733.77	318.02	0.01
Trib9A	Reach1	595.9685	307.32	624.2		632.67	0	0.09	3577.52	500.46	0.01
Trib9A	Reach1	414.1037	307.32	624.23		632.67	0	0.06	4974.36	695.11	0
Trib9A	Reach1	257.3464	307.32	624.18	629.81	632.67	0	0.07	4247.55	658.63	0
Trib9A	Reach1	224.5333	Culvert								
Trib9A	Reach1	202.3861	307.32	626.4	629.16	630.44	0.009731	9.08	33.87	46.02	1
Trib9A	Reach1	144.9389	307.32	626.4	628.23	629.46	0.000854	2.3	139.69	357.81	0.29
Trib9	Reach1	9117.615	653.57	640.84		645.18	0.001936	4.5	176.49	69.64	0.41
Trib9	Reach1	9077.479	690.26	640.39	643.36	645.09	0.001597	3.69	199.79	153.09	0.36
Trib9	Reach1	8844.545	748.77	638.63	642.99	644.46	0.004541	5.99	127.79	186.35	0.6
Trib9	Reach1	8497.488	816.56	636.98	641.6	642.57	0.008828	7.77	122.45	59.65	0.8
Trib9	Reach1	8127.862	873.86	635.22	638.7	639.89	0.00611	7.96	117.83	50.98	0.81
Trib9	Reach1	7838.573	926.26	633.85		638.34	0.004357	6.78	139.23	52.38	0.69
Trib9	Reach1	7590.214	1008.31	632.73		637.28	0.004179	6.96	149.83	54.39	0.68
Trib9	Reach1	7228.194	1088.21	631.02		635.79	0.004013	6.76	163.68	57.3	0.67
Trib9	Reach1	6902.914	1147.93	629.49		634.89	0.001787	5.57	222.29	64.23	0.47
Trib9	Reach1	6675.061	1185.98	628.32		634.57	0.000811	4.23	305.39	78.46	0.33

Table N-7. Summary Output - Brushy Creek Tributary 9 Model

River	Reach	River Sta	Q Total	Min Ch El	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude #
			(cfs)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Trib9	Reach1	6535.973	1221.58	627.66	631.15	634.46	0.00063	3.87	339.92	240.36	0.29
Trib9	Reach1	6497.112	Culvert								
Trib9	Reach1	6440.529	1221.58	627.22	630.82	633.64	0.000959	4.54	286.07	197.45	0.35
Trib9	Reach1	6409.82	1293.99	627.07	631.97	633.46	0.007638	9.96	137.6	49.85	0.93
Trib9	Reach1	6164.214	1293.99	625.96		631.79	0.003625	7.25	195.58	73.82	0.65
Trib9	Reach1	5913.901	1293.99	624.82	629.13	630.81	0.004144	7.08	204.62	370.96	0.62
Trib9	Reach2	5516.619	1542.37	622.27	627.31	628.29	0.009805	8.63	230.87	615.51	0.79
Trib9	Reach2	5119.891	1585.76	619.99	624.99	625.69	0.004323	5.61	423.13	528.96	0.52
Trib9	Reach2	4805.504	1614.71	617.97	623.58	624.16	0.009204	7.18	329.1	331.67	0.74
Trib9	Reach2	4600.565	1642.75	617.69	621.93	622.75	0.003481	4.19	539.48	379.6	0.45
Trib9	Reach2	4579.47	Culvert								
Trib9	Reach2	4556.512	1642.75	617.58	621.26	622.37	0.004681	6.26	447.34	347.94	0.55
Trib9	Reach2	4405.474	1700.38	615.41	620.99	621.78	0.003491	6.02	513.55	358.75	0.48
Trib9	Reach2	4014.771	1748.96	612.91	619.12	619.8	0.008006	7.19	339.25	300.97	0.7
Trib9	Reach2	3695.623	1757.18	610.81	617.53	618.92	0.001673	4.59	574.9	597.16	0.35
Trib9	Reach2	3642.472	1776.33	610.4	617.5	618.65	0.005678	9.39	261.52	439.83	0.66
Trib9	Reach2	3607.019	Culvert								
Trib9	Reach2	3564.069	1776.33	609.82	616.88	617.55	0.002234	6.16	655.98	476.07	0.41
Trib9	Reach2	3519.712	1833.27	609.61	616.63	617.3	0.010066	7.3	361	307.69	0.67
Trib9	Reach2	3162.177	1895.24	606.77	612.08	613.47	0.010302	7.7	305.14	129.43	0.66
Trib9	Reach2	2785.514	1948.99	603.79	607.88	611.22	0.003377	3.05	732.02	232.99	0.23
Trib9	Reach2	2468.663	1993.59	599.71	606.96	609.51	0.008949	5.27	471.56	232.35	0.38
Trib9	Reach2	2212.271	1993.59	597.81		608.38	0.00262	5.02	536.14	250.53	0.35
Trib9	Reach2	1954.11	2269.47	597.21	604.04	608.11	0.00041	2.53	1338.67	424.38	0.15
Trib9	Reach2	1824.769	2274.92	594.94	601.4	608.05	0.000439	3.01	1081.57	315.64	0.16
Trib9	Reach2	1782.695	Culvert								
Trib9	Reach2	1741.032	2274.92	594.32	600.66	605.81	0.001775	5.48	499.23	133.46	0.31
Trib9	Reach2	1601.685	2279.69	593.29		605.34	0.00626	8.16	338.73	91.2	0.52
Trib9	Reach2	1406.717	2279.69	591.85	601.48	604.56	0.002001	5.66	549.35	326.5	0.38

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Dam_14_Trib	Reach1	3943.68	62.2	702.96	704.27	704.6	0.066092	5.1	14.86	25.17	1.05
Dam_14_Trib	Reach1	3729.39	70.33	701.07	702.11	702.13	0.003236	1.18	59.76	79.9	0.24
Dam_14_Trib	Reach1	3517.27	79.23	698.86	701.59	701.64	0.001773	1.76	45.84	26.75	0.22
Dam_14_Trib	Reach1	3311.85	103	696.39	701.41	701.44	0.000635	1.34	78.91	31.58	0.14
Dam_14_Trib	Reach1	3206.85	Culvert								
Dam_14_Trib	Reach1	3072.18	103	696.39	698.96	699.06	0.002331	2.79	46.33	33.62	0.35
Dam_14_Trib	Reach1	2859.11	107.51	695.82	698.22	698.38	0.004319	3.23	33.74	23.6	0.46
Dam_14_Trib	Reach1	2785.16	154.31	695.11	697.57	697.87	0.008999	4.39	35.23	25.36	0.65
Dam_14_Trib	Reach1	2161.71	178.84	691.77	695.98	696.08	0.001448	2.52	71.94	33.83	0.28
Dam_14_Trib	Reach1	1907.22	274.41	691.81	694.8	695.2	0.007696	5.05	55.98	36.02	0.63
Dam_14_Trib	Reach1	1168.61	325.16	689.11	692.52	692.65	0.002011	3.25	157.86	145.84	0.35
Dam_14_Trib	Reach1	875.82	479.67	687.65	690.16	691.02	0.016387	7.88	75.8	50.65	0.95
Dam_14_Trib	Reach1	205.1	485.82	684.19	688.97	688.98	0.000118	0.98	922.58	588.13	0.09
Dam_14_Trib	Reach1	183.1	Inl Struct								
Dam_14_Trib	Reach1	163.44	491.39	686.06	688.95	688.96	0.000821	1.32	735.52	640.15	0.16
Ch_Br_Trib5	Reach2	1187.19	143.96	645.66	649.11	649.13	0.000527	0.9	166.33	62.26	0.09
Ch_Br_Trib5	Reach2	777.87	161.74	640.16	649.05	649.05	0.000094	0.67	368.25	130.74	0.04
Ch_Br_Trib5	Reach2	609.33	183.62	638.87	649.04	649.04	0.000033	0.42	572.2	133.81	0.03
Ch_Br_Trib5	Reach2	425.67	220.03	636.42	649.03	649.04	0.000032	0.43	677.52	155.18	0.03
Ch_Br_Trib5	Reach2	163.79	220.03	634.09	649.03	649.03	0.000013	0.28	1081.42	237.44	0.02
Ch_Br_Trib5	Reach1	5660.94	1107.95	687.3	693.13	693.33	0.001571	3.68	331.45	95.36	0.3
Ch_Br_Trib5	Reach1	5616.49	1107.95	686.6	693.13	693.24	0.000575	2.67	423.31	159.71	0.2
Ch_Br_Trib5	Reach1	5559.21	Culvert								
Ch_Br_Trib5	Reach1	5466.29	1107.95	685.4	692.36	692.45	0.000507	2.69	572.34	308.32	0.18
Ch_Br_Trib5	Reach1	5411.72	1126.85	686.37	691.99	692.32	0.003279	4.77	272.64	163.58	0.42
Ch_Br_Trib5	Reach1	5302.05	1149.75	686.15	691.02	691.63	0.012029	6.71	196.56	139.78	0.74
Ch_Br_Trib5	Reach1	5171.66	1227.73	685.81	689.72	690.17	0.008015	5.76	243.14	146.06	0.61
Ch_Br_Trib5	Reach1	4746.24	1267.33	683.58	686.83	687.19	0.006559	4.99	282.64	200.44	0.55
Ch_Br_Trib5	Reach1	4540.48	1288.38	681.06	686.4	686.5	0.001425	2.99	582.32	392.58	0.28
Ch_Br_Trib5	Reach1	4433.7	1312.07	679.93	686.35	686.39	0.000466	2.43	941.38	498.12	0.17

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Ch_Br_Trib5	Reach1	4406.67	Culvert								
Ch_Br_Trib5	Reach1	4373.59	1312.07	679	683.35	684.33	0.011458	9.29	188.88	86.52	0.79
Ch_Br_Trib5	Reach1	4315.58	1329.08	678.26	682.68	683.44	0.011765	7.44	215.31	153.67	0.75
Ch_Br_Trib5	Reach1	4232.06	1373.71	677.47	682.01	682.41	0.005858	5.2	274.9	132.83	0.53
Ch_Br_Trib5	Reach1	4017.98	1402.39	675.47	679.3	680.22	0.020313	8.02	189.12	110.38	0.95
Ch_Br_Trib5	Reach1	3884.03	1430.69	674.21	677.49	677.98	0.011837	6.44	283.98	228.06	0.73
Ch_Br_Trib5	Reach1	3754.53	1465.85	672.77	677.2	677.33	0.002454	3.29	516.03	268.73	0.35
Ch_Br_Trib5	Reach1	3597.12	1531.32	671.52	676.14	676.66	0.006719	5.96	278.43	115.18	0.59
Ch_Br_Trib5	Reach1	3313.89	1612.16	671.58	675.12	675.36	0.003077	4.02	422.75	179.8	0.4
Ch_Br_Trib5	Reach1	2980.39	1719.29	671.75	674.55	674.65	0.001445	2.5	709.71	327.4	0.28
Ch_Br_Trib5	Reach1	2563.33	1770.75	671.69	673.98	674.04	0.001426	2.07	875.71	462.05	0.25
Ch_Br_Trib5	Reach1	2372.15	1847.33	671.67	673.7	673.76	0.001463	1.96	959.58	565.73	0.25
Ch_Br_Trib5	Reach1	2097.71	1847.33	671.55	673.23	673.29	0.002001	2.01	933.31	637.69	0.28
Ch_Br_Trib4	Reach1	11610.6	108.58	774.65	776.24	776.52	0.020643	4.29	25.67	28.35	0.75
Ch_Br_Trib4	Reach1	11171.8	112.01	768.06	769.81	770.15	0.010834	4.78	24.86	122.38	0.79
Ch_Br_Trib4	Reach1	11047.3	114.22	766.71	768.5	768.88	0.009369	5.09	23.97	21.43	0.76
Ch_Br_Trib4	Reach1	10969	121.93	764.5	767.47	768.1	0.009769	6.49	20.14	12.64	0.77
Ch_Br_Trib4	Reach1	10707.6	128.97	762.38	765.56	765.96	0.006595	5.19	26.01	16.69	0.65
Ch_Br_Trib4	Reach1	10482.9	135.92	760.56	763.16	763.89	0.013109	7	21.1	16.13	0.91
Ch_Br_Trib4	Reach1	10272.6	143.51	758.86	760.67	760.79	0.006106	3.57	56.16	89.67	0.58
Ch_Br_Trib4	Reach1	10055.1	153.29	757.17	758.23	758.45	0.018831	4.75	42.89	94.4	0.97
Ch_Br_Trib4	Reach1	9791	166.65	754.27	756.61	756.87	0.004409	4.14	41.36	28.13	0.54
Ch_Br_Trib4	Reach1	9456.5	171.61	752.25	755.29	755.51	0.00362	3.78	47.21	35.63	0.49
Ch_Br_Trib4	Reach1	9338.93	178.03	753.3	754.39	754.7	0.016237	4.56	41.7	71.4	0.91
Ch_Br_Trib4	Reach1	9191.9	192.45	751.2	754.05	754.14	0.000779	2.38	80.6	41.3	0.26
Ch_Br_Trib4	Reach1	9122.58	Culvert								
Ch_Br_Trib4	Reach1	8970.78	192.45	747	748.96	749.31	0.001937	4.74	40.68	22.04	0.61
Ch_Br_Trib4	Reach1	8880.08	197.72	747.18	749.12	749.13	0.000032	0.62	319.02	189.04	0.08
Ch_Br_Trib4	Reach1	8771.88	204.98	747.17	749.12	749.12	0.000004	0.23	905.16	527.06	0.03
Ch_Br_Trib4	Reach1	8627.46	213.15	747.19	749.12	749.12	0.000012	0.34	624.41	421.62	0.05

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Ch_Br_Trib4	Reach1	8471.03	214.67	747.68	748.73	749.08	0.005507	4.81	47.08	74.13	0.94
Ch_Br_Trib4	Reach1	8442.53	218.93	745.57	746.52	746.8	0.019201	4.29	52.8	97.94	0.96
Ch_Br_Trib4	Reach1	8363.8	229.76	743.4	745.04	745.15	0.002891	2.68	88.65	76.03	0.42
Ch_Br_Trib4	Reach1	8170.38	257.87	741.68	745	745.02	0.000238	1.32	203.85	82.33	0.14
Ch_Br_Trib4	Reach1	7708.25	283.28	738.5	745.01	745.01	0.000002	0.17	1663.66	432.36	0.01
Ch_Br_Trib4	Reach1	7331.99	285.53	737.15	745	745.01	0.000018	0.61	493.71	642.57	0.04
Ch_Br_Trib4	Reach1	7300.29	Inl Struct								
Ch_Br_Trib4	Reach1	7263.14	329.43	736.07	739.47	739.84	0.003391	5.05	72.02	63.99	0.52
Ch_Br_Trib4	Reach1	6727.6	366.95	731.85	737.26	737.74	0.004429	5.65	72.01	226.09	0.57
Ch_Br_Trib4	Reach1	6295.6	438.04	729.2	734.32	735.18	0.007691	8.41	70.06	313.77	0.76
Ch_Br_Trib4	Reach1	5586.57	511.04	724.86	729.32	729.65	0.004872	5.68	161.73	247.1	0.6
Ch_Br_Trib4	Reach1	4969.28	592.27	721.07	725.66	725.98	0.005577	5.44	188.62	326.5	0.62
Ch_Br_Trib4	Reach1	4378.6	660.7	717.44	721.84	722.02	0.003303	4.23	267.73	394	0.49
Ch_Br_Trib4	Reach1	3940.77	672.49	714.76	719.36	719.77	0.010776	6.17	152.76	232.53	0.83
Ch_Br_Trib4	Reach1	3869.97	675.44	714.33	718.88	718.99	0.002459	3.38	293.62	313.89	0.41
Ch_Br_Trib4	Reach1	3852.4	Inl Struct								
Ch_Br_Trib4	Reach1	3839.49	735.36	712.72	716.27	716.74	0.004805	5.53	139.59	70.55	0.6
Ch_Br_Trib4	Reach1	3512.07	789.15	709.76	714.76	715	0.005389	4.2	231.77	180.81	0.45
Ch_Br_Trib4	Reach1	3229.38	842.91	706.31	712.04	712.66	0.012316	7.18	162.96	156.01	0.69
Ch_Br_Trib4	Reach1	2965.46	947.16	704	708.71	709.32	0.001748	7.3	189.78	136.64	0.67
Ch_Br_Trib4	Reach1	2894.19	Bridge								
Ch_Br_Trib4	Reach1	2805.71	947.16	703.64	707.26	707.37	0.000264	2.68	361.62	154.07	0.26
Ch_Br_Trib4	Reach1	2498.53	1032.31	700.11	706.47	707.04	0.004359	7.74	293.33	276.65	0.6
Ch_Br_Trib4	Reach1	2153.79	1092.04	697.18	704.13	704.25	0.004779	3.37	441.31	306.37	0.31
Ch_Br_Trib4	Reach1	1928.52	1149.42	695.27	702.38	702.69	0.010541	3.77	277.9	212.8	0.38
Ch_Br_Trib4	Reach1	1723.49	1212.02	693.53	700.45	700.65	0.007181	2.98	370.6	248.79	0.32
Ch_Br_Trib4	Reach1	1511.12	1339.46	691.73	698	698.49	0.020466	4.85	255.44	208.1	0.52
Ch_Br_Trib4	Reach1	1110.77	1431.69	688.33	695.28	695.42	0.004774	3.15	508.03	284.02	0.29
Ch_Br_Trib4	Reach1	844.12	1575.93	686.07	692.71	693.09	0.015423	5.77	377.2	246.89	0.56
Ch_Br_Trib4	Reach1	459.74	1662.72	682.8	688.67	689.1	0.007496	5.57	337.31	177.97	0.55

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Ch_Br_Trib4	Reach1	245.06	1702.8	680.98	687.09	687.56	0.007323	5.73	323.29	152.23	0.57
Ch_Br_Trib4	Reach1	149.68	1702.8	680.17	686.84	687.03	0.00303	3.8	493.11	229.04	0.35
Ch_Br_Trib3b	Reach1	1559.58	279.52	738.09	741.99	742.28	0.015213	4.67	69.23	27.95	0.44
Ch_Br_Trib3b	Reach1	1420.86	312.56	736.11	740.52	740.72	0.008387	3.73	94.59	34.07	0.33
Ch_Br_Trib3b	Reach1	1291.42	364.41	734.52	738.28	738.79	0.029922	5.89	66.57	28.16	0.6
Ch_Br_Trib3b	Reach1	1113.62	376.77	731.83	735.03	735.16	0.011218	3.13	132.86	68.76	0.35
Ch_Br_Trib3b	Reach1	1074.97	402.56	731.29	734.52	734.71	0.015808	3.82	118.1	59.64	0.42
Ch_Br_Trib3b	Reach1	998.26	525.23	729.85	732.97	733.28	0.019987	4.54	118.44	50.57	0.48
Ch_Br_Trib3b	Reach1	950.63	Culvert								
Ch_Br_Trib3b	Reach1	910.62	525.23	728.95	731.48	731.87	0.003801	5.02	105.5	57.25	0.61
Ch_Br_Trib3b	Reach1	690.12	608.78	727.32	730.01	730.72	0.006079	6.89	93.76	47.2	0.79
Ch_Br_Trib3b	Reach1	519.1	692.98	725.94	729.59	729.98	0.002261	5.12	142.97	52.91	0.5
Ch_Br_Trib3b	Reach1	369.02	859.78	724.66	729.33	729.7	0.001527	4.88	177.02	56.37	0.43
Ch_Br_Trib3b	Reach1	322.91	Culvert								
Ch_Br_Trib3b	Reach1	284.38	859.78	724.16	727.93	728.57	0.003783	6.48	133.78	85.8	0.65
Ch_Br_Trib3b	Reach1	119.16	859.78	723.43	726.4	727.52	0.008963	8.56	103.91	110.66	0.96
Ch_Br_Trib3a	Reach1	4032.51	130.83	733.91	736.9	736.98	0.00587	2.19	63.03	33.85	0.25
Ch_Br_Trib3a	Reach1	3867.39	145.09	732.75	736.04	736.11	0.0048	2.13	74.61	39.32	0.23
Ch_Br_Trib3a	Reach1	3659.31	161.55	731.61	735.07	735.14	0.004557	2.17	81.37	40.68	0.23
Ch_Br_Trib3a	Reach1	3443.2	181.34	730.32	733.73	733.84	0.00793	2.73	71.46	38.02	0.3
Ch_Br_Trib3a	Reach1	3210.86	185.6	728.95	732.46	732.53	0.004158	2.1	95.16	44.27	0.22
Ch_Br_Trib3a	Reach1	3164.1	205.22	728.44	732.25	732.33	0.004045	2.32	92.33	42.02	0.22
Ch_Br_Trib3a	Reach1	3131.41	Culvert								
Ch_Br_Trib3a	Reach1	3076.78	205.22	727.79	731.37	731.44	0.00339	2.19	110.6	46.58	0.21
Ch_Br_Trib3a	Reach1	2962.09	214.37	726.91	730.71	730.84	0.008295	2.95	78.05	38.16	0.31
Ch_Br_Trib3a	Reach1	2874.39	214.37	725.57	728.2	728.99	0.077045	7.72	32.55	21.43	0.91
Ch_Br_Trib3a	Reach2	2510.07	1197.23	722.42	725.11	725.53	0.00484	5.3	231.35	130.91	0.68
Ch_Br_Trib3a	Reach2	2219.55	927.11	720.99	723.45	723.84	0.007485	5.05	188.43	128.44	0.7
Ch_Br_Trib3a	Reach2	1978.02	641.6	720.29	722.41	722.58	0.003089	3.31	197.28	126.59	0.45
Ch_Br_Trib3a	Reach2	1630.32	465.25	718.51	720.34	720.71	0.016322	5.09	98.91	148.01	0.94

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Ch_Br_Trib3a	Reach2	1326.74	465.25	716.45	718.85	718.9	0.002002	2.7	291.92	433.71	0.36
Ch_Br_Trib3	Reach1	11376.6	198.85	809.27	810.79	811.06	0.01059	4.68	56.2	110.55	0.78
Ch_Br_Trib3	Reach1	11268	203.41	803.86	804.87	805.04	0.011715	3.58	70.54	219.34	0.76
Ch_Br_Trib3	Reach1	11204	224.45	801	802.12	802.51	0.017793	5.09	46.03	61.72	0.97
Ch_Br_Trib3	Reach1	10926.4	260.93	791.54	793.84	794.58	0.013679	7.09	39.45	29.16	0.95
Ch_Br_Trib3	Reach1	10501.5	294.82	778.1	780.83	780.86	0.000372	1.39	239.06	139.76	0.16
Ch_Br_Trib3	Reach1	10157	309.68	774.48	780.69	780.75	0.000285	2.26	173.76	50.13	0.17
Ch_Br_Trib3	Reach1	10018.3	317.74	771.41	780.73	780.73	0.000005	0.38	996.35	193.27	0.02
Ch_Br_Trib3	Reach1	9945.77	343.67	770.36	776.76	779.81	0.009771	14.02	24.52	110.17	1
Ch_Br_Trib3	Reach1	9875.29	Culvert								
Ch_Br_Trib3	Reach1	9789.84	343.67	767.77	771	771.37	0.004666	4.9	72.02	46.9	0.58
Ch_Br_Trib3	Reach1	9724.47	348.53	767.4	770.8	771.07	0.003153	4.26	89.23	53.25	0.48
Ch_Br_Trib3	Reach1	9684.84	352.77	767.19	770.57	770.92	0.003893	4.73	77.12	37.55	0.54
Ch_Br_Trib3	Reach1	9650.72	362.69	767	770.22	770.73	0.005988	5.82	65.76	34.9	0.66
Ch_Br_Trib3	Reach1	9572.5	368.8	766.57	769.23	770.04	0.013755	7.34	52.51	33.81	0.96
Ch_Br_Trib3	Reach1	9525.38	258.26	766.3	768.85	769.31	0.008595	5.53	48.33	32.36	0.75
Ch_Br_Trib3	Reach1	9480.54	307.87	766.1	768.85	769.03	0.001724	3.4	91.47	38.13	0.36
Ch_Br_Trib3	Reach1	9418.91	Culvert								
Ch_Br_Trib3	Reach1	9350.63	307.87	765.34	768.08	768.65	0.007679	6.28	53.45	31.25	0.74
Ch_Br_Trib3	Reach1	8962.38	340.48	763.2	767.13	767.31	0.001622	3.51	103.49	44.51	0.36
Ch_Br_Trib3	Reach1	8665.44	377.98	762.86	765.91	766.4	0.005187	5.91	73.11	40.16	0.63
Ch_Br_Trib3	Reach1	8357.28	416.91	760.95	764.86	765.19	0.002937	4.66	93.94	39.5	0.48
Ch_Br_Trib3	Reach1	8068.24	432.53	759.73	762.67	763.58	0.012345	7.79	58.29	33.13	0.94
Ch_Br_Trib3	Reach1	7959.74	470.34	759.5	762.41	762.62	0.001893	3.69	128.7	52.03	0.38
Ch_Br_Trib3	Reach1	7916.12	Culvert								
Ch_Br_Trib3	Reach1	7810.93	470.34	756.86	760.61	760.92	0.013876	4.53	106.54	38.38	0.46
Ch_Br_Trib3	Reach1	7712.62	493.69	755.52	759.8	759.95	0.006388	3.23	161.58	79.8	0.32
Ch_Br_Trib3	Reach1	7569.74	526.8	754.2	758.37	758.66	0.012592	4.31	126.82	60.93	0.44
Ch_Br_Trib3	Reach1	7378.29	583.7	753.02	755.48	756.33	0.011249	7.5	81.44	45.8	0.9
Ch_Br_Trib3	Reach1	7075.81	633.74	750.3	754.21	754.6	0.003158	5.07	129.13	158.77	0.5

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Ch_Br_Trib3	Reach1	6833.29	704.47	748.69	754.37	754.4	0.000156	1.53	463.64	161.37	0.12
Ch_Br_Trib3	Reach1	6521.25	785.62	749.58	753.76	754.21	0.004381	5.87	161.37	84	0.59
Ch_Br_Trib3	Reach1	6199.7	859.21	748.16	752.38	752.77	0.004439	5.15	176.59	84.01	0.58
Ch_Br_Trib3	Reach1	5935.67	969.6	747	751.26	751.64	0.00415	5.06	200	233.62	0.56
Ch_Br_Trib3	Reach1	5579.22	1024.74	745.43	749.47	749.94	0.005391	5.62	188.53	477.26	0.63
Ch_Br_Trib3	Reach1	5416.09	1039.53	744.81	748.25	748.84	0.008535	6.34	172.06	396.38	0.78
Ch_Br_Trib3	Reach1	5373.83	1045.03	744.72	747.57	748.28	0.013318	7.04	160.5	112.41	0.94
Ch_Br_Trib3	Reach1	5295	Culvert								
Ch_Br_Trib3	Reach1	5245.68	1045.03	744.6	747.41	747.65	0.002319	4.04	263.62	121.1	0.43
Ch_Br_Trib3	Reach1	4999.32	1068.23	742.87	746.22	746.67	0.007239	5.37	202.59	258.69	0.7
Ch_Br_Trib3	Reach1	4773.15	1083.35	741.85	744.72	744.94	0.007275	4.22	316.26	395.68	0.66
Ch_Br_Trib3	Reach1	4628.38	1103.94	740.68	744.07	744.22	0.003264	3.57	379.28	320.77	0.47
Ch_Br_Trib3	Reach1	4434.5	1128.61	738.99	743.4	743.52	0.003875	3.59	416.95	364.96	0.38
Ch_Br_Trib3	Reach1	4403.07	Culvert								
Ch_Br_Trib3	Reach1	4368.83	1128.61	738.64	743.14	743.23	0.003297	3.12	469.34	424.54	0.34
Ch_Br_Trib3	Reach1	4206.84	1134.93	738.67	742.81	742.88	0.002179	2.51	589.22	577.66	0.28
Ch_Br_Trib3	Reach1	4149.27	1156.11	738.99	742.71	742.76	0.002295	3.09	711.36	680.91	0.3
Ch_Br_Trib3	Reach1	4121.87	Culvert								
Ch_Br_Trib3	Reach1	4096.99	1156.11	737.94	742.04	742.1	0.003032	3.3	658.6	676.05	0.34
Ch_Br_Trib3	Reach1	3958.88	1181.75	736.42	741.74	741.8	0.001632	2.44	778.23	675.86	0.25
Ch_Br_Trib3	Reach1	3732.96	1241.03	734.91	740.55	741.09	0.004358	6.98	342.78	579.33	0.6
Ch_Br_Trib3	Reach1	3228.88	1280.3	731.54	737.6	738.13	0.003457	6.57	320.99	350.59	0.55
Ch_Br_Trib3	Reach1	2907.99	1330.26	729.39	735.91	736.29	0.005055	7.35	391.92	490.45	0.6
Ch_Br_Trib3	Reach1	2513.75	1420.23	726.62	732.38	732.69	0.006445	5.8	392.58	396.55	0.5
Ch_Br_Trib3	Reach1	1839.68	1471.92	722.25	729	729.74	0.003819	7.41	293.26	309.35	0.59
Ch_Br_Trib3	Reach1	1471.51	1494.76	719.55	725.06	726.37	0.008847	10.21	180.28	88.87	0.86
Ch_Br_Trib3	Reach1	1312.88	1504.84	718.11	723.63	723.75	0.000618	2.99	565.4	160.55	0.24
Ch_Br_Trib3	Reach1	1243.7	1547.14	717.86	723.37	723.64	0.001167	4.19	380.49	86.35	0.33
Ch_Br_Trib3	Reach1	1191.26	Culvert								
Ch_Br_Trib3	Reach1	1155.03	1547.14	717.31	723.07	723.36	0.001324	4.35	360.44	83.59	0.35

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Ch_Br_Trib3	Reach1	958.18	1585.41	716.43	720.81	722.4	0.010369	10.31	162.79	54.47	0.94
Ch_Br_Trib3	Reach1	706.49	1585.41	715.3	720.42	720.6	0.002	4.2	503.14	261.74	0.41
Ch_Br_Trib2	Reach1	14890.8	109.77	870.57	871.87	872.25	0.014609	5.11	23.78	34.55	0.9
Ch_Br_Trib2	Reach1	14786.3	129.78	864.4	867.86	867.98	0.001077	2.77	47.67	25.72	0.28
Ch_Br_Trib2	Reach1	14684.5	Culvert								
Ch_Br_Trib2	Reach1	14624.9	129.78	862	864.38	864.57	0.002774	3.54	37.82	27.81	0.43
Ch_Br_Trib2	Reach1	14430.6	130.15	860.76	864.35	864.37	0.000242	0.96	156.65	220.08	0.13
Ch_Br_Trib2	Reach1	14424.6	Inl Struct								
Ch_Br_Trib2	Reach1	14390.9	140.38	860.31	862.19	862.4	0.005705	3.75	38.36	35.67	0.59
Ch_Br_Trib2	Reach1	14263.9	145.13	859.93	861.3	861.5	0.008885	3.64	42.76	93.5	0.69
Ch_Br_Trib2	Reach1	14193.2	152.41	858.01	860.05	860.64	0.016037	6.14	25.11	22.75	0.97
Ch_Br_Trib2	Reach1	14089.3	184.62	856.66	858.23	858.7	0.01516	5.54	34.42	40.31	0.93
Ch_Br_Trib2	Reach1	13682.1	196.71	851.3	853.51	853.61	0.010251	2.52	83.5	204.15	0.33
Ch_Br_Trib2	Reach1	13547.4	210.81	848.99	850.77	851	0.046214	3.89	58.35	81.99	0.64
Ch_Br_Trib2	Reach1	13400.3	257.25	837.99	840.83	841.72	0.083306	7.72	35.66	21.89	0.93
Ch_Br_Trib2	Reach1	12977.5	304.65	820.96	823.9	824.23	0.017246	4.69	67.66	39.14	0.58
Ch_Br_Trib2	Reach1	12618.3	364.96	812.27	815.29	815.8	0.032703	5.79	65.65	34.39	0.67
Ch_Br_Trib2	Reach1	12234.7	398.73	804.5	808.74	808.96	0.011167	3.86	110.17	52.12	0.41
Ch_Br_Trib2	Reach1	12046.8	466.53	802.81	806.52	806.9	0.01049	5.2	111.11	109.77	0.61
Ch_Br_Trib2	Reach1	11713.3	507.54	797.34	801.82	801.99	0.021348	3.81	168.97	226.08	0.51
Ch_Br_Trib2	Reach1	11534.4	587.65	795.42	799.71	800.11	0.008653	5.89	133.99	141.93	0.76
Ch_Br_Trib2	Reach1	11223.1	627.41	792.07	796.57	797.4	0.008063	7.69	97.63	64.03	0.79
Ch_Br_Trib2	Reach1	11084.1	749.45	790.57	794.59	795.74	0.011152	8.73	90.09	40.58	0.92
Ch_Br_Trib2	Reach1	10706.6	922.76	786.26	790.42	791.8	0.009813	9.73	104.38	40.46	0.91
Ch_Br_Trib2	Reach1	10264.8	940.63	781.75	787.88	787.91	0.000189	1.65	664.84	179.16	0.13
Ch_Br_Trib2	Reach1	10224	1036.62	781.31	787.84	787.9	0.000274	2.09	626.49	213.86	0.16
Ch_Br_Trib2	Reach1	10017.6	1685.31	779.63	785.44	787.17	0.007752	11.01	171.69	46.42	0.85
Ch_Br_Trib2	Reach1	9973.07	Culvert								
Ch_Br_Trib2	Reach1	9906.05	1685.31	778.62	782.99	784.58	0.01096	10.29	170.98	229.9	0.96
Ch_Br_Trib2	Reach1	9697.27	1729.63	777.09	783.42	783.52	0.000332	2.56	722.47	148.22	0.18

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Ch_Br_Trib2	Reach1	9445.54	1775.26	776.98	783.41	783.44	0.000101	1.44	1289.86	277.24	0.1
Ch_Br_Trib2	Reach1	9193.04	1798.31	776.4	783.03	783.31	0.001014	4.58	508.57	199.46	0.32
Ch_Br_Trib2	Reach1	9178.35	Culvert								
Ch_Br_Trib2	Reach1	9165.5	1798.31	776.1	779.96	781.77	0.011991	10.82	167.24	50.6	1
Ch_Br_Trib2	Reach1	9067.97	1851.12	775.07	779.64	779.74	0.000542	2.5	769.49	235.34	0.22
Ch_Br_Trib2	Reach1	8787.35	1900.93	773.8	779.58	779.63	0.000204	1.81	1108.85	263.92	0.14
Ch_Br_Trib2	Reach1	8529.85	1975.21	772.05	779.44	779.55	0.000406	2.79	808.29	191.79	0.2
Ch_Br_Trib2	Reach1	8158.18	1996.55	770.79	779.46	779.48	0.000058	1.17	1907.3	403.64	0.08
Ch_Br_Trib2	Reach1	8053.99	2033.78	770.44	779.41	779.46	0.000235	2.44	1308.05	419.13	0.16
Ch_Br_Trib2	Reach1	8021.29	Culvert								
Ch_Br_Trib2	Reach1	7981.34	2033.78	770.05	776.17	777.15	0.005931	9.36	300.67	147.74	0.74
Ch_Br_Trib2	Reach1	7874.87	2093.76	768.99	773.86	775.07	0.009954	9.4	252.72	119.54	0.91
Ch_Br_Trib2	Reach1	7593.01	2173.45	765.93	770.01	770.63	0.012606	8.2	361.82	307.49	0.95
Ch_Br_Trib2	Reach1	7230.83	2173.45	766.35	769.89	769.97	0.000549	2.17	1009.6	319.72	0.21
Ch_Br_Trib2	Reach1	7102.29	1029.46	765.6	769.68	769.85	0.001011	3.4	318.51	174.57	0.3
Ch_Br_Trib2	Reach1	7025.39	Culvert								
Ch_Br_Trib2	Reach1	6928.4	1029.46	765.58	767.76	768.7	0.014312	7.85	132.2	100.98	1
Ch_Br_Trib2	Reach1	6761.76	1048.58	761.6	766.34	766.72	0.003688	5	229.02	172.61	0.53
Ch_Br_Trib2	Reach1	6457.67	1056.83	760.11	765.79	765.86	0.00161	2.17	529.49	504.54	0.21
Ch_Br_Trib2	Reach1	6328.04	1083.54	759.48	765.59	765.66	0.002226	2.31	521.08	580.74	0.22
Ch_Br_Trib2	Reach1	5915.65	1099.17	757.47	762.37	764.01	0.010275	10.45	112.02	37.64	0.91
Ch_Br_Trib2	Reach1	5678.83	1107.56	756.52	759.94	760.64	0.009458	7.21	181.47	124.38	0.83
Ch_Br_Trib2	Reach1	5553.15	1114.63	756.02	758.9	759.2	0.005214	4.36	258.29	233.16	0.59
Ch_Br_Trib2	Reach1	5448.08	1118.03	755.61	758.41	758.66	0.004713	4.07	277.37	175.08	0.56
Ch_Br_Trib2	Reach1	5397.66	1138.31	755.4	757.56	758.16	0.015514	6.31	185.14	155.45	0.97
Ch_Br_Trib2	Reach1	5337.93	Culvert								
Ch_Br_Trib2	Reach1	5284.54	1138.31	754.86	757.2	757.58	0.007745	5	229.93	154.72	0.71
Ch_Br_Trib2	Reach1	5100.62	1156.66	753.8	755.79	756.16	0.007539	4.83	240.68	166.27	0.69
Ch_Br_Trib2	Reach1	4836.31	1179.01	751.65	754.22	754.53	0.005018	4.52	265.33	152.94	0.59
Ch_Br_Trib2	Reach1	4519.96	1202.56	749.94	752.82	753.1	0.004037	4.3	282.47	146.99	0.53

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Ch_Br_Trib2	Reach1	4193.04	1232.09	748.54	751.94	752.14	0.002156	3.57	351.3	174.1	0.4
Ch_Br_Trib2	Reach1	3792.07	1246.28	746.22	750.35	750.76	0.006052	5.19	246.36	138.93	0.65
Ch_Br_Trib2	Reach1	3602.83	1264.97	745.13	748.25	749.02	0.014143	7.16	184.87	127.14	0.97
Ch_Br_Trib2	Reach1	3356.84	1271.98	743.7	746.72	746.93	0.003189	3.78	346.69	193.66	0.47
Ch_Br_Trib2	Reach1	3265.46	1282.24	743.17	746.43	746.66	0.002739	3.87	341.86	162.45	0.45
Ch_Br_Trib2	Reach1	3132.64	1294.4	741.4	746.4	746.48	0.000378	2.34	554.63	169.08	0.19
Ch_Br_Trib2	Reach1	3091.28	Culvert								
Ch_Br_Trib2	Reach1	3040.1	1294.4	741.1	744.74	744.9	0.001058	3.21	404.23	168.15	0.3
Ch_Br_Trib2	Reach1	2976.66	1319.47	741.11	744.69	744.82	0.000962	2.89	461.12	164.84	0.28
Ch_Br_Trib2	Reach1	2659.56	1344.52	739.82	744.58	744.63	0.000281	1.9	720.26	179.02	0.16
Ch_Br_Trib2	Reach1	2348.77	1368.58	738.53	744.5	744.55	0.000248	1.85	757	188.13	0.15
Ch_Br_Trib2	Reach1	2055.67	1395.72	737.79	744.23	744.35	0.004726	3.1	523.78	367.28	0.28
Ch_Br_Trib2	Reach1	1731.05	1415.84	735.64	742.01	742.23	0.00955	4.24	403.99	364.12	0.39
Ch_Br_Trib2	Reach1	1494.5	1435.46	734.32	740.7	740.82	0.00453	2.89	509.87	316.06	0.27
Ch_Br_Trib2	Reach1	1267.04	1453	733.85	739.01	739.2	0.011306	4.06	457.02	258.57	0.4
Ch_Br_Trib2	Reach1	1066.34	1453	730.82	738.15	738.2	0.002812	2.27	965.67	549.55	0.2
Ch_Br_Trib1	Reach2	2235.03	119.56	778.73	780.22	780.3	0.007081	2.28	53.58	52.72	0.38
Ch_Br_Trib1	Reach2	1634.22	290.83	772.68	776.96	777.07	0.005067	2.75	119.65	69.35	0.28
Ch_Br_Trib1	Reach2	1021.63	467.3	771.67	774.34	774.44	0.003988	2.67	193.81	116.05	0.31
Ch_Br_Trib1	Reach2	694.81	467.3	768.29	770.56	771.26	0.043104	6.77	71.38	54.04	0.97
Ch_Br_Trib1	Reach1	7480.89	604.35	812.09	815.32	815.56	0.00367	4.06	168.74	104.38	0.46
Ch_Br_Trib1	Reach1	6986.39	639.24	809.8	812.38	812.63	0.011328	4.33	170.32	125.69	0.53
Ch_Br_Trib1	Reach1	6696.31	694.34	806.19	809.77	810.02	0.006864	4.11	185.85	91.62	0.43
Ch_Br_Trib1	Reach1	6268.99	762.94	803.96	807.22	807.4	0.005374	3.45	235.76	116.51	0.38
Ch_Br_Trib1	Reach1	5781.95	833.14	802.22	804.73	804.85	0.005228	2.8	325.26	199.77	0.35
Ch_Br_Trib1	Reach1	5327	915.07	795.32	798.67	799.66	0.032683	8.3	121.05	64.96	0.92
Ch_Br_Trib1	Reach1	4842.18	988.97	790.43	795.05	795.2	0.002717	3.14	327.87	100.98	0.28
Ch_Br_Trib1	Reach1	4440.78	1096.04	789.64	792.72	793.31	0.008512	6.32	186.48	96.02	0.7
Ch_Br_Trib1	Reach1	3909.43	1096.04	787.09	791.15	791.31	0.002001	3.66	384.91	196.94	0.36
Chandler_Branch	Reach6	29669	229.2	700.86	706.78	706.87	0.000964	2.48	93.16	28.77	0.23

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Chandler_Branch	Reach6	28909	275.33	702.54	706.28	706.31	0.000595	1.62	207.41	122.72	0.18
Chandler_Branch	Reach6	28576.9	376.18	701.81	705.61	705.78	0.005222	3.3	119.15	72.48	0.42
Chandler_Branch	Reach6	28011.7	539.73	698.25	703.06	703.33	0.00384	4.15	133.34	44.76	0.39
Chandler_Branch	Reach6	27357.9	819.03	696.37	702.1	702.18	0.001067	2.27	378.58	105.81	0.2
Chandler_Branch	Reach6	27269.7	Culvert								
Chandler_Branch	Reach6	27089.7	819.03	695.75	701.71	702.14	0.005663	5.4	175.7	65.62	0.45
Chandler_Branch	Reach6	26602.7	964.69	694.01	700.19	700.34	0.002422	3.09	334.31	117.45	0.29
Chandler_Branch	Reach6	26306.2	1053.7	694.14	699.06	699.26	0.005462	4.8	385.28	160.16	0.43
Chandler_Branch	Reach6	26146.4	1053.7	692.04	697.99	698.49	0.00487	5.88	240.29	131.94	0.51
Chandler_Branch	Reach6	25885.1	1088.18	690.73	696.96	697.34	0.003897	5.09	255.89	96.66	0.45
Chandler_Branch	Reach6	25579.5	1155.33	691.14	696.06	696.34	0.002553	4.26	276.77	72.74	0.37
Chandler_Branch	Reach6	25520.4	Culvert								
Chandler_Branch	Reach6	25455.7	1155.33	690.68	695.98	696.13	0.001222	3.14	377.35	92.55	0.26
Chandler_Branch	Reach6	25011.1	1228.02	689.06	695.14	695.35	0.002539	3.74	357.83	126.56	0.36
Chandler_Branch	Reach6	24431.9	1319.35	688.65	693.24	693.52	0.003889	4.64	372.68	163.16	0.42
Chandler_Branch	Reach6	23751.1	1431.89	684.54	692.47	692.63	0.000656	3.29	482.53	137.46	0.25
Chandler_Branch	Reach6	22974.1	1584.16	688.61	691.67	691.81	0.001819	3.05	544.05	241.01	0.33
Chandler_Branch	Reach6	22014.9	1584.16	685.12	689.46	689.52	0.003379	3.29	937.8	526.51	0.33
Chandler_Branch	Reach7	21171.5	2197.74	683.28	687.57	687.6	0.001771	2	1599.43	703.07	0.2
Chandler_Branch	Reach7	20588.9	2197.74	681.21	687.08	687.11	0.000457	1.76	2094.91	572.97	0.13
Chandler_Branch	Reach3	49503.9	59.49	802.37	802.75	802.86	0.018995	2.73	22.42	104.89	0.96
Chandler_Branch	Reach3	49292.1	87.12	783.97	784.97	785.31	0.054069	4.68	19.35	32.98	0.96
Chandler_Branch	Reach3	48827.3	119.19	771.56	773.11	773.13	0.001779	1.17	105.57	103.47	0.19
Chandler_Branch	Reach3	48445.4	161.08	769.67	771.28	771.45	0.013215	3.38	50.77	50.05	0.52
Chandler_Branch	Reach3	48078.5	208.75	766.26	771.17	771.18	0.000237	0.84	253.66	87.58	0.08
Chandler_Branch	Reach3	47762.6	276.01	768.92	770.64	770.86	0.016808	3.93	84.17	111.53	0.59
Chandler_Branch	Reach3	47422.3	276.01	766.52	769.94	769.96	0.000952	1.45	239.21	151.21	0.16
Chandler_Branch	Reach4	46807.2	736.44	760.63	769.72	769.75	0.000262	1.25	614.95	145.96	0.09
Chandler_Branch	Reach4	46737.2	Inl Struct								
Chandler_Branch	Reach4	46661	761.66	760.34	767.19	767.25	0.001011	2.15	394.7	111.51	0.18

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Chandler_Branch	Reach4	45474.5	1295.98	758.04	765.24	765.34	0.002271	2.55	539.62	164.48	0.2
Chandler_Branch	Reach4	45055.3	1386.38	758.06	764.49	764.58	0.0015	2.59	673.57	301.8	0.21
Chandler_Branch	Reach4	44788.7	1492.41	757.56	764.22	764.27	0.000889	2.01	931.17	370.12	0.17
Chandler_Branch	Reach4	44497.3	1641.57	757.91	763.97	764.01	0.000901	1.73	1108.61	428.65	0.16
Chandler_Branch	Reach4	44120.7	1859.34	756.76	763.71	763.74	0.000772	1.7	1238.55	414.77	0.15
Chandler_Branch	Reach4	43628.1	2245.36	755.44	763.5	763.52	0.0004	1.29	2058.78	688.96	0.11
Chandler_Branch	Reach4	42882.2	2467.44	755.84	763.28	763.29	0.000376	0.99	2702.75	814.59	0.08
Chandler_Branch	Reach4	42509.3	2958.98	754.14	763.22	763.24	0.000156	1.23	3342.77	795.83	0.08
Chandler_Branch	Reach4	42444.8	Culvert								
Chandler_Branch	Reach4	42401.2	2958.98	753.49	760.33	760.53	0.005665	3.68	880.03	431.04	0.39
Chandler_Branch	Reach4	41791	2958.98	752.12	757.41	757.51	0.004277	2.92	1182.63	498.09	0.27
Chandler_Branch	Reach4	41040	3175.12	749.03	754.39	754.53	0.004758	3.05	1074.32	346.4	0.28
Chandler_Branch	Reach4	40222.7	3247.81	744.56	751.67	751.87	0.002325	3.88	1013.37	316.96	0.28
Chandler_Branch	Reach4	39960.3	3321.29	744.19	751.16	751.33	0.001791	3.35	1089.53	281.92	0.25
Chandler_Branch	Reach4	39700.9	3428.46	742.22	750.11	750.56	0.003982	5.48	646.79	117.38	0.37
Chandler_Branch	Reach4	39652.6	Bridge								
Chandler_Branch	Reach4	39607.7	3428.46	742.22	748.48	749.39	0.010967	7.7	456.38	98.95	0.6
Chandler_Branch	Reach4	39332.7	3484.55	739.59	747.65	747.85	0.002366	3.76	1019.3	246.49	0.28
Chandler_Branch	Reach4	39144.6	3626.37	738.08	747.07	747.34	0.00299	4.39	949.9	265.14	0.32
Chandler_Branch	Reach4	38682.1	3767.97	736.2	745.95	746.17	0.002166	4.06	1147.04	315.61	0.28
Chandler_Branch	Reach4	38238	3805.92	735.09	742.99	744.18	0.011407	8.94	460.88	104.11	0.63
Chandler_Branch	Reach4	38121.8	3805.92	734.98	742.7	743.17	0.004578	5.67	711.25	134.46	0.4
Chandler_Branch	Reach4	37943.6	3840.01	734.63	742.02	742.37	0.003839	4.83	819.03	165.5	0.36
Chandler_Branch	Reach4	37923.7	Bridge								
Chandler_Branch	Reach4	37892.8	3840.01	734.64	741.44	741.99	0.006001	6.15	670.81	145.43	0.45
Chandler_Branch	Reach4	37865.1	3861.79	734.66	741.34	741.78	0.005097	5.49	753.99	177.01	0.41
Chandler_Branch	Reach4	37815.3	3957.31	734.7	741.34	741.62	0.000785	4.29	946.53	206.47	0.32
Chandler_Branch	Reach4	37735	Bridge								
Chandler_Branch	Reach4	37630.6	3957.31	734.73	741.22	741.45	0.000639	3.9	1043.73	215.01	0.29
Chandler_Branch	Reach4	37600.2	3968.97	734.48	740.97	741.37	0.001365	5.35	804.8	246.22	0.42

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Chandler_Branch	Reach4	37574.3	4017.66	734.28	740.44	741.21	0.00263	7.09	577.47	134.76	0.58
Chandler_Branch	Reach4	37553.9	Bridge								
Chandler_Branch	Reach4	37524.2	4017.66	733.96	739.59	740.86	0.005371	9.09	449.74	122.19	0.8
Chandler_Branch	Reach4	37467	4107.08	734.11	739.72	740.22	0.00364	5.82	775.21	618.48	0.48
Chandler_Branch	Reach4	37273.2	4209.68	732.39	738.91	739.28	0.005728	6	1048.43	506.53	0.5
Chandler_Branch	Reach4	37056	4338.39	732.53	737.9	738.23	0.004001	5.32	1212.3	421.59	0.44
Chandler_Branch	Reach4	36790.9	4429.54	731.5	737.32	737.42	0.00209	2.67	1909.26	669.38	0.22
Chandler_Branch	Reach4	36607.9	4502.55	730.92	736.88	737.02	0.002224	3.16	1744.77	828.38	0.25
Chandler_Branch	Reach4	36464	4502.55	730.46	736.62	736.72	0.001749	2.68	2120	930.25	0.21
Chandler_Branch	Reach8	19882.3	3903.24	677.16	686.17	686.33	0.002181	5.06	1384.11	273.32	0.31
Chandler_Branch	Reach8	19768.5	Bridge								
Chandler_Branch	Reach8	19665	3903.24	676.66	684.12	684.69	0.003937	6.72	818.04	203.32	0.49
Chandler_Branch	Reach8	19065.9	4089.12	674.22	682.57	682.85	0.002443	5.78	1293.9	339.18	0.39
Chandler_Branch	Reach8	18543.5	4224.45	673.64	681.25	681.44	0.003046	5.05	1486.57	435.25	0.35
Chandler_Branch	Reach8	18177.9	4417.89	672.57	678.79	679.42	0.013115	8.66	811.36	259.48	0.7
Chandler_Branch	Reach8	17675.2	4642.65	672.28	677.47	677.58	0.001473	3.15	1964.19	695.1	0.26
Chandler_Branch	Reach8	17117.9	4719.07	664.15	676.26	676.54	0.002871	5.67	1616.49	420.23	0.35
Chandler_Branch	Reach8	16934.6	4719.07	666.2	675.83	676.09	0.00311	4.79	1269.85	330.6	0.33
Chandler_Branch	Reach8	16667	4737.95	664.68	675.14	675.31	0.001884	3.61	1481.99	395.52	0.25
Chandler_Branch	Reach8	16274.1	4760.36	663.74	674.63	674.83	0.001145	3.74	1358.86	284.11	0.24
Chandler_Branch	Reach8	15809.6	4776.26	662.02	674.04	674.23	0.00248	3.45	1578.79	416.62	0.21
Chandler_Branch	Reach8	15481.5	4794.92	660.8	673.29	673.45	0.003095	3.95	1660.43	394.15	0.24
Chandler_Branch	Reach8	15097.7	4821.61	659.58	672.38	672.51	0.002871	3.89	1982.86	601.24	0.23
Chandler_Branch	Reach8	14551.4	4842.86	658.56	671.1	671.28	0.00334	4.24	1741.14	495.38	0.25
Chandler_Branch	Reach8	14118.7	4862.93	657.76	670.26	670.36	0.001945	3	2172.63	547.31	0.19
Chandler_Branch	Reach8	13711.6	4873.13	656.61	669.84	669.9	0.000994	2.42	2500.15	506.85	0.14
Chandler_Branch	Reach8	13505.4	4894.56	656.57	669.7	669.76	0.000725	1.98	2650.29	558.71	0.12
Chandler_Branch	Reach8	13073.6	4907.04	655.81	669.13	669.3	0.002677	3.49	1527.62	326.1	0.22
Chandler_Branch	Reach8	12822.9	4922.12	655.35	668.46	668.64	0.002872	3.86	1535.79	324.13	0.23
Chandler_Branch	Reach8	12520.9	4933.05	654.78	667.9	668.01	0.001756	3.03	1904.36	307.55	0.18

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Chandler_Branch	Reach8	12302.6	4941.93	654.38	667.43	667.59	0.002211	3.61	1646.98	384.21	0.21
Chandler_Branch	Reach8	12125.6	4943.48	654.05	666.84	667.11	0.003641	4.23	1215.76	503.56	0.26
Chandler_Branch	Reach8	12094.7	4947.74	653.99	666.57	666.95	0.005242	4.97	1032.52	227.59	0.31
Chandler_Branch	Reach8	12068.7	Bridge								
Chandler_Branch	Reach8	12040.6	4947.74	653.53	666.18	666.57	0.005517	5.05	1009.05	370.69	0.32
Chandler_Branch	Reach8	12010	4957.62	653.08	666.09	666.37	0.003855	4.27	1190.77	889.43	0.27
Chandler_Branch	Reach8	11813.5	4964.96	651.85	665.35	665.59	0.003973	4.15	1310.33	932.99	0.27
Chandler_Branch	Reach8	11668.1	4977.45	651.61	664.92	665.12	0.002898	3.84	1564.78	1016.66	0.23
Chandler_Branch	Reach8	11420.7	4997.7	651.2	664.51	664.6	0.001535	2.5	2119.12	939.88	0.17
Chandler_Branch	Reach8	11021.2	5021.58	650.54	663.6	663.78	0.0031	3.71	1623.74	471.65	0.24
Chandler_Branch	Reach8	10552	5034.95	649.76	662.78	662.86	0.001363	2.44	2240.6	425.29	0.16
Chandler_Branch	Reach8	10290.2	5926.83	649.33	662.11	662.28	0.003474	4.17	1902.02	501.29	0.25
Chandler_Branch	Reach8	10049.4	5949.53	648.93	661.67	661.78	0.001746	3.18	2368.74	517.86	0.18
Chandler_Branch	Reach8	9824.42	5968.04	648.55	661.2	661.4	0.003433	4.54	1736.97	425.69	0.25
Chandler_Branch	Reach8	9641.58	5984.25	648.25	660.51	660.76	0.004341	5.08	1627.42	388.92	0.29
Chandler_Branch	Reach8	9481.96	6000.8	647.99	660.17	660.42	0.001315	2.87	1635.31	382.46	0.16
Chandler_Branch	Reach8	9319.36	6016.3	647.72	660.05	660.28	0.001259	2.79	1725.96	402.52	0.16
Chandler_Branch	Reach8	9167.5	6043.52	645.5	660.05	660.15	0.000628	1.78	2513.97	560.03	0.1
Chandler_Branch	Reach8	9155.66	Bridge								
Chandler_Branch	Reach8	9143.18	6043.52	645.5	660.03	660.11	0.000526	1.64	2710.94	609.66	0.09
Chandler_Branch	Reach8	8901.81	6062.4	647.02	659.95	660.04	0.000726	2.09	2592.06	444.09	0.12
Chandler_Branch	Reach8	8718.23	6075.44	647	659.88	659.99	0.000734	2.03	2444.92	415.63	0.12
Chandler_Branch	Reach8	8696.62	Culvert								
Chandler_Branch	Reach8	8689.15	6075.44	646.74	659.82	659.93	0.000863	2.22	2293.46	403.4	0.13
Chandler_Branch	Reach8	8591.72	6090.37	646.08	659.77	659.87	0.000598	2.02	2477.77	361.83	0.11
Chandler_Branch	Reach8	8447.31	6121.41	645.65	659.66	659.78	0.000925	2.88	2208.32	345.63	0.17
Chandler_Branch	Reach8	8148.1	6135.32	644.75	659.1	659.34	0.002802	4.05	1603.82	298.76	0.23
Chandler_Branch	Reach8	8014.42	6149.45	644.34	658.63	658.93	0.003469	4.49	1456.13	290.74	0.26
Chandler_Branch	Reach8	7879.08	6169.33	643.93	658.3	658.53	0.00239	3.84	1625.83	480.08	0.23
Chandler_Branch	Reach8	7689.12	6183.09	643.36	657.97	658.12	0.001844	3.2	2021.93	554.5	0.19

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Chandler_Branch	Reach8	7557.97	6201.61	643.27	657.79	657.9	0.001118	2.55	2436.41	395.53	0.15
Chandler_Branch	Reach8	7381.92	6217.49	643.23	657.34	657.58	0.003236	4.05	1633.69	258.67	0.25
Chandler_Branch	Reach8	7231.36	6223.89	643.18	656.84	657.09	0.003446	4.11	1579.07	247.65	0.25
Chandler_Branch	Reach8	7170.85	6229.99	643.2	656.62	656.88	0.003588	4.33	1560.08	272.24	0.26
Chandler_Branch	Reach8	7113.17	6241.12	643.12	656.52	656.67	0.002349	3.75	2204.57	453.17	0.21
Chandler_Branch	Reach8	7008.05	6260.05	643.11	656.46	656.53	0.000549	2.09	3144.22	468.57	0.12
Chandler_Branch	Reach8	6982.75	Culvert								
Chandler_Branch	Reach8	6942.06	6260.05	641.51	656.45	656.51	0.000387	1.94	3412.67	502.71	0.11
Chandler_Branch	Reach8	6829.81	6268.41	640.77	656.28	656.42	0.00123	2.97	2119.29	323.34	0.16
Chandler_Branch	Reach8	6751.3	6283.27	640.53	656.2	656.33	0.001014	2.68	2217.67	328.19	0.14
Chandler_Branch	Reach8	6611.87	6303.6	640.11	656.04	656.2	0.0012	2.93	2034.53	309.73	0.15
Chandler_Branch	Reach8	6421.71	6326.33	639.54	655.81	655.97	0.001588	3.2	2012.79	308.6	0.18
Chandler_Branch	Reach8	6209.86	6338.73	638.9	655.31	655.56	0.002543	3.94	1615.1	247.58	0.22
Chandler_Branch	Reach8	6094.6	6355.22	638.55	655.08	655.28	0.002015	3.76	1839.1	278.92	0.2
Chandler_Branch	Reach8	5941.72	6367.72	638.13	654.78	654.97	0.001919	3.62	1893.88	228.36	0.2
Chandler_Branch	Reach8	5826	6403.59	637.81	654.5	654.72	0.002367	3.81	1747.87	209.14	0.22
Chandler_Branch	Reach8	5495.39	6438.58	636.91	653.76	653.97	0.002375	3.91	1845.08	240.87	0.22
Chandler_Branch	Reach8	5174.67	6461.34	636.02	653.04	653.23	0.002412	4.01	1985.13	299.67	0.22
Chandler_Branch	Reach8	4966.97	6484.28	635.45	652.65	652.84	0.002192	4.19	2049.12	300.81	0.21
Chandler_Branch	Reach8	4758.33	6505.51	634.88	652.27	652.48	0.00189	3.82	1979	280.75	0.2
Chandler_Branch	Reach8	4565.97	6524.44	634.35	652.01	652.13	0.001461	3.32	2436.71	384.19	0.17
Chandler_Branch	Reach8	4394.93	6562.18	633.88	651.73	651.87	0.00159	3.43	2302.77	327.92	0.18
Chandler_Branch	Reach8	4055.38	6573.72	632.95	651.43	651.51	0.000885	2.59	3210.02	478.45	0.13
Chandler_Branch	Reach8	3952.02	6603.53	632.66	651.25	651.36	0.001119	3.02	2507.06	318.23	0.15
Chandler_Branch	Reach8	3685.71	6607.61	631.93	650.93	651.09	0.001114	2.97	2201.23	304.84	0.16
Chandler_Branch	Reach8	3649.35	6612.32	631.83	650.88	650.99	0.00103	3.19	2658.16	454.03	0.15
Chandler_Branch	Reach8	3633.91	Bridge								
Chandler_Branch	Reach8	3624.23	6612.32	631.58	650.44	650.57	0.001187	3.57	2526.97	449.05	0.16
Chandler_Branch	Reach8	3607.38	6643.28	631.57	649.95	650.41	0.00438	5.55	1286.05	499.58	0.3
Chandler_Branch	Reach8	3332.44	6643.28	631.59	648.99	649.32	0.003522	4.85	1583.38	450.55	0.28

Table N-8. Summary Output - Chandler Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Chandler_Branch	Reach2	55202.4	120.07	794.5	798.09	798.11	0.000288	0.94	130.62	59.17	0.1
Chandler_Branch	Reach2	54845.4	145.58	796.25	797.9	797.92	0.001071	0.88	165.71	183.8	0.16
Chandler_Branch	Reach2	54474.1	180.47	795.01	796.19	796.48	0.043961	4.33	42.19	76.34	1
Chandler_Branch	Reach2	54059.9	275.36	789.81	794.93	794.97	0.001454	1.79	168.52	57.29	0.16
Chandler_Branch	Reach2	53245.3	417.3	788.72	790.53	791	0.023866	5.56	78.67	72.31	0.85
Chandler_Branch	Reach2	52443.9	586.02	782.73	788.39	788.48	0.001431	2.55	254.59	91.56	0.22
Chandler_Branch	Reach2	51789.3	800.03	783.6	786.35	786.47	0.007182	2.78	301.54	158.05	0.34
Chandler_Branch	Reach2	51189.1	886.01	779.13	784.64	784.71	0.001689	2.21	467.09	170.64	0.18
Chandler_Branch	Reach2	50992.3	1018.01	779.2	784.36	784.41	0.001334	1.86	564.48	154.06	0.16
Chandler_Branch	Reach2	50724.6	1018.01	779.68	783.91	783.98	0.002001	2.23	491.02	154.66	0.2
Chandler_Branch	Reach5	35812.3	5785.39	728.08	735.22	735.33	0.002502	2.93	2208.98	810.35	0.26
Chandler_Branch	Reach5	35578.4	5853.03	727.35	734.64	734.78	0.002524	3.23	2208.22	780.47	0.28
Chandler_Branch	Reach5	35152.7	5905.1	726.03	733.48	733.62	0.002916	3.11	1998.47	621.48	0.27
Chandler_Branch	Reach5	34828.4	5965.39	725.01	732.15	732.35	0.005507	3.9	1937.15	826.67	0.36
Chandler_Branch	Reach5	34456.3	6039.63	723.85	730.28	730.4	0.004046	3.44	2633.23	1309.84	0.32
Chandler_Branch	Reach5	34003.3	6186.82	722.44	729.35	729.42	0.001546	2.61	3965.65	1686.15	0.22
Chandler_Branch	Reach5	33121.5	6247.19	719.88	728.22	728.29	0.001789	2.15	3158.24	802.04	0.17
Chandler_Branch	Reach5	32765.8	6305.21	718.84	727.29	727.42	0.0037	2.96	2296.11	623.81	0.24
Chandler_Branch	Reach5	32427.2	6355.56	717.86	725.86	726.06	0.005233	3.92	1850.03	498.81	0.29
Chandler_Branch	Reach5	32136	6432.48	717.01	724.96	725.16	0.002009	3.7	1866.26	375.24	0.26
Chandler_Branch	Reach5	31695.3	6489.02	715.75	723.47	723.75	0.005368	4.81	1676.09	687.69	0.41
Chandler_Branch	Reach5	31374.8	6489.02	714.82	721.37	721.76	0.007991	5.76	1361.16	462.91	0.49
Chandler_Branch	Reach5	31106	6489.02	714.05	720.56	720.74	0.001998	3.49	2046.77	491.99	0.26
Chandler_Branch	Reach9	3139.03	6756.55	631.45	648.69	648.85	0.001498	3.35	2282.23	419.99	0.18
Chandler_Branch	Reach9	3030.18	6801.78	631.15	648.31	648.61	0.003277	4.79	1759.22	407.21	0.27
Chandler_Branch	Reach9	2742.28	6859.13	630.35	647.62	647.84	0.002207	4.07	1931.82	351.8	0.22
Chandler_Branch	Reach9	2379.91	6914.02	629.35	646.75	646.99	0.002423	4.25	1896.54	308.51	0.23
Chandler_Branch	Reach9	2036.01	6966.96	628.4	646.05	646.24	0.002024	4.08	2222.87	368.35	0.21
Chandler_Branch	Reach9	1706.8	6997.85	627.49	645.33	645.59	0.002411	4.89	1917.63	282.72	0.23
Chandler_Branch	Reach9	1515.94	7014.19	626.96	644.83	645.01	0.001735	3.78	2332.96	365.44	0.2

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River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Chandler_Branch	Reach9	1415.26	7035.02	626.68	644.74	644.85	0.001165	3.25	2989.8	457.82	0.16
Chandler_Branch	Reach9	1365.39	Bridge								
Chandler_Branch	Reach9	1313.61	7035.02	626.65	644.61	644.72	0.000889	2.71	2860.13	338.35	0.14
Chandler_Branch	Reach9	1287.32	7056.22	626.7	644.57	644.69	0.000866	2.83	2568	219.08	0.14
Chandler_Branch	Reach9	1232.54	Bridge								
Chandler_Branch	Reach9	1181.76	7056.22	626.77	644.26	644.45	0.001459	3.69	2104.77	202.23	0.18
Chandler_Branch	Reach9	1157.46	7079.9	626.7	644.09	644.38	0.002163	4.48	1788.77	307.18	0.22
Chandler_Branch	Reach9	1136.24	Bridge								
Chandler_Branch	Reach9	1099.11	7079.9	626.43	643.56	643.98	0.003218	5.43	1459.28	472.35	0.26
Chandler_Branch	Reach9	1012.87	7140.21	624.84	643.51	643.69	0.001245	3.79	2350.02	600.57	0.17
Chandler_Branch	Reach9	646.84	7178.05	622.68	642.97	643.22	0.001791	4.58	2034.34	416.23	0.2
Chandler_Branch	Reach9	418.76	7209.01	621.64	642.56	642.81	0.001716	4.53	2032.79	377.2	0.19
Chandler_Branch	Reach9	233	7209.01	620.34	642.25	642.49	0.002003	4.97	2284.95	594.66	0.2
Chandler_Branch	Reach1	74132.3	445.3	932.08	934.05	934.15	0.009412	2.68	183.71	181.95	0.41
Chandler_Branch	Reach1	73750.9	512.21	928.82	931.5	931.6	0.005311	2.64	222.11	166.14	0.33
Chandler_Branch	Reach1	73169.8	650.92	925.54	927.7	927.81	0.007893	2.78	255.8	240.66	0.39
Chandler_Branch	Reach1	72175	746.31	918.3	921.82	921.94	0.004933	2.98	294.08	192.55	0.33
Chandler_Branch	Reach1	71607.3	859.75	912.95	915.83	916.38	0.022917	6.39	174.9	167.1	0.71
Chandler_Branch	Reach1	71019.9	929.06	906.86	910.49	910.61	0.00485	3.33	373.43	227.28	0.34
Chandler_Branch	Reach1	70698.1	1093.6	902.86	905.78	906.78	0.038749	8.23	144.18	289.16	0.92
Chandler_Branch	Reach1	70021.2	1093.6	892.35	897.58	897.74	0.004179	3.2	364.29	186.61	0.31
Chandler_Branch	Reach1	69634.2	1218.9	891.58	894.58	894.94	0.015254	4.96	268.78	150.19	0.57
Chandler_Branch	Reach1	69134.4	1357.44	885.28	890.4	890.63	0.005829	3.91	365.6	145.21	0.37
Chandler_Branch	Reach1	68638.3	1533.59	883.07	884.55	884.76	0.026393	4.53	420.76	440.42	0.69
Chandler_Branch	Reach1	68076.1	1720.37	875.07	878.94	879.15	0.007275	4.05	528.19	305.99	0.41
Chandler_Branch	Reach1	67546.5	1768.4	868.47	874.59	874.99	0.009681	5.82	380.77	145.41	0.5
Chandler_Branch	Reach1	67419.6	1768.4	868.31	873.17	873.52	0.007768	5.04	411.15	257.23	0.45
Chandler_Branch	Reach1	67033.7	2192.36	865.22	869.72	870.06	0.010355	5.5	485.62	189.37	0.51
Chandler_Branch	Reach1	66218.2	2748.44	856.58	862.54	863.01	0.007443	5.65	520.41	138.74	0.45
Chandler_Branch	Reach1	65360.4	2856.23	848.27	862.26	862.29	0.000246	1.37	2237.4	424.4	0.09

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Chandler_Branch	Reach1	65214.4	2884.04	848.06	862.24	862.26	0.000147	1.18	2594.53	394.31	0.07
Chandler_Branch	Reach1	65177.6	Inl Struct								
Chandler_Branch	Reach1	65112.7	2933.77	849.14	854.73	855.01	0.005665	4.82	720.92	208.28	0.39
Chandler_Branch	Reach1	64586	3179.21	844.82	852.04	852.38	0.004785	4.97	732.62	188.89	0.37
Chandler_Branch	Reach1	64052.5	3483.43	840.62	848.95	849.44	0.006338	5.81	695.33	215.56	0.43
Chandler_Branch	Reach1	63445.7	3846.06	839.59	846.41	846.77	0.003349	5.65	906.79	280.58	0.41
Chandler_Branch	Reach1	62788.1	3846.06	833.83	840.68	842.43	0.016659	10.71	386.01	149.03	0.87
Chandler_Branch	Reach1	62267.9	3918.86	833.11	838.36	838.58	0.003329	4.54	1090.38	382.8	0.39
Chandler_Branch	Reach1	61785.3	4010.24	827.11	835.56	836.47	0.007241	8.32	626.4	234.86	0.59
Chandler_Branch	Reach1	61192.2	4106.22	826.46	832.84	833.27	0.003846	5.55	847.94	250.07	0.43
Chandler_Branch	Reach1	60583.6	4226.49	822.04	830.8	831.21	0.003085	5.23	877.04	228.16	0.39
Chandler_Branch	Reach1	59840.7	4374.63	820.6	828.11	828.59	0.004106	5.84	844.95	231.81	0.44
Chandler_Branch	Reach1	58954.3	4374.63	814.13	821.4	822.71	0.012038	9.4	499.12	134.09	0.75
Chandler_Branch	Reach1	58483.5	4474.35	812.63	820.27	820.53	0.002109	4.37	1241.64	416.17	0.32
Chandler_Branch	Reach1	57970.1	4562.51	808.17	820.16	820.22	0.000223	1.93	2568.83	563.77	0.12
Chandler_Branch	Reach1	57525.6	4584.11	809.71	820	820.09	0.000392	2.48	2037.61	473.53	0.16
Chandler_Branch	Reach1	57418.1	Inl Struct								
Chandler_Branch	Reach1	57340.9	4676.31	807.03	812.14	812.81	0.008556	7.13	755.64	274.94	0.61
Chandler_Branch	Reach1	56964.5	4747.97	802.99	807.04	808.2	0.01808	8.67	555.35	250.67	1
Chandler_Branch	Reach1	56618	4804.86	799.07	804.86	805.58	0.003817	6.99	735.89	173.98	0.53
Chandler_Branch	Reach1	56346.7	4804.86	797.84	804.33	804.76	0.002001	5.35	933.07	182.11	0.39

Table N-9. Summary Output - Cottonwood Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cottonwood Creek	Reach1	65242.71	231.91	808.08	809.59	809.97	0.019513	4.92	47.36	199.03	1
Cottonwood Creek	Reach1	64607.77	312.48	796.67	798.68	798.7	0.000905	1.23	291.72	382.7	0.22
Cottonwood Creek	Reach1	64111.8	360.38	788.83	791.3	791.44	0.004846	3.49	142.02	254.34	0.54
Cottonwood Creek	Reach1	63874.56	368.61	786.81	789.08	789.57	0.010341	5.75	75.62	99.58	0.84
Cottonwood Creek	Reach1	63837.02	Culvert								
Cottonwood Creek	Reach1	63760.18	421.64	780.01	781.53	782.16	0.015564	6.4	66.86	54.26	0.98
Cottonwood Creek	Reach1	63613.46	459.56	778.18	781.02	781.16	0.001752	3.04	151.42	67.24	0.36
Cottonwood Creek	Reach1	63470.21	507.24	776.12	781	781.05	0.000301	1.71	322.88	227.66	0.16
Cottonwood Creek	Reach1	63269.69	Culvert								
Cottonwood Creek	Reach1	62480.31	507.24	768.7	772.34	773.88	0.01265	9.96	50.94	378.2	1
Cottonwood Creek	Reach1	62024.49	537.26	765.01	767.59	767.7	0.002393	3	221.5	825.3	0.4
Cottonwood Creek	Reach1	61759.03	601.01	764.2	765.89	766.28	0.015095	5.77	126.75	693.43	0.94
Cottonwood Creek	Reach1	61241.28	687.48	760.6	762.54	762.54	0.000007	0.12	3139.86	1079.97	0.02
Cottonwood Creek	Reach1	60620.61	761.44	752.11	756.16	756.39	0.006779	4.39	232.38	672.8	0.5
Cottonwood Creek	Reach1	60148.85	834.5	747.45	752.85	753.12	0.007481	4.62	231.47	257.73	0.55
Cottonwood Creek	Reach1	59725.79	944.01	744.28	750.18	750.29	0.005549	3.06	412.26	258.46	0.28
Cottonwood Creek	Reach1	59156.45	1690.56	739.28	747.24	747.36	0.005112	3.62	732.48	452.37	0.28
Cottonwood Creek	Reach1	58070.72	1844.16	735.03	739.7	739.87	0.009586	3.4	571.66	426	0.36
Cottonwood Creek	Reach1	57199.02	2101.19	726.27	734.5	734.65	0.004597	3.18	684.47	303.27	0.26
Cottonwood Creek	Reach1	55891.16	2257.72	721.97	726.92	727.59	0.007205	7.31	404.46	195.28	0.63
Cottonwood Creek	Reach1	55170.95	2324.17	717.7	723.61	723.81	0.004509	4.45	714.74	533.34	0.46
Cottonwood Creek	Reach1	54880.21	2472.88	714.89	722.21	722.62	0.005609	6.61	572.33	481.21	0.6
Cottonwood Creek	Reach1	54258.52	2618.24	712.06	718.47	719.23	0.007311	7.88	419.48	186.55	0.7
Cottonwood Creek	Reach1	53686	2704.58	709.29	715.57	716.07	0.004288	5.89	520.92	271.64	0.53
Cottonwood Creek	Reach1	53360.81	2740.07	705.95	713.42	714.29	0.006971	7.57	387.08	149.14	0.68
Cottonwood Creek	Reach1	53230.11	2740.07	703.95	713.15	713.63	0.00274	5.55	504.5	473.94	0.44
Cottonwood Creek	Reach1	53148.76	2751.58	703.38	713.2	713.35	0.000783	3.51	1072.45	822.37	0.24
Cottonwood Creek	Reach1	53128.96	Bridge								
Cottonwood Creek	Reach1	53114.44	2751.58	703.15	711.95	712.7	0.002885	7.16	462.56	542.11	0.46
Cottonwood Creek	Reach1	53060.81	2778.64	702.94	711.99	712.37	0.002492	5.58	694.06	593.12	0.42

Table N-9. Summary Output - Cottonwood Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cottonwood Creek	Reach1	52855.35	2798.37	702.11	710.05	711.25	0.010156	9.23	348.27	417.01	0.81
Cottonwood Creek	Reach1	52706.83	2835.85	701.52	709.45	709.8	0.002697	5.32	657.07	582.55	0.43
Cottonwood Creek	Reach1	52427.6	2914.9	700.39	709.12	709.19	0.001685	2.38	1357.52	741.12	0.18
Cottonwood Creek	Reach1	51850.48	2955.33	698.07	708.2	708.35	0.004458	3.57	1057.25	694.15	0.29
Cottonwood Creek	Reach1	51561.28	2997.75	696.91	706.3	706.81	0.008713	6.38	583.66	369.04	0.44
Cottonwood Creek	Reach1	51262.14	3088.75	695.71	704.7	704.91	0.006882	4.34	864.32	473.01	0.36
Cottonwood Creek	Reach1	50634.41	3140	693.18	702.56	702.72	0.004241	3.85	1019.21	441.28	0.29
Cottonwood Creek	Reach1	50288.98	3185.51	692.22	701.41	701.65	0.004535	4.78	921.8	456.91	0.32
Cottonwood Creek	Reach1	49986.91	3230.77	690.58	701.02	701.12	0.001997	3.34	1306.17	564.08	0.21
Cottonwood Creek	Reach1	49690.79	3357.35	689.39	700.41	700.58	0.003045	3.91	1075.4	528.09	0.26
Cottonwood Creek	Reach1	48884.05	3410.66	686.15	696.72	697.3	0.01032	6.98	610.65	359.37	0.47
Cottonwood Creek	Reach1	48553.42	3410.66	686.99	694.48	694.78	0.006381	5.44	832.04	319.2	0.38
Cottonwood Creek	Reach1	48113.98	3437.73	683.05	692.3	692.57	0.005622	4.21	833.24	291.41	0.34
Cottonwood Creek	Reach1	47910.99	3459.59	682.24	691.45	691.92	0.001916	6.47	686.93	175.54	0.44
Cottonwood Creek	Reach1	47748.27	3518.45	681.58	690.85	691.49	0.00367	6.54	577.28	199.12	0.57
Cottonwood Creek	Reach1	47315.16	3591.91	679.84	689.2	690.03	0.00335	8.92	569.76	164.81	0.58
Cottonwood Creek	Reach1	46784.67	3625.14	677.71	686.29	687.71	0.006944	10.36	427.41	146.55	0.8
Cottonwood Creek	Reach1	46548.26	3716.84	676.86	685.61	686.02	0.001769	5.12	740.64	170.78	0.41
Cottonwood Creek	Reach1	45906.91	3763.77	674.95	684.28	684.77	0.002523	6.41	738.24	229.28	0.48
Cottonwood Creek	Reach1	45584.77	3774.98	674.02	682.53	683.62	0.00446	9.9	556.81	241.29	0.67
Cottonwood Creek	Reach1	45508.46	3778.42	673.81	682.79	683.22	0.001519	5.85	823.45	253.78	0.4
Cottonwood Creek	Reach1	45485.05	3805.25	673.74	682.35	683.13	0.004824	8.15	602.91	225.48	0.66
Cottonwood Creek	Reach1	45303.37	3855.48	673.22	681.95	682.52	0.002155	6.79	759.87	261.61	0.47
Cottonwood Creek	Reach1	44966.71	3883.62	672.25	681.01	681.69	0.003047	7.63	781.3	399.3	0.55
Cottonwood Creek	Reach1	44780.05	3917.64	671.72	680.91	681.11	0.00142	5.25	1297.2	581.22	0.37
Cottonwood Creek	Reach1	44764.24	Culvert								
Cottonwood Creek	Reach1	44748.87	3917.64	671.63	680.88	681.06	0.001303	4.81	1349	597.82	0.35
Cottonwood Creek	Reach1	44556.1	3977.88	671.08	680.67	680.82	0.000959	4.61	1514.1	716.19	0.31
Cottonwood Creek	Reach1	44164.38	4067.95	669.95	680.32	680.54	0.001007	4.83	1408.36	626.58	0.32
Cottonwood Creek	Reach1	43589.51	4100.53	668.32	677.49	677.75	0.001621	5.19	1155.24	474.2	0.39

Table N-9. Summary Output - Cottonwood Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cottonwood Creek	Reach1	43384.72	4131.99	667.72	676.36	677.05	0.004798	9.08	741.27	410.96	0.66
Cottonwood Creek	Reach1	43373.59	Culvert								
Cottonwood Creek	Reach1	43360.51	4131.99	667.65	676.24	676.94	0.004521	8.33	722.58	356.1	0.65
Cottonwood Creek	Reach1	43188.53	4192.31	667.14	675.87	676.29	0.00253	7.14	944.06	684.22	0.5
Cottonwood Creek	Reach1	42816.46	4264.18	666.05	675.58	675.7	0.000763	3.72	1610.34	499.3	0.27
Cottonwood Creek	Reach1	42380.06	4264.18	666.71	674.97	675.12	0.003456	3.85	1486.25	525.43	0.25
Cottonwood Creek	Reach1	42127.37	4323.58	666.6	674.17	674.3	0.003387	3.54	1516.9	471.65	0.24
Cottonwood Creek	Reach1	41811.06	4400.64	664.47	673.02	673.26	0.003935	4.76	1186.29	480.29	0.32
Cottonwood Creek	Reach1	41407.09	4440.28	664.7	670.72	671.17	0.008369	4.74	840.09	258.72	0.37
Cottonwood Creek	Reach1	41202.08	4496.93	661.31	669.9	670.14	0.002978	3.38	1174.34	363.97	0.23
Cottonwood Creek	Reach1	40912.17	4496.93	660.45	669.48	669.59	0.002081	2.91	1665.91	454.47	0.19
Cottonwood Creek	Reach1	40672.11	4481.72	659.75	669.24	669.32	0.001254	2.39	1984.74	475.1	0.16
Cottonwood Creek	Reach1	40452.71	4454.41	659.15	668.85	669.02	0.00197	2.62	1496.76	565.07	0.18
Cottonwood Creek	Reach1	40056.85	4412.73	658.06	665.59	667.3	0.029522	10.83	496.91	409.35	0.78
Cottonwood Creek	Reach1	39448.08	4412.73	656.4	664.44	666.09	0.008414	11.56	523.7	517.73	0.89
Cottonwood Creek	Reach1	39120.57	4412.73	655.5	664.71	664.91	0.001406	4.53	1347.67	845.41	0.36
Cottonwood Creek	Reach1	38432.82	4412.73	653.62	662.52	663.56	0.004849	9.69	722.47	372.96	0.69
Cottonwood Creek	Reach1	38141.8	4412.73	652.82	662.77	662.9	0.000588	4.25	1823.02	592.39	0.25
Cottonwood Creek	Reach1	37992.83	4412.73	652.34	662.67	662.76	0.000366	2.99	2237.51	773.09	0.2
Cottonwood Creek	Reach1	37832.31	4784.93	652.7	662.5	662.67	0.001149	3.54	1712.07	860.29	0.32
Cottonwood Creek	Reach1	37784.68	Culvert								
Cottonwood Creek	Reach1	37731.39	4784.93	652.56	660.95	661.06	0.000349	2.85	1959.21	565.49	0.19
Cottonwood Creek	Reach1	37616.99	4792.5	651.13	660.74	660.97	0.000736	4.3	1532.14	541.79	0.28
Cottonwood Creek	Reach1	37495.58	4793.66	650.74	660.48	660.78	0.001819	5.68	1310.51	577.37	0.42
Cottonwood Creek	Reach1	37476.93	4814.63	650.68	660.41	660.75	0.002243	5.94	1230.85	566.66	0.46
Cottonwood Creek	Reach1	37141.29	4828.37	649.61	659.88	660.21	0.001745	5.41	1210.49	474.16	0.41
Cottonwood Creek	Reach1	36922.1	4840.8	648.9	659.29	659.71	0.003182	6.41	1095.68	416.81	0.4
Cottonwood Creek	Reach1	36724.41	4854.97	648.27	658.75	659.18	0.004122	6.76	1058.35	494.43	0.43
Cottonwood Creek	Reach1	36499.7	4893.57	647.54	658.56	658.61	0.000627	2.3	2860.93	1172.46	0.13
Cottonwood Creek	Reach1	36458.43	Culvert								

Table N-9. Summary Output - Cottonwood Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cottonwood Creek	Reach1	36410.29	4893.57	647.26	657.82	657.87	0.000647	2.17	2878.16	1137.95	0.13
Cottonwood Creek	Reach1	35890.81	4920.4	645.59	657	657.4	0.003164	4.74	1012.46	537.93	0.28
Cottonwood Creek	Reach1	35470.45	4938.91	648.22	655.66	656.01	0.003905	3.99	1101.51	458.29	0.3
Cottonwood Creek	Reach1	35181.77	4964.65	646.57	654.4	654.88	0.003739	7.46	1072.18	544.46	0.59
Cottonwood Creek	Reach1	34782.07	5281.15	642.02	654.18	654.37	0.000472	4.18	2065.31	757.94	0.24
Cottonwood Creek	Reach1	34757.44	Culvert								
Cottonwood Creek	Reach1	34729.04	5281.15	641.85	652.57	653.54	0.002326	8.41	889.45	534.1	0.51
Cottonwood Creek	Reach1	34377.9	5348.47	640.72	651.91	652.37	0.002954	6.98	1236	633.3	0.52
Cottonwood Creek	Reach1	33924.68	5355.01	639.27	651.2	651.41	0.001312	5.08	1831.58	809.25	0.32
Cottonwood Creek	Reach1	33881	Inl Struct								
Cottonwood Creek	Reach1	33858.26	5388.27	639.05	651.19	651.33	0.000769	3.9	2239.78	842.5	0.25
Cottonwood Creek	Reach1	33659.43	5399.56	638.41	651.07	651.2	0.000727	4.05	2414.58	866.34	0.24
Cottonwood Creek	Reach1	33650.75	Culvert								
Cottonwood Creek	Reach1	33637	5399.56	638.34	651.04	651.16	0.000724	4.1	2426.28	888.45	0.24
Cottonwood Creek	Reach1	33584.54	5403.96	638.17	651.01	651.13	0.000578	3.75	2529.57	891.37	0.22
Cottonwood Creek	Reach1	33555.38	5468.42	638.08	650.99	651.11	0.000578	3.88	2535.72	911.92	0.22
Cottonwood Creek	Reach1	33537.5	Bridge								
Cottonwood Creek	Reach1	33515.41	5468.42	637.97	650.93	651.05	0.00055	3.68	2642.45	1046.92	0.22
Cottonwood Creek	Reach1	33131.14	5520.98	637.38	650.59	650.76	0.001105	4.16	1799.94	1064.42	0.24
Cottonwood Creek	Reach1	32788.89	5628.65	636.86	650.47	650.53	0.000339	2.45	3226.31	1202.08	0.14
Cottonwood Creek	Reach1	32097.79	5672.69	635.8	650.4	650.42	0.000093	1.47	4778.73	1251.48	0.08
Cottonwood Creek	Reach1	31818.98	5689.04	635.38	650.35	650.4	0.000109	2.15	3394.92	1431.81	0.11
Cottonwood Creek	Reach1	31716.01	5694.16	635.22	650.23	650.37	0.000253	3.11	1939.22	1247.74	0.17
Cottonwood Creek	Reach1	31683.82	5880.06	635.17	650.1	650.33	0.000407	4.07	1555.35	1247.52	0.22
Cottonwood Creek	Reach1	31610.52	Bridge								
Cottonwood Creek	Reach1	31570.1	5880.06	634.94	648.88	649.5	0.001199	7.14	985.57	155.84	0.38
Cottonwood Creek	Reach1	31565.51	5880.92	634.9	648.9	649.47	0.001284	7.25	1369.55	483.94	0.39
Cottonwood Creek	Reach1	31557.21	Culvert								
Cottonwood Creek	Reach1	31547.29	5880.92	634.72	649.26	649.37	0.000219	3.2	2294.44	1352.55	0.16
Cottonwood Creek	Reach1	31520.9	5880.92	634.47	647.87	649.04	0.002129	8.96	721.61	96.83	0.5

Table N-9. Summary Output - Cottonwood Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cottonwood Creek	Reach1	31520.87	5882.13	634.47	647.73	648.94	0.002243	9.11	707.85	95.38	0.51
Cottonwood Creek	Reach1	31502.94	Bridge								
Cottonwood Creek	Reach1	31479.76	5882.13	633.7	646.67	648.44	0.003883	11.19	589.05	269.49	0.65
Cottonwood Creek	Reach1	31458.04	5884.6	633.03	647.22	647.81	0.001193	6.3	964.37	1133.99	0.37
Cottonwood Creek	Reach1	31437.69	Culvert								
Cottonwood Creek	Reach1	31415.63	5884.6	632.35	647.13	647.16	0.000103	1.9	4763.71	1113.98	0.11
Cottonwood Creek	Reach1	31330.24	5892.08	632.15	645.25	646.71	0.00537	10.33	718.88	716.32	0.72
Cottonwood Creek	Reach1	30942.78	5898.47	631.25	643.15	643.81	0.001961	7.89	1155.02	449.38	0.46
Cottonwood Creek	Reach1	30612.42	5902.02	630.47	642.43	643	0.003071	7.36	1228.18	688.14	0.54
Cottonwood Creek	Reach1	30429.45	5906.45	630.04	642.22	642.48	0.001292	5.5	1898.2	897.28	0.36
Cottonwood Creek	Reach1	30401.86	Culvert								
Cottonwood Creek	Reach1	30385.06	5906.45	630	642.24	642.42	0.000866	4.71	2225.64	918.04	0.3
Cottonwood Creek	Reach1	30200.53	5909.35	629.56	641.63	642.12	0.001775	7.23	1354.72	443.86	0.43
Cottonwood Creek	Reach1	30050.76	5912.35	629	641.2	641.61	0.006846	5.8	1363.62	386.45	0.37
Cottonwood Creek	Reach1	29896.36	5914.27	629.7	639.99	640.46	0.009659	6.85	1256.62	395	0.44
Cottonwood Creek	Reach1	29797.36	5917.02	629.15	639.57	639.67	0.001309	2.74	2337.71	413.24	0.17
Cottonwood Creek	Reach1	29655.78	5919.98	628.84	638.85	639.27	0.006673	4.65	1158.7	409.05	0.35
Cottonwood Creek	Reach1	29503.3	5922.05	628.39	638.09	638.39	0.004601	4.2	1346.13	490.72	0.31
Cottonwood Creek	Reach1	29396.5	5925.78	628.2	637.65	637.89	0.003433	3.14	1565.83	570.79	0.25
Cottonwood Creek	Reach1	29204.96	5929.72	627.52	636.99	637.25	0.004404	4.29	1469.59	724.4	0.31
Cottonwood Creek	Reach1	29002.29	5932.87	626.92	636.4	636.63	0.004832	4.43	1629.55	792.95	0.31
Cottonwood Creek	Reach1	28840.07	5936.68	626.45	635.63	635.91	0.005297	3.45	1442	756.73	0.3
Cottonwood Creek	Reach1	28644.6	5942.64	625.88	634.84	635.12	0.004464	4.87	1437.14	771.91	0.37
Cottonwood Creek	Reach1	28338.74	5945.75	625.08	633.73	634.19	0.003582	7.65	1452.06	823.14	0.58
Cottonwood Creek	Reach1	28179.14	5954.81	624.66	633.5	633.8	0.002374	6.5	1727.62	894.04	0.48
Cottonwood Creek	Reach1	27715.09	5962.78	623.46	632.55	633	0.004022	7.28	1341.9	823.3	0.6
Cottonwood Creek	Reach1	27307.34	5975.83	622.4	631.98	632.08	0.001439	2.36	2485.65	920.99	0.16
Cottonwood Creek	Reach1	26641.3	5984.22	620.68	631.05	631.22	0.005015	4.73	1952.1	917.43	0.31
Cottonwood Creek	Reach1	26213.72	5999.21	619.57	629.78	629.95	0.005105	4.86	2018.48	1018.23	0.31
Cottonwood Creek	Reach1	25451.3	6005.38	617.59	627.23	627.5	0.003972	5.09	1488.8	746.34	0.38

Table N-9. Summary Output - Cottonwood Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cottonwood Creek	Reach1	25137.57	6019.17	616.77	626.78	626.9	0.001032	2.96	2313.96	875.05	0.2
Cottonwood Creek	Reach1	24438.75	6026.79	614.95	625.69	625.85	0.002233	4.29	1952.59	949.86	0.29
Cottonwood Creek	Reach1	24053.01	6041.91	613.94	624.88	625.02	0.002499	3.82	2156.65	1250.83	0.23
Cottonwood Creek	Reach1	23289.53	6056.36	611.95	621.84	622.32	0.002561	8.07	1703.66	719.91	0.52
Cottonwood Creek	Reach1	22561.07	6069.12	610.05	619.42	619.78	0.012333	5.56	1351.84	709.79	0.46
Cottonwood Creek	Reach1	21919.71	6080.3	608.41	618.04	618.25	0.001615	6.3	2114.1	911.74	0.4
Cottonwood Creek	Reach1	21359.06	7048.52	606.87	617.53	617.71	0.002668	3.09	2109.81	824.96	0.22
Cottonwood Creek	Reach1	20715.8	7065.08	605.15	616.33	616.53	0.003815	3.56	1939.63	1287.7	0.26
Cottonwood Creek	Reach1	19611.47	7065.08	602.19	612.63	612.86	0.005213	3.74	1867.49	1222.28	0.3
Cottonwood Creek	Reach1	18792.29	7076.46	603.69	608.74	609.21	0.005196	2.32	1569.86	828.26	0.28
Cottonwood Creek	Reach1	18101.38	7141.47	598	607.6	607.68	0.001184	1.88	3370.61	1609.07	0.15
Cottonwood Creek	Reach1	17373.24	7341.04	595.89	604.39	605.14	0.033846	8	1153.52	1128.86	0.73
Cottonwood Creek	Reach1	15178.58	7493.42	589.18	600.63	601.09	0.002155	8.01	1862.23	919.74	0.54
Cottonwood Creek	Reach1	14339.25	7534	584.6	597.52	599.12	0.003773	13.03	924.51	293.94	0.74
Cottonwood Creek	Reach1	12928.89	7542.24	576.87	597	597.05	0.000145	2.49	4532.84	825.7	0.13
Cottonwood Creek	Reach1	12643.46	7544.13	581.84	596.96	597.02	0.000182	2.98	4515.83	1257.96	0.15
Cottonwood Creek	Reach1	12596.13	Bridge								
Cottonwood Creek	Reach1	12557.5	7544.13	579.75	592.79	593.27	0.004504	6.46	1497.85	524.4	0.43
Cottonwood Creek	Reach1	12355.19	7554.96	579.11	592.05	592.33	0.003638	4.86	1914.92	826.44	0.36
Cottonwood Creek	Reach1	11194.66	7561.53	575.45	587.43	587.92	0.003342	6.09	1379.48	445.32	0.41
Cottonwood Creek	Reach1	10491.06	7567.06	573.24	585.44	585.83	0.002895	5.13	1571.4	449.12	0.38
Cottonwood Creek	Reach1	9900.327	7747.36	568.42	583.73	584.11	0.002762	5.16	1568.23	484.81	0.3
Cottonwood Creek	Reach1	9018.586	7763.99	565.13	580.46	581.08	0.005326	8.15	1402.11	779.15	0.49
Cottonwood Creek	Reach1	7947.667	7777.77	561.18	576.81	577.3	0.002638	6.86	1579.06	609.41	0.37
Cottonwood Creek	Reach1	7061.162	7802.35	557.91	575.86	576.05	0.001104	4.07	2307.76	735.63	0.23
Cottonwood Creek	Reach1	5484.309	7802.35	552.09	574.42	574.59	0.001375	3.2	3034.38	749.2	0.15
Cottonwood Creek	Reach1	3741.852	7930.65	555.89	568.91	569.76	0.021869	8.24	1321.02	2479.43	0.6
Cottonwood Creek	Reach1	2117.039	7760.02	549.19	569.23	569.4	0.002506	3.92	2787.82	2658.27	0.22
Cottonwood Creek	Reach1	1112.838	7760.02	545.47	558.41	562.29	0.060138	15.81	490.84	562	1

Table N-10. Summary Output - Dam 18 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Dam18	Reach1	8271.07	178.92	642	644.78	644.81	0.00078	1.62	195	352.6	0.22
Dam18	Reach1	7876.736	241.68	638.95	642.17	642.71	0.011549	6.06	43.76	45.88	0.85
Dam18	Reach1	7633.87	277.24	637.08	641.86	641.93	0.00075	2.26	172.4	202.77	0.24
Dam18	Reach1	7523.008	284.28	636.22	641.83	641.86	0.000556	1.75	257.58	296.07	0.2
Dam18	Reach1	7502.753	Culvert								
Dam18	Reach1	7483.623	284.28	635.97	641.6	641.64	0.000465	1.81	236.41	255.29	0.19
Dam18	Reach1	7436.653	378.03	635.84	641.51	641.6	0.000787	2.62	201.74	165.75	0.25
Dam18	Reach1	7272.527	399.25	635.36	641.32	641.37	0.003274	2.12	259.22	183.8	0.2
Dam18	Reach1	7228.423	410.72	635.23	641.16	641.22	0.003431	2.26	240.83	158.14	0.21
Dam18	Reach1	7205.538	Culvert								
Dam18	Reach1	7143.407	410.72	634.98	640.91	640.92	0.00076	1.1	526.57	324.23	0.1
Dam18	Reach1	7083.166	546.37	634.81	640.76	640.82	0.002856	2.13	348	256.2	0.19
Dam18	Reach1	6975.032	600.94	634.49	640.58	640.61	0.001102	1.43	549.38	336.49	0.12
Dam18	Reach1	6898.126	624.45	634.27	640.37	640.42	0.006272	2.42	401.23	425.23	0.27
Dam18	Reach1	6867.127	Culvert								
Dam18	Reach1	6833.341	624.45	634.04	640.33	640.4	0.004488	2.6	417.25	478.45	0.24
Dam18	Reach1	6753.239	785.77	633.51	639.31	639.64	0.017321	4.69	186.86	97.17	0.46
Dam18	Reach1	6681.521	825.13	633.03	638.87	639	0.004327	2.93	320.92	131.28	0.24
Dam18	Reach1	6642.037	825.13	632.76	638.5	638.73	0.010553	3.87	213.06	60.45	0.36
Dam18	Reach1	6610.027	Bridge								
Dam18	Reach1	6562.315	825.13	632.14	637.83	638	0.006319	3.32	253.98	75.2	0.29
Dam18	Reach1	6553.626	827.13	632.01	637.81	637.94	0.003947	3.04	294.74	79.55	0.24
Dam18	Reach1	6535.412	832.13	631.73	637.7	637.85	0.006102	3.06	272.13	73.33	0.28
Dam18	Reach1	6506.8	Bridge								
Dam18	Reach1	6468.43	833.07	630.79	637.04	637.27	0.011319	3.9	213.43	63.06	0.37
Dam18	Reach1	6455.851	834.17	630.67	636.95	637.11	0.008772	3.28	254.5	81.38	0.33
Dam18	Reach1	6441.16	835.72	630.53	636.71	636.94	0.012653	3.86	216.66	71.2	0.39
Dam18	Reach1	6420.444	Bridge								
Dam18	Reach1	6399.919	835.72	630.9	634.71	635.46	0.063585	6.94	120.46	55.37	0.83
Dam18	Reach1	6287.142	879	630.34	633.43	633.92	0.005345	5.7	171.37	153.92	0.63
Dam18	Reach1	5858.728	906.28	626.32	631.05	631.59	0.005431	6.22	166.7	204.48	0.65

Table N-10. Summary Output - Dam 18 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Dam18	Reach1	5518.777	929.11	624.73	628.85	629.44	0.007563	6.31	158.19	191.91	0.74
Dam18	Reach1	5242.017	957.81	623.29	627.24	627.58	0.00573	5.41	213.7	165.24	0.64
Dam18	Reach1	4903.557	1001.24	621.94	625.84	626.07	0.003757	4.42	273.35	189.03	0.52
Dam18	Reach1	4410.177	1025.74	619.64	624.67	624.82	0.001878	3.9	508.23	424.3	0.39
Dam18	Reach1	4141.238	1052.61	622.53	623.32	623.59	0.018968	3.03	277.67	539.85	0.89
Dam18	Reach1	3853.604	1087.85	616.71	621.91	621.98	0.000554	2.23	514.04	446.44	0.2
Dam18	Reach1	3487.235	1120.94	616.51	620.89	621.44	0.00631	6.35	221.15	1171.27	0.71
Dam18	Reach1	3153.922	1151.15	614.26	620.27	620.42	0.001534	3.6	401.28	1081.19	0.35
Dam18	Reach1	2858.017	1201.46	614.1	619.85	620.01	0.001658	3.9	414.83	1076.88	0.37
Dam18	Reach1	2382.132	1226.91	613.22	617.16	618.28	0.01382	8.5	144.26	64.21	1
Dam18	Reach1	2148.946	1264.12	610.08	615.45	616.03	0.005355	6.12	206.43	61.02	0.59
Dam18	Reach1	1816.591	1294.83	608.79	613.98	614.44	0.004113	5.49	235.93	66.73	0.51
Dam18	Reach1	1549.584	1294.83	607.7	612.48	613.09	0.00625	6.29	205.97	64.77	0.62
Dam18	Reach1	985.6104	1329.09	604.4	612.78	612.8	0.000071	1.13	1272.57	688.88	0.08
Dam18	Reach1	909.2335	1345.94	606.53	612.62	612.77	0.000852	3.14	428.26	570.14	0.26
Dam18	Reach1	872.3931	Bridge								
Dam18	Reach1	832.1856	1345.94	604.89	612.6	612.7	0.000375	2.45	548.96	568.41	0.18
Dam18	Reach1	794.2153	1390.56	607.53	611.73	612.46	0.010852	7.05	215.91	580.35	0.87
Dam18	Reach1	777.0065	1419.34	609.17	611.37	612	0.013996	6.39	227.1	566.36	0.96
Dam18	Reach1	717.0882	1436.55	603.59	609.68	609.95	0.001569	4.19	343.18	392.65	0.37
Dam18	Reach1	681.8404	Bridge								
Dam18	Reach1	640.7347	1436.55	603.97	609.43	609.78	0.002359	4.78	300.37	335	0.45
Dam18	Reach1	528.0754	1644.54	601.45	609.22	609.56	0.001647	4.68	351.23	306.45	0.39
Dam18	Reach1	286.38	1644.54	601.33	606.84	608.34	0.012932	9.84	167.14	395.86	1
Dam18	Reach2	25412.15	301.68	762.95	765.99	766.34	0.006539	4.76	64.83	53.33	0.65
Dam18	Reach2	24808.01	363.07	758.1	759.41	759.73	0.019891	5.49	81.94	138.07	1.03
Dam18	Reach2	24037.86	399.58	747.75	751.54	751.95	0.006225	5.85	99.14	168.93	0.66
Dam18	Reach2	23639.58	434.63	744.94	749.05	749.3	0.004689	5.02	139.21	265.18	0.57
Dam18	Reach2	23290.01	444.05	742.48	746.62	746.65	0.004135	1.83	349.98	334.58	0.22
Dam18	Reach2	23200.85	445.14	741.85	745.86	745.93	0.012792	2.58	220.78	300.42	0.37
Dam18	Reach2	23190.67	Culvert								

Table N-10. Summary Output - Dam 18 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Dam18	Reach2	23182.24	465.15	741.72	745.85	745.9	0.006837	2.57	278.84	317.4	0.28
Dam18	Reach2	23007.8	556.71	737.92	743.22	743.67	0.022955	5.55	115.53	158.58	0.55
Dam18	Reach2	22260.79	571.54	732.01	735.7	735.77	0.005977	2.61	278.14	279.7	0.28
Dam18	Reach2	22151.55	575.12	730.75	734.31	734.6	0.045753	5.81	160.31	272.26	0.73
Dam18	Reach2	22125.58	Culvert								
Dam18	Reach2	22099.05	590.94	729.52	733.35	733.46	0.012074	3.28	238.16	243.18	0.38
Dam18	Reach2	22012.77	632.9	728.54	732.46	732.57	0.009073	3.06	266.08	266.75	0.34
Dam18	Reach2	21727.57	694.06	726.39	730.66	730.72	0.005375	2.65	378.87	344.87	0.27
Dam18	Reach2	21344.05	759.82	722.13	726.77	727.06	0.020783	4.97	198.45	208.43	0.52
Dam18	Reach2	20967.69	848.85	719.73	723.14	723.22	0.006172	2.26	392.3	340.43	0.27
Dam18	Reach2	20507.04	936.58	716.97	720.33	720.63	0.005854	4.7	276.96	257.55	0.52
Dam18	Reach2	20098.14	973.97	712.7	716.3	716.55	0.019325	3.95	249.78	427.03	0.48
Dam18	Reach2	19935.41	982.18	710.34	714.78	714.87	0.006896	3.37	487.21	350.12	0.32
Dam18	Reach2	19900.53	Culvert								
Dam18	Reach2	19882.01	1007.85	709.27	714.37	714.49	0.008059	3.59	456.92	356.65	0.34
Dam18	Reach2	19793.23	1054.54	709.92	713.8	713.86	0.005313	2.42	511.07	253.88	0.26
Dam18	Reach2	19604.97	1642.23	709.22	712.66	712.79	0.009184	3.14	561.75	257.3	0.34
Dam18	Reach2	19414.71	1642.23	706.51	710.67	710.96	0.018762	5.2	417.84	227.21	0.51
Dam18	Reach2	19030.25	1698.52	704.1	708.54	708.62	0.003731	2.69	730.63	230.63	0.24
Dam18	Reach2	18602.9	1750.75	699.73	706.4	706.58	0.00648	4.26	550.4	272.94	0.32
Dam18	Reach2	18218.86	1810.69	696.75	703.66	703.84	0.006949	4.6	589.71	357.81	0.34
Dam18	Reach2	17792	1826.74	692.89	700.62	700.8	0.007569	3.49	551.05	322.59	0.33
Dam18	Reach2	17680.1	1838.99	691.95	697.47	698.74	0.064126	9.15	210.8	87.48	0.93
Dam18	Reach2	17595.36	1838.99	691.25	698.17	698.21	0.000263	2.11	1216.92	1000.23	0.16
Dam18	Reach2	17524.07	Culvert								
Dam18	Reach2	17452.13	1870.35	690.06	695.26	695.44	0.001138	3.54	583.33	272.87	0.32
Dam18	Reach2	17251.08	1909.13	688.39	695.11	695.25	0.000803	3.06	638.62	160.65	0.27
Dam18	Reach2	17007.11	1959.49	686.36	693.37	694.51	0.006697	8.56	228.96	57.16	0.75
Dam18	Reach2	16697.54	1987.61	684.69	692.14	692.44	0.006341	5.52	473.23	178.44	0.41
Dam18	Reach2	16528.11	2041.32	682.33	690.25	690.92	0.012032	7.61	337.18	99.75	0.57
Dam18	Reach2	16211.11	2082.55	680.49	688.42	688.62	0.004534	4.25	599.88	333.17	0.34

Table N-10. Summary Output - Dam 18 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Dam18	Reach2	15973.39	2166.61	679.37	686.86	687.29	0.00687	5.9	484.01	244.05	0.44
Dam18	Reach2	15502.91	2225.03	677.47	684.32	684.57	0.005023	4.67	604.41	332.53	0.37
Dam18	Reach2	15186.58	2287.51	675.79	682.99	683.19	0.004088	4.42	758.55	510.79	0.34
Dam18	Reach2	14857.38	2350.22	674.33	681.22	681.44	0.006835	4.76	651.22	468.53	0.41
Dam18	Reach2	14456.58	2406.6	672.72	679.3	679.59	0.006162	4.67	629.18	470.97	0.47
Dam18	Reach2	14253.96	2457.5	671.61	678.39	678.57	0.004319	4.51	803.89	579.92	0.34
Dam18	Reach2	14005.15	2533.22	670.19	676.54	677.06	0.010883	6.86	487.21	250.07	0.62
Dam18	Reach2	13644.37	2578.76	668.35	674.06	674.46	0.005791	7.25	587.87	439.76	0.68
Dam18	Reach2	13432.5	2667.23	667.22	672.84	673.28	0.006347	7.13	631.65	576.75	0.71
Dam18	Reach2	13031.5	2756.71	664.55	671.36	671.67	0.003556	5.95	706.31	460.54	0.54
Dam18	Reach2	12639.17	2842.72	661.93	669.7	670.27	0.004366	7.59	601.74	373.59	0.62
Dam18	Reach2	12273.89	2923.95	659.5	667.41	668.25	0.008649	8.78	465.92	311.16	0.82
Dam18	Reach2	11938.92	3022.41	657.26	666.57	666.99	0.001726	5.89	727.5	301.05	0.41
Dam18	Reach2	11545.17	3030.72	655.62	665.78	665.95	0.004368	3.54	946.62	422.12	0.26
Dam18	Reach2	11512.56	3033.43	655.49	665.65	665.81	0.004053	3.39	965.39	421.82	0.25
Dam18	Reach2	11501.91	Culvert								
Dam18	Reach2	11480.17	3051.14	655.35	665.1	665.3	0.004443	3.82	889.98	391.8	0.27
Dam18	Reach2	11432.72	3137.16	655.16	664.87	665.1	0.004551	3.74	893.66	379.77	0.27
Dam18	Reach2	11102.16	3137.16	653.78	663.59	663.74	0.00416	3.49	1052.32	446.41	0.26

Table N-11. Summary Output - Dam 22 Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Dam22	Reach1	7462.103	875.49	606.54	610.2	610.39	0.003451	4.77	280.41	182.6	0.47
Dam22	Reach1	7110.028	1351.82	603.55	607.45	608.15	0.011406	8.41	233.39	154.18	0.84
Dam22	Reach1	6370.68	1367.29	600.86	604.53	604.57	0.000456	1.87	880.67	324.59	0.17
Dam22	Reach1	6351.31	1384.8	602.26	604.06	604.51	0.016212	6.64	277.95	279.56	0.91
Dam22	Reach1	6329.662	1384.8	599.62	602.04	602.52	0.017789	7.28	259.75	244.16	0.96
Dam22	Reach1	4554.477	64.06	584.44	585.93	585.97	0.002238	1.5	42.62	55.07	0.3
Dam22	Reach1	4216.463	64.82	582.79	585.92	585.92	0.000034	0.37	274.93	322.17	0.04
Dam22	Reach1	4200.32	68.75	582.71	584.67	585.63	0.019044	7.87	8.74	34.68	1.01
Dam22	Reach1	4185.925	Culvert								
Dam22	Reach1	4169.959	68.75	582.14	584.5	584.76	0.031204	4.06	16.95	34.49	1.02
Dam22	Reach1	4119.94	79.92	582	583.99	584.06	0.003046	2.13	37.57	35.33	0.36
Dam22	Reach1	3914.656	102.61	581.25	582.71	582.91	0.009955	3.58	29.27	196.04	0.65
Dam22	Reach1	3573.655	105.91	579.65	582.5	582.52	0.000364	1.22	129.84	567.4	0.14
Dam22	Reach1	3530.403	113	579.44	582.42	582.48	0.001229	1.96	69.9	546.93	0.25
Dam22	Reach1	3513.094	Culvert								
Dam22	Reach1	3497.817	113	579.28	581.98	582.06	0.001609	2.26	52.55	515.77	0.29
Dam22	Reach1	3441.993	129.76	579.06	581.88	581.95	0.002453	2.45	87	939.42	0.34
Dam22	Reach1	3253.355	170.72	578.34	580.13	580.65	0.020722	5.75	29.68	841.31	0.95
Dam22	Reach1	2879.015	180.33	577.34	579.51	579.53	0.000994	1.31	142.39	951.65	0.21
Dam22	Reach1	2804.342	186.66	577.24	579.43	579.46	0.001058	1.31	146.6	1147.91	0.22
Dam22	Reach1	2757.255	268.36	577.17	579.41	579.42	0.000447	1.07	280.45	1402.23	0.15
Dam22	Reach1	2261.906	648.53	576.02	579.26	579.28	0.00026	1.1	710.91	1559	0.12
Dam22	Reach1	1058.024	696.31	569.86	578.94	578.99	0.000267	2.04	456.27	1252.42	0.14
Dam22	Reach1	961.0392	763.9	569.48	578.88	578.94	0.001755	2.12	429.17	1144.64	0.16
Dam22	Reach1	946.0751	Culvert								
Dam22	Reach1	931.1268	763.9	569.37	576.71	576.99	0.009387	4.26	179.18	41.78	0.36
Dam22	Reach1	834.6452	763.9	569.01	574.44	575.23	0.037014	7.13	107.15	32.38	0.69

Table N-12. Summary Output - Dry Fork Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Honey_Bear_Creek	Reach1	20222.09	60.69	943.49	944.17	944.23	0.019531	1.89	32.05	62.8	0.47
Honey_Bear_Creek	Reach1	19907.2	76.22	935.31	936.48	936.66	0.028915	3.37	23.32	29.65	0.62
Honey_Bear_Creek	Reach1	19536.91	98.69	926.12	927.35	927.49	0.021784	3.06	35.21	47.56	0.55
Honey_Bear_Creek	Reach1	19116.99	123.81	918.29	919.5	919.62	0.016795	2.84	46.24	56.11	0.49
Honey_Bear_Creek	Reach1	18748.38	131.16	914.36	915.65	915.76	0.016235	2.79	52.9	82.01	0.48
Honey_Bear_Creek	Reach1	18654.72	169.32	908.19	910.53	910.69	0.015054	3.4	58.22	150.5	0.49
Honey_Bear_Creek	Reach1	18239.67	222.96	903.56	905.71	905.91	0.017003	3.99	71.67	84.4	0.53
Honey_Bear_Creek	Reach1	17792.35	306.62	898.02	899.55	899.7	0.011861	3.24	103.32	101.13	0.5
Honey_Bear_Creek	Reach1	17274.48	306.62	891.76	893.33	893.46	0.012249	2.97	111.02	173.58	0.49
Honey_Bear_Creek	Reach1	17111.89	306.62	889.75	892.13	892.19	0.00529	2.29	186.78	225.16	0.3
Honey_Bear_Creek	Reach2	16530.45	711.25	884.25	887.03	887.17	0.011117	3.42	261.83	243.03	0.44
Honey_Bear_Creek	Reach2	16382.83	735.61	881.81	886.02	886.14	0.005292	3.3	334.58	291.65	0.33
Honey_Bear_Creek	Reach2	16086.98	768.55	880.99	884.36	884.46	0.005864	3.16	374.92	358.53	0.34
Honey_Bear_Creek	Reach2	15702	802.98	878.2	882.43	882.53	0.004944	3.1	448.86	551.41	0.31
Honey_Bear_Creek	Reach2	15316.95	833.5	875.42	880.43	880.63	0.006214	4.04	313.81	263.11	0.36
Honey_Bear_Creek	Reach2	14989.2	881.73	873.05	878.19	878.46	0.008163	4.3	246.63	183.73	0.41
Honey_Bear_Creek	Reach2	14494.97	940.44	869.47	875.91	876.14	0.003272	4.03	300.6	203.97	0.34
Honey_Bear_Creek	Reach2	13928.57	1010.88	865.67	872.63	873.07	0.010271	5.52	217.06	147.69	0.47
Honey_Bear_Creek	Reach2	13293.93	1058.61	863.72	870.62	870.69	0.002308	2.86	576.33	284.54	0.23
Honey_Bear_Creek	Reach2	12888.55	1102.45	862.47	869.29	869.4	0.003104	3.32	501.27	254.52	0.26
Honey_Bear_Creek	Reach2	12532.01	1160.05	861.38	867.49	867.72	0.007107	4.93	407.71	225.97	0.4
Honey_Bear_Creek	Reach2	12084.54	1217.65	860	865.43	865.54	0.003592	3.14	543.66	287.14	0.28
Honey_Bear_Creek	Reach2	11658.73	1292.26	858.69	863.85	863.96	0.004622	3.71	605.94	419.06	0.32
Honey_Bear_Creek	Reach2	11136.25	1352.24	857.08	861.78	861.86	0.004113	3.37	677.15	407.83	0.3
Honey_Bear_Creek	Reach2	10737.59	1415.61	855.7	860.09	860.2	0.004514	3.73	598.81	326.69	0.32
Honey_Bear_Creek	Reach2	10335.21	1469.31	853.41	858.37	858.61	0.005539	4.42	450.57	333.01	0.36
Honey_Bear_Creek	Reach2	10008.06	1469.31	853.25	857.3	857.39	0.004195	3.24	736.26	552.95	0.3
Honey_Bear_Creek	Reach3	9566.66	2211.07	850.85	855.75	855.8	0.003203	2.39	1283.17	677.21	0.21
Honey_Bear_Creek	Reach3	9150.94	2258.62	849.72	854.61	854.71	0.003391	3.13	943.47	408.77	0.27
Honey_Bear_Creek	Reach3	8789.45	2298.35	847.41	853.44	853.59	0.005248	4.49	842.81	397.23	0.35
Honey_Bear_Creek	Reach3	8493.15	2357.11	847.7	852.28	852.39	0.004738	3.51	946.63	621.14	0.32

Table N-12. Summary Output - Dry Fork Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Honey_Bear_Creek	Reach3	8064.27	2421.3	846.52	851.79	851.88	0.00113	3.21	1336.65	548.81	0.25
Honey_Bear_Creek	Reach3	7607.81	2483.29	844.78	850.99	851.15	0.005071	3.9	906.34	405.11	0.32
Honey_Bear_Creek	Reach3	7178.35	2553.37	843.27	848.65	849.16	0.0053	6.96	500.29	229.5	0.6
Honey_Bear_Creek	Reach3	6705.49	2614.92	841.55	847.68	847.89	0.001551	4.62	874.71	304.63	0.34
Honey_Bear_Creek	Reach3	6300.8	2648.17	840.55	846.8	846.96	0.003279	3.39	908.53	363.57	0.26
Honey_Bear_Creek	Reach3	6086.19	2699.34	839.76	846.19	846.29	0.002892	3.32	1127.16	439.51	0.25
Honey_Bear_Creek	Reach3	5761.03	2739.32	838.99	845.15	845.28	0.003648	3.72	983.98	361.02	0.28
Honey_Bear_Creek	Reach3	5511.2	2764.95	838.27	844.8	844.93	0.00114	3.86	1210.54	456.41	0.29
Honey_Bear_Creek	Reach3	5353.01	2768.56	837.81	844.64	844.74	0.002491	3.07	1133.67	402.12	0.23
Honey_Bear_Creek	Reach3	5330.83	2837.01	837.75	844.5	844.64	0.004127	4.04	1079.65	437.78	0.3
Honey_Bear_Creek	Reach3	4915.88	2896.84	836.56	843.73	843.79	0.001749	2.66	1608.44	630.43	0.19
Honey_Bear_Creek	Reach3	4561.34	2935.99	835.52	843.34	843.4	0.00109	2.18	1615.65	868.77	0.16
Honey_Bear_Creek	Reach3	4333.26	2949.61	835.64	843.11	843.21	0.001095	2.42	1326.58	950.8	0.16
Honey_Bear_Creek	Reach3	4254.64	2967.34	835.61	842.55	842.93	0.001265	5.36	610.78	1374.3	0.36
Honey_Bear_Creek	Reach3	4152.38	Culvert								
Honey_Bear_Creek	Reach3	4057.37	2967.34	833.89	839.8	840.15	0.002798	5.33	643.26	1222.53	0.41
Honey_Bear_Creek	Reach3	3979.99	3042.42	833.53	839.25	839.65	0.005525	6.47	751.59	1178.91	0.55
Honey_Bear_Creek	Reach3	3657.35	3186.45	832.02	836.87	837.52	0.016405	6.16	503.38	703.25	0.56
Honey_Bear_Creek	Reach3	3060.05	3290.35	829.25	835.09	835.31	0.002545	4.57	1028.35	542.71	0.38
Honey_Bear_Creek	Reach3	2645.73	3290.35	827.33	834.4	834.59	0.002	4.7	1134.49	578.98	0.35
HoneyBear_Trib2	Reach1	4233.5	147.57	902.69	903.92	904.02	0.00737	2.57	60.51	70.87	0.45
HoneyBear_Trib2	Reach1	4010.7	165.6	898.1	899.18	899.52	0.115846	4.72	36.46	57.56	0.95
HoneyBear_Trib2	Reach1	3761.01	193.23	891.74	894.2	894.28	0.009069	2.31	88.71	61.89	0.3
HoneyBear_Trib2	Reach1	3426.73	216.18	888.05	890.05	890.15	0.017301	2.77	95.83	123.75	0.41
HoneyBear_Trib2	Reach1	3183.645	248.7	885.55	887.53	887.59	0.007321	2.06	137.06	139.38	0.31
HoneyBear_Trib2	Reach1	2880.083	287.77	881.93	884.01	884.11	0.019327	2.73	115.92	118.84	0.42
HoneyBear_Trib2	Reach1	2564.055	302.46	877.12	880.19	880.33	0.008312	3.1	107.94	129.01	0.38
HoneyBear_Trib2	Reach1	2456.22	314.8	875.85	877.75	878.24	0.072693	5.61	56.09	85.42	1
HoneyBear_Trib2	Reach1	2369.59	344.65	874.84	877.33	877.39	0.001797	2.07	167.44	158.8	0.3
HoneyBear_Trib2	Reach1	2323.97	Culvert								
HoneyBear_Trib2	Reach1	2277.26	344.65	873.76	877.27	877.3	0.000458	1.43	240.83	120.69	0.16

Table N-12. Summary Output - Dry Fork Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
HoneyBear_Trib2	Reach1	2173.334	400.33	872.52	877.05	877.14	0.009451	2.47	170.3	413.09	0.31
HoneyBear_Trib2	Reach1	1848.91	489.95	868.74	873.36	873.54	0.013329	3.67	168.14	236.73	0.39
HoneyBear_Trib2	Reach1	1411.32	578.43	863.48	867.08	867.82	0.013112	6.9	83.98	42.7	0.85
HoneyBear_Trib2	Reach1	1051.71	655.35	860.05	864.88	865.09	0.0047	3.96	234.55	212.53	0.45
HoneyBear_Trib2	Reach1	781.26	809.88	857.73	862.08	862.44	0.023323	5.24	206.35	383.95	0.53
HoneyBear_Trib2	Reach1	322.63	809.88	853.79	858.02	858.2	0.012407	3.96	271.38	171.3	0.39
HoneyBear_Trib1	Reach1	1186.33	229.12	897.72	899.46	899.54	0.010722	2.85	110.18	139.83	0.41
HoneyBear_Trib1	Reach1	938.25	296.67	894.16	896.05	896.18	0.014505	3.34	119.33	167.5	0.48
HoneyBear_Trib1	Reach1	545.04	351.97	889.71	892.39	892.49	0.006935	2.67	147.05	168.86	0.35
HoneyBear_Trib1	Reach1	284.91	377	887.59	889.41	889.63	0.019004	3.94	107.25	149.17	0.56
HoneyBear_Trib1	Reach1	180.33	392.69	886.02	888.33	888.43	0.007255	2.61	162.24	267.81	0.35
HoneyBear_Trib1	Reach1	118.3	392.69	885	888.19	888.21	0.001743	1.16	352.49	288.13	0.17
DryFork_Trib1	Reach1	6871.38	787.33	862.74	865.54	865.63	0.002697	2.45	337.81	205	0.31
DryFork_Trib1	Reach1	6687.54	857.15	861.71	864.16	864.45	0.022178	4.44	202.58	233.08	0.79
DryFork_Trib1	Reach1	6316.08	942.11	856.69	861.16	861.38	0.004685	4.43	270.45	146.48	0.47
DryFork_Trib1	Reach1	5902.94	1037.13	853.99	857.5	858.21	0.01328	7.67	168.54	96.71	0.8
DryFork_Trib1	Reach1	5482.84	1058.98	851.24	857.74	857.76	0.000216	1.37	967.54	331.67	0.11
DryFork_Trib1	Reach1	5391.68	1106.19	850.64	857.02	857.55	0.002867	5.85	189.15	204.88	0.42
DryFork_Trib1	Reach1	5328.3	Culvert								
DryFork_Trib1	Reach1	5250.34	1106.19	849.88	853.14	854.23	0.011466	8.39	131.86	51.23	0.92
DryFork_Trib1	Reach1	5201.01	1162.39	849.66	852.59	853.57	0.01318	7.96	146.2	71.18	0.97
DryFork_Trib1	Reach1	4984.35	1212.1	848.68	852.63	852.96	0.00047	4.58	264.86	93.08	0.48
DryFork_Trib1	Reach1	4801.29	1289.52	847.85	852.5	852.79	0.001936	4.33	298.08	83.12	0.4
DryFork_Trib1	Reach1	4530.62	1393.01	846.63	852.22	852.41	0.000965	3.47	400.94	92.34	0.29
DryFork_Trib1	Reach1	4193.14	1480.93	844.88	852.01	852.12	0.000658	2.66	557.01	105.93	0.2
DryFork_Trib1	Reach1	3925.57	1526.56	843.9	851.9	851.99	0.000324	2.39	639.91	114.08	0.18
DryFork_Trib1	Reach1	3792.91	1553.91	843.3	851.94	851.95	0.000012	0.59	3679.16	921.22	0.04
DryFork_Trib1	Reach1	3691.56	Culvert								
DryFork_Trib1	Reach1	3592.2	1553.91	842.15	846.17	847.29	0.026025	9.5	191.04	572.89	0.93
DryFork_Trib1	Reach1	3306.84	1583.03	840.4	843.38	843.52	0.004993	3.36	555	479.44	0.39
DryFork_Trib1	Reach1	3008.5	1655.71	838.23	841.06	841.31	0.011267	4.96	442.52	345.17	0.58

Table N-12. Summary Output - Dry Fork Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryFork_Trib1	Reach1	2287.03	1655.71	834.83	838.35	838.41	0.002	2.01	924.05	465.98	0.21
DryFork	Reach1	14771	156.57	816.28	818.52	818.72	0.005035	3.52	44.45	28.17	0.49
DryFork	Reach1	14272	186.3	813.9	818.34	818.36	0.000222	1.33	285.13	163.35	0.12
DryFork	Reach1	14261	Culvert								
DryFork	Reach1	14225	186.3	813.9	815.93	816.69	0.021136	7.02	26.52	35.55	1.01
DryFork	Reach1	13740	213.84	812.78	815.43	815.45	0.000577	1.46	207.94	142.39	0.18
DryFork	Reach1	13318	230.09	809.26	815.42	815.42	0.000018	0.53	475.83	136.6	0.04
DryFork	Reach1	13290	Bridge								
DryFork	Reach1	13223	230.09	811.62	814.46	814.48	0.000187	0.97	238.29	179.52	0.12
DryFork	Reach1	13094	233.04	809.8	814.46	814.47	0.000045	0.71	362.15	160.29	0.06
DryFork	Reach1	13055	235.95	812.07	814.3	814.42	0.00367	3.08	95.96	102.06	0.47
DryFork	Reach1	13017	248.94	811.56	814.13	814.26	0.005227	3.1	104.1	112.62	0.45
DryFork	Reach1	12853	275.75	810.04	813.88	813.91	0.000975	1.7	277.65	213.28	0.19
DryFork	Reach1	12809	Culvert								
DryFork	Reach1	12759	275.75	810.67	813.54	813.58	0.001523	2.29	262.56	260.83	0.26
DryFork	Reach1	12540	306.25	810.4	813.33	813.35	0.000784	1.61	292.88	197.55	0.19
DryFork	Reach1	12219	332.75	810.36	813.27	813.28	0.000104	0.84	446.96	264.33	0.09
DryFork	Reach1	12204	Bridge								
DryFork	Reach1	12171	332.75	807.99	811.79	812.67	0.009073	8.48	66.84	171.07	0.85
DryFork	Reach1	11965	337.24	808.25	810.9	810.95	0.000549	1.72	237.4	138.41	0.2
DryFork	Reach1	11924	Inl Struct								
DryFork	Reach1	11895	393.23	804.96	809	809.17	0.00416	3.84	170.16	120.15	0.37
DryFork	Reach1	11454	444.64	805.74	807.83	807.89	0.002106	1.91	261.83	169.49	0.24
DryFork	Reach1	11078	467.13	805.48	807.53	807.55	0.000465	1.22	579.62	419.49	0.16
DryFork	Reach1	10927	490.12	805.08	806.82	807.22	0.017533	5.32	122.04	179.96	0.88
DryFork	Reach1	10780	614.89	801.2	803.4	803.53	0.004632	3.65	269.64	190.07	0.49
DryFork	Reach1	10086	787.74	795.24	798.31	798.82	0.009215	5.76	153.53	111.62	0.71
DryFork	Reach1	9328	904.81	790.17	795.12	795.4	0.002756	4.46	257.85	139.56	0.42
DryFork	Reach1	8904	904.81	789.8	794.98	795.03	0.000325	1.89	659.57	270.98	0.15
DryFork	Reach1	8560	1035.8	788.8	794.86	794.9	0.000402	2.05	987.95	406.61	0.15
DryFork	Reach1	8530	Culvert								

Table N-12. Summary Output - Dry Fork Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryFork	Reach1	8502	1035.8	787.02	791.61	793.82	0.022252	11.93	86.79	165.72	1
DryFork	Reach1	8098	1076.77	783.98	788.35	788.67	0.004247	4.87	283.97	108.79	0.43
DryFork	Reach1	7445	1109.84	781.7	785.47	785.74	0.004663	4.2	272.21	102.36	0.43
DryFork	Reach1	6936	1120.77	778.42	782.85	783.15	0.005595	5.32	372.35	161.36	0.48
DryFork	Reach1	6771	1131.95	777.9	781.86	782.14	0.006876	5.63	405.31	210.83	0.53
DryFork	Reach1	6604	1170.94	776.01	779.6	780.34	0.018864	8.49	269.16	173.14	0.86
DryFork	Reach1	6034	1184.65	774.36	778.58	778.64	0.000321	1.92	767.61	276.33	0.17
DryFork	Reach1	5838	1199.88	773.74	777.61	778.27	0.009968	7.53	231.67	167.23	0.85
DryFork	Reach1	5623	1225.83	768.77	774.97	775.02	0.000287	1.96	759.83	248.86	0.15
DryFork	Reach1	5263	1273.41	768.84	774.86	774.91	0.0003	1.94	804.68	235.09	0.15
DryFork	Reach1	4622	1286.72	768.82	774.78	774.81	0.000084	1.24	1323.91	381.01	0.09
DryFork	Reach1	4447	1304.66	769.36	773.84	774.55	0.007268	7.27	259.12	239.58	0.76
DryFork	Reach1	4214	1318.37	768.49	772.73	772.78	0.000338	1.66	839.16	245.4	0.15
DryFork	Reach1	4038	1336.04	767.59	771.82	772.44	0.007142	7.14	286.57	231.59	0.75
DryFork	Reach1	3814	1374.36	765.44	770.13	770.22	0.000463	2.42	584.38	213.92	0.21
DryFork	Reach1	3338	1406.58	762.05	770.09	770.11	0.000085	1.53	1666.51	400.1	0.1
DryFork	Reach1	3298	Culvert								
DryFork	Reach1	3208	1406.58	759.1	763.85	764.87	0.011996	11.81	215.1	164.34	1.02
DryFork	Reach1	2948	1412.95	758.84	763.24	763.37	0.002354	3.06	535.23	266.22	0.27
DryFork	Reach1	2872	1448.05	757.73	761.55	762.59	0.02773	7.05	181.9	121.14	0.8
DryFork	Reach1	2459	1473.48	751	757.05	757.24	0.001293	3.64	472.37	126.08	0.28
DryFork	Reach1	2166	1481.38	751.1	756.62	756.88	0.001081	4.26	478.87	142.63	0.32
DryFork	Reach1	2076	1482.96	751.77	756.15	756.63	0.005696	7.11	314.68	128.16	0.62
DryFork	Reach1	2058	1508.83	749.44	755.97	756.53	0.00613	7.38	302.87	127.94	0.58
DryFork	Reach1	2009	Culvert								
DryFork	Reach1	1912	1508.83	749.56	752.7	753.71	0.013005	8.31	209.67	108.9	0.88
DryFork	Reach1	1767	1538.15	748.72	752.5	752.78	0.001883	4.32	386.96	124.63	0.4
DryFork	Reach1	1443	1542.09	748.29	751.83	752.08	0.002382	4.02	389.64	154.18	0.43
DryFork	Reach1	1400	Inl Struct								
DryFork	Reach1	1390	1552.57	744.88	751.8	751.92	0.000893	2.91	674.72	174.72	0.22
DryFork	Reach1	1286	1588.96	742.9	751.74	751.83	0.000527	2.74	815.83	158.08	0.18

Table N-12. Summary Output - Dry Fork Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryFork	Reach1	1259	Mult Open								
DryFork	Reach1	1201	1588.96	742.53	747.26	747.94	0.016985	10.48	301.63	123.66	0.87
DryFork	Reach1	896	1588.96	738.45	744.89	745.45	0.004545	6.5	324.6	71.9	0.47
DryFork	Reach1	493	1588.96	735.46	743.79	744.21	0.001999	5.66	422.39	92.19	0.36

Table N-13. Summary Output - Dry Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Dyer_Branch	Reach1	11155.8	190.17	773.24	775.02	775.61	0.01623	6.16	31.48	28.49	0.98
Dyer_Branch	Reach1	10905.9	231.45	766.32	768.17	768.72	0.017276	5.99	38.84	36.36	1
Dyer_Branch	Reach1	10583.6	243.95	764.97	766.65	766.72	0.002452	2.24	121.91	147.95	0.38
Dyer_Branch	Reach1	10497.3	351.62	761.3	765.93	766.21	0.010937	4.26	84.56	20.54	0.35
Dyer_Branch	Reach1	10163.3	Culvert								
Dyer_Branch	Reach1	9968.88	351.62	753.65	757.86	758.07	0.001269	3.67	96.38	50.16	0.33
Dyer_Branch	Reach1	9897.38	393.75	753.53	757.74	757.88	0.004074	3.08	146.54	107.53	0.29
Dyer_Branch	Reach1	9711.67	499.92	752.11	754.59	755.45	0.061394	7.44	67.29	40.76	1
Dyer_Branch	Reach1	9319.95	671.62	746.65	749.92	750.01	0.004922	2.6	308.99	202.79	0.3
Dyer_Branch	Reach1	8835.47	842.61	741.4	742.89	743.44	0.052693	5.74	143.45	257.07	0.89
Dyer_Branch	Reach1	8463.28	965.54	736.15	739.42	739.99	0.057901	6.1	163.62	285.65	0.94
Dyer_Branch	Reach1	8239.83	1196.51	732.34	736.76	736.86	0.005285	2.34	493.4	253.31	0.3
Dyer_Branch	Reach1	7887.88	1650.91	727.99	733.96	734.27	0.009333	4.48	384.67	187.38	0.45
Dyer_Branch	Reach1	7359.63	1650.91	725.46	731.84	731.94	0.002545	2.67	676.83	393.27	0.24
Dyer_Branch	Reach1	7284.87	1686.94	725.22	731.53	731.72	0.002483	3.4	487.94	457.41	0.25
Dyer_Branch	Reach1	7227.23	Culvert								
Dyer_Branch	Reach1	7185.17	1686.94	724.6	730.31	730.61	0.008256	4.62	404.2	95.98	0.35
Dyer_Branch	Reach1	7023.75	1715.13	724.68	729.05	729.25	0.007769	3.7	478.15	278.49	0.34
Dyer_Branch	Reach1	6823.39	1744.69	723.83	727.79	727.91	0.005495	2.79	654.35	548.83	0.28
Dyer_Branch	Reach1	6616.75	1771.07	719.68	725.76	726.12	0.01514	5.04	418.31	545.25	0.46
Dyer_Branch	Reach1	6435.31	1817.7	718.11	723.72	723.95	0.009712	4.36	523.18	267.26	0.38
Dyer_Branch	Reach1	6121.04	1826.37	715.39	721.62	721.76	0.005432	3.5	684.72	321.16	0.29
Dyer_Branch	Reach1	6063.51	1868.9	714.88	720.44	721.03	0.040228	7.61	363.68	272.49	0.69
Dyer_Branch	Reach1	5785.15	1903.42	711.8	718.81	718.92	0.002075	2.55	734.57	250.23	0.19
Dyer_Branch	Reach1	5563.84	1956.03	715.34	716.95	717.75	0.030537	2.51	276.43	174.16	0.5
Dyer_Branch	Reach1	5234.14	2005.1	705.69	715.2	715.34	0.003624	3.58	772.72	392.71	0.25
Dyer_Branch	Reach1	4934.52	2041.6	702.37	708.65	710.55	0.044691	11.33	197.6	195.48	0.9
Dyer_Branch	Reach1	4716.42	2120.98	699.89	707.21	707.34	0.004605	3.96	898.61	463.84	0.29
Dyer_Branch	Reach1	4255.14	2167.54	695.91	700.88	702.14	0.053425	9.04	243.46	187.52	0.86
Dyer_Branch	Reach1	3992.6	2199.01	692.38	698.48	698.65	0.005243	3.3	673.04	172.48	0.28
Dyer_Branch	Reach1	3818.31	2304.96	690.77	696.91	697.27	0.01239	5.1	493.34	159.03	0.44

Table N-13. Summary Output - Dry Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Dyer_Branch	Reach1	3249.28	2331.45	684.33	691.21	691.45	0.009084	4.1	645.21	232.38	0.35
Dyer_Branch	Reach1	3111.11	2412.65	682.64	688.01	688.94	0.045369	7.86	320.95	149.85	0.72
Dyer_Branch	Reach1	2697.11	2487.01	675.97	684.05	684.27	0.00482	3.84	713.36	172.47	0.26
Dyer_Branch	Reach1	2330.09	2538.37	673.57	681.78	682.02	0.008128	3.96	670.76	178.63	0.32
Dyer_Branch	Reach1	2082.88	2546.49	672.14	679.29	679.6	0.012185	4.73	603.32	186.5	0.39
Dyer_Branch	Reach1	2044.26	2560.06	671.73	678.84	679.16	0.010869	4.6	576.71	146.64	0.38
Dyer_Branch	Reach1	2011.58	Bridge								
Dyer_Branch	Reach1	1989.68	2560.06	671.15	678.07	678.42	0.012814	4.78	547.64	143.83	0.42
Dyer_Branch	Reach1	1980.01	2582.87	671.03	677.87	678.27	0.016174	5.07	516.42	145.8	0.46
Dyer_Branch	Reach1	1960.24	Bridge								
Dyer_Branch	Reach1	1934.29	2582.87	670.56	676.28	677.2	0.032547	9.1	366.54	133.43	0.75
Dyer_Branch	Reach1	1872.77	2613.47	670.46	676.23	676.37	0.003265	3	876.9	204.72	0.24
Dyer_Branch	Reach1	1730.34	2685.46	670.36	673.82	674.86	0.052895	8.36	338.63	146.8	0.89
Dyer_Branch	Reach1	1401.76	2735.25	659.48	669.11	669.59	0.008248	6.09	535.3	115.98	0.4
Dyer_Branch	Reach1	1179.61	2796.38	657.22	667.28	667.79	0.007978	5.97	530.14	118.08	0.39
Dyer_Branch	Reach1	912.36	2821.34	655.24	665.61	665.94	0.005901	4.98	679.07	170.65	0.34
Dyer_Branch	Reach1	804.906	2869.84	655.48	665.34	665.52	0.002834	3.74	931.12	200.35	0.24
Dyer_Branch	Reach1	598.771	2896.74	652.97	664.54	664.85	0.004312	4.89	799.65	230.1	0.3
Dyer_Branch	Reach1	485.98	2956.6	652.94	664.64	664.67	0.000365	1.52	2214.5	363.76	0.09
Dyer_Branch	Reach1	238.652	2956.6	647.63	664.54	664.59	0.00043	1.98	1929.54	422.59	0.1
DryBranch_Trib1A	Reach1	506.682	1129.6	726.59	734.95	735.29	0.010002	4.7	262.34	102.45	0.34
DryBranch_Trib1A	Reach1	435.466	1130.84	726.54	734.12	734.5	0.012139	5.01	236.14	52.99	0.37
DryBranch_Trib1A	Reach1	393.268	1135.7	726.26	733.92	734.12	0.004457	3.68	318.61	66.02	0.24
DryBranch_Trib1A	Reach1	351.324	Culvert								
DryBranch_Trib1A	Reach1	311.319	1135.7	725.83	731.21	731.57	0.002327	4.8	236.82	94.8	0.37
DryBranch_Trib1A	Reach1	227.839	1137.64	725.5	730.91	731.3	0.004138	5.14	237.63	194.17	0.46
DryBranch_Trib1A	Reach1	161.927	1137.64	725.51	729.83	730.71	0.013627	8	168.27	137.13	0.81
DryBranch_Trib1	Reach1	11681	908.64	765.6	769.76	770.02	0.008639	4.26	230.91	79.48	0.37
DryBranch_Trib1	Reach1	11606.5	Culvert								
DryBranch_Trib1	Reach1	11420.1	908.64	763.9	768.21	768.44	0.001438	4.06	240.18	67.83	0.34
DryBranch_Trib1	Reach1	11329.6	932.11	764.14	767.78	768.19	0.003819	5.14	183.86	84.2	0.54

Table N-13. Summary Output - Dry Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryBranch_Trib1	Reach1	11135.2	945.85	763.24	765.83	766.76	0.013444	7.81	123.5	78.13	0.97
DryBranch_Trib1	Reach1	11023.6	956.19	759.14	762.89	763.32	0.004349	5.25	184.17	76.72	0.57
DryBranch_Trib1	Reach1	10940.7	971.76	759.04	762.07	762.8	0.008485	6.88	142.56	63.99	0.79
DryBranch_Trib1	Reach1	10817.5	990.48	757.13	762.14	762.35	0.0011	3.73	273.75	73.73	0.31
DryBranch_Trib1	Reach1	10672	1012.01	756.08	761.78	762	0.008871	3.75	275.48	72.34	0.31
DryBranch_Trib1	Reach1	10507.9	1031.12	756.09	759.41	760.15	0.013726	6.97	151.01	67.82	0.75
DryBranch_Trib1	Reach1	10365.3	1052.8	753.8	757.72	758.72	0.007448	8.05	132.68	54.95	0.88
DryBranch_Trib1	Reach1	10206.6	1085.87	752.87	756.21	757.38	0.009436	8.73	127.07	57.09	0.98
DryBranch_Trib1	Reach1	9970.72	1115.71	750.73	753.82	755	0.009272	8.77	130.33	58.05	0.98
DryBranch_Trib1	Reach1	9763.96	1133.88	749.14	753.03	753.4	0.002826	4.91	233.1	96.52	0.54
DryBranch_Trib1	Reach1	9640.78	1149.51	746.74	752.6	753.1	0.00198	5.74	213.26	64.64	0.49
DryBranch_Trib1	Reach1	9536.4	1164.14	746.38	752.58	752.89	0.001086	4.7	300.96	130.75	0.37
DryBranch_Trib1	Reach1	9439.95	1196.85	744.6	752.51	752.8	0.000696	4.63	338.9	111.44	0.29
DryBranch_Trib1	Reach1	9408.05	Culvert								
DryBranch_Trib1	Reach1	9374.64	1196.85	744.6	748.56	750.42	0.009763	11.01	110.25	37.63	0.98
DryBranch_Trib1	Reach1	9228.62	1221.69	743.83	747.22	748.54	0.009488	9.22	133.33	53.13	0.99
DryBranch_Trib1	Reach1	9071.92	1253.68	742.31	746.3	747.15	0.005596	7.4	170.58	63.42	0.77
DryBranch_Trib1	Reach1	8874.84	1288.3	741.08	744.44	745.73	0.008803	9.17	143.3	56.98	0.97
DryBranch_Trib1	Reach1	8667.07	1305.61	738.69	742.51	743.73	0.008001	8.93	151.19	60.59	0.93
DryBranch_Trib1	Reach1	8565.3	1327.02	738.09	741.86	742.96	0.006551	8.46	161.43	60.23	0.85
DryBranch_Trib1	Reach1	8441.27	1368.29	736.58	741.37	742.2	0.004652	7.39	193.56	71.48	0.72
DryBranch_Trib1	Reach1	8207.69	1375.59	734.65	740.98	741.45	0.001832	5.59	295.03	210.76	0.47
DryBranch_Trib1	Reach1	8167.13	1399.29	734.6	740.95	741.36	0.001199	5.26	380.92	295.03	0.39
DryBranch_Trib1	Reach1	8122.65	Culvert								
DryBranch_Trib1	Reach1	8080.37	1399.29	734.5	739.17	740.49	0.005797	9.61	230.93	173.97	0.8
DryBranch_Trib1	Reach1	8036.82	1422.38	734.16	738.99	739.67	0.002673	6.95	225.74	64.48	0.58
DryBranch_Trib1	Reach1	7912.02	1444.83	733.57	737.71	738.98	0.006731	9.19	164.33	57.06	0.87
DryBranch_Trib1	Reach1	7792.6	1469.98	732.58	736.54	738.03	0.009117	9.79	150.76	52.61	0.99
DryBranch_Trib1	Reach1	7660.97	1484.73	730.13	735.08	735.94	0.004188	7.49	201.27	61.89	0.69
DryBranch_Trib1	Reach1	7584.83	1497.15	730.22	735.1	735.62	0.002117	5.84	267.27	75.49	0.51
DryBranch_Trib1	Reach1	7521.29	1532.32	729.6	735.14	735.42	0.000809	4.27	363.38	92.77	0.33

Table N-13. Summary Output - Dry Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryBranch_Trib1	Reach1	7479.81	Culvert								
DryBranch_Trib1	Reach1	7438.45	1532.32	729.28	734.39	734.74	0.002475	4.74	326.46	95.73	0.38
DryBranch_Trib1	Reach1	7344.24	1571.23	728.16	731.84	733.02	0.015552	8.76	182.17	63.95	0.87
DryBranch_Trib1	Reach1	7152.98	1571.23	724.78	728.31	729.67	0.019237	9.46	171.42	65.69	0.97
DryBranch_Trib1	Reach2	6872.29	2732.05	720.8	725.52	726.23	0.006652	6.79	412.39	116.8	0.6
DryBranch_Trib1	Reach2	6722.78	2763.72	720.13	723.78	724.83	0.01323	8.22	338.08	111.26	0.81
DryBranch_Trib1	Reach2	6520.48	2789.1	717.34	721.27	722.23	0.012265	7.91	356.32	120.15	0.78
DryBranch_Trib1	Reach2	6360.02	2829.64	715.71	719.75	720.54	0.008747	7.18	407.3	140.07	0.67
DryBranch_Trib1	Reach2	6106.76	2866.8	713.33	718.09	718.71	0.005732	6.43	472.71	169.78	0.56
DryBranch_Trib1	Reach2	5877.71	2913.27	712.28	717.04	717.51	0.0045	5.58	567.68	200.96	0.49
DryBranch_Trib1	Reach2	5595.47	2945.57	710.42	713.68	715.05	0.020621	9.45	315.07	118.58	0.99
DryBranch_Trib1	Reach2	5401.96	2991.87	704.56	710.37	711.19	0.006203	7.32	416.84	98.81	0.59
DryBranch_Trib1	Reach2	5128.18	3034.86	702.37	708.68	709.48	0.006241	7.19	424.41	96.36	0.59
DryBranch_Trib1	Reach2	4877.78	3100.32	699.95	706.97	707.81	0.007082	7.36	422.87	100.12	0.61
DryBranch_Trib1	Reach2	4503.2	3182.88	697.73	703.7	704.77	0.009249	8.29	385.6	93.96	0.71
DryBranch_Trib1	Reach2	4041.86	3238.69	693.97	701.04	701.76	0.004568	6.83	483.39	103.5	0.53
DryBranch_Trib1	Reach2	3736.77	3269.93	693.32	699.59	700.32	0.00489	6.91	484.77	106.98	0.54
DryBranch_Trib1	Reach2	3568.24	3292.15	691.9	698.68	699.45	0.005323	7.11	470.97	102.37	0.55
DryBranch_Trib1	Reach2	3449.39	3322.62	691.47	698.19	698.83	0.004544	6.47	522.92	162.83	0.51
DryBranch_Trib1	Reach2	3287.7	3340.91	690.51	695.85	697.4	0.019724	9.98	334.92	103.96	0.98
DryBranch_Trib1	Reach2	3191.3	3390.02	689.49	695.75	696.2	0.003382	5.38	637.41	142.04	0.44
DryBranch_Trib1	Reach2	3096.5	Bridge								
DryBranch_Trib1	Reach2	3020.74	3390.02	688.99	693.39	694.59	0.013807	8.83	386.65	139.18	0.91
DryBranch_Trib1	Reach2	2935.18	3466.05	688.08	692.51	693.55	0.009238	8.24	427.99	134.9	0.77
DryBranch_Trib1	Reach2	2545.87	3566.86	684.15	688.65	689.85	0.009535	8.83	406.33	110.75	0.79
DryBranch_Trib1	Reach2	2042.63	3685.32	679.7	686.15	686.84	0.003813	6.72	562.4	126.94	0.53
DryBranch_Trib1	Reach2	1469.16	3752.87	677.11	684.06	684.62	0.003801	6.04	633.55	124.07	0.45
DryBranch_Trib1	Reach2	1150.32	3800.73	676.06	683.08	683.56	0.002809	5.61	696.14	232.28	0.4
DryBranch_Trib1	Reach2	927.864	3843.5	675.19	682.64	683.01	0.001941	4.92	817.19	211.16	0.34
DryBranch_Trib1	Reach2	731.438	3875.27	674.05	682.41	682.67	0.001155	4.15	945.84	285.01	0.28
DryBranch_Trib1	Reach2	694.025	Culvert								

Table N-13. Summary Output - Dry Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryBranch_Trib1	Reach2	643.793	3875.27	672.9	681.67	681.91	0.000839	3.99	1124.47	294.63	0.26
DryBranch_Trib1	Reach2	586.952	3933.01	672.8	681.62	681.86	0.000988	3.92	1094.42	290.38	0.26
DryBranch_Trib1	Reach2	327.371	3955.45	672.71	681.23	681.55	0.001219	4.55	934.59	230.87	0.29
DryBranch_Trib1	Reach2	227.507	3955.45	672.12	681.17	681.43	0.000822	4.11	1021.9	224.33	0.26
DryBranch	Reach1	14170.9	693.68	759	764.47	764.52	0.000395	1.87	456.25	215.81	0.16
DryBranch	Reach1	14109.5	724.37	758.3	764.34	764.45	0.002889	2.68	272.56	52.56	0.2
DryBranch	Reach1	14064.5	Culvert								
DryBranch	Reach1	13997.9	724.37	757.3	763.91	763.98	0.001517	2.21	354.76	63.63	0.15
DryBranch	Reach1	13917.3	738.33	756.9	763.8	763.86	0.001396	2.14	366.85	67.38	0.15
DryBranch	Reach1	13832.4	771.39	756.48	763.31	763.42	0.002168	2.72	284.88	70.45	0.19
DryBranch	Reach1	13724.1	Culvert								
DryBranch	Reach1	13672	771.39	755	762.8	762.83	0.004988	1.62	609.86	291.49	0.1
DryBranch	Reach1	13637.8	803.01	753.32	762.52	762.59	0.009686	2.37	470.69	233.01	0.14
DryBranch	Reach1	13459.4	831.33	752.44	760.08	760.17	0.018873	2.72	371.92	181.08	0.19
DryBranch	Reach1	13305.5	879.39	751.16	756.43	756.52	0.029845	2.43	376.71	117.66	0.22
DryBranch	Reach1	13055.8	950.91	747.27	752.34	752.55	0.01009	3.83	272.53	111.59	0.38
DryBranch	Reach1	12708.5	1001.64	743.32	749.49	749.66	0.00713	3.58	319.25	114.56	0.32
DryBranch	Reach1	12477.6	1062.95	741.32	747.23	747.52	0.012628	4.4	254.3	92.17	0.42
DryBranch	Reach1	12213.7	1118.41	739.38	744.13	744.29	0.011036	3.6	371.45	201.49	0.38
DryBranch	Reach1	11987.7	1150.92	737.39	744.03	744.05	0.000366	1.27	1058.3	267.91	0.1
DryBranch	Reach1	11860.4	1173.62	736.68	744	744.02	0.000264	1.3	1136.43	265.93	0.09
DryBranch	Reach1	11773.7	1194.91	735.89	743.99	744	0.000111	0.95	1510.7	284.93	0.06
DryBranch	Reach1	11693.8	1221.03	734	741.83	743.77	0.028016	11.74	121.94	36.86	0.81
DryBranch	Reach1	11597.8	1327.46	732.15	741.51	741.54	0.004259	1.48	996.6	213.63	0.1
DryBranch	Reach1	11504.7	Bridge								
DryBranch	Reach1	11421.2	1327.46	732.15	738.43	738.54	0.029153	2.79	511.65	133.62	0.23
DryBranch	Reach1	11226.5	1390.51	730.37	736.38	736.47	0.005557	2.69	591.97	295.05	0.27
DryBranch	Reach1	11020.4	1475.64	728.49	735.43	735.52	0.003648	2.49	643.02	270.54	0.23
DryBranch	Reach1	10756.4	1553.72	726.77	732.59	733.26	0.033478	6.65	242.92	92.93	0.67
DryBranch	Reach1	10527.4	1638.83	724.26	729.8	730.02	0.00893	4.23	458.6	181.53	0.37
DryBranch	Reach1	10290.5	1762.82	721.81	728.69	728.8	0.003846	2.77	671.76	210	0.24

Table N-13. Summary Output - Dry Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryBranch	Reach1	9966.52	1897.32	719.55	725.51	726.02	0.027877	5.77	338.24	153.33	0.63
DryBranch	Reach1	9639.89	1777.81	715.87	725.19	725.23	0.000629	1.65	1194.43	278.47	0.11
DryBranch	Reach1	9471.38	1809.13	714.32	725.15	725.17	0.000222	1.01	1955.04	462.68	0.06
DryBranch	Reach1	9328.22	1824.12	713.74	722.09	724.78	0.060186	13.41	145.08	29.35	0.92
DryBranch	Reach1	9260.56	1833.41	713.01	721.5	721.62	0.001853	2.9	693.9	216.69	0.19
DryBranch	Reach1	9218.91	1866.36	712.87	721.34	721.53	0.001358	3.61	528.46	116.54	0.23
DryBranch	Reach1	9175.3	Culvert								
DryBranch	Reach1	9127.53	1866.36	711.85	716.03	717.12	0.012064	8.42	224.1	74.45	0.73
DryBranch	Reach1	9072.86	1892.66	711.35	715.68	716.26	0.010151	6.17	313.91	129.99	0.63
DryBranch	Reach1	8958.14	1917.25	710.03	714.87	715.23	0.006549	4.85	404.95	156.71	0.5
DryBranch	Reach1	8852.31	1928.21	708.82	713	713.91	0.028163	7.73	256.28	144.93	0.98
DryBranch	Reach1	8805.55	1978.13	708.32	712.12	712.43	0.004559	4.49	449.84	145.87	0.43
DryBranch	Reach1	8595.99	1992.98	705.88	710.15	710.8	0.01529	6.53	316.34	141.08	0.73
DryBranch	Reach1	8534.69	2018.57	704.79	709.83	710.12	0.006229	4.35	479.44	121.24	0.36
DryBranch	Reach1	8430.09	2049.3	703.98	709.39	709.63	0.003495	4	520.16	128.39	0.33
DryBranch	Reach1	8306.21	2070.48	703.07	708.93	709.13	0.004447	3.61	594.77	210.07	0.3
DryBranch	Reach1	8221.89	2126.08	702.1	708.37	708.61	0.008995	4.11	562.64	222.7	0.4
DryBranch	Reach1	8004.63	2180.13	699.11	706.87	707.05	0.005806	4.26	662.84	245.34	0.33
DryBranch	Reach1	7798.81	2211.95	696.75	705.28	705.64	0.011972	5.99	521.3	245.84	0.48
DryBranch	Reach1	7680.02	2257.66	695.39	703.46	703.94	0.011232	5.94	459.72	198.64	0.43
DryBranch	Reach1	7512.3	2305.61	693.42	699.41	700.69	0.038065	9.21	262.1	65.76	0.73
DryBranch	Reach1	7339.98	2346.74	689.14	697.8	698.18	0.006552	5.02	495.28	84.36	0.33
DryBranch	Reach1	7195.03	2413.03	686.73	696.6	697.1	0.00833	5.81	446.28	76.27	0.37
DryBranch	Reach1	6966.63	2451.67	685.29	694.93	695.36	0.006772	5.36	482.28	74.08	0.33
DryBranch	Reach1	6836.4	2577.77	684.53	693.99	694.45	0.00729	5.55	495.56	78.2	0.35
DryBranch	Reach1	6425.16	2623.68	681.45	690.77	691.26	0.008227	5.65	482.48	76.63	0.36
DryBranch	Reach1	6280.42	2719.98	680.01	689.82	690.2	0.006177	5	560.02	84.52	0.32
DryBranch	Reach1	5984.9	2792.75	677.74	687.38	687.93	0.009683	6.08	518.24	150.46	0.39
DryBranch	Reach1	5768.41	2837.69	676.45	686.07	686.39	0.005026	4.63	637.82	97.82	0.29
DryBranch	Reach1	5637.53	2847.8	676.11	685.3	685.68	0.005919	4.99	595.96	91.35	0.31
DryBranch	Reach1	5608.37	2878.78	675.35	685.26	685.48	0.002861	3.88	817.18	156.29	0.22

Table N-13. Summary Output - Dry Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryBranch	Reach1	5583.3	Culvert								
DryBranch	Reach1	5551.19	2878.78	675.3	684.77	685.04	0.003485	4.22	744.16	118.97	0.24
DryBranch	Reach1	5519.66	2934.28	675.04	684.45	684.85	0.006204	5.12	602.7	99.74	0.32
DryBranch	Reach1	5363.11	2965.43	673.62	683.41	683.83	0.006792	5.27	590.18	93.11	0.33
DryBranch	Reach1	5276.53	3017.17	672.84	682.61	683.13	0.009382	5.85	539.23	92.47	0.38
DryBranch	Reach1	5134.71	3017.17	671.55	680.98	681.62	0.012184	6.54	493.19	110.14	0.44
DryBranch	Reach2	4855.56	6842.59	670.53	680.83	681.18	0.000747	4.78	1432.54	198.33	0.31
DryBranch	Reach2	4844.98	6852.94	670.6	680.29	681.12	0.002743	7.32	936.63	438.74	0.48
DryBranch	Reach2	4661.25	6859.79	668.25	677.37	680	0.012907	13.03	531.1	538.34	0.97
DryBranch	Reach2	4539.95	6862.98	667.5	678.25	678.91	0.001981	6.53	1057.09	582.05	0.44
DryBranch	Reach2	4483.42	6877.89	666.8	676.13	678.5	0.014747	12.36	556.52	119.72	1.01
DryBranch	Reach2	4219.68	6895.82	664.06	676.43	676.53	0.000417	1.27	2894.69	591.86	0.09
DryBranch	Reach2	3903.34	6910.18	660.45	676.08	676.2	0.000676	1.96	2553.5	527.64	0.11
DryBranch	Reach2	3650.62	6925.49	659.22	675.88	676.02	0.001276	2.76	2586.39	714.64	0.16
DryBranch	Reach2	3381.7	6943.45	655.64	675.19	675.49	0.004194	5.99	2109.45	611.01	0.27
DryBranch	Reach2	3067.1	6950.53	655.69	674.47	674.68	0.00285	4.56	2235.5	520	0.24
DryBranch	Reach2	2943.13	6965.91	655.8	674.07	674.34	0.003666	5.56	2067.45	482.19	0.27
DryBranch	Reach2	2674.6	6978.44	655.85	672.8	673.33	0.004607	6.22	1385.12	265.51	0.32
DryBranch	Reach2	2456.29	6985.1	656.97	671.21	671.98	0.007468	7.02	994.77	102.47	0.4
DryBranch	Reach2	2447.17	Bridge								
DryBranch	Reach2	2410.41	6985.1	656.31	670.5	671.34	0.009965	7.32	953.74	114.69	0.45
DryBranch	Reach2	2340.45	6999.48	656.03	670.39	670.57	0.002359	4.52	2458.54	527.11	0.23
DryBranch	Reach2	2090.41	7004.3	652.36	669.22	669.75	0.006227	6.9	1468.47	328.6	0.37
DryBranch	Reach2	2006.84	7004.9	651.42	668.64	669.25	0.006548	6.76	1301.78	273.83	0.37
DryBranch	Reach2	1996.44	Inl Struct								
DryBranch	Reach2	1968.13	7012.46	650.63	668.45	669.08	0.005671	6.85	1277.84	253.55	0.36
DryBranch	Reach2	1865.32	7021.82	649.27	667.79	668.47	0.006824	7.06	1208.21	228.27	0.38
DryBranch	Reach2	1703.32	7037.55	648.82	667.36	667.69	0.002798	4.84	1733.68	307.07	0.25
DryBranch	Reach2	1431.46	7053.71	648.13	666.82	667.01	0.001842	4.03	2204.8	331.36	0.2
DryBranch	Reach2	1152.67	7060.51	647.3	665.64	666.19	0.004524	6.72	1376.31	202.84	0.32
DryBranch	Reach2	1035.74	7074.85	646.98	665.29	665.67	0.00302	5.78	1579.95	191.27	0.27

Table N-13. Summary Output - Dry Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
DryBranch	Reach2	789.181	7085.53	646.3	664.75	665.05	0.002069	4.52	1690.03	177.5	0.22
DryBranch	Reach2	605.854	7085.53	645.07	664.53	664.73	0.001284	3.84	2150.6	249.86	0.18
DryBranch	Reach3	326.796	7085.53	644.83	664.14	664.31	0.00169	4.11	2771.73	671.25	0.2
DryBranch	Reach3	254.403	7085.53	644.48	664.06	664.2	0.001284	3.66	3040.92	608.48	0.17
DryBranch	Reach3	166.258	7085.53	644.42	663.86	664.06	0.002003	4.29	2590.15	537.37	0.2

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Rattan_Creek	Reach2	3822	193.49	756.03	761.4	761.4	0.000026	0.38	700.63	229.27	0.03
Rattan_Creek	Reach2	3027	3145.62	753.07	760.16	760.45	0.002805	5	1007.98	290.85	0.34
Rattan_Creek	Reach2	2547	3095.55	750.98	759.02	759.26	0.002142	4.64	1183.13	367.28	0.31
Rattan_Creek	Reach2	1927	3066.14	749.34	757.88	758.06	0.001846	4.71	1331.4	330.82	0.29
Rattan_Creek	Reach2	1558	3066.14	749.58	757.08	757.29	0.002368	4.93	1215.99	332.78	0.32
Rattan_Creek	Reach3	1201	3684.79	747.96	756.19	756.39	0.002624	5.43	1341.41	316.58	0.34
Rattan_Creek	Reach3	577	3684.79	744.66	754.83	755	0.001929	5.47	1533.96	324.73	0.31
Rattan_Creek	Reach1	32206.71	651.12	928.77	932.12	932.92	0.025853	7.18	90.68	57.12	1
Rattan_Creek	Reach1	32020.74	725.34	917.28	925.1	925.54	0.004495	5.29	137.12	26.49	0.41
Rattan_Creek	Reach1	31673.85	807	916.58	922.81	923.45	0.007965	6.41	125.83	36.86	0.61
Rattan_Creek	Reach1	31330.99	970.34	914.74	921.64	921.91	0.002557	4.2	231.13	55.99	0.36
Rattan_Creek	Reach1	31252.19	Culvert								
Rattan_Creek	Reach1	31127.2	970.34	913.35	919.72	920.54	0.005759	8.82	197.89	61.05	0.64
Rattan_Creek	Reach1	31096.35	Bridge								
Rattan_Creek	Reach1	31038.71	970.34	912.12	918.21	918.93	0.006589	6.82	143.51	87.93	0.64
Rattan_Creek	Reach1	30738.58	1101.56	908.95	914.45	915.78	0.015318	9.26	119.01	40	0.95
Rattan_Creek	Reach1	30330.96	1232.17	906.19	911.23	911.9	0.006214	6.6	193.54	202.71	0.62
Rattan_Creek	Reach1	29970.83	1329.78	903.64	908.3	909.2	0.008916	7.6	176.28	331.78	0.74
Rattan_Creek	Reach1	29725.84	1469.14	900.79	906.91	907.33	0.005757	5.66	424.76	301.41	0.53
Rattan_Creek	Reach1	29405.52	1484.19	898.48	905.86	906.15	0.00231	4.36	340.45	72.48	0.35
Rattan_Creek	Reach1	29339.52	Culvert								
Rattan_Creek	Reach1	29297.52	1484.19	896.7	904.99	905.15	0.000926	3.28	459.58	180.1	0.23
Rattan_Creek	Reach1	29251.41	1533.23	896.65	901.59	902.24	0.013449	6.62	245.87	67.91	0.55
Rattan_Creek	Reach1	29104.34	1567.97	894.8	900.65	900.89	0.006197	4.49	413.21	138.56	0.37
Rattan_Creek	Reach1	29002.99	1618.1	894.22	899.66	900.07	0.010244	5.66	329.61	110.74	0.48
Rattan_Creek	Reach1	28860.6	1698.05	893.42	898.5	898.78	0.00842	4.96	407.37	133.2	0.43
Rattan_Creek	Reach1	28642.4	1748.82	892.19	898.19	898.25	0.001242	2.21	897.97	213.31	0.17
Rattan_Creek	Reach1	28509.11	1778.93	891.05	898.15	898.17	0.000296	1.24	1627.82	314.86	0.09
Rattan_Creek	Reach1	28431.87	1778.93	890.38	898.11	898.13	0.000398	1.48	1517.42	367.7	0.1
Rattan_Creek	Reach1	28392	Culvert								
Rattan_Creek	Reach1	28363.76	1814.83	889.9	895.52	896.08	0.012233	6.39	350.99	182.91	0.53
Rattan_Creek	Reach1	28222.46	1855.88	888.59	893.96	894.61	0.008806	6.98	332.84	169.45	0.61
Rattan_Creek	Reach1	28064.31	1918.12	887.35	892.55	893.12	0.009849	8	365.73	215.06	0.66
Rattan_Creek	Reach1	27831.03	1973.1	885.23	889.74	890.35	0.015418	8.94	329.36	168.96	0.8

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Rattan_Creek	Reach1	27631.19	2047.65	883.51	888.16	888.51	0.006833	6.46	486.52	261.82	0.55
Rattan_Creek	Reach1	27368.93	2122.81	881	885.77	886.31	0.008723	7.17	425.18	262.71	0.62
Rattan_Creek	Reach1	27114.02	2195.78	879.07	884.11	884.41	0.006164	6.13	584.26	334.54	0.52
Rattan_Creek	Reach1	26875.04	2291.1	877.02	882.06	882.53	0.009182	7.47	461.76	238.01	0.64
Rattan_Creek	Reach1	26574.54	2351.13	874.44	878.71	879.32	0.012476	8.05	404.39	192.89	0.73
Rattan_Creek	Reach1	26391.63	2430.36	872.86	877.28	877.67	0.006363	6.1	508.91	207.89	0.53
Rattan_Creek	Reach1	26157.26	2453.57	870.86	876.46	876.67	0.002851	4.65	732.92	408.63	0.37
Rattan_Creek	Reach1	26090.05	2495.22	870.35	876.01	876.39	0.003291	5.23	509.05	386.06	0.4
Rattan_Creek	Reach1	26038.88	Culvert								
Rattan_Creek	Reach1	25985.99	2495.22	869.52	873.88	874.75	0.014949	9.08	341.59	125.53	0.8
Rattan_Creek	Reach1	25811.83	2545.68	868.45	873.17	873.39	0.003522	4.42	698.3	324.03	0.39
Rattan_Creek	Reach1	25604.65	2609.83	867.24	872.04	872.35	0.006844	6.35	627.03	323.6	0.55
Rattan_Creek	Reach1	25347.14	2664.68	865.97	870.65	870.88	0.005254	5.02	729.26	379.93	0.47
Rattan_Creek	Reach1	25131.94	2703.4	864.92	869.39	869.74	0.007628	5.83	614.83	286.5	0.56
Rattan_Creek	Reach1	24982.65	2785.49	864.18	868.65	868.79	0.002757	3.5	988.91	452.88	0.34
Rattan_Creek	Reach1	24673.14	2908.7	862.66	867.54	867.84	0.005883	5.52	743.67	352.49	0.5
Rattan_Creek	Reach1	24225.28	2964.35	860.46	865.36	865.73	0.005832	5.98	654.32	256.11	0.51
Rattan_Creek	Reach1	24029.18	3052.48	859.5	864.21	864.57	0.00595	5.95	678.79	285.19	0.51
Rattan_Creek	Reach1	23726.02	3118.69	857.6	862.78	863.05	0.00432	5.07	835.58	380.36	0.44
Rattan_Creek	Reach1	23503.98	3165.26	856.92	862.06	862.24	0.003195	4.65	980.69	423.1	0.38
Rattan_Creek	Reach1	23350.63	3181.31	856.17	861.83	861.92	0.001416	3.26	1412.04	499.52	0.26
Rattan_Creek	Reach1	23298.29	3209.88	855.91	861.73	861.83	0.001654	3.82	1306.09	504.93	0.28
Rattan_Creek	Reach1	23284.35	Culvert								
Rattan_Creek	Reach1	23261.33	3209.88	855.56	861.7	861.78	0.00104	3.06	1536.96	539.34	0.23
Rattan_Creek	Reach1	23205.77	3289.21	855.38	861.3	861.59	0.004056	5.56	973.99	396.32	0.44
Rattan_Creek	Reach1	22953.16	3367.26	853.84	860.78	860.92	0.001693	3.97	1303.36	438.1	0.29
Rattan_Creek	Reach1	22710.49	3411.63	852.37	860.39	860.55	0.001423	4.14	1125.38	371.48	0.27
Rattan_Creek	Reach1	22575.03	3455.82	851.63	860.31	860.39	0.000754	3.24	1584.7	392.21	0.2
Rattan_Creek	Reach1	22441.87	3498.45	851.42	860.25	860.31	0.000424	2.48	1917	565.16	0.15
Rattan_Creek	Reach1	22315.01	3534.93	851.54	859.96	860.16	0.004124	3.75	1000.12	784.35	0.24
Rattan_Creek	Reach1	22268.61	Bridge								
Rattan_Creek	Reach1	22143.06	3534.93	851.21	857.26	857.74	0.015371	5.97	641.53	682.69	0.47
Rattan_Creek	Reach1	21941.29	3576.05	849.63	854.85	855.11	0.012182	5.16	882.16	439.32	0.45
Rattan_Creek	Reach1	21716.37	3652.78	848.21	852.98	853.19	0.0073	4.33	1048.98	485.01	0.36

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Rattan_Creek	Reach1	21303.5	3740.03	844.23	849.83	850.12	0.01168	6.12	933.19	351.02	0.47
Rattan_Creek	Reach1	20844.4	3792.6	839.93	847.53	847.71	0.005325	4.9	1253.37	414.89	0.33
Rattan_Creek	Reach1	20572.92	3838.23	840.36	846.56	846.68	0.00346	3.58	1491.83	452.49	0.26
Rattan_Creek	Reach1	20340.33	3881.1	838.21	845.75	845.89	0.00327	4	1362.47	333.17	0.26
Rattan_Creek	Reach1	20124.33	3932.75	837.25	845.06	845.22	0.003507	4.19	1321.88	322.12	0.27
Rattan_Creek	Reach1	19867.22	3969.14	836.2	844.1	844.25	0.003549	3.96	1328.41	313.95	0.27
Rattan_Creek	Reach1	19688.1	3969.14	835.38	843.32	843.54	0.005082	5.02	1126.65	275.25	0.32
Rattan_Creek	Reach1	19531.49	4020.85	834.57	842.52	842.85	0.006923	5.88	937.53	218.53	0.38
Rattan_Creek	Reach1	19178.89	4058.38	832.61	840.83	841.11	0.005374	5.17	1082.38	289.99	0.33
Rattan_Creek	Reach1	18925.8	4163.59	830.71	839.83	840.07	0.004367	4.64	1198.51	298.82	0.3
Rattan_Creek	Reach1	18228.54	4225.96	827.85	835.75	836.11	0.0085	6.05	1200.73	593.17	0.41
Rattan_Creek	Reach1	17823.55	4272.09	826.48	833.47	833.62	0.005514	4.52	1573.85	638.72	0.32
Rattan_Creek	Reach1	17527.77	4324.69	825.07	831.14	831.46	0.011583	5.38	1108.37	569.76	0.45
Rattan_Creek	Reach1	17194.4	4443.71	823.27	829	829.11	0.004533	3.59	1790.11	686.2	0.29
Rattan_Creek	Reach1	16454.83	4516.41	819.52	826.91	827.02	0.003293	3.64	1854.73	597.8	0.26
Rattan_Creek	Reach1	16012.75	4614.12	816.39	825.8	825.95	0.003345	4.33	1880.71	660.23	0.27
Rattan_Creek	Reach1	15429.69	4671.1	815.05	823.19	823.51	0.006186	4.98	1184.5	347.65	0.35
Rattan_Creek	Reach1	15095.36	4726.86	811.98	821.69	821.96	0.004455	4.73	1327.76	349.4	0.3
Rattan_Creek	Reach1	14772.12	4803.86	809.68	820.55	820.8	0.003997	5.07	1348.52	294.5	0.29
Rattan_Creek	Reach1	14331.94	4867.53	809.81	819.13	819.33	0.002779	4.04	1487.71	294.27	0.25
Rattan_Creek	Reach1	13973.25	4933.3	807.84	817.73	818.03	0.004828	5.39	1278.18	285.9	0.32
Rattan_Creek	Reach1	13607.59	4978.38	806.35	816.15	816.37	0.00434	5.12	1468.1	359.58	0.31
Rattan_Creek	Reach1	13359.84	5072.39	805.1	815.31	815.5	0.004214	4.81	1695.74	553.06	0.29
Rattan_Creek	Reach1	12850.17	5140.28	803.57	812.55	812.87	0.008255	6.55	1421.94	540.81	0.41
Rattan_Creek	Reach1	12488.01	5198.03	802	811.18	811.41	0.004148	5.04	1653.55	483.09	0.3
Rattan_Creek	Reach1	12183.64	5235.57	802.22	810.35	810.5	0.002451	3.48	2022.1	561.38	0.23
Rattan_Creek	Reach1	11987.62	5262.62	799.41	809.74	809.93	0.0039	5.03	1821.69	540.76	0.29
Rattan_Creek	Reach1	11847.27	5262.62	799.08	809.32	809.49	0.002634	3.89	1889.41	499.91	0.24
Rattan_Creek	Reach1	11555.03	5296.43	797.57	808.2	808.49	0.004715	5.67	1396.5	314.52	0.32
Rattan_Creek	Reach1	11301.54	5331.33	796.3	806.93	807.24	0.005328	5.85	1364.46	318.27	0.34
Rattan_Creek	Reach1	11041.6	5375.34	795	805.73	805.99	0.004727	5.52	1568.21	413.88	0.32
Rattan_Creek	Reach1	10716.27	5424.31	793.38	804.31	804.61	0.004034	5.23	1433.46	298.78	0.3
Rattan_Creek	Reach1	10357.34	5494.7	791.58	803.1	803.32	0.003435	4.96	1734.73	427.62	0.28
Rattan_Creek	Reach1	9847.072	5557.07	789.98	801.53	801.77	0.003077	4.73	1648.32	340.36	0.26

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Rattan_Creek	Reach1	9400.368	5607.5	788.6	800.27	800.47	0.002736	4.51	1919.67	459.19	0.25
Rattan_Creek	Reach1	9042.837	5663.97	787.49	799.53	799.69	0.001896	3.77	2197.09	518.08	0.21
Rattan_Creek	Reach1	8646.278	5728.68	786.14	799.22	799.27	0.000745	2.65	3505.61	659.96	0.13
Rattan_Creek	Reach1	8196.692	5768.59	784.87	798.94	798.98	0.000646	2.5	3665.79	641.32	0.13
Rattan_Creek	Reach1	7921.877	5821.08	784.02	798.8	798.83	0.000445	2.28	4418.16	752.63	0.11
Rattan_Creek	Reach1	7563.402	5849.36	782.91	798.73	798.74	0.000228	1.72	5676.95	843.42	0.08
Rattan_Creek	Reach1	7371.627	5872.35	782.31	798.71	798.71	0.000071	0.98	10098.79	1496.63	0.04
Rattan_Creek	Reach1	7216.385	5942.46	781.83	798.7	798.7	0.000033	0.66	13210.7	1570.17	0.03
Rattan_Creek	Reach1	7138.334	Bridge								
Rattan_Creek	Reach1	7085.906	5942.46	781.47	794.79	795.37	0.005578	6.42	995.72	1397.06	0.35
Rattan_Creek	Reach1	6746.629	5989.88	780.98	794.43	794.51	0.00077	2.82	2929.36	996.37	0.14
Rattan_Creek	Reach1	6432.06	5999.21	780.52	794.33	794.38	0.000635	2.65	3564.76	656.4	0.13
Rattan_Creek	Reach1	6370.505	6474.96	780.43	794.18	794.3	0.001377	3.87	2613.63	453.38	0.19
Rattan_Creek	Reach1	6320.077	Culvert								
Rattan_Creek	Reach1	6267.797	6474.96	780.28	790.84	791.63	0.013374	9.8	1153.52	338.66	0.54
Rattan_Creek	Reach1	5875.49	6489.55	778.96	788.54	788.74	0.00381	4.77	2009.76	473.71	0.29
Rattan_Creek	Reach1	5568.144	6505.79	777.91	787.6	787.73	0.002735	4.11	2413.18	561.71	0.24
Rattan_Creek	Reach1	5227.049	6534.36	776.76	786.69	786.83	0.002576	3.9	2398.99	558.34	0.24
Rattan_Creek	Reach1	4628.787	6544.43	774.56	784.32	784.69	0.005513	5.67	1549.05	352.38	0.35
Rattan_Creek	Reach1	4418.637	6552.09	773.38	783.34	783.52	0.00414	5.14	2255.98	666.26	0.3
Rattan_Creek	Reach1	4258.871	6563.41	772.53	782.87	783.02	0.002893	4.16	2413.18	588.88	0.25
Rattan_Creek	Reach1	4023.211	6576.99	772.67	782.5	782.62	0.002642	4.11	2414.15	520.36	0.24
Rattan_Creek	Reach1	3741.073	6587.16	771.01	781.71	781.99	0.004469	5.37	1864.75	475.06	0.31
Rattan_Creek	Reach1	3530.048	6609.61	769.65	781.02	781.29	0.00427	5.34	1882.36	460.65	0.31
Rattan_Creek	Reach1	3065.703	6619.68	769.44	779.8	779.95	0.003087	4.68	2305.84	541.38	0.26
Rattan_Creek	Reach1	2857.815	6634.76	768.18	778.87	779.19	0.005156	6.04	1776.16	457.77	0.34
Rattan_Creek	Reach1	2547.124	6650.17	767.67	777.86	778.1	0.003559	4.39	1899.14	402.91	0.27
Rattan_Creek	Reach1	2230.452	6678.55	766.45	776.54	776.83	0.004693	5.24	1776.18	416.77	0.32
Rattan_Creek	Reach1	1649.221	6693.47	764.62	774.37	774.59	0.004081	4.88	1947.97	431.67	0.3
Rattan_Creek	Reach1	1344.551	6708.08	763.59	773.21	773.4	0.003957	4.82	2059.74	470.38	0.29
Rattan_Creek	Reach1	1046.78	6718.25	762.58	771.51	771.85	0.008309	6.82	1665.37	549.85	0.42
Rattan_Creek	Reach1	839.9879	6729.3	761.87	770.84	770.99	0.003021	3.95	2348.19	564.14	0.25
Rattan_Creek	Reach1	615.5835	6735.37	761.61	768.79	769.54	0.016152	8.29	1093.69	302.28	0.57
Rattan_Creek	Reach1	492.5801	6742.48	761.49	768.76	769.2	0.000533	5.93	1354.17	304.45	0.41

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River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Rattan_Creek	Reach1	409.8677	Bridge								
Rattan_Creek	Reach1	362.6219	6742.48	761.38	768.7	769.05	0.000428	5.26	1522.07	363.5	0.37
Rattan_Creek	Reach1	348.6483	6743.46	761.37	768.71	769.03	0.000397	4.85	1584.2	428.07	0.35
Rattan_Creek	Reach1	328.7861	6743.46	761.36	768.72	769.01	0.000359	4.65	1684.93	422.7	0.33
Rattan_Creek	Reach1	285.7455	Bridge								
Rattan_Creek	Reach1	223.7936	6743.46	761.17	768.66	768.94	0.000328	4.5	1653.31	380.43	0.32
Rattan_Creek	Reach1	20.21005	6743.46	759.8	768.53	768.8	0.001996	5.21	1786.67	415.36	0.33
Rattan_Ck_Trib1b	Reach1	1334	267.95	841.14	842.85	843.17	0.020298	5	70.94	119.51	0.84
Rattan_Ck_Trib1b	Reach1	734	267.95	827.67	828.86	829.15	0.025652	4.98	79.8	192.26	0.92
Rattan_Ck_Trib1a	Reach1	10765	373.66	839.51	842.75	843.57	0.023366	7.34	53.92	35.67	0.97
Rattan_Ck_Trib1a	Reach1	10471	917.33	835.5	839.54	839.76	0.00562	5.4	373.97	295.38	0.53
Rattan_Ck_Trib1a	Reach1	10001	1387.23	829.4	834.08	834.63	0.018991	6.83	310.49	351.5	0.88
Rattan_Ck_Trib1a	Reach1	9553	Culvert								
Rattan_Ck_Trib1a	Reach1	9503	1387.23	823.46	829.16	829.61	0.007404	5.63	351.42	386.99	0.59
Rattan_Ck_Trib1a	Reach1	8922	1387.23	820.6	822.81	823.13	0.018293	6.1	363.89	314.79	0.85
Rattan_Ck_Trib1	Reach1	7966	1956.49	815.09	818.05	818.13	0.002906	3.58	930.32	512.63	0.37
Rattan_Ck_Trib1	Reach1	6587	2214.79	805.44	808.78	809.25	0.023466	6.85	454.5	483.09	1.05
Rattan_Ck_Trib1	Reach1	5760	50	801.21	805.75	805.75	0	0.05	1944.52	881.93	0
Rattan_Ck_Trib1	Reach1	5610	128.63	804.09	805.74	805.75	0.000191	0.58	221.22	184.98	0.09
Rattan_Ck_Trib1	Reach1	5581	Bridge								
Rattan_Ck_Trib1	Reach1	5425	128.63	800.36	802.7	802.71	0.000605	0.78	194.11	311.2	0.11
Rattan_Ck_Trib1	Reach1	5248	Bridge								
Rattan_Ck_Trib1	Reach1	5166	128.63	799.71	801.12	801.48	0.02364	4.95	30.13	709.32	0.88
Rattan_Ck_Trib1	Reach1	4483	229.58	795.44	798.05	798.05	0.000558	1.02	431.95	1244.35	0.15
Rattan_Ck_Trib1	Reach1	3792	542.81	792.16	798.04	798.04	0.000011	0.33	2519.66	2227.02	0.03
Rattan_Ck_Trib1	Reach1	3756	Bridge								
Rattan_Ck_Trib1	Reach1	3733	542.81	789.63	795.39	795.45	0.000646	2.28	534.77	789.8	0.2
Rattan_Ck_Trib1	Reach1	3713	Culvert								
Rattan_Ck_Trib1	Reach1	3634	542.81	786.11	789.21	790.26	0.019413	8.2	66.16	32.08	1.01
Rattan_Ck_Trib1	Reach1	3224	559.53	779.33	782.9	783.16	0.003872	4.17	134.34	54.83	0.47
Rattan_Ck_Trib1	Reach1	2786	573.98	777	781.24	781.52	0.003639	4.3	133.49	49.21	0.46
Rattan_Ck_Trib1	Reach1	2418	594.5	774.71	777.8	778.81	0.019083	8.06	73.74	36.57	1
Rattan_Ck_Trib1	Reach1	1911	595.82	770.8	774.21	774.54	0.004159	4.56	130.6	48.49	0.49
Rattan_Ck_Trib1	Reach1	1879	596.27	770.8	773.17	774.1	0.019775	7.76	76.87	41.74	1.01

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Rattan_Ck_Trib1	Reach1	1868	613.7	768.8	771.93	772.98	0.014922	8.24	74.5	36.05	1.01
Rattan_Ck_Trib1	Reach1	1805	Culvert								
Rattan_Ck_Trib1	Reach1	1733	613.7	767.7	771.81	772.22	0.004217	5.2	118.13	44.64	0.56
Rattan_Ck_Trib1	Reach1	1452	629.72	766.09	769.48	770.22	0.012421	6.91	91.15	41.54	0.82
Rattan_Ck_Trib1	Reach1	1080	657.81	760.25	763.43	764.22	0.021532	8.2	124.37	79.06	0.89
Rattan_Ck_Trib1	Reach1	450	657.81	752.59	757.44	757.52	0.00112	2.36	392.01	167.42	0.22
Lake_Creek_Trib5	Reach1	3821.815	2141.63	762.79	767.58	767.87	0.007791	5.82	561.07	279.41	0.49
Lake_Creek_Trib5	Reach1	3565.159	2655.42	761.66	766.97	767.05	0.001709	2.98	1330.62	543.22	0.24
Lake_Creek_Trib5	Reach1	3144.182	3030.42	758.06	766.88	766.9	0.00015	1.23	3203.53	597.27	0.08
Lake_Creek_Trib5	Reach1	2885.574	3297.09	760.46	765.79	766.67	0.012332	7.64	448.55	897.91	0.62
Lake_Creek_Trib5	Reach1	2720.468	3297.09	757.67	762.21	763.58	0.030239	9.55	364.86	724.41	0.92
Lake_Creek_Trib5	Reach1	2326.381	2681.32	753.8	758.15	758.37	0.005945	4.63	773.12	388.39	0.42
Lake_Creek_Trib5	Reach1	2144.166	2311.24	753.38	757	757.21	0.006884	4.54	656.13	309.57	0.44
Lake_Creek_Trib5	Reach1	2013.252	1647.27	752.15	756.03	756.28	0.007556	4.23	469.62	308.64	0.45
Lake_Creek_Trib5	Reach1	1714.744	1032.09	749.36	753.08	753.51	0.01354	6.66	219	612.58	0.63
Lake_Creek_Trib5	Reach1	1302.65	756.56	745.51	748.6	748.87	0.008975	4.36	188.19	375.17	0.48
Lake_Creek_Trib5	Reach1	1028.911	574.99	741.76	747.89	747.95	0.001303	1.89	305.36	284.41	0.19
Lake_Creek_Trib5	Reach1	787.0194	465.57	740.69	747.84	747.85	0.000147	0.98	553.69	388.54	0.07
Lake_Creek_Trib5	Reach1	600.967	409.37	738.72	747.83	747.83	0.000056	0.59	707.81	452.83	0.04
Lake_Creek_Trib5	Reach1	487.5819	330.02	737.28	747.82	747.83	0.00002	0.42	873.05	595.14	0.03
Lake_Creek_Trib5	Reach1	297.6703	279.08	737.25	747.82	747.82	0.000008	0.25	1186.93	714.83	0.02
Lake_Creek_Trib5	Reach1	149.8941	279.08	736.41	747.82	747.82	0.000041	0.76	887.64	831.98	0.04
Lake_Creek_Trib5	Reach1	124.9021	Culvert								
Lake_Creek_Trib5	Reach1	100.6904	279.08	736.09	747.82	747.82	0.000009	0.38	1381.02	808.46	0.02
Lake_Creek_Trib4	Reach1	3143.379	666.67	797.99	803.04	803.19	0.005163	3.29	244.74	116.96	0.29
Lake_Creek_Trib4	Reach1	2687.432	713.9	793.43	796.49	797.37	0.05653	7.85	102.05	62.52	0.9
Lake_Creek_Trib4	Reach1	2221.01	744.26	787.33	794.3	794.37	0.001814	2.25	362.2	114.26	0.18
Lake_Creek_Trib4	Reach1	1937.2	769.52	790.49	792.43	792.85	0.050872	5.74	167.83	197.28	0.8
Lake_Creek_Trib4	Reach1	1709.797	802.43	783.76	788.14	788.37	0.007579	3.95	222.06	83.92	0.35
Lake_Creek_Trib4	Reach1	1424.438	837.7	781.62	786.05	786.23	0.007341	3.52	256.21	113.06	0.34
Lake_Creek_Trib4	Reach1	1131.349	883.72	780.72	783.68	783.83	0.009134	3.36	300.9	158.77	0.37
Lake_Creek_Trib4	Reach1	766.9211	927.99	775.87	779.46	779.68	0.014899	4.34	280.94	201.14	0.47
Lake_Creek_Trib4	Reach1	433.8465	927.99	772.04	776.82	776.96	0.006162	3.65	346.65	175.83	0.32
Lake_Creek_Trib3	Reach1	8599.197	750.42	922.13	923.83	923.98	0.004942	2.51	244.49	473.56	0.45

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek_Trib3	Reach1	8567.182	801.27	915.51	921.17	921.29	0.000612	2.79	291.25	341.01	0.21
Lake_Creek_Trib3	Reach1	8524.626	Culvert								
Lake_Creek_Trib3	Reach1	8476.636	801.27	914.74	920.8	920.97	0.003788	3.29	243.41	304.7	0.24
Lake_Creek_Trib3	Reach1	8377.419	844.91	914.56	919.5	920.09	0.020049	6.18	140.01	58.85	0.63
Lake_Creek_Trib3	Reach1	8223.896	903.06	913.61	917.32	917.7	0.011925	5.43	186.86	63.07	0.5
Lake_Creek_Trib3	Reach1	8031.23	964.09	910.41	915.57	915.87	0.007501	5.09	229.65	69.8	0.42
Lake_Creek_Trib3	Reach1	7841.922	1013.23	908.58	914.21	914.52	0.007061	4.99	240.92	175.83	0.4
Lake_Creek_Trib3	Reach1	7698.017	1103.86	907.89	912.92	913.3	0.009099	5.45	236.36	72.89	0.46
Lake_Creek_Trib3	Reach1	7450.035	1213.03	905.83	910.85	911.17	0.008246	5.26	275.89	80.32	0.43
Lake_Creek_Trib3	Reach1	7177.036	1347.78	903.63	909.07	909.34	0.005448	4.43	435.48	345.58	0.36
Lake_Creek_Trib3	Reach1	6872.138	1523.79	901.12	906.31	906.85	0.012467	5.93	262.7	126.34	0.52
Lake_Creek_Trib3	Reach1	6516.832	1778.83	897.95	902.62	902.99	0.009792	5.54	384.9	165.71	0.47
Lake_Creek_Trib3	Reach1	6068.879	1998.62	894.21	897.05	897.33	0.016253	5	529.83	387.6	0.56
Lake_Creek_Trib3	Reach1	5731.652	2069.37	889.98	893.42	893.59	0.007661	3.91	658.73	405.67	0.39
Lake_Creek_Trib3	Reach1	5375.6	2137.49	887.51	890.12	890.28	0.010798	3.63	684.11	597.69	0.44
Lake_Creek_Trib3	Reach1	5044.166	2205.65	883.82	887.32	887.48	0.00658	3.01	704.66	568.93	0.35
Lake_Creek_Trib3	Reach1	4722.881	2244.02	881.32	885.21	885.42	0.009608	4.24	656.28	507.6	0.44
Lake_Creek_Trib3	Reach1	4546.396	2327.77	880.87	884.35	884.5	0.005781	3.34	764.18	405.52	0.34
Lake_Creek_Trib3	Reach1	4171.365	2397.61	878.8	882.05	882.39	0.010046	5.44	520.95	291.76	0.6
Lake_Creek_Trib3	Reach1	3868.834	2466.1	875.79	879.8	880.15	0.007468	5.91	565.87	357.05	0.56
Lake_Creek_Trib3	Reach1	3580.559	2521.19	873.97	877.82	878.16	0.006547	5.27	541.81	201.53	0.51
Lake_Creek_Trib3	Reach1	3354.484	2613.11	872.31	876.38	876.73	0.005651	5.03	568.08	389.66	0.48
Lake_Creek_Trib3	Reach1	2987.955	2672.24	869.48	874.41	874.74	0.005637	5.74	612.09	566.4	0.5
Lake_Creek_Trib3	Reach1	2758.979	2740.84	867.72	872.47	872.99	0.009396	7.3	515.33	581.03	0.63
Lake_Creek_Trib3	Reach1	2499.555	2826.9	865.72	870.11	870.37	0.010152	6.57	891.14	801.11	0.62
Lake_Creek_Trib3	Reach1	2183.133	2883.66	863.28	867.95	868.11	0.006339	5.2	1010.73	794.16	0.5
Lake_Creek_Trib3	Reach1	1979.705	2926.99	861.71	866.34	866.57	0.007825	6.31	867.43	612.87	0.56
Lake_Creek_Trib3	Reach1	1827.062	2976.66	860.54	865.41	865.61	0.005425	4.71	874.75	725.73	0.46
Lake_Creek_Trib3	Reach1	1654.823	3003.59	859.21	865.07	865.15	0.001462	3.01	1623.61	789.76	0.25
Lake_Creek_Trib3	Reach1	1562.658	3049.78	858.44	864.95	865.03	0.00117	3.35	1852.99	808.54	0.24
Lake_Creek_Trib3	Reach1	1406.47	3146.94	856.37	864.15	864.55	0.006188	5.06	622.36	994.56	0.32
Lake_Creek_Trib3	Reach1	1304.038	Culvert								
Lake_Creek_Trib3	Reach1	1234.362	3146.94	855.53	861.69	861.75	0.002297	2.54	1789.13	693.31	0.19
Lake_Creek_Trib3	Reach1	1085.514	3200.12	854.82	861.05	861.23	0.009744	5	986.11	552.77	0.37

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek_Trib3	Reach1	914.0101	3265.96	853.5	859.67	859.86	0.008416	4.48	952.22	415.37	0.35
Lake_Creek_Trib3	Reach1	705.5814	3304.37	851.9	858.83	858.91	0.003082	2.97	1480.97	531.94	0.22
Lake_Creek_Trib3	Reach1	585.926	3359.9	850.98	858.17	858.34	0.00683	4.26	1087.92	443.08	0.3
Lake_Creek_Trib3	Reach1	415.3683	3359.9	849.66	854.49	855.5	0.07554	10.52	451.93	247.98	0.96
Lake_Creek_Trib2	Reach1	5942.545	1232.07	901.09	906.47	906.8	0.002422	4.66	264.25	62.6	0.4
Lake_Creek_Trib2	Reach1	5923.98	1265.27	901.36	906.3	906.72	0.003402	5.25	241.02	61.78	0.47
Lake_Creek_Trib2	Reach1	5911.881	Bridge								
Lake_Creek_Trib2	Reach1	5902.091	1265.27	900.72	906.29	906.59	0.001948	4.43	285.84	59.68	0.36
Lake_Creek_Trib2	Reach1	5721.697	1320.05	900.1	905.62	906.07	0.003798	5.39	245	66.49	0.49
Lake_Creek_Trib2	Reach1	5399.295	1390.58	898.49	904.36	904.85	0.003695	5.62	247.31	61.22	0.49
Lake_Creek_Trib2	Reach1	5003.324	1471.88	896.52	902.41	903.08	0.005328	6.57	224.18	57.35	0.59
Lake_Creek_Trib2	Reach1	4571.126	1550.61	894.37	900.61	901.12	0.003788	5.68	272.9	183.69	0.5
Lake_Creek_Trib2	Reach1	4174.749	1601.91	892.4	898.48	899.22	0.005956	6.93	235.44	79.46	0.62
Lake_Creek_Trib2	Reach1	3927.161	1617.47	890.96	897.75	898.16	0.002745	5.14	314.5	96.12	0.43
Lake_Creek_Trib2	Reach1	3853.627	1631.49	890.51	897.46	897.92	0.003752	5.43	300.55	347.9	0.49
Lake_Creek_Trib2	Reach1	3787.952	1677.03	890.11	897.35	897.71	0.002192	4.76	352.01	412.36	0.4
Lake_Creek_Trib2	Reach1	3578.555	1719.1	888.84	895.57	896.69	0.007588	8.51	204.15	51.7	0.71
Lake_Creek_Trib2	Reach1	3541.281	Culvert								
Lake_Creek_Trib2	Reach1	3504.264	1719.1	888.32	893.55	894.56	0.007226	8.06	213.39	54.67	0.69
Lake_Creek_Trib2	Reach1	3390.101	1756.09	887.7	892.74	893.57	0.008555	7.3	240.43	61.91	0.65
Lake_Creek_Trib2	Reach1	3228.159	1802.55	886.72	891.57	892.15	0.007558	6.14	293.48	80.31	0.57
Lake_Creek_Trib2	Reach1	3029.517	1868.07	885.45	889.91	890.57	0.00832	6.5	287.47	78.36	0.6
Lake_Creek_Trib2	Reach1	2757.935	1957.87	883.84	888.23	888.85	0.004961	6.32	309.98	80.5	0.57
Lake_Creek_Trib2	Reach1	2400.774	1973.81	881.71	886.93	887.4	0.003182	5.52	357.6	81.12	0.46
Lake_Creek_Trib2	Reach1	2339.07	2003.61	881.33	886.84	887.19	0.001967	4.74	422.57	107.31	0.38
Lake_Creek_Trib2	Reach1	2313.129	Culvert								
Lake_Creek_Trib2	Reach1	2279.509	2003.61	880.54	884.55	885.88	0.013686	9.27	216.08	67.75	0.92
Lake_Creek_Trib2	Reach1	2225.081	2091.25	879.54	884.34	885.13	0.006267	7.12	293.54	75.14	0.64
Lake_Creek_Trib2	Reach1	1899.423	2209.12	877.23	882.19	882.9	0.00722	6.79	325.58	79.38	0.59
Lake_Creek_Trib2	Reach1	1482.33	2334.55	874	878.59	879.64	0.008301	8.22	284.03	72.58	0.73
Lake_Creek_Trib2	Reach1	1062.239	2378.59	870.69	876.06	876.81	0.005275	6.94	342.94	80.18	0.59
Lake_Creek_Trib2	Reach1	920.0903	2409.28	869.84	875.46	876.06	0.004687	6.2	388.46	83.01	0.51
Lake_Creek_Trib2	Reach1	822.5518	2470.09	869.18	874.92	875.58	0.005098	6.51	379.62	78.4	0.52
Lake_Creek_Trib2	Reach1	632.9475	2524.11	868.11	874.11	874.69	0.004089	6.09	414.18	81.47	0.48

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek_Trib2	Reach1	468.3735	2584.64	867.11	873.69	874.16	0.002368	5.5	469.81	84.6	0.41
Lake_Creek_Trib2	Reach1	288.1299	2604.29	865.77	873.37	873.76	0.001836	4.97	524.02	91.3	0.37
Lake_Creek_Trib2	Reach1	230.5154	2628.8	865.68	873.23	873.64	0.001834	5.15	511.21	92.49	0.37
Lake_Creek_Trib2	Reach1	222.56	Bridge								
Lake_Creek_Trib2	Reach1	209.4691	2628.8	865.22	873.24	873.57	0.001462	4.62	575.95	127.15	0.33
Lake_Creek_Trib2	Reach1	159.2552	2628.8	864.94	873.21	873.46	0.001415	3.99	674.21	228.65	0.28
Lake_Creek_Trib1	Reach1	1014.718	1451.89	886.25	891.48	891.59	0.003337	2.69	540.8	412.87	0.23
Lake_Creek_Trib1	Reach1	849.0571	1444.33	886.01	891.16	891.21	0.001622	1.87	824.71	710.44	0.16
Lake_Creek_Trib1	Reach1	660.7575	1442.1	885.7	890.84	891.01	0.000664	3.24	444.94	605.96	0.28
Lake_Creek_Trib1	Reach1	605.15	1435.81	885.7	890.83	890.96	0.000542	2.92	530.17	671.42	0.26
Lake_Creek_Trib1	Reach1	581.5559	Culvert								
Lake_Creek_Trib1	Reach1	554.5011	1435.81	885.38	890.65	890.76	0.000583	3.2	774.12	629.62	0.26
Lake_Creek_Trib1	Reach1	447.5648	1430.35	884.51	890.61	890.71	0.000306	2.56	562.46	596.02	0.2
Lake_Creek_Trib1	Reach1	310.4787	1427.36	884.44	890.58	890.67	0.000276	2.48	579.09	788.72	0.19
Lake_Creek_Trib1	Reach1	235.1265	1423.06	884.28	890.55	890.65	0.000288	2.55	610.64	942.38	0.19
Lake_Creek_Trib1	Reach1	211.19	Culvert								
Lake_Creek_Trib1	Reach1	185.1916	1423.06	884.32	890.42	890.53	0.000291	2.61	577.22	966.72	0.2
Lake_Creek_Trib1	Reach1	126.4049	1423.06	883.93	890.41	890.51	0.000268	2.49	584.54	995.17	0.19
Lake_Creek	Reach6	44435.66	319.25	807.44	809.9	809.96	0.00356	2.62	175.56	172.87	0.32
Lake_Creek	Reach6	44217.66	336.08	806.49	809.27	809.34	0.002148	2.31	182.59	155.64	0.26
Lake_Creek	Reach6	44003.66	361.27	805.91	808.59	808.71	0.003968	3.02	143.93	138.74	0.35
Lake_Creek	Reach6	43702.66	383.72	804.57	807.15	807.3	0.005429	3.25	136.37	108.34	0.4
Lake_Creek	Reach6	43451.66	411.41	803.72	806.38	806.43	0.002554	2.27	245.35	192.99	0.27
Lake_Creek	Reach6	43161.46	426.12	802.86	805.42	805.51	0.004007	2.74	191.22	141.39	0.34
Lake_Creek	Reach6	43015.16	430.32	802.46	804.92	804.99	0.002777	2.41	202	119.43	0.29
Lake_Creek	Reach6	42974.26	435.58	802.32	804.77	804.86	0.003727	2.78	185.03	119.99	0.33
Lake_Creek	Reach6	42923.65	440.97	802.1	804.56	804.65	0.003659	2.86	190.65	126.03	0.33
Lake_Creek	Reach6	42872.46	484.09	801.79	804.18	804.34	0.00893	4.3	178.42	188.53	0.51
Lake_Creek	Reach6	42483.96	519.37	798.9	802.19	802.28	0.004224	2.74	245.9	190.9	0.29
Lake_Creek	Reach6	42190.96	557.83	797.59	800.5	800.65	0.007856	3.41	196.76	130.76	0.39
Lake_Creek	Reach6	41893.46	586.8	795.69	799.35	799.45	0.002571	2.94	259.63	153.83	0.29
Lake_Creek	Reach6	41682.56	623.26	794.41	798.92	799.02	0.002004	2.8	287.75	145.99	0.26
Lake_Creek	Reach6	41431.56	632.77	793.81	798.44	798.53	0.001783	2.79	291.61	148.5	0.25
Lake_Creek	Reach6	41368.46	651.01	793.66	798.3	798.41	0.001817	2.81	273.52	112.95	0.25

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek	Reach6	41333.96	Bridge								
Lake_Creek	Reach6	41316.46	651.01	793.53	798.13	798.24	0.002081	2.84	251.12	89.99	0.27
Lake_Creek	Reach6	41250.14	669.44	793.27	798.01	798.1	0.001987	2.71	300.5	191.11	0.26
Lake_Creek	Reach6	41133.84	704.57	792.8	797.72	797.84	0.002493	3.18	305.29	180.64	0.29
Lake_Creek	Reach6	40920.84	751.58	791.94	797	797.19	0.004433	4.33	261.57	165.34	0.38
Lake_Creek	Reach6	40651.84	829.74	790.86	795.6	795.82	0.005762	4.8	265.57	173.32	0.43
Lake_Creek	Reach6	40239.84	905.52	789.21	794.14	794.21	0.002849	2.27	415	171.08	0.21
Lake_Creek	Reach6	39875.84	965.25	787.74	793.59	793.63	0.001112	1.81	618.08	193.72	0.14
Lake_Creek	Reach6	39609.84	1037.1	786.68	793.57	793.58	0.000045	0.96	1376.59	343.97	0.07
Lake_Creek	Reach6	39535.84	Bridge								
Lake_Creek	Reach6	39345.84	1037.1	785.55	793.5	793.51	0.000073	1.26	1128.15	312.51	0.09
Lake_Creek	Reach6	39310.8	1115.47	785.27	793.49	793.51	0.000096	1.46	1104.55	319.2	0.1
Lake_Creek	Reach6	39236.8	Bridge								
Lake_Creek	Reach6	39157.8	1115.47	784.32	793.43	793.48	0.00016	1.95	710.88	178.49	0.13
Lake_Creek	Reach6	39007.41	1115.47	783.63	793.4	793.44	0.000363	1.64	780.64	173.28	0.11
Lake_Creek	Reach5	38934.41	5334.64	782.07	792.71	792.93	0.002505	4.8	1630.63	391.36	0.29
Lake_Creek	Reach5	38614.04	5356.58	780.79	791.99	792.2	0.002253	4.29	1644.57	373.96	0.27
Lake_Creek	Reach5	38400.72	5379.26	779.94	791.58	791.75	0.001765	4.22	1947.41	453.9	0.24
Lake_Creek	Reach5	38181.1	5403.64	779.07	791.37	791.46	0.001088	2.65	2479.78	446.48	0.15
Lake_Creek	Reach5	37946.05	5418.63	778.13	790.53	790.95	0.006715	6.02	1199.39	286.86	0.35
Lake_Creek	Reach5	37802.1	5451.95	777.56	790.01	790.26	0.003627	4.77	1515.78	306.9	0.27
Lake_Creek	Reach5	37483.52	5473.71	776.29	788.76	789.09	0.004015	5.5	1370.66	287.34	0.29
Lake_Creek	Reach5	37276.52	5524.21	775.46	787.97	788.27	0.003767	5.29	1488.66	340.1	0.28
Lake_Creek	Reach5	36799.15	5560.43	774.06	786.15	786.38	0.003757	4.5	1621.18	407.34	0.27
Lake_Creek	Reach5	36459.5	5603.91	773.06	785.28	785.41	0.002024	3.61	2240.88	550.61	0.2
Lake_Creek	Reach5	36054.68	5655.67	771.86	784.52	784.62	0.001507	3.37	2578.54	535.56	0.18
Lake_Creek	Reach5	35576.85	5696.74	770.45	783.51	783.72	0.002951	4.78	1776.18	354.34	0.25
Lake_Creek	Reach5	35200.83	5739.62	769.34	782.1	782.49	0.005075	5.7	1406.92	354.05	0.32
Lake_Creek	Reach5	34811.1	5810.15	768.19	780.83	780.99	0.002573	4.15	2061.88	402.41	0.23
Lake_Creek	Reach5	34176.27	5833.45	766.32	778.3	778.75	0.005333	6.06	1229.36	251.95	0.33
Lake_Creek	Reach5	33968.27	5833.45	765.71	777.15	777.63	0.005476	5.79	1185.6	294.68	0.33
Lake_Creek	Reach10	31210.69	693.26	956.84	962.07	962.37	0.003295	4.38	159.88	46.37	0.4
Lake_Creek	Reach10	31156.69	Bridge								
Lake_Creek	Reach10	31095.31	693.26	955.55	960.72	960.97	0.003989	3.99	174.05	68	0.43

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek	Reach10	30897.04	819.16	954.06	960.36	960.49	0.001397	2.91	295.06	154.66	0.27
Lake_Creek	Reach10	30622.39	941.62	952.92	960.12	960.21	0.000735	2.42	501.71	384.55	0.22
Lake_Creek	Reach10	30578.39	Bridge								
Lake_Creek	Reach10	30558.07	941.62	952.87	959.73	959.85	0.000993	2.96	488.97	394.36	0.26
Lake_Creek	Reach10	30393.06	1049.14	952.08	959.68	959.73	0.00034	2.07	742.32	375.36	0.16
Lake_Creek	Reach10	30215.09	1134.42	950.49	959.62	959.67	0.00033	1.94	898.58	350.76	0.15
Lake_Creek	Reach10	30133.09	Culvert								
Lake_Creek	Reach10	30068.18	1134.42	950.72	956.58	956.99	0.003341	5.14	220.85	62.56	0.46
Lake_Creek	Reach10	29840.66	1267.6	950.05	955.85	956.24	0.00313	5.06	262.15	121.45	0.45
Lake_Creek	Reach10	29517.49	1807.64	948.3	954.01	954.74	0.005621	6.89	262.36	67.14	0.61
Lake_Creek	Reach10	29401.49	Bridge								
Lake_Creek	Reach10	29312.38	1807.64	947.44	953.02	953.52	0.003534	5.69	327.33	169.55	0.49
Lake_Creek	Reach10	28484.22	1975.84	943.41	951.54	951.72	0.001333	3.62	752.41	373.25	0.28
Lake_Creek	Reach10	28225.19	2175.7	942.73	951.03	951.34	0.00132	4.69	615.47	295.64	0.32
Lake_Creek	Reach10	28112.19	Culvert								
Lake_Creek	Reach10	28040.83	2175.7	942.52	948.67	949.39	0.005446	6.79	320.42	80.69	0.6
Lake_Creek	Reach10	27235.65	2382.8	938.96	945.84	946.24	0.002783	5.28	617.9	365.37	0.44
Lake_Creek	Reach10	26475.9	2663.84	935.86	943.58	944.09	0.002891	6.35	683.22	328.79	0.46
Lake_Creek	Reach10	25544.26	2872.6	932.9	941.83	942.18	0.001453	4.88	820.5	368.08	0.34
Lake_Creek	Reach10	25434.23	Bridge								
Lake_Creek	Reach10	25380.14	2872.6	931.32	940.35	941.25	0.005222	7.59	386.72	106.75	0.6
Lake_Creek	Reach10	24913.83	3015.82	930.01	936.63	937.91	0.009386	9.09	331.59	80.95	0.79
Lake_Creek	Reach10	24507.26	3158.65	926.6	933.53	934.54	0.006887	8.12	412.75	159.48	0.69
Lake_Creek	Reach10	24392.26	Culvert								
Lake_Creek	Reach10	24316.58	3158.65	925.62	932.25	933.04	0.004804	7.13	444.16	96.85	0.58
Lake_Creek	Reach10	23552.37	3322.63	922.23	930.21	930.54	0.002062	5.23	921.27	363.89	0.39
Lake_Creek	Reach10	22716.51	3375.82	920.83	928.28	928.61	0.002652	5.1	1017.92	385.12	0.39
Lake_Creek	Reach10	22454.22	3451.16	919.68	927.28	927.74	0.003876	6.78	956.03	477.99	0.48
Lake_Creek	Reach10	22367.22	Culvert								
Lake_Creek	Reach10	22191.64	3451.16	919.52	925.59	926.6	0.008765	8.47	496.82	313.43	0.7
Lake_Creek	Reach10	22089.68	3474.77	917.78	924.47	925.53	0.011916	9.3	614	305.36	0.8
Lake_Creek	Reach10	21977.1	4087.1	915.66	921.87	923.46	0.015003	10.11	404.24	99.18	0.88
Lake_Creek	Reach10	21876.1	Culvert								
Lake_Creek	Reach10	21487.19	4087.1	913.37	919.79	920.62	0.004332	7.3	560.08	106.06	0.56

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek	Reach10	21279.02	4113.29	911.69	919.04	919.78	0.003526	6.91	595.08	104.48	0.51
Lake_Creek	Reach10	20261.44	4136.56	906.74	913.36	914.53	0.007751	8.67	477.02	108.85	0.73
Lake_Creek	Reach10	19362.21	4146.17	901.85	910.98	911.4	0.001764	5.19	811.56	166.49	0.37
Lake_Creek	Reach10	18992.63	4177.92	900.61	910.38	910.75	0.001615	4.95	935.02	321.43	0.35
Lake_Creek	Reach10	18892.63	Bridge								
Lake_Creek	Reach10	18770.57	4177.92	899	906.66	907.53	0.004865	7.51	584.67	163.18	0.59
Lake_Creek	Reach10	18380.06	4211.16	898.02	903.25	904.6	0.011464	9.71	592.13	285.39	0.87
Lake_Creek	Reach10	17974.57	4236.16	893.49	900.79	901.38	0.004963	6.55	851.86	297.23	0.49
Lake_Creek	Reach10	17671.6	4263.99	892.15	898.9	899.59	0.006945	6.74	699.96	250.42	0.56
Lake_Creek	Reach10	17336.43	4344.24	889.86	897.96	898.37	0.001878	5.11	872.71	221.47	0.38
Lake_Creek	Reach10	17215.43	Bridge								
Lake_Creek	Reach10	17152.27	4344.24	889.14	895.77	896.7	0.005466	7.73	562.15	117.17	0.62
Lake_Creek	Reach10	16382.25	4344.24	885.5	892.16	892.96	0.004185	7.23	644.06	174.51	0.55
Lake_Creek	Reach4	33788.27	6201.55	765.04	775.97	776.11	0.001194	3.53	2505.35	472.69	0.2
Lake_Creek	Reach4	33393.57	6208.7	764.55	774.84	775.28	0.004943	5.67	1356.43	313.05	0.33
Lake_Creek	Reach4	32918.12	6215.21	764.24	773.47	773.63	0.002381	3.85	1974.63	409.79	0.23
Lake_Creek	Reach4	32485.71	6221.29	761.43	772.09	772.49	0.004069	5.64	1350.04	293.63	0.32
Lake_Creek	Reach4	32082.21	6226.27	761.22	771.05	771.28	0.001948	4.09	1740.84	320.04	0.24
Lake_Creek	Reach4	31752.39	6231.99	761.12	770.39	770.64	0.002325	4.2	1671.44	347.28	0.25
Lake_Creek	Reach4	31373.48	6240.36	761.67	769.35	769.63	0.003316	4.6	1557.91	553.03	0.3
Lake_Creek	Reach4	30820.43	6247.11	757.59	768.2	768.32	0.002082	3.93	2751.29	946.62	0.22
Lake_Creek	Reach4	30374.6	6254.24	756.7	766.71	767.04	0.00553	5.8	1823.25	660.18	0.35
Lake_Creek	Reach4	29904.11	6260.88	756.32	765.07	765.22	0.002757	3.94	2199.3	489.73	0.24
Lake_Creek	Reach4	29466.19	6268.47	752.06	764.03	764.21	0.00206	3.8	2177.63	476.16	0.22
Lake_Creek	Reach4	28966.52	6274.98	751.62	762.58	762.91	0.003607	5.29	1528.45	254.12	0.29
Lake_Creek	Reach4	28538.11	6279.64	751.65	761.11	761.39	0.003465	4.69	1663.88	323.33	0.28
Lake_Creek	Reach4	28231.92	6285.36	751.48	760.09	760.31	0.003411	4.39	1790.78	329.18	0.27
Lake_Creek	Reach4	27856.91	6287.67	751.15	759.07	759.2	0.002529	3.56	2300.58	474.26	0.23
Lake_Creek	Reach4	27704.99	6289.41	750.03	758.71	758.83	0.001883	3.17	2490.76	502.23	0.2
Lake_Creek	Reach4	27590.81	6289.91	749.15	758.37	758.53	0.002706	3.88	2142.16	466.14	0.24
Lake_Creek	Reach4	27558.47	6290.65	748.82	758.15	758.41	0.00467	4.58	1747.25	458.07	0.31
Lake_Creek	Reach4	27509.76	6291.44	748.56	757.79	758.16	0.005032	5.31	1436.36	342.4	0.33
Lake_Creek	Reach4	27458.02	6294.41	748.93	756.47	757.59	0.025185	9.7	866.14	308.05	0.7
Lake_Creek	Reach4	27263.39	6298.75	748.39	755.69	755.9	0.004129	4.2	1857.06	423.8	0.29

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek	Reach4	26979.32	6298.75	744.9	754.91	755.08	0.00255	3.78	1999.78	347.66	0.23
Lake_Creek	Reach9	15740.64	5726.81	882.22	890.08	890.24	0.003451	3.2	1789.79	1004.82	0.42
Lake_Creek	Reach9	15634.64	Bridge								
Lake_Creek	Reach9	15588.08	5726.81	880.91	887.43	888.63	0.006116	8.78	652.29	214.95	0.67
Lake_Creek	Reach9	15035.72	5735.32	877.16	882.83	884.67	0.007616	10.91	525.8	130.13	0.96
Lake_Creek	Reach9	14398.07	5745.41	873.47	880.67	881.59	0.002869	7.7	747.69	156.87	0.61
Lake_Creek	Reach9	13643.83	5750.91	870.26	875.85	878.04	0.008212	11.86	484.91	111.21	1
Lake_Creek	Reach9	13232.71	5750.91	867.05	873.64	874.74	0.003445	8.39	685.73	138.02	0.66
Lake_Creek	Reach3	25966	9482.01	742.1	752.29	752.98	0.003613	9.02	2134.17	359.56	0.51
Lake_Creek	Reach3	25486	9433.37	737.96	751.39	751.91	0.001378	7.45	2635.35	345.31	0.37
Lake_Creek	Reach3	24882	9394.65	739.04	750.16	750.94	0.001984	7.9	1854.42	268.36	0.43
Lake_Creek	Reach3	24399	9333.73	738.75	748.89	749.84	0.002614	8.62	1669.95	312.8	0.49
Lake_Creek	Reach3	23635	9297.87	733.89	748.07	748.28	0.001371	5.21	3061.22	444.64	0.26
Lake_Creek	Reach3	23183	9297.87	733.19	747.5	747.74	0.001195	5.42	3583.04	553.43	0.27
Lake_Creek	Reach2	23085	10935.8	733.5	747.13	747.56	0.001189	5.65	2927.17	544.07	0.28
Lake_Creek	Reach2	23045	Culvert								
Lake_Creek	Reach2	23003	10935.8	733.46	746.9	747.46	0.001899	6.51	2649.28	499.79	0.32
Lake_Creek	Reach2	22924	10926.6	733.04	746.42	747.18	0.00435	7.79	2635.27	737.17	0.4
Lake_Creek	Reach2	22473	10916.8	732.85	744.41	745.04	0.004823	8.76	3545.58	845.29	0.48
Lake_Creek	Reach2	21988	10905	730.61	742.68	743.36	0.003712	8.54	3367.94	842.96	0.47
Lake_Creek	Reach2	21405	10887.5	729.53	741.01	741.67	0.003384	8.39	3428.61	882.95	0.48
Lake_Creek	Reach2	20541	10876.9	722.15	739.84	740.17	0.001138	6.37	4260.74	749.07	0.3
Lake_Creek	Reach2	20016	10870.2	721.89	738.87	739.51	0.002059	7.95	3004.04	609.51	0.39
Lake_Creek	Reach2	19685	10861.3	722.4	737.25	738.11	0.001822	7.95	2010.73	294.05	0.38
Lake_Creek	Reach2	19242	10858	720.56	736.42	737.24	0.002145	7.75	1966.52	400.38	0.4
Lake_Creek	Reach2	19080	10847.7	720.21	736.59	736.82	0.000424	3.99	3527.6	523.03	0.18
Lake_Creek	Reach2	19010	Culvert								
Lake_Creek	Reach2	18957	10847.7	719.67	736.5	736.73	0.000504	4.05	3833.01	615.56	0.18
Lake_Creek	Reach2	18571	10840.8	718.92	736.09	736.43	0.001024	5.93	4209.71	852.22	0.28
Lake_Creek	Reach2	18225	10831.9	718.89	733.72	735.4	0.004799	12.23	2176.08	888.97	0.6
Lake_Creek	Reach2	17785	10823.6	717.88	733.58	734.05	0.00128	7.04	4357.59	1176.84	0.32
Lake_Creek	Reach2	17369	10820.9	716.56	731.44	732.9	0.003737	9.85	1331.27	654.05	0.52
Lake_Creek	Reach2	17293	Culvert								
Lake_Creek	Reach2	17239	10820.9	717.92	731.11	732.27	0.002223	8.71	1355.81	814.28	0.5

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek	Reach2	16784	10790.7	717.53	730.88	731.35	0.000808	5.54	2047.34	344.69	0.31
Lake_Creek	Reach2	16332	10790.7	714.75	730.56	731	0.000708	6.55	2917.82	382.63	0.3
Lake_Creek	Reach2	16272.13	10787.3	716.11	730.53	730.61	0.000753	2.65	5354.46	746.06	0.13
Lake_Creek	Reach2	15902.26	10802.1	716.14	730.27	730.32	0.000708	2.56	6325.3	1466.37	0.12
Lake_Creek	Reach2	15539.34	10812.2	716.18	729.92	730.03	0.001022	3.03	4505.43	1279.81	0.15
Lake_Creek	Reach2	15290.35	10814.6	716.18	729.5	729.69	0.001647	3.94	3193.91	1118.65	0.19
Lake_Creek	Reach2	15232.8	10819.7	716.2	729.11	729.49	0.003704	5.56	2269.28	1564.47	0.28
Lake_Creek	Reach2	15198.79	Bridge								
Lake_Creek	Reach2	15157.27	10819.7	715.18	728.43	728.77	0.003118	5.08	2364.26	1427.95	0.26
Lake_Creek	Reach2	15106.38	10828.1	714.55	727.93	728.52	0.00456	7.21	2002.64	1707.32	0.38
Lake_Creek	Reach2	14900.5	10835.7	711.78	723.99	726.27	0.020622	13.46	1045.8	914.71	0.77
Lake_Creek	Reach2	14714.03	10838.1	710.6	724.26	724.5	0.002239	5.06	3069.46	1297.56	0.26
Lake_Creek	Reach2	14655.87	10844.1	711.4	724.32	724.35	0.000351	1.73	7966.84	1731.9	0.09
Lake_Creek	Reach2	14610.02	Bridge								
Lake_Creek	Reach2	14569.39	10844.1	710.46	722.98	723.41	0.004281	5.98	2076.48	967.22	0.3
Lake_Creek	Reach2	14507.77	10853.9	709.39	722.7	723.15	0.003924	5.4	2038.52	200.14	0.29
Lake_Creek	Reach2	14420.5	Bridge								
Lake_Creek	Reach2	14360.07	10853.9	706.89	721.24	721.69	0.00389	6.06	2054.17	204.11	0.29
Lake_Creek	Reach2	14267.5	10860.3	705.53	721.05	721.34	0.002319	4.39	2499.87	681.13	0.22
Lake_Creek	Reach2	14225.99	Bridge								
Lake_Creek	Reach2	14193.22	10860.3	704.45	719.83	719.89	0.000441	2.02	6014.96	1419.1	0.1
Lake_Creek	Reach2	14112.14	10882.9	703.75	719.76	719.83	0.000877	2.9	5150.99	1335.65	0.14
Lake_Creek	Reach2	13558.88	10902.1	701.86	718.85	719.12	0.002272	4.68	2894.83	469.21	0.22
Lake_Creek	Reach2	13091.53	10920.6	700.36	717.58	717.94	0.002846	5.93	2377.21	293.56	0.26
Lake_Creek	Reach2	12642.06	10922	698.91	717.21	717.4	0.000498	2.53	3761.19	788.4	0.11
Lake_Creek	Reach2	12606.42	10927.3	698.79	717.01	717.33	0.001147	3.87	2635.88	761.71	0.16
Lake_Creek	Reach2	12540.48	Bridge								
Lake_Creek	Reach2	12492.31	10927.3	698.51	714.38	714.75	0.002041	4.47	2239.85	238.04	0.2
Lake_Creek	Reach2	12477.44	10934.1	697.97	714.41	714.69	0.001054	3.37	2674.7	272.24	0.15
Lake_Creek	Reach2	12423.56	Bridge								
Lake_Creek	Reach2	12370.92	10934.1	696.54	714.2	714.39	0.000387	1.99	3308.49	919.39	0.09
Lake_Creek	Reach2	12313.38	10934.1	696.24	714.22	714.34	0.000272	1.73	4151.68	1108.94	0.07
Lake_Creek	Reach8	12686.07	7431.28	863.78	871.45	872.6	0.004307	8.7	901.76	188	0.65
Lake_Creek	Reach8	12150.12	7444.3	861.26	870.18	871.01	0.00181	7.32	1066.4	269.26	0.5

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek	Reach8	12060.12	Inl Struct								
Lake_Creek	Reach8	11983.04	7492.94	860.73	868.75	869.82	0.002715	8.33	899.7	153.23	0.61
Lake_Creek	Reach8	11725.39	7502.27	858.6	868.28	869.09	0.002024	7.2	1043.52	184.13	0.52
Lake_Creek	Reach8	11661.39	Inl Struct								
Lake_Creek	Reach8	11627.41	7567.88	858.95	865.74	867.4	0.004656	10.36	742.37	155.92	0.78
Lake_Creek	Reach8	11213.81	7611.68	856.89	864.55	865.68	0.00275	8.55	890.42	146.95	0.61
Lake_Creek	Reach8	10917.11	7631.25	855.1	864.03	864.9	0.001777	7.51	1032.47	205.23	0.5
Lake_Creek	Reach8	10785.11	Inl Struct								
Lake_Creek	Reach8	10745.87	7686.15	854.81	861.81	863.17	0.00364	9.35	822.05	146.56	0.7
Lake_Creek	Reach8	10416.6	7763.75	853.25	859.96	861.68	0.004859	10.52	738.4	139.84	0.8
Lake_Creek	Reach8	9900.24	7779.92	850.58	859.18	859.92	0.001481	7.01	1308.28	354.75	0.46
Lake_Creek	Reach8	9793.24	Inl Struct								
Lake_Creek	Reach8	9718.438	7852.46	850.71	856.9	858.38	0.004219	9.99	966.21	288.57	0.75
Lake_Creek	Reach8	9316.179	7861.17	847.6	856.1	857.01	0.001854	7.92	1319.11	306.18	0.52
Lake_Creek	Reach8	9259.179	Inl Struct								
Lake_Creek	Reach8	9209.661	7949.74	847.3	855.35	856.39	0.00231	8.44	1266.01	314.58	0.57
Lake_Creek	Reach8	8683.253	7949.74	847.17	854.62	854.78	0.002163	3.21	2476	591.02	0.28
Lake_Creek	Reach8	8580.253	Inl Struct								
Lake_Creek	Reach8	8551.45	7949.74	845.11	854.61	854.69	0.000337	2.27	3497.72	743.83	0.18
Lake_Creek	Reach7	8161.937	11414.4	843.45	854.5	854.68	0.00106	3.41	3346.25	497.69	0.23
Lake_Creek	Reach7	7904.937	11494.2	842.49	854.3	854.45	0.000729	3.07	3745.5	496.7	0.2
Lake_Creek	Reach7	7535.61	11625	841.43	854.1	854.21	0.000868	3.04	4696	570.56	0.16
Lake_Creek	Reach7	6935.525	11671.5	837.15	851.43	852.99	0.00215	11.26	1963.01	546.18	0.59
Lake_Creek	Reach7	6862.61	Bridge								
Lake_Creek	Reach7	6699.925	11671.5	838.56	848.19	849.4	0.009543	14.13	1707.08	1097.16	0.82
Lake_Creek	Reach7	5985.739	11709.4	833.93	844.49	844.82	0.003972	6.68	2830.23	941.98	0.44
Lake_Creek	Reach7	5407.522	11762.3	831.76	841.5	841.98	0.006197	8.68	2461.32	927.88	0.55
Lake_Creek	Reach7	4601.908	11797.9	828.74	836.99	837.28	0.00569	5.77	2903.75	1267.27	0.5
Lake_Creek	Reach7	4062.685	11842.9	826.72	834.41	834.67	0.004472	6.55	3116.77	1287.23	0.46
Lake_Creek	Reach7	3381.805	11842.9	824.17	832.27	832.51	0.003805	5.53	3343.57	1347.04	0.42
Lake_Creek	Reach1	12060.33	11486.9	694.92	714.08	714.19	0.001048	3.49	5033.77	990.5	0.15
Lake_Creek	Reach1	11733.15	11486.8	693.21	713.87	713.97	0.00077	3.16	4775.15	998.03	0.13
Lake_Creek	Reach1	11616.46	11486.7	692.6	713.43	713.76	0.0022	5.34	2588.36	846.12	0.22
Lake_Creek	Reach1	11568.32	Bridge								

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek	Reach1	11520.83	11486.7	692.21	707.86	708.66	0.008369	7.87	1801.13	271.07	0.4
Lake_Creek	Reach1	11483.23	11486.3	692.7	707.7	708.26	0.006911	7.42	1973.34	573.5	0.36
Lake_Creek	Reach1	11469.41	Culvert								
Lake_Creek	Reach1	11446.71	11486.3	693.12	707.78	707.97	0.001657	3.78	3454.28	538.5	0.18
Lake_Creek	Reach1	11115.76	11486.1	692.91	706.97	707.25	0.004144	5.78	2924.6	556.55	0.28
Lake_Creek	Reach1	10891.31	11485.9	691.14	706.13	706.42	0.00441	5.58	2865.49	561.39	0.28
Lake_Creek	Reach1	10714.33	11485.9	689.72	705.68	705.9	0.002807	5.38	3309.25	544.18	0.24
Lake_Creek	Reach1	10695.3	11485.6	689.56	705.64	705.84	0.001836	4.24	3693.93	551.26	0.2
Lake_Creek	Reach1	10414.49	11485.6	687.3	705.14	705.31	0.001884	4.42	3990.51	571.95	0.2
Lake_Creek	Reach1	10346.33	11485.5	686.76	704.89	705.17	0.002183	4.84	3096.28	357.64	0.21
Lake_Creek	Reach1	10320.12	11485.4	686.55	704.89	705.05	0.001307	3.83	4184.31	591.21	0.17
Lake_Creek	Reach1	10285	Culvert								
Lake_Creek	Reach1	10263.66	11485.4	686.37	704.82	704.99	0.001336	3.83	4164.11	597.34	0.17
Lake_Creek	Reach1	10204.57	11485.2	686.03	704.67	704.9	0.001863	4.5	3482.44	436.49	0.2
Lake_Creek	Reach1	10011.7	11484.8	686.08	704.26	704.52	0.00231	5.02	3137.75	432.3	0.22
Lake_Creek	Reach1	9574.578	11484.3	685.44	703.12	703.47	0.003099	5.26	2653.25	402.69	0.25
Lake_Creek	Reach1	9119.471	11483.9	685.01	701.46	701.8	0.004451	6.57	2551	477.43	0.29
Lake_Creek	Reach1	8720.809	11483.8	684.64	699.71	700.07	0.004889	6.15	2508.41	362.63	0.3
Lake_Creek	Reach1	8531.063	11483.7	684.46	699.28	699.43	0.001696	3.38	3889.41	523.46	0.18
Lake_Creek	Reach1	8472.097	11483.5	684.41	699.04	699.16	0.001485	3.18	4319.02	636.37	0.16
Lake_Creek	Reach1	8449.343	Culvert								
Lake_Creek	Reach1	8433.54	11483.5	684.37	698.99	699.1	0.001555	3.17	4363.24	663.75	0.15
Lake_Creek	Reach1	8248.498	11483.2	683.26	698.81	698.96	0.001766	3.97	3857.6	474.56	0.19
Lake_Creek	Reach1	7944.275	11482.9	681.67	697.35	697.91	0.006779	7.42	2099.41	311.95	0.36
Lake_Creek	Reach1	7675.267	11482.7	680.42	696.09	696.63	0.004491	5.71	2107.65	366.49	0.28
Lake_Creek	Reach1	7461.408	11482.7	679.43	695.62	695.88	0.001899	3.75	2888.92	458.89	0.18
Lake_Creek	Reach1	7169.673	11480.8	678.07	695.14	695.37	0.002709	4.93	3271.71	517.3	0.23
Lake_Creek	Reach1	6803.97	11479.1	676.37	694.16	694.44	0.003466	5.87	2935.76	451.05	0.26
Lake_Creek	Reach1	6463.629	11477.1	674.79	693.04	693.32	0.003126	5.52	2855.69	376.52	0.24
Lake_Creek	Reach1	6077.107	11475.1	673	692.48	692.63	0.001553	4.11	3791.36	445	0.17
Lake_Creek	Reach1	5679.648	11472.9	671.15	691.73	691.99	0.002161	5.15	2983.28	275.12	0.21
Lake_Creek	Reach1	5235.625	11472	669.09	690.14	690.67	0.003782	6.92	2210.62	212.93	0.28
Lake_Creek	Reach1	5071.032	11471	668.33	689.44	690.06	0.004242	7.16	2047.33	199.41	0.29
Lake_Creek	Reach1	4866.492	11468.5	667.73	689	689.32	0.002583	5.62	2747.2	297.75	0.23

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Lake_Creek	Reach1	4389.372	11466.6	666.36	688.23	688.43	0.001755	4.48	3382.02	337.91	0.19
Lake_Creek	Reach1	4015.968	11465	665.29	687.68	687.88	0.001504	4.71	3628.51	380.82	0.18
Lake_Creek	Reach1	3685.363	11463	664.34	686.97	687.33	0.002282	5.95	2785.61	280.47	0.23
Lake_Creek	Reach1	3295.868	11462.2	662.65	685.75	686.32	0.002964	6.67	2257.47	242.59	0.26
Lake_Creek	Reach1	3135.014	11461.3	661.99	685.14	685.8	0.003444	6.73	2021.43	234.77	0.27
Lake_Creek	Reach1	2970.384	11459.6	662.12	684.55	685.22	0.003593	6.97	2044.98	231.11	0.28
Lake_Creek	Reach1	2899.802	Bridge								
Lake_Creek	Reach1	2820.93	11459.6	661.23	683.84	684.41	0.003218	6.42	2131.89	221.4	0.26
Lake_Creek	Reach1	2632.218	11458.5	661.15	682.74	683.53	0.004711	7.6	1817.96	291.1	0.31
Lake_Creek	Reach1	2409.13	11457.7	660.49	681.87	682.61	0.004812	8.43	1858.75	263.61	0.33
Lake_Creek	Reach1	2263.544	11457.3	659.79	681.27	681.92	0.003839	7.55	2043.82	207.31	0.29
Lake_Creek	Reach1	2187.297	11456.3	659.51	681	681.41	0.002359	5.79	2524.6	230.61	0.23
Lake_Creek	Reach1	1986.475	11454	657.62	680.68	681.05	0.002436	5.83	2625.7	233.52	0.23
Lake_Creek	Reach1	1527.849	11453.1	656.2	679.3	679.89	0.003378	7.21	2372.67	296.52	0.27
Lake_Creek	Reach1	1354.262	11451.4	656.05	678.14	678.75	0.003627	7.51	2265.05	262.06	0.29
Lake_Creek	Reach1	1012.217	11450.7	653.72	677.27	677.68	0.002446	6.21	2732.45	326.98	0.23
Lake_Creek	Reach1	870.3603	11450.2	653.39	676.89	677.31	0.002732	6.28	2510.97	247.23	0.24
Lake_Creek	Reach1	784.537	11449.1	653.28	676.46	677.04	0.003311	6.99	2100.74	171.66	0.27
Lake_Creek	Reach1	564.5126	11449.1	653.3	675.76	676.34	0.003498	6.86	2123.32	198.59	0.27
LakeCreek_Trib6A	Reach1	4202.221	62.37	782.71	784.27	784.38	0.007913	3.03	26.68	36.76	0.48
LakeCreek_Trib6A	Reach1	3914.111	81.84	780.02	781.58	781.75	0.010457	3.34	26.65	31.68	0.55
LakeCreek_Trib6A	Reach1	3537.36	115.35	776.75	778.71	778.84	0.006372	2.95	44.65	49.5	0.44
LakeCreek_Trib6A	Reach1	3061.202	166.62	773.86	776.14	776.22	0.004979	2.51	78.37	257.33	0.38
LakeCreek_Trib6A	Reach1	2551.109	210.26	765.44	767.99	768.64	0.077792	6.55	33.28	33.49	0.87
LakeCreek_Trib6A	Reach1	2228.388	255.25	761.99	764.75	764.91	0.004842	3.19	85.21	80.84	0.4
LakeCreek_Trib6A	Reach1	1959.408	291.11	758.99	761.75	762.43	0.01988	6.79	46.38	29.47	0.83
LakeCreek_Trib6A	Reach1	1777.027	309.13	757	761.36	761.49	0.001842	3.04	116.77	43.85	0.28
LakeCreek_Trib6A	Reach1	1693.715	370.18	756.12	761.26	761.36	0.001165	2.65	156.18	55.07	0.23
LakeCreek_Trib6A	Reach1	1651.415	Culvert								
LakeCreek_Trib6A	Reach1	1574.247	370.18	754.25	759.49	759.71	0.00805	3.88	104.6	31.49	0.33
LakeCreek_Trib6A	Reach1	1443.702	385.26	753.5	758.35	758.58	0.009225	4.06	108.73	39.62	0.35
LakeCreek_Trib6A	Reach1	1388.333	478.54	752.77	757.94	758.13	0.006827	3.71	146.41	47.67	0.31
LakeCreek_Trib6A	Reach1	1346.937	Culvert								
LakeCreek_Trib6A	Reach1	1283.922	478.54	751.68	757.23	757.41	0.006138	3.59	149.42	48.9	0.29

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
LakeCreek_Trib6A	Reach1	1087.528	569.66	750.24	755.59	755.83	0.009938	4.19	176.53	276.95	0.36
LakeCreek_Trib6A	Reach1	845.7571	652.54	747.65	752.58	752.86	0.014897	4.68	190.77	348.77	0.43
LakeCreek_Trib6A	Reach1	657.3228	745.18	746.55	751.65	751.7	0.003229	2.33	454.06	414.49	0.2
LakeCreek_Trib6A	Reach1	473.1585	812	745.77	751.23	751.26	0.001832	1.87	637.89	511.29	0.15
LakeCreek_Trib6A	Reach1	354.039	961.13	744.91	751	751.03	0.001883	2.27	726.21	589.83	0.17
LakeCreek_Trib6A	Reach1	120.128	961.13	743.21	750.85	750.86	0.000399	1.09	1349.39	866.22	0.08
LakeCreek_Trib6	Reach1	5450.013	641.08	753.28	757.62	758.27	0.029908	6.65	103.87	37.67	0.61
LakeCreek_Trib6	Reach1	5390.549	745.81	750.85	756.7	757.1	0.013112	5.14	154.32	43.53	0.42
LakeCreek_Trib6	Reach1	5234.421	854.03	745.49	756.82	756.84	0.000357	1.21	719.76	117.97	0.08
LakeCreek_Trib6	Reach1	5094.614	854.03	744.37	756.81	756.81	0.000057	0.57	1590.36	299.79	0.03
LakeCreek_Trib6	Reach1	5009.385	Inl Struct								
LakeCreek_Trib6	Reach1	4917.171	854.03	743.48	751.96	752.08	0.00214	2.83	331.02	61.79	0.18
LakeCreek_Trib6	Reach2	4740.194	1992.95	741.72	750.14	750.79	0.013318	6.74	334.02	821.57	0.46
LakeCreek_Trib6	Reach2	4660.59	2011.26	741.14	748.93	749.57	0.018168	7.56	471.8	910.68	0.52
LakeCreek_Trib6	Reach2	4637.579	Culvert								
LakeCreek_Trib6	Reach2	4610.068	2011.26	740.59	748.21	749.08	0.02063	7.65	312.93	783.11	0.55
LakeCreek_Trib6	Reach2	4587.132	2034.99	740.09	745.79	747.89	0.073634	11.68	177.23	354.64	0.98
LakeCreek_Trib6	Reach2	4492.963	2041.78	738.65	745.67	746.08	0.003027	6.67	824.07	513.37	0.52
LakeCreek_Trib6	Reach2	4466.203	2065.21	737.08	743.64	745.68	0.008199	11.78	193.25	168.15	0.88
LakeCreek_Trib6	Reach2	4374.573	2082.79	736.49	743.14	744.38	0.005073	9.13	251.22	100.48	0.69
LakeCreek_Trib6	Reach2	4306.525	2102.64	735.29	743.25	744	0.002442	7.05	341.75	185.12	0.49
LakeCreek_Trib6	Reach2	4230.362	2145	733.5	743.41	743.66	0.00068	4.39	766.01	452.88	0.27
LakeCreek_Trib6	Reach2	4196.093	Culvert								
LakeCreek_Trib6	Reach2	4159.62	2145	732.51	742.5	742.84	0.005329	4.76	493.35	247.84	0.29
LakeCreek_Trib6	Reach2	4070.198	2176.75	731.73	742.08	742.33	0.004939	4.37	727.11	378.15	0.28
LakeCreek_Trib6	Reach2	3952.201	2212.13	731	741.06	741.53	0.008179	5.62	439.2	228.25	0.36
LakeCreek_Trib6	Reach2	3822.742	2247.18	730.21	739.91	740.4	0.009188	5.82	472.48	226.11	0.38
LakeCreek_Trib6	Reach2	3696.498	2295.96	729.44	736.98	738.32	0.032842	9.49	258.97	58.05	0.69
LakeCreek_Trib6	Reach2	3524.055	2347.97	728.38	736	736.92	0.003218	7.76	314.93	66.08	0.56
LakeCreek_Trib6	Reach2	3344.202	2400.49	727.28	733.72	735.89	0.00894	12.14	231.44	66.67	0.92
LakeCreek_Trib6	Reach2	3166.582	2431.01	726.19	733.04	733.24	0.000939	4.11	702.35	171.33	0.3
LakeCreek_Trib6	Reach2	3065.105	2476.65	725.57	733.08	733.14	0.00024	2.22	1281.97	257.63	0.16
LakeCreek_Trib6	Reach2	2915.766	2506.24	724.66	733.09	733.12	0.000107	1.67	1862.38	352.62	0.11
LakeCreek_Trib6	Reach2	2820.392	2581.7	724.07	733	733.09	0.000356	3.13	1320.43	415.93	0.2

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
LakeCreek_Trib6	Reach2	2739.029	Culvert								
LakeCreek_Trib6	Reach2	2634.479	2581.7	722.4	732.53	732.58	0.000091	1.8	1600.03	504.41	0.1
LakeCreek_Trib6	Reach2	2582.201	2804.86	722.94	732.47	732.56	0.000032	2.48	1833.57	531.5	0.16
LakeCreek_Trib6	Reach2	2412.832	Culvert								
LakeCreek_Trib6	Reach2	2097.113	2804.86	717.89	723.29	723.83	0.0004	5.95	658.17	287.94	0.54
LakeCreek_Trib6	Reach2	1916.488	2887.68	716.01	722.33	723.54	0.014012	9.26	345.98	524.13	0.69
LakeCreek_Trib6	Reach2	1682.812	2941.76	713.93	719.74	720.76	0.009674	8.48	445.91	312.69	0.68
LakeCreek_Trib6	Reach2	1533.815	3015.48	712.38	718.34	719.39	0.008796	8.91	490.32	305.82	0.69
LakeCreek_Trib6	Reach2	1335.069	3103.27	710.37	717.04	717.42	0.004734	5.49	675.97	404.92	0.41
LakeCreek_Trib6	Reach2	1104.643	3178.9	708	714.37	715.64	0.013075	9.24	368.82	141.12	0.7
LakeCreek_Trib6	Reach2	911.2885	3244.46	706.2	714.45	714.6	0.001708	3.87	1178.59	520.53	0.25
LakeCreek_Trib6	Reach2	747.3691	3324.45	704.45	714.44	714.48	0.000252	1.64	2145.33	562.93	0.1
LakeCreek_Trib6	Reach2	551.8004	3342.92	702.59	714.43	714.44	0.000115	1.23	4010.4	792.22	0.07
LakeCreek_Trib6	Reach2	507.3001	3403.86	701.65	714.43	714.43	0.00008	1.06	4666.98	965.71	0.06
LakeCreek_Trib6	Reach2	485.5314	Culvert								
LakeCreek_Trib6	Reach2	469.0413	3403.86	701.11	714.37	714.38	0.000045	0.84	6196.8	1097.93	0.04
LakeCreek_Trib6	Reach2	362.2343	3403.86	699.62	714.37	714.37	0.000051	0.96	5516.48	1152.26	0.05
Davis_Spring	Reach1	20315.99	508.97	882.01	884.18	884.22	0.005252	1.93	329.73	254.55	0.25
Davis_Spring	Reach1	19987.25	685.79	879.86	882.02	882.09	0.008117	2.41	339.48	347.81	0.31
Davis_Spring	Reach1	19687.12	859.23	876.14	880.24	880.32	0.005326	3.1	436.8	310.41	0.28
Davis_Spring	Reach1	19460.18	859.23	874.49	876.92	877.48	0.05465	6.86	164.76	142.07	0.82
Davis_Spring	Reach2	19271.48	879.59	872.65	875.48	875.51	0.002986	1.77	624.42	384.75	0.2
Davis_Spring	Reach2	19120.58	912.69	871.57	874.82	874.88	0.005787	2.68	477.71	288.06	0.28
Davis_Spring	Reach2	18882.65	941.63	869.42	874.02	874.1	0.004428	2.8	460.12	236.14	0.25
Davis_Spring	Reach2	18681.54	973.57	869.09	873.52	873.57	0.002719	2.31	593.62	297.63	0.2
Davis_Spring	Reach2	18466.64	992.41	867.66	873.12	873.18	0.002279	2.43	625.36	382.57	0.19
Davis_Spring	Reach2	18343.15	1012.01	866.99	872.24	872.59	0.008587	4.79	219.32	156.77	0.37
Davis_Spring	Reach2	18265.13	Culvert								
Davis_Spring	Reach2	18163.22	1012.01	866.21	870.46	870.88	0.006733	5.29	197.88	293.74	0.48
Davis_Spring	Reach2	18075.85	1042.1	865.89	870.11	870.3	0.004676	4.05	331.77	276.77	0.38
Davis_Spring	Reach2	17944.97	1113.32	865.36	869.5	869.59	0.005698	2.89	478.26	411.31	0.28
Davis_Spring	Reach2	17649.73	1198.58	864.07	867.71	867.94	0.005322	4	378.04	434.72	0.41
Davis_Spring	Reach2	17320.19	1266.04	861.79	866.28	866.37	0.005421	3.23	592.27	494.56	0.28
Davis_Spring	Reach2	17075.66	1392.93	861.21	865.37	865.45	0.005986	3.17	658.73	521.94	0.29

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Davis_Spring	Reach2	16649.07	1507.35	859.57	864.35	864.4	0.002073	2.12	965.05	503.03	0.18
Davis_Spring	Reach2	16296.5	1601.99	857.86	863.41	863.52	0.005309	3.34	715.01	551.44	0.28
Davis_Spring	Reach2	16024.56	1688.57	857.81	862.03	862.13	0.007604	3.82	689.97	562.39	0.33
Davis_Spring	Reach2	15789.47	1809.85	856.68	860.44	860.5	0.006881	3.16	951.48	745.63	0.31
Davis_Spring	Reach2	15479.7	1809.85	853.48	859.22	859.27	0.00291	2.68	1196.34	681.43	0.21
Davis_Spring	Reach2	15043.48	1851.16	852.61	856.88	857.1	0.016894	5.6	535.44	307.84	0.5
Davis_Spring	Reach2	14708.47	1906.35	850.95	855.3	855.34	0.002271	2.09	1266.18	537.52	0.18
Davis_Spring	Reach2	14272.33	1951.2	848.37	854.2	854.29	0.004491	3.27	895.57	383.3	0.27
Davis_Spring	Reach2	13927.07	1991.68	847.69	853.11	853.19	0.004011	3.07	996.48	465.17	0.25
Davis_Spring	Reach2	13622.26	2015.04	845.38	851.8	851.96	0.005495	3.76	713.83	281.95	0.3
Davis_Spring	Reach2	13449.15	2042.55	845.38	851.04	851.14	0.004204	3.27	872.74	361.04	0.26
Davis_Spring	Reach2	13247.82	2075.15	844.41	850.45	850.53	0.002174	3.29	1030.75	436.26	0.25
Davis_Spring	Reach2	13012.77	2090.31	843.3	850.13	850.2	0.001191	2.56	1189.59	451.37	0.19
Davis_Spring	Reach2	12904.69	2114.46	842.84	848.55	849.73	0.024754	9.14	269.94	323.5	0.79
Davis_Spring	Reach2	12734.12	2165.29	842.11	848.05	848.21	0.003705	4.21	759.19	313.92	0.32
Davis_Spring	Reach2	12381.47	2219.39	840.61	846.75	846.97	0.003902	4.28	687.12	259.16	0.33
Davis_Spring	Reach2	12015.12	2288.65	839.05	845.18	845.41	0.005088	4.98	704.54	318.07	0.38
Davis_Spring	Reach2	11558.94	2345.12	836.88	842.77	843.09	0.008429	6.02	631.35	324.73	0.48
Davis_Spring	Reach2	11197.06	2406.6	835.14	840.4	840.69	0.008744	5.55	603.72	262.75	0.48
Davis_Spring	Reach2	10812.91	2406.6	832.29	838.44	838.64	0.005303	4.53	876.18	578.41	0.38
Davis_Spring	Reach2	10627.14	2421.45	831.16	837.34	837.52	0.005099	4.65	952.48	632.54	0.37
Davis_Spring	Reach2	10528.77	2447.08	830.86	837.02	837.14	0.002969	3.74	1116.32	623.6	0.29
Davis_Spring	Reach2	10360.39	2469.43	831.05	836.32	836.55	0.00662	4.85	800.49	481.87	0.42
Davis_Spring	Reach2	10215.04	2502.15	831.38	835.64	835.82	0.006965	4.6	828.76	505.93	0.42
Davis_Spring	Reach2	10004.58	2572.15	829.73	834.88	835.05	0.005274	3.82	865.8	411.63	0.36
Davis_Spring	Reach2	9563.38	2599.42	828.21	833.8	833.98	0.003997	4.27	821.57	270.32	0.33
Davis_Spring	Reach2	9394.739	2624.39	827.2	833.14	833.25	0.00262	3.3	1107.94	439.65	0.27
Davis_Spring	Reach2	9241.917	2692.1	826.33	832.73	832.82	0.001972	3.06	1269.8	487.31	0.24
Davis_Spring	Reach2	8834.591	2761.28	824.89	831.66	831.88	0.00481	5.3	832.4	303.56	0.38
Davis_Spring	Reach2	8428.907	2807.1	824	830.46	830.62	0.003354	4.27	950.35	307.13	0.31
Davis_Spring	Reach2	8165.774	2830.1	822.57	829.56	829.73	0.003399	4.37	955.16	331.81	0.31
Davis_Spring	Reach2	8035.305	2928.27	823	828.51	829.14	0.002655	6.61	461.48	231.7	0.51
Davis_Spring	Reach2	7826.252	Culvert								
Davis_Spring	Reach2	7127.023	2928.27	822.12	826.15	827.33	0.007783	8.97	377.27	656.29	0.82

Table N-14. Summary Output - Lake Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Davis_Spring	Reach2	6566.197	2997.14	817.12	820.87	821.5	0.007186	7.94	491.77	237.5	0.77
Davis_Spring	Reach2	6183.904	3036.84	814.03	819.37	819.77	0.003018	6.95	648.17	245.25	0.54
Davis_Spring	Reach2	5967.532	3086.82	813.11	818.5	819.06	0.00452	8.45	617.64	303.72	0.66
Davis_Spring	Reach2	5699.065	3192.41	811.5	818.03	818.3	0.003002	4.7	800.72	301.55	0.35
Davis_Spring	Reach2	5145.945	3300.19	810.18	815.89	816.26	0.00651	6.26	811.24	423.43	0.5
Davis_Spring	Reach2	4599.925	3371.65	806.6	813.96	814.31	0.004094	5.3	791.7	238.01	0.4
Davis_Spring	Reach2	4247.62	3417.56	807.05	812.59	812.87	0.004235	5.12	869.34	280.99	0.4
Davis_Spring	Reach2	4025.203	3471.77	805.6	811.64	811.92	0.00414	5.37	894.14	295.39	0.41
Davis_Spring	Reach2	3766.431	3522.83	803.73	809.74	810.43	0.010059	8.33	616.34	239.8	0.63
Davis_Spring	Reach2	3526.325	3526.15	802.91	808.81	809.38	0.002498	8.26	653.43	303.62	0.67
Davis_Spring	Reach2	3480.445	Bridge								
Davis_Spring	Reach2	3443.136	3526.15	801.03	808.3	809.04	0.003384	11.36	624.89	337.05	0.77
Davis_Spring	Reach2	3428.111	3589.08	800.67	808.21	808.92	0.002787	8.47	632.04	317.36	0.68
Davis_Spring	Reach2	3238.755	Bridge								
Davis_Spring	Reach2	3175.936	3589.08	800.44	807.34	807.83	0.001367	6.34	742.98	295.27	0.5
Davis_Spring	Reach2	3146.654	3675.53	800.42	807.36	807.74	0.001084	5.59	837.26	306.68	0.45
Davis_Spring	Reach2	3103.429	Bridge								
Davis_Spring	Reach2	3059.2	3675.53	800.01	807.23	807.47	0.000596	4.69	1075.63	385.01	0.34
Davis_Spring	Reach2	2767.867	3741.68	798.67	806.82	807.1	0.005224	5.81	950.2	286.44	0.39
Davis_Spring	Reach2	2484.045	3809.42	797.36	805.59	805.9	0.005525	5.29	970.83	329.05	0.4
Davis_Spring	Reach2	2198.53	3877.64	796.04	804.16	804.44	0.005757	5.64	1009.52	339.94	0.4
Davis_Spring	Reach2	1916.074	3961.43	794.74	802.34	802.67	0.006724	5.84	964.44	360.8	0.43
Davis_Spring	Reach2	1575.845	4018.26	793.17	800.93	801.35	0.003373	7.62	1092.11	353.06	0.52
Davis_Spring	Reach2	1349.174	4050.31	792.12	800.41	800.65	0.003715	5	1110.2	301.15	0.33
Davis_Spring	Reach2	1222.751	4074.48	791.22	799.98	800.2	0.003331	4.72	1133.59	282.52	0.32
Davis_Spring	Reach2	1128.099	4168.94	790.54	799.49	799.78	0.00398	5.18	1045.89	260.37	0.35
Davis_Spring	Reach2	763.3817	4272.43	787.93	797.61	797.94	0.007893	5.72	957.73	299.06	0.44
Davis_Spring	Reach2	373.1533	4334.28	785.14	793.71	794.38	0.011015	8.15	815.38	318.4	0.56
Davis_Spring	Reach2	144.4539	4334.28	783.51	793.14	793.36	0.002727	5.03	1304.83	308.2	0.3
DavisSpringTrib1	Reach1	949.8451	261.13	880.9	884.07	884.34	0.013456	5.26	81.46	369.94	0.55
DavisSpringTrib1	Reach1	773.4822	427.55	879.54	883.25	883.36	0.00386	3.02	184.46	497.27	0.3
DavisSpringTrib1	Reach1	561.8313	655.33	876.97	882.17	882.37	0.005293	3.99	215.39	438.21	0.36
DavisSpringTrib1	Reach1	378.5166	859.23	875.68	879.85	880.33	0.02286	6.3	188.68	475.77	0.7
DavisSpringTrib1	Reach1	262.2341	859.23	874.87	877.07	877.1	0.002488	1.31	572.27	379.03	0.21

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Trib3	Reach1	8484.147	1494.04	675.43	680.19	680.39	0.003906	5.12	564.44	594.86	0.49
McNutt_Trib3	Reach1	8099.885	1542.27	673.58	676.97	677.41	0.015708	6.9	326.73	358.39	0.9
McNutt_Trib3	Reach1	7701.834	1563.75	671.6	675.05	675.15	0.002405	3.13	651.5	469.26	0.37
McNutt_Trib3	Reach1	7528.48	1567.98	670.41	674.63	674.77	0.003082	4.05	560.59	380.2	0.43
McNutt_Trib3	Reach1	7494.596	1584.83	670.15	674.16	674.58	0.008868	7.14	381.04	380.05	0.73
McNutt_Trib3	Reach1	7360.681	1619.01	669.78	672.16	672.74	0.023103	6.43	265.42	310.07	1.02
McNutt_Trib3	Reach1	7093.301	1692.47	668.76	671.58	671.73	0.003728	3.45	550.81	371.51	0.44
McNutt_Trib3	Reach1	6537.274	1720.74	665.06	669.17	669.8	0.009313	7.75	323.74	229.65	0.76
McNutt_Trib3	Reach1	6329.698	1761.15	663.71	667.66	668.11	0.00897	6.83	409.58	389.3	0.73
McNutt_Trib3	Reach1	6038.843	1807.49	661.15	666.4	666.68	0.003894	5.77	507.85	319.07	0.51
McNutt_Trib3	Reach1	5713.349	1815.83	659.04	664.92	665.32	0.005324	5.84	506.04	621.8	0.58
McNutt_Trib3	Reach1	5655.653	1825.19	658.1	664.11	664.23	0.001976	4.23	849.86	712.53	0.36
McNutt_Trib3	Reach1	5620.8	Culvert								
McNutt_Trib3	Reach1	5591.284	1825.19	658.1	663.05	663.29	0.004686	5.39	520.68	677.64	0.54
McNutt_Trib3	Reach1	5072.49	1844.75	656.4	660.68	661.06	0.008915	5.22	378.29	196.47	0.54
McNutt_Trib3	Reach1	4715.863	1849.25	652.19	658.72	659.13	0.006437	6.35	427.48	252.66	0.49
McNutt_Trib3	Reach1	4634.401	1860.84	651.26	658.49	658.67	0.002684	4.42	631.41	310.78	0.33
McNutt_Trib3	Reach1	4600.251	Culvert								
McNutt_Trib3	Reach1	4556.29	1860.84	650.85	657.2	657.38	0.001631	4.43	679.32	367.86	0.34
McNutt_Trib3	Reach1	4425.532	1888.24	650.63	656.17	656.88	0.005948	7.17	332.25	211.61	0.63
McNutt_Trib3	Reach1	3936.524	1900.86	648.45	652.79	653.58	0.008635	7.79	310.11	205.37	0.74
McNutt_Trib3	Reach1	3713.855	1924.08	648.56	651.85	652.12	0.00408	4.89	491.5	249.34	0.5
McNutt_Trib3	Reach1	3307.778	1947.76	644.67	650.02	650.45	0.005001	6.12	395.76	175.98	0.57
McNutt_Trib3	Reach1	2898.731	1949.89	642.8	648.45	648.83	0.003804	6.21	457.82	214.71	0.51
McNutt_Trib3	Reach1	2862.064	1973.89	640.97	647.59	648.58	0.00848	8.68	296.95	167.79	0.75
McNutt_Trib3	Reach1	2453.07	2001.23	638.97	643.25	643.46	0.0034	4.64	563.58	289.02	0.46
McNutt_Trib3	Reach1	1992.947	2018.2	633.57	641.53	641.69	0.005791	3.63	675.28	304.81	0.28
McNutt_Trib3	Reach1	1710.498	2031.41	630.89	640.17	640.32	0.005243	3.78	720.81	317.28	0.27
McNutt_Trib3	Reach1	1492.424	2046.74	629.26	638.96	639.18	0.006414	4.41	629.46	204.26	0.31
McNutt_Trib3	Reach1	1241.006	2067.2	627.67	637.28	637.55	0.008059	4.97	612.08	277.01	0.34
McNutt_Trib3	Reach1	908.3	2087.04	626.1	634.69	634.97	0.007254	4.47	574.32	235.87	0.32
McNutt_Trib3	Reach1	588.8505	2094.82	623.62	633.42	633.55	0.004288	3.76	835.23	432.59	0.25

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Trib3	Reach1	464.3279	2094.82	623	633.18	633.25	0.002241	2.81	1169.23	519.94	0.18
McNutt_Trib2B	Reach1	2417.389	208.86	715.24	716.4	716.58	0.008997	3.57	65.96	113.15	0.69
McNutt_Trib2B	Reach1	1954.556	255.08	709.42	711.48	711.77	0.011642	4.39	59.92	89.01	0.8
McNutt_Trib2B	Reach1	1479.175	328.18	704.47	706.5	706.8	0.009579	4.53	81.38	116.96	0.75
McNutt_Trib2B	Reach1	879.9736	328.18	698.01	700.28	700.62	0.011212	5.78	80.08	107.67	0.84
McNutt_Trib2A	Reach1	5084.014	232.14	783.12	784.63	785.07	0.015782	5.43	45.08	54.99	0.94
McNutt_Trib2A	Reach1	4515.064	326.9	772.26	773.6	773.91	0.012318	4.98	81.25	127.92	0.84
McNutt_Trib2A	Reach1	3809.755	489.94	759.74	761.14	761.51	0.014107	5.2	105.79	160.83	0.9
McNutt_Trib2A	Reach1	2976.064	751.13	749.35	750.92	751.23	0.011965	5.43	187.76	300.75	0.85
McNutt_Trib2A	Reach1	2095.66	802.12	736.72	740.49	740.72	0.003283	4.49	240.03	311.31	0.5
McNutt_Trib2A	Reach1	1960.358	828.46	735.46	739.58	740.09	0.007107	6.16	175.41	333.93	0.72
McNutt_Trib2A	Reach1	1893.783	888.5	733.73	738.77	739.31	0.00939	6.08	168.5	355.27	0.79
McNutt_Trib2A	Reach1	1749.619	1137.6	733.55	736.79	737.15	0.004716	5.27	260.97	317.08	0.59
McNutt_Trib2A	Reach1	1240.416	1590.24	729.15	731.6	732.18	0.017196	6.41	261.67	249.63	0.99
McNutt_Trib2A	Reach1	550.27	1590.24	720.52	725.86	725.92	0.001248	1.99	800.68	521.6	0.28
McNutt_Trib2A	Reach1	513.1198	Culvert								
McNutt_Trib2A	Reach1	483.1137	1590.24	720.5	724.56	724.98	0.007664	6.63	377.74	411.06	0.75
McNutt_Trib2	Reach1	2893.136	66.48	683.22	684.82	684.89	0.011824	2.15	30.89	27.69	0.36
McNutt_Trib2	Reach1	2404.861	91.5	679.35	682.47	682.51	0.003107	1.66	65.79	60.47	0.2
McNutt_Trib2	Reach1	1856.813	115.34	674.99	677.43	677.78	0.042496	4.69	24.59	17.23	0.69
McNutt_Trib2	Reach1	1459.461	135.8	671.83	677.39	677.39	0.000231	0.64	236.93	86.57	0.06
McNutt_Trib2	Reach1	1179.309	145.24	669.61	677.36	677.36	0.000062	0.44	433.64	242.63	0.04
McNutt_Trib2	Reach1	1063.983	167.71	668.69	677.36	677.36	0.000029	0.32	754.08	290.74	0.02
McNutt_Trib2	Reach1	817.1949	172.45	666.73	677.35	677.35	0.000007	0.2	1391.6	377.77	0.01
McNutt_Trib2	Reach1	769.389	202.01	666.35	677.35	677.35	0.00001	0.23	1388.91	477.38	0.01
McNutt_Trib2	Reach1	680.8124	Culvert								
McNutt_Trib2	Reach1	602.0122	202.01	665.12	669.49	669.57	0.004288	2.34	86.24	27.14	0.23
McNutt_Trib2	Reach1	497.9529	215.29	664.41	669.15	669.21	0.002728	1.87	115.38	37.75	0.19
McNutt_Trib2	Reach1	388.7319	215.29	663.91	669.03	669.07	0.000674	1.67	128.76	45.9	0.18
McNutt_Trib2	Reach3	9174.098	600.17	742.59	743.71	744.03	0.01807	5.89	140.63	234.56	1.01
McNutt_Trib2	Reach3	8882.131	777.03	737.1	740.22	740.77	0.008214	6.25	154.31	201.8	0.76
McNutt_Trib2	Reach3	8391.192	945.94	732.58	735.72	736.26	0.008468	7.12	191.81	234.83	0.8

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Trib2	Reach3	8017.301	1228.31	729.55	731.46	731.69	0.007507	4.6	333.23	347.21	0.68
McNutt_Trib2	Reach3	7520.74	1460.95	724.34	727.22	727.52	0.019081	5.56	344.67	314.65	0.68
McNutt_Trib2	Reach3	7191.039	1590.24	719.17	724.11	724.3	0.00659	4.92	522.99	498.43	0.44
McNutt_Trib2	Reach3	7029.854	1590.24	718.43	723.67	723.77	0.001665	3.53	747.58	621.02	0.36
McNutt_Trib2	Reach3	7004.553	Culvert								
McNutt_Trib2	Reach3	6981.511	1590.24	716.62	721.14	721.59	0.007347	7.03	365.77	364.13	0.75
McNutt_Trib2	Reach2	6777.838	1764.61	714.95	718.69	719.29	0.010026	7.73	319.68	462.55	0.86
McNutt_Trib2	Reach2	6201.447	1887.78	712.03	714.42	714.89	0.013036	6.69	363.86	544.07	0.92
McNutt_Trib2	Reach2	5827.652	2086.2	706.19	710.52	711.04	0.007552	7.77	407.25	401.81	0.78
McNutt_Trib2	Reach2	5273.994	2321.31	701.93	706.2	706.74	0.007353	7.59	487.74	458.22	0.77
McNutt_Trib2	Reach2	4682.438	2321.31	697.87	701.6	701.98	0.008211	6.56	495.86	386.47	0.77
McNutt_Trib1B	Reach1	1613.084	1251.62	722.58	726.36	726.66	0.004438	6.01	381	406.25	0.6
McNutt_Trib1B	Reach1	1070.97	1326.81	717.5	722.08	722.61	0.005046	7.13	277.05	232.5	0.65
McNutt_Trib1B	Reach1	671.2245	1326.81	715.63	719.26	719.94	0.009202	6.67	205.23	279.12	0.81
McNutt_Trib1A	Reach1	3344.741	126.14	762.54	763.67	763.86	0.00948	3.48	36.21	46.67	0.7
McNutt_Trib1A	Reach1	2887.493	190.67	755.6	756.61	756.9	0.022326	4.34	43.92	77.52	1.02
McNutt_Trib1A	Reach1	2441.067	283.05	750.11	751.09	751.2	0.006691	3.08	109.89	179.57	0.59
McNutt_Trib1A	Reach1	2014.181	450.17	745.22	746.41	746.74	0.013443	5.31	107.19	163.68	0.88
McNutt_Trib1A	Reach1	1512.792	711.43	736.96	740.49	740.89	0.006141	5.65	180.47	243.59	0.67
McNutt_Trib1A	Reach1	1018.28	1008.62	732.69	735.4	735.7	0.008381	5.77	267.28	328.15	0.75
McNutt_Trib1A	Reach1	641.1038	1008.62	729.75	731.18	731.59	0.014206	5.87	208.45	243	0.93
McNutt_Trib1	Reach3	11050.55	508	762.95	764.4	764.62	0.010026	4.55	157.53	295.3	0.76
McNutt_Trib1	Reach3	10679.97	554.46	760.64	761.84	761.96	0.006235	2.92	207.05	317.56	0.57
McNutt_Trib1	Reach3	10337.97	650.84	757.44	758.49	758.74	0.01351	4.63	176.95	336.65	0.86
McNutt_Trib1	Reach3	9711.607	747.97	747.59	750.67	750.99	0.006657	5.52	199.46	230.1	0.68
McNutt_Trib1	Reach3	9167.954	843.69	743.45	745.73	746.23	0.012375	6.59	172.26	200.91	0.9
McNutt_Trib1	Reach3	8697.346	1008.62	738.15	740.99	741.48	0.008712	6.92	212.46	199.8	0.8
McNutt_Trib1	Reach3	7999.516	1008.62	732.12	734.16	734.57	0.010543	5.36	197.53	158.08	0.81
McNutt_Trib1	Reach2	6849.928	45.43	721.37	722.19	722.36	0.01474	3.3	15.35	63.8	0.81
McNutt_Trib1	Reach2	6295.517	45.43	715.91	718.27	718.27	0.000106	0.59	90.79	88.71	0.08
McNutt_Trib1	Reach1	5481.202	2235.87	709.5	714.32	714.99	0.006567	7.84	405.65	280.3	0.74
McNutt_Trib1	Reach1	5095.749	2268.83	706.55	712.08	712.81	0.005324	8.09	456.12	401.89	0.69

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Trib1	Reach1	4668.905	2314.15	703.63	709.4	710.14	0.005334	8.11	414.27	242.75	0.69
McNutt_Trib1	Reach1	4092.012	2336.84	699.69	705.94	706.84	0.006166	9.09	395.77	246.57	0.74
McNutt_Trib1	Reach1	3807.437	2360.85	697.74	704.42	705.17	0.003866	7.15	386.92	221.23	0.59
McNutt_Trib1	Reach1	3509.255	2393.8	695.71	701.97	703.47	0.008349	10.38	282.11	188.03	0.86
McNutt_Trib1	Reach1	3105.001	2407.06	692.94	700.92	701.07	0.000738	4.05	1053.49	527.84	0.27
McNutt_Trib1	Reach1	2943.826	2424.75	691.84	700.91	700.95	0.00019	2.13	1778.8	582.34	0.14
McNutt_Trib1	Reach1	2919.395	Bridge								
McNutt_Trib1	Reach1	2869.765	2424.75	691.32	698.44	698.7	0.001444	4.8	774.68	440.09	0.37
McNutt_Trib1	Reach1	2730.326	2463.81	690.27	698.24	698.37	0.003194	3.37	894.36	402.52	0.23
McNutt_Trib1	Reach1	2264.176	2496.44	686.75	696.48	696.76	0.005337	4.58	720.19	314.51	0.3
McNutt_Trib1	Reach1	1880.344	2544.75	683.85	693.57	694.07	0.009653	5.8	524.3	249.7	0.4
McNutt_Trib1	Reach1	1321.289	2565.86	679.63	690.65	690.9	0.003943	4.33	696.62	159.89	0.27
McNutt_Trib1	Reach1	1080.33	2565.86	677.81	688.86	689.35	0.010035	5.75	484.37	108.57	0.4
McNutt_Fork	Reach1	19103.41	185.53	840.03	842.12	842.37	0.009397	4.03	46.04	38.64	0.65
McNutt_Fork	Reach1	18624.74	209.73	833.36	834.83	835.3	0.024333	5.54	37.85	40.35	1.01
McNutt_Fork	Reach1	18316.52	224.27	830.61	832.55	832.59	0.001652	1.9	163.23	259.06	0.28
McNutt_Fork	Reach1	18148.05	243.87	827.58	830.83	831.74	0.009061	7.65	31.86	170.84	0.76
McNutt_Fork	Reach1	18125.48	Culvert								
McNutt_Fork	Reach1	18094.65	243.87	824.74	827.92	828.12	0.002332	3.56	68.55	58.23	0.37
McNutt_Fork	Reach1	17937.46	275.9	824.03	827.51	827.67	0.003151	3.2	86.44	48.67	0.41
McNutt_Fork	Reach1	17627.35	327.09	822.2	825.12	825.51	0.018297	5.01	65.42	71.41	0.88
McNutt_Fork	Reach1	17199.58	413.94	814.32	815.95	816.45	0.023949	5.66	73.17	74.85	1.01
McNutt_Fork	Reach1	16607.71	504.14	803.48	806.59	806.74	0.002491	3.12	161.82	73.86	0.37
McNutt_Fork	Reach1	16112.21	606.98	801.93	804.25	804.53	0.008377	4.97	166.56	191.04	0.66
McNutt_Fork	Reach1	15645.64	773.16	797.35	799.34	799.66	0.01408	5.71	176.83	189.84	0.83
McNutt_Fork	Reach1	15037.42	972.78	787.99	792.49	793.16	0.008861	7.06	182.02	164.05	0.73
McNutt_Fork	Reach1	14460.14	1096.54	781.07	790.37	790.38	0.0001	1.06	1503.08	481.67	0.07
McNutt_Fork	Reach1	14159.14	1239.74	777.43	789.82	790.19	0.00181	4.9	255.87	539.72	0.27
McNutt_Fork	Reach1	14130.17	Culvert								
McNutt_Fork	Reach1	14076.24	1239.74	774.36	779.33	780.12	0.00547	7.27	175.67	58.23	0.62
McNutt_Fork	Reach1	13662.46	1342.11	772.36	776.6	777.24	0.009292	6.8	232.11	147.05	0.74
McNutt_Fork	Reach1	13394.98	1603.47	768.81	773.86	774.57	0.009468	8.54	276.03	180.09	0.78

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Fork	Reach1	12795.18	1833.74	762.73	770.47	770.74	0.002851	4.89	516.23	292.56	0.43
McNutt_Fork	Reach1	12342.82	2032.21	760.85	767.88	768.69	0.007765	7.89	340.35	209.82	0.7
McNutt_Fork	Reach1	11996.38	2255.38	757.71	767.14	767.36	0.000823	4.04	746.17	450.25	0.26
McNutt_Fork	Reach1	11971.58	Culvert								
McNutt_Fork	Reach1	11948.06	2255.38	756.42	764.23	766.07	0.008493	10.89	207.19	76.87	0.78
McNutt_Fork	Reach1	11645.12	2255.38	755.89	763.18	763.69	0.004113	6.65	480.67	383.65	0.54
McNutt_Fork	Reach1	10987.36	2076.08	752.65	759.71	759.97	0.008731	4.7	600.72	282.62	0.37
McNutt_Fork	Reach1	10584.46	1953.96	747.45	756.89	757.15	0.00585	4.65	601.78	342.19	0.31
McNutt_Fork	Reach1	10289.59	1827.15	747.98	755.27	755.42	0.005551	3.82	698.25	352.21	0.29
McNutt_Fork	Reach1	9963.232	1598.79	745.68	753.02	753.22	0.00908	4.52	546.8	411.98	0.37
McNutt_Fork	Reach1	9313.878	1457.25	744.8	749.7	749.77	0.003686	2.49	666.91	477.53	0.23
McNutt_Fork	Reach1	8863.032	1347.8	742.66	746.96	747.36	0.010105	6.97	334.27	376	0.75
McNutt_Fork	Reach1	8483.266	1293.93	740.7	746.81	746.84	0.000496	2.2	1076.52	668.71	0.18
McNutt_Fork	Reach1	8284.875	3819.87	739.67	745.39	745.85	0.010735	8.05	871.69	891.88	0.81
McNutt_Fork	Reach1	8268.484	Culvert								
McNutt_Fork	Reach1	8250.77	3819.87	739.5	744.73	745.17	0.009295	7.91	897.37	819.63	0.76
McNutt_Fork	Reach1	8123.781	3852.03	738.84	743.98	744.27	0.007114	6.43	996.83	792.32	0.65
McNutt_Fork	Reach1	7935.809	3938.73	737.87	743.17	743.42	0.006753	6.11	1038.95	780.8	0.62
McNutt_Fork	Reach1	7436.788	4005.78	735.3	741.29	741.71	0.005713	7.73	938.3	580.54	0.63
McNutt_Fork	Reach1	7058.356	4111.44	733.34	739.45	739.8	0.005233	6.97	986.33	568.83	0.59
McNutt_Fork	Reach1	6474.676	4217.5	730.33	736.05	736.35	0.008514	6.59	1033.26	630.54	0.59
McNutt_Fork	Reach1	5903.659	4366.08	726.31	732.87	733.11	0.005618	5.93	1215.94	644.81	0.49
McNutt_Fork	Reach1	5127.438	4466.36	723.33	730.11	730.29	0.003828	3.84	1370.38	635.28	0.39
McNutt_Fork	Reach1	4618.316	4522.81	719.45	729.2	729.29	0.001131	2.81	1981.46	638.46	0.23
McNutt_Fork	Reach1	4336.737	4548.46	717.3	728.69	728.94	0.001151	4.06	1178.83	336.14	0.33
McNutt_Fork	Reach1	4274.015	Culvert								
McNutt_Fork	Reach1	4210.26	4548.46	716.64	724.16	726.07	0.006694	11.09	410.14	127.96	0.81
McNutt_Fork	Reach1	3977.13	4622.66	715.94	724.54	724.8	0.000957	4.47	1177.85	320.33	0.31
McNutt_Fork	Reach1	3310.231	4720.46	713.97	722.04	723.25	0.00558	9.6	637.45	294.18	0.73
McNutt_Fork	Reach1	2447.417	4720.46	715.36	721.35	721.4	0.000724	1.49	2598.1	938.36	0.11
McNutt_Creek	Reach4	20891.14	87.98	690.24	692.49	692.54	0.001134	1.84	47.83	32.13	0.27
McNutt_Creek	Reach4	20434.25	108.04	690	691.82	691.86	0.001859	1.7	63.64	70.95	0.32

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Creek	Reach4	20160.53	121.8	688.39	691.38	691.45	0.00126	2.17	56.23	31.75	0.29
McNutt_Creek	Reach4	20000.81	143.59	688.15	691.13	691.22	0.001515	2.41	59.59	33.18	0.32
McNutt_Creek	Reach4	19954.63	Culvert								
McNutt_Creek	Reach4	19913.84	143.59	686.94	690.19	690.44	0.003407	4.02	35.72	18.97	0.47
McNutt_Creek	Reach4	19781.46	168.3	683.06	690.3	690.31	0.000037	0.82	279.44	95.96	0.06
McNutt_Creek	Reach4	19773.93	Culvert								
McNutt_Creek	Reach4	19755.82	168.3	682.93	687.49	687.5	0.000092	0.86	196.08	67.02	0.09
McNutt_Creek	Reach4	19569.82	201.66	682.11	687.42	687.44	0.002245	1.33	152.1	73.14	0.16
McNutt_Creek	Reach4	19328.82	235.9	681.04	687.12	687.14	0.000818	1.16	203.17	55.73	0.11
McNutt_Creek	Reach4	19119.81	333.03	680.11	686.9	686.94	0.001141	1.46	229.16	60.18	0.13
McNutt_Creek	Reach4	18660.27	517.26	678.06	686.05	686.14	0.002383	2.37	227.88	63.58	0.19
McNutt_Creek	Reach4	18073.45	638.81	675.46	685.61	685.63	0.000469	1.28	501.71	83.14	0.09
McNutt_Creek	Reach4	17792.17	638.81	674.21	685.3	685.34	0.000658	1.68	432.4	101.1	0.1
McNutt_Creek	Reach3	16997.49	2899.56	670.56	683.62	683.88	0.003126	4.24	797.95	153.67	0.24
McNutt_Creek	Reach3	16839.01	2901.95	669.82	683.43	683.55	0.001204	2.73	1101.76	135.58	0.15
McNutt_Creek	Reach3	16823.58	2916.58	669.75	683.44	683.52	0.000853	2.35	1274.82	156.45	0.13
McNutt_Creek	Reach3	16729.13	3040.8	669.31	683.35	683.44	0.000877	2.5	1347.14	193.76	0.13
McNutt_Creek	Reach3	15946.29	3131	665.68	682.98	683.02	0.000375	1.77	2234.92	377.53	0.08
McNutt_Creek	Reach3	15397.62	3214.26	663.13	682.88	682.9	0.000132	1.24	3175.45	445.49	0.06
McNutt_Creek	Reach3	14904.99	3249.63	660.85	682.82	682.84	0.000116	1.25	3734.38	480.91	0.05
McNutt_Creek	Reach3	14699.6	3268.29	659.9	682.81	682.82	0.000082	1.09	4203.77	483.34	0.04
McNutt_Creek	Reach3	14592.13	3285.89	659.42	682.8	682.82	0.000023	1.12	4188	483.02	0.04
McNutt_Creek	Reach3	14491.32	3327.59	658.98	682.76	682.8	0.000079	1.9	2377.16	330.15	0.08
McNutt_Creek	Reach3	14458.34	Bridge								
McNutt_Creek	Reach3	14415.69	3327.59	658.66	669.37	670.62	0.006478	9	369.78	53.93	0.61
McNutt_Creek	Reach3	14254.58	3327.59	658.05	668.67	669.16	0.007072	5.75	640.9	162.02	0.37
McNutt_Creek	Reach2	13959.76	3609.02	656.93	667.53	667.79	0.003733	4.18	912.31	213.23	0.28
McNutt_Creek	Reach2	13628.54	3707.38	655.69	665.83	666.54	0.003609	6.98	623.7	209.71	0.47
McNutt_Creek	Reach2	13083.26	3879.69	653.61	665.47	665.84	0.001415	5.52	975.44	250.51	0.31
McNutt_Creek	Reach2	12874.12	3943.34	652.83	665.36	665.58	0.000783	4.38	1302.4	310.95	0.24
McNutt_Creek	Reach2	12704.38	3964.93	652.19	665.25	665.45	0.000669	4.08	1304.6	259.81	0.22
McNutt_Creek	Reach2	12678.92	Culvert								

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Creek	Reach2	12654.97	3964.93	651.81	665.21	665.38	0.000653	3.82	1500.42	288.59	0.19
McNutt_Creek	Reach2	12560.13	4029.14	650.57	664.9	665.24	0.002155	5.81	1085.92	237.88	0.28
McNutt_Creek	Reach2	12281.01	4074.65	649.48	663.86	664.44	0.00359	6.19	706.99	121.59	0.35
McNutt_Creek	Reach2	12085.89	4135.86	648.73	663.36	663.67	0.003552	4.96	1150.67	255.54	0.25
McNutt_Creek	Reach2	11826.87	4209.41	647.74	662.36	662.66	0.004277	4.89	1153.27	260.65	0.27
McNutt_Creek	Reach2	11520.62	4300.06	646.56	661.27	661.49	0.003291	3.92	1211.22	226.25	0.23
McNutt_Creek	Reach2	11150.48	4471.32	645.14	659.43	659.86	0.005938	5.75	1027.22	249.68	0.32
McNutt_Creek	Reach2	10471.99	4566.59	642.54	657.98	658.1	0.001357	2.89	1817.01	275.96	0.16
McNutt_Creek	Reach2	10105.72	4566.59	641.14	657.39	657.54	0.001795	3.61	1679.32	329.02	0.18
McNutt_Creek	Reach2	9914.197	4567.01	650.1	655.71	656.5	0.02604	7.3	659.92	170.82	0.6
McNutt_Creek	Reach2	9881.88	Inl Struct								
McNutt_Creek	Reach2	9824.535	4567.01	641.12	654.89	655.08	0.002333	3.57	1387.06	259.47	0.2
McNutt_Creek	Reach2	9493.918	4570.11	638.79	653.96	654.2	0.003084	4.24	1369.6	306.38	0.23
McNutt_Creek	Reach2	9138.242	4571.77	637.45	652.68	652.98	0.003825	4.66	1252.65	338.21	0.26
McNutt_Creek	Reach2	8787.45	4573.64	636.46	651.56	651.79	0.002974	4.2	1463.92	417.17	0.23
McNutt_Creek	Reach2	8392.124	4576.39	635.36	650.49	650.67	0.002797	3.95	1585.12	395.68	0.22
McNutt_Creek	Reach2	7813.91	4579.07	633.74	649.15	649.33	0.001926	3.54	1519.3	300.07	0.18
McNutt_Creek	Reach2	7247.469	4582.27	632.15	647.55	647.83	0.003846	4.77	1449.67	476.22	0.26
McNutt_Creek	Reach2	6575.002	4584.53	630.27	644.64	644.95	0.005306	5.3	1366.74	459.41	0.3
McNutt_Creek	Reach2	6098.395	4587.14	628.86	643.16	643.33	0.00251	3.57	1707.02	491.64	0.2
McNutt_Creek	Reach2	5548.874	4590.34	626.94	641.48	641.68	0.003759	4.23	1606.68	523.66	0.24
McNutt_Creek	Reach2	4876.52	4593	624.61	639.07	639.34	0.004449	4.6	1219.65	280.52	0.27
McNutt_Creek	Reach2	4316.593	4594.12	622.66	637.02	637.28	0.003156	4.55	1275.92	240.34	0.24
McNutt_Creek	Reach2	4082.363	4594.39	621.84	636.52	636.69	0.001998	3.53	1507.74	278.97	0.19
McNutt_Creek	Reach2	4025.172	4594.92	621.64	636.3	636.54	0.002651	4.69	1388.01	285.08	0.23
McNutt_Creek	Reach2	3996.717	Culvert								
McNutt_Creek	Reach2	3966.774	4594.92	621.43	635.35	635.63	0.003825	5.63	1335.37	277.63	0.27
McNutt_Creek	Reach2	3914.292	4596.41	621.23	635.22	635.43	0.002665	4.23	1461.69	286.43	0.22
McNutt_Creek	Reach2	3600.899	4597.46	619.99	634.46	634.63	0.002268	4.09	1604.67	291.2	0.21
McNutt_Creek	Reach2	3382.125	4598.82	619.12	633.83	634.06	0.003002	4.04	1327.96	243.35	0.23
McNutt_Creek	Reach2	3095.859	4599.92	617.75	633.03	633.24	0.002695	4.48	1491.7	283.1	0.22
McNutt_Creek	Reach2	2865.374	4599.92	616.64	632.21	632.52	0.003633	4.61	1139.3	287.1	0.25

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Creek	Reach5	37841.82	94.89	853.05	854.47	854.57	0.016151	2.99	40.02	49.05	0.46
McNutt_Creek	Reach5	37567.13	113.55	844.97	846.11	846.34	0.063481	4.13	32.85	91.1	0.84
McNutt_Creek	Reach5	37264.04	137.3	835.24	837.06	837.45	0.016168	5.02	27.37	24.59	0.84
McNutt_Creek	Reach5	36943.5	140.35	831.14	832.31	832.51	0.013457	4.03	39.59	57.78	0.74
McNutt_Creek	Reach5	36906.43	157.77	830.8	831.87	832.08	0.013799	3.89	43.9	62.74	0.75
McNutt_Creek	Reach5	36708.93	165.84	827.2	828.63	828.94	0.017603	4.79	40.57	66.53	0.86
McNutt_Creek	Reach5	36624.81	181.89	824.44	827.08	827.08	0.000022	0.3	600.73	260.84	0.04
McNutt_Creek	Reach5	36468.88	204.02	824.4	827.07	827.08	0.000037	0.4	506.78	207.46	0.05
McNutt_Creek	Reach5	36275.06	227.75	824.38	827.07	827.07	0.000024	0.33	693.36	283.2	0.04
McNutt_Creek	Reach5	36089.4	263.26	824.38	827.07	827.07	0.000021	0.3	876.61	375.57	0.03
McNutt_Creek	Reach5	35792.54	Culvert								
McNutt_Creek	Reach5	35622.02	263.26	809.84	811.02	811.43	0.02356	5.62	52.14	64.4	1
McNutt_Creek	Reach5	35543.42	350.1	807.84	809.34	809.81	0.017471	5.69	67.62	74.52	0.9
McNutt_Creek	Reach5	35363.67	425.29	803.9	805.99	806.46	0.011175	5.55	79.44	58.73	0.75
McNutt_Creek	Reach5	35035.32	430.84	799.3	802.91	803.31	0.007992	5.97	106.24	109.14	0.66
McNutt_Creek	Reach5	35013.41	441.76	798.93	802.65	803.11	0.009192	6.34	100.9	114.05	0.71
McNutt_Creek	Reach5	34971.19	468.18	798.33	801.85	802.41	0.011973	6.67	90.57	98.46	0.8
McNutt_Creek	Reach5	34873.16	511.42	796.93	801.81	801.91	0.001323	2.63	224.34	142.81	0.28
McNutt_Creek	Reach5	34724.06	592.3	794.82	800.21	801.28	0.020356	8.3	71.36	77.24	1
McNutt_Creek	Reach5	34476.26	689.89	791.21	794.84	795.75	0.013614	8.28	98.17	58.33	0.89
McNutt_Creek	Reach5	34218.82	777.1	787.28	789.94	790.78	0.016678	7.39	108.86	72.16	0.94
McNutt_Creek	Reach5	34017.93	824.17	784.78	787.35	787.66	0.008443	4.44	185.62	124.66	0.64
McNutt_Creek	Reach5	33918.66	835.62	783.37	786.45	786.74	0.006666	5.27	205.15	141.07	0.61
McNutt_Creek	Reach5	33895.39	853.21	783.11	785.98	786.51	0.020056	6.85	149.72	138.28	0.98
McNutt_Creek	Reach5	33860.22	1016.49	783.11	785.37	785.95	0.018986	7.48	172.47	146.16	0.99
McNutt_Creek	Reach5	33564.67	1106.5	780.24	783.82	784.11	0.003325	4.55	268.84	112.89	0.46
McNutt_Creek	Reach5	33421.47	1378.48	779.21	782.29	783.14	0.012336	7.83	206.29	131.48	0.85
McNutt_Creek	Reach5	33050.54	1504.06	774.31	779.55	779.64	0.000569	2.33	659.44	179.76	0.2
McNutt_Creek	Reach5	32903.38	1617.12	774.26	779.41	779.53	0.000902	2.75	588.93	159.55	0.24
McNutt_Creek	Reach5	32781.06	1772.13	771.92	779.23	779.4	0.000984	3.96	731.07	399.14	0.28
McNutt_Creek	Reach5	32767.22	Bridge								
McNutt_Creek	Reach5	32756.42	1772.13	771.52	776.18	777.67	0.014672	10	185.7	69.49	0.96

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Creek	Reach5	32626.57	1772.13	769.84	774.08	774.33	0.003736	4.89	458.04	405.19	0.48
McNutt_Creek	Reach5	32383.05	1794.29	766.69	773.81	773.92	0.000925	2.96	747.14	293.5	0.25
McNutt_Creek	Reach5	32242.67	1806.95	764.87	773.7	773.81	0.00055	3.31	797.34	273.56	0.21
McNutt_Creek	Reach5	32163.25	1848.96	765.39	773.08	773.59	0.002694	6.24	330.23	286.3	0.44
McNutt_Creek	Reach5	32075.14	Culvert								
McNutt_Creek	Reach5	31988.79	1848.96	764.46	770.85	771.56	0.003936	7.6	309.6	247.13	0.55
McNutt_Creek	Reach5	31903.71	1958.82	762.97	770.99	771.27	0.000925	4.38	460.37	441.96	0.28
McNutt_Creek	Reach5	31760.31	Culvert								
McNutt_Creek	Reach5	31378.69	1958.82	758.65	765.38	765.63	0.001041	4.03	485.85	104.47	0.31
McNutt_Creek	Reach5	31251.81	2053.23	757.43	764.19	765.16	0.006567	9.29	306.04	311.89	0.75
McNutt_Creek	Reach5	30720.19	2117.24	754.83	759.72	760	0.005734	6.04	572.9	518.26	0.65
McNutt_Creek	Reach5	30373.44	2194.53	752.18	757.25	757.67	0.004626	7.11	550.85	436.5	0.63
McNutt_Creek	Reach5	29968.51	2263.16	748.74	754.08	754.39	0.003429	6.54	625.56	499.07	0.55
McNutt_Creek	Reach5	29620.74	2301.12	746.34	751.29	751.92	0.005948	7.67	452.77	315.47	0.71
McNutt_Creek	Reach5	29432.88	2365.35	744.88	749.79	750.44	0.007801	8.42	428.43	289.08	0.8
McNutt_Creek	Reach5	29121.95	2434.87	742.47	747.55	748.13	0.006277	7.66	495.16	364.84	0.72
McNutt_Creek	Reach5	28794.78	2501.52	739.93	745.42	745.86	0.007144	7.45	521.59	398.14	0.74
McNutt_Creek	Reach5	28489.77	2501.52	737.57	743.95	744.32	0.004644	7.43	622.77	568.4	0.62
McNutt_Creek	Reach5	27952.82	2512.48	733.42	740.71	741.25	0.007722	7.99	501.61	368.97	0.76
McNutt_Creek	Reach5	27726.6	2534.66	732.15	739.47	739.72	0.003256	5.48	666.14	354.92	0.5
McNutt_Creek	Reach5	27271.88	2571.34	729.59	738.26	738.69	0.004452	7.25	682.54	595.23	0.6
McNutt_Creek	Reach5	26528.58	2591.84	725.42	733.98	734.67	0.008148	8.78	448.71	286.29	0.78
McNutt_Creek	Reach5	26117.7	2608.55	723.11	732.08	732.68	0.005643	8.31	542.96	376.33	0.67
McNutt_Creek	Reach5	25785.2	2629.26	721.24	730.82	731.1	0.001557	5.71	836.96	486.58	0.38
McNutt_Creek	Reach5	25376.13	2641.25	718.95	730.5	730.58	0.001779	2.77	1227.82	709.36	0.17
McNutt_Creek	Reach5	25140.55	2645.66	717.62	730.22	730.31	0.001768	2.87	1231.45	704.22	0.17
McNutt_Creek	Reach5	25054.31	2652.31	717.14	729.58	729.98	0.00562	6.07	579.67	216.15	0.32
McNutt_Creek	Reach5	25029.38	Bridge								
McNutt_Creek	Reach5	25004.08	2652.31	716.84	727.17	728.27	0.023388	9.83	335.87	77.33	0.6
McNutt_Creek	Reach5	24924.37	2669.55	716.33	726.74	727.06	0.005924	5.57	709.41	321.63	0.33
McNutt_Creek	Reach5	24589.11	2696.54	714.16	724.99	725.22	0.005249	5.05	896.27	451.66	0.3
McNutt_Creek	Reach5	24068.73	2696.54	710.8	722.14	722.47	0.00648	5.27	754.09	411.74	0.34

Table N-15. Summary Output - McNutt Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
McNutt_Creek	Reach1	2222.41	6327.03	613.55	632.21	632.4	0.001673	4.1	1918.6	186.57	0.18
McNutt_Creek	Reach1	1926.69	6332.66	612.13	631.96	632.1	0.001022	3.54	2242.37	266.85	0.15
McNutt_Creek	Reach1	1877.541	6340.23	611.9	631.63	631.97	0.002353	5.17	1461.5	120.21	0.22
McNutt_Creek	Reach1	1852.897	Bridge								
McNutt_Creek	Reach1	1821.4	6340.23	611.6	631.22	631.66	0.002886	6.06	1298.11	102.19	0.25
McNutt_Creek	Reach1	1811.583	6354.61	611.49	631.19	631.62	0.002831	5.94	1289.16	98.12	0.24
McNutt_Creek	Reach1	1767.728	Bridge								
McNutt_Creek	Reach1	1728.508	6354.61	610.63	630.54	630.93	0.002618	6.12	1375.39	105.97	0.24
McNutt_Creek	Reach1	1686.373	6360.25	610.29	630.5	630.78	0.002143	4.4	1522.65	666.41	0.2
McNutt_Creek	Reach1	1637.305	6374.61	609.9	630.22	630.62	0.002606	5.75	1372.17	110.31	0.23
McNutt_Creek	Reach1	1619.865	Bridge								
McNutt_Creek	Reach1	1603.235	6374.61	609.66	630.04	630.41	0.002531	5.51	1410.59	114.65	0.23
McNutt_Creek	Reach1	1512.671	6389.09	609.3	629.62	630.11	0.004238	5.76	1218.1	385.66	0.27
McNutt_Creek	Reach1	1387.289	6419.14	608.81	629.04	629.54	0.004926	5.88	1260.21	191.34	0.29
McNutt_Creek	Reach1	1128.009	6455.29	607.78	628.29	628.58	0.002619	4.63	1715.73	340.28	0.22
McNutt_Creek	Reach1	817.6443	6455.29	606.56	627.19	627.59	0.003942	5.57	1507.44	420.96	0.26

Table N-16. Summary Output - Onion Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
OnionBranch_T1	Reach1	914.1318	209.88	750.67	754.06	754.07	0.001237	1.09	250.98	212.07	0.12
OnionBranch_T1	Reach1	803.2889	223.94	750.3	753.96	753.97	0.000661	0.8	355.35	235.1	0.09
OnionBranch_T1	Reach1	691.0887	255.12	749.73	753.91	753.92	0.000399	0.98	398.23	231.62	0.09
OnionBranch_T1	Reach1	651.6896	Culvert								
OnionBranch_T1	Reach1	603.7889	255.12	749.9	752.87	753.09	0.013023	3.8	70.81	55.64	0.47
OnionBranch_T1	Reach1	465.6295	273.2	748.47	750.82	750.88	0.005965	2.4	146.51	160.88	0.32
OnionBranch_T1	Reach1	347.2321	290.7	747.89	749.92	750.02	0.009138	2.8	122.66	124.4	0.39
OnionBranch_T1	Reach1	239.8738	290.7	746.67	749.52	749.55	0.002412	1.51	215.61	167.47	0.2
OnionBranch	Reach2	19145.15	55.7	755.75	758.45	758.46	0.00016	0.75	96.29	77.35	0.09
OnionBranch	Reach2	19007.15	77.88	755.02	758.44	758.44	0.000088	0.7	164.65	93.06	0.07
OnionBranch	Reach2	18898.15	Culvert								
OnionBranch	Reach2	18810.15	77.88	755.02	756.79	756.91	0.009297	2.89	28.19	40.12	0.44
OnionBranch	Reach2	18579.15	96.89	753.95	755.42	755.46	0.004601	1.64	59.12	61.21	0.29
OnionBranch	Reach2	18300.15	139.33	751.68	754.12	754.2	0.004511	2.31	63.36	47.4	0.32
OnionBranch	Reach2	17836.15	169.31	750.03	752.85	752.89	0.002024	1.67	119.35	84.74	0.2
OnionBranch	Reach2	17587.15	219.76	749.28	752.46	752.5	0.001294	1.61	158.37	94.99	0.18
OnionBranch	Reach2	17254.05	272.62	747.65	751.97	752.01	0.002017	1.55	187.34	84.65	0.16
OnionBranch	Reach2	17204.7	Culvert								
OnionBranch	Reach2	17160.37	272.62	747.39	751.05	751.22	0.006287	3.27	84.95	33.88	0.35
OnionBranch	Reach2	16978.74	272.62	746.87	750.17	750.24	0.004224	2.21	128.25	81.47	0.27
OnionBranch	Reach2	16811.53	272.62	746.4	749.76	749.8	0.001783	1.64	175.92	94.16	0.18
OnionBranch	Reach1	16289.59	601.48	744.93	749.14	749.16	0.001038	1.35	546.09	336.14	0.14
OnionBranch	Reach1	16152.41	725.66	744.16	748.96	748.99	0.001293	1.72	540.44	294.58	0.16
OnionBranch	Reach1	15896.64	819.76	743.82	748.83	748.86	0.000324	1.45	674.04	411.55	0.16
OnionBranch	Reach1	15730.5	935.97	743.1	748.81	748.83	0.000115	1.17	1334.01	717.51	0.1
OnionBranch	Reach1	15549.84	1325.19	742.32	748.77	748.79	0.000542	1.41	1214.83	492.29	0.11
OnionBranch	Reach1	15076	1598.04	741.5	748.45	748.5	0.001003	1.76	915.73	332.95	0.15
OnionBranch	Reach1	14820.88	1750.6	740.78	748.3	748.33	0.00047	1.76	1196.47	520.43	0.12
OnionBranch	Reach1	14696.63	1758.81	740.85	748.01	748.16	0.003824	3.52	579.37	638.92	0.24
OnionBranch	Reach1	14618.85	Culvert								
OnionBranch	Reach1	14566.71	1758.81	740.95	746.15	746.9	0.023026	7.04	259.65	149.8	0.57

Table N-16. Summary Output - Onion Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
OnionBranch	Reach1	14517.89	1779.13	740.95	746	746.43	0.003076	4.87	344.52	347.01	0.43
OnionBranch	Reach1	14398.1	1795.46	740.91	746.04	746.2	0.000924	3.29	613.96	416.46	0.27
OnionBranch	Reach1	14302.85	1809.46	741.06	745.98	746.11	0.001213	2.94	641.66	428.07	0.27
OnionBranch	Reach1	14221.86	1844.76	740.41	745.64	745.95	0.001478	4.46	419.91	100.66	0.37
OnionBranch	Reach1	14185.51	Culvert								
OnionBranch	Reach1	14134.83	1844.76	740.34	745.3	745.54	0.001223	3.9	479.74	219.28	0.33
OnionBranch	Reach1	14020.37	1881.59	740.39	745.23	745.37	0.000914	3.09	646.94	374.34	0.26
OnionBranch	Reach1	13814.24	1930.93	740.08	744.84	745.1	0.00185	4.45	660.59	296.78	0.39
OnionBranch	Reach1	13544.34	1963.81	739.57	744.69	744.79	0.000709	2.98	808.71	275.03	0.25
OnionBranch	Reach1	13368.28	2009.3	739.76	744.65	744.7	0.000329	2.1	1193.66	343.88	0.17
OnionBranch	Reach1	13129.49	2073.36	739.07	744.55	744.61	0.000436	2.53	1349.93	425.13	0.2
OnionBranch	Reach1	12802.23	2130.76	738.64	744.45	744.49	0.000259	2.13	1779.64	533.21	0.16
OnionBranch	Reach1	12517.49	2167.89	738.24	744.44	744.46	0.000056	1.04	2647.66	632.74	0.08
OnionBranch	Reach1	12337.37	2170.2	738.56	744.44	744.45	0.00005	0.9	2904.06	769.41	0.07
OnionBranch	Reach1	12326.26	Inl Struct								
OnionBranch	Reach1	12290.83	2218.94	738.48	744.39	744.43	0.000237	1.95	1698.78	791.22	0.15
OnionBranch	Reach1	12094.67	2224.47	736.15	744.32	744.38	0.000281	2.27	1314.47	803.81	0.17
OnionBranch	Reach1	12068.7	2279.4	736.1	744.05	744.3	0.00104	4.36	686.23	291.52	0.32
OnionBranch	Reach1	12023.01	Culvert								
OnionBranch	Reach1	11969.54	2279.4	735.2	742.06	742.3	0.00196	4.97	820.24	490.47	0.35
OnionBranch	Reach1	11814.33	2294.31	735.67	741.73	741.85	0.001786	3.95	1038.03	561.54	0.32
OnionBranch	Reach1	11746.36	2408.27	735.55	741.63	741.71	0.00121	3.06	1213.64	587.92	0.26
OnionBranch	Reach1	11240.88	2473.94	733.94	740.5	740.72	0.004495	4.38	748.31	423.11	0.37
OnionBranch	Reach1	10960.32	2548.99	733.03	738.93	739.21	0.00807	4.77	622.46	321.81	0.47
OnionBranch	Reach1	10907	Inl Struct								
OnionBranch	Reach1	10648.71	2608.66	732.19	738.92	739.11	0.004483	4.1	822.89	510.13	0.36
OnionBranch	Reach1	10407.42	2697.32	731.61	738.11	738.22	0.002416	3.12	1012.14	488.52	0.27
OnionBranch	Reach1	10058.92	2762.99	730.78	737.2	737.35	0.003091	3.49	888.72	430.8	0.31
OnionBranch	Reach1	9808.083	2777.3	730.18	736.85	736.93	0.001255	2.64	1256.12	567.63	0.2
OnionBranch	Reach1	9754.217	2798.25	730.05	735.63	736.52	0.023816	9.18	463.64	386.71	0.83
OnionBranch	Reach1	9728.593	Culvert								

Table N-16. Summary Output - Onion Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
OnionBranch	Reach1	9702.937	2798.25	729.93	736.11	736.24	0.00291	3.55	1071.41	507.16	0.3
OnionBranch	Reach1	9675.865	2885.8	729.86	736.02	736.15	0.003129	4.2	1159.88	530.26	0.32
OnionBranch	Reach1	9354.611	3001.68	729.09	735.25	735.33	0.002121	2.84	1407.13	631.94	0.25
OnionBranch	Reach1	8944.061	3062.24	728.11	733.94	734.11	0.004999	4.23	1000.01	506.57	0.38
OnionBranch	Reach1	8735.798	3113.08	727.23	733.16	733.26	0.003029	3.27	1214.34	473.65	0.29
OnionBranch	Reach1	8564.087	3163.42	726.25	732.73	732.86	0.00299	3.66	1158.93	473.33	0.3
OnionBranch	Reach1	8396.817	3212.68	725.43	732.02	732.24	0.003609	4.14	925.63	391.22	0.34
OnionBranch	Reach1	8235.7	3253.05	724.51	730.66	731.4	0.004366	6.81	477.15	257.47	0.53
OnionBranch	Reach1	7997.349	Culvert								
OnionBranch	Reach1	7738.053	3253.05	722.29	727.39	728.61	0.002706	8.88	366.22	180.79	0.71
OnionBranch	Reach1	7622.307	3494.38	721.44	727.7	728.01	0.000767	4.47	782	363.2	0.37
OnionBranch	Reach1	6959	3614.78	719.17	727	727.27	0.001681	4.49	1101.63	443.35	0.32
OnionBranch	Reach1	6645	3775.82	718.9	726.76	726.86	0.000837	3.09	2335.48	1162.56	0.23
OnionBranch	Reach1	6241	3775.82	718.03	725.95	726.28	0.002239	4.78	883.55	599.18	0.36
OnionBranch	Reach1	6136	Bridge								
OnionBranch	Reach1	5964	3775.82	716.58	723.72	724.17	0.002683	6.29	1019.09	421.61	0.45
OnionBranch	Reach1	5900	Culvert								
OnionBranch	Reach1	5654	3775.82	716.34	722.93	723.56	0.004791	8.07	923.24	436.6	0.6
OnionBranch	Reach1	5228	4066.72	715.18	721.85	722.06	0.002112	4.37	1401.1	560.39	0.38
OnionBranch	Reach1	4980	4098.23	713.77	719.95	721.07	0.009123	10.61	671.39	306.32	0.81
OnionBranch	Reach1	4717	4205.68	713.48	718.73	719.01	0.002807	5.85	1289.12	543.29	0.5
OnionBranch	Reach1	3835	4300.53	708.11	715.2	715.94	0.004699	7.26	766.2	288.28	0.58
OnionBranch	Reach1	3075	4393.39	704.04	710.82	711.75	0.006659	8.5	775.7	295.03	0.69
OnionBranch	Reach1	2347	4439.4	695.29	704.88	706.23	0.008489	11.12	646.27	174.42	0.67
OnionBranch	Reach1	1992	4480.89	692.27	701.18	702.82	0.010827	12.16	581.77	163.43	0.81
OnionBranch	Reach1	1675	4558.74	690.16	700.36	700.92	0.002348	6.32	826.8	124.22	0.39
OnionBranch	Reach1	1598	Bridge								
OnionBranch	Reach1	1434	4558.74	686.71	697.66	699.05	0.003015	9.46	486.11	84.83	0.63
OnionBranch	Reach1	1088	4607.7	684.76	693.59	697	0.006083	15.3	357.51	60.97	0.95
OnionBranch	Reach1	724	4640.81	683.29	692.39	693.24	0.003586	8.4	740.76	125.96	0.5
OnionBranch	Reach1	480	4678.82	679.63	691.74	692.35	0.002876	8.89	1096.9	179.11	0.46

Table N-16. Summary Output - Onion Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
OnionBranch	Reach1	412	Culvert								
OnionBranch	Reach1	373	4678.82	679.63	689.61	692.28	0.02576	20.86	540.83	105.02	1.17
OnionBranch	Reach1	202	4678.82	674.92	684.74	688.15	0.018274	15.02	342.22	56.99	0.96
OnionBranch	Reach3	34036.21	781.52	839.38	843.87	844.33	0.021637	5.45	146.92	60.71	0.57
OnionBranch	Reach3	33579.66	962.66	833.73	844.04	844.05	0.00011	0.85	1339.93	246.15	0.05
OnionBranch	Reach3	33411.51	1109.34	830.95	844.04	844.04	0.000024	0.76	2089.62	298.17	0.04
OnionBranch	Reach3	33297.11	919.2	830.94	844.03	844.04	0.00001	0.82	1136.19	315.57	0.04
OnionBranch	Reach3	33168.34	Culvert								
OnionBranch	Reach3	33051.97	919.2	825.65	831.72	832.15	0.007146	5.34	176.99	71.67	0.46
OnionBranch	Reach3	32862.13	939.16	827.66	830.44	830.66	0.007687	3.96	263.79	138.36	0.44
OnionBranch	Reach3	32769.02	1041.69	826.87	829.56	829.81	0.009435	4.38	265.89	136.99	0.49
OnionBranch	Reach3	32319.9	1192	822	825.55	825.79	0.008696	4.37	322.26	185.51	0.48
OnionBranch	Reach3	31735.69	1322.02	816.4	820.7	820.95	0.008347	4.32	372.45	247.46	0.47
OnionBranch	Reach3	31286.98	1523.37	812.09	816	816.2	0.013112	3.99	424.23	303.28	0.54
OnionBranch	Reach3	30672.55	1682.09	806.14	811.02	811.29	0.005973	5.11	477.39	241.95	0.43
OnionBranch	Reach3	30242.96	1871.38	802.07	808.16	808.55	0.006936	5.53	428.84	183.39	0.46
OnionBranch	Reach3	29780.76	1871.38	797.64	805.08	805.49	0.006717	5.66	421.27	175.4	0.46
OnionBranch	Reach3	29495.78	1920.03	799.6	803.39	803.63	0.006016	4.27	519.26	233.24	0.41
OnionBranch	Reach3	29184.15	1991.86	797.55	801.98	802.29	0.003327	4.7	495.42	194.23	0.42
OnionBranch	Reach3	28738.15	2025.93	795.53	800.22	800.68	0.003911	5.7	440.07	243.42	0.51
OnionBranch	Reach3	28532.15	2152.7	795.18	798.31	799.19	0.015113	8.41	348.99	214.36	0.94
OnionBranch	Reach3	27795.15	2152.7	790.16	793.59	793.81	0.002595	3.89	569.95	204.73	0.4
OnionBranch	Reach3	27199.15	2741.43	788.23	791.69	792.01	0.003278	4.58	615.05	203.22	0.45
OnionBranch	Reach3	26619.15	2822.03	785.5	788.63	789.18	0.007439	5.93	475.92	204.02	0.66
OnionBranch	Reach3	26459.15	Culvert								
OnionBranch	Reach3	26371.15	2822.03	784.69	788.07	788.54	0.004613	5.46	517.69	204.54	0.54
OnionBranch	Reach3	25893.15	2870.54	782.69	786.13	786.5	0.003795	4.93	610.52	206.32	0.49
OnionBranch	Reach3	25466.15	2931.32	780.74	784.4	784.8	0.004213	5.12	581.83	197.21	0.51
OnionBranch	Reach3	24941.15	2982.3	778.75	782.42	782.78	0.003491	4.82	631.23	203.33	0.47
OnionBranch	Reach3	24509.15	3079.76	776.82	780.74	781.14	0.004087	5.05	619.51	210.09	0.51
OnionBranch	Reach3	24390.15	Culvert								

Table N-16. Summary Output - Onion Branch Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
OnionBranch	Reach3	24300.15	3079.76	776.03	780.27	780.72	0.005653	5.44	583.94	184.68	0.49
OnionBranch	Reach3	23656.15	3292.03	772.24	778.67	778.89	0.001596	3.87	900	176.44	0.28
OnionBranch	Reach3	22321.15	3292.03	768.52	775.94	776.25	0.002562	4.98	930.08	269.24	0.36

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
S.Brushy_Trib4	Reach1	1250.09	822.12	790.38	794.08	794.27	0.011065	3.8	249.81	124.34	0.41
S.Brushy_Trib4	Reach1	956.524	907.44	783.01	788.08	788.5	0.040682	5.98	191.47	151.97	0.72
S.Brushy_Trib4	Reach1	503.7781	907.44	773.44	779.08	779.52	0.011431	5.43	180.85	51.8	0.45
S.Brushy_Trib4	Reach1	353.6314	907.44	771.49	775.07	775.85	0.080285	7.1	127.73	80.83	1
S.Brushy_Trib3	Reach1	1360.363	302.41	811.52	812.53	812.73	0.084469	3.64	84.65	152.95	0.82
S.Brushy_Trib3	Reach1	1102.494	304.38	808.26	809.9	809.92	0.00424	1.42	258.12	258.92	0.21
S.Brushy_Trib3	Reach1	1061.314	307.54	806.32	809.82	809.83	0.001118	0.98	445.7	350.75	0.1
S.Brushy_Trib3	Reach1	1041.663	Culvert								
S.Brushy_Trib3	Reach1	1018.298	307.54	805.93	809.17	809.2	0.003431	1.85	296.07	324.3	0.2
S.Brushy_Trib3	Reach1	995.5257	320.13	805.3	808.06	808.77	0.091892	6.82	48.08	175.85	0.99
S.Brushy_Trib3	Reach1	740.5443	330.25	802.13	804.88	804.89	0.001473	1.08	412.42	372.6	0.13
S.Brushy_Trib3	Reach1	542.8433	340.15	797.6	800.64	801.54	0.010757	8.03	48.33	383.93	0.89
S.Brushy_Trib3	Reach1	354.9864	345.25	793.73	796.89	797.21	0.005191	5.62	104.66	282.14	0.62
S.Brushy_Trib3	Reach1	260.4128	345.25	791.8	794.36	795.19	0.013446	7.36	48.45	139.37	0.95
S.Brushy_Trib2A	Reach1	1061.914	264.95	851.78	853.19	853.26	0.011244	2.1	137.95	157.67	0.35
S.Brushy_Trib2A	Reach1	810.9984	359.2	848.83	850.54	850.6	0.009447	1.9	191.19	190.55	0.32
S.Brushy_Trib2A	Reach1	619.1356	444.23	846.83	848.63	848.68	0.010173	2.37	251	298.38	0.35
S.Brushy_Trib2A	Reach1	485.191	523.21	845.12	846.64	846.75	0.021247	3.02	209.53	246.18	0.48
S.Brushy_Trib2A	Reach1	382.0284	523.21	843.91	844.97	845.05	0.011709	1.48	235.31	308.04	0.33
S.Brushy_Trib2A	Reach1	273.7155	523.21	841.86	843.78	843.85	0.010808	1.87	247.58	310.65	0.34
S.Brushy_Trib2	Reach2	2693.568	259.1	849.87	851.48	851.56	0.011371	2.55	121.1	122.54	0.37
S.Brushy_Trib2	Reach2	2622.015	311.14	847.58	851.12	851.16	0.003687	2.19	215.35	160.49	0.23
S.Brushy_Trib2	Reach2	2599.563	Culvert								
S.Brushy_Trib2	Reach2	2576.644	311.14	847.18	849.71	849.81	0.012744	3.29	130.79	123.96	0.41
S.Brushy_Trib2	Reach2	2502.334	346.34	845.02	848.81	848.96	0.0099	3.22	129.37	116.01	0.37
S.Brushy_Trib2	Reach2	2432.251	418.02	843.82	847.06	847.54	0.039326	5.89	83.41	72.5	0.72
S.Brushy_Trib2	Reach2	2309.247	523.21	841.73	846.08	846.21	0.005315	2.99	191.8	92.73	0.29
S.Brushy_Trib2	Reach2	2162.474	523.21	839.24	844.13	844.6	0.033664	5.5	100.57	86.81	0.67
S.Brushy_Trib2	Reach1	1894.203	534.36	836.55	839.22	839.41	0.012343	3.46	155.1	74.72	0.41
S.Brushy_Trib2	Reach1	1834.143	Culvert								
S.Brushy_Trib2	Reach1	1794.383	534.36	835.04	837.18	837.51	0.025165	4.62	115.72	68.03	0.57

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
S.Brushy_Trib2	Reach1	1735.807	551.68	832.98	835.21	835.72	0.035504	5.74	99.36	53.79	0.69
S.Brushy_Trib2	Reach1	1496.111	565.85	822.28	827.88	828.61	0.024827	6.89	85.23	25.44	0.6
S.Brushy_Trib2	Reach1	1305.58	569.35	820.91	826.15	826.29	0.006446	3.13	205.24	102.81	0.31
S.Brushy_Trib2	Reach1	1259.365	569.35	822.04	824.89	825.61	0.051436	7.26	92.59	65.41	0.85
S.Brushy_Trib1	Reach1	2042.801	1112.25	844.89	849.66	849.91	0.010888	4.56	286.65	105.16	0.42
S.Brushy_Trib1	Reach1	1955.116	1118.24	844.3	849	849.19	0.008389	3.86	353.97	194.51	0.37
S.Brushy_Trib1	Reach1	1864.298	1125.41	842.55	848.39	848.55	0.005664	3.31	385.2	169.13	0.3
S.Brushy_Trib1	Reach1	1756.374	1133.97	841.62	846.33	847.24	0.034444	7.63	148.64	43.64	0.73
S.Brushy_Trib1	Reach1	1628.457	1153.29	840.18	845.04	845.26	0.006596	4.12	317.74	178.65	0.34
S.Brushy_Trib1	Reach1	1481.52	Culvert								
S.Brushy_Trib1	Reach1	1428.944	1153.29	837.06	844.31	844.34	0.000578	1.65	929.94	228.91	0.11
S.Brushy_Trib1	Reach1	1343.16	1160.3	836.01	843.58	844.08	0.010341	5.87	217.84	52.15	0.43
S.Brushy_Trib1	Reach1	1240.939	1167.45	833.83	843.24	843.44	0.002727	3.77	348.4	61.9	0.24
S.Brushy_Trib1	Reach1	1137.208	1171.87	832.84	843.14	843.24	0.001105	2.7	532.86	91.71	0.16
S.Brushy_Trib1	Reach1	1073.416	1191.98	832.17	843.06	843.17	0.000967	2.73	502.17	65.7	0.15
S.Brushy_Trib1	Reach1	786.0031	1195.29	826.48	843.05	843.07	0.000128	1.22	1112.28	281.26	0.06
S.Brushy_Trib1	Reach1	739.2223	1196.97	824.93	843.05	843.06	0.000099	1.09	1129.96	213.47	0.05
S.Brushy_Trib1	Reach1	715.5082	1202.72	824.35	842.78	843	0.002848	3.76	324.53	178.15	0.17
S.Brushy_Trib1	Reach1	692.5131	Culvert								
S.Brushy_Trib1	Reach1	666.0092	1202.72	823.82	830.97	833.86	0.099761	13.65	88.08	15.07	1
S.Brushy_Trib1	Reach1	634.6218	1221.18	823.86	831.7	832.08	0.006591	4.99	252.36	46.04	0.35
S.Brushy_Trib1	Reach1	377.3376	1233.13	822.54	828.9	829.52	0.015571	6.57	209.24	60.72	0.52
S.Brushy_Trib1	Reach1	212.8841	1233.13	819.7	826.23	827.01	0.014881	7.38	186.11	40.75	0.53
S.Brushy_Creek	Reach3	8314.746	1170.21	778.02	785.03	785.3	0.005091	4.97	371.21	147.84	0.45
S.Brushy_Creek	Reach3	7576.026	1170.21	777.13	783.4	783.54	0.001346	3.42	479.37	117.43	0.25
S.Brushy_Creek	Reach6	23437.74	3797.74	838.22	847.01	847.93	0.005395	8.28	590.46	106.1	0.53
S.Brushy_Creek	Reach6	22751.62	3828.59	834.54	844.87	845.39	0.002357	7.01	816.4	151.62	0.4
S.Brushy_Creek	Reach6	22599.12	Bridge								
S.Brushy_Creek	Reach6	22433.62	3828.59	833.47	843.59	844.37	0.003753	8.31	657.09	143.43	0.49
S.Brushy_Creek	Reach6	21560.15	3857.43	832.58	840.76	841.21	0.003155	6.31	940.45	182.75	0.41
S.Brushy_Creek	Reach6	20455.27	3877.57	828.18	836.03	836.62	0.005695	8.32	799.23	151.35	0.55

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
S.Brushy_Creek	Reach6	19688.26	3904.73	823.59	833.1	833.51	0.002966	5.51	872.73	160.92	0.36
S.Brushy_Creek	Reach6	18660.4	4021	817.82	828.78	829.61	0.004904	8.51	800.91	186.65	0.5
S.Brushy_Creek	Reach6	17944.01	4021	817.73	826.57	826.95	0.002657	5.78	1011.51	174.99	0.36
S.Brushy_Creek	Reach5	16919.82	4594.71	813.75	823.63	824	0.003094	5.93	1119.96	182.22	0.37
S.Brushy_Creek	Reach5	15863.43	4850.97	808.82	818.24	819.05	0.007617	7.72	775.71	182.98	0.53
S.Brushy_Creek	Reach5	15114.01	4939.88	804.96	817.02	817.28	0.000907	4.08	1209.5	140.16	0.25
S.Brushy_Creek	Reach5	15079.01	Bridge								
S.Brushy_Creek	Reach5	15014.01	4939.88	804.97	816.83	816.97	0.000632	3.04	1624.42	227.54	0.2
S.Brushy_Creek	Reach5	14863.24	4939.88	802.88	816.74	816.89	0.00052	3.5	2002.74	262.61	0.19
S.Brushy_Creek	Reach5	14837.09	Bridge								
S.Brushy_Creek	Reach5	14763.24	4939.88	802.84	816.43	816.62	0.000828	4.44	2074.49	419.25	0.24
S.Brushy_Creek	Reach2	6964.026	1695.38	775.27	782.22	782.42	0.00236	4.89	674.43	183.54	0.34
S.Brushy_Creek	Reach2	6215.087	2012.22	773.55	780.81	781.03	0.001498	4.03	653.64	145.9	0.28
S.Brushy_Creek	Reach2	5893.353	2012.22	772.47	780.17	780.3	0.00347	2.95	682.75	166.9	0.26
S.Brushy_Creek	Reach2	5511.087	2287.89	770.73	778.52	778.77	0.004585	4.01	590.52	115.94	0.29
S.Brushy_Creek	Reach2	5216.858	2287.89	769.41	777.75	777.88	0.00216	3.28	833.43	155.31	0.21
S.Brushy_Creek	Reach2	4983.516	2461.65	768.34	777.22	777.36	0.002215	3.05	844.02	166.41	0.21
S.Brushy_Creek	Reach2	4682.722	2493.18	766.98	776.48	776.66	0.002445	3.56	775.29	154.25	0.23
S.Brushy_Creek	Reach2	4630.419	2503.94	766.75	776.28	776.51	0.003024	3.92	683.9	120.31	0.25
S.Brushy_Creek	Reach2	4619.051	Bridge								
S.Brushy_Creek	Reach2	4610.026	2503.94	766.66	776.22	776.44	0.002792	3.76	707.57	116.32	0.24
S.Brushy_Creek	Reach2	4556.811	2507.28	766.52	776.22	776.29	0.000861	2.2	1198.42	210.53	0.14
S.Brushy_Creek	Reach2	4540.328	2513.99	766.48	776.16	776.26	0.001405	2.65	1022.65	196.54	0.17
S.Brushy_Creek	Reach2	4507.322	2550.22	766.39	775.77	776.15	0.005961	5.31	607.3	197.34	0.34
S.Brushy_Creek	Reach2	4330.508	2623.58	765.93	775.46	775.57	0.001679	2.71	1019.98	177.22	0.18
S.Brushy_Creek	Reach2	3980.034	2697.09	765.02	774.66	774.83	0.002646	3.59	854.89	166.33	0.23
S.Brushy_Creek	Reach2	3638.595	2772.07	764.14	773.78	773.97	0.00245	3.61	862.21	169.33	0.23
S.Brushy_Creek	Reach2	3299.721	2821.38	763.26	772.99	773.17	0.002306	3.59	895.67	161.78	0.22
S.Brushy_Creek	Reach2	3081.847	2872.26	762.5	772.59	772.72	0.001723	3.05	1026.28	172.34	0.19
S.Brushy_Creek	Reach2	2861.015	2872.26	761.52	772.21	772.34	0.00174	3	1016.41	166.08	0.19
S.Brushy_Creek	Reach1	2585.122	3743.59	760.76	771.39	771.67	0.003222	4.38	959.54	177.99	0.26

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
S.Brushy_Creek	Reach1	2304.373	3779.51	759.78	770.5	770.77	0.003169	4.3	959.25	163.53	0.26
S.Brushy_Creek	Reach1	1943.921	3823.74	758.52	768.85	769.25	0.005797	5.32	818.99	165.72	0.34
S.Brushy_Creek	Reach1	1504.834	3856.88	756.99	767.45	767.64	0.002357	3.73	1240.91	261.65	0.22
S.Brushy_Creek	Reach1	1179.127	3895.12	755.85	766.74	766.92	0.002065	3.46	1162.59	154.45	0.21
S.Brushy_Creek	Reach1	806.8167	3936.31	754.55	765.95	766.16	0.002057	3.73	1143.7	165.66	0.21
S.Brushy_Creek	Reach1	409.778	3939.75	753.16	765.04	765.27	0.00245	4.11	1130.88	337.72	0.23
S.Brushy_Creek	Reach1	376.8119	3946.9	753.05	764.67	765.1	0.00543	5.68	854	278.08	0.33
S.Brushy_Creek	Reach1	366.5427	Bridge								
S.Brushy_Creek	Reach1	343.8601	3946.9	752.94	763.65	764.12	0.006404	5.88	780.69	173.09	0.36
S.Brushy_Creek	Reach1	308.4187	3949.33	752.84	763.16	763.82	0.009005	6.73	636.93	151.33	0.43
S.Brushy_Creek	Reach1	285.1706	3956.19	752.77	762.96	763.61	0.008973	6.61	644.44	142.76	0.42
S.Brushy_Creek	Reach1	219.6953	3956.19	752.58	763.03	763.17	0.001384	3.19	1496.33	245	0.18
S.Brushy_Creek	Reach1	181.8592	Bridge								
S.Brushy_Creek	Reach1	138.7541	3956.19	752.09	761.68	761.84	0.002004	3.3	1364.9	259.29	0.21
S.Brushy_Creek	Reach4	13921.62	7271.18	804.97	814.47	815.13	0.00298	7.44	1409.84	213.64	0.45
S.Brushy_Creek	Reach4	13391.22	7733.09	804.97	813.46	813.79	0.001787	4.77	1732.85	282.24	0.33
S.Brushy_Creek	Reach4	12763.37	8535.22	802.35	812.08	812.53	0.00209	5.41	1578.4	547.47	0.36
S.Brushy_Creek	Reach4	12716.09	Bridge								
S.Brushy_Creek	Reach4	12580.09	8535.22	799.25	811.72	812.07	0.001386	4.76	1968.23	675.65	0.3
S.Brushy_Creek	Reach4	11413.5	9360.85	804	810.66	810.78	0.000833	3.6	3897.76	869.9	0.27
S.Brushy_Creek	Reach4	10322.05	9360.85	805.06	809.1	809.42	0.002	4.51	2094.62	601.32	0.41
Cluck_Creek	Reach3	22464	114.76	1036.15	1047.27	1047.27	0.000001	0.1	1941.29	376.01	0.01
Cluck_Creek	Reach3	22278	Inl Struct								
Cluck_Creek	Reach3	22255	186.25	1039.78	1041.48	1042.15	0.022449	6.53	28.54	21.82	1.01
Cluck_Creek	Reach3	21363	280.68	1030.24	1032.12	1032.72	0.006789	6.28	49.9	194.68	0.91
Cluck_Creek	Reach3	20588	303.39	1024.03	1026.8	1026.9	0.000976	2.93	202.45	260.59	0.37
Cluck_Creek	Reach3	20441	336.73	1022.94	1025.71	1025.74	0.0024	1.84	304.74	276.04	0.27
Cluck_Creek	Reach3	20244	423.01	1021.32	1023.12	1023.38	0.033484	4.45	124.68	611.99	0.91
Cluck_Creek	Reach3	19813	515.87	1017.33	1021.04	1021.09	0.002582	3.08	366.36	772.2	0.29
Cluck_Creek	Reach3	19796	Culvert								
Cluck_Creek	Reach3	19631	515.87	1017.01	1017.75	1017.76	0.001991	0.72	552.31	425.78	0.19

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cluck_Creek	Reach3	19438	558.78	1011.6	1014.47	1014.99	0.019768	6.23	131.65	160.45	0.75
Cluck_Creek	Reach3	19287	641.21	1004.37	1008.56	1009.17	0.015205	6.48	111.82	62.45	0.69
Cluck_Creek	Reach3	19027	722.3	1002.83	1005.07	1005.39	0.01335	4.84	178.31	109.31	0.61
Cluck_Creek	Reach3	18802	747.81	998.92	1004.27	1004.41	0.001895	3.03	248.26	73.79	0.28
Cluck_Creek	Reach3	18689	Culvert								
Cluck_Creek	Reach3	18481	747.81	996.21	998.86	999.54	0.018535	6.76	119.64	68.68	0.81
Cluck_Creek	Reach3	18357	825.69	991.84	996.89	997.79	0.010761	7.65	109.9	40.4	0.72
Cluck_Creek	Reach3	18279	Culvert								
Cluck_Creek	Reach3	18220	825.69	991.25	994.55	995.79	0.023161	8.91	92.65	38.64	1
Cluck_Creek	Reach3	18003	874.95	983.2	993.08	993.18	0.00044	2.59	338.45	51.67	0.18
Cluck_Creek	Reach3	17972	Culvert								
Cluck_Creek	Reach3	17942	874.95	983.47	991.59	991.72	0.000693	2.84	308.39	59.19	0.22
Cluck_Creek	Reach3	17796	931.82	982.44	991.42	991.59	0.00093	3.35	314.9	151.81	0.23
Cluck_Creek	Reach3	17773	Culvert								
Cluck_Creek	Reach3	17745	931.82	982.74	990.41	990.61	0.001351	3.6	259.07	48.28	0.27
Cluck_Creek	Reach3	17571	1003.83	981.97	990.14	990.37	0.001404	3.8	268.86	52.52	0.28
Cluck_Creek	Reach3	17557	Culvert								
Cluck_Creek	Reach3	17532	1003.83	981.79	989.1	989.4	0.002229	4.39	228.77	44.7	0.34
Cluck_Creek	Reach3	17305	1053.34	981.48	988.85	989.01	0.000986	3.35	483.09	222.71	0.24
Cluck_Creek	Reach3	17290	Culvert								
Cluck_Creek	Reach3	17268	1053.34	980.07	988.83	988.94	0.000605	2.75	524.84	182.87	0.19
Cluck_Creek	Reach3	17133	1207.16	980.19	987.14	988.36	0.013931	8.87	136.02	62.93	0.72
Cluck_Creek	Reach3	17087	Culvert								
Cluck_Creek	Reach3	17044	1207.16	980.01	985.3	987.73	0.020527	12.52	96.38	43.74	0.98
Cluck_Creek	Reach3	16646	1287.42	976.67	981.36	981.96	0.008352	6.68	292.47	198.64	0.59
Cluck_Creek	Reach3	16416	1369.57	974.86	979.94	980.39	0.005416	5.89	375.53	220.16	0.53
Cluck_Creek	Reach3	16399	Culvert								
Cluck_Creek	Reach3	16327	1369.57	974	979.24	979.95	0.010433	7.85	346.6	283.85	0.72
Cluck_Creek	Reach3	16254	Culvert								
Cluck_Creek	Reach3	16214	1369.57	974.04	978.07	978.8	0.011197	7.42	306.53	292.88	0.74
Cluck_Creek	Reach3	15894	1407.89	969.69	975.93	976.2	0.004093	4.59	457.87	350.91	0.45

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cluck_Creek	Reach3	15655	1482.45	969.48	975.16	975.24	0.003394	3.26	751.62	497.36	0.31
Cluck_Creek	Reach3	15208	1503.83	966.65	971.58	972.6	0.014107	9.01	258.5	148.49	0.84
Cluck_Creek	Reach3	15084	1609.1	964.81	969.87	970.77	0.013616	8.42	283.32	174.67	0.82
Cluck_Creek	Reach3	14498	1609.1	961.2	965.55	965.73	0.00418	4.55	593.58	342.92	0.45
Cluck_Creek	Reach3	13998	1638.93	957.01	962.51	963	0.008728	7.61	511.84	465.77	0.65
Cluck_Creek	Reach3	13948	Culvert								
Cluck_Creek	Reach3	13905	1638.93	955.27	961.1	961.66	0.007616	7.36	487.44	405.02	0.62
Cluck_Creek	Reach3	13862	Culvert								
Cluck_Creek	Reach3	13831	1638.93	953.47	960.09	960.33	0.002706	4.99	619.76	327.82	0.39
Cluck_Creek	Reach3	13662	1660.12	952.23	958.57	959.4	0.007181	7.85	346.09	320.5	0.61
Cluck_Creek	Reach3	13611	Culvert								
Cluck_Creek	Reach3	13588	1660.12	952.56	958.42	959.37	0.009301	8.84	368.21	275.98	0.72
Cluck_Creek	Reach3	13427	1701.09	951.73	956.48	957.26	0.013302	8.48	411.62	309.34	0.8
Cluck_Creek	Reach3	13400	Culvert								
Cluck_Creek	Reach3	13369	1701.09	951.27	955.53	956.15	0.018105	8.61	424.77	296.57	0.9
Cluck_Creek	Reach3	13338	Culvert								
Cluck_Creek	Reach3	13311	1701.09	951.12	955.21	955.6	0.013372	7.27	506.31	422.13	0.78
Cluck_Creek	Reach3	12981	1721.49	947.66	952.15	952.38	0.007645	5.17	600.36	382.94	0.5
Cluck_Creek	Reach3	12763	1753.31	945.79	949.88	950.19	0.013756	6.34	518.9	383.75	0.66
Cluck_Creek	Reach3	12428	1784.35	938.42	942.84	944.11	0.022402	9.02	197.83	78.36	1
Cluck_Creek	Reach3	12360	Culvert								
Cluck_Creek	Reach3	12256	1784.35	938.48	942.32	942.79	0.00483	5.5	324.59	103.48	0.55
Cluck_Creek	Reach3	12107	1817.93	937.14	940.14	941.32	0.018022	8.72	208.4	89.36	1.01
Cluck_Creek	Reach3	12027	Culvert								
Cluck_Creek	Reach3	11937	1817.93	936.24	940.2	940.76	0.005736	6.03	301.56	95.28	0.6
Cluck_Creek	Reach3	11766	1860.96	934.85	939.12	939.75	0.005861	6.36	292.59	86.33	0.61
Cluck_Creek	Reach3	11338	1897.02	931.77	937.36	937.59	0.003692	4.39	648.19	264.48	0.37
Cluck_Creek	Reach3	11308	Culvert								
Cluck_Creek	Reach3	11201	1897.02	930.61	936.29	936.54	0.00441	5.2	621.24	234.04	0.41
Cluck_Creek	Reach3	10987	1936	928.2	933.59	934.64	0.018542	9.58	336.42	164.52	0.82
Cluck_Creek	Reach3	10615	1961.36	924.58	931.77	932.06	0.003017	4.53	566.54	208.82	0.34

Table N-17. Summary Output - South Brushy Model

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Cluck_Creek	Reach3	10574	Culvert								
Cluck_Creek	Reach3	10465	1961.36	922.81	927.56	928.46	0.00728	7.61	260.44	103.53	0.69
Cluck_Creek	Reach3	10060	1981.32	920.11	923.65	924.6	0.01281	7.79	254.26	137.59	0.86
Cluck_Creek	Reach3	9745	2030.26	917.4	921.84	922.27	0.004069	5.44	471.82	259.79	0.51
Cluck_Creek	Reach3	8986	2090.99	910.36	914.97	916.36	0.018754	9.92	270.7	119.67	0.89
Cluck_Creek	Reach3	8069	2128.43	898.9	906.44	906.98	0.003878	6.02	422.29	283.74	0.43
Cluck_Creek	Reach3	7517	2151.33	897.41	901.43	902.65	0.021798	8.88	242.19	161.14	0.92
Cluck_Creek	Reach3	7184	2155.21	895.6	901.3	901.42	0.000707	2.8	888.19	382.72	0.23
Cluck_Creek	Reach3	7128	Inl Struct								
Cluck_Creek	Reach3	7084	2161.52	889.29	900.31	901.39	0.013674	9.1	388.96	225.33	0.6
Cluck_Creek	Reach3	7037	2187.94	888.39	898.97	899.13	0.001555	3.19	686.14	110.19	0.23
Cluck_Creek	Reach3	7013	Culvert								
Cluck_Creek	Reach3	6881	2187.94	887.96	897.93	898.28	0.00183	4.77	458.85	67.65	0.32
Cluck_Creek	Reach3	6659	2217.11	885.48	897.41	897.85	0.001865	5.77	512.59	114.66	0.34
Cluck_Creek	Reach3	6596	Bridge								
Cluck_Creek	Reach3	6493	2217.11	886.78	895.35	895.83	0.002928	5.63	424.18	106.48	0.41
Cluck_Creek	Reach3	6247	2250	882.57	895.2	895.35	0.000718	3.52	979.1	230.07	0.21
Cluck_Creek	Reach3	5789	2250	880.08	895.12	895.16	0.000166	2.37	2254.12	517.89	0.11
Cluck_Creek	Reach3	5764	Bridge								
Cluck_Creek	Reach3	5716.637	2250	879.26	895.12	895.14	0.000027	1.27	3428.85	539.12	0.06
Cluck_Creek	Reach2	5639	3377.69	877.36	895.09	895.13	0.000098	2.09	3060.12	567.25	0.1
Cluck_Creek	Reach2	5590	Bridge								
Cluck_Creek	Reach2	5494	3377.69	875.39	888.21	888.62	0.001312	6.02	835.39	178.77	0.32
Cluck_Creek	Reach2	5484	Bridge								
Cluck_Creek	Reach2	5476	3377.69	875.39	888.08	888.47	0.001393	6.35	901.47	169.05	0.33
Cluck_Creek	Reach2	5392	3401.13	874.28	887.55	888.25	0.00159	7.03	614.66	105.84	0.37
Cluck_Creek	Reach2	5332	Bridge								
Cluck_Creek	Reach2	5163	3401.13	874.3	882.1	884.94	0.012953	13.63	257.86	85.59	0.98
Cluck_Creek	Reach2	5013	3414.81	872.99	882.39	882.99	0.00208	6.31	583.52	93.92	0.41
Cluck_Creek	Reach2	4793	3449.26	869.8	881.67	882.44	0.002627	7.63	566.55	83.68	0.42
Cluck_Creek	Reach2	4640	Bridge								

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cluck_Creek	Reach2	4517	3449.26	869.68	878.02	879.92	0.010289	11.24	351.31	81.97	0.78
Cluck_Creek	Reach2	4243	3493.54	866.66	875.9	877.35	0.007246	10.21	461.77	110.14	0.66
Cluck_Creek	Reach2	3544	3493.54	861.48	871.54	872.57	0.005964	8.9	520.26	106.76	0.55
Cluck_Creek	Reach1	3053.88	3774.97	859.02	868.87	869.75	0.005257	7.78	570.28	116.28	0.52
Cluck_Creek	Reach1	1807.23	3830.88	851.93	860.99	862.14	0.007148	9.26	542.53	105.98	0.6
Cluck_Creek	Reach1	1169.93	3895.65	848.62	858.65	859.21	0.002918	6.25	735.67	118.03	0.39
Cluck_Creek	Reach1	443	3895.65	840.79	855.91	856.86	0.003222	7.94	554.82	83.84	0.41
Cluck_Creek	Reach1	440.5	Bridge								
Cluck_Creek	Reach1	437	3895.65	840.79	852.67	854.64	0.009922	11.28	351.6	50.75	0.68
CluckCreek_Trib2	Reach1	1502.928	219.84	885.25	890.17	890.22	0.000449	1.82	137.05	45.85	0.16
CluckCreek_Trib2	Reach1	1478.495	222.49	885.3	890.17	890.2	0.000361	1.55	151.95	49.74	0.14
CluckCreek_Trib2	Reach1	1448.973	289.95	884.71	889.96	890.14	0.001519	3.6	93.67	29.66	0.29
CluckCreek_Trib2	Reach1	1343.144	Culvert								
CluckCreek_Trib2	Reach1	819.5989	289.95	877.06	880.27	880.63	0.02467	4.9	59.91	28.12	0.53
CluckCreek_Trib2	Reach1	796.1058	292.83	877.19	879.93	880.09	0.01468	3.28	93.01	54.7	0.4
CluckCreek_Trib2	Reach1	771.7151	306.42	876.62	879.78	879.85	0.004807	2.15	143.13	57.42	0.23
CluckCreek_Trib2	Reach1	747.3664	Culvert								
CluckCreek_Trib2	Reach1	722.0476	306.42	876.32	879.7	879.79	0.0048	2.41	131.48	56.64	0.24
CluckCreek_Trib2	Reach1	659.8967	315.28	875.49	878.1	878.83	0.067433	7.05	48.12	29.51	0.85
CluckCreek_Trib2	Reach1	589.6249	323.54	874.69	876.97	877.06	0.009175	2.77	138.2	108.36	0.37
CluckCreek_Trib2	Reach1	525.8963	337.43	873.8	875.88	876.12	0.028942	4.21	86.41	68.43	0.62
CluckCreek_Trib2	Reach1	422.2409	347.9	869.63	874.21	874.48	0.009682	4.2	90.88	48.64	0.41
CluckCreek_Trib2	Reach1	346.9024	373.11	868.56	873.42	873.71	0.01076	4.4	90.97	38.26	0.43
CluckCreek_Trib2	Reach1	174.4295	373.11	866.75	872.07	872.3	0.006386	4.24	115.28	54.17	0.35
CluckCreek_Trib1	Reach1	7143.226	483.16	938.32	941.56	941.76	0.00209	3.55	137.58	60.17	0.4
CluckCreek_Trib1	Reach1	6927.254	505.84	937.32	941.36	941.47	0.000797	2.78	194.96	71.2	0.26
CluckCreek_Trib1	Reach1	6660.156	520.37	934.86	941.23	941.34	0.000362	2.69	195.07	61.07	0.19
CluckCreek_Trib1	Reach1	6612.571	Culvert								
CluckCreek_Trib1	Reach1	6571.168	520.37	933.62	939.72	941.21	0.01641	9.79	53.18	17.78	1
CluckCreek_Trib1	Reach1	6495.334	539.6	933.64	936.38	936.88	0.005828	5.72	97.24	46.86	0.66
CluckCreek_Trib1	Reach1	6284.096	560.65	931.86	934.6	935.33	0.009042	6.92	85.05	42.94	0.81

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
CluckCreek_Trib1	Reach1	6061.361	578.68	930.06	932.7	933.41	0.008203	6.84	87.84	42.41	0.78
CluckCreek_Trib1	Reach1	5877.118	596.76	928.8	931.81	932.22	0.004614	5.11	116.93	50.25	0.58
CluckCreek_Trib1	Reach1	5697.989	621.14	927.64	930.12	930.94	0.011125	7.32	87.24	46.99	0.89
CluckCreek_Trib1	Reach1	5464.914	642.23	925.48	928.48	929.03	0.005854	6.07	111.3	51.34	0.67
CluckCreek_Trib1	Reach1	5270.571	650.01	923.71	926.39	927.32	0.014006	7.79	85.2	47.79	0.99
CluckCreek_Trib1	Reach1	5200.482	683.67	916.88	919.9	919.92	0.000189	1.07	715.73	344.55	0.12
CluckCreek_Trib1	Reach1	4906.614	719.63	915.17	919.89	919.9	0.000024	0.55	1634.6	541.43	0.05
CluckCreek_Trib1	Reach1	4608.189	724.1	914.2	919.89	919.89	0.000009	0.39	2254.36	556.4	0.03
CluckCreek_Trib1	Reach1	4572.147	727.73	914.11	919.89	919.89	0.000008	0.38	2295.69	546.41	0.03
CluckCreek_Trib1	Reach1	4543.048	746.34	913.99	919.78	919.87	0.000332	2.31	323.9	167.88	0.18
CluckCreek_Trib1	Reach1	4506.104	Culvert								
CluckCreek_Trib1	Reach1	4453.05	746.34	913.6	916.22	917.33	0.014113	8.46	88.54	41.19	1
CluckCreek_Trib1	Reach1	4396.056	765.42	912.15	914.2	914.89	0.016185	6.72	118.75	90.98	0.97
CluckCreek_Trib1	Reach1	4249.11	821.63	910.7	912.65	912.98	0.007262	4.63	179.27	120.96	0.66
CluckCreek_Trib1	Reach1	3836.596	884.35	908.21	911.07	911.29	0.002634	3.74	239.12	112.43	0.44
CluckCreek_Trib1	Reach1	3408.414	948.5	906.79	908.9	909.38	0.008386	5.54	173.23	108.55	0.75
CluckCreek_Trib1	Reach1	3000.742	1017.58	903.15	906.07	906.37	0.006398	4.38	232.62	107.37	0.52
CluckCreek_Trib1	Reach1	2591.491	1082.78	899.54	902.2	902.85	0.011597	6.56	172.6	93.32	0.81
CluckCreek_Trib1	Reach1	2230.012	1108.26	896.36	900.73	900.94	0.002728	3.72	305.31	97.22	0.35
CluckCreek_Trib1	Reach1	2094.619	1132.8	895.16	900.51	900.67	0.001377	3.32	356.32	95.02	0.28
CluckCreek_Trib1	Reach1	1967.135	1180.66	894.04	900.41	900.54	0.000766	2.93	423.14	90.85	0.22
CluckCreek_Trib1	Reach1	1726.247	1237.46	893	899.52	900.07	0.007209	5.94	209.82	156.59	0.5
CluckCreek_Trib1	Reach1	1452.736	1273.59	892	897.01	898.06	0.007124	8.24	157.14	49.17	0.77
CluckCreek_Trib1	Reach1	1285.202	1280.84	891.02	896.45	897.06	0.003907	6.34	209.93	64.09	0.58
CluckCreek_Trib1	Reach1	1252.194	1305.7	890.64	896.56	896.83	0.001034	4.23	317.25	65.35	0.32
CluckCreek_Trib1	Reach1	1223.656	Culvert								
CluckCreek_Trib1	Reach1	1194.877	1305.7	890.39	895.85	896.26	0.0018	5.17	257.21	64.46	0.4
CluckCreek_Trib1	Reach1	1140.261	1380.17	889	895.19	895.99	0.004324	7.19	194.38	48.62	0.6
CluckCreek_Trib1	Reach1	817.3983	1459.6	885	895.07	895.3	0.000616	3.86	387.85	63.3	0.25
CluckCreek_Trib1	Reach1	491.7052	1459.6	881.03	895.15	895.17	0.000082	1.24	1366.49	276.59	0.08
Buttercup_Creek	Reach1	4250	223.15	865.29	877.77	877.77	0.000003	0.29	1296.6	266.5	0.02

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Buttercup_Creek	Reach1	3877	225.51	867.21	877.77	877.77	0.000002	0.22	1547.03	375.72	0.01
Buttercup_Creek	Reach1	3850	Inl Struct								
Buttercup_Creek	Reach1	3785	235.66	869.71	877.76	877.76	0.00003	0.51	1001.54	413.04	0.04
Buttercup_Creek	Reach1	3737	326.84	869.43	877.76	877.76	0.000037	0.65	1087.04	437.6	0.05
Buttercup_Creek	Reach1	3668	Culvert								
Buttercup_Creek	Reach1	3555	326.84	863.9	869.7	869.76	0.000807	2	180.38	67.11	0.18
Buttercup_Creek	Reach1	2898	434.6	862.27	869.62	869.63	0.000079	0.99	664.91	240.17	0.07
Buttercup_Creek	Reach1	2167	589.04	861.89	869.61	869.61	0.000012	0.42	1395.27	232.93	0.03
Buttercup_Creek	Reach1	1387	768.13	862.53	869.6	869.6	0.00001	0.27	1891.04	427.07	0.02
Buttercup_Creek	Reach1	1325	Bridge								
Buttercup_Creek	Reach1	1294	768.13	862.2	867.67	867.67	0.000007	0.16	1884.73	306.26	0.01
Buttercup_Creek	Reach1	706	894.25	861.99	867.66	867.67	0.000041	0.7	1338.54	327.79	0.05
Buttercup_Creek	Reach1	316	907.6	858.42	867.59	867.63	0.000138	1.55	608.46	509.35	0.11
Buttercup_Creek	Reach1	278	Inl Struct								
Buttercup_Creek	Reach1	211	931.62	857.99	862.53	863.91	0.017907	9.42	98.9	35.92	1
Buttercup_Creek	Reach1	125	Bridge								
Buttercup_Creek	Reach1	38	931.62	840.59	849.49	849.57	0.00068	2.62	546.04	157.49	0.18
Buttercup_Creek	Reach2	16440	1451.94	937.94	942.68	942.95	0.005002	4.55	441.26	184.17	0.39
Buttercup_Creek	Reach2	15790	1484.77	934.19	939.04	939.32	0.006217	4.4	403.13	194.39	0.42
Buttercup_Creek	Reach2	15317	1531.54	932.03	935.98	936.28	0.006658	4.55	401.73	187.87	0.44
Buttercup_Creek	Reach2	15219	Culvert								
Buttercup_Creek	Reach2	15107	1531.54	930.81	935.76	935.92	0.002278	3.24	523.18	285.43	0.27
Buttercup_Creek	Reach2	14661	1567.66	929.46	934.34	934.5	0.0047	4.41	643.01	286.31	0.38
Buttercup_Creek	Reach2	14168	1640.53	925.94	929.42	930.3	0.018081	7.88	266.71	177.84	0.83
Buttercup_Creek	Reach2	13207	1648.15	921.46	927.02	927.1	0.001134	3.14	1112.81	584.29	0.28
Buttercup_Creek	Reach2	13109	Inl Struct								
Buttercup_Creek	Reach2	12866	2571.7	920.16	927.01	927.08	0.000628	2.82	2251.26	975.68	0.22
Buttercup_Creek	Reach2	12626	2565.6	918.53	926.66	926.83	0.000831	4.02	1066.07	937.68	0.26
Buttercup_Creek	Reach2	12509	Culvert								
Buttercup_Creek	Reach2	12410	2565.6	918.37	924.02	924.22	0.001174	3.82	1080.15	592	0.29
Buttercup_Creek	Reach2	12114	2558.1	918.02	923.13	923.56	0.004261	6.61	801.46	387.07	0.55

Table N-17. Summary Output - South Brushy Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Buttercup_Creek	Reach2	11481	2558.09	910.79	917.05	918.86	0.012668	11.3	288.31	102.95	0.85
Buttercup_Creek	Reach2	11186	2550.51	907.9	914.07	914.53	0.003839	5.42	485.79	365.74	0.46
Buttercup_Creek	Reach2	10877	2524.5	907.32	913.52	913.63	0.001832	3.55	1159.11	308.42	0.29
Buttercup_Creek	Reach2	9810	4701.96	902.95	909.37	909.79	0.006743	7.64	1353.48	590.7	0.57
Buttercup_Creek	Reach2	9017	4747.11	895.13	905.28	905.81	0.00456	7.9	1512.47	576.46	0.49
Buttercup_Creek	Reach2	8643	4793.43	894.28	904.72	904.96	0.001556	5.03	1944.65	529.61	0.3
Buttercup_Creek	Reach2	8263	4911.35	894.8	902.36	903.79	0.006655	11.23	821.82	280.07	0.74
Buttercup_Creek	Reach2	7312	5042.34	888.25	898.57	899.1	0.003578	6.64	1169.54	462.45	0.47
Buttercup_Creek	Reach2	6282	5090.76	888.42	892.57	893.79	0.007804	9.42	842.22	574.64	0.83
Buttercup_Creek	Reach2	5908	5156.89	888.03	891.07	891.27	0.002342	3.66	1464.36	663.19	0.42
Buttercup_Creek	Reach2	5403	5156.89	887.74	890.17	890.28	0.002	2.73	1891.19	1114.47	0.37

Table N-18. Summary Output - Spanish Oak Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
SpanishOak_Trib1	Reach1	2025	545.12	910.06	912.68	913.64	0.042269	7.96	70.97	84.62	0.94
SpanishOak_Trib1	Reach1	1937.22	662.24	908.82	912.49	913.1	0.00174	6.3	109.02	187.52	0.65
SpanishOak_Trib1	Reach1	1916.39	Bridge								
SpanishOak_Trib1	Reach1	1708.08	662.24	907.1	910.44	910.92	0.003796	5.69	125.42	125.86	0.85
SpanishOak_Trib1	Reach1	1567.25	759.67	906.97	910.17	910.2	0.003475	2.2	501.35	363.08	0.24
SpanishOak_Trib1	Reach1	1306.35	902.06	906.72	909.39	909.44	0.004245	2.11	505.78	326.25	0.26
SpanishOak_Trib1	Reach1	979.78	1098.95	904.97	908.28	908.33	0.003097	2.05	661.51	382.24	0.23
SpanishOak_Trib1	Reach1	604.48	1353.7	902.5	904.97	905.26	0.036734	5.31	345.59	372.47	0.73
SpanishOak_Trib1	Reach1	208.19	1353.7	899.64	904.21	904.23	0.001224	1.65	1183.16	602.42	0.15
SpanishOak	Reach1	26519	546.82	995.81	1000.47	1001.11	0.025917	6.45	84.94	72.67	0.89
SpanishOak	Reach1	25965	582.9	989.76	993.33	993.67	0.008254	4.99	169.13	153.6	0.55
SpanishOak	Reach1	25567	624.95	985.78	989.17	989.46	0.013643	6.27	277.14	393.21	0.7
SpanishOak	Reach1	25536	Culvert								
SpanishOak	Reach1	25500	624.95	985.55	988.87	989.15	0.010406	6.18	316.2	430.6	0.63
SpanishOak	Reach1	25133	658.31	979.72	983.83	984.03	0.0081	5.26	300.87	273.31	0.55
SpanishOak	Reach1	24809	681.09	977.31	980.62	980.78	0.012476	6.51	299.95	253.07	0.67
SpanishOak	Reach1	24782	Culvert								
SpanishOak	Reach1	24755	681.09	977.47	980.27	980.36	0.007946	5.06	363.42	297.52	0.55
SpanishOak	Reach1	24597	686.03	974.48	978.11	978.66	0.012483	6.34	175.96	226.15	0.69
SpanishOak	Reach1	24552	Inl Struct								
SpanishOak	Reach1	24476	734.82	966.43	975.58	975.61	0.000078	1.4	526.04	94.97	0.08
SpanishOak	Reach1	24124	741.33	966.15	975.55	975.58	0.000082	1.48	502.73	76.7	0.09
SpanishOak	Reach1	24069	Inl Struct								
SpanishOak	Reach1	24040	767.98	965.97	973.32	973.32	0.000013	0.48	1614.31	229.46	0.03
SpanishOak	Reach1	23849	Inl Struct								
SpanishOak	Reach1	23742	785.43	965.56	972.75	972.8	0.0002	1.78	462.22	65.96	0.12
SpanishOak	Reach1	23709	Inl Struct								
SpanishOak	Reach1	23428	823.78	964.68	972.57	972.59	0.000045	0.95	888.58	146.96	0.06
SpanishOak	Reach1	23412	Inl Struct								
SpanishOak	Reach1	23241	846.7	964.21	971.86	971.87	0.000037	0.82	1305.62	394.75	0.06
SpanishOak	Reach1	23204	Inl Struct								

Table N-18. Summary Output - Spanish Oak Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
SpanishOak	Reach1	23158	1111.26	966.03	971.71	971.86	0.00085	3.15	357.29	1074.38	0.25
SpanishOak	Reach1	23090	Culvert								
SpanishOak	Reach1	23009	1111.26	965.25	968.99	970.31	0.01626	9.51	126.1	675.93	0.99
SpanishOak	Reach1	22415	1259.5	958.26	961.6	961.63	0.000543	1.77	974.06	600.4	0.18
SpanishOak	Reach1	22060	1275.39	954.48	961.57	961.58	0.000051	0.83	3251.3	1224.32	0.06
SpanishOak	Reach1	22021	Bridge								
SpanishOak	Reach1	21975	1275.39	954.12	958.05	959.19	0.016725	8.76	155.52	533.1	0.98
SpanishOak	Reach1	21882	1280.9	948.94	953.41	953.81	0.005321	5.08	253.3	97.95	0.56
SpanishOak	Reach1	21850	Inl Struct								
SpanishOak	Reach1	21815	1347.5	948.39	952.27	952.87	0.008721	6.25	215.47	84.74	0.69
SpanishOak	Reach1	21474	1428.11	944.93	948.32	949.14	0.0134	7.26	196.61	88.59	0.86
SpanishOak	Reach1	21043	1434.67	941.27	944.99	945.41	0.00517	5.2	287.16	111.53	0.57
SpanishOak	Reach1	21009	Inl Struct								
SpanishOak	Reach1	20712	1525.23	937.8	941.66	942.12	0.006271	5.4	284.3	114.53	0.6
SpanishOak	Reach1	20555	Inl Struct								
SpanishOak	Reach1	20504	1696.17	930.07	939.78	939.88	0.000434	2.55	665.83	109.15	0.18
SpanishOak	Reach1	19767	1716.18	930	939.78	939.8	0.000018	0.82	2093.87	1447.91	0.05
SpanishOak	Reach1	19680	Inl Struct								
SpanishOak	Reach1	19642	2015.8	920	929.15	929.33	0.000411	3.37	598.76	188.26	0.2
SpanishOak	Reach1	19595	Culvert								
SpanishOak	Reach1	19370	2015.8	920	929.18	929.19	0.000028	0.98	2046.58	588	0.06
SpanishOak	Reach1	18988	2015.8	920	929.15	929.17	0.000058	1.27	1586.95	374.48	0.08
SpanishOak	Reach1	18861	Inl Struct								
SpanishOak	Reach1	18815	2124.73	920.02	926.11	926.5	0.001918	5.01	424.51	94.48	0.42
SpanishOak	Reach1	18492	2229	919.6	925.37	925.73	0.002887	4.78	466.73	144.48	0.4
SpanishOak	Reach1	18198	2244.95	917	925	925.18	0.001001	3.41	658.06	594.1	0.24
SpanishOak	Reach1	17962	Culvert								
SpanishOak	Reach1	17602	2244.95	912.35	916.9	917.43	0.013837	6.62	426.26	323.28	0.67
SpanishOak	Reach1	17464	Bridge								
SpanishOak	Reach1	17344	2244.95	910.08	914.86	915.2	0.006232	6.93	572.26	488.2	0.58
SpanishOak	Reach1	17222	2276.09	908.7	914.26	914.56	0.004037	4.88	570.86	202.83	0.46

Table N-18. Summary Output - Spanish Oak Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
SpanishOak	Reach1	17113	Bridge								
SpanishOak	Reach1	16988	2276.09	908.7	912.7	913.11	0.006812	5.45	534.62	312.21	0.57
SpanishOak	Reach1	16488	2293.2	902.75	905.75	906.77	0.028545	8.11	283.29	145.06	1
SpanishOak	Reach1	16089	2293.2	898.41	904.77	904.85	0.001514	3.24	1588.17	739.48	0.26
SpanishOak	Reach2	15397	3573.38	892.79	901.06	901.84	0.013171	8.73	813.78	505.12	0.69
SpanishOak	Reach2	14645	3649.03	891.29	897.22	897.4	0.002563	4.12	1200.04	463.06	0.32
SpanishOak	Reach2	14102	3739.67	884.57	894.37	895.1	0.008339	8.49	790.18	249.99	0.56
SpanishOak	Reach2	13466	3801.05	882.27	889.49	889.9	0.008485	7.13	1026.57	406.11	0.56
SpanishOak	Reach2	13044	3844.71	876.85	886.43	886.73	0.007394	6.15	1184.54	546.65	0.5
SpanishOak	Reach2	12748	3925.5	872.63	885.18	885.54	0.002623	5.76	1232.48	394.26	0.33
SpanishOak	Reach2	12714	Culvert								
SpanishOak	Reach2	12657	3925.5	871.61	882.2	882.8	0.004784	6.53	768.72	232.29	0.44
SpanishOak	Reach2	12209	4040.02	867.9	879.8	880.23	0.006517	6.43	1075.22	426.39	0.49
SpanishOak	Reach2	11722	4087.65	865.17	874.96	876.21	0.010388	9.26	588.25	307.47	0.64
SpanishOak	Reach2	10947	4145.11	859.99	870.93	871.29	0.00402	5.91	1200.09	419.42	0.41
SpanishOak	Reach2	10024	4200.27	854.24	861.93	863.9	0.021269	11.3	381.31	172.87	0.95
SpanishOak	Reach2	9150	4237.02	843.47	854.67	855.61	0.005072	7.81	542.8	71.43	0.5
SpanishOak	Reach2	8574	4266.54	840.6	853.25	853.59	0.002246	4.81	1051.2	288.5	0.33
SpanishOak	Reach2	8115	4282.57	840.68	849.35	851.26	0.01639	11.25	416.28	110.96	0.86
SpanishOak	Reach2	7867	4296.13	837.88	849.42	849.73	0.001186	4.5	977.05	195.83	0.31
SpanishOak	Reach2	7768	Bridge								
SpanishOak	Reach2	7658	4313.25	837.8	848.09	848.66	0.002904	6.27	762.57	407.74	0.47
SpanishOak	Reach2	7395	4313.25	838.26	845.53	847.1	0.009631	11.05	607.5	610.38	0.84
SpanishOak	Reach4	4972	313.18	811.52	815.53	815.62	0.001702	2.38	132.78	51.01	0.25
SpanishOak	Reach4	3773	335.6	808.24	809.69	810.26	0.022134	6.08	55.88	51.88	1
SpanishOak	Reach4	3154	378.96	801.39	805.89	806.04	0.001947	3.11	126.47	48.33	0.31
SpanishOak	Reach4	2975	Culvert								
SpanishOak	Reach4	2646	378.96	801.07	805.84	805.88	0.00055	1.63	234.4	78.77	0.16
SpanishOak	Reach4	2066	395.91	800.98	805.69	805.7	0.000167	0.87	524.84	199.03	0.09
SpanishOak	Reach4	1674	431.52	793.19	805.69	805.69	0.000008	0.37	1215.69	157.49	0.02
SpanishOak	Reach4	1647	Bridge								

Table N-18. Summary Output - Spanish Oak Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
SpanishOak	Reach4	1591	431.52	792.35	796.96	797.22	0.004465	4.13	110.7	50.86	0.41
SpanishOak	Reach4	903	431.52	789.48	793.6	793.84	0.005401	3.91	110.44	44.04	0.43
SpanishOak	Reach3	7160.93	5666.49	832.39	841.71	843.37	0.011132	10.33	555.34	121.95	0.79
SpanishOak	Reach3	7002.3	5676.01	831.44	840.85	842.05	0.005503	9.11	678.12	118.26	0.59
SpanishOak	Reach3	6814.9	5701.63	830.32	837.64	839.85	0.037511	12.11	488.23	116.11	0.94
SpanishOak	Reach3	6312	5701.63	827.3	831.6	832.14	0.006006	5.99	1018.29	367.01	0.56
PostOak_Creek	Reach1	14959.32	321.28	929.91	931.91	932.13	0.01685	3.79	90.76	73.41	0.52
PostOak_Creek	Reach1	14691.22	336.41	926.72	928.14	928.23	0.012535	2.74	147.06	176.64	0.43
PostOak_Creek	Reach1	14423.26	346.97	924.39	926.35	926.39	0.004355	1.98	247.01	366.31	0.27
PostOak_Creek	Reach1	14243.42	369.1	923.55	924.6	924.9	0.020197	5.39	96.62	239.62	1.01
PostOak_Creek	Reach1	13883.53	369.1	919.99	922.39	922.4	0.000491	1.45	409.41	471.38	0.18
PostOak_Creek	Reach1	13875.45	Culvert								
PostOak_Creek	Reach1	13794.62	385.74	918.34	920.93	921.08	0.004227	3.7	189.31	388.19	0.52
PostOak_Creek	Reach1	13528.27	395.27	916.19	918.73	919.03	0.020987	5.11	99.99	573.05	0.69
PostOak_Creek	Reach1	13380.88	409.54	915.11	916.38	916.56	0.045441	5.52	125.89	313.66	0.94
PostOak_Creek	Reach1	13166.63	435.72	913.44	915.32	915.33	0.000467	0.57	604.58	569.16	0.1
PostOak_Creek	Reach1	13157.91	Culvert								
PostOak_Creek	Reach1	13070.67	435.72	912.63	913.9	914.06	0.00603	2.89	138.4	512.71	0.56
PostOak_Creek	Reach1	12792.43	454.58	908.36	911.46	911.72	0.013569	5.3	143.69	284.91	0.72
PostOak_Creek	Reach1	12536.52	466.05	904.43	907.98	908.44	0.011768	5.76	109.34	239.89	0.7
PostOak_Creek	Reach1	12385.96	482.32	902.12	905.63	905.89	0.012538	5.52	154.75	249.66	0.7
PostOak_Creek	Reach1	12178.71	491.56	898.93	903.4	903.47	0.011015	2.99	253.54	220.23	0.31
PostOak_Creek	Reach1	12167.32	Bridge								
PostOak_Creek	Reach1	12146.51	491.56	898.51	902.46	902.8	0.031221	5.89	145.17	167.21	0.6
PostOak_Creek	Reach1	12064.07	500.58	897.86	901.19	901.29	0.009289	3.01	201.53	189.89	0.33
PostOak_Creek	Reach1	11954.24	508.08	896.98	899.98	900.09	0.013691	3.65	213.52	219.21	0.4
PostOak_Creek	Reach1	11937.74	Culvert								
PostOak_Creek	Reach1	11919.31	508.08	896.71	899.87	899.92	0.007758	2.87	314.73	284.07	0.3
PostOak_Creek	Reach1	11864.39	513.08	895.91	899.2	899.28	0.009098	3.14	235.89	166.94	0.33
PostOak_Creek	Reach1	11805.27	528.07	895.03	897.88	898.2	0.037382	5.86	124.3	118.66	0.65
PostOak_Creek	Reach1	11799.52	Culvert								

Table N-18. Summary Output - Spanish Oak Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
PostOak_Creek	Reach1	11784.01	528.07	894.5	897.97	898.13	0.014191	3.76	190.55	141.9	0.41
PostOak_Creek	Reach1	11631.38	540.38	892.43	896.53	896.63	0.008574	3.7	240.87	152.73	0.33
PostOak_Creek	Reach1	11492.2	552.36	889.15	894.13	894.46	0.033339	5.15	138.59	104.16	0.52
PostOak_Creek	Reach1	11359.8	564.58	888.12	892.18	892.29	0.009295	3.07	237.99	154.49	0.33
PostOak_Creek	Reach1	11227.55	580.84	886.41	890.39	890.64	0.017795	4.45	168.54	116.85	0.46
PostOak_Creek	Reach1	11056.07	594.51	883.86	887.91	888.06	0.015127	3.89	210.31	141.58	0.42
PostOak_Creek	Reach1	10915.61	611.67	881.79	886.43	886.59	0.00852	3.73	210.48	89.74	0.33
PostOak_Creek	Reach1	10743.72	635.92	879.2	884.19	884.54	0.01776	5.07	156.2	95.06	0.47
PostOak_Creek	Reach1	10508.86	662.03	876.5	881.97	882.12	0.007589	3.67	252.99	128.59	0.31
PostOak_Creek	Reach1	10265.82	674.82	874.72	879.92	880.07	0.009558	3.79	264.6	177.59	0.35
PostOak_Creek	Reach1	10150.29	695.43	874.18	877.79	878.06	0.036963	4.99	196.93	236.67	0.62
PostOak_Creek	Reach1	9968.56	735.05	873.46	877.8	877.81	0.000285	0.62	1099.66	413.26	0.06
PostOak_Creek	Reach1	9961.1	Culvert								
PostOak_Creek	Reach1	9886.47	735.05	866.47	872.45	872.71	0.005246	4.12	180.97	44.33	0.33
PostOak_Creek	Reach1	9633.94	766.63	863.83	871.15	871.38	0.005186	3.8	201.53	47.84	0.33
PostOak_Creek	Reach1	9379.83	798.2	862.08	867.72	868.69	0.022515	8.4	110.04	35.42	0.69
PostOak_Creek	Reach1	9136.13	820.8	861.24	866.86	866.96	0.002776	2.7	408.85	305.55	0.24
PostOak_Creek	Reach1	8967.47	818.38	860.23	864.95	865.63	0.032135	7.2	144.27	195.63	0.77
PostOak_Creek	Reach1	8963.6	Culvert								
PostOak_Creek	Reach1	8924.88	818.38	856.47	863.8	864.06	0.003799	4.21	222.47	107.94	0.3
PostOak_Creek	Reach1	8831.21	814.27	855.79	863.02	863.44	0.011194	5.22	159.87	89.3	0.47
PostOak_Creek	Reach1	8671.54	808.67	854.64	860.02	860.94	0.020371	7.86	112.24	61.25	0.65
PostOak_Creek	Reach1	8452.65	801.91	853.06	857.37	857.72	0.010094	4.74	173.63	60.3	0.46
PostOak_Creek	Reach1	8186.25	795.82	847.26	855.06	855.38	0.00771	4.52	175.94	43.31	0.4
PostOak_Creek	Reach1	7944.29	792.28	845.7	853	853.31	0.009463	4.48	181.34	44.17	0.35
PostOak_Creek	Reach1	7802.84	787.17	844.89	851.77	852.04	0.008388	4.14	195.02	50.35	0.34
PostOak_Creek	Reach1	7597.29	778.09	843.53	850.15	850.37	0.007793	3.75	207.28	47.06	0.32
PostOak_Creek	Reach1	7229.14	772.1	839.85	847.2	847.58	0.007415	4.99	163.35	34.37	0.36
PostOak_Creek	Reach1	6984.1	772.1	838.88	845.45	845.74	0.007411	4.34	180.96	44.43	0.35
Cottonwood_Creek	Reach1	8738.39	409.27	929.26	932.42	932.68	0.005491	4.08	106.98	98.63	0.49
Cottonwood_Creek	Reach1	8654.58	442.55	929.38	931.73	932.06	0.009833	4.84	111.54	128.02	0.63

Table N-18. Summary Output - Spanish Oak Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cottonwood_Creek	Reach1	8546.55	480.63	928.81	930.98	931.14	0.006672	3.99	188	261.16	0.52
Cottonwood_Creek	Reach1	8432.47	527.12	928.16	929.99	930.17	0.010704	4.44	197.71	270	0.64
Cottonwood_Creek	Reach1	8304.89	574.33	927.81	929.13	929.23	0.006458	2.8	227.49	271.72	0.47
Cottonwood_Creek	Reach1	8186.37	620.12	926.76	928.57	928.68	0.004256	3.02	252.41	325.86	0.41
Cottonwood_Creek	Reach1	8080.35	771.7	925.81	927.4	927.78	0.020464	6.08	170.43	235.09	0.89
Cottonwood_Creek	Reach1	7778.17	785.79	921.05	923.22	923.4	0.005399	3.95	234.11	147.55	0.48
Cottonwood_Creek	Reach1	7771.08	Bridge								
Cottonwood_Creek	Reach1	7700.17	785.79	919.04	921.7	921.86	0.003214	3.23	250.29	122.66	0.38
Cottonwood_Creek	Reach1	7595.6	802.81	918.48	921.35	921.54	0.00327	3.49	235.92	520.34	0.39
Cottonwood_Creek	Reach1	7471.76	848.77	918.41	920.97	921.14	0.003667	3.62	261.28	127.74	0.41
Cottonwood_Creek	Reach1	7462.11	Bridge								
Cottonwood_Creek	Reach1	7365.55	848.77	917.87	920.25	920.49	0.00521	3.93	219.91	111.42	0.48
Cottonwood_Creek	Reach1	7150.09	884.22	916.11	918.64	919.02	0.008555	5.23	181.2	91.09	0.62
Cottonwood_Creek	Reach1	6913.61	932.43	913.91	916.73	917.09	0.007833	5.28	196.18	95.77	0.6
Cottonwood_Creek	Reach1	6606.86	987.38	911.15	914.32	914.7	0.007775	5.49	201.57	94.22	0.6
Cottonwood_Creek	Reach1	6275.97	1040.3	908.17	911.19	911.69	0.010484	6.44	189.11	94.58	0.7
Cottonwood_Creek	Reach1	5974.23	1097.27	905.46	909.01	909.36	0.006187	5.22	234.18	97.88	0.54
Cottonwood_Creek	Reach1	5666.15	1123.11	902.46	905.45	906.22	0.019367	8.69	163.66	90.94	0.94
Cottonwood_Creek	Reach1	5531.65	1182.04	900.43	902.51	903.17	0.023795	6.71	187.56	147.31	0.96
Cottonwood_Creek	Reach1	5236.14	1218.76	896.03	902.1	902.1	0.000026	0.55	2364.4	451.79	0.04
Cottonwood_Creek	Reach1	5059.34	1255.9	895.69	902.09	902.1	0.00003	0.6	2243.86	430.36	0.04
Cottonwood_Creek	Reach1	4885.91	1183.8	894.86	902.09	902.09	0.000034	0.68	2040.22	411	0.05
Cottonwood_Creek	Reach1	4608.51	1197.36	892.16	902.06	902.08	0.0001	1.37	1684.31	727.34	0.08
Cottonwood_Creek	Reach1	4601.19	Culvert								
Cottonwood_Creek	Reach1	4527.98	1197.36	891.32	899.36	899.83	0.008064	5.64	254.29	187	0.44
Cottonwood_Creek	Reach1	4338.69	1210.32	888.97	896.69	897.67	0.014695	8.55	167.15	211.26	0.6
Cottonwood_Creek	Reach1	4083.79	1226.57	885.81	890.77	892.08	0.03603	9.73	145.61	56.96	0.88
Cottonwood_Creek	Reach1	3767.96	1237.09	880.93	885.76	885.81	0.000426	1.02	704.39	167.79	0.09
Cottonwood_Creek	Reach1	3565.85	1249.03	879.39	884.7	885.51	0.01019	7.41	198.47	331.44	0.62
Cottonwood_Creek	Reach1	3338.22	1266.34	876.57	881.44	882.75	0.013776	10.11	153.34	78.3	0.86
Cottonwood_Creek	Reach1	3012.35	1274.61	872.52	876.82	877.13	0.003392	4.79	294.74	100.41	0.43

Table N-18. Summary Output - Spanish Oak Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Cottonwood_Creek	Reach1	2858.22	1288.19	869.68	874.61	876.05	0.020035	9.62	133.87	43.68	0.97
Cottonwood_Creek	Reach1	2607.36	1298.14	864.7	870.27	871.45	0.016208	8.87	157	74.94	0.88
Cottonwood_Creek	Reach1	2425.07	1317.9	861.7	868.67	869.11	0.002828	5.33	248.5	59.93	0.4
Cottonwood_Creek	Reach1	2417.53	Culvert								
Cottonwood_Creek	Reach1	2342.16	1317.9	861	867.03	867.76	0.004637	7.04	200.48	40.59	0.53
Cottonwood_Creek	Reach1	2067.36	1333.1	859.02	864.06	865.41	0.016207	9.47	146.64	50.2	0.9
Cottonwood_Creek	Reach1	1795.82	1348.44	852.75	858.93	860.72	0.017463	10.75	126.26	32.56	0.93
Cottonwood_Creek	Reach1	1524.86	1369.91	847.8	854.6	856.36	0.01482	10.87	138.11	45.46	0.87
Cottonwood_Creek	Reach1	1150.94	1390.24	843.15	848.49	849.51	0.009163	8.11	173.53	44.05	0.69
Cottonwood_Creek	Reach1	802.04	1410	839.68	845.88	846.67	0.006934	7.18	199.62	51.57	0.61
Cottonwood_Creek	Reach1	467.95	1410	840.18	845.9	845.95	0.00066	2.11	848.95	349.04	0.19

Table N-19. Summary Output - Zimmerman Creek Model

River	Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #
Zimmerman Creek	Reach1	14210.36	674.24	582.09	585.24	585.34	0.002732	3.74	294.46	262.47	0.4
Zimmerman Creek	Reach1	13606.86	713.98	579.31	580.56	580.76	0.018039	4.63	202.54	351.71	0.86
Zimmerman Creek	Reach1	13074.09	741.48	576.46	578.61	578.64	0.00159	2.1	566.02	753.03	0.28
Zimmerman Creek	Reach1	12722.43	807.96	575.5	577.12	577.34	0.016915	5.23	244.7	569.76	0.87
Zimmerman Creek	Reach1	11923.58	850.23	573.31	575.83	575.85	0.000637	1.61	830.43	758.92	0.19
Zimmerman Creek	Reach1	11449.07	927.47	572.02	575.63	575.64	0.000321	1.46	929.79	521.37	0.14
Zimmerman Creek	Reach1	10639.97	957.29	570.5	575.5	575.51	0.000112	1.01	1301.3	514.87	0.09
Zimmerman Creek	Reach1	10345.61	980.63	570.28	575.33	575.43	0.00126	2.9	575.57	903.81	0.28
Zimmerman Creek	Reach1	10321.51	Culvert								
Zimmerman Creek	Reach1	10293.25	980.63	570.25	574.16	574.89	0.007057	6.84	143.37	859.29	0.67
Zimmerman Creek	Reach1	10121.45	1052.8	568.94	574.11	574.22	0.001056	3.26	439.74	396.01	0.3
Zimmerman Creek	Reach1	9460.7	2067.3	568.01	572.79	573.05	0.002097	4.77	567.69	633.96	0.43
Zimmerman Creek	Reach1	8512.455	2132.39	565.47	570.96	571.13	0.002244	5.04	839.74	722.93	0.44
Zimmerman Creek	Reach1	7778.792	2202.78	563.5	567.12	567.65	0.011612	8.43	415.53	359.17	0.93
Zimmerman Creek	Reach1	7010.092	2343.16	561.45	565.28	565.32	0.000685	2.28	1531.54	987.18	0.23
Zimmerman Creek	Reach1	5547.992	2371.55	557.53	564.05	564.15	0.002438	4.01	1053.76	632.33	0.3
Zimmerman Creek	Reach1	5263.017	2415.55	556.77	563.55	563.61	0.001247	2.91	1289.5	488.7	0.22
Zimmerman Creek	Reach1	4827.958	2455.43	555.65	562.86	562.99	0.001692	3.59	897.34	238.23	0.26
Zimmerman Creek	Reach1	4440.434	2494.63	554.71	562.68	562.74	0.000502	3.29	1515.27	477.4	0.22
Zimmerman Creek	Reach1	4065.564	2524.75	553.81	562.39	562.52	0.001283	3.72	1022.81	340.67	0.23
Zimmerman Creek	Reach1	3781.55	2550.52	553.12	562.21	562.27	0.00064	2.75	1448.57	381.09	0.17
Zimmerman Creek	Reach1	3541.204	2611.15	552.25	562.09	562.13	0.000968	2.13	1692.88	359.88	0.13
Zimmerman Creek	Reach1	2985.176	2640.83	551.41	561.76	561.82	0.00144	2.79	1424.95	324.17	0.16
Zimmerman Creek	Reach1	2717.66	2677.49	550.93	561.46	561.53	0.001604	3.01	1396.33	339.07	0.18
Zimmerman Creek	Reach1	2391.44	2691.87	550.36	560.99	561.05	0.001782	3.03	1504.44	426.17	0.18
Zimmerman Creek	Reach1	2264.629	2793.24	550.07	560.83	560.86	0.00073	2.1	2254.55	565.67	0.12
Zimmerman Creek	Reach1	2229.406	Culvert								
Zimmerman Creek	Reach1	2181.87	2793.24	549.77	560.89	560.97	0.000228	2.91	1850.54	542.45	0.16
Zimmerman Creek	Reach1	1389.754	2813.99	544.96	560.7	560.82	0.000263	3.07	1483.62	630.83	0.17
Zimmerman Creek	Reach1	1214.674	2865.1	543.72	560.61	560.71	0.001426	2.86	1208.98	472.62	0.17
Zimmerman Creek	Reach1	788.683	2865.1	542.2	559.52	559.83	0.003606	4.66	765.41	233.71	0.24

Exhibit O
Figures with Estimated 1% AEP Flood Extents

Exhibit O
List of Figures

Figure Number	System ID
1	Blockhouse Creek
2	Brushy Creek
3	Brushy Creek Tributary 5
4	Brushy Creek Tributary 6
5	Brushy Creek Tributary 7
6	Brushy Creek Tributary 8
7	Brushy Creek Tributary 9
8	Chandler Branch
9	Cottonwood
10	Dam 18
11	Dam 22
12	Dry Branch
13	Dry Fork
14	Lake Creek
15	McNutt Creek
16	Onion Branch
17	South Brushy Creek
18	Spanish Oak
19	Zimmerman Creek

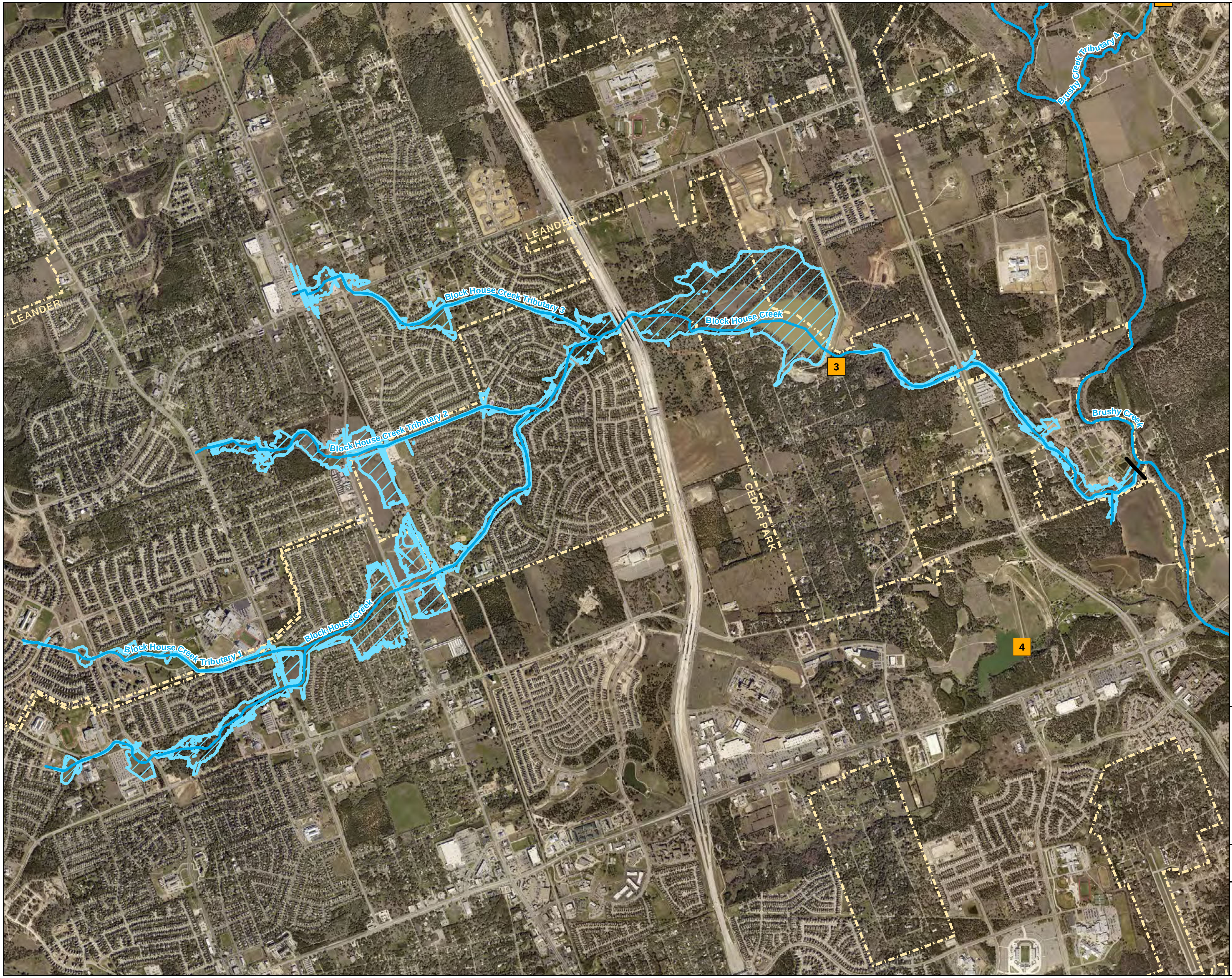


Figure O-1

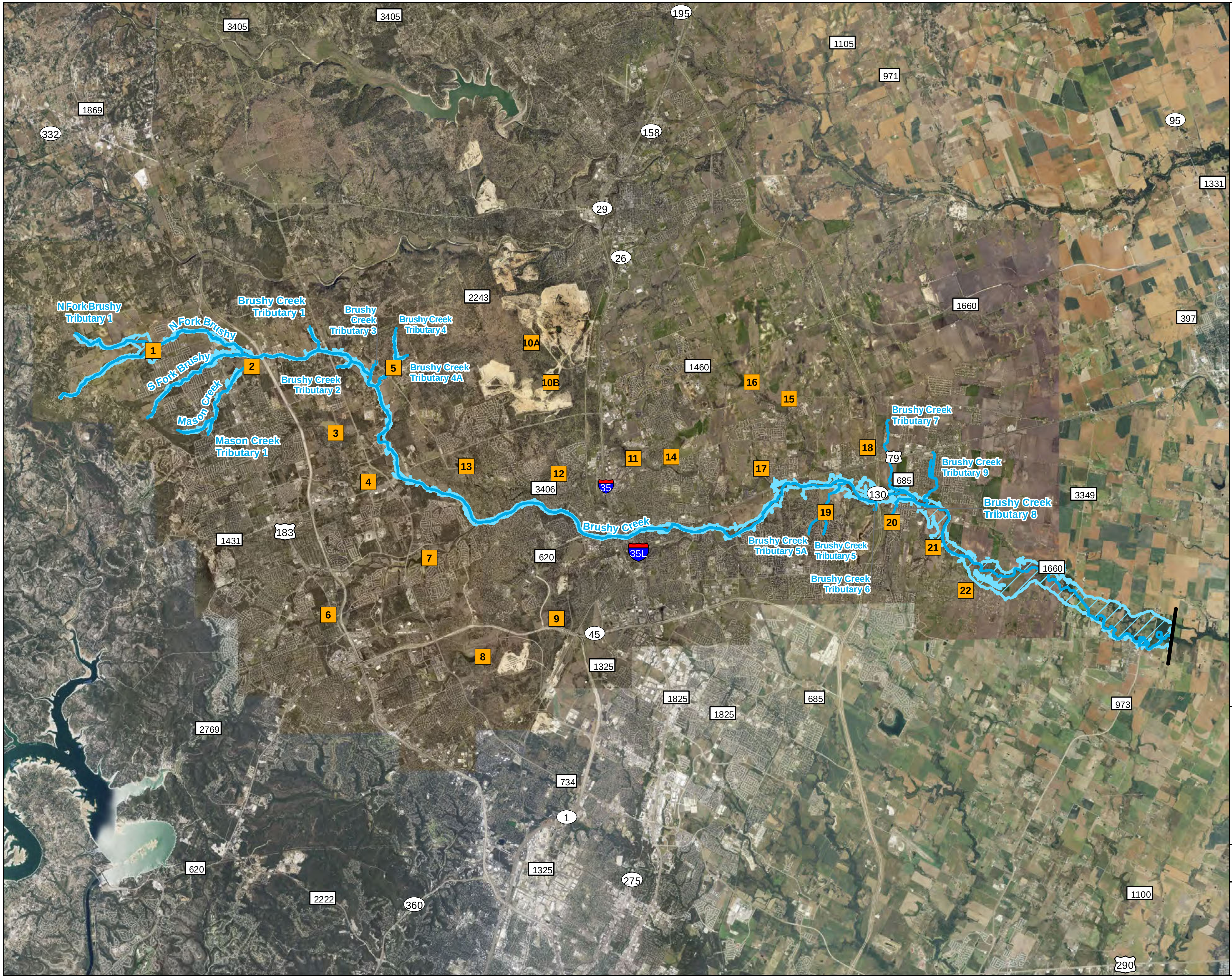
Upper Brushy Creek WCID

System ID: Blockhouse Creek

4/16/2013

Texas Water Development Board

URS



NRCS Dam

Streamline

Limit of Study

City Boundary

DRAFT 100-Year Floodplain Extent

N

0 1 2

Miles

Figure O-2

Upper Brushy Creek WCID

System ID: Brushy Creek

4/16/2013

Upper Brushy Creek W.C.I.D.

Texas Water Development Board

URS

NRCS Dam
Streamline
Limit of Study
City Boundary
DRAFT 100-Year Floodplain Extent

N

0 0.065 0.13
Miles

Figure O-3

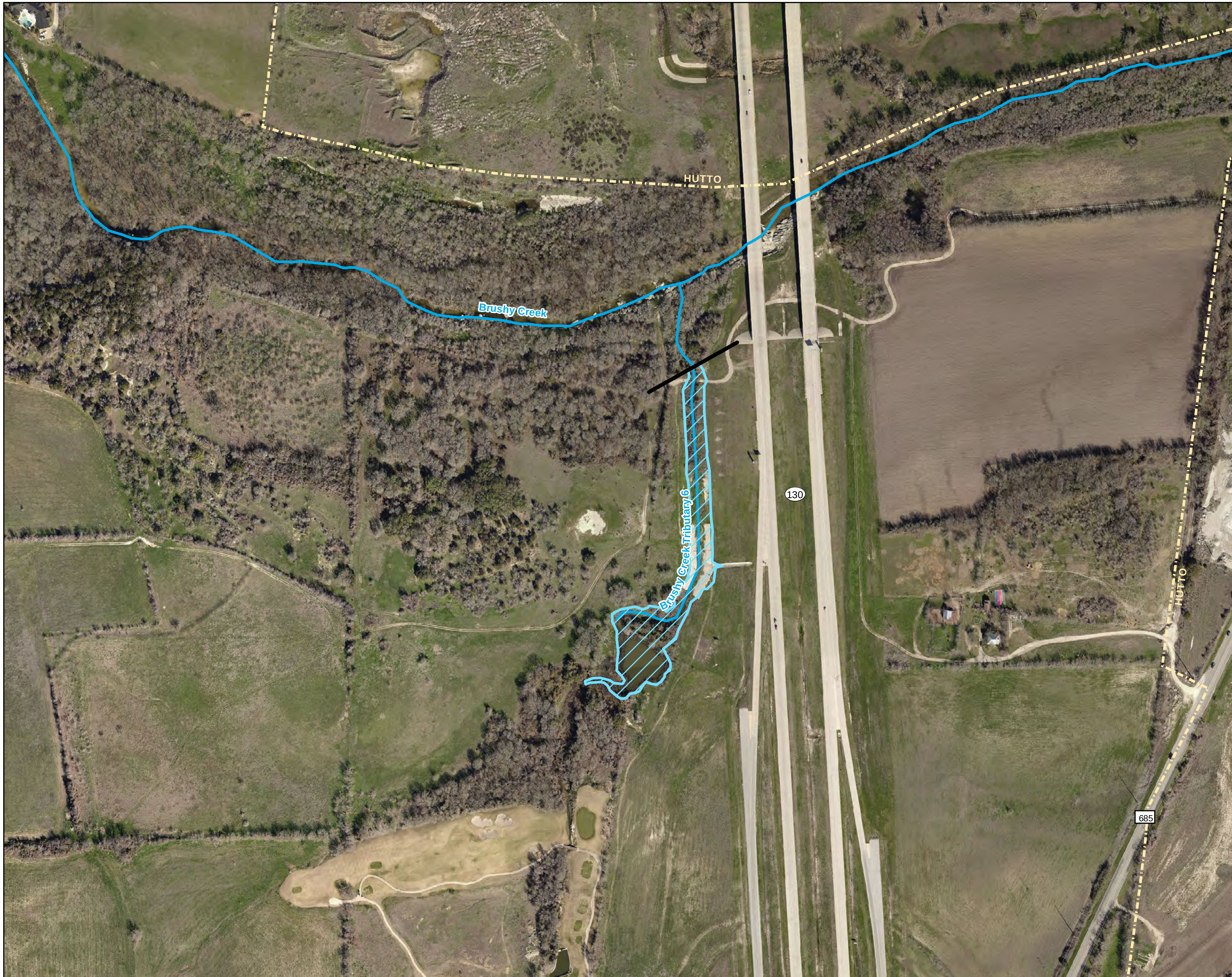
Upper Brushy Creek WCID

System ID: Brushy Creek Tributary 5

4/16/2013

Texas Water Development Board

URS



Streamline
Limit of Study
City Boundary
DRAFT 100-Year Floodplain Extent

N
0 0.03 0.06
Miles

Figure O-4

Upper Brushy Creek WCID

System ID: Brushy Creek Tributary 6

4/16/2013

Upper Brushy Creek W.C.I.D.

Texas Water Development Board

URS

Figure O-5

Upper Brushy Creek WCID

System ID: Brushy Creek Tributary 7

4/16/2013

Texas Water Development Board

URS

Figure O-6

Upper Brushy Creek WCID

System ID: Brushy Creek Tributary 8

4/16/2013

Upper Brushy Creek W.C.I.D.

Texas Water Development Board

URS

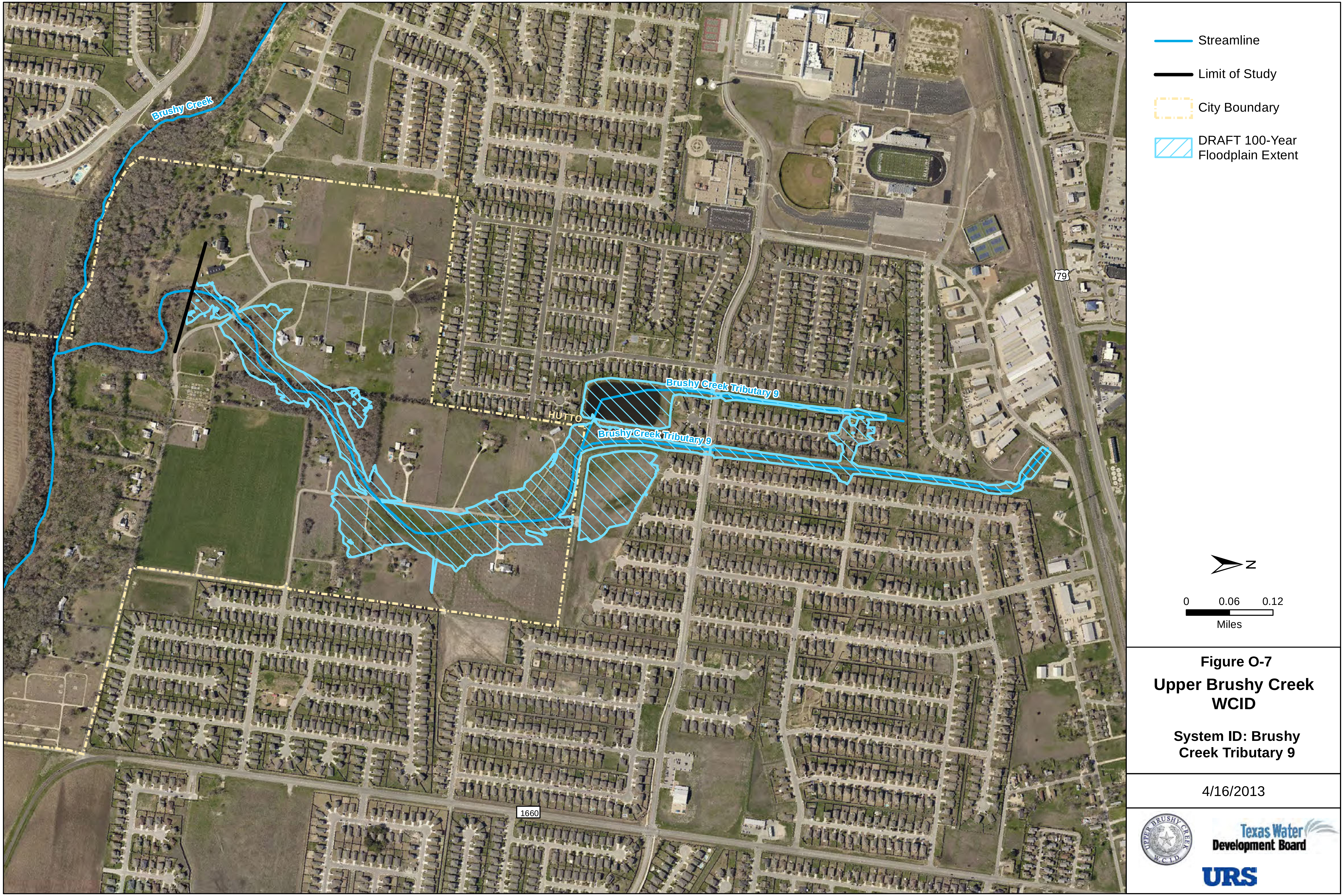


Figure O-7

Upper Brushy Creek WCID

System ID: Brushy Creek Tributary 9

4/16/2013

Texas Water Development Board

URS

- NRCS Dam
- Streamline
- Limit of Study
- City Boundary
- DRAFT 100-Year Floodplain Extent

N

0 0.4 0.8
Miles

Figure O-8

Upper Brushy Creek WCID

System ID: Chandler Branch

4/16/2013

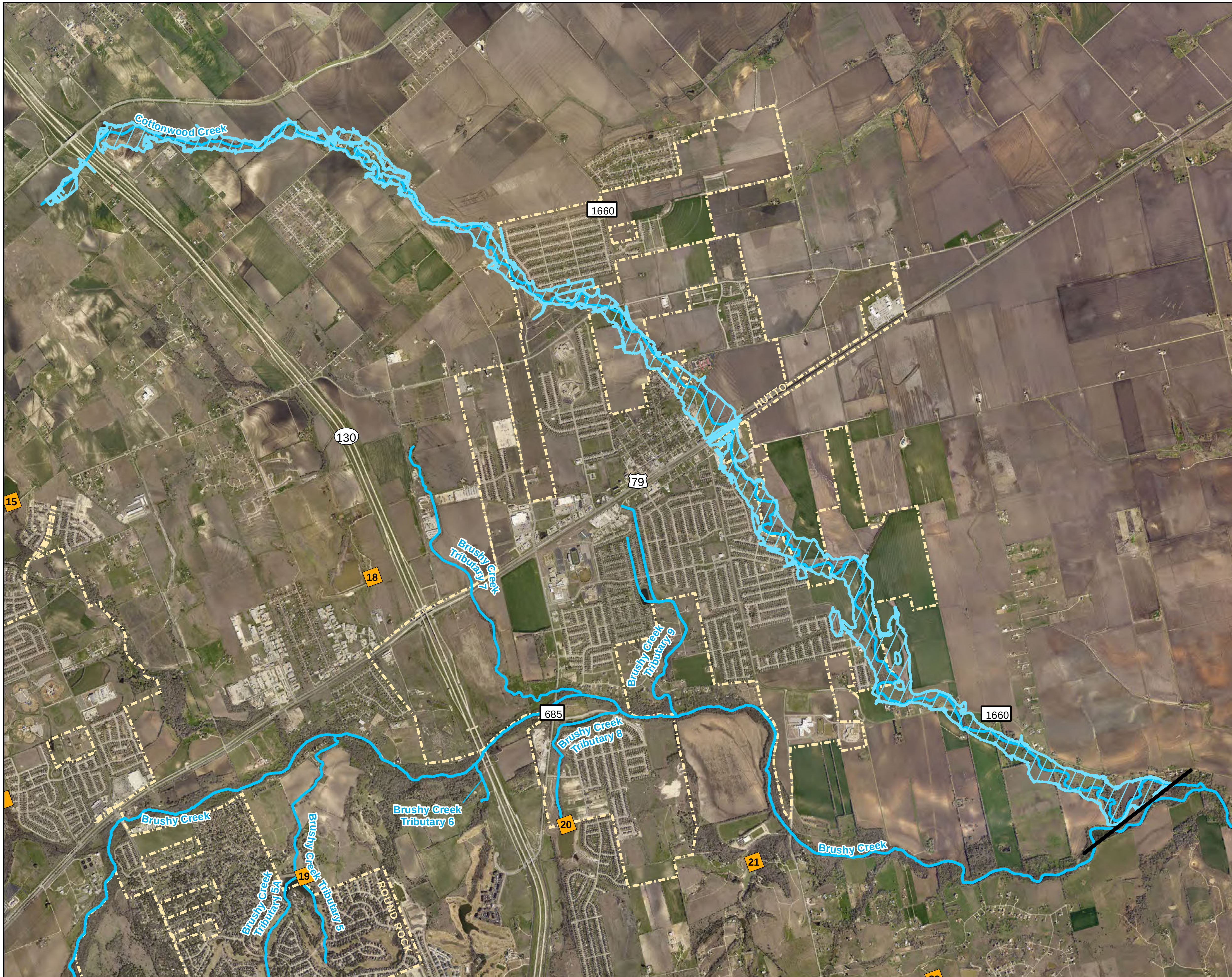


Figure O-9

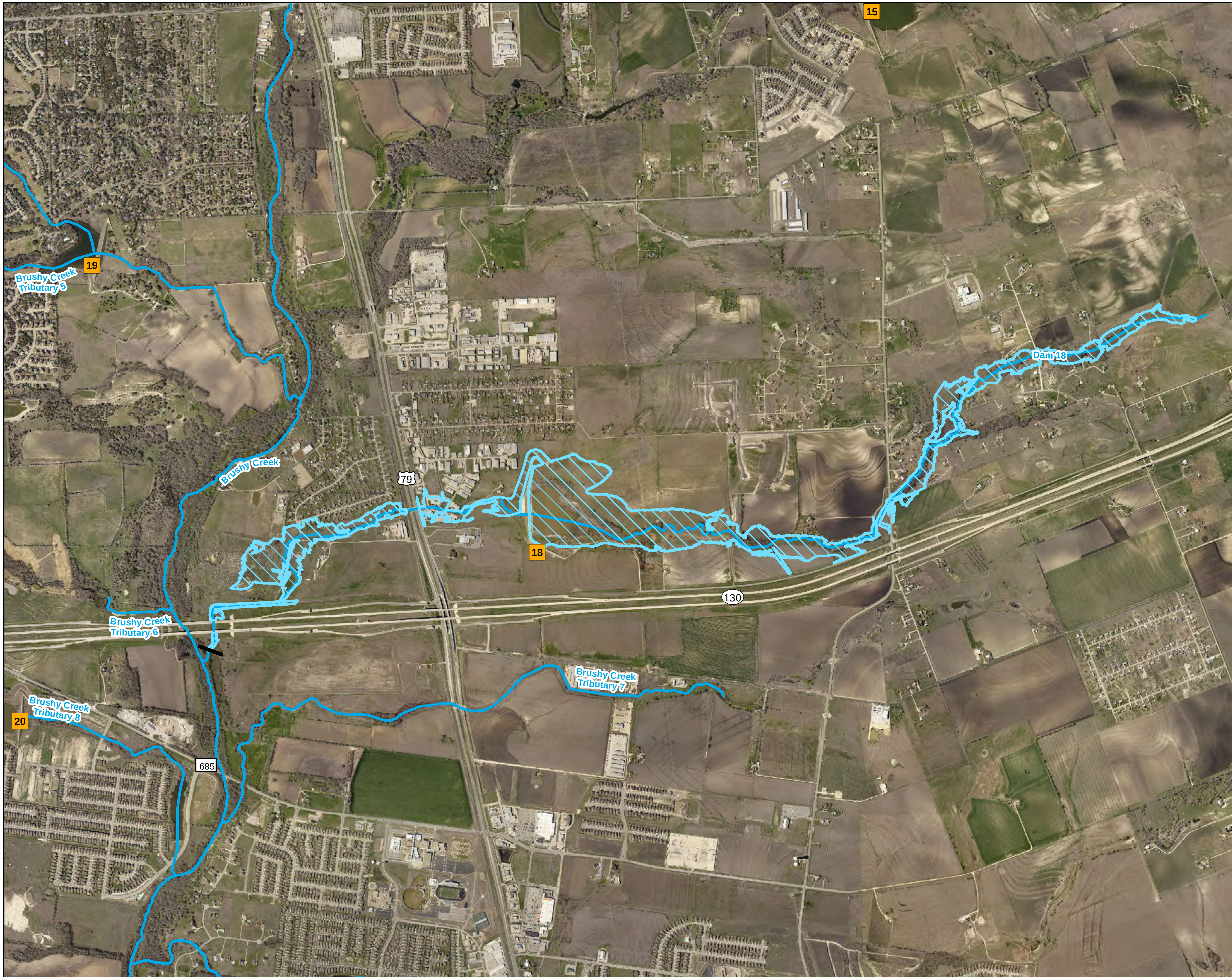
Upper Brushy Creek WCID

System ID: Cottonwood

4/16/2013

Texas Water Development Board

URS



NRCS Dam

Streamline

Limit of Study

City Boundary

DRAFT 100-Year Floodplain Extent

N

0 0.2 0.4

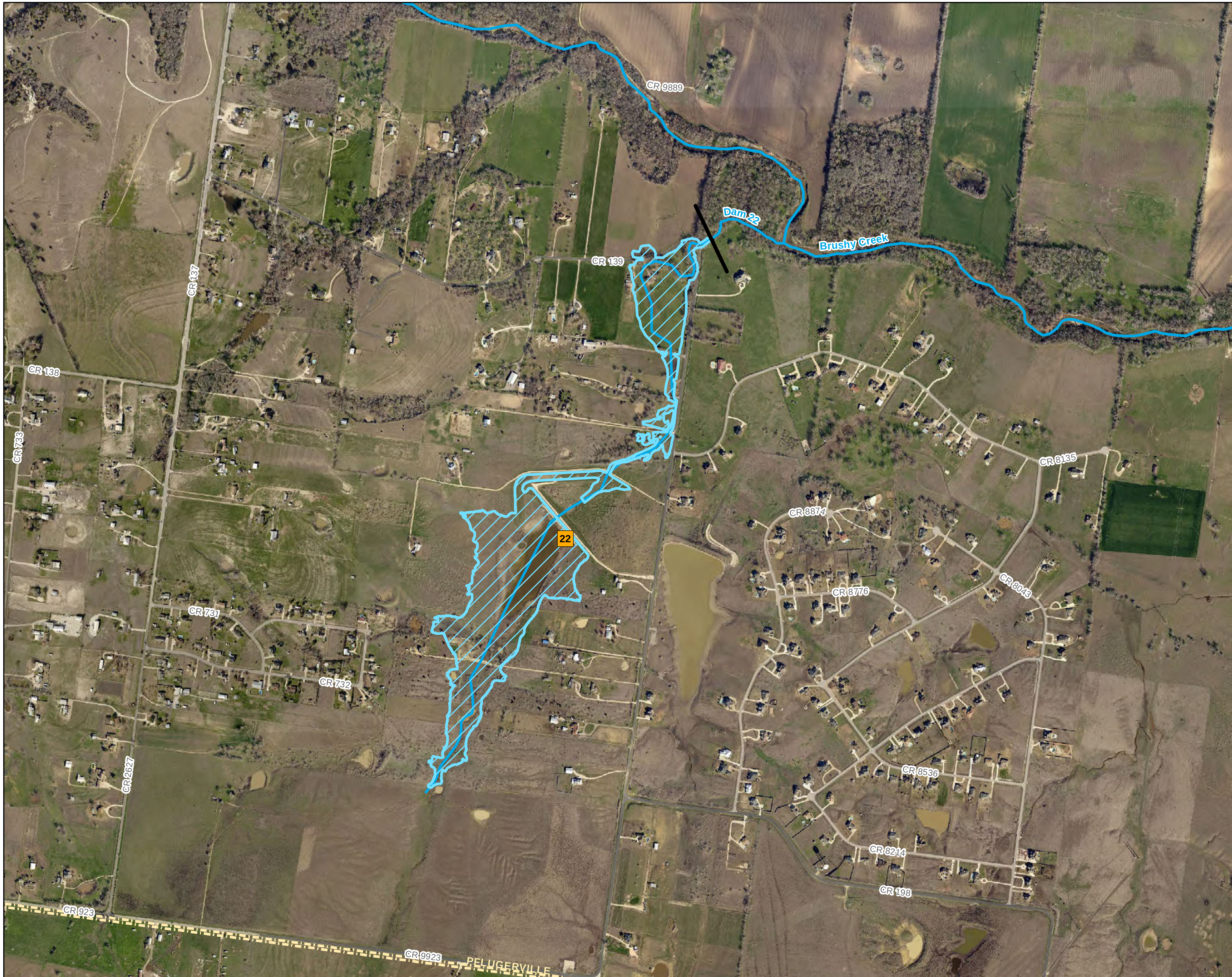
Miles

Figure O-10

Upper Brushy Creek WCID

System ID: Dam 18

4/16/2013



NRCS Dam
Streamline
Limit of Study
City Boundary
DRAFT 100-Year Floodplain Extent

N

0 0.08 0.16
Miles

Figure O-11

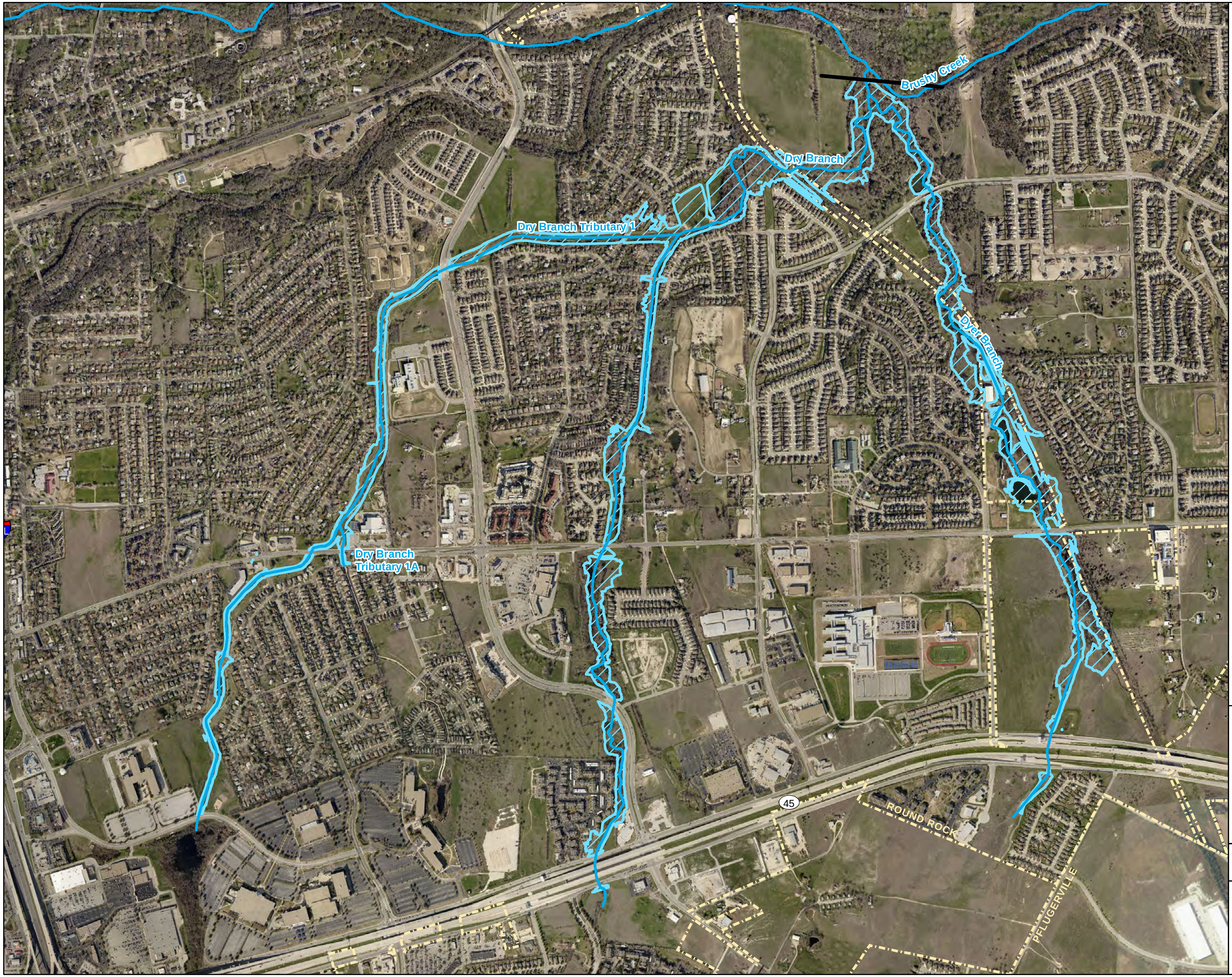
Upper Brushy Creek WCID

System ID: Dam 22

4/16/2013

Texas Water Development Board

URS



Streamline

Limit of Study

City Boundary

DRAFT 100-Year Floodplain Extent

N

0 0.1 0.2
Miles

Figure O-12

Upper Brushy Creek WCID

System ID: Dry Branch

4/16/2013

Upper Brushy Creek W.C.I.D.

Texas Water Development Board

URS

NRCS Dam

Streamline

Limit of Study

City Boundary

DRAFT 100-Year Floodplain Extent

N

0 0.15 0.3
Miles

Figure O-13

Upper Brushy Creek WCID

System ID: Dry Fork

4/16/2013

Upper Brushy Creek W.C.I.D.

Texas Water Development Board

URS

NRCS Dam

Streamline

Limit of Study

City Boundary

DRAFT 100-Year Floodplain Extent

N

0 0.5 1

Miles

Figure O-14

Upper Brushy Creek WCID

System ID: Lake Creek

4/16/2013

Texas Water Development Board

URS

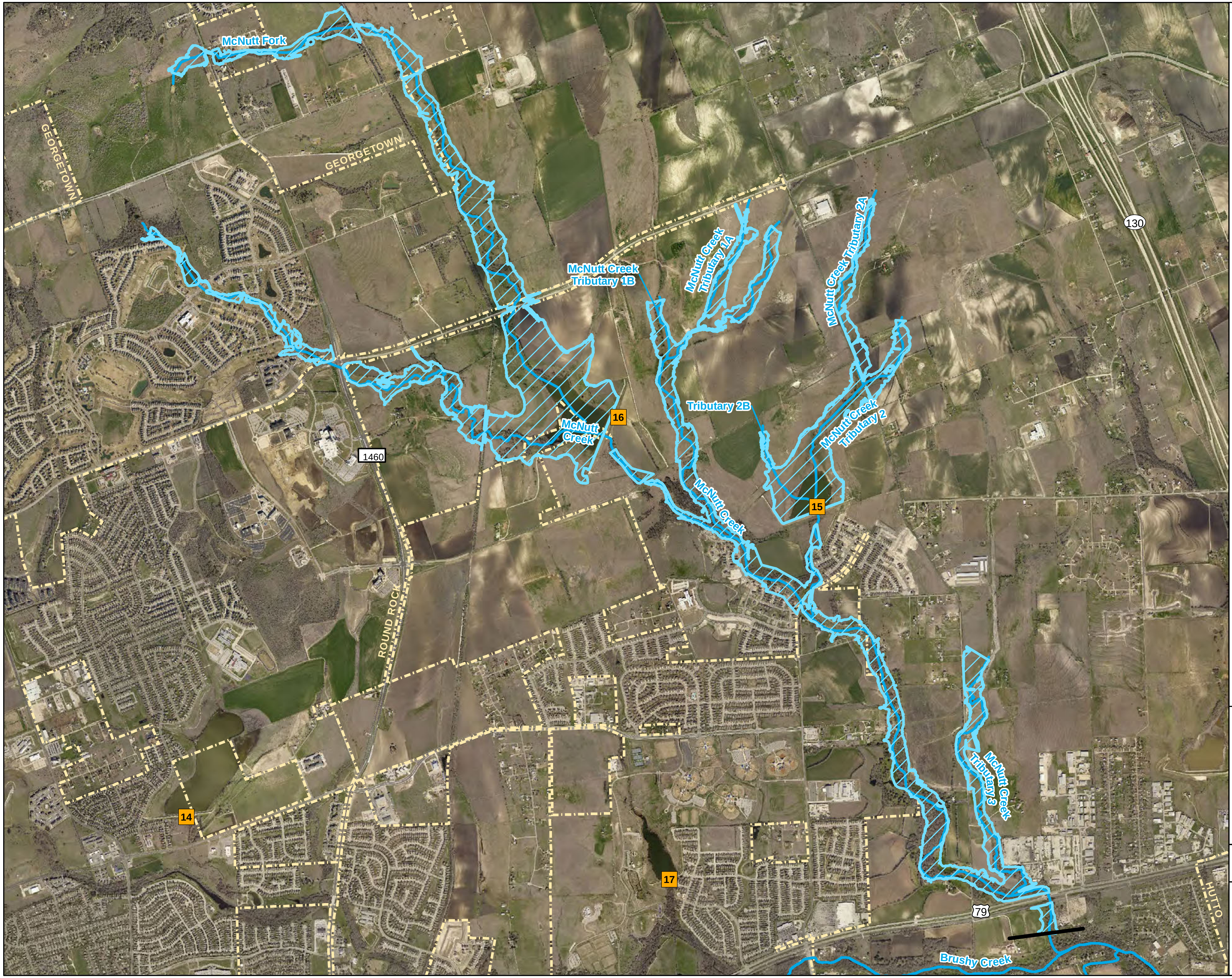


Figure O-15

Upper Brushy Creek WCID

System ID: McNutt Creek

4/16/2013

Texas Water Development Board

URS

Figure O-16

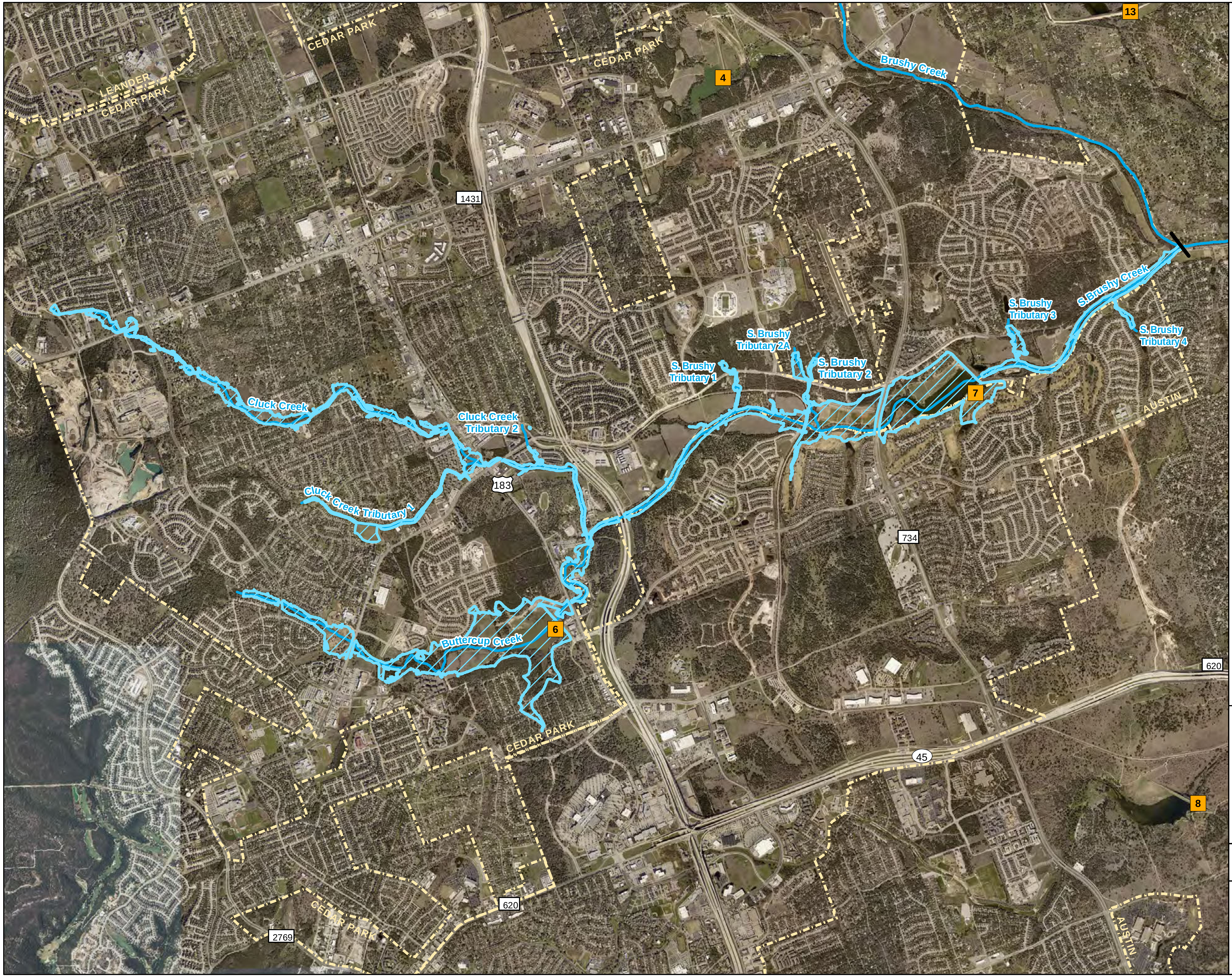
Upper Brushy Creek WCID

System ID: Onion Branch

4/16/2013

Texas Water Development Board

URS



NRCS Dam

Streamline

Limit of Study

City Boundary

DRAFT 100-Year Floodplain Extent

N

0 0.3 0.6

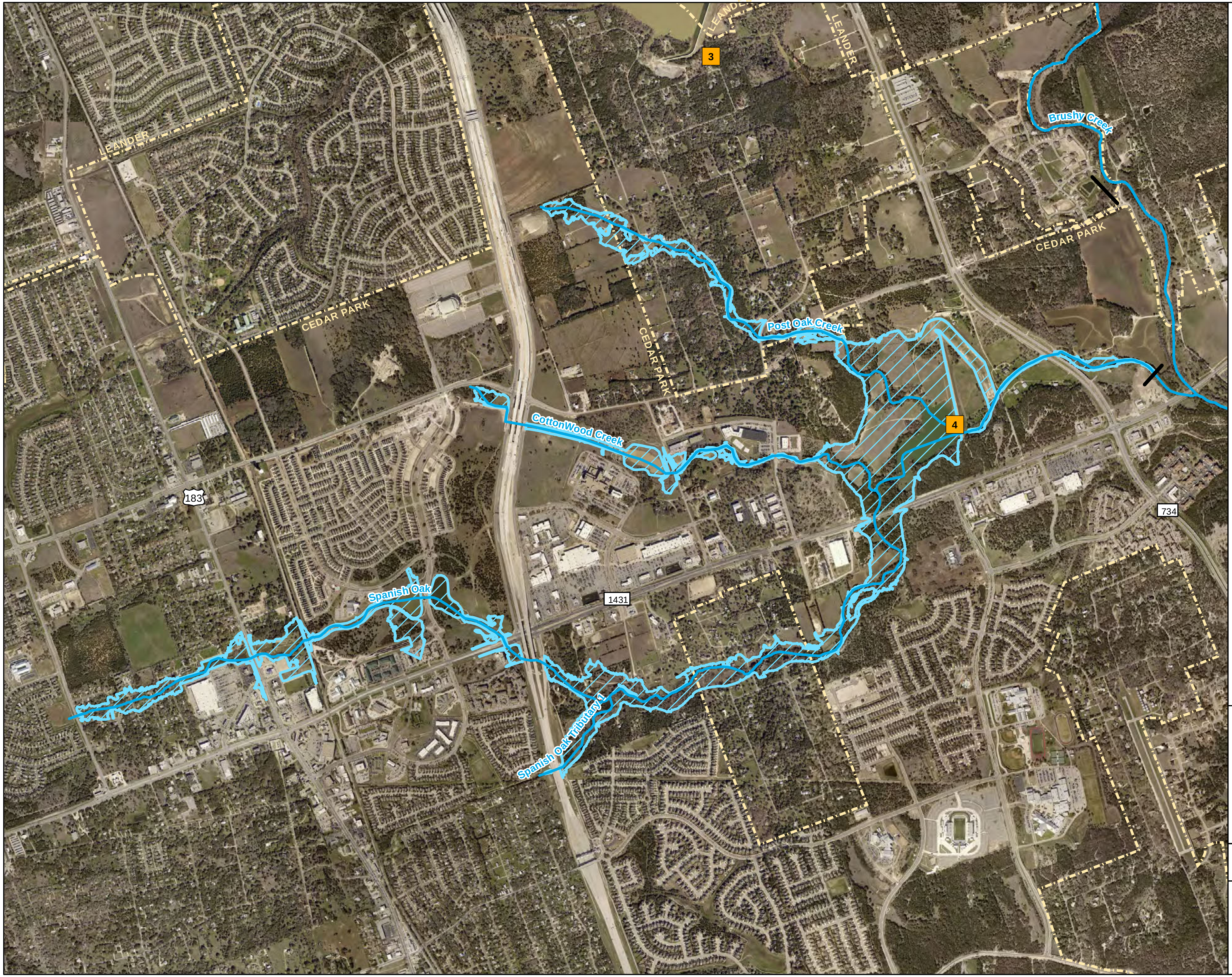
Miles

Figure O-17

Upper Brushy Creek WCID

System ID:
South Brushy Creek

4/16/2013



NRCS Dam

Streamline

Limit of Study

City Boundary

DRAFT 100-Year Floodplain Extent

N

0 0.15 0.3

Miles

Figure O-18

Upper Brushy Creek WCID

System ID: Spanish Oak

4/16/2013

UPPER BRUSHY CREEK W.C.I.D.

Texas Water Development Board

URS

NRCS Dam
Streamline
Limit of Study
City Boundary
DRAFT 100-Year Floodplain Extent

N

0 0.1 0.2
Miles

Figure O-19

Upper Brushy Creek WCID

System ID: Zimmerman Creek

4/16/2013

Upper Brushy Creek W.C.I.D.
Texas Water Development Board
URS

Exhibit P
Hydraulic Model Calibration

URS

Exhibit P

TO: Ruth Haberman, General Manager, Upper Brushy Creek Water Control and Improvement District

FROM: Jeff Irvin, PE, URS Corporation

DATE: January 14, 2013

RE: Calibration of Upper Brushy Watershed Hydraulic Models

1.0 MEMORANDUM PURPOSE AND ORGANIZATION

The purpose of this memorandum is to provide documentation of the hydraulic calibration of the HEC-RAS models developed for the Upper Brushy Creek Flood Protection Plan (FPP). The FPP is being developed for the Upper Brushy Creek Water Control and Improvement District (District), and the Texas Water Development Board (TWDB). Technical Memorandum No. 3 (TM3), reviewed and approved by the District, TWDB, and the FPP Technical Advisory Committee (TAC), noted the calibration would consist of using the calibrated watershed hydrologic model (HEC-HMS) to produce flows associated with Tropical Storm (TS) Hermine (September, 2010), which would be entered into watershed hydraulic models (HEC-RAS) and compared to measured high water marks (HWMs) during that event. This memorandum consists of the following sections:

- A summary of data sources accessed in assembling the calibration dataset;
- A discussion of calibration methodology;
- Presentation of initial calibration results, considered valid for hydraulic models other than those within the Lake Creek watershed;
- Presentation of calibration results for hydraulic models within the Lake Creek watershed; and
- Recommendations for selection of calibration parameters and modeling methods affected by calibration.

2.0 SUMMARY OF DATA SOURCES

In general, the calibration hinged upon use of historic HWMs, flood insurance claim records and rainfall data collected during recent floods (primarily TS Hermine and the July 2012 flood on Lake Creek).

2.1 High Water Marks

The locations of HWMs collected during TS Hermine and the July 2012 flood are shown in overview in Figures P-1A to P-1C. These data have all been collected and entered into the TWDB HWM database:

https://www.google.com/fusiontables/DataSource?docid=1gT3F42twZSi5TCc2Q5GSF0enntCC2rPW404n-J4

These HWMs were in all cases provided to TWDB through members of the FPP TAC. Selected HWMs have both a surveyed elevation and global positioning system (GPS) location, others have only a GPS location, a photograph, or text description.

Following initial attempts to calibrate Brushy Creek and Lake Creek models, an additional data source was received from TWDB for each of these two models: the record of post-flood insurance claims to the National Flood Insurance Program. These data were collected and processed as follows:

- The location of each claim was found by the address on the claim.
- Claims located within or adjacent to model flood extents were identified.
- The claims provided depth of flooding above finished flood elevation (FFE). Generally this was a coarse measurement, to the nearest foot.
- The FFE at each address was estimated from 2012 LiDAR data, with a visual inspection made within current online side view aerials to confirm FFE and surrounding terrain were close in elevation.
- The HWM elevation was assumed to be at the structure location, with an elevation equal to the FFE plus the depth of flooding stated on the claim.

These estimates of HWM elevations are acknowledged to be less accurate than those procured from the TWDB website. Details of specific claims are not provided in this report, per agreement with TWDB.

2.2 Rainfall Data

A complete discussion of TS Hermine and available rainfall data collected during that event is presented in Appendix D (Curve Number Calibration) and Appendix E (Lag Time Calibration) of Technical Memorandum (TM) 4, Hydrologic Model Results – DRAFT, dated September 25, 2012. The rainfall dataset that is both the most representative (in terms of spatial coverage) and most homogeneous (in terms of consistency in means of collection), and which has sufficient detail (i.e., collected at 5-minute intervals) for the period of TS Hermine is the rainfall dataset collected at the District dams.

Precipitation data at uniform 5-minute intervals were collected at many of the District dams throughout the watershed during TS Hermine. A quality check on these data was performed by Freese & Nichols (FNI, 2012) and URS Corporation (URS) (in TM4). Some dams were estimated to not record reliable stage data, some dams did not record reliable precipitation, and some dams did not record reliable data of either type. The total precipitation values for all dam rainfall datasets of estimated reliable accuracy are listed in Table P-1.

Table P-1. Rainfall Data Summary for District Dams for TS Hermine

Dam Name	Total Precipitation (in)
NRCS Dam #1	10.75
NRCS Dam #2	10.39
NRCS Dam #3	13.62
NRCS Dam #4	11.61
NRCS Dam #5	13.66
NRCS Dam #7	10.98
NRCS Dam #8	11.57
NRCS Dam #11	7.48
NRCS Dam #12	11.22
NRCS Dam #13A	12.60
NRCS Dam #14	7.80
NRCS Dam #16	6.26
NRCS Dam #17	6.22
NRCS Dam #19	5.31
NRCS Dam #21	5.04

2.3 Roughness Values

The choice for roughness (Manning's n) applied across each hydraulic cross-section derives from values tabulated in the HEC-RAS User's Manual and provided in Appendix A of TM3. Specific values used in the FPP models associated with channel and overbank land use descriptions are provided in Attachment 1 to this memorandum.

3.0 INITIAL CALIBRATION METHODOLOGY

3.1 Overview

The calibration methodology was chosen to be consistent with available data. The entire watershed model was calibrated with a combination of direct and indirect calibrations. The following hydraulic models (extents shown on Figure P-1) have HWMs and were calibrated directly:

- Brushy Creek main stem;
- Onion Branch; and
- Lake Creek.

For these models, the calibration strategy was as follows:

- TS Hermine peak flows were derived from a combination of the calibrated hydrologic model per TM4 and measured hydrographs discharged from District dams; and

- The HEC-RAS model was run with these flows, and adjustments to the model were made as needed to match HWMs with a target tolerance of 0.5 foot, in the following priority:
  - Adjust channel and overbank roughness by category (originally assigned per Attachment 1 to this memorandum), within limits (maximum to minimum) provided for each category (per HEC-RAS User's Manual, see Appendix A of TM3).
  - Change hydrologic routing method, as needed, to alter peak flows to improve calibration.

The remaining 16 hydraulic models were indirectly calibrated, i.e., the same model adjustments were made to each of these 16 models as made in the direct calibration of the three models with HWMs. In this manner, calibration adjustments were applied to the full extent of FPP models, and the entire suite of models can be considered calibrated within the limits of available data.

The initial strategy for calibration described in this section was successful for calibration of Upper Brushy Creek and Onion Branch, but not for Lake Creek. The successful strategy for calibration of Lake Creek is described in Section 6.

3.2 Derivation of Peak Flows for TS Hermine

The basic strategy for the derivation of peak flows used in calibration varies by hydraulic model calibrated.

3.2.1 Derivation of Peak Flows for Upper Brushy Creek Model

The TS Hermine peak flows for Upper Brushy Creek were derived as follows:

- The hydrologic model for the full FPP watershed was truncated to remove watersheds upstream of the District dams listed in Table P-1;
- The hydrographs measured during TS Hermine at each dam location in Table P-1 were input directly into the truncated FPP watershed model;
- The flows from the uncontrolled watershed (shown shaded in yellow in Figure P-2A) were derived using the calibrated HEC-HMS model using TS Hermine rainfall and curve numbers appropriate for the TS Hermine event; and
- Peak flows in the creek were derived by hydrograph addition and routing per the methods and logic documented in TM4.

3.2.2 Derivation of Peak Flows for Onion Branch Model

The TS Hermine peak flows for Onion Branch were derived as follows:

- The hydrologic model for the FPP Onion Branch watershed was truncated to remove the watershed upstream of the District Dam 12;
- The hydrograph measured during TS Hermine at Dam 12 was input directly into the truncated Onion Branch watershed model;
- The flows from the uncontrolled watershed were derived using the calibrated HEC-HMS model using TS Hermine rainfall and curve numbers appropriate for the TS Hermine event; and
- Peak flows in the creek were derived by hydrograph addition and routing per the methods and logic documented in TM4.

3.2.3 Derivation of Peak Flows for Lake Creek Model

The TS Hermine peak flows for Lake Creek were derived as follows:

- The hydrologic model for the FPP Lake Creek watershed was truncated to remove the watershed upstream of District Dams 8 and 9;
- The hydrographs measured during TS Hermine at Dams 8 and 9 were input directly into the truncated Lake Creek watershed model;
- The flows from the uncontrolled watershed were derived using the calibrated HEC-HMS model using TS Hermine rainfall and curve numbers appropriate for the TS Hermine event; and
- Peak flows in the creek were derived by hydrograph addition and routing per the methods and logic documented in TM4.

3.3 Methodology Used in Applying Gaged Rainfall to Uncontrolled Watershed

The Thiessen polygon method was used to distribute the rainfall data from point rainfall gages at the dams spatially across the watershed. The 5-minute rainfall data from each dam rain gage in Table P-1 was applied to the Thiessen polygon associated with that gage. The Thiessen polygons used are depicted in Figures P-2A and P-2B.

The gage weight method in HEC-HMS was used to enter this rainfall. This method allows the engineer to apply rainfall to each sub-basin in the model based on weights of an unlimited number of recording gages. The sum of all weights for each sub-basin should equal exactly 1. For sub-basins that fall completely within a Thiessen polygon, a weight of 1 was given to the gage associated with that polygon and weights of 0 were given to every other gage. Wherever a sub-basin intersected multiple Thiessen polygons, the weights were computed based on the proportional area of each Thiessen polygon compared to the full area of the sub-basin.

3.4 Methodology Used in Applying Curve Numbers to Uncontrolled Watershed

Previous calibration performed to select curve numbers throughout the study area (Appendix D of TM4) revealed that Texas Department of Transportation (TxDOT) adjustments to curve numbers were most representative of runoff conditions throughout the watershed. It was also estimated from calibration that data from TS Hermine exhibited antecedent rainfall conditions very similar to ARC Type I. Because these adjustments were found to accurately predict observed data in the hydrologic calibration during TS Hermine, they were used in hydrologic modeling performed to estimate peak flows for hydraulic calibration as well.

3.4.1 Software Used in Calibration

The software used in the calibration included:

- **HEC-HMS, Version 3.5**. The basic calibrated hydrologic model used in the study was modified to represent the hydrologic conditions of TS Hermine.
- **HEC-RAS, Version 4.1**. These are the basic hydraulic models used to develop flood depths, velocities, and extents within the study area.
- **ArcGIS Desktop 10**. This software was used to develop the spatial distribution of rainfall from TS Hermine.
- **URS Flow Script**. This Excel-based software, developed by URS, was used to distribute the hydrologic flows throughout the hydraulic models using base-10 logarithmic interpolation, per the method described in TM5, Appendix B.

3.4.2 Flow Application from Hydrologic Model Results to Hydraulic Model

Appendix B to TM5 provides a detailed explanation of how peak flows generated in the HEC-HMS model were applied to hydraulic model cross-sections. Results for calibration runs were generated by two techniques for applying the peak flows: the full reach-based interpolation and cross-section-based interpolation. The second technique is the method used in generation of TM5 statistical floodplains. Tables P-3 and P-4 demonstrate that the results in terms of predicted water surface elevation are not significantly different between the two methods of flow application.

4.0 CALIBRATION RESULTS

The hydraulic models for Onion Branch, Brushy Creek Main Stem, and Lake Creek were run using the flows determined above, and the resulting maximum water surface profiles were compared with the observed HWMs. A comparison of elevations is shown in Tables P-2 through P-4 and Figures P-3 (Onion Branch), P-4A, P-4B, P-4C (all Brushy Creek), P-5A and P-5B (Lake Creek). A comparison of HWMs versus location in plan and floodplain in plan is shown in Figure P-6A (Hutto), P-6B (Leander), P-6C and P-6D (Round Rock). There are no HWM elevations associated with the Hutto HWMs shown in Figure P-6A.

Table P-2. Calibration Elevations, Onion Branch

Calibration Points								
				X-Section based Interpolation		Full reach based Interpolation		
ID	Model	Station	Observed Elev (ft)	Modeled Elev (ft)	Diffe-rence with Observed (ft)	Modeled Elev (ft)	Diffe-rence with Observed (ft)	Within 0.5 feet of observed?
OB02	Onion Branch	17160.16	750.64	750.85	-0.21	750.65	-0.01	yes
OB03	Onion Branch	14155.14	745.18	744.82	0.35	744.81	0.36	yes
OB04	Onion Branch	5970.83	722.93	723.27	-0.34	723.27	-0.34	yes
OB05	Onion Branch	5926.94	721.99	723.12	-1.13	723.12	-1.13	On opposite bank from OC04, measurements inconsistent
OB06	Onion Branch	1502.31	695.65	695.81	-0.16	695.80	-0.15	yes

Table P-3. Calibration Elevations, Brushy Creek

Calibration Points								
				X-Section based Interpolation		Full reach based Interpolation		
ID	Model	Station	Observed Elev (ft)	Modeled Elev (ft)	Diffe-rence with Observed (ft)	Modeled Elev (ft)	Diffe-rence with Observed (ft)	Within 0.5 feet of observed?
FBC	Brushy_Creek	181030	931.78	931.16	0.62	931.17	0.61	no
BC01	Brushy_Creek	127939	758.43	758.99	-0.56	759.00	-0.57	yes
BC02	Brushy_Creek	120582	738.46	740.74	-2.28	740.74	-2.28	Nearby inline structure likely cause of difference
BC03	Brushy_Creek	111410	711.71	711.35	0.36	711.35	0.36	yes
BC04B	Brushy_Creek	110677	709.95	708.85	1.10	708.85	1.10	On opposite bank from BC04A, measurements inconsistent
BC04A	Brushy_Creek	110657	708.53	708.62	-0.09	708.62	-0.09	yes
BC05	Brushy_Creek	109125	703.55	704.09	-0.54	704.09	-0.54	yes
BC06	Brushy_Creek	107802	699.53	701.05	-1.52	701.05	-1.52	no
BC07	Brushy_Creek	105822	695.06	695.23	-0.17	695.23	-0.17	yes
BC08	Brushy_Creek	98539	677.83	677.26	0.57	677.27	0.56	yes
Claim 1	Brushy_Creek	139241	785.86			783.34	2.52	no
Claim 2	Brushy_Creek	75839	630.29			630.65	-0.36	yes
Claim 3	Brushy_Creek	75452	628.24			630.27	-2.03	no
Claim 4	Brushy_Creek	73221	627.99			627.04	0.95	no
Claim 5	Brushy_Creek	30063	557.78			557.04	0.74	no

Table P-4. Calibration Elevations, Lake Creek

Calibration Points						
				Full reach based Interpolation		
ID	Model	Station	Observed Elev (ft)	Modeled Elev (ft)	Diffe-rence with Observed (ft)	Within 0.5 feet of observed?
LC01A	Lake_Creek	23062	744.29	746.87	-2.58	no
LC01B	Lake_Creek	23024	744.27	746.76	-2.49	no
LC02	Lake_Creek	18977	733	736.25	-3.25	no
LC03	Lake_Creek	17282	728.03	731.11	-3.08	no
LC04	Lake_Creek	12509	708.64	714.77	-6.13	no
LC05	Lake_Creek	10303	698.7	704.61	-5.91	no
LC06A	Lake_Creek	9740	698.76	703.30	-4.54	no
LC06B	Lake_Creek	9706	698.82	703.22	-4.40	no
LC07A	Lake_Creek	8469	695.81	698.80	-2.99	no
LC07B	Lake_Creek	8440	695.95	698.75	-2.80	no
Claim 6	Lake_Creek	23637	743.4	747.76	-4.36	no
Claim 7	Lake_Creek	20571	736.77	739.61	-2.84	no
Claim 8	Lake_Creek	20561	736.7	739.60	-2.90	no
Claim 9	Lake_Creek	20506	735.99	739.50	-3.51	no
Claim 10	Lake_Creek	20092	738.21	738.72	-0.51	yes
Claim 11	Lake_Creek	20047	735.91	738.64	-2.73	no
Claim 12	Lake_Creek	19956	734.67	738.29	-3.62	no
Claim 13	Lake_Creek	18630	732.42	735.87	-3.45	no
Claim 14	Lake_Creek	18620	733.12	735.86	-2.74	no
Claim 15	Lake_Creek	18580	736	735.81	0.19	yes
Claim 16	Lake_Creek	18578	740.29	735.81	4.48	no
Claim 17	Lake_Creek	18560	732.54	735.73	-3.19	no
Claim 18	Lake_Creek	18409	732.27	734.76	-2.49	no
Claim 19	Lake_Creek	18321	733.11	734.20	-1.09	no
Claim 20	Lake_Creek	18263	732.23	733.82	-1.59	no
Claim 21	Lake_Creek	18180	733.8	733.56	0.24	yes
Claim 22	Lake_Creek	18062	732.23	733.50	-1.27	no
Claim 23	Lake_Creek	10149	698.85	704.29	-5.44	no
Claim 24	Lake_Creek	9859	697.54	703.61	-6.07	no
Claim 25	Lake_Creek	9580	706.38	702.89	3.49	no

Table P-5 summarizes the results presented in Tables P-2 through P-4. In the case of Onion Branch, HWM OB05 was not considered because of its inconsistency with a paired measurement.

Table P-5. Calibration Results, Summary

Model	Number of HWM	Model Results: Model Elev Vs HWM Elev # within 0.5 ft of HWM elev	# within 1.0 ft of HWM elev	# within 1.5 ft of HWM elev	Average Difference (ft)
Onion Branch	4	4	4	4	-0.04
Brushy Creek	15	5	10	12	-0.05
Lake Creek	30	3	3	5	-2.6

Conclusions derived from these results are presented in Section 5.0.

A few of the points with large discrepancies can be readily explained. For instance, BC02 was surveyed 2.85 feet below the predicted model elevation. However, when plotted in plan-view, it becomes quickly apparent that model cross-section orientation in this reach of stream leads to some ambiguity as to whether the HWM was collected upstream of the instream dam (as modeled) or downstream of the dam (see Figure P-7). BC04B also has a large differential being surveyed 1.28 feet above the modeled water line. However, a corresponding HWM, BC04A, was surveyed on the opposite side of Brushy Creek only 20 feet downstream at an elevation 1.4 feet lower. There is no feature between these points that would cause such a drop, so it is reasonable to assume that one of the marks is in error. BC04A was surveyed only 0.02 foot below the modeled water surface elevation (WSE).

Shortly after the flooding from TS Hermine, a photograph was taken at the intersection of Great Oaks and Hairy Man Road which depicts debris from inundation near the top of a stop sign. HWM BC01 was recorded on the opposite bank and fell within a half foot of the modeled WSE at this location. The stop sign was located spatially using a comparison of the photograph with aerial photography, and it was discovered that the flood depth at this point was modeled at 7 feet, which is a typical height for a stop sign (see Figure P-8).

5.0 CONCLUSIONS FROM INITIAL CALIBRATION

5.1 Conclusions

The results summarized in Table P-5 demonstrate the adequacy of the initial calibration for Onion Branch and the Brushy Creek main stem. No adjustments to initial estimates (per TM2 and TM3) of roughness or initial methodology chosen for hydrologic routing were made. Adequate calibration for the Lake Creek model was not achieved in the initial calibration process. These conclusions have been presented to and accepted by the FPP TAC. Each model is discussed in more detail below.

5.2 Calibration of Onion Branch Model

In the case of all four HWMs for Onion Branch, the hydraulic model predicted a WSE within 0.5 foot of the HWM elevations. This excellent calibration over a long reach of model provides a strong demonstration that the basic methods used in both hydrologic and hydraulic modeling are valid. In particular, this calibration demonstrates the basic reasonableness of flow peaks predicted by the hydrologic model and confirms the adequacy of the Muskingum Cunge routing method. Note that these four HWMs were provided by a single source.

5.3 Calibration of Brushy Creek Model

The calibration of the Brushy Creek model is less precise than that achieved by the Onion Branch model, with one-third of the model predictions at HWM locations matching HWM elevations within 0.5 foot, two-thirds matching within 1.0 foot, and 80% matching within 1.5 feet. The average of the differences between model and HWM elevations was less than 0.1 foot. The HWMs considered in Tables P-3 and P-5 are located in the middle and upper portions of the watershed and do not include those in Figure P-6A, located in Hutto along Brushy Creek at the lower end of the model. This figure demonstrates accuracy of the calibration in the lower portion of the watershed.

The above results demonstrate adequate calibration of this model because:

- There is no consistent variation within the model-predicted WSE in a high or low direction from the HWM.
- Two-thirds of the differences between model and HWM were less than 1 foot;
- The average of differences was less than 0.1 foot, demonstrating a randomness of the differences; and
- The number of HWMs considered was high (15) and from varied sources, to include rough flood depths listed (as a whole number of feet generally) on claims. The inaccuracy of the HWM elevations would lead to an expected spread in accuracy of model prediction.

5.4 Calibration of Lake Creek Model

The Lake Creek model results differed materially from those of the other two creeks in terms of matching HWM elevations, in that very few of the model-predicted WSE were within 1 foot of the estimated HWM elevation. The model consistently predicted elevations several feet above HWM elevations. The cause of the lack of calibration could be either in the magnitude of predicted flows or in the hydraulic modeling.

Potential for Inaccuracies in Hydrologic Modeling

The Lake Creek watershed (see Figure P-11) is largely contained within the Edwards Aquifer Recharge Zone (EARZ). In this zone, there is the potential for karst features (sinkholes, caves) to capture significant volume of flow. There is significant evidence that in this watershed, there are major losses into the aquifer during floods. This evidence includes:

- Dam 9 collected stage data during TS Hermine, but the rain gage failed to operate properly. During hydrologic model calibration, flows were predicted into Dam 9 based upon less accurate (than successfully operating dam rain gage) radar data and also upon less accurate Weather Underground website data. The flow data for discharge from Dam 9 was found to be unreasonably low relative to the flows from these hydrologic models. The calibrated ARC I Curve Number was an extremely low 11 to 13, leading to an estimate of an ARC II Curve Number of 23 to 26. These estimates were dismissed at the time as likely to be caused by a malfunctioning stage gage.

- Hydrologic calibration of the Dam 8 watershed to the measured rainfall and flows during TS Hermine yields even lower estimated curve numbers, such that virtually all runoff not associated with impervious area is lost.
- The volume of flow per the measured flows at the USGS gage on Lake Creek during and following TS Hermine also leads to low curve numbers similar to those derived from Dam 8 and Dam 9 data.

Note that calibrations of curve numbers for dam watersheds also sited in the EARZ (Dams 13A, 12, and 11) all yielded (through calibration) consistent estimates for curve number (ARC II range 57 to 70 for both TS Hermine and 2007). These estimates are much higher than the values for Lake Creek watershed.

Potential for Inaccuracies in Hydraulic Model

Given the successful calibration of hydraulic models in watersheds where flows estimated for TS Hermine are thought to be relatively accurate, and the strong potential for the hydrologic model for Lake Creek to be significantly less accurate, the potential for poor calibration in Lake Creek due to the hydraulic model is slim.

In sum, the poor calibration of the Lake Creek model is likely due to unidentified large losses within the watershed due to unknown karst features within channels or dam flood pools.

6.0 REFINED CALIBRATION METHODOLOGY FOR LAKE CREEK WATERSHED MODELS

6.1 Description of Revised Methodology

The revised calibration method for models within the Lake Creek watershed was developed in tandem with and with the ultimate concurrence of all members of the FPP TAC, to include the District. The method used is described below.

1. Following discussion with the TAC and with karst geologists with COA, the decision was made to attempt calibration by retaining curve numbers per the current hydrologic model (documented in TM4); adjusting impervious cover through a connectivity analysis per USEPA methods (“Estimating Change in Impervious Area (IA) and Directly Connected Impervious Areas (DCIA) for New Hampshire Small MS4 Permit,” April 2011); and back-calculating a value of initial abstraction per standard NRCS curve number method equations.

2. Calibration of initial abstraction with impervious cover adjustment per USEPA was compared to calibration without adjustment (as is done in the remainder of the model):

- Fourteen storm events were chosen for calibration, ranging in rainfall depth from 2.28 inches to 11.57 inches (see Table P-6).

- The stage event records for the USGS gage on Lake Creek and at Dam 8 and at Dam 9 were used in the calibration analysis.

- The estimation of initial abstraction for each storm was performed using a water balance at each gage/dam location, using NRCS equations, given rainfall depth (measured), runoff volume (measured), percent impervious (measured in GIS, adjusted per EPA), and CN (estimated per TM4, adjusted for ARC of each storm).

The estimation could be performed only for the larger events: for 6 of the 14 storms selected at Dam 8, for 1 of the 6 storms at the USGS gage, and for 2 of the 13 storms at Dam 9 (for a total of 9 out of 33 storms). The adjustment of impervious cover could not account for the large measured losses for 24 storms. For example, in Table P-6, for Storm 6, the runoff into Dam 8 was measured as 0.42 inch. The application of 3.03 inches of rain over a watershed with 39% impervious cover should produce at least 3.03 inches * 0.39 = 1.18 inches of runoff. Because the measured value for runoff volume is less than the minimum value associated with watershed impervious area alone, Storm 6 data could not be used in calibration for this dam. Where this condition occurred (for most of the smaller storms), calibrated values for initial abstraction could not be estimated and are marked with an asterisk (*) in Table P-6.

- Given that use of an impervious cover adjustment would create an inconsistency across the full model, the calibration was also performed without impervious cover adjustment to allow for comparison. The estimation of initial abstraction for each storm was performed again using a water balance at each gage/dam location, using NRCS equations, given rainfall depth (measured), runoff volume (measured), percent impervious (measured in GIS, no adjustment), and curve number (estimated per TM4, adjusted for ARC of each storm). As with the previous estimation, the estimation without impervious cover adjustment could be performed only for larger events: for 7 of the 33 storms. This estimation method had a marginal difference in calibration success relative to the use of an impervious cover adjustment.

- The shaded cells in Table P-6 show storms where a value for initial abstraction could be calibrated, with or without an adjustment in impervious cover. With adjustment of impervious cover per USEPA methodology, values could be calibrated for 9 of 14 storms. Without adjustment of impervious cover per USEPA methodology, values could be calibrated for 7 of 14 storms. Given this marginal difference and the preference for consistency in impervious cover estimation with the remainder of the full watershed model, calibration to HWMs proceeded using initial abstraction per calibration without impervious cover adjustment.

Table P-6. Lake Creek Calibration at Gages

	Storm	Impervious Cover Original (%)	Impervious Cover Adjusted per EPA (%)	ARC	Curve Number	Measured Precipitation (in)	Measured Runoff (in)	Initial Abstraction (in) (ARC of Storm)			Initial Abstraction (in) (ARC 2)		
								(0.2S Method)	Original IC	Adjusted IC	(0.2S Method)	Original IC	Adjusted IC
USGS Gage	Hermine	0.5064	0.4049	1	43.6	11.57	6.66	2.58	5.61	3.04	1.08	2.36	1.28
	2012 Event	0.5064	0.4049	3	80.9	3.96	1.33	0.47	*	*	1.08	*	*
	Storm 8	0.5064	0.4049	3	80.9	2.22	0.28	0.47	*	*	1.08	*	*
	Storm 13	0.5064	0.4049	1	43.6	2.44	0.38	2.58	*	*	1.08	*	*
	Storm 15	0.5064	0.4049	1	43.6	2.48	0.41	2.58	*	*	1.08	*	*
	Storm 16	0.5064	0.4049	1	43.6	2.28	0.61	2.58	*	*	1.08	*	*
Dam 8	Hermine	0.3891	0.3081	1	43.5	11.57	4.63	2.60	9.42	5.75	1.09	3.96	2.42
	2012 Event	0.3891	0.3081	3	80.8	3.96	2.4	0.48	1.09	0.80	1.09	2.50	1.84
	2007 Event	0.3891	0.3081	2	64.7	2.91	1.15	1.09	2.45	1.28	1.09	2.45	1.28
	Storm 6	0.3891	0.3081	1	43.5	3.03	0.42	2.60	*	*	1.09	*	*
	Storm 7	0.3891	0.3081	1	43.5	2.8	1.02	2.60	*	1.07	1.09	*	0.45
	Storm 8	0.3891	0.3081	3	80.8	2.22	0.63	0.48	*	*	1.09	*	*
	Storm 9	0.3891	0.3081	1	43.5	3.39	0.92	2.60	*	*	1.09	*	*
	Storm 10	0.3891	0.3081	1	43.5	2.28	0.31	2.60	*	*	1.09	*	*
	Storm 11	0.3891	0.3081	1	43.5	2.95	0.69	2.60	*	*	1.09	*	*
	Storm 12	0.3891	0.3081	1	43.5	3.31	0.64	2.60	*	*	1.09	*	*
	Storm 13	0.3891	0.3081	1	43.5	2.44	0.73	2.60	*	*	1.09	*	*
	Storm 14	0.3891	0.3081	1	43.5	3.39	1.22	2.60	*	1.52	1.09	*	0.64
	Storm 15	0.3891	0.3081	1	43.5	2.48	0.49	2.60	*	*	1.09	*	*
	Storm 16	0.3891	0.3081	1	43.5	2.28	0.9	2.60	1.76	0.38	1.09	0.74	0.16
Dam 9	Hermine	0.17942	0.1404	1	44.3	11.41	3.17	2.52	5.99	5.15	1.06	2.52	2.16
	2012 Event	0.17942	0.1404	3	81.3	4.83	1.45	0.46	2.65	2.38	1.06	6.10	5.48
	2007 Event	0.17942	0.1404	2	65.4	5.24	0.44	1.06	*	*	1.06	*	*
	Storm 6	0.17942	0.1404	1	44.3	3.46	0	2.52	*	*	1.06	*	*
	Storm 7	0.17942	0.1404	1	44.3	3.35	0	2.52	*	*	1.06	*	*
	Storm 8	0.17942	0.1404	1	44.3	4.38	0	2.52	*	*	1.06	*	*
	Storm 9	0.17942	0.1404	1	44.3	3.39	0.46	2.52	*	*	1.06	*	*
	Storm 10	0.17942	0.1404	1	44.3	3.03	0.01	2.52	*	*	1.06	*	*
	Storm 11	0.17942	0.1404	1	44.3	2.95	0	2.52	*	*	1.06	*	*
	Storm 12	0.17942	0.1404	1	44.3	3.35	0	2.52	*	*	1.06	*	*
	Storm 13	0.17942	0.1404	1	44.3	2.28	0	2.52	*	*	1.06	*	*
	Storm 14	0.17942	0.1404	1	44.3	4.06	0	2.52	*	*	1.06	*	*
	Storm 16	0.17942	0.1404	1	44.3	2.28	0.15	2.52	*	*	1.06	*	*
										max	1.09	3.96	2.42
										min	1.06	0.74	0.16
										ave	1.09	2.42	1.28

* For these storms runoff volume from impervious cover alone exceeds measured runoff volume.

- Per the calibration without impervious cover adjustment, the initial abstraction associated with this watershed was (for an ARC II condition) on average 1.28 inches more than the default initial abstraction in HEC-HMS (see Table P-6), used elsewhere in the full watershed model. This adjustment is consistent with the physical description of this watershed as having karst-related high watershed surface storage.

3. Two scenarios of adjusted values of initial abstraction were input into the hydrologic model for TS Hermine (September 2010). Initial abstraction adjustments were only applied to watersheds within the EARZ. The model was configured with watersheds above Dams 8 and 9 removed and replaced with dam discharges per measured reservoir stage. The two scenarios were:

   - Add 1.0 inch to each subwatershed's default ARC II initial abstraction value and convert the value to an ARC I condition (the condition of the watershed prior to TS Hermine); and

   - Add 1.5 inches to each subwatershed's default ARC II initial abstraction value and convert the value to an ARC I condition (the condition of the watershed prior to TS Hermine).

4. Flows generated by the TS Hermine hydrologic model were input to the HEC-RAS hydraulic model, and the model was run in steady-state mode to estimate WSE.

5. Similarly, two scenarios of adjusted values of initial abstraction were input into the hydrologic model for the July 2012 flood model. The model was configured with watersheds above Dams 8 and 9 removed and replaced with dam discharges per measured reservoir stage. The two scenarios were:

   - Add 1.0 inch to each subwatershed's default ARC II initial abstraction value and convert the value to an ARC III condition (the condition of the watershed prior to the July flood); and

   - Add 1.5 inches to each subwatershed's default ARC II initial abstraction value and convert the value to an ARC III condition (the condition of the watershed prior to the July flood).

6. Flows generated by the July 2012 flood hydrologic model were input to the HEC-RAS hydraulic model, and the model was run in steady-state mode to estimate WSE.

7. To investigate whether use of an unsteady-flow hydraulic model would improve calibration, the TS Hermine and July 2012 flood steady-state models were converted to unsteady state. The basic steps for this conversion were:

   - A separate hydraulic model was created for the reach of Lake Creek from Dam 8 to the junction with Brushy Creek.

- Hydrographs were input into the hydraulic model at Dam 8 (per measurements during the event) and at each HEC-HMS subwatershed outlet. These latter hydrographs varied per initial abstraction adjustment scenario. The Dam 9 measured hydrograph was input as a subwatershed in the HEC-HMS model.

8. Similar modeling was performed to check calibration at the location of the USGS gage along Lake Creek (see Figure P-11 for gage location). For this scenario, the hydrologic model watershed was truncated at the gage location, flows were generated for TS Hermine and the July 2012 event, and these flows were entered in the hydraulic model to estimate WSE.

6.2 Results of Revised Calibration for Lake Creek

The results of the model calibration runs are presented in Table P-7. The table depicts the following:

- ID of the HWM, claim, or gage (USGS Lake Creek gage) that provided the observed value for WSE;
- The HEC-RAS model station associated with the observed value;
- The associated storm event for the observed value;
- The observed WSE value;
    - Predicted WSE at the station for four scenarios, with difference from observed value. The four scenarios are: Steady-state hydraulic model, using flows based upon a hydrologic model where initial abstraction has been increased over default value by 1 inch;
    - Steady-state hydraulic model, using flows based upon a hydrologic model where initial abstraction has been increased over default value by 1.5 inches;
    - Unsteady-steady state hydraulic model, using flows based upon a hydrologic model where initial abstraction has been increased over default value by 1 inch; and
    - Unsteady-state hydraulic model, using flows based upon a hydrologic model where initial abstraction has been increased over default value by 1.5 inches.
- Differences between elevations predicted by the steady-state and unsteady-state models are also shown.

Table P-7. Lake Creek Calibration at HWMs

Lake Creek Calibration Points													
		Station per		Steady IA +1.0 *		Unsteady IA +1.0 **		Diff Between	Steady IA +1.5		Unsteady IA +1.5		Diff Between
		HEC-RAS	Observed	Modeled		Modeled		Steady and	Modeled		Modeled		Steady and
ID	Event	Model	Elev (ft)	Elev (ft)	Diff (ft)	Elev (ft)	Diff (ft)	Unsteady (ft)	Elev (ft)	Diff (ft)	Elev (ft)	Diff (ft)	Unsteady (ft)
LC01A	Hermine	23062	744.29	744.18	-0.11	743.39	-0.90	-0.79	743.06	-1.23	743.02	-1.27	-0.04
LC01B	Hermine	23024	744.27	743.98	-0.29	743.09	-1.18	-0.88	742.87	-1.40	742.59	-1.68	-0.28
LC02	Hermine	18977	733	734.21	1.21	733.05	0.05	-1.16	732.67	-0.33	732.14	-0.86	-0.53
LC03	Hermine	17282	728.03	728.90	0.87	727.92	-0.11	-0.97	727.67	-0.36	727.04	-0.99	-0.63
LC04	Hermine	12509	708.64	708.07	-0.57	707.26	-1.38	-0.81	706.62	-2.02	706.07	-2.57	-0.55
LC05	Hermine	10303	698.7	699.41	0.71	699.82	1.12	0.41	698.54	-0.16	698.97	0.27	0.43
LC06A	Hermine	9740	698.76	698.18	-0.58	698.76	0.00	0.58	697.39	-1.37	698.04	-0.72	0.65
LC06B	Hermine	9706	698.82	698.14	-0.68	698.73	-0.09	0.59	697.35	-1.47	698.01	-0.81	0.67
LC07A	Hermine	8469	695.81	694.63	-1.18	694.54	-1.27	-0.09	693.68	-2.13	693.74	-2.07	0.07
LC07B	Hermine	8440	695.95	694.52	-1.43	694.41	-1.54	-0.11	693.56	-2.39	693.59	-2.36	0.04
HWM_8B	2012	17321	726.2	726.81	0.61	726.09	-0.11	-0.71	726.49	0.29	725.90	-0.30	-0.59
HWM_8A	2012	17268	725.7	726.60	0.90	725.96	0.26	-0.65	726.33	0.63	725.76	0.06	-0.56
HWM_7B	2012	14395	713.8	713.95	0.15	713.79	-0.01	-0.16	713.74	-0.06	713.67	-0.13	-0.08
HWM_7A	2012	14275	713.3	713.21	-0.09	713.20	-0.10	0.00	713.00	-0.30	713.02	-0.28	0.03
HWM_6A	2012	12415	706	705.84	-0.16	705.26	-0.74	-0.57	705.51	-0.49	704.98	-1.02	-0.53
HWM_5A	2012	11531	702.1	702.88	0.78	702.39	0.29	-0.49	702.64	0.54	702.20	0.10	-0.44
HWM_4A	2012	10323	697.3	698.67	1.37	698.82	1.52	0.16	698.43	1.13	698.59	1.29	0.17
HWM_4B	2012	10317	697.2	698.62	1.42	698.78	1.58	0.16	698.39	1.19	698.56	1.36	0.17
HWM_3B	2012	8713	694.2	694.61	0.41	694.75	0.55	0.14	694.47	0.27	694.59	0.39	0.12
HWM_3A	2012	8650	694.2	694.28	0.08	694.34	0.14	0.06	694.11	-0.09	694.17	-0.03	0.06
USGS_Herm	Hermine	16169	908.59	908.46	-0.13				907.96	-0.63			
USGS_2012	2012	16169	907.16	906.93	-0.23				906.85	-0.31			
				Average (ft)	0.14	Average (ft)	-0.09		Average (ft)	-0.49	Average (ft)	-0.58	

* Case where hydrologic model is altered to increase the model default initial abstraction by 1 inch and flows input to the steady-state hydraulic model.

** Case where hydrologic model is altered to increase the model default initial abstraction by 1 inch and flows input to the unsteady-state hydraulic model.

Figures P-9A and P-9B depict steady and unsteady model flow profiles for TS Hermine and July 2012, respectively, for the case of adding 1.0 inch to initial abstractions.

During review of calibration results, a request was made to compare model results to an additional HWM not previously considered. Shortly after the flooding from TS Hermine, photographs were taken upstream and downstream of the Deerbrook Trail bridge over Lake Creek which depict debris lines from inundation. These debris lines were visually compared with the model results at that location and found to align reasonably well with the case of adding 1.0 inch to the initial abstraction. Figures P-10A and P-10B depict the visual comparison upstream and downstream of the Deerbrook Trail bridge, respectively.

7.0 CONCLUSIONS FROM REVISED CALIBRATION OF LAKE CREEK MODEL

Table P-7 shows the following:

- The 1-inch addition to default initial abstraction values matched well with HWMs per the steady-state model (15 of the 20 higher quality HWMs were matched within 1 foot, 7 within 0.5 foot). The average difference between model and HWM elevation was 0.17 foot (model prediction below measurement); and
- The unsteady-state model had similar results (13 of the 20 higher quality HWMs were matched within 1 foot, 10 within 0.5 foot). The average difference between model and HWM elevation was 0.09 foot (model prediction above measurement).

These results demonstrate that the steady-state and unsteady-state models produce very similar flood profiles. Significant differences occur between stations 15500 to 17000 and between 9000 and 10500). The differences: 1) are associated with flows through structures; and 2) vary in that in one of these two reaches, the unsteady profile exceeds the steady profile, and in the other, this relationship is reversed (i.e., one model is not consistently more conservative than the other). The consistency in results in the longer reaches between structures is a further independent demonstration that the 8-point cross-section Muskingum storage routing used in the HEC-HMS model is valid.

These conclusions have been presented to and accepted by the FPP TAC.

8.0 REFERENCES

Freese & Nichols, Inc. (FNI). *Memorandum on Flood Monitoring System Data and Observations*. January 20, 2012.

U.S. Environmental Protection Agency (USEPA). *Estimating Change in Impervious Area (IA) and Directly Connected Impervious Areas (DCIA) for New Hampshire Small MS4 Permit*, 2011.

Attachment 1 to Exhibit P

Guidelines to Selection of Manning's 'N' Values

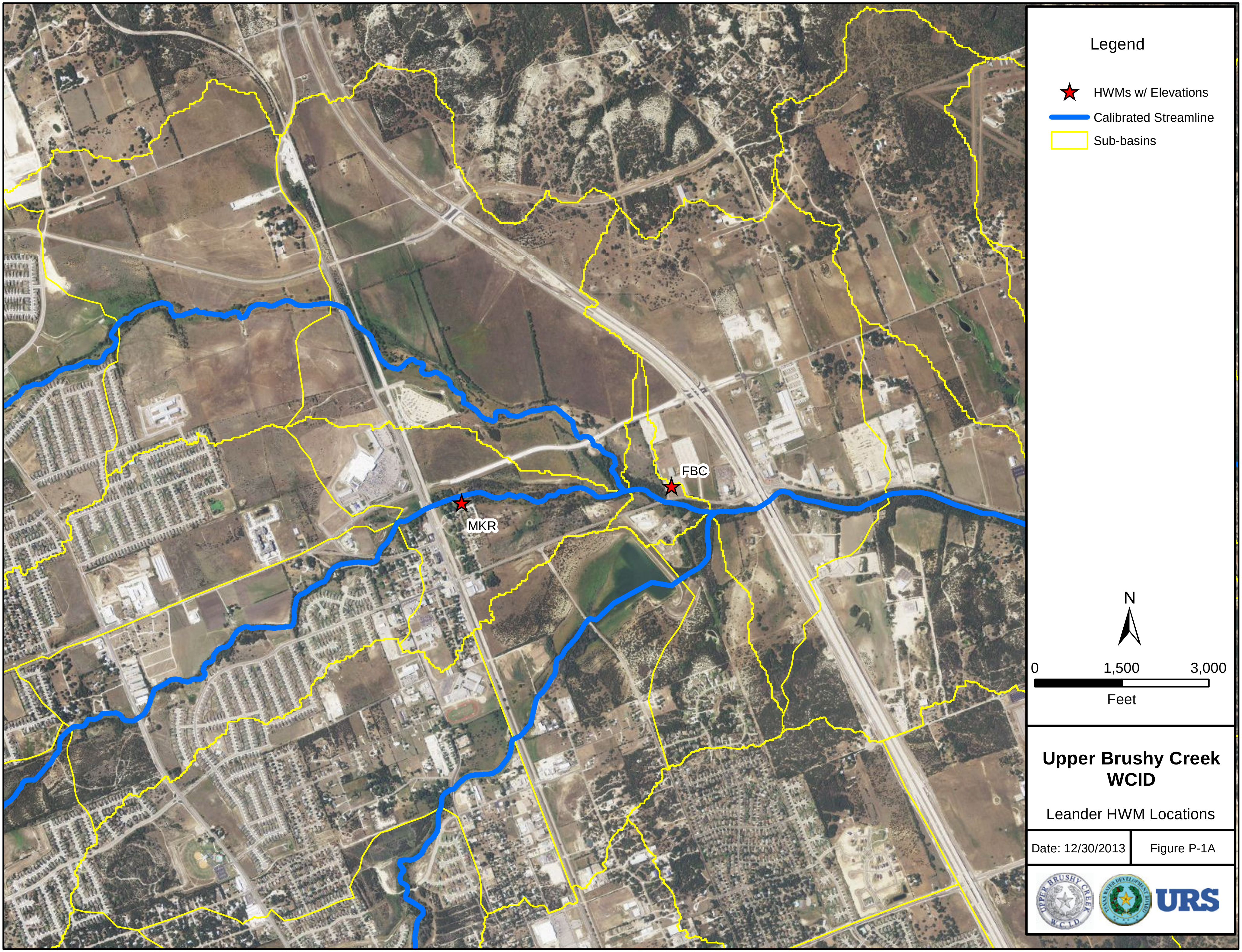
	Description	Manning's 'N' Value
Main Channels	Clean, straight, full no rifts or pools	0.030
	More stones and weeds	0.035
	Winding, some pools and shoals	0.040
	Some weeds and stones	0.045
	More ineffective slopes and sections	0.048
	More stones	0.050
	Sluggish, weedy, with deep pools	0.070
	With heavy stands of brush and timber	0.100
Flood Plains		
	Short grass/dry field no crops	0.030
	High/green grass	0.035
	Mature field crops/rough or eroded areas with stones	0.040
	Cleared land with tree stumps, no undergrowth	0.040
	Scattered, evenly spaced brush	0.05
	Light brush including small trees	0.055
	Small trees, some undergrowth	0.060
	Medium to dense brush or trees, tightly clumped, undergrowth	0.085
	Heavy stand of timber, undergrowth and fallen trees	0.100
Land Use		
	Neighborhoods with fences, trees, and buildings to include pavements	0.090
	Significant paved roadways	0.010

***If neighborhoods are densely packed or developed use 0.09 to describe entire developed area.**

***Only describe pavement with 0.01 if crosses significant roadway distinct from highly developed area described by 0.09**

*Be more detailed/specific closer to the channel

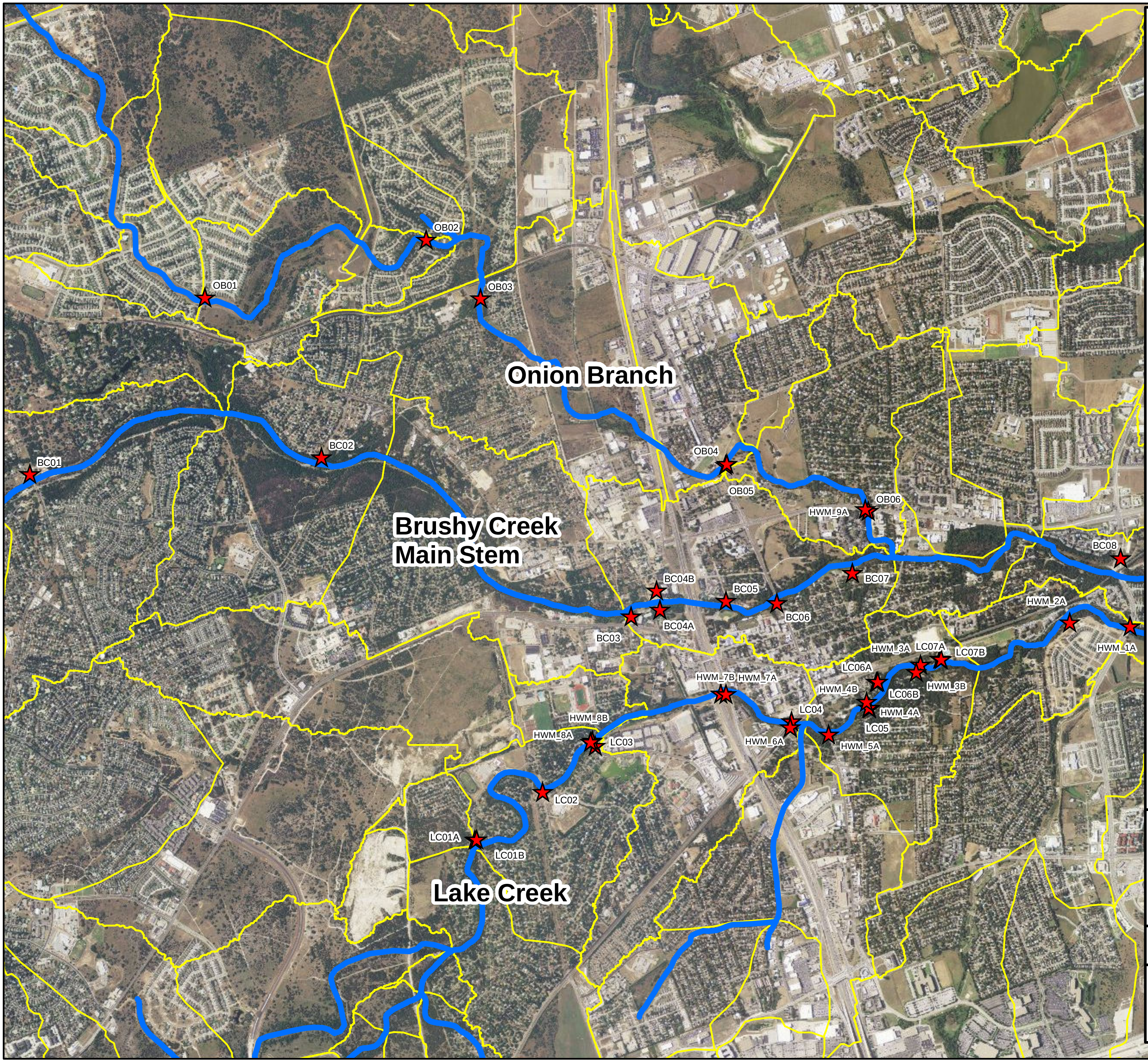
Figures



Upper Brushy Creek WCID

Leander HWM Locations

Date: 12/30/2013	Figure P-1A



Legend

HWMs w/ Elevations

Calibrated Streamline

Sub-basins

N

0 2,000 4,000

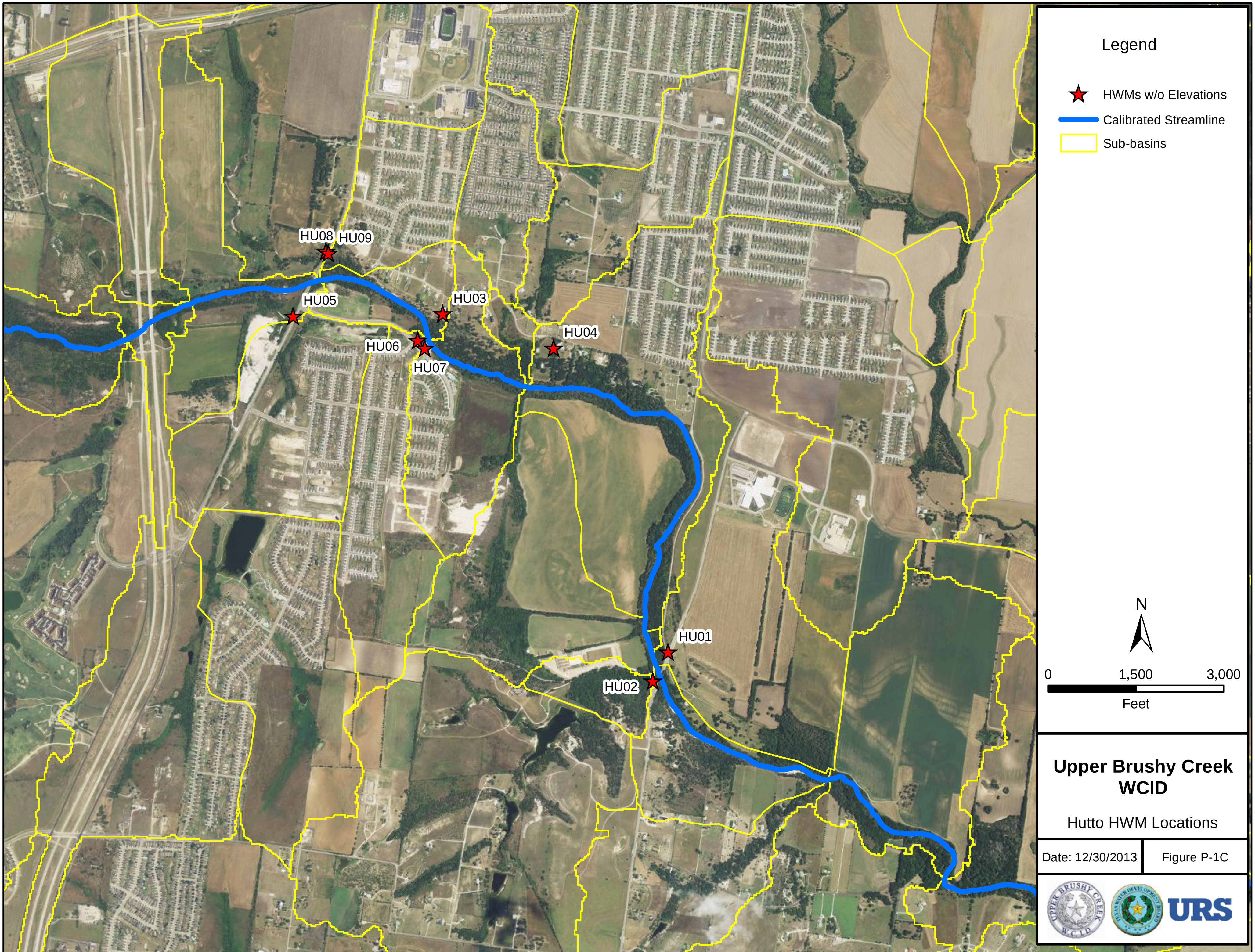
Feet

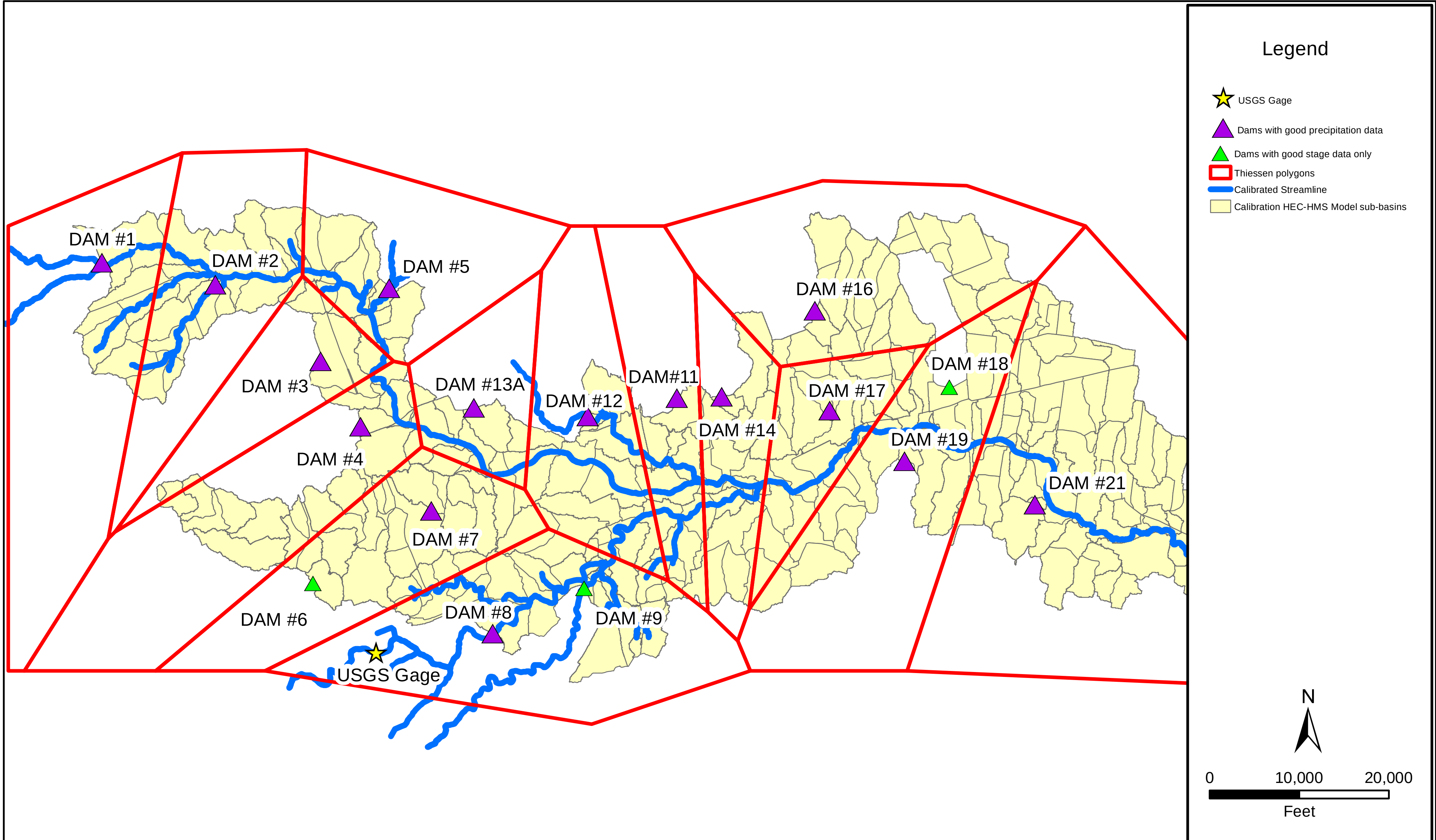
Upper Brushy Creek WCID

Round Rock HWM Locations

Date: 12/30/2013 | Figure P-1B

URS

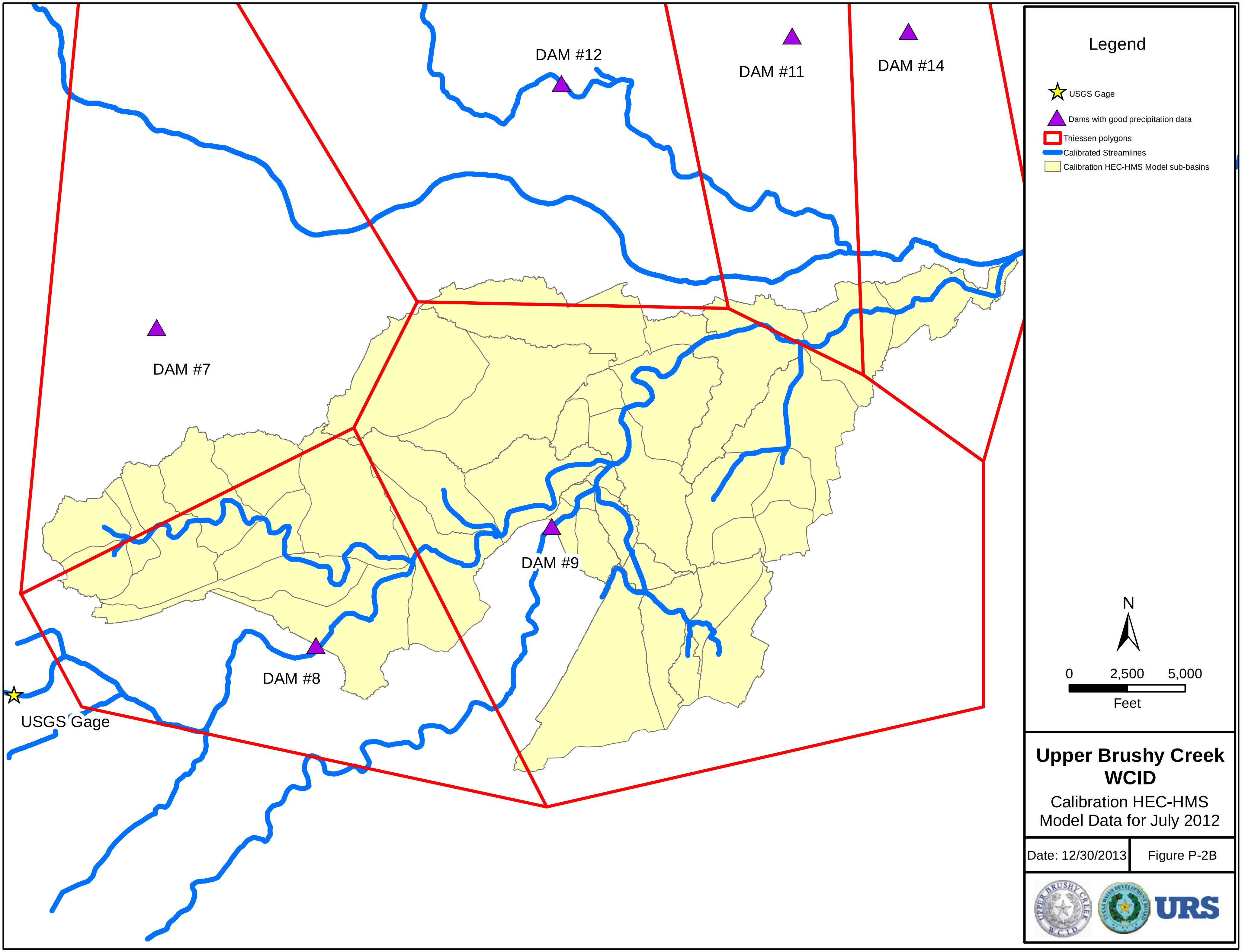

HU08
HU09
HU05
HU03
HU04
HU06
HU07
HU01
HU02
Legend
HWMs w/o Elevations
Calibrated Streamline
Sub-basins
N
0
1,500
3,000
Feet
Upper Brushy Creek WCID
Hutto HWM Locations
Date: 12/30/2013
Figure P-1C
URS



Upper Brushy Creek WCID

Calibration HEC-HMS Model Data for TS Hermine

Date: 12/30/2013	Figure P-2A


DAM #12
DAM #11
DAM #14
DAM #7
DAM #9
DAM #8
USGS Gage
Legend
USGS Gage
Dams with good precipitation data
Thiessen polygons
Calibrated Streamlines
Calibration HEC-HMS Model sub-basins
N
0
2,500
5,000
Feet
Upper Brushy Creek WCID
Calibration HEC-HMS Model Data for July 2012
Date: 12/30/2013
Figure P-2B
URS

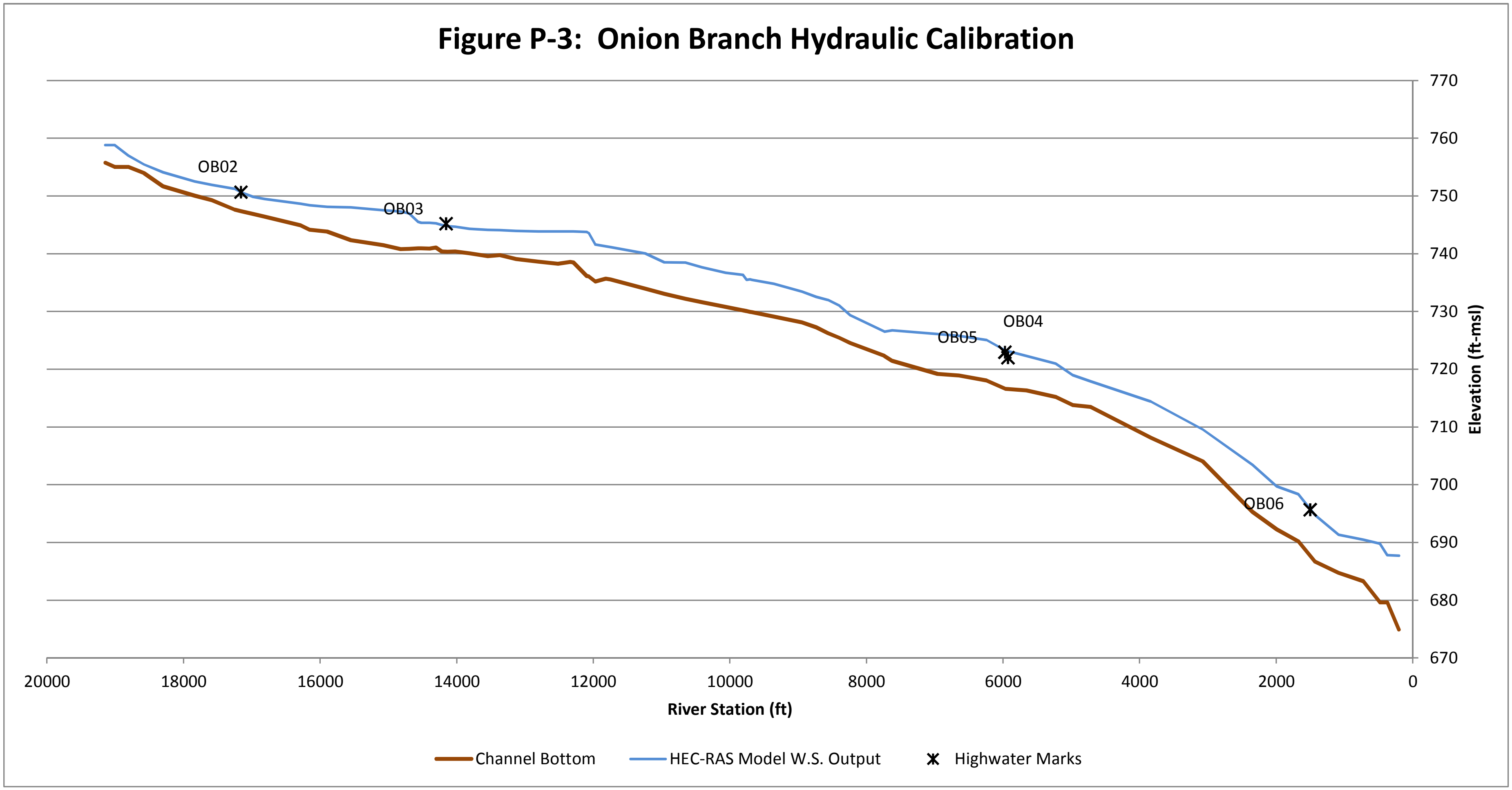


Figure P-3: Onion Branch Hydraulic Calibration
770
760
750
740
730
720
710
700
690
680
670
Elevation (ft-msl)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
River Station (ft)
OB02
OB03
OB05
OB04
OB06
Channel Bottom
HEC-RAS Model W.S. Output
Highwater Marks

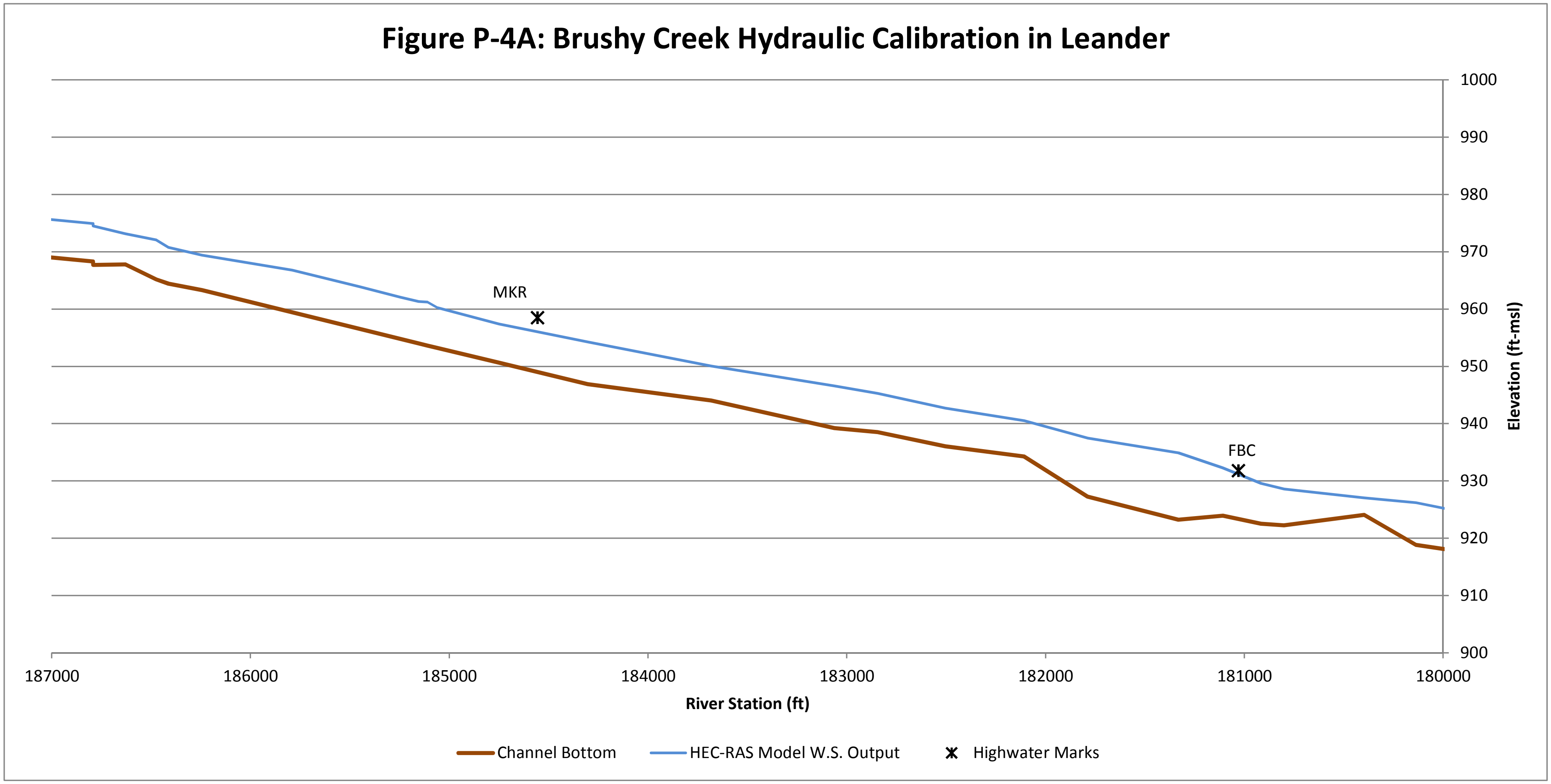
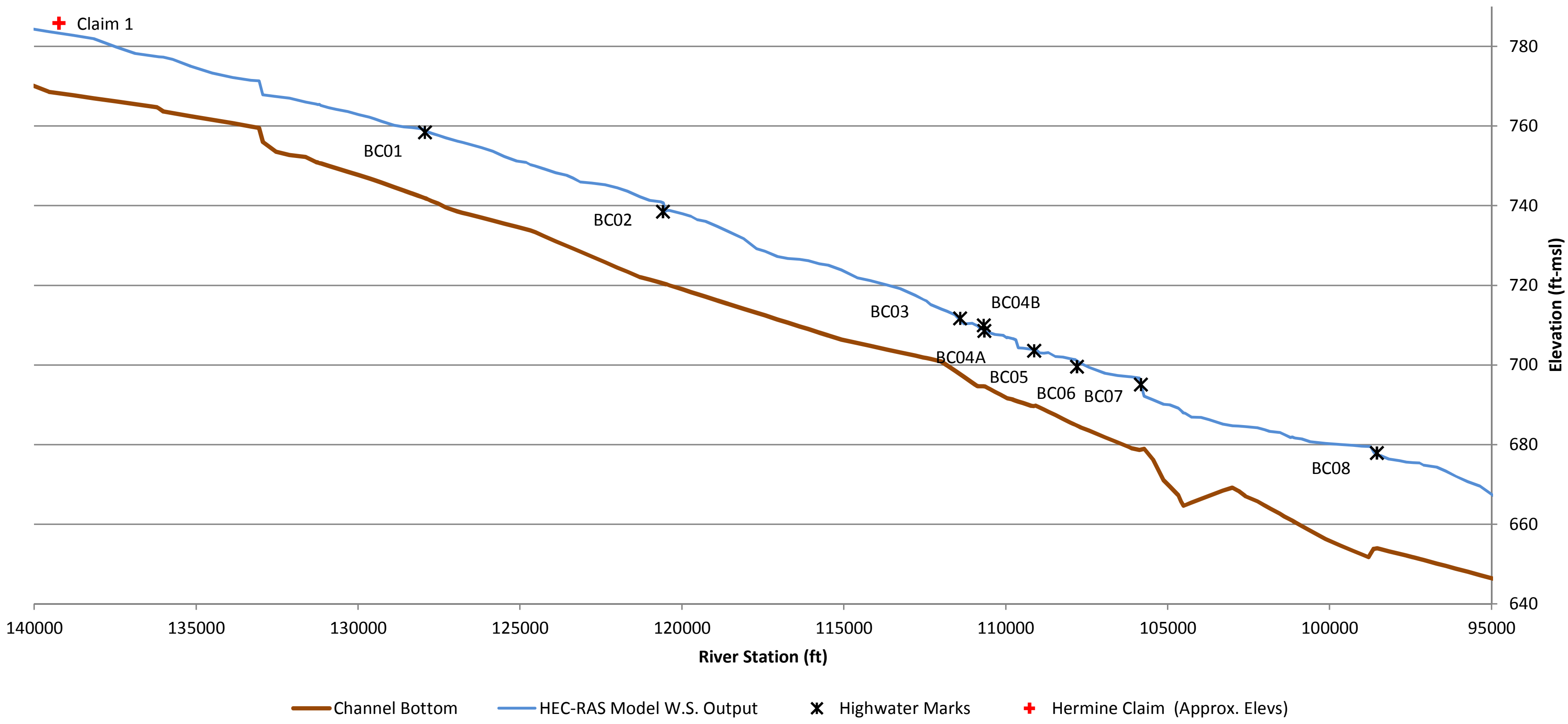


Figure P-4A: Brushy Creek Hydraulic Calibration in Leander
1000
990
980
970
960
950
940
930
920
910
900
Elevation (ft-msl)
MKR
FBC
187000
186000
185000
184000
183000
182000
181000
180000
River Station (ft)
Channel Bottom
HEC-RAS Model W.S. Output
Highwater Marks

Figure P-4B: Brushy Creek Hydraulic Calibration in Round Rock



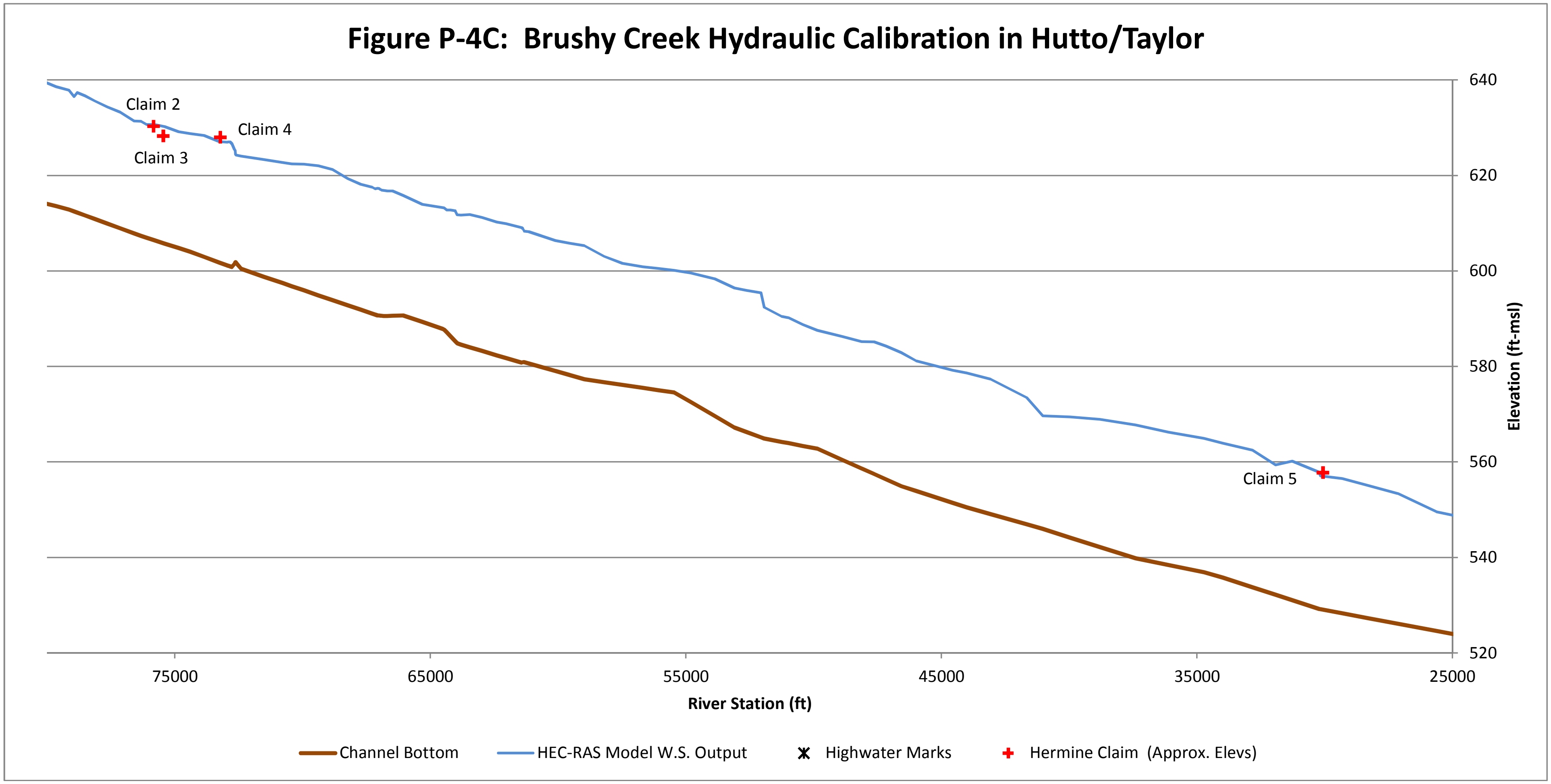
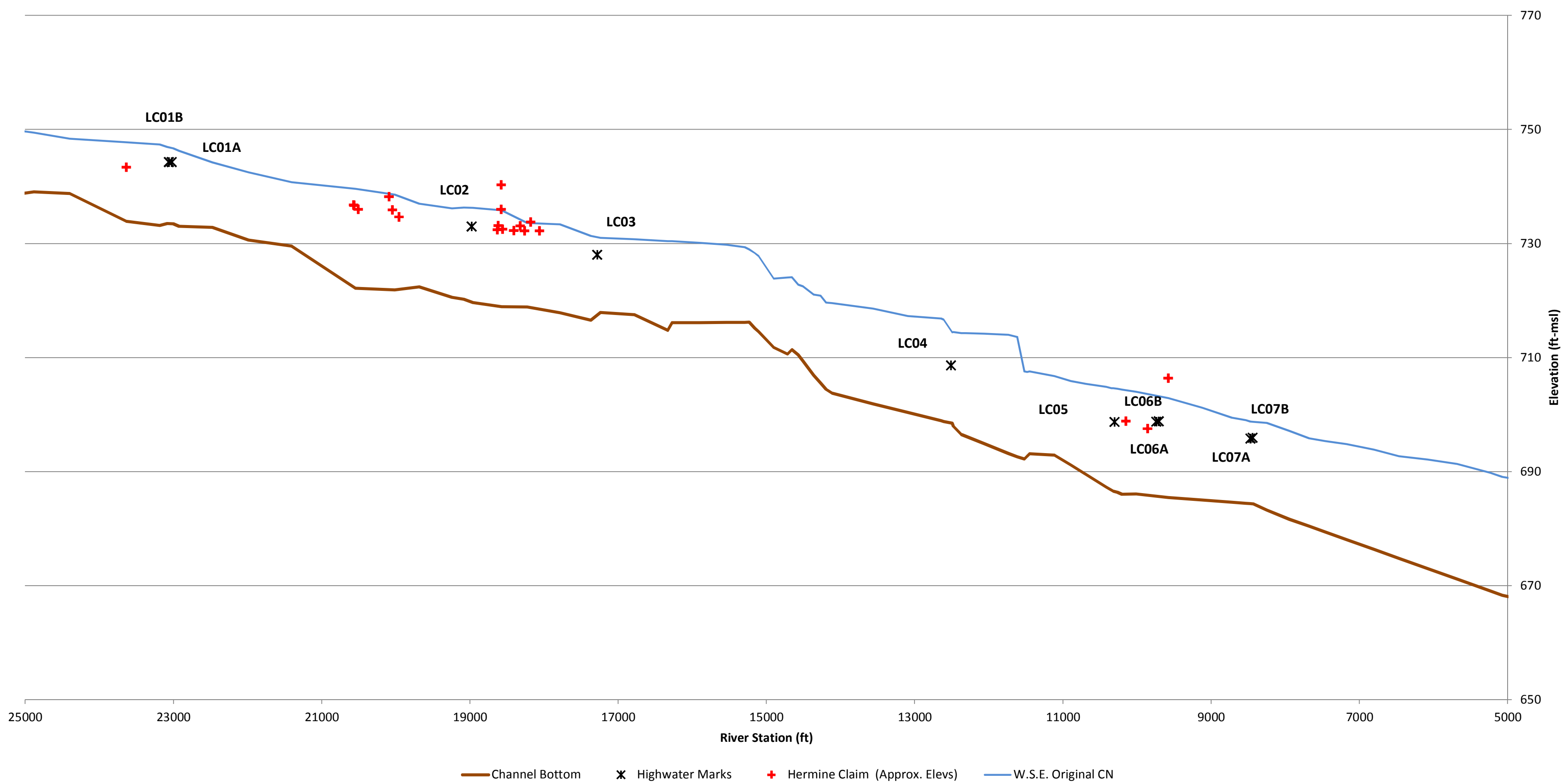


Figure P-4C: Brushy Creek Hydraulic Calibration in Hutto/Taylor
Claim 2
Claim 3
Claim 4
Claim 5
640
620
600
580
560
540
520
Elevation (ft-msl)
75000
65000
55000
45000
35000
25000
River Station (ft)
Channel Bottom
HEC-RAS Model W.S. Output
Highwater Marks
Hermine Claim (Approx. Elevs)

Figure P-5A: Hermine Lake Creek Hydraulic Calibration



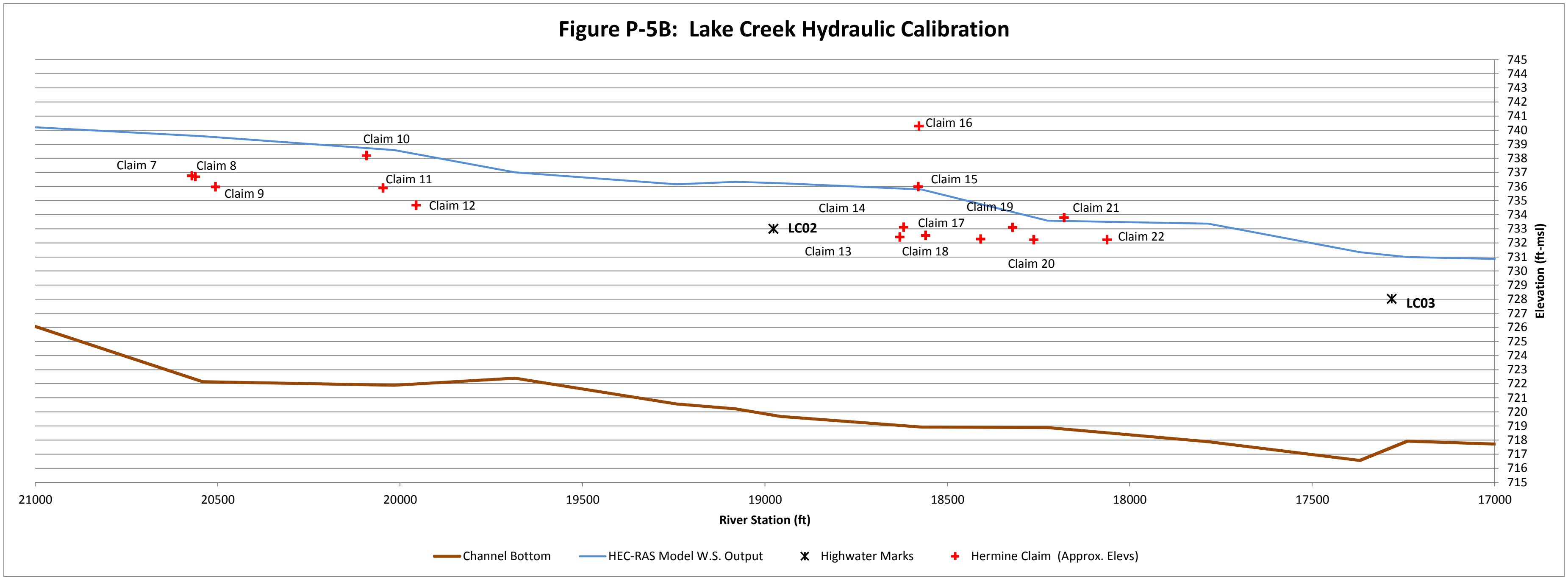


Figure P-5B: Lake Creek Hydraulic Calibration
Claim 7
Claim 8
Claim 9
Claim 10
Claim 11
Claim 12
Claim 13
Claim 14
Claim 15
Claim 16
Claim 17
Claim 18
Claim 19
Claim 20
Claim 21
Claim 22
LC02
LC03
Elevation (ft-msl)
River Station (ft)
Channel Bottom
HEC-RAS Model W.S. Output
Highwater Marks
Hermine Claim (Approx. Elevs)

Legend

HWMs w/ Elevations

Modeled Flood Extents

Calibrated Streamline

N

0 700 1,400

Feet

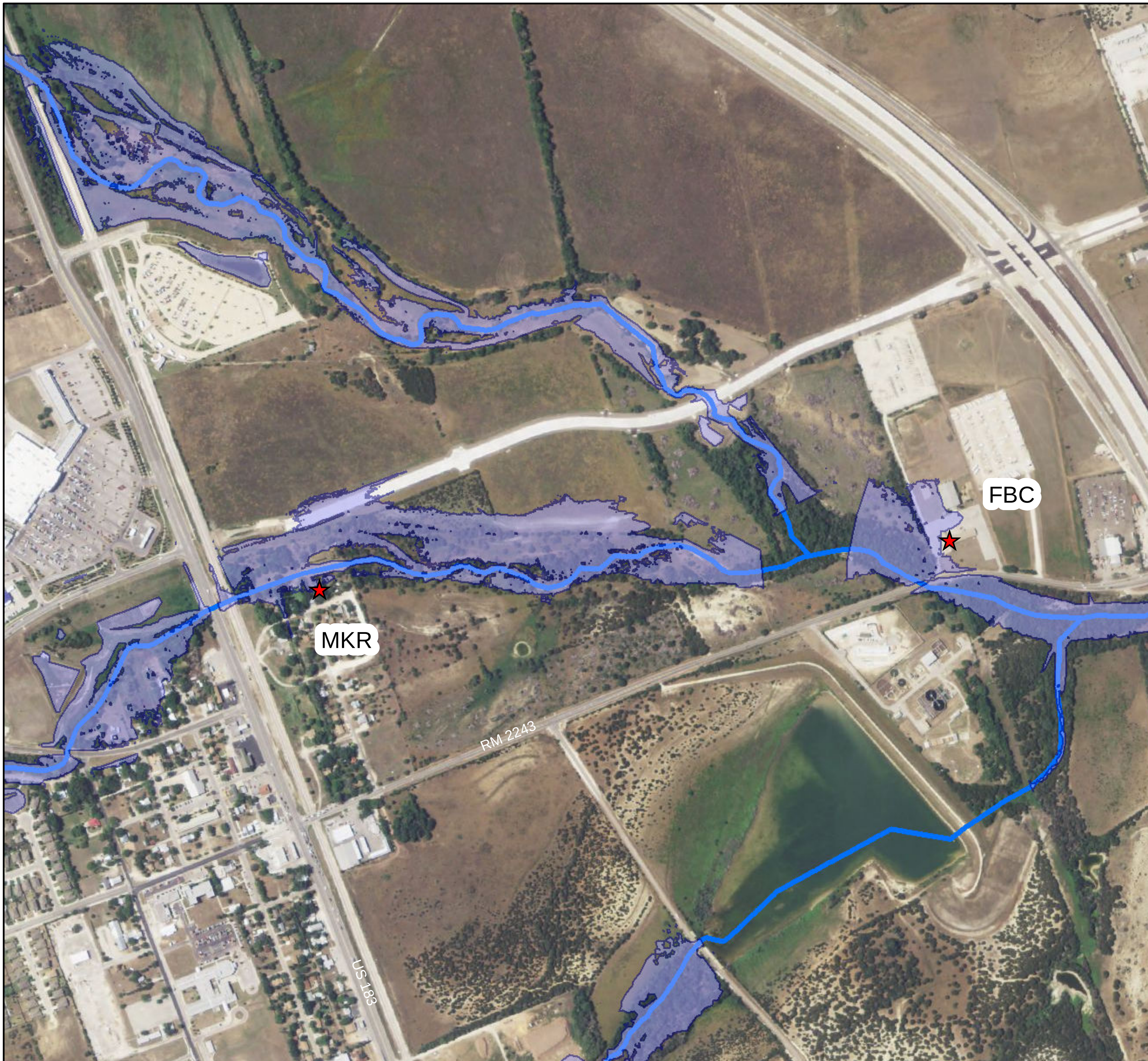
Upper Brushy Creek WCID

Hutto High Water Marks

Date: 12/30/2013

Figure P-6A

URS



Legend

- HWMs w/ Elevations
- Modeled Flood Extents
- Calibrated Streamline

N

0 500 1,000

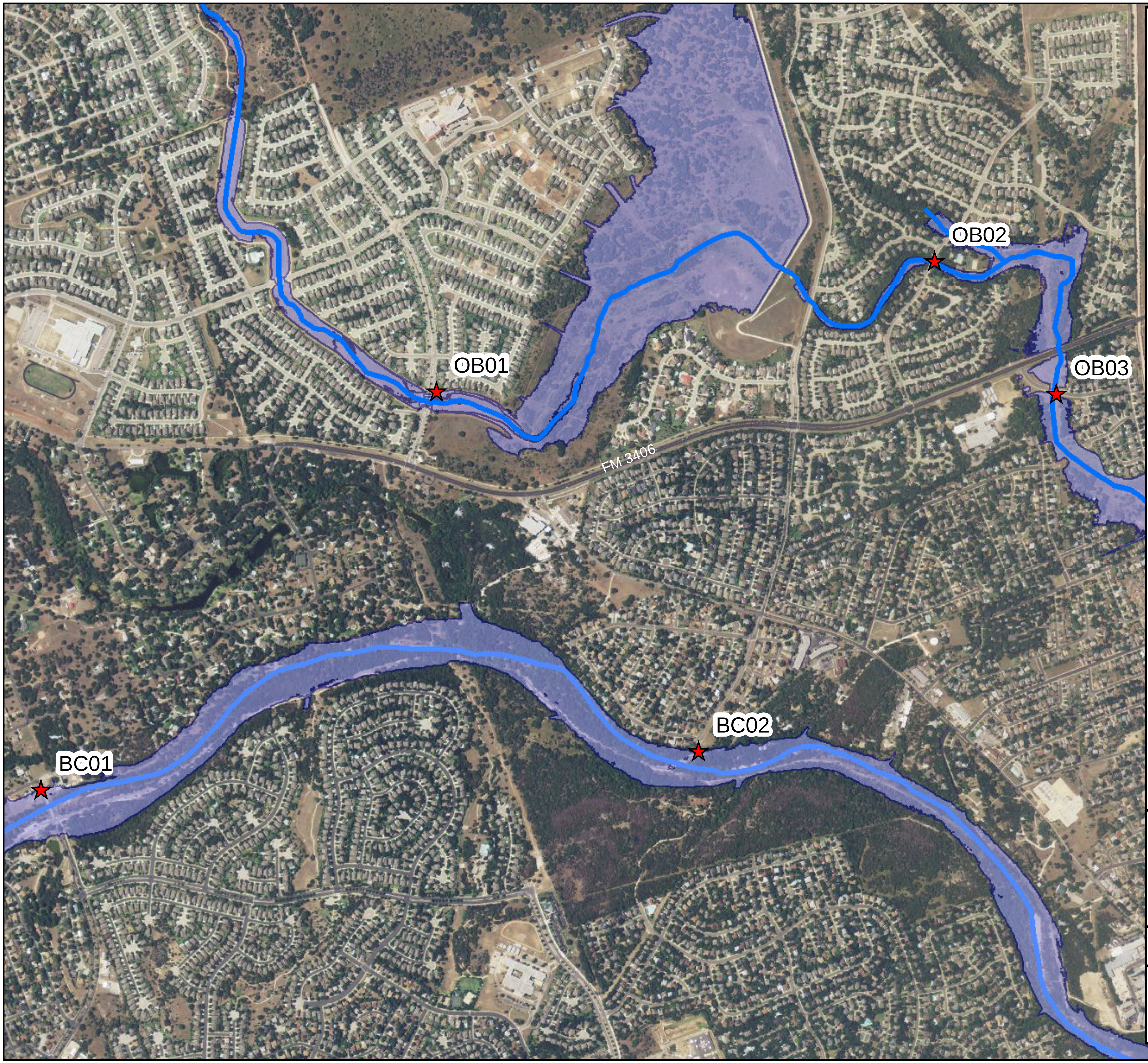
Feet

Upper Brushy Creek WCID

Leander High Water Marks

Date: 12/30/2013

Figure P-6B



Legend

HWMs w/ Elevations
Modeled Flood Extents
Calibrated Streamline

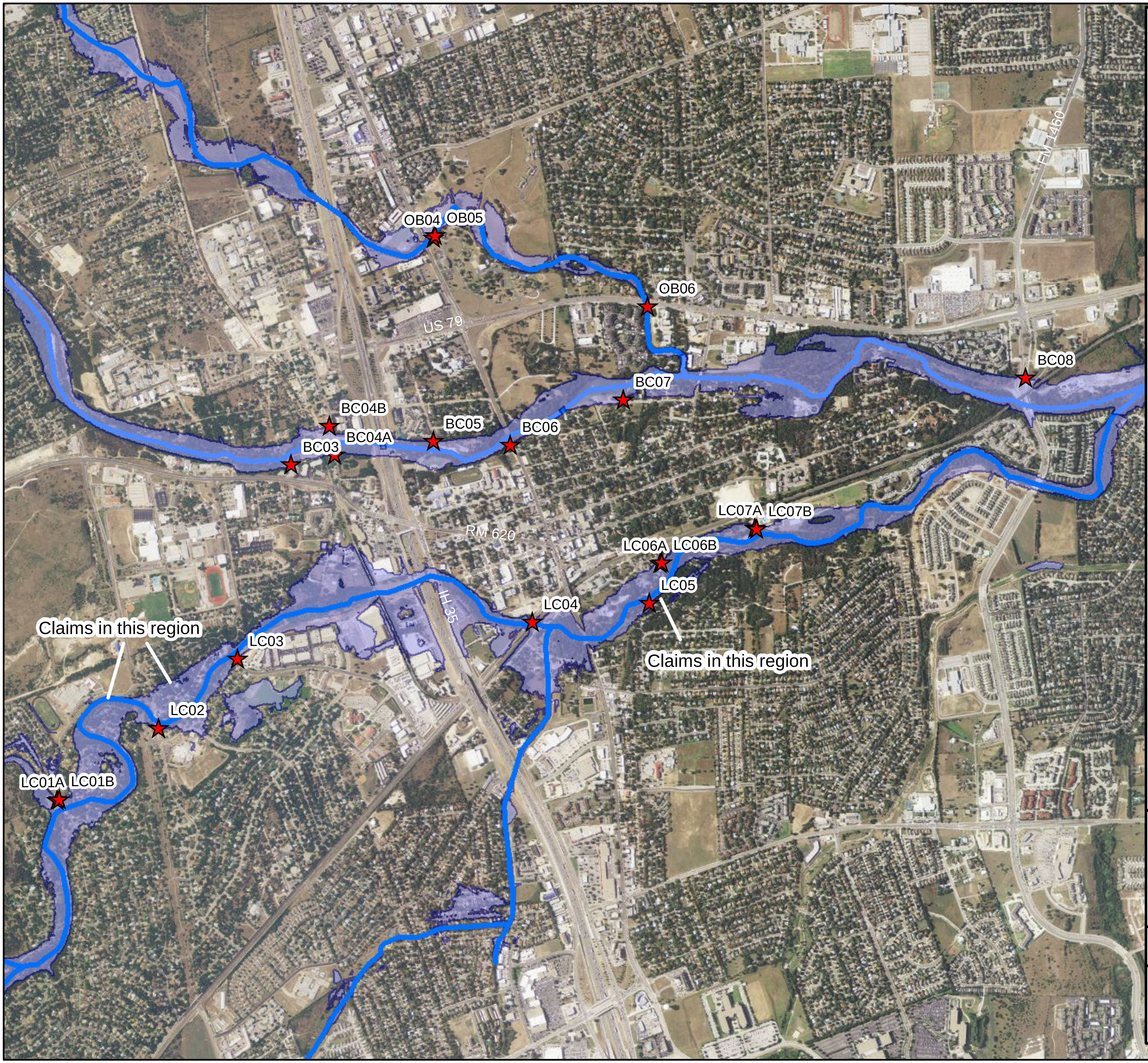
N

0 1,000 2,000
Feet

Upper Brushy Creek WCID

Round Rock HWMs I

Date: 12/30/2013	Figure P-6C



Legend

HWMs w/ Elevations
Modeled Flood Extents
Calibrated Streamline

N

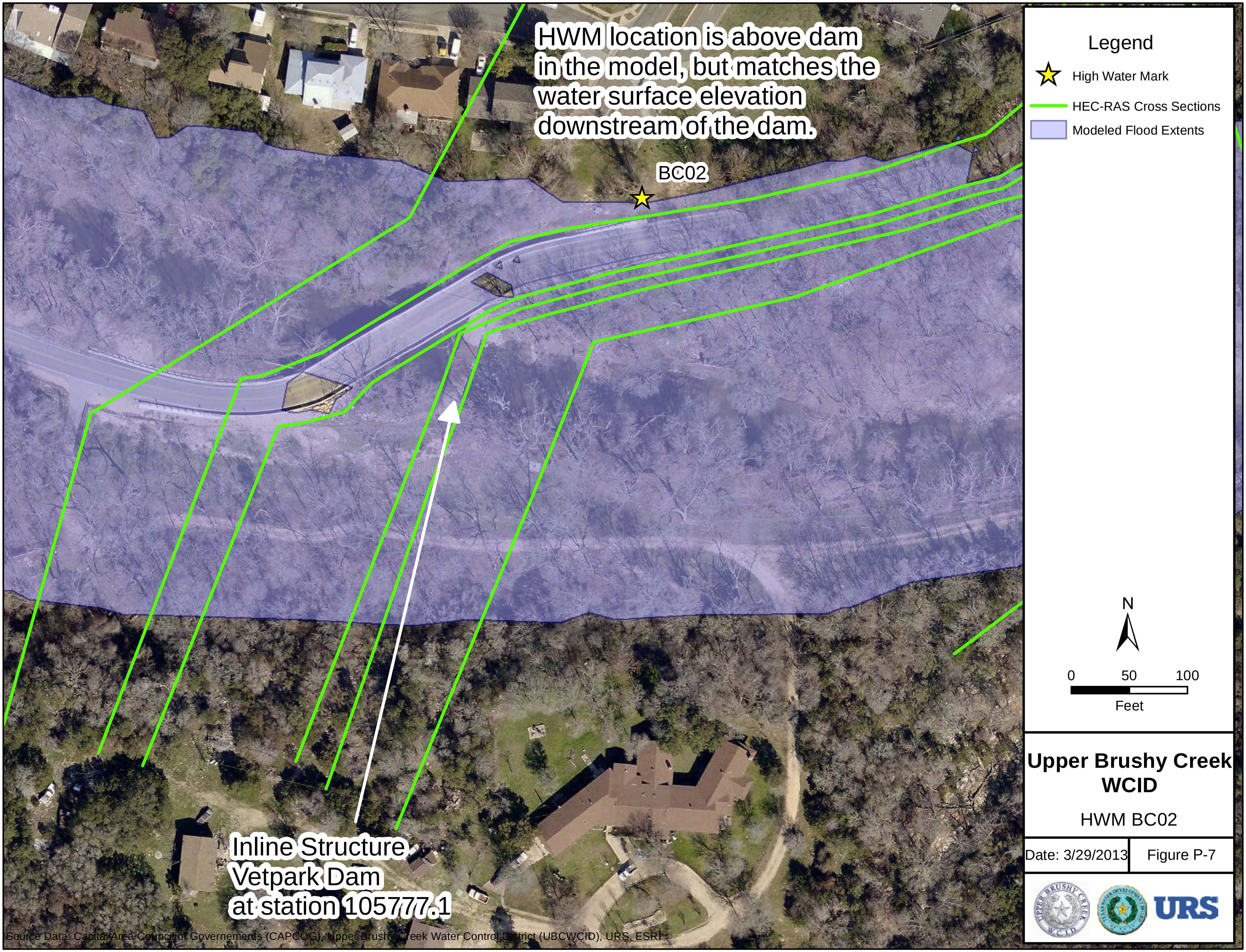
0 1,500 3,000
Feet

Upper Brushy Creek WCID

Round Rock HWMs II

Date: 12/30/2013	Figure P-6D

URS


HWM location is above dam in the model, but matches the water surface elevation downstream of the dam.
BC02
Inline Structure Vetpark Dam at station 105777.1
Legend
High Water Mark
HEC-RAS Cross Sections
Modeled Flood Extents
N
0
50
100
Feet
Upper Brushy Creek WCID
HWM BC02
Date: 3/29/2013
Figure P-7
URS
Source Data: Capital Area Council of Governements (CAPCOG), Upper Brushy Creek Water Control District (UBCWCID), URS, ESRI

Legend

- Claims
- HWMs w/ Elevations
- HWMs w/o Elevations
- Modeled Flood Extents

N

0 390 780
Feet

Upper Brushy Creek WCID

Great Oaks and Hairy Man

Date: 4/3/2013 | Figure P-8

URS

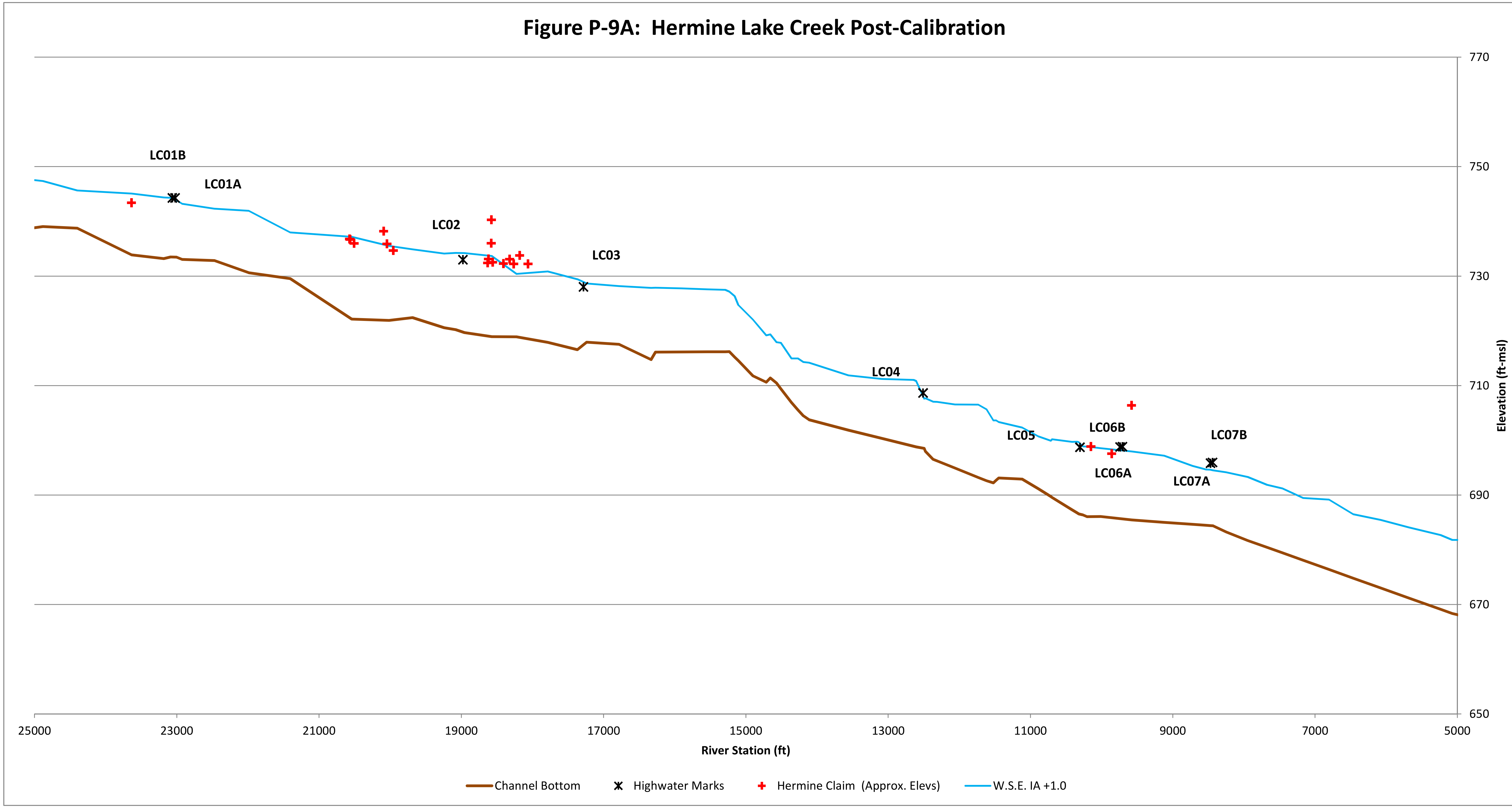


Figure P-9A: Hermine Lake Creek Post-Calibration
LC01B
LC01A
LC02
LC03
LC04
LC05
LC06B
LC06A
LC07B
LC07A
770
750
730
710
690
670
650
Elevation (ft-msl)
25000
23000
21000
19000
17000
15000
13000
11000
9000
7000
5000
River Station (ft)
Channel Bottom
Highwater Marks
Hermine Claim (Approx. Elevs)
W.S.E. IA +1.0

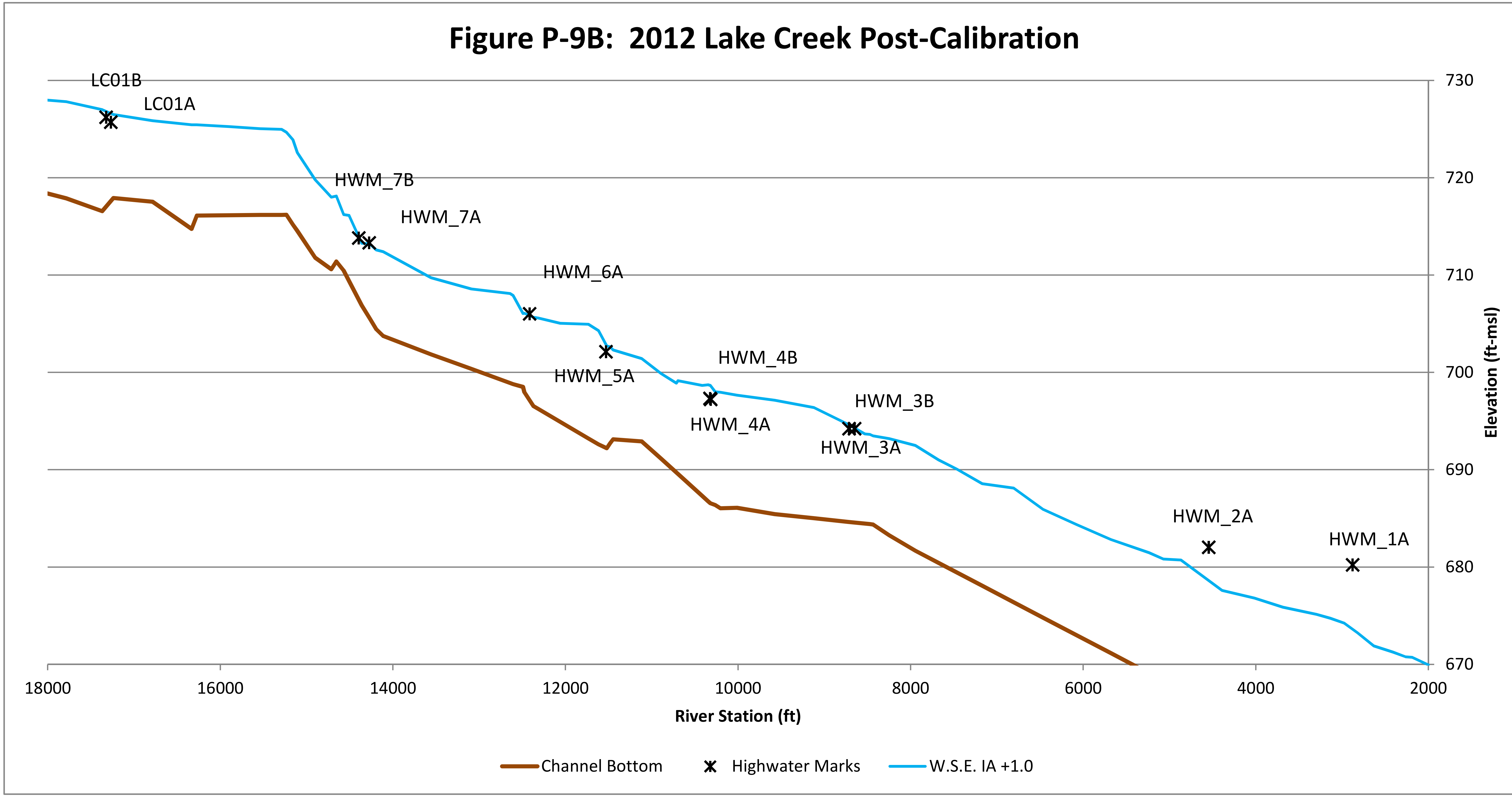
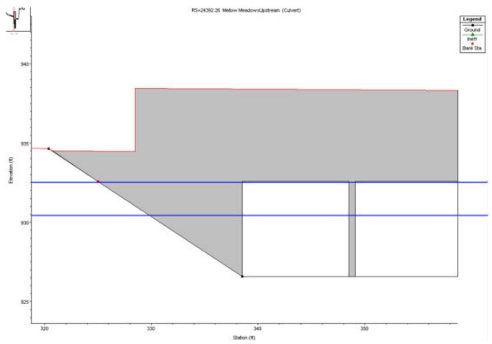
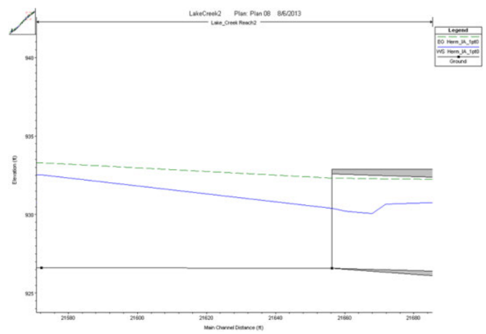
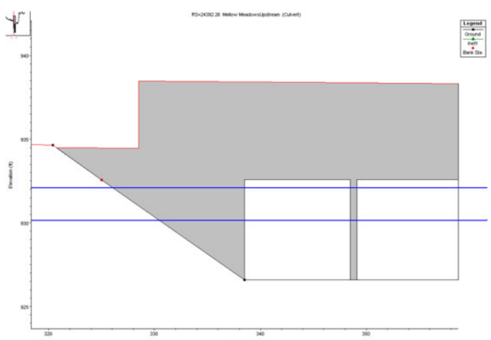


Figure P-9B: 2012 Lake Creek Post-Calibration
LC01B
LC01A
HWM_7B
HWM_7A
HWM_6A
HWM_5A
HWM_4B
HWM_4A
HWM_3B
HWM_3A
HWM_2A
HWM_1A
730
720
710
700
690
680
670
Elevation (ft-msl)
18000
16000
14000
12000
10000
8000
6000
4000
2000
River Station (ft)
Channel Bottom
Highwater Marks
W.S.E. IA +1.0

Figure P-10A: Lake Creek Photographs at Deerbrook Trail, Upstream







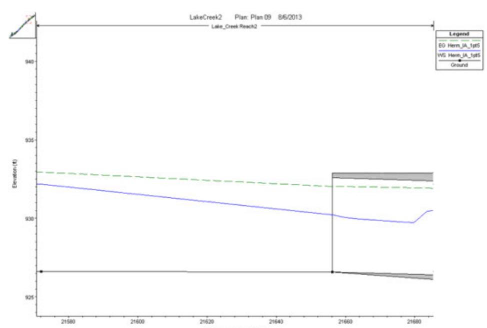
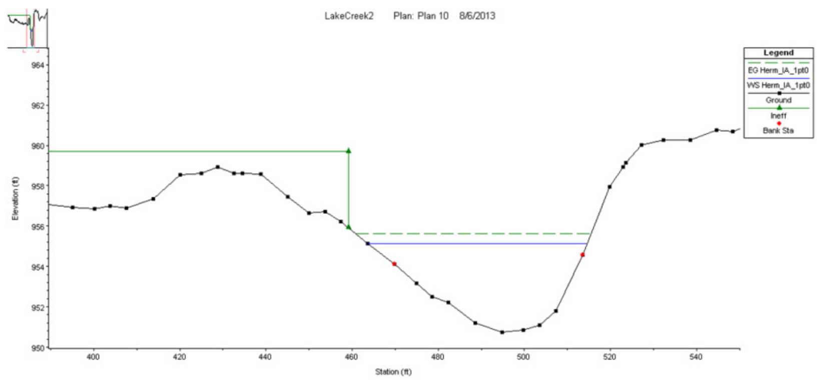
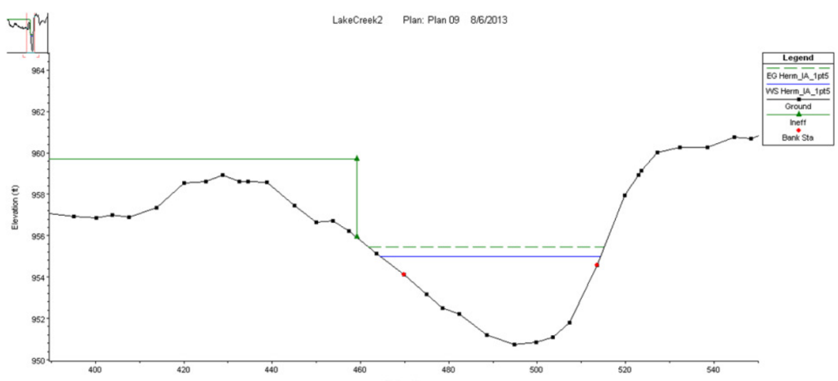
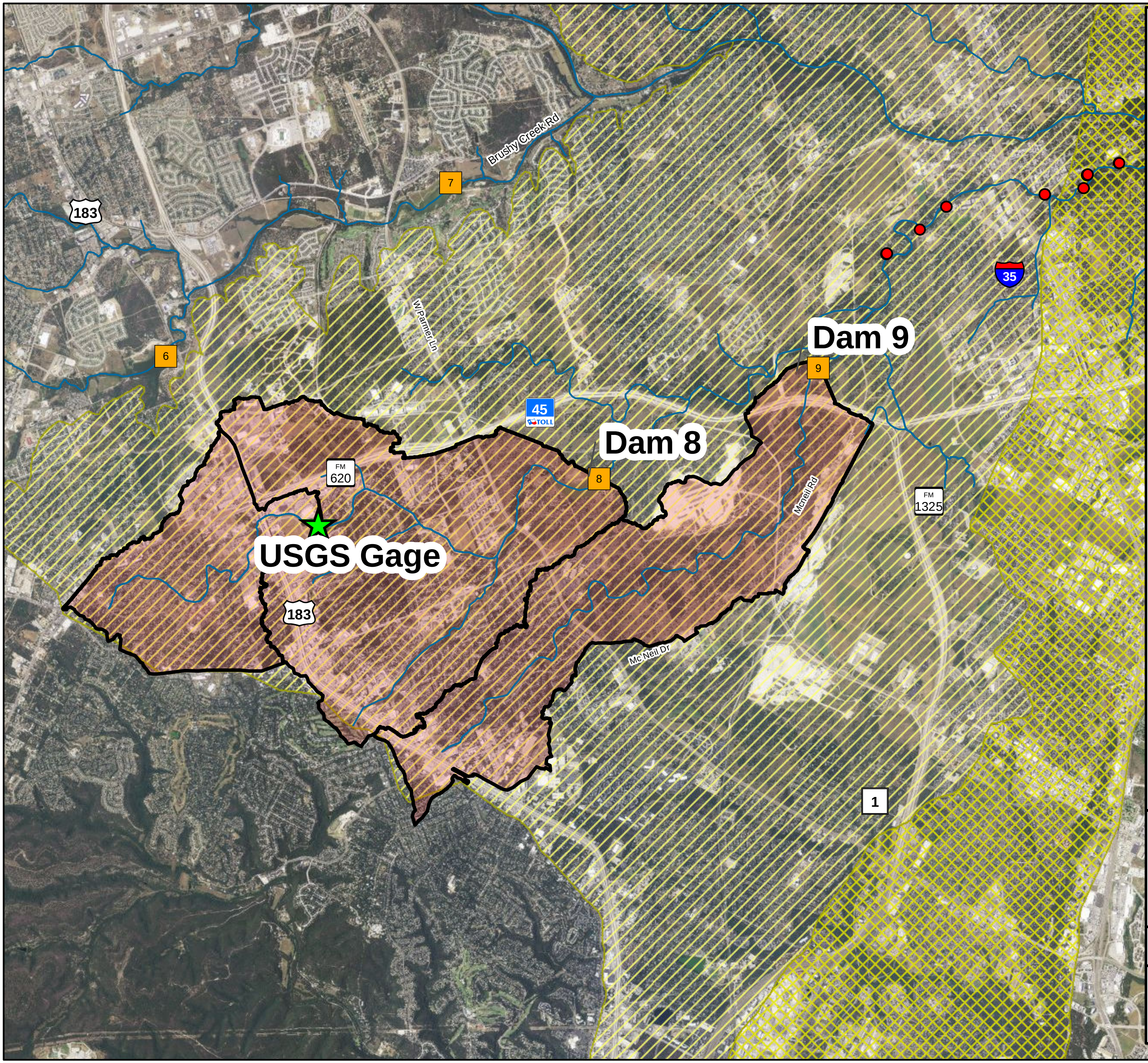


Figure P-10B: Lake Creek Photographs at Deerbrook Trail, Downstream







Upper Brushy Creek WCID

Lake Creek Calibration Analysis

Date: 1/7/2013 | Figure P-11

Exhibit Q
Priority Areas

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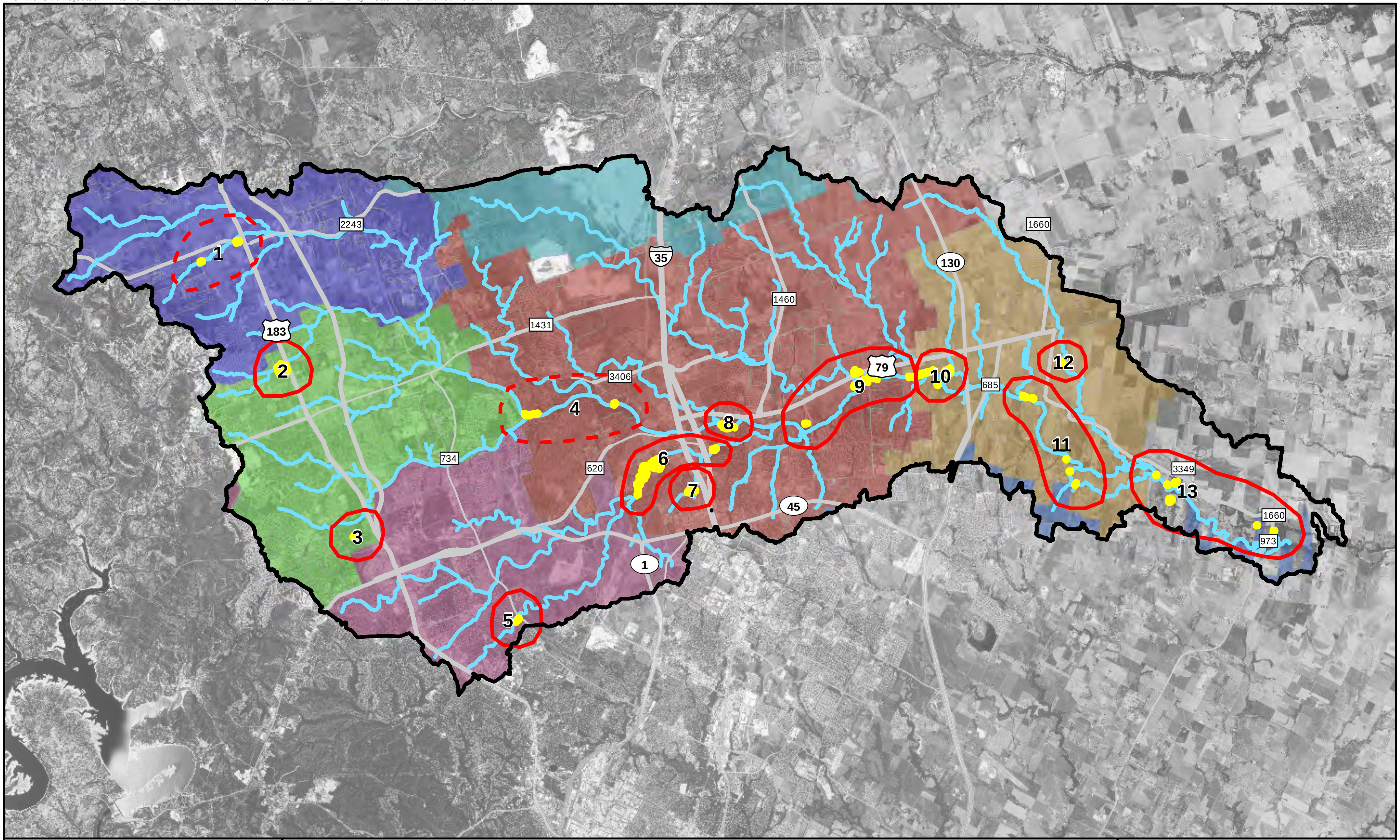


Legend

- Priority Areas (higher priority)
- Priority Areas (lower priority)
- Habitable Structures Damage Center
- Stream

Texas Water Development Board

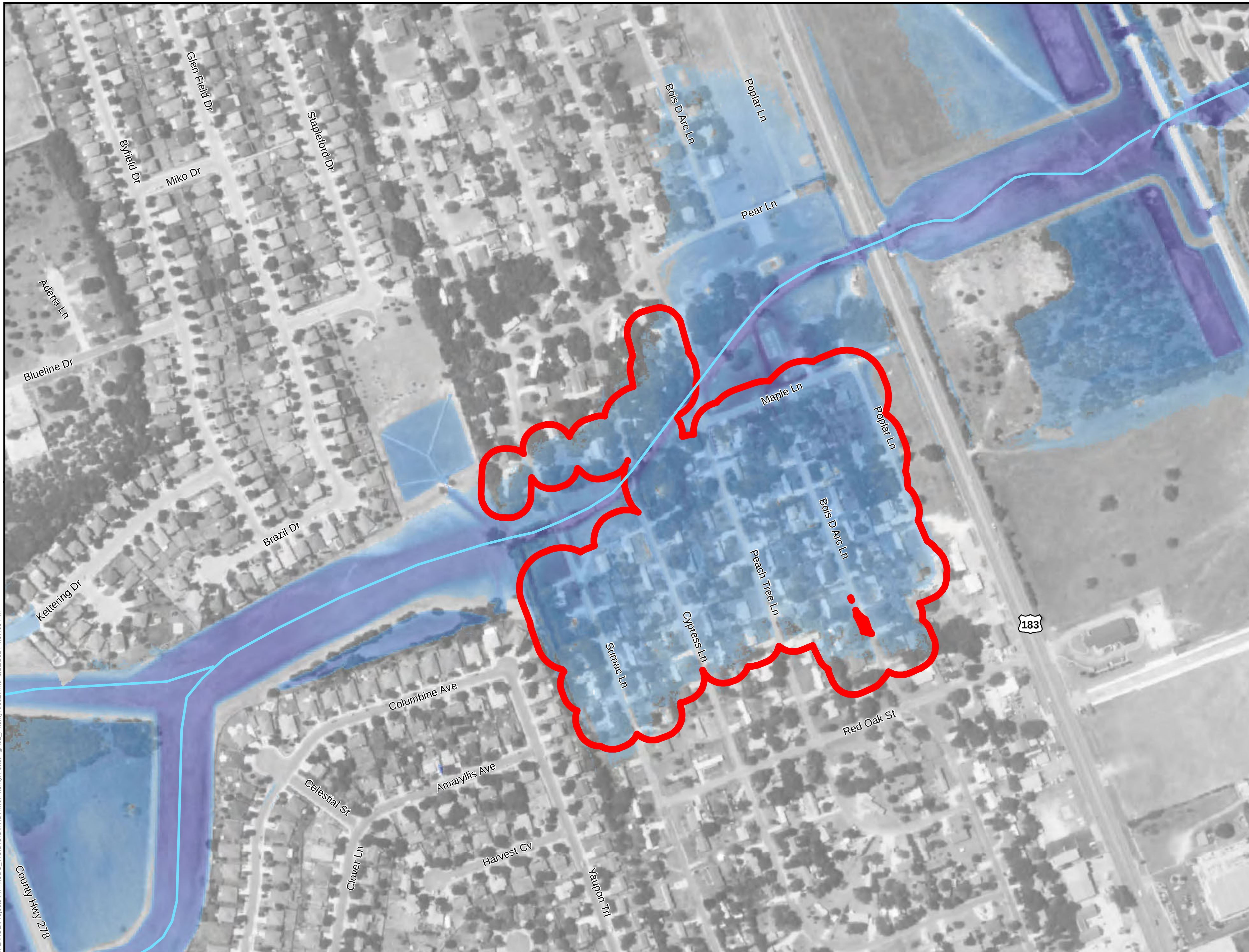
URS

Upper Brushy Creek WCID

Priority Areas

Date: 5/12/2014

Figure Q-1



Legend

Habitable Structures Damage Center

Stream

100-yr Flood Depth

High : 5

Low : -1

N

0 150 300 Feet

Aerial Photography Source:
National Agriculture Imagery Program (NAIP), 2012.

Upper Brushy Creek WCID

Priority Area 2

Date: 5/12/2014	Figure Q-2

Texas Water Development Board

URS

File: L:\AGE\Projects\INFR\UBC_WCID\GIS\MXD\TM6\PriorityAreas\FigA02_PriorityArea2.mxd 5/12/2014 4:57:03 PM

Legend

Habitable Structures Damage Center

Stream

100-yr Flood Depth

High : 5

Low : -1

N

0 225 450 Feet

Aerial Photography Source:
National Agriculture Imagery Program (NAIP), 2012.

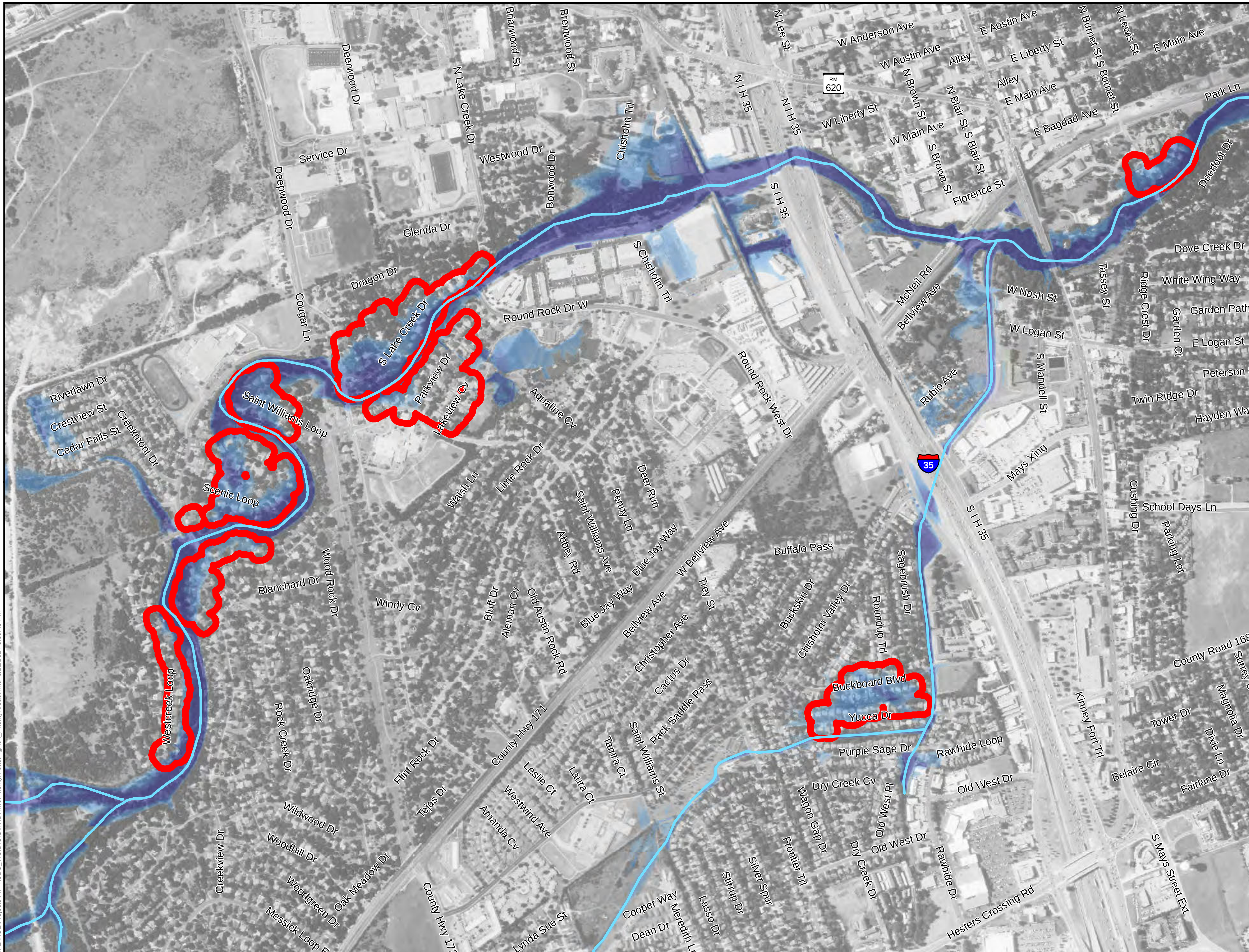
Upper Brushy Creek WCID

Priority Area 3

Date: 5/12/2014	Figure Q-3

Texas Water Development Board

URS



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Legend

Habitable Structures Damage Center

Stream

100-yr Flood Depth

High : 5

Low : -1

N

0 450 900 Feet

Aerial Photography Source:
National Agriculture Imagery Program (NAIP), 2012.

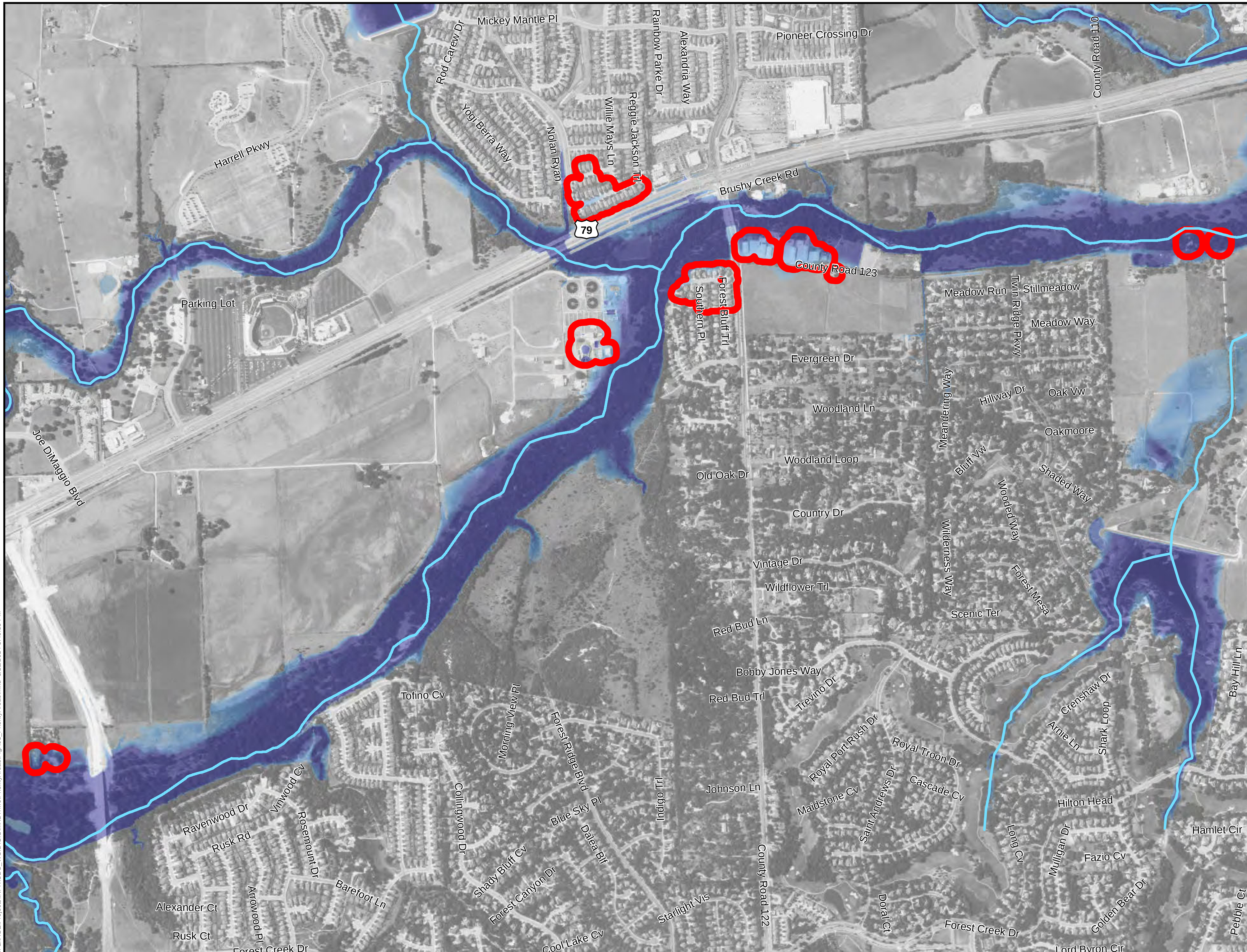
Upper Brushy Creek WCID

Priority Area 6

Date: 5/12/2014	Figure Q-4

Texas Water Development Board

URS



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Legend

- Habitable Structures Damage Center
- Stream

100-yr Flood Depth

- High : 5
- Low : -1

N

0 525 1,050 Feet

Aerial Photography Source:
National Agriculture Imagery Program (NAIP), 2012.

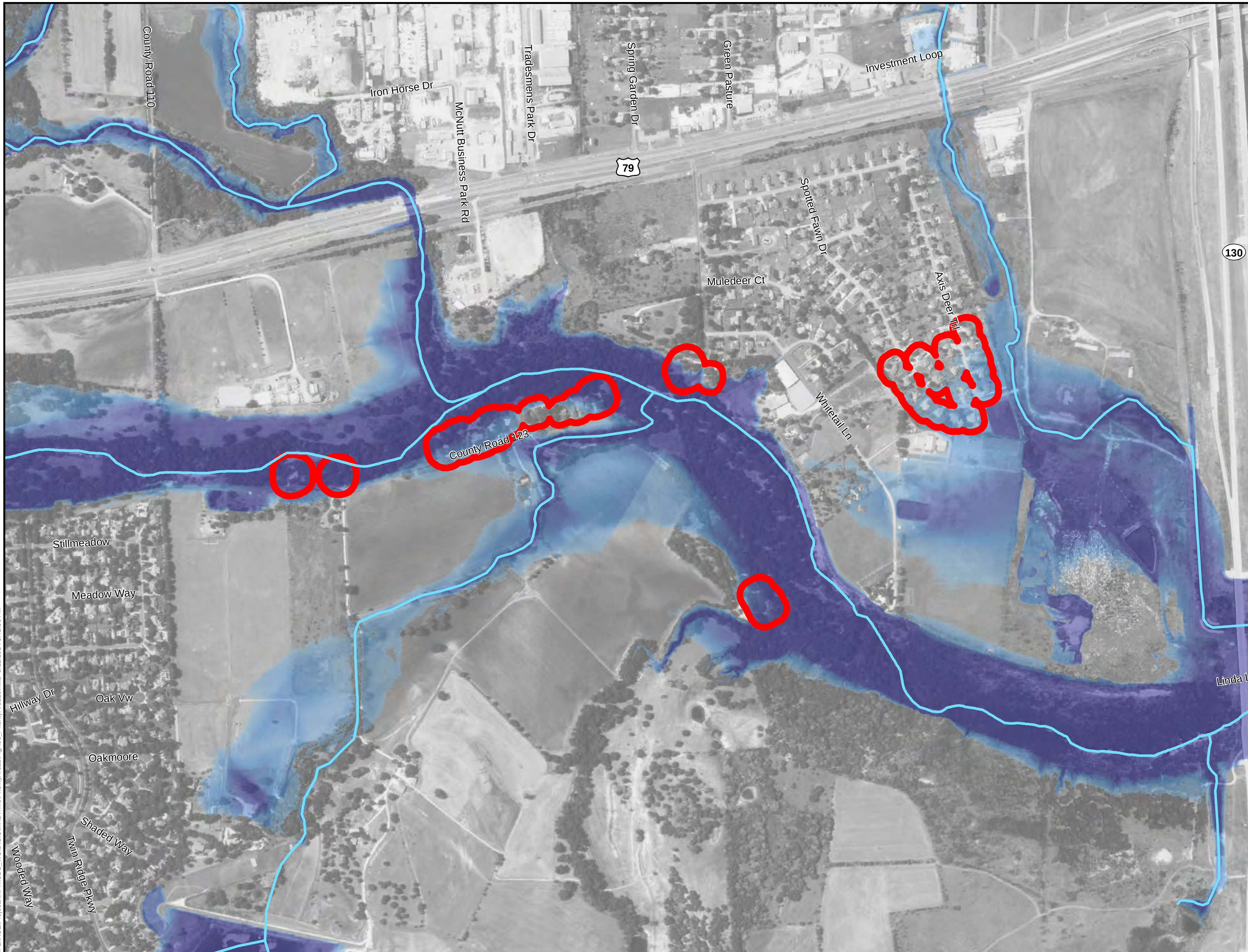
Upper Brushy Creek WCID

Priority Area 9

Date: 5/12/2014	Figure Q-5

Texas Water Development Board

URS



Legend

Habitable Structures Damage Center

Stream

100-yr Flood Depth

High : 5

Low : -1

N

0 350 700 Feet

Aerial Photography Source:
National Agriculture Imagery Program (NAIP), 2012.

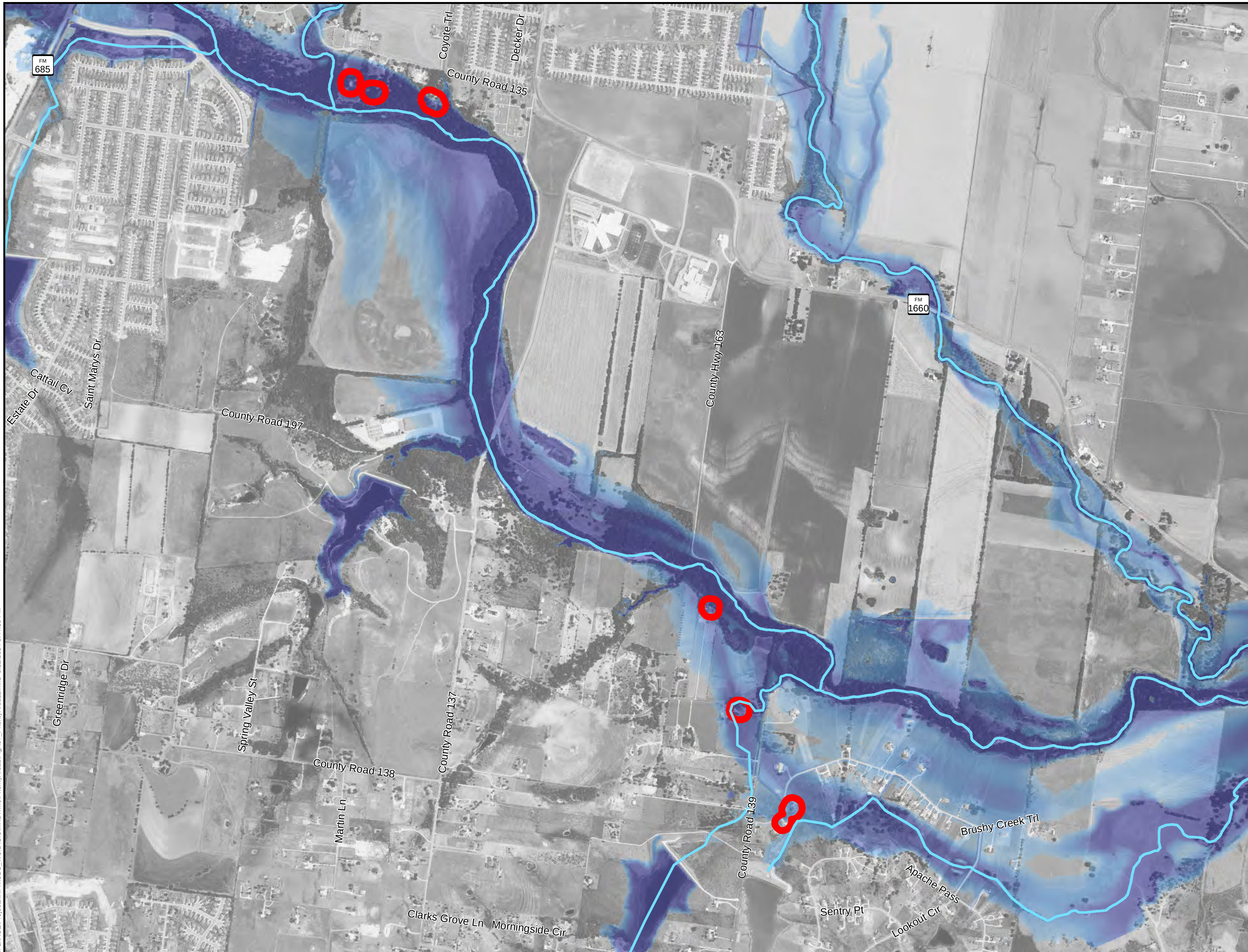
Upper Brushy Creek WCID

Priority Area 10

Date: 5/12/2014	Figure Q-6

Texas Water Development Board

URS



Legend

Habitable Structures Damage Center

Stream

100-yr Flood Depth

High : 5

Low : -1

N

0 700 1,400 Feet

Aerial Photography Source:
National Agriculture Imagery Program (NAIP), 2012.

Upper Brushy Creek WCID

Priority Area 11

Date: 5/12/2014	Figure Q-7

Texas Water Development Board

URS

File: L:\AGE\Projects\INFR\UBC_WCID\GIS\MXD\TM6\PriorityAreas\FigA07_PriorityArea11.mxd 5/12/2014 3:44:36 PM

Legend

Habitable Structures Damage Center

Stream

100-yr Flood Depth

High : 5

Low : -1

N

0 225 450 Feet

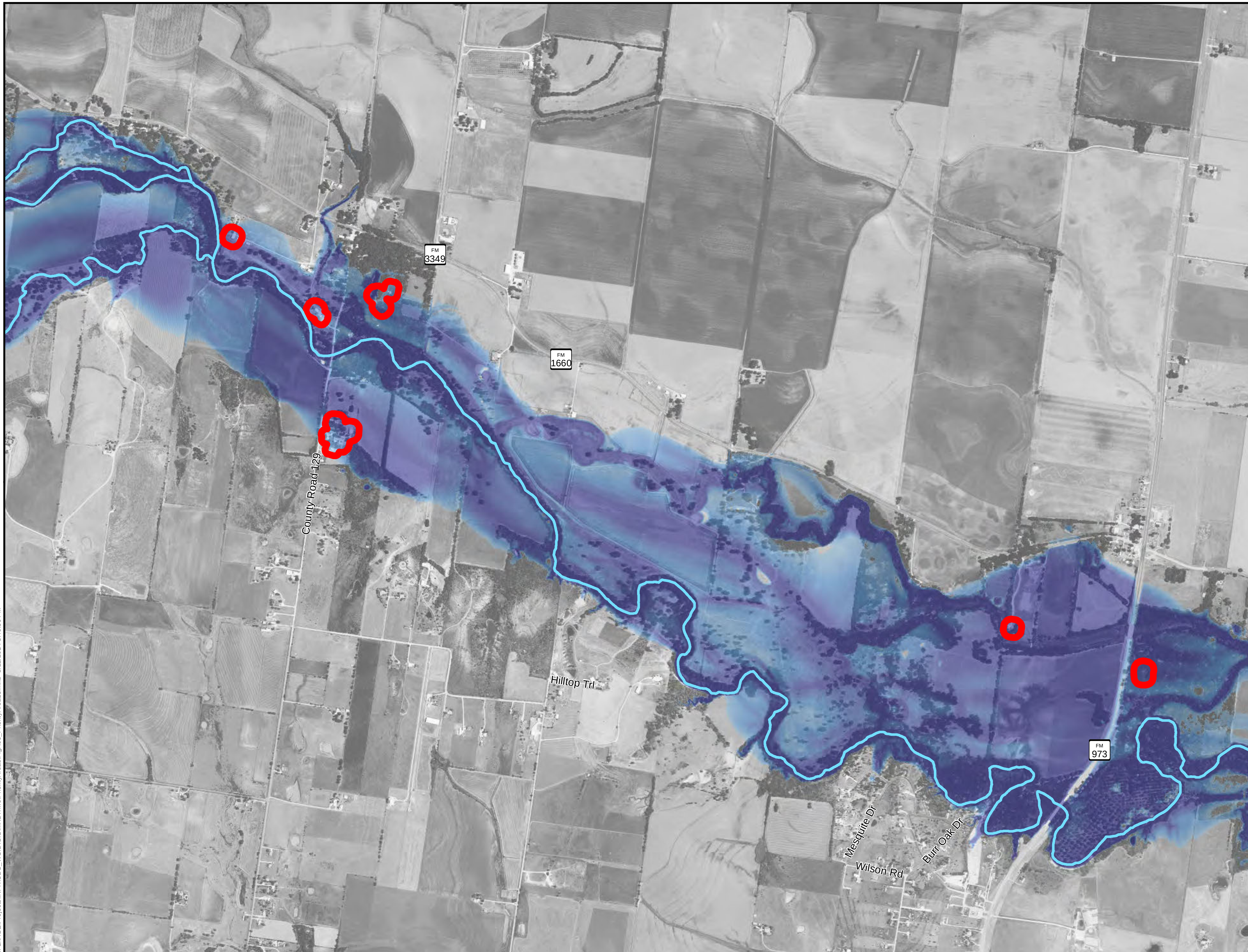
Aerial Photography Source:
National Agriculture Imagery Program (NAIP), 2012.

Upper Brushy Creek WCID

Priority Area 12

Date: 5/12/2014	Figure Q-8

File: L:\AGE\Projects\INFR\UBC_WCID\GIS\MXD\TM6\PriorityAreas\FigA08_PriorityArea12.mxd 5/12/2014 3:45:40 PM



Legend

Habitable Structures Damage Center

Stream

100-yr Flood Depth

High : 5

Low : -1

N

0 750 1,500 Feet

Aerial Photography Source:
National Agriculture Imagery Program (NAIP), 2012.

Upper Brushy Creek WCID

Priority Area 13

Date: 5/12/2014	Figure Q-9

Upper Brushy Creek W.C.I.D.
Texas Water Development Board
URS

Exhibit R
Factor Weighting Sensitivity Analysis Memo
URS Corporation, November 4, 2013

TO: Ruth Haberman, General Manager, Upper Brushy Creek Water Control and Improvement District

FROM: Jeff Irvin, P.E.

DATE: November 4, 2013

RE: Factor Weighting Sensitivity Analysis Memo
Flood Protection Planning for Upper Brushy Creek Watershed

Memorandum Purpose

The purpose of this memorandum is to discuss a sensitivity analysis that was performed to evaluate the impact of weighting eight factors (seven qualitative factors and one flood score factor) that were considered when selecting the top eight Priority Areas for the Upper Brushy Creek Flood Protection Plan. Base weighting values were developed from pairwise comparisons that were performed by each member of the Upper Brushy Creek Water Control and Improvement District (UBCWCID) Board and by each member of the Upper Brushy Creek Flood Protection Plan Technical Advisory Committee (TAC) at a public meeting held on 10/11/2013. Following the public meeting, there was some discussion about the results of the pairwise comparisons and the potential impact of the assigned weighting values on the top eight Priority Areas that were selected. Based on these discussions, it was requested that URS perform a sensitivity analysis to assess the individual impact of each factor's weighting value.

Software

The software used in this analysis included:

- Logical Decisions, Version 7.1. This software was used to efficiently apply weighting values to each of the eight factors considered in the analysis for each scenario. The program applied these weighting values to the scores given to the top 41 HSDCs for each factor and calculated a total score for each HSDC for each scenario.
- Microsoft Office Excel. This software was used to compile the results of the pairwise comparison performed at the public meeting on 10/18/2013, to calculate the revised weighting values for each factor for the scenarios included in the sensitivity analysis, and to process the results of the Logical Decisions analysis.

Scenarios Considered In Sensitivity Analysis

The purpose for each of the scenarios considered in this analysis was to estimate the sensitivity of the selection of the top eight Priority Areas to each of the eight factors considered. This was accomplished by systematically modifying the results of the base scenario to remove one factor from consideration in each alternate scenario. The points that were assigned to that factor in the base scenario were redistributed to each of the other factors that it was compared against for the alternate scenario. Each of the considered scenarios are described below.

Base Scenario

This scenario consisted of the unaltered results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC. The resulting weighting values for each factor are included in Table R-1.

Scenario 1

This scenario consisted of altering the results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC to achieve a weighting value of zero for the "flood score" factor. This was accomplished by assigning zero points to the "flood score" factor when it was compared to any other factor and assigning a score of 4 to any factor that was compared against the "flood score" factor. The resulting weighting values for each factor are included in Table R-1.

Scenario 2

This scenario consisted of altering the results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC to achieve a weighting value of zero for the "Risk of Structural Failure for Any Inhabited Structure in DC" factor. This was accomplished by assigning zero points to the "Risk of Structural Failure for Any Inhabited Structure in DC" factor when it was compared to any other factor and assigning a score of 4 to any factor that was compared against the "Risk of Structural Failure for Any Inhabited Structure in DC" factor. The resulting weighting values for each factor are included in Table R-1.

Scenario 3

This scenario consisted of altering the results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC to achieve a weighting value of zero for the "Critical Public Facility at Risk" factor. This was accomplished by assigning zero points to the "Critical Public Facility at Risk" factor when it was compared to any other factor and assigning a score of 4 to any factor that was compared against the "Critical Public Facility at Risk" factor. The resulting weighting values for each factor are included in Table R-1.

Scenario 4

This scenario consisted of altering the results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC to achieve a weighting value of zero for the "Large Commercial Developments" factor. This was accomplished by assigning zero points to the "Large Commercial Developments" factor when it was compared to any other factor and assigning a score of 4 to any factor that was compared against the "Large Commercial Developments" factor. The resulting weighting values for each factor are included in Table R-1.

Scenario 5

This scenario consisted of altering the results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC to achieve a weighting value of zero for the "Risk of Loss of Access to Damage Center in Flood" factor. This was accomplished by assigning zero points to the "Risk of Loss of Access to Damage Center in

Flood" factor when it was compared to any other factor and assigning a score of 4 to any factor that was compared against the "Risk of Loss of Access to Damage Center in Flood" factor. The resulting weighting values for each factor are included in Table R-1.

Scenario 6

This scenario consisted of altering the results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC to achieve a weighting value of zero for the "Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or Bridge Modification" factor. This was accomplished by assigning zero points to the "Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or Bridge Modification" factor when it was compared to any other factor and assigning a score of 4 to any factor that was compared against that factor. The resulting weighting values for each factor are included in Table R-1.

Scenario 7

This scenario consisted of altering the results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC to achieve a weighting value of zero for the "Likelihood that FFE Estimate Erroneously Raises FS" factor. This was accomplished by assigning zero points to the "Likelihood that FFE Estimate Erroneously Raises FS" factor when it was compared to any other factor and assigning a score of 4 to any factor that was compared against the "Likelihood that FFE Estimate Erroneously Raises FS" factor. The resulting weighting values for each factor are included in Table R-1.

Scenario 8

This scenario consisted of altering the results of the pairwise comparisons that were performed by each of the UBCWCID Board Members and each member of the TAC to achieve a weighting value of zero for the "Likelihood of Occupancy During Flood" factor. This was accomplished by assigning zero points to the "Likelihood of Occupancy During Flood" factor when it was compared to any other factor and assigning a score of 4 to any factor that was compared against the "Likelihood of Occupancy During Flood" factor. The resulting weighting values for each factor are included in Table R-1.

Summary of Weight Applied in Each Scenario

Table R-1 includes the weighting values applied to each factor in each scenario.

Table R-1. Weighting Values Applied to Each Factor in Considered Scenarios

Factor	Scenario								
	Base	1	2	3	4	5	6	7	8
	Weighting Value Applied								
flood score	0.13	0.00	0.15	0.15	0.14	0.15	0.15	0.14	0.14
Risk of Structural Failure for Any Inhabited Structure in DC	0.16	0.18	0.00	0.18	0.17	0.18	0.18	0.17	0.18
Critical Public Facility at Risk	0.16	0.17	0.18	0.00	0.17	0.17	0.17	0.17	0.17
Large Commercial Developments	0.10	0.12	0.12	0.12	0.00	0.12	0.12	0.11	0.12
Risk of Loss of Access to Damage Center in Flood	0.13	0.15	0.16	0.15	0.15	0.00	0.15	0.14	0.15
Feasibility of DC Being Addressed by Existing Dam Pool Alteration, Removing Channel Constriction, or Bridge Modification	0.12	0.14	0.15	0.15	0.14	0.14	0.00	0.13	0.14
Likelihood that FFE Estimate Erroneously Raises FS	0.08	0.10	0.10	0.10	0.10	0.10	0.11	0.00	0.10
Likelihood of Occupancy During Flood	0.12	0.14	0.14	0.15	0.14	0.14	0.14	0.14	0.00

Sensitivity Analysis Results

The weighting values per qualitative value (shown in Table R-1) were imported into the Logical Decisions software for each scenario. For each considered scenario, the program applied the weighting value to the scores assigned to each of the HSDCs for each factor. A composite score was then calculated using the Logical Decisions software for each HSDC, which was then ranked by composite score for each scenario. The highest ranked HSDC associated with each of the 13 Priority Areas was identified and used to rank the Priority Areas for the scenario. The rankings of the Priority Areas by scenario are shown in Table R-2.

Table R-2. Priority Area Ranking by Scenario

Rank	Scenario								
	Base	1	2	3	4	5	6	7	8
	Priority Area Number								
1	3	3	3	2	3	3	2	3	3
2	2	2	6	6	2	2	3	2	2
3	6	9	2	3	6	6	9	6	6
4	9	13	13	9	9	9	6	9	9
5	13	6	11	13	13	11	13	13	13
6	11	11	9	11	11	13	10	11	11
7	10	10	10	10	10	10	11	10	10
8	12	12	12	12	12	5	12	5	8
9	5	5	5	5	5	7	7	12	12
10	8	8	8	4	4	4	8	8	1
11	7	4	4	7	7	8	1	7	4
12	4	1	7	8	8	1	4	4	5
13	1	7	1	1	1	12	5	1	7

The results shown in Table R-2 indicate that adjusting the weighting values applied in the base scenario, such that a weighting value of zero is applied to a single factor in each alternative scenario, does not have a significant effect on the selection of the top eight Priority Areas. The Priority Areas found within the top seven ranking positions are consistent across all scenarios considered in this sensitivity analysis. In addition, the eighth ranked Priority Area only changes in three of the scenarios considered in the sensitivity analysis. After review of the scores assigned to each factor for each HSDC, it appears that this occurs because a majority of the lowest ranked HSDCs have comparatively low scores for most of the eight factors considered, and the highest ranked HSDCs have comparatively high scores for multiple factors considered. The impact of this on the composite scores for the HSDCs, and ultimately on the Priority Area selection, can be illustrated by comparing the average composite score for the highest ranked HSDCs for each Priority Areas in the base scenario. The average composite score for the highest ranked HSDC associated with the top seven Priority Areas in the base scenario is 0.50 (out of a maximum of 1), while the average composite score for the highest ranked HSDC associated with the bottom six Priority Areas is 0.25. As a result of this large disparity between the composite scores for the HSDCs associated with the top seven Priority Areas and the bottom six Priority

Areas, the top seven Priority Areas are consistent through each scenario. In summary, this analysis demonstrates the relative insignificance of removing any one factor from consideration when identifying the top eight Priority Areas.

The results for Scenario 1 (removal of the flood score factor) merit further discussion. It is important to understand that the scoring was only performed for the top 41 HSDCs in ranking by flood score. If no qualitative factors were considered other than the flood score (see Table R-3), then relative to the Base scenario, all of the Priority Areas would be retained except for Priority Area 12 (City of Hutto). This Priority Area would be replaced with Priority Area 7 (Chisholm Valley, CORR). The primary qualitative factor difference between these two areas is in emergency access. Flooding in Priority Area 12 is relatively deep (greater than 2 feet) and within overbank flows from Cottonwood Creek directly connected to channel flows; i.e., flooding would be rapid and several homes would be inaccessible to emergency help. Flooding in Priority Area 7 is shallow, slow flow into a low area adjacent to the main conveyance channel, disconnected from the main flow. Based upon this information, it was assumed that emergency vehicles would have access to homes in Priority Area 7. This portion of the hydraulic model is currently under re-evaluation, with the likely results being that the flooding in the Chisholm Valley area will either be removed or designated as shallow flow.

Table R-3. Ranking by Flood Score Only

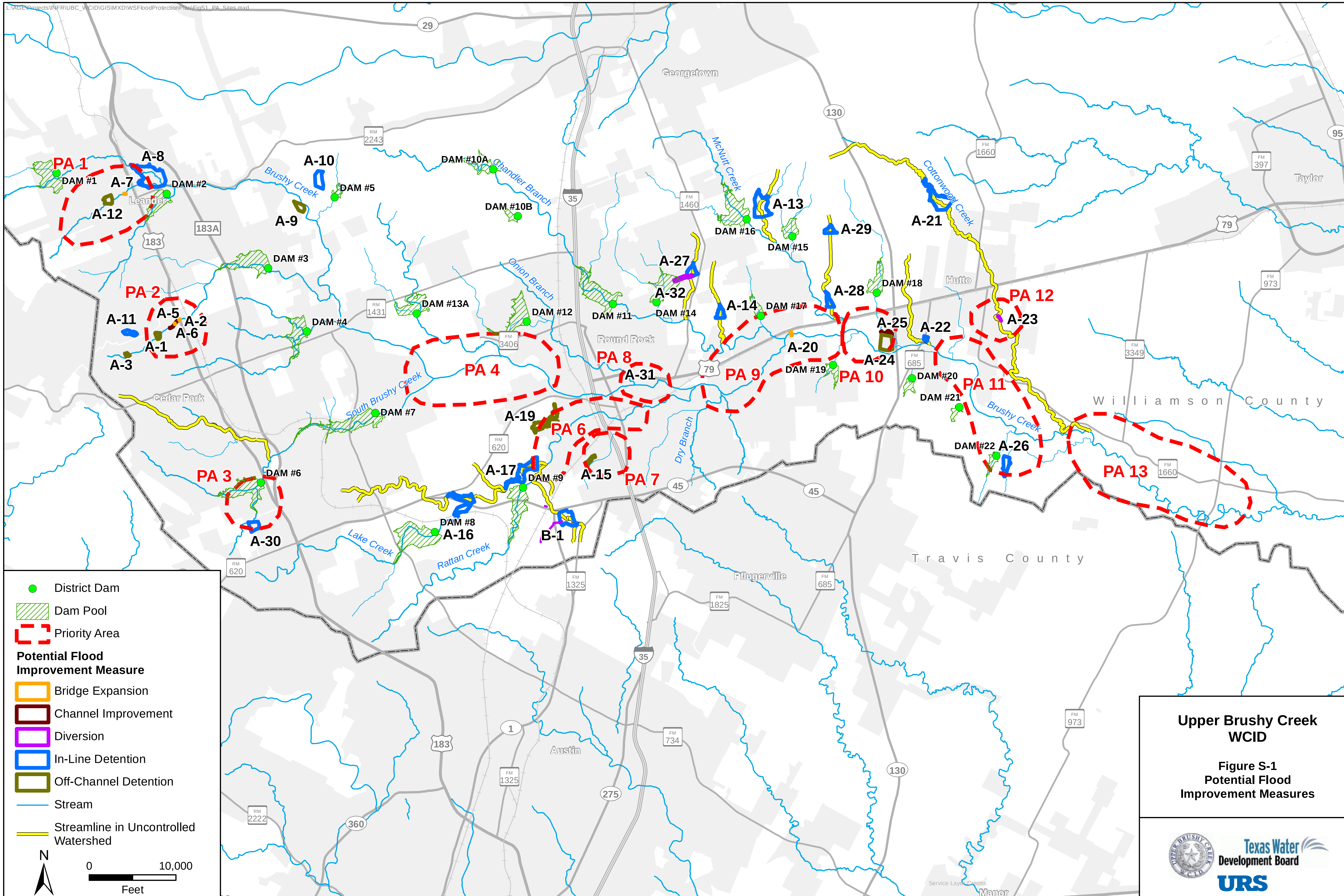
Rank	Priority Area
1	2
2	6
3	3
4	13
5	10
6	9
7	7
8	11
9	8
10	4
11	1
12	12
13	5

Exhibit S
Concept Designs for
Flood Mitigation Measures

INTRODUCTION TO EXHIBIT S

This appendix provides a separate discussion of each potential flood mitigation project addressed in the Flood Protection Plan. Each discussion provides summary data on concept design dimensions and a figure in plan showing approximate project location and layout. None of the locations presented in this appendix are fixed, i.e., no coordination has been made with affected landowners, and locations should be considered representative of the area in which they have been sited. Alternate locations in the general vicinity may be considered should a project be selected for further consideration and implementation.

Figure S-1 provides a summary of project locations in the context of existing District dams and flood Priority Areas.


Upper Brushy Creek WCID
Figure S-1
Potential Flood Improvement Measures
District Dam
Dam Pool
Priority Area
Potential Flood Improvement Measure
Bridge Expansion
Channel Improvement
Diversion
In-Line Detention
Off-Channel Detention
Stream
Streamline in Uncontrolled Watershed
N
0
10,000
Feet
Texas Water Development Board
URS
PA 1
PA 2
PA 3
PA 4
PA 6
PA 7
PA 8
PA 9
PA 10
PA 11
PA 12
PA 13
A-1
A-2
A-3
A-5
A-6
A-7
A-8
A-9
A-10
A-11
A-12
A-13
A-14
A-15
A-16
A-17
A-19
A-20
A-21
A-22
A-23
A-24
A-25
A-26
A-27
A-28
A-29
A-30
A-31
A-32
B-1
DAM #1
DAM #2
DAM #3
DAM #4
DAM #5
DAM #6
DAM #7
DAM #8
DAM #9
DAM #10A
DAM #10B
DAM #11
DAM #12
DAM #13A
DAM #14
DAM #15
DAM #16
DAM #17
DAM #18
DAM #19
DAM #20
DAM #21
DAM #22
Brushy Creek
South Brushy Creek
Chandler Branch
Onion Branch
McNutt Creek
Cottonwood Creek
Dry Branch
Lake Creek
Rattan Creek
Georgetown
Leander
Cedar Park
Round Rock
Hutto
Taylor
Pflugerville
Austin
Manor
Williamson County
Travis County

SITES B1, C2, AND C5 – DAM 9 DIVERSION – OPTION 1 (NEW DAM, DIVERSION CHANNELS, DAM 9 MODIFICATION)

Project Purpose

The project is conceived to detain flood flows from Rattan Creek, Tributary 1 [see Figure B1(1)-1] for the purpose of lowering peak flows and associated flooding along Lake Creek in PA6 and other PAs downstream along Brushy Creek.

Project Description

The new Dam B1 associated with the Dam 9 Diversion Project is located in line with Rattan Creek Tributary 1, southeast of the SH45/Loop 1 interchange in the City of Austin ETJ [see Figure B1(1)-1]. Channel diversion improvements associated with the project include constructing two diversion channels (C2 and C5) leading into Dam 9 from the existing diversion channel located west of the SH45/McNeil Road intersection [see Figure B1(1)-2]. Modification to the auxiliary spillway for Dam 9 is also a component of the Dam 9 Diversion Project [see Figure B1(1)-3].

The upstream watershed to Dam B1 is approximately 857 acres. The contributing watershed includes an area west of Loop 1 and east of McNeil Road that is to be diverted into Dam B1 by proposed Diversion Channel B2. This diversion channel is critical to effectively lower downstream peak flows as detailed in this project, and it is assumed that this channel is constructed simultaneously with Dam B1.

The majority of the flood pool and the embankment of Dam B1 are located in an area designated to be undeveloped open space per a City of Austin Ordinance agreed upon by the property owners. The principal and auxiliary spillway crest elevations were designed based on the goal of achieving a total discharge of 1,135 cfs from the dam for the 1% AEP event, which would prevent overtopping of the downstream railroad culvert located northeast of the SH45/McNeil Road intersection [see Figure B1(1)-2]. The principal spillway for Dam B1 includes a 203-ft-long, 42-inch-diameter RCP as well as an intake structure and a stilling basin. The auxiliary spillway for Dam B1 is 100 feet wide and is estimated to require articulated concrete block (ACB) armoring for much of its length. This concept may be altered to a concrete overflow structure in a later phase of design. The embankment for Dam B1 is 1,955 feet long and has an elevation of 819 ft-msl.

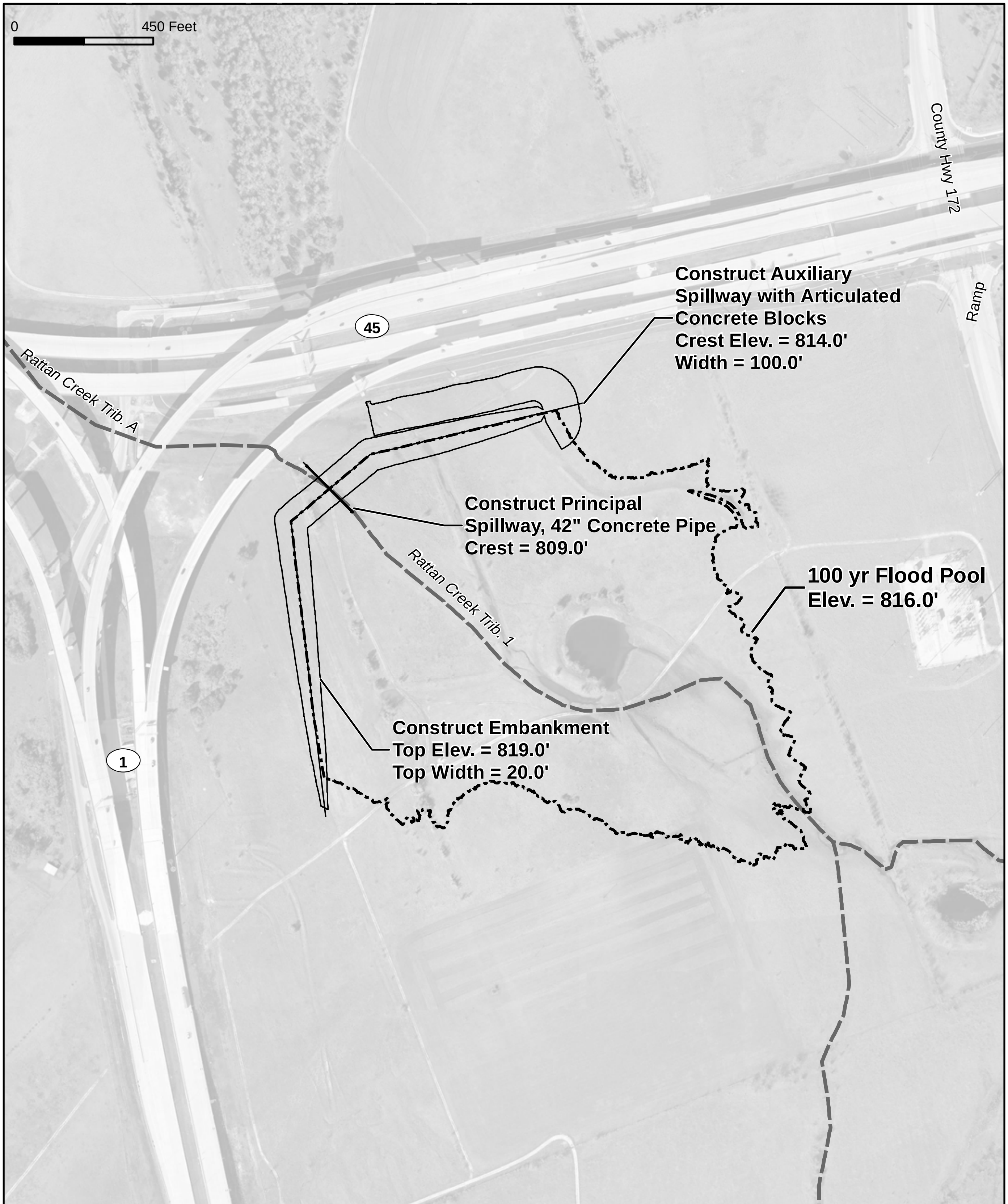
Diversion Channel C5 is conceived to divert flow into Dam 9 along the north side of the westbound SH45 access road. Channel C5 requires berms on either side of the channel, wherever adjacent ground elevations drop below the top-of-dam elevation for Dam 9, which is 792 ft-msl. The existing diversion channel northwest of the SH45/McNeil Road intersection is connected to Diversion Channel C5 by an 88-ft-long weir with a concrete crest. C5 is a 16-ft-wide rectangular concrete channel that transforms into a 40-ft-wide trapezoidal channel after passing through the southeast section of the Dam 9 embankment. Rock riprap will be installed at the downstream end of the channel to prevent erosion.

Diversion Channel C2 is conceived to divert flow from the 108-acre watershed located southwest of the intersection of SH45 and McNeil Road, which is currently a quarry. C2 is a triangular, earthen channel that will drain the quarry area during flood events. C2 transitions into a natural channel on the downstream end.

The Dam 9 auxiliary spillway will be widened by 150 feet to contain 76% of the PMF per *TCEQ Chapter 299 – Dams and Reservoirs, Subchapter B* (January 1, 2009).

Table B1(1)-1. Design Dimensions

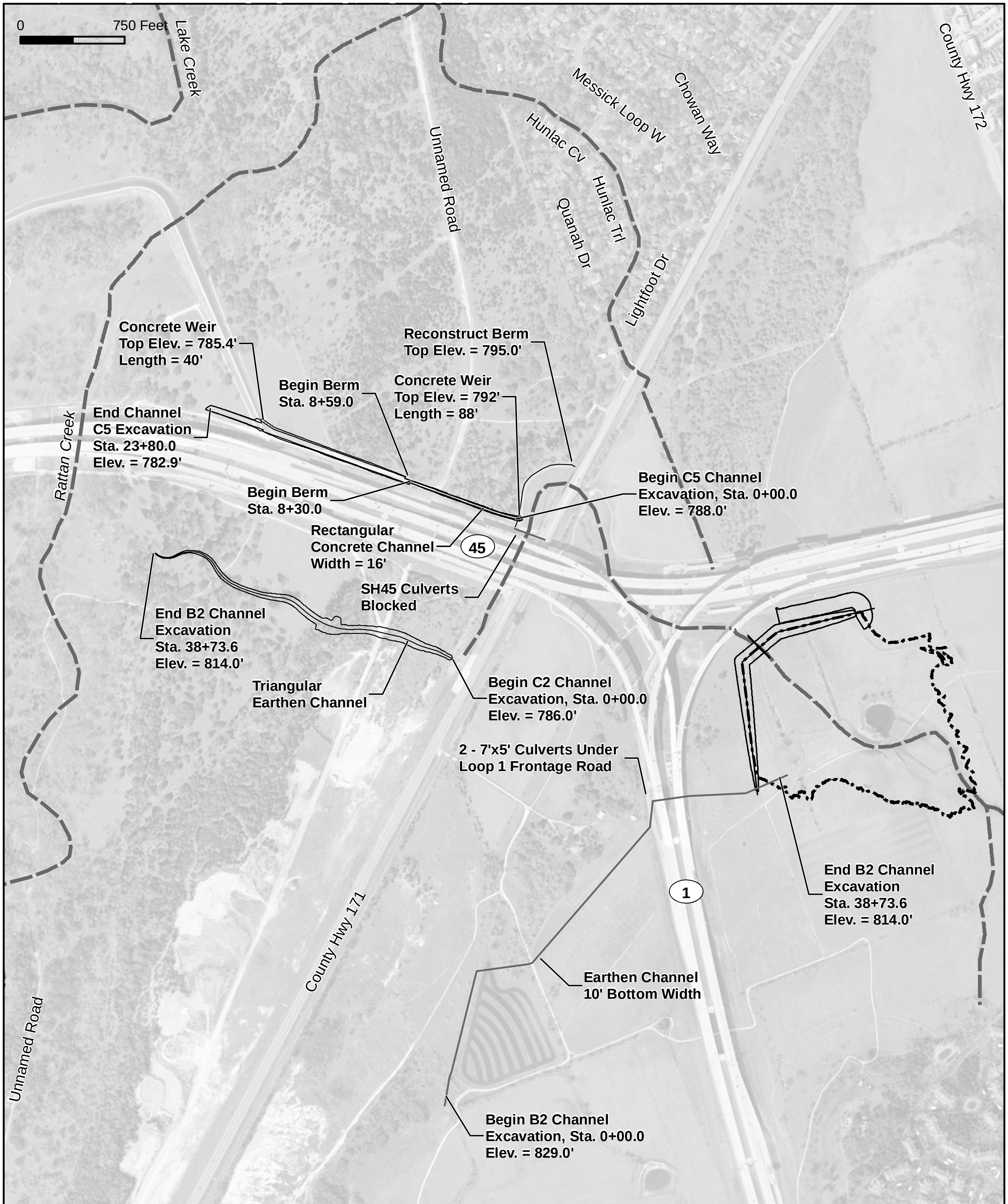
Site B1 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	819	Open Space Boundary
Embankment Top Width (ft)	20	
Toe of Embankment (ft-msl)	805	
Principal Spillway Crest (ft-msl)	809	
Principal Spillway Diameter (in)	42	
Principal Spillway Length (ft)	203	
Auxiliary Spillway Crest (ft-msl)	814	
Auxiliary Spillway Width (ft)	100	
Volume Detained in 1% AEP Event (ac-ft)	227	



Upper Brushy Creek WCID

Figure B1 (Option 1)-1
Site Concept Design
B1(1)-1

Texas Water Development Board
URS



N

Texas Water Development Board

URS

Legend

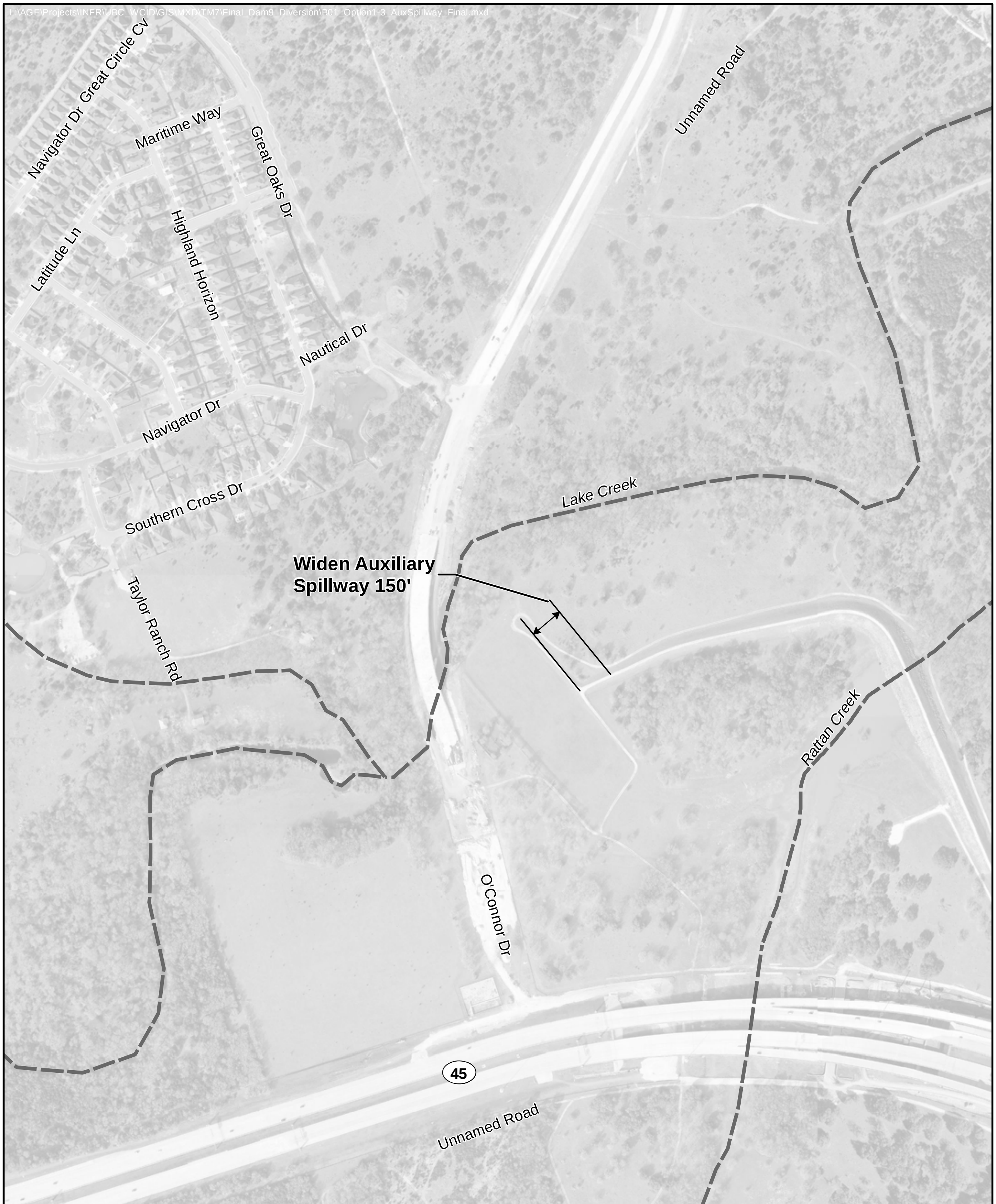
Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure B1 (Option 1)-2
Site Concept Design
B1(1)-2



0 600 Feet

N

Texas Water Development Board

URS

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure B1 (Option 1)-3
Site Concept Design
B1(1)-3

SITES B1, C2, – DAM 9 DIVERSION - OPTION 2 (NEW DAM, DIVERSION CHANNELS, DAM 9 MODIFICATION)

Project Purpose

The project is conceived to detain flood flows from Rattan Creek, Tributary 1 [see Figure B1(2)-1] for the purpose of lowering peak flows and associated flooding along Lake Creek in PA6 and other PAs downstream along Brushy Creek.

Project Description

The Dam 9 Diversion Project includes a new Dam B1 located in line with Rattan Creek Tributary 1, southeast of the SH45/Loop 1 interchange in the City of Austin ETJ [see Figure B1(2)-1]. It also includes channel diversion improvements to include constructing a channel (C2) leading into Dam 9 from the existing quarry system southwest of the SH45/McNeil Road intersection [see Figure B1(2)-2]. Modification to the existing Dam 9 auxiliary spillway is also a component of the Dam 9 Diversion Project [see Figure B1(2)-3].

The upstream watershed to Dam B1 is approximately 857 acres. The contributing watershed includes an area west of Loop 1 and east of McNeil Road that is to be diverted into Dam B1 by proposed Diversion Channel B2. This diversion channel is critical to effectively lower downstream peak flows as detailed in this project, and it is assumed that this channel is constructed simultaneously with Dam B1.

The majority of the flood pool and the embankment of Dam B1 are located in an area designated to be undeveloped open space per a City of Austin Ordinance agreed upon by the property owners. The principal and auxiliary spillway crest elevations were designed based on the goal of achieving a total discharge of 406 cfs from the dam for the 1% AEP event, maximizing the possible storage of the dam and minimizing downstream flows given the space constraints. The principal spillway for Dam B1 includes a 203-ft-long, 42-inch-diameter RCP as well as an intake structure and a stilling basin. The auxiliary spillway for Dam B1 is 100 feet wide at an elevation of 817 ft-msl, and is estimated to require articulated concrete block (ACB) armoring for much of its length. This concept may be altered to a concrete overflow structure in a later phase of design. The embankment for Dam B1 is 2,217 feet long and has an elevation of 823.5 ft-msl.

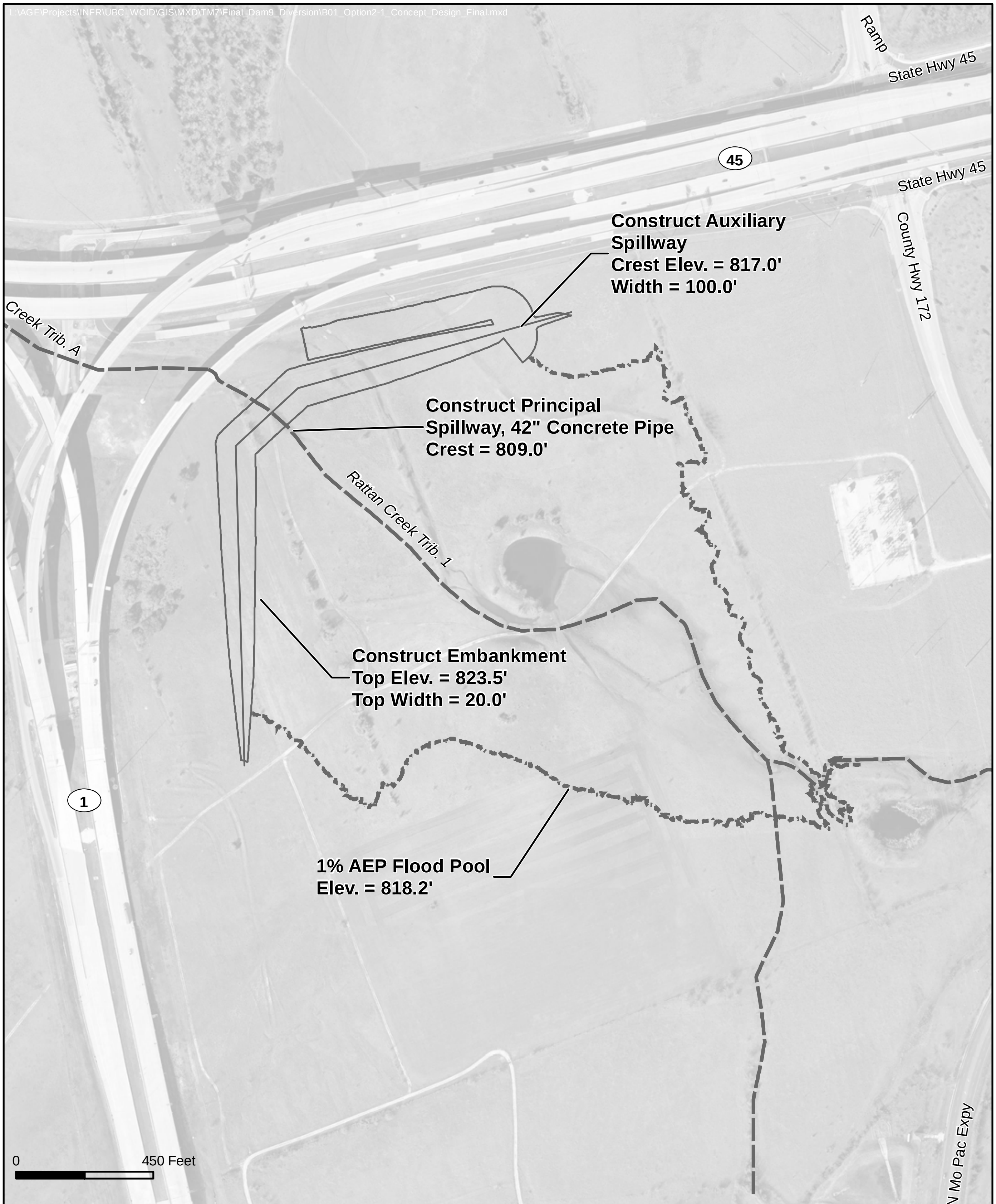
Given the upstream storage associated with Dam B1, the peak flow entering the existing diversion channel west of the SH45/McNeil Road interchange is reduced to 620 cfs. Rather than allow this flow to continue south, through two existing SH45 access road culverts and into the existing quarry, the north SH45 access road culverts are proposed to be blocked. By removing a portion of the existing diversion berm, flow will be diverted northwest via overland flow paths, eventually discharging into Rattan Creek. The flood flow into these overland flow paths will be reduced relative to estimated existing flood flows into the same area. As this area is developed in the future, this flow can be channelized and routed appropriately.

Diversion Channel C2 is conceived to divert flow from the 108-acre watershed located southwest of the SH45/McNeil Road intersection, which is currently a quarry. C2 is a triangular, earthen channel that will drain the quarry area during flood events by diverting flow into Dam 9. C2 transitions into a natural channel on the downstream end.

The Dam 9 auxiliary spillway will be widened by 100 feet to contain 76% of the PMF per TCEQ Chapter 299 – Dams and Reservoirs, Subchapter B (January 1, 2009).

Table B1(2)-1. Design Dimensions

Site B1 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	823.5	Open Space Boundary
Embankment Top Width (ft)	20	
Toe of Embankment (ft-msl)	805	
Principal Spillway Crest (ft-msl)	809	
Principal Spillway Diameter (in)	42	
Principal Spillway Length (ft)	203	
Auxiliary Spillway Crest (ft-msl)	817	
Auxiliary Spillway Width (ft)	100	
Volume Detained in 1% AEP Event (ac-ft)	312	



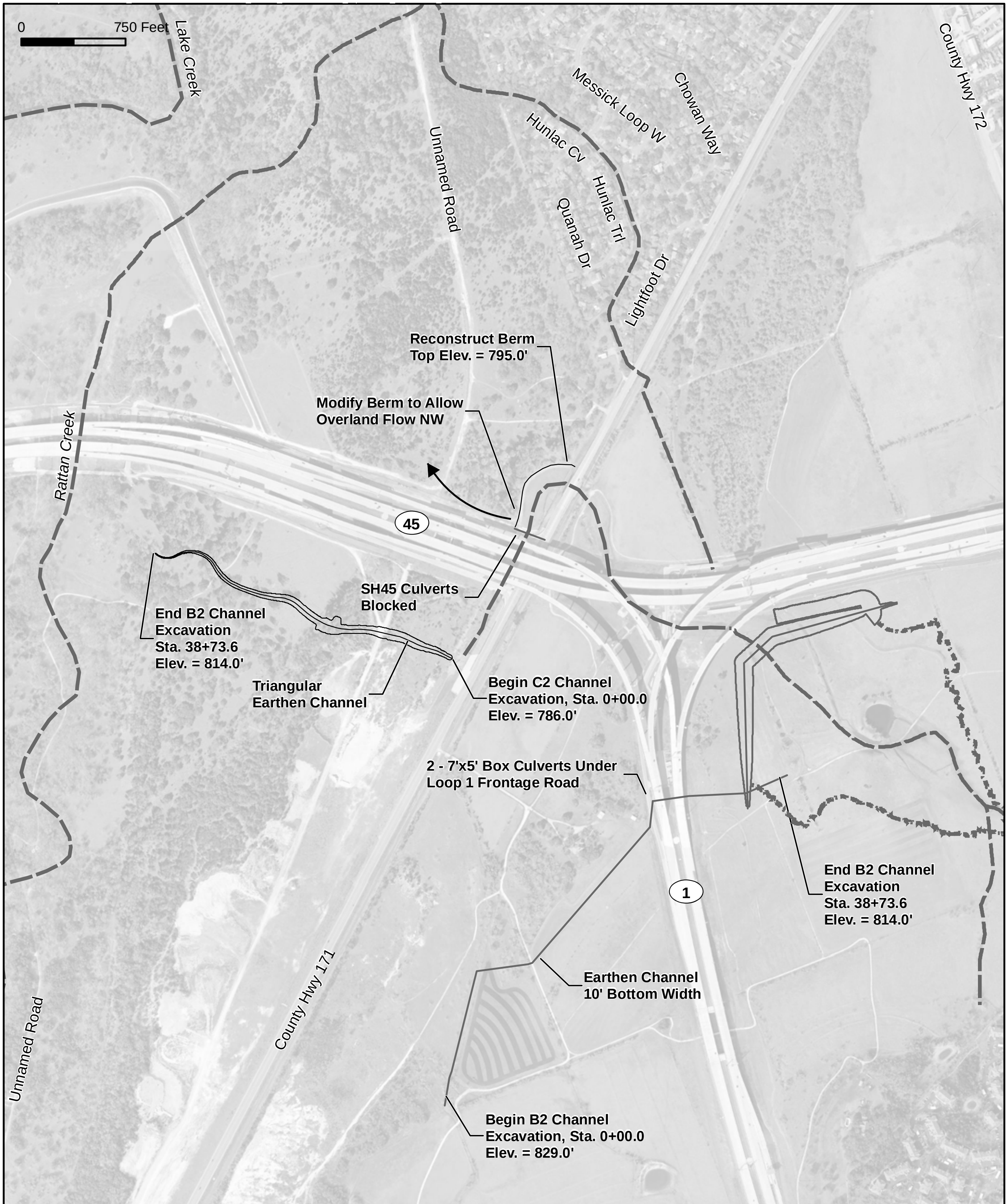
Legend

Existing Stream

Recommended Improvement

Upper Brushy Creek WCID

Figure B1 (Option 2)-1
Site Concept Design
B1(2)-1



N

Upper Brushy Creek W.C.I.D.
Texas Water Development Board
URS

Legend

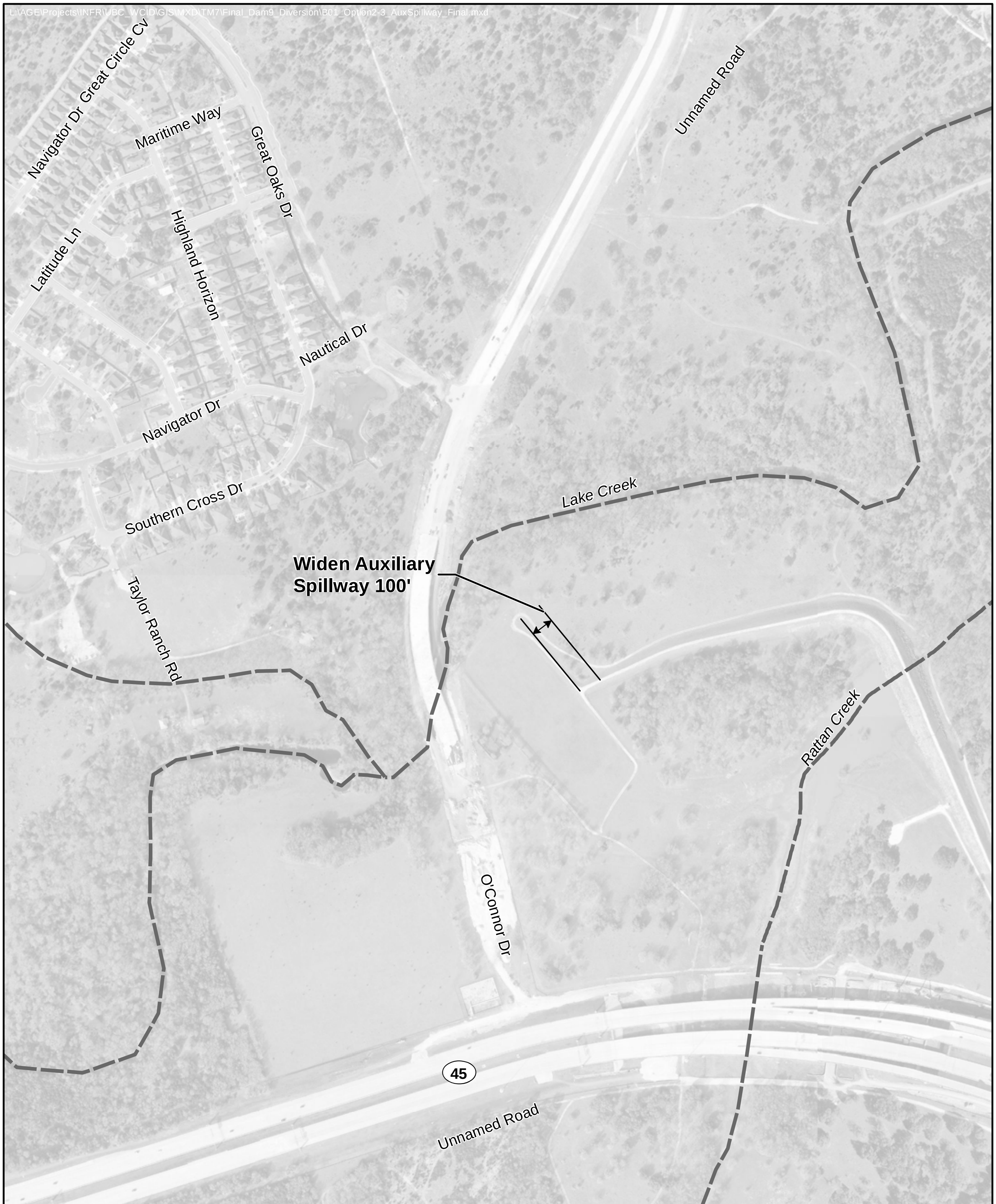
Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure B1 (Option 2)-2
Site Concept Design
B1(2)-2



0 600 Feet
N

Texas Water Development Board

URS

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure B1 (Option 2)-3
Site Concept Design
B1(2)-3

SITE A-1 – BAGDAD DETENTION (OFF-CHANNEL RESERVOIR)

Project Purpose

The project is conceived to detain flood flows from Blockhouse Creek and Blockhouse Creek Tributary 1 (see Figure A1-1) for the purpose of lowering peak flows and associated flooding in Priority Area (PA) 2 (see Figure S-1).

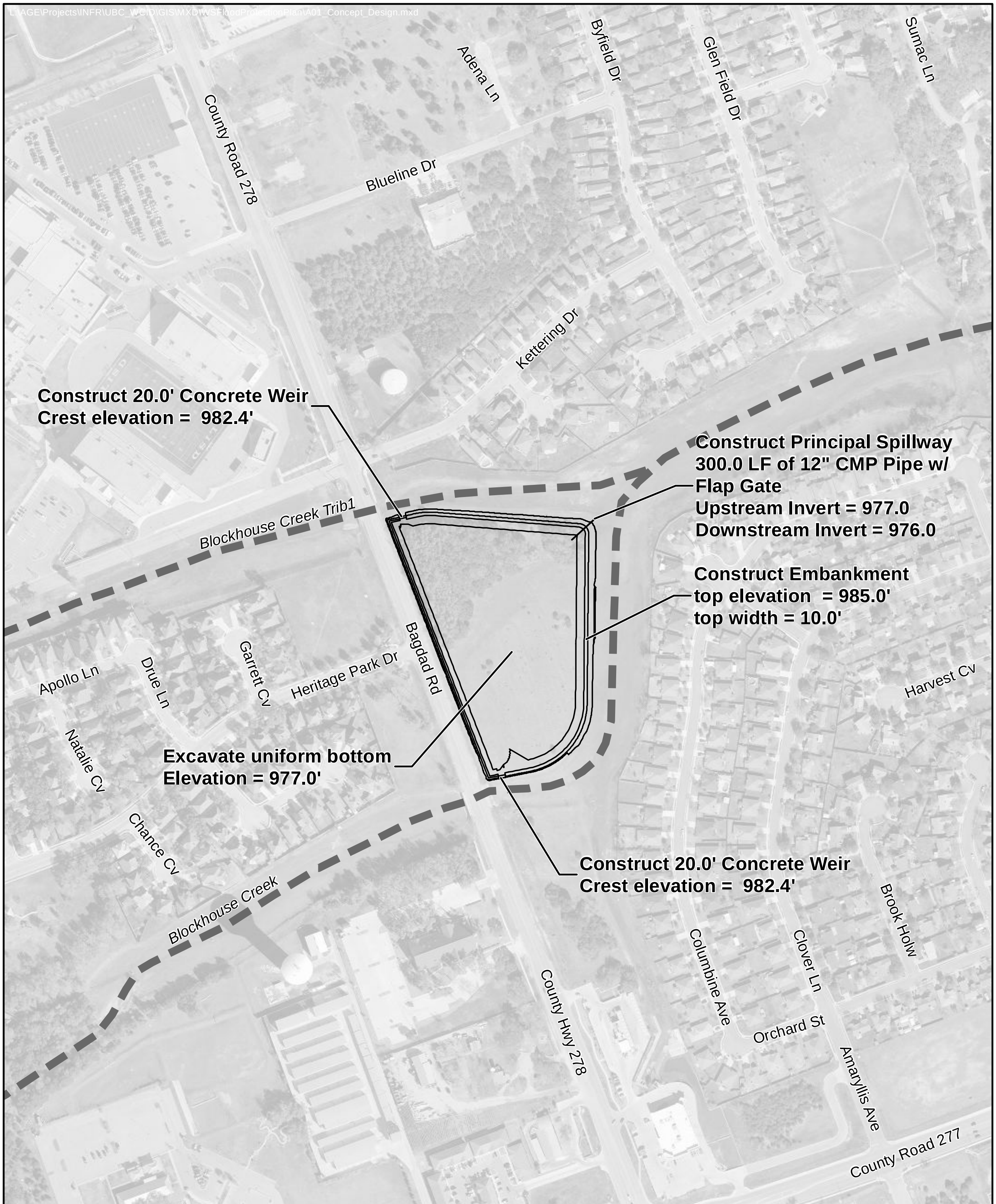
Project Description

Two weirs are proposed on either side of a new detention area between Blockhouse Creek Trib 1, Reach 1, and Blockhouse Creek Reach 2, on the east side of Bagdad Road. An outlet pipe with a flap gate allows the area to drain slowly while preventing backflow. See Figure A1-1. The weirs are sized such that they engage approximately during the event in which the first habitable structure in PA2 experiences flooding, and the new detention area fills completely to the weir elevation during the 1% AEP. Due to these improvements, peak flow in the adjacent stream during the 1% AEP event is expected to drop 31%.

The modifications will involve excavating 54,300 cubic yards of soil to achieve a uniform bottom elevation, constructing a 10-foot embankment approximately 2,280 feet long with 3:1 side slopes, two concrete broad-crested weirs 20 feet in length, and a 12-inch-diameter concrete outlet pipe with a grated inlet and downstream flap gate. Estimated costs are $2,545,000; see Table B-1.

Table A1-1. Project Summary Table

Site A-1 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	985	986 (max)
Embankment Width (ft)	10	
Outlet Upstream Invert (ft-msl)	977	
Outlet Downstream Invert (ft-msl)	976	
Outlet Diameter (in)	12	
Weir #1 Width (ft)	20	
Weir #1 Crest Elevation (ft-msl)	982.4	
Weir #2 Width (ft)	20	
Weir #2 Crest Elevation (ft-msl)	982.4	
Volume Detained in 100-yr Event (ac-ft)	38.1	80.6 (est.)



N

0 400 Feet

Legend

Existing Stream

Recommended Improvement

Construction

Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A1-1
Site Concept Design
A-1

SITES A-2 AND A-6 – BLOCKHOUSE CREEK ROAD CROSSING IMPROVEMENTS, PEACH TREE LANE AND U.S. 183

Sites A-2 and A-6 refer to potential road crossing improvement projects associated with Blockhouse Creek crossings of U.S. 183 and Peach Tree Lane, respectively. They are presented together as the two projects each are proposed to address flooding within PA2. These projects were developed using project-specific methodologies, which are explained within this appendix. The method included an assessment of existing condition, followed by an alternatives analysis that included estimation of the project's Flood Score (FS) reduction.

Existing Condition

The portion of Blockhouse Creek between Sumac Lane and U.S. 183 has historically experienced high levels of flooding; the very flat topography allows water to spread out into the mobile home neighborhoods adjacent to the creek, as shown on Figure A2-1. Although this area was included in Cedar Park’s 2010 Preliminary Drainage Study as a flood-prone area, only a very rough alternative concept design was developed to mitigate flooding. The report included an excavation volume for a 750-foot-wide main channel with a 5-foot trickle channel, but no quantitative estimates were performed on the possible reduction in water surface elevations based on this design.

Peach Tree Lane is located immediately upstream of U.S. 183 and acts as an inline weir with water flowing over the surface of the structure in all base flow conditions. Although the streambed has room to expand horizontally through the park downstream of Peach Tree Lane, a bedrock hard pan prevents the channel from dropping significantly in elevation before reaching U.S. 183. All of the seven 10-ft x 8-ft concrete box culverts under U.S. 183 are either partially blocked or obstructed by the hard pan as shown on Figure A2-2, significantly reducing the capacity of the system. This blockage, together with the shallowness of the channel itself, contributes to the majority of the flooding observed in this area.

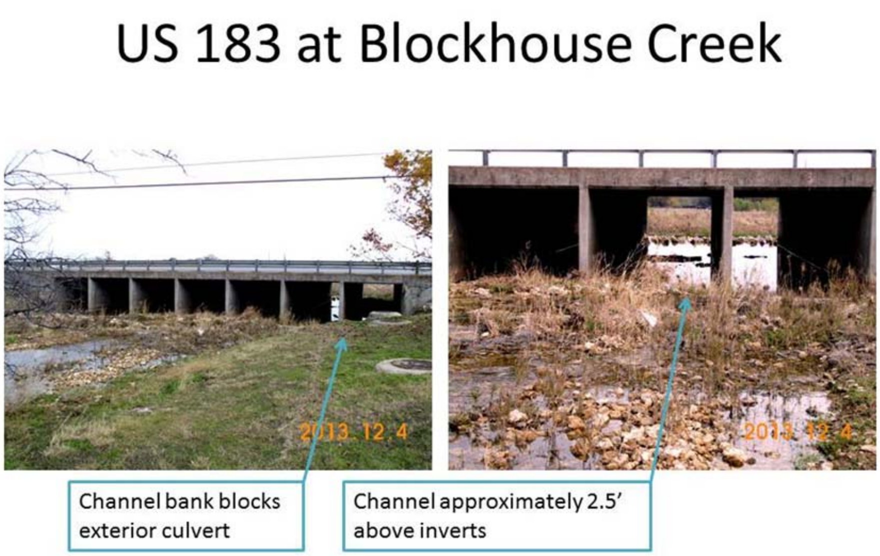


Figure A2-2. U.S. 183 Crossing Blockhouse Creek

N
0 600 Feet

Stream
XS Cut Line
Modeled 100-Year Floodplain
Modeled 500-Year Floodplain

Upper Brushy Creek WCID
Texas Water Development Board
URS

Upper Brushy Creek WCID

Blockhouse Creek

9/19/2014 | Figure A2-1

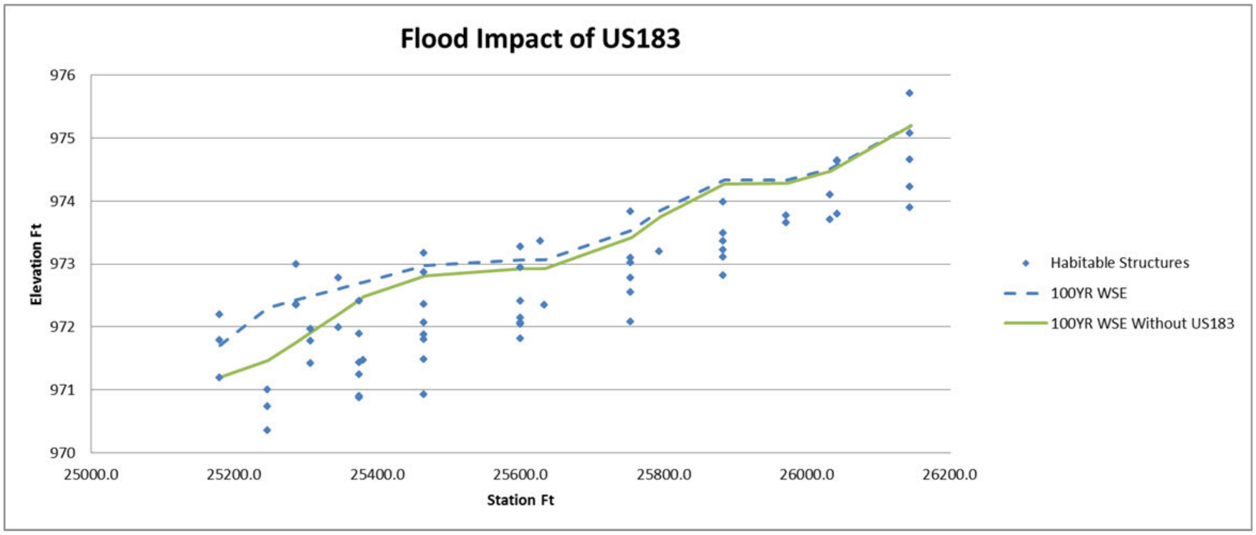


Figure A2-3. U.S. 183 Flood Profiles

Table A2-1. U.S. 183 Existing Depth of Flooding

HS_ID	Depth of Flooding (ft)					
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr
742	0.00	0.00	0.00	0.27	0.52	2.15
743	0.00	0.00	0.00	0.00	0.00	1.56
744	0.00	0.00	0.00	0.00	0.00	1.14
726	0.10	0.91	1.28	1.66	1.94	3.19
727	0.00	0.54	0.91	1.29	1.56	2.82
728	0.00	0.27	0.64	1.02	1.30	2.55
739	0.00	0.00	0.00	0.00	0.00	0.62
740	0.00	0.00	0.00	0.00	0.09	1.27
741	0.00	0.00	0.00	0.00	0.07	1.26
729	0.00	0.09	0.44	0.81	1.07	2.22
730	0.00	0.00	0.09	0.46	0.72	1.87
731	0.00	0.00	0.00	0.27	0.53	1.68
719	0.00	0.00	0.00	0.00	0.00	0.93
1383	0.00	0.00	0.02	0.38	0.62	1.71
720	0.00	0.00	0.00	0.05	0.29	1.33
721	0.00	0.00	0.22	0.57	0.80	1.85
722	0.00	0.33	0.67	1.02	1.26	2.30
723	0.00	0.52	0.86	1.21	1.45	2.49
724	0.12	0.90	1.24	1.59	1.82	2.87
725	0.10	0.87	1.21	1.56	1.79	2.84
1372	0.00	0.32	0.66	1.01	1.24	2.28
710	0.29	1.12	1.46	1.81	2.04	2.99
711	0.00	0.24	0.59	0.93	1.17	2.12
712	0.00	0.56	0.90	1.25	1.48	2.43
713	0.00	0.00	0.03	0.37	0.61	1.56
714	0.00	0.00	0.33	0.67	0.91	1.86
715	0.00	0.00	0.00	0.00	0.11	1.06

HS_ID	Depth of Flooding (ft)					
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr
716	0.00	0.00	0.00	0.00	0.00	0.75
1382	0.00	0.17	0.52	0.86	1.10	2.05
704	0.00	0.00	0.00	0.00	0.00	0.71
705	0.00	0.00	0.00	0.00	0.12	1.04
706	0.00	0.07	0.43	0.76	1.00	1.92
707	0.00	0.32	0.68	1.01	1.25	2.17
708	0.00	0.09	0.44	0.78	1.02	1.94
709	0.00	0.00	0.08	0.42	0.66	1.58
1370	0.00	0.00	0.34	0.68	0.92	1.84
1385	0.00	0.00	0.00	0.00	0.00	0.62
695	0.00	0.00	0.14	0.47	0.71	1.63
696	0.00	0.60	0.94	1.24	1.46	2.21
697	0.00	0.13	0.47	0.77	0.98	1.74
698	0.00	0.00	0.00	0.23	0.45	1.20
699	0.00	0.00	0.00	0.00	0.00	0.46
1371	0.00	0.00	0.24	0.54	0.76	1.51
1374	0.00	0.00	0.00	0.30	0.51	1.27
691	0.00	0.00	0.17	0.45	0.65	1.29
686	0.00	0.00	0.00	0.19	0.35	0.83
687	0.00	0.39	0.70	0.95	1.12	1.59
688	0.00	0.79	1.10	1.35	1.52	1.99
689	0.00	0.50	0.81	1.06	1.23	1.70
690	0.00	0.25	0.56	0.81	0.98	1.45
1375	0.00	0.12	0.43	0.68	0.85	1.32
677	0.00	0.00	0.16	0.41	0.57	1.05
678	0.00	0.00	0.27	0.52	0.68	1.16
680	0.00	0.07	0.38	0.64	0.81	1.30
681	0.00	0.00	0.00	0.24	0.41	0.90
679	0.00	0.04	0.35	0.61	0.78	1.28
682	0.00	0.00	0.00	0.00	0.00	0.44
683	0.00	0.00	0.00	0.00	0.00	0.42
671	0.00	0.00	0.00	0.00	0.00	0.01
672	0.00	0.00	0.04	0.33	0.54	1.07
673	0.00	0.17	0.47	0.76	0.96	1.49
674	0.00	0.50	0.80	1.09	1.30	1.83
1377	0.00	0.00	0.00	0.00	0.11	0.64
664	0.00	0.00	0.00	0.00	0.00	0.22
665	0.00	0.00	0.00	0.00	0.00	0.01
666	0.00	0.00	0.00	0.00	0.04	0.57
667	0.00	0.00	0.00	0.08	0.26	0.80
668	0.33	0.81	1.08	1.35	1.53	2.07
669	0.00	0.00	0.00	0.00	0.00	0.00
675	0.00	0.33	0.63	0.94	1.15	1.75

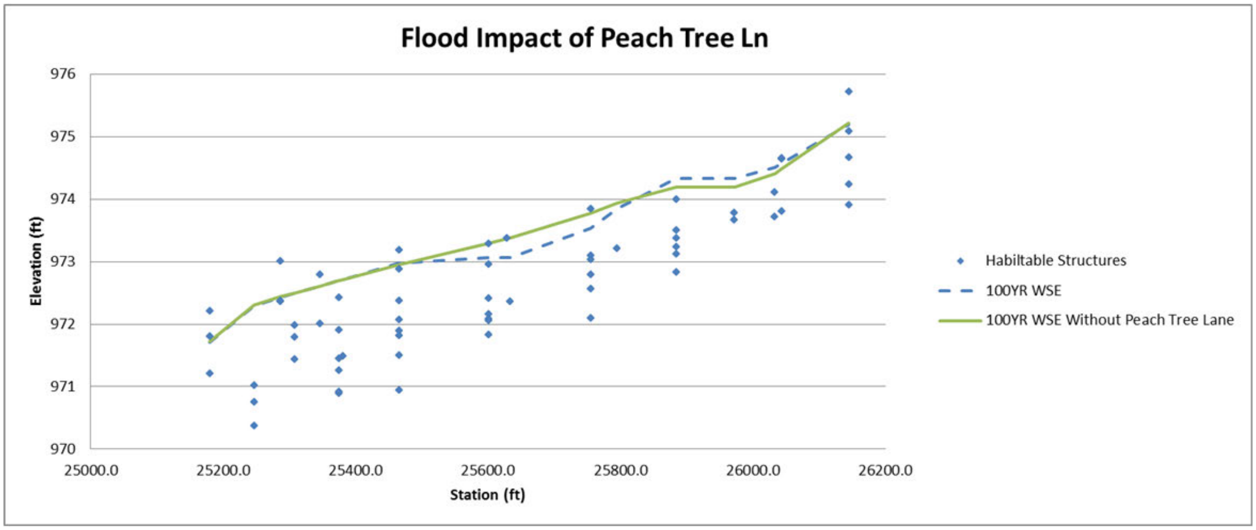


Figure A2-4. Peach Tree Lane Existing Flood Profiles

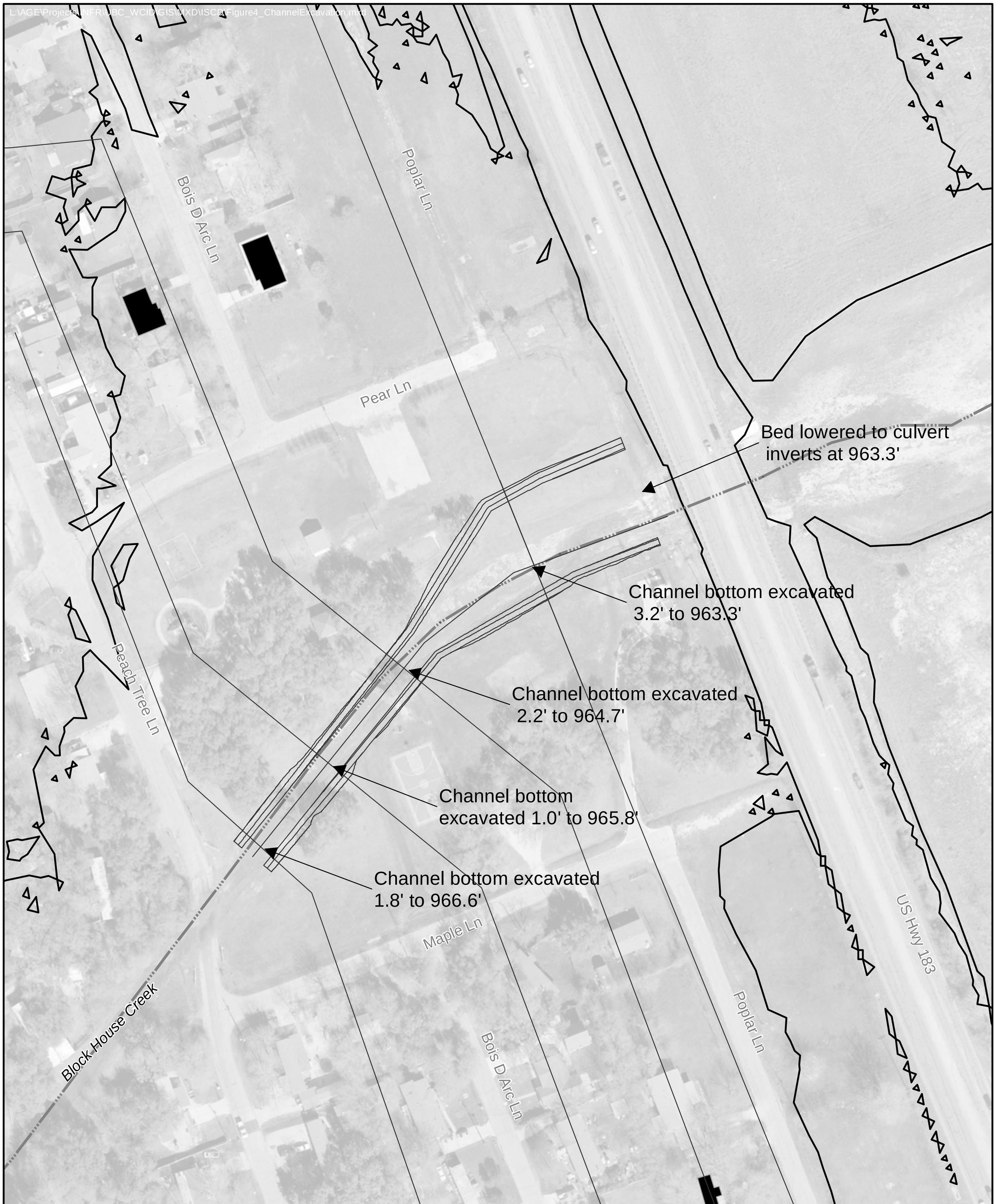
Alternatives Analysis

Using the procedure discussed in Section 2b, analysis showed that removing Peach Tree Lane does little to mitigate flooding upstream. Removing the weir actually increased flood depths at that location as the local water velocities decreased. Consequently, modifications to this structure were not considered.

Removing U.S. 183 from the hydraulic model significantly reduced water surface elevations upstream; several modifications to the structure were considered to similarly lower water surface elevations. These modifications included:

- Lowering the channel to the culvert invert elevations for maximum capacity, per the excavation elevations presented in Figure A2-5.
- Adding two additional 10-ft x 8-ft concrete box culverts on the north side of the crossing (the adjacent lift station prevents modifications on the south side).
- Adding two 4-foot-diameter concrete pipes on north and south sides of the structure to capture flows from the drainage ditches parallel to the roadway in high flow events.

These modifications were considered individually and in tandem, and the results were compared to determine the most cost-effective expansion design. Although all three modifications individually lowered the water surface at U.S. 183, the most significant increase in capacity was achieved by lowering the channel alone. The addition of two 10-ft x 8-ft culverts only lowered the flood profile within 200 feet of the crossing. The addition of two more culverts in the overbank lowered the flood profile minimally. Figure A2-5 for plan and Figure A2-6 for profile view of these modifications.



N
0 200 Feet

Texas Water Development Board

URS

Structure Removed from Proposed Flood Zone
Blockhouse Proposed Channel
Stream
Modeled 100-Year Floodplain

Upper Brushy Creek WCID

Blockhouse Creek Channel Expansion

9/22/2014

Figure A2-5

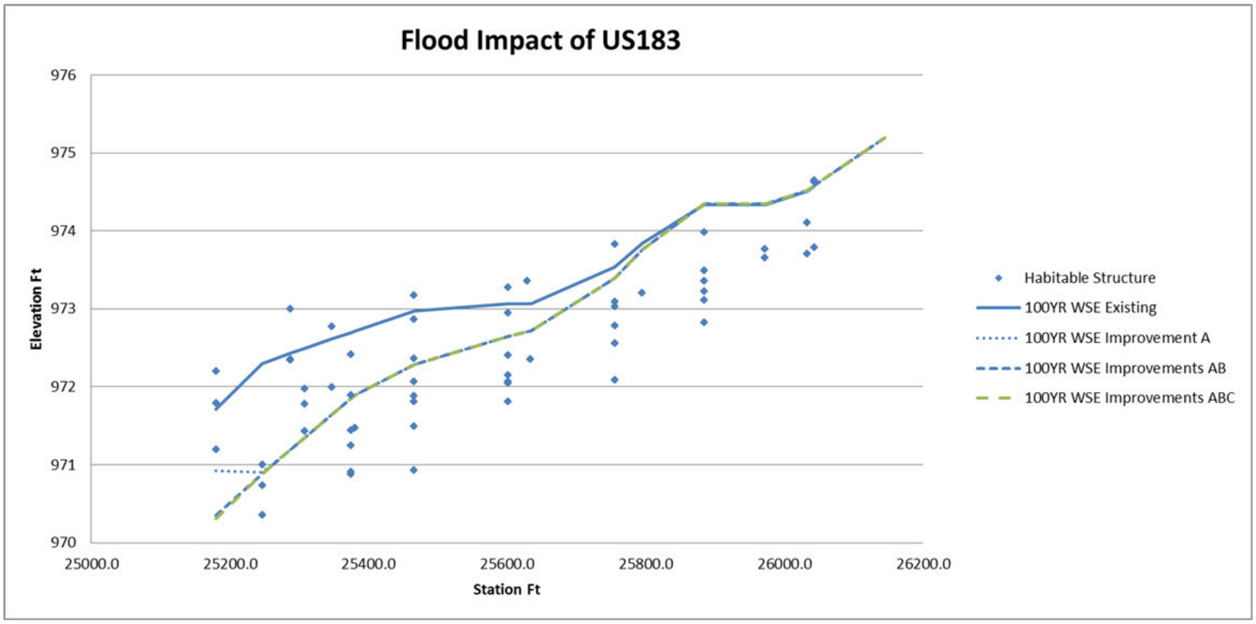


Figure A2-6. US183 Proposed Alternatives

Benefits Analysis

The lowering of the channel reduced cumulative flood scores in the area by 32.7, removed 12 houses from the floodplain and improved flood levels at 54 houses. Adding two more culverts did not remove any more houses from the floodplain, but reduced flood scores by an additional 3.9.

Recommendations

For this Priority Area, the clear economic choice is the lowering of the approach channel to the existing bridge opening under US183. Therefore, the preferred configuration for A-1 is to perform only the excavation presented in concept in Figure A2-5. The costs in Appendix B provide cost estimates for this alternative.

SITE A-3 – LISD POND (OFF-CHANNEL RESERVOIR)

Project Purpose

The project is conceived to detain flood flows from Blockhouse Creek (see Figure A3-1) for the purpose of lowering peak flows and associated flooding in PA2 (see Figure S-1).

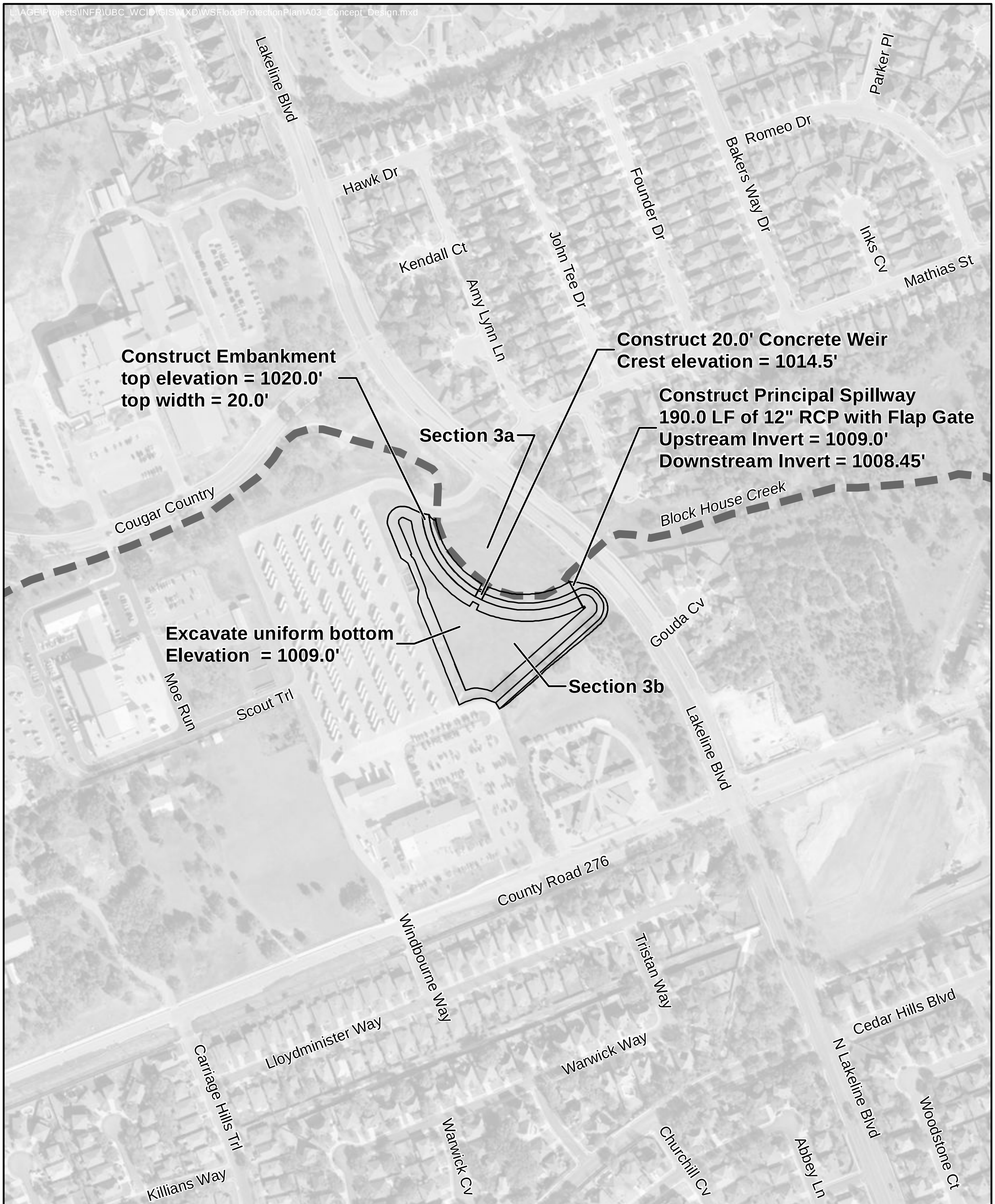
Project Description

A new embankment is proposed along Blockhouse Creek, Reach 1 on the west side of Lakeline Blvd. near the LISD transportation center, north of New Hope Road. This embankment will enclose an in-line storage area known as Section 3a. A weir is proposed to convey flood waters from Section 3a to a new off-channel storage area called Section 3b. An outlet pipe with a flap gate allows Section 3b to drain slowly back into Section 3a while preventing backflow. See Figure 3. The weir is sized such that Section 3b fills completely to the weir elevation during the 1% AEP. Due to these improvements, peak flow out of the system during the 1% AEP event is expected to drop 51%.

The modifications will involve excavating 13,200 cubic yards of soil in Section 3b to achieve a uniform bottom elevation and constructing a 20-foot embankment between Sections 3a and 3b approximately 1,100 feet long with 3:1 side slopes, a concrete broad-crested weir 20 feet in length, and a 12-inch-diameter concrete outlet pipe with a grated inlet and downstream flap gate. Estimated costs are $1,416,000; see Table B-3.

Table A3-1. Project Summary Table

Site A-3 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	1020	1021 (max)
Embankment Width (ft)	20	
Weir Width (ft)	20	
Weir Crest Elevation (ft-msl)	1014.5	
Outlet Upstream Invert (ft-msl)	1009	
Outlet Downstream Invert (ft-msl)	1008.45	
Outlet Diameter (in)	12	
Max Volume Detained in Section 3a during 100-yr Event (ac-ft)	5	9.5 (est.)
Volume Detained in Section 3b during 100-yr Event (ac-ft)	20.3	28.6 (est.)



Legend

Existing Stream

Recommended Improvement

Construction

Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A3-1
Site Concept Design
A-3

SITE A-5 – BLOCKHOUSE CHANNEL IMPROVEMENT (CHANNEL IMPROVEMENT)

Project Purpose

The project is conceived to expand channel capacity along Blockhouse Creek (see Figure A5-1) for the purpose of lowering peak flood elevations and associated flooding in PA2 (see Figure S-1).

Project Description

A widening is proposed to Blockhouse Creek, Reach 1, from just upstream of Sumac Lane to U.S. Highway 183, north of Red Oak Street, to alleviate flooding in PA2. A series of alternative widths for an expanded channel were modeled to estimate effect on FS. Channel widths of 100 feet, 150 feet, 200 feet, and 250 feet yield FS reductions of 29, 36, 55, and 68, respectively. See Figure A5-1.

The estimated cost for a modification that would involve excavating a 150-ft-wide channel approximately 1,400 feet in length with uniform slope would be $1,478,000 and involve buyout of houses; see Table B-4. An alternative improvement, the lowering of the channel bed in the vicinity of this crossing (Site A-2 in this Appendix) is much more cost effective than this alternative.

Recommendation

The pairing of a lesser (than 150 feet) widening with the Site A-2 channel lowering may be a cost effective combination of projects for this area.

Legend

Existing Stream

Recommended Improvement

Channel Excavation

Upper Brushy Creek WCID

Figure A5-1
Site Concept Design
A-5

SITE A-8 – LEANDER DAM (NEW DAM)

Project Purpose

The project is conceived to detain flood flows from North Fork and South Fork of Brushy Creek (see Figure S-1) for the purpose of lowering peak flows and associated flooding in the reach of Brushy Creek below the confluence.

Project Description

A constraint of 942 ft-msl maximum elevation was placed on the auxiliary spillway of Site A-8, based on the estimated surface elevation of recently constructed Hero Way to the north of the site.

A SITES model was developed for this site. Using this model, it was estimated that with a 60-inch-diameter principal spillway outlet, this auxiliary spillway crest elevation would not contain the 1% AEP. To contain the 1% AEP event, the auxiliary spillway would need to be lowered to approximately 937.5 ft-msl, which would require concrete lining to protect the spillway from erosion during frequent engagement. With this configuration, the maximum flow downstream of the dam during the 1% AEP would be reduced by approximately 10%. The nearest PA downstream is PA4, and construction of this dam was estimated to provide marginal benefit at that location. Based on this knowledge, this project was not considered sufficiently effective for analysis to be continued.

SITE A-9 – OFF-CHANNEL DETENTION NEAR CR-177 (OFF-CHANNEL RESERVOIR)

Project Purpose

The project is conceived as an off-channel detention dam to reduce peak flows along the Brushy Creek main stem (see Figure S-1), for the purpose of providing flood mitigation at PA4.

Project Description

This site was found to provide minimal effect on Brushy Creek peak flows in the vicinity of PA4. Based on this knowledge, this project was not considered sufficiently effective for analysis to be continued.

SITE A-10 – NEW DETENTION STORAGE NEAR CR-176 (NEW DAM)

Project Purpose

The project is conceived as an in-line detention dam on an unnamed tributary to reduce peak flows along the Brushy Creek main stem (see Figure S-1), for the purpose of providing flood mitigation at PA4.

Project Description

This site was found to provide minimal effect on Brushy Creek peak flows in the vicinity of PA4. Based on this knowledge, this project was not considered sufficiently effective for analysis to be continued.

SITE A-11 – LEANDER HIGH SCHOOL POND (IN-LINE DETENTION)

Project Purpose

The project is conceived to detain flood flows from Blockhouse Creek Tributary 1 (see Figure A11-1) for the purpose of lowering peak flows and associated flooding in PA2 (see Figure S-1).

Project Description

An existing storage area near Leander High School is proposed to be excavated to increase storage capacity. The existing outlet for this area is a bridge on the southeast side. A proposed new embankment on the southeast side just upstream of the bridge with a 5-ft x 8-ft concrete opening will serve to further slow outflow from the storage area, thus improving attenuation of peak flow. See Figure A11-1. Due to these improvements, peak flow out of the pond during the 1% AEP event is expected to drop 83%.

The modifications will involve excavating 99,700 cubic yards of soil to achieve a uniform bottom elevation of 992.2 feet and constructing a 20-foot embankment approximately 500 feet long with 3:1 side slopes, a concrete broad-crested weir 20 feet in length, and a 12-inch-diameter concrete outlet pipe with a grated inlet and downstream flap gate. Estimated costs are $3,217,000; see Table B-5.

Table A11-1. Project Summary Table

Site A-11 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	1002	1001.9 (max)
Embankment Width (ft)	20	
Outlet Width (ft)	5	
Outlet Bottom Elevation (ft-msl)	992.2	
Volume Detained in Section 3b during 100-yr Event (ac-ft)	106.1	194 (est.)

N

0 400 Feet

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A11-1
Site Concept Design
A-11

SITE A-12 – BROADE STREET POND (OFF-CHANNEL RESERVOIR)

Project Purpose

The project is conceived to detain flood flows from South Fork of Brushy Creek Tributary 1 (see Figure A12-1), for the purpose of lowering peak flows and associated flooding in PA1 (see Figure S-1).

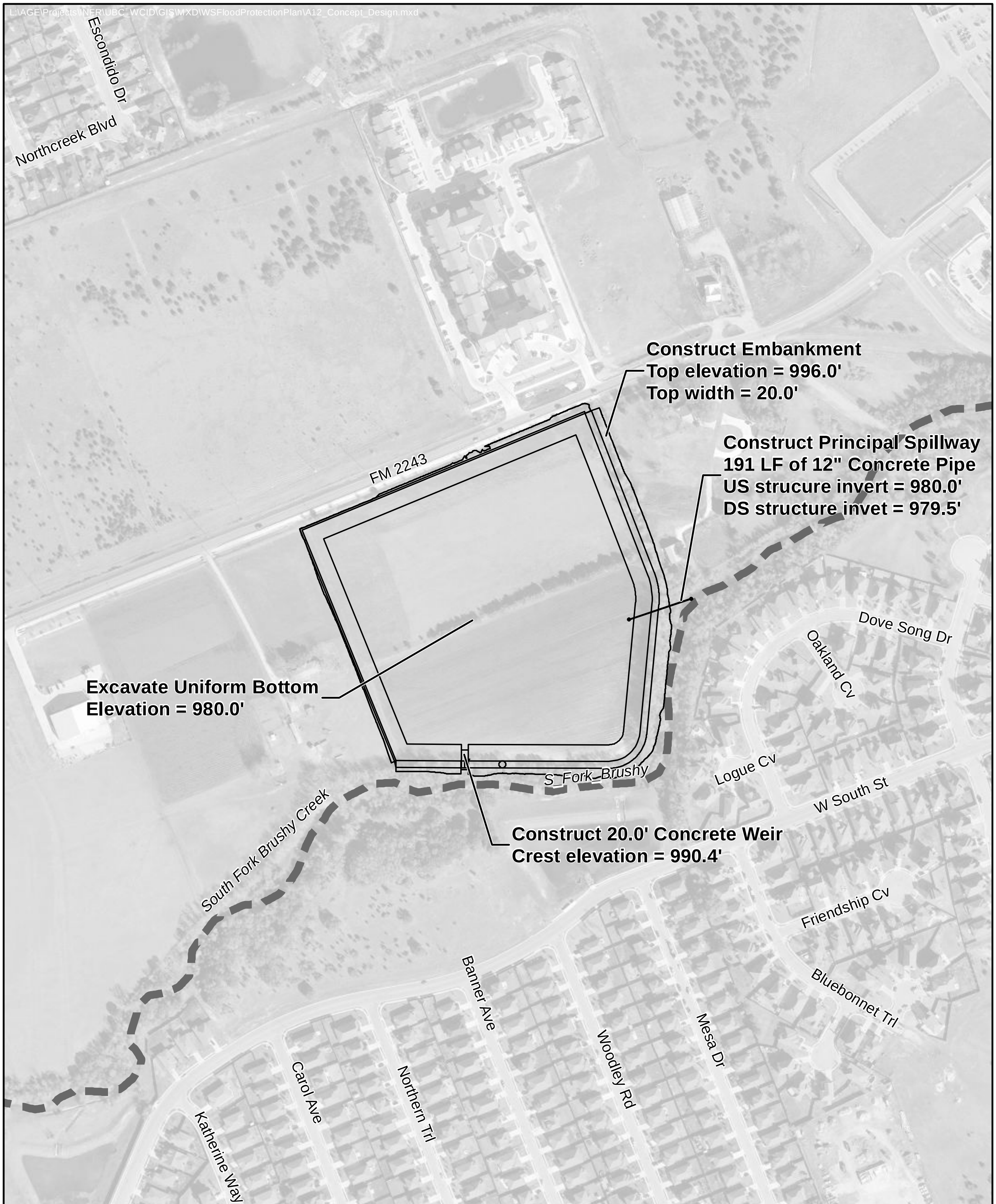
Project Description

An off-channel reservoir is proposed for South Fork Brushy Creek on the south side of Old FM 2243, west of Broade Street. A 20-foot broad-crested weir is proposed as an inlet structure, and a 12-inch-diameter concrete pipe is proposed for the outlet to allow slow draining with a grated inlet and a flap gate to prevent backflow. A new embankment will surround the reservoir on all sides. See Figure 6. Due to these improvements, peak flow in the adjacent stream during the 1% AEP event is expected to drop 44%.

The modifications will involve excavating 266,800 cubic yards of soil to achieve a uniform bottom elevation of 980 feet, constructing a 10-foot embankment approximately 3,350 feet long with 3:1 side slopes, and installing a 191-foot concrete outlet pipe with a grated inlet. Estimated costs are $6,378,000; see Table B-6.

Table A12-1. Project Summary Table

Site A-12 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	996	N/A
Embankment Width (ft)	10	
Weir Width (ft)	20	
Weir Crest Elevation (ft-msl)	990.4	
Outlet Upstream Invert (ft-msl)	980	
Outlet Downstream Invert (ft-msl)	979.5	
Outlet Diameter (in)	12	
Volume Detained in 100-yr Event (ac-ft)	168	257.2 (est.)



N

0 400 Feet

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A12-1
Site Concept Design
A-12

SITE A-13 – DAM NEAR CR-112 (NEW DAM)

Project Purpose

The project is conceived to detain flood flows from McNutt Creek, Tributary 1 (see Figure A13-1) for the purpose of lowering peak flows and associated flooding in PA10 and other PAs downstream (see Figure S-1).

Project Description

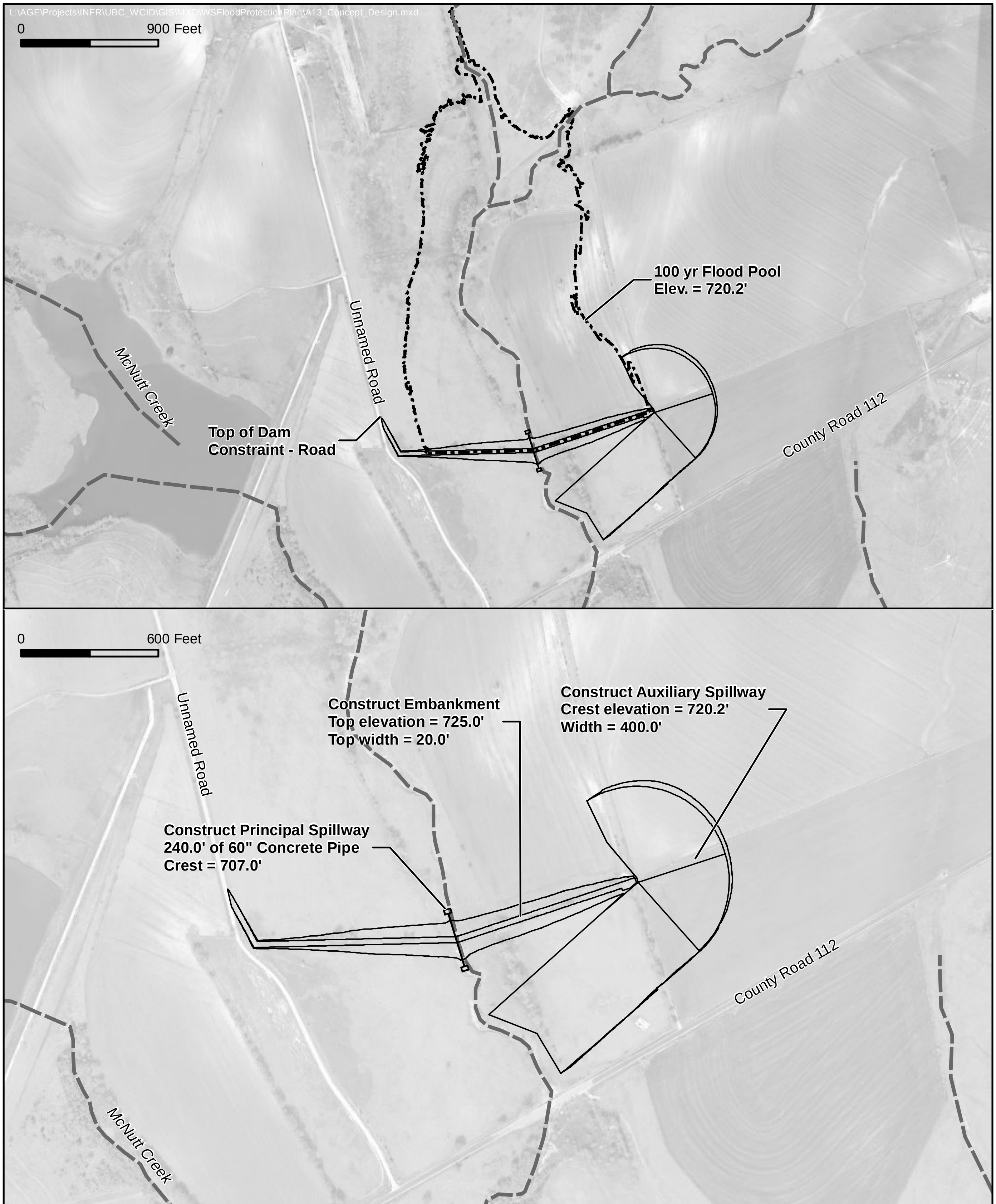
A new dam is proposed on McNutt Creek, Tributary 1, on the north side of County Road 112, just east of District Dam Number 16. A 60-inch-diameter concrete principal spillway is proposed with an intake structure and a 400-foot auxiliary spillway on the east side. See Figure A13-1.

The modifications will involve construction of a new 25-foot-wide embankment approximately 2,000 feet in length with a maximum height of approximately 25 feet; installation of a 200-foot-long, 60-inch-diameter concrete pipe, an intake structure, and stilling basin; and construction of a 400-foot auxiliary spillway. Estimated costs are $6,881,000; see Table B-7.

Table A13-1. Project Summary Table

Site A-13 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	725	724 (maximum) *
Embankment Width (ft)	25	
Toe of Embankment (ft-msl)	700	
Principal Spillway Crest (ft-msl)	707	
Principal Spillway Diameter (in)	60	
Principal Spillway Length (ft)	200	
Auxiliary Spillway Crest (ft-msl)	720.2	724 (maximum)
Auxiliary Spillway Width (ft)	400	200 (maximum) *
Volume Detained in 1% AEP Event (ac-ft)	363.4	550 (est.)

*Dam was aligned to not impose on the constraint.



N

Texas Water Development Board

URS

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A13-1
Site Concept Design
A-13

SITE A-14 – DAM NEAR CHANDLER CREEK BLVD (NEW DAM)

Project Purpose

The project is conceived to detain flood flows from an unnamed tributary of Chandler Branch (see Figure A14-1) for the purpose of lowering peak flows and associated flooding in PA9 and other PAs downstream (see Figure S-1).

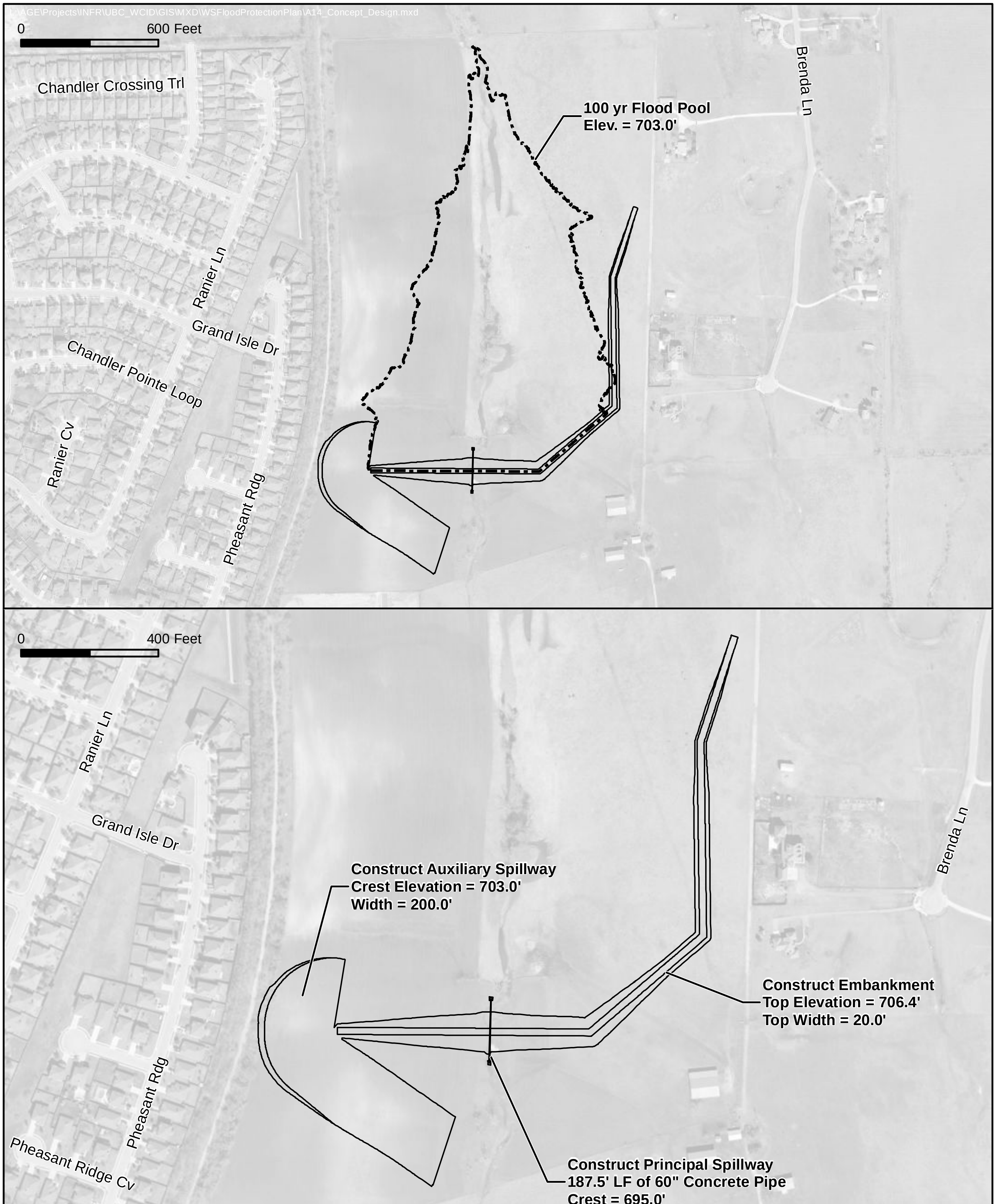
Project Description

A new dam is proposed on an unnamed stream in the Chandler Branch watershed, south of Highway 113, and east of Ranier Lane. A 60-inch-diameter concrete principal spillway is proposed with an intake structure and a 200-foot auxiliary spillway on the west side. See Figure A14-1.

The modifications will include a construction of a new 20-foot-wide embankment approximately 2,050 feet in length with a maximum height of approximately 16 feet; installation of a 180-foot-long, 60-inch-diameter concrete pipe, an intake structure, and stilling basin; and construction of a 200-foot auxiliary spillway. Estimated costs are $2,549,000; see Table B-8.

Table A14-1. Project Summary Table

Site A-14 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	706	706 (maximum)
Embankment Width (ft)	20	
Toe of Embankment (ft-msl)	690	
Principal Spillway Crest (ft-msl)	695	
Principal Spillway Diameter (in)	60	
Principal Spillway Length (ft)	180	
Auxiliary Spillway Crest (ft-msl)	703	706 (maximum)
Auxiliary Spillway Width (ft)	200	200 (maximum)
Volume Detained in 1% AEP Event (ac-ft)	98.9	168 (est.)



N

Texas Water Development Board

URS

Legend

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A14-1
Site Concept Design
A-14

SITE A-15 – OFF-CHANNEL STORAGE NEAR HESTER'S CROSSING (OFF-CHANNEL RESERVOIR)

Analysis of an off-channel storage on Lake Creek Trib 6A, Reach 1, near the intersection of Chisholm Valley Drive and Frontier Trail (see Figure S-1), is being undertaken by the City of Round Rock, separate from the FPP. The predicted reduction in FS associated with this project is 24.4 (existing condition FS of 54.8, post-project condition FS of 30.4). Given the short timing of this tributary basin with the minimal pre- and post-project differences in discharge, it is anticipated that this project will have insignificant impacts to Lake Creek. Tributary 6 outlet results are summarized in Table A-15-1.

Table A-15-1. Results for Tributary 6 Outlet

	Discharge (cfs)		
	50-Year	**100-Year**	**500-Year**
Existing Condition	2,590	3,315	4,640
Post-Project	2,500	3,085	4,550

SITE A-16 – NEW DAM ON LAKE CREEK AT DAVIS SPRINGS

Project Purpose

The project is conceived to detain flood flows from Davis Springs (see Figure A16-1) for the purpose of lowering peak flows and associated flooding along Lake Creek in PA6 and other PAs downstream along Brushy Creek (see Figure S-1).

Project Description

Proposed new Dam A-16 is located on Lake Creek at its confluence with Davis Springs. It is intended to further control the upstream watershed of approximately 8,009 acres, containing Dam 8. Dam A-16 is intended to reduce the flood risk primarily at PA6 on Lake Creek, but will have additional benefit at PAs 9, 10, 11, and 13. Multiple dam alignments were considered, but it has been decided to position the dam on Robinson-owned property. The proposed dam and flood pool are primarily within Robinson open space area.

The 1% AEP (100-year) event design scenario used assumed full development of the Robinson property upstream of the dam. This assumption was made to facilitate potential agreements with the landowner.

The principal spillway size is designed to contain this 100-year without discharge from the auxiliary spillway. The maximum water surface elevation during the 100-year event is constrained by the westbound frontage road of Texas State Highway 45 at an elevation of 803 feet above mean sea level (ft-msl). It has been estimated that four 60-inch-diameter conduits set at an upstream invert of 788 ft-msl would be sufficient to contain the 100-year event with a maximum water surface elevation of 802.7 ft-msl. The 100-year maximum flow at the dam location is reduced from 4,682 cubic feet per second (cfs) to 1,504 cfs.

Dam A-16 is a high-hazard dam of intermediate size. The auxiliary spillway configuration is designed to contain the 75% PMF. This is in accordance with *TCEQ Chapter 299 – Dams and Reservoirs, Subchapter B* (January 1, 2009). The maximum water surface elevation during the 75% PMF is constrained by the westbound lanes of Texas State Highway 45 at an elevation of 808 ft-msl. It has been estimated that a labyrinth weir would be necessary to pass the 75% PMF, as there is not enough room for an earthen or concrete weir spillway of sufficient length. The labyrinth weir is to be 350 feet in length, containing 10 cycles at a magnification of 4.95, located on the south side of the dam. The 75% PMF maximum flow at the dam location is reduced from 28,524 cfs to 27,503 cfs.

The flood pool of proposed Dam A-16 impounds water on the Capital Metro right-of-way at a water surface elevation of approximately 794 ft-msl and against the railroad embankment at approximately 796 ft-msl. Basic design dimensions are provided in Table A16-1. A preliminary geotechnical evaluation of the site is provided in Appendix C.

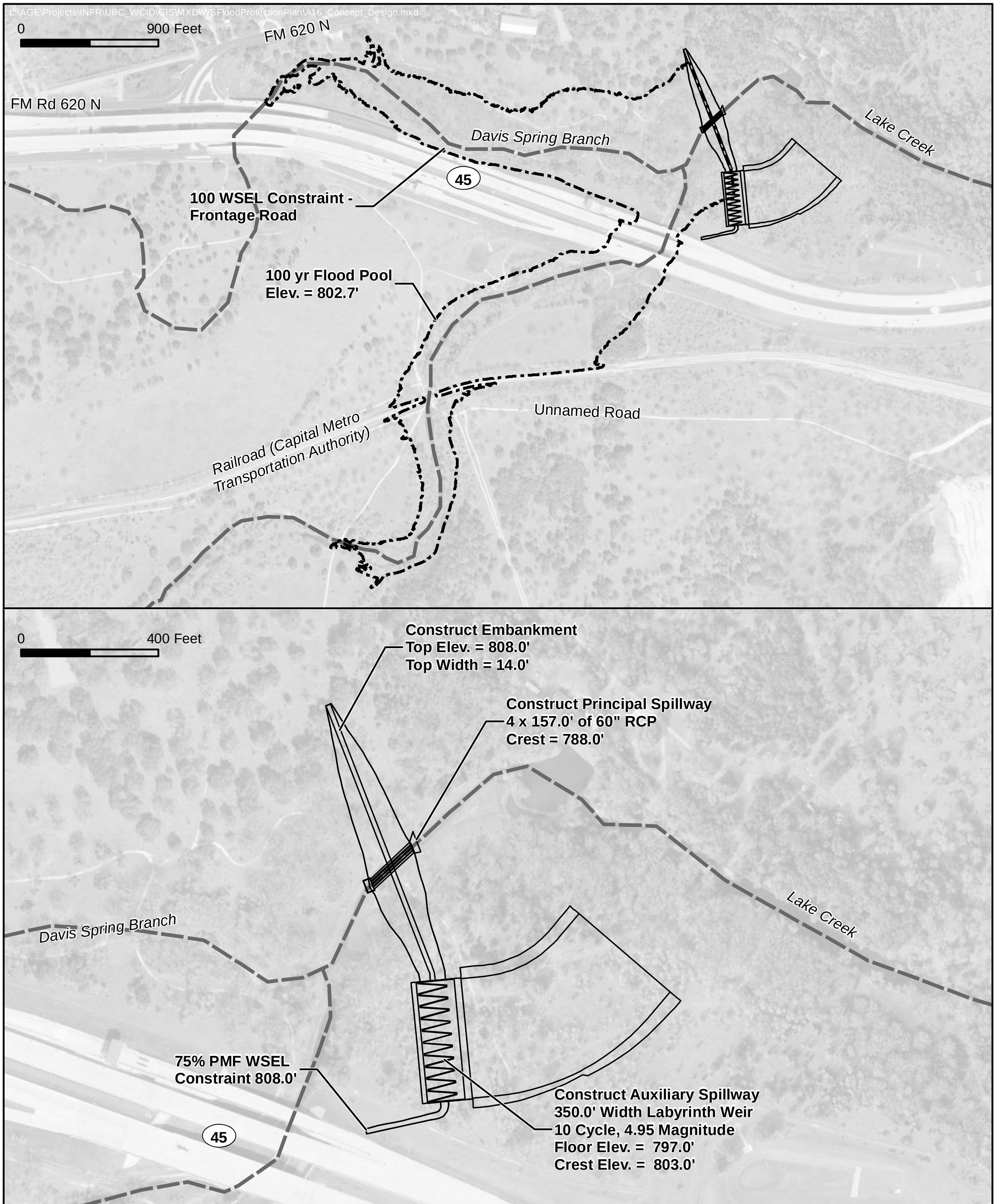
Table A16-1. Design Dimensions

Site A-16 Concept Design Parameters	Design	Constraint
Thalweg Dam (ft-msl)	782.7	
Top of Embankment (ft-msl)	808.0	TX 45 W
Embankment Top Width (ft)	14	
Dam Height (ft)	25.3	
Principal Spillway Upstream Invert (ft-msl)	788	
Principal Spillway Conduit Diameter (in)	60	
Number of Principal Spillway Conduits	4	
Auxiliary Spillway Crest Elevation (ft-msl)	803	
Spillway Width (ft)	350	
Number of Cycles	10	
Magnification (L/W)	4.95	
100-yr Max WSEL	802.7	TX 45 W Frontage (803)
75% PMF Max WSEL Elevation (ft-msl)	807.5	TX 45 W (808)
Volume Detained in 100-yr event (ac-ft)	396.4	
Volume Detained in 75% PMF-yr event (ac-ft)	824.7	
100-yr Maximum Inflow (cfs)	4,682	
100-yr Maximum Outflow (cfs)	1,504	
75% PMF Maximum Inflow (cfs)	28,524	
75% PMF Maximum Outflow (cfs)	27,503	

Karst Mitigation

Embankment dams with karst conditions in the foundation can be at risk of piping or internal erosion as well as foundation erosion-related modes of failure. Karst conditions are variable with openings ranging from tight to cavern sized. Also important is the degree of interconnectivity of the openings. Risk to the embankment can include erosion of the foundation rock, leading to collapse of the foundation and overlying embankment, or piping of the embankment materials if the openings are in contact with the karst features and water flows through the karst features. Based on a review of the desktop geologic report for the A-17 site, relatively large, open karst features exist within the Edwards Limestone that will form the foundation for the embankment.

During design, a number of foundation treatment features could be used to reduce risk of embankment piping and foundation erosion. Investigations to identify the location, orientation, and extent of the karst features might be conducted to select mitigation alternatives. The mitigation alternatives might include foundation blanket grouting, curtain grouting, excavation of portions of the karstic rock, cleaning and backfilling of large karst features, filters and drains for protection from seepage, a concrete grout cap, and cutoff walls. The final design would likely include a combination of these mitigation features. Based on the current understanding of site conditions, design will require piping control features, and although less likely needed, foundation erosion control features. The choice of treatment feature and its cost will follow detailed foundation investigation associated with the next phase of design. Costs associated with foundation treatment are not included in the table in Appendix B.



N

Texas Water Development Board

URS

Legend

Recommended Improvement

——— Construction

Upper Brushy Creek WCID

Figure A16-1
Site Concept Design
A-16

SITE A-17 – NEW DAM ON LAKE CREEK DOWNSTREAM OF DAVIS BRANCH AND UPSTREAM OF RATTAN CREEK

Project Purpose

The project is sited downstream of Dam A16 and is to detain flood flows from Davis Springs (see Figure A17-1) for the purpose of lowering peak flows and associated flooding along Lake Creek in PA6 and other PAs downstream along Brushy Creek (see Figure S-1). The site has less storage capacity than Dam 16 and would be constructed following the construction of Dam 16, barring factors arising that preclude the construction of Dam A-16.

Project Description

Proposed new Dam A-17 is located on Lake Creek downstream of its confluence with Davis Springs and upstream of its confluence with Rattan Creek. It is intended to further control the upstream watershed of approximately 8,912 acres, containing Dam 8 and the proposed Dam A-16. As noted above, Dam A-17 has been designed assuming Dam A-16 has been built. Dam A-17 is intended to reduce the flood risk primarily at PA6 on Lake Creek, but will have additional benefit at PAs 9, 10, 11, and 13. Multiple dam alignments were considered, but it has been decided to position the dam on the Robinson-owned property to the west within the Robinson open space area.

The 1% AEP (100-year) event design scenario used assumed full development of the Robinson property upstream of the dam. This assumption was made to facilitate potential agreements with the landowner.

The principal spillway configuration is designed to contain the 100-year event without discharge from the auxiliary spillway. The maximum water surface elevation during the 100-year event is constrained by the saddle on the southeast side of the flood pool, where the auxiliary spillway will be located, at an elevation of approximately 771 ft-msl. It has been estimated that four 60-inch-diameter conduits set at an upstream invert of 756 ft-msl would be sufficient to contain the 100-year event with a maximum water surface elevation of 770.1 ft-msl. The 100-year maximum flow at the dam location is reduced from 3,005 cfs to 1,466 cfs.

Dam A-17 is a high-hazard dam of intermediate size. The auxiliary spillway configuration is designed to contain the 75% PMF. This is in accordance with *TCEQ Chapter 299 – Dams and Reservoirs*, *Subchapter B* (January 1, 2009). The maximum water surface elevation during the 75% PMF is constrained by the quarry to the northeast at an elevation of 775 ft-msl. It has been estimated that a labyrinth weir would be necessary to pass the 75% PMF over the auxiliary spillway, as there is not enough room for an earthen or concrete weir spillway of sufficient length. The labyrinth weir will be 455 feet in length, containing 13 cycles at a magnification of 4.95, located in the saddle on the southeast side of the flood pool. The auxiliary spillway discharges into Rattan Creek downstream of Dam 9. The 75% PMF maximum flow at the dam location is reduced from 35,226 cfs to 35,093 cfs.

Basic design dimensions are provided in Table A17-1. A preliminary geotechnical evaluation of the site is provided in Appendix C.

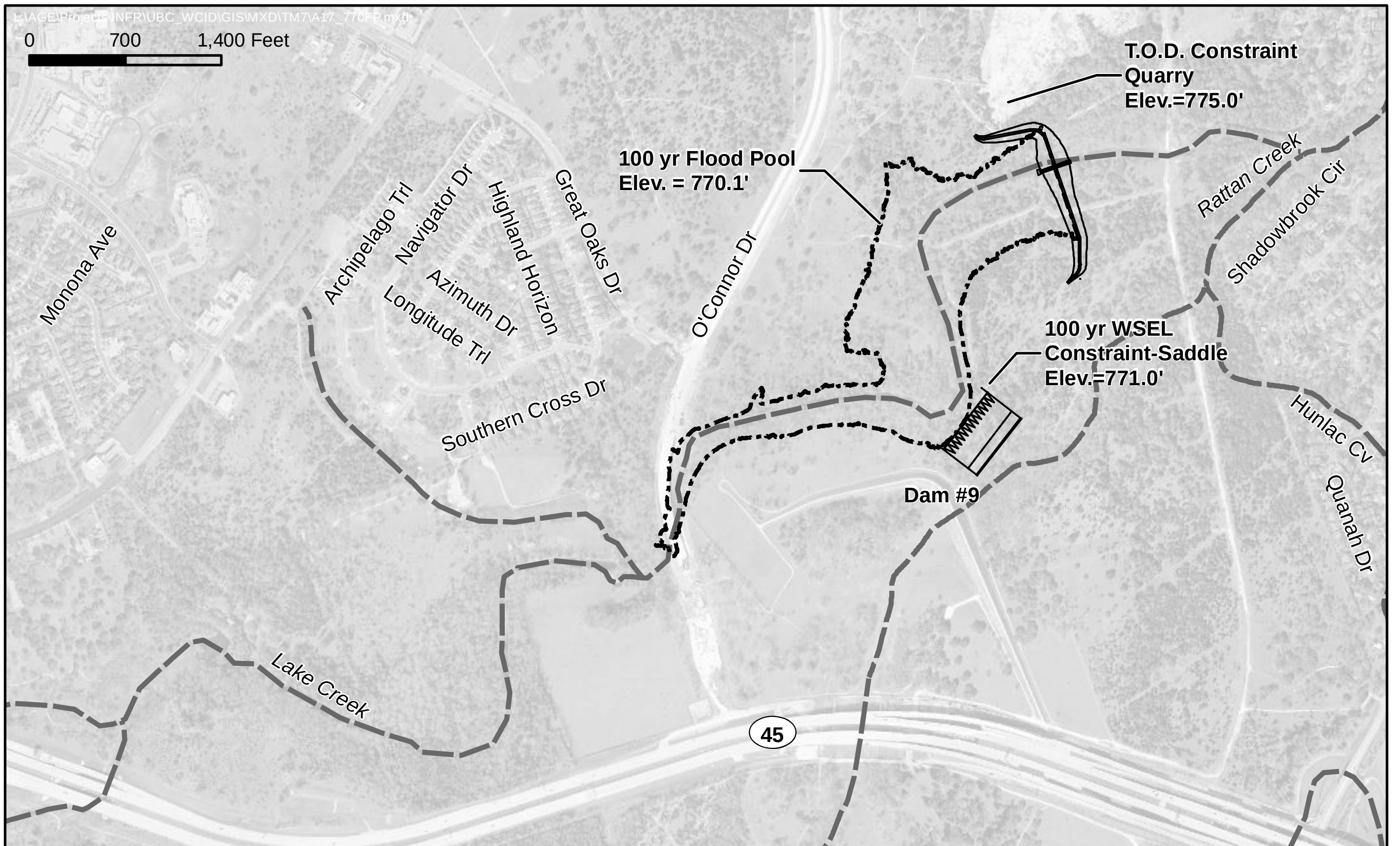
Table A17-1. Design Dimensions

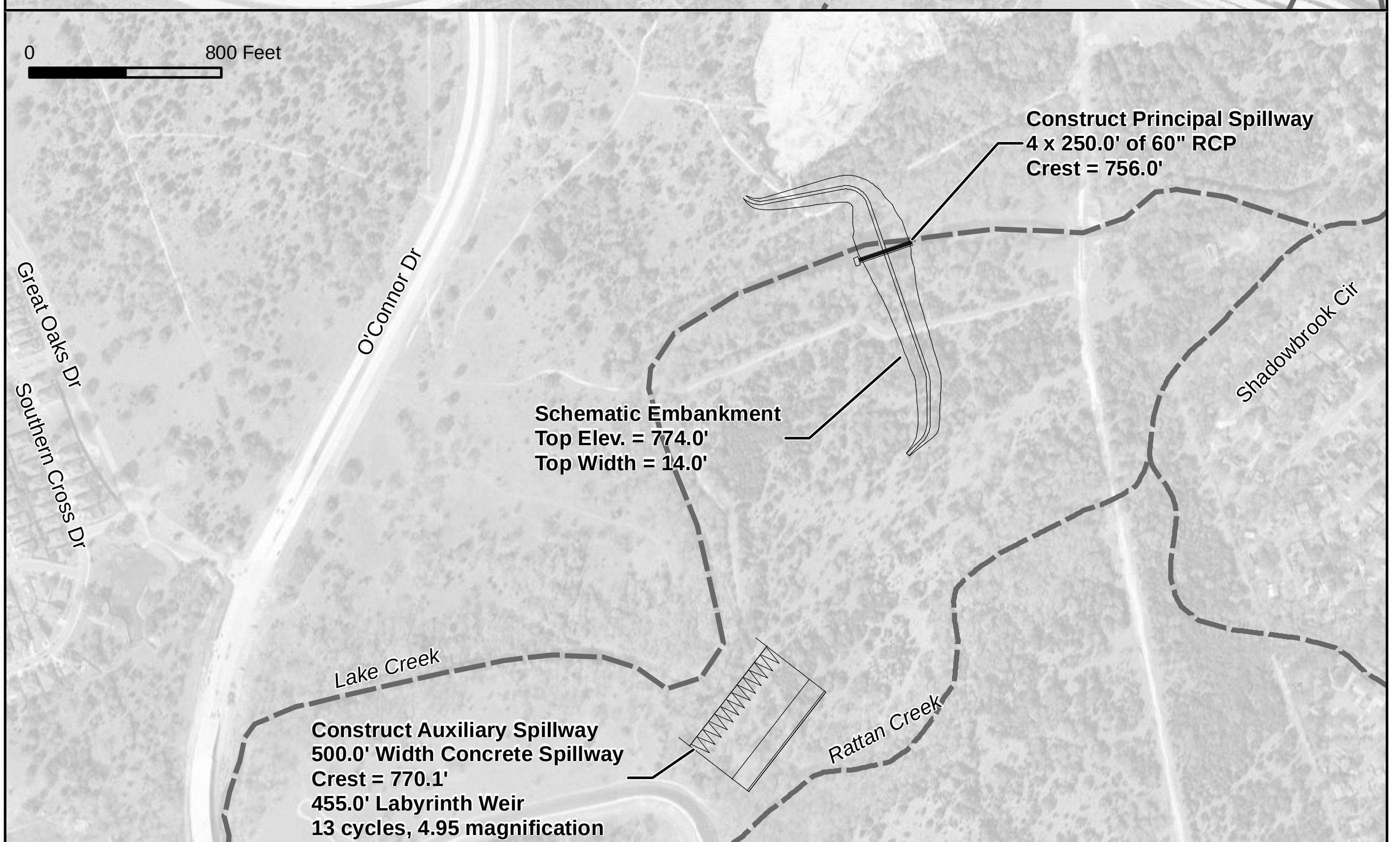
Site A-17 Concept Design Parameters	Design	Constraint
Thalweg Dam (ft-msl)	751.19	
Top of Embankment (ft-msl)	774	
Embankment Top Width (ft)	14	
Dam Height (ft)	22.81	
Principal Spillway Upstream Invert (ft-msl)	756	
Principal Spillway Conduit Diameter (in)	60	
Number of Principal Spillway Conduits	4	
Auxiliary Spillway Crest Elevation (ft-msl)	770.1	
Spillway Width (ft)	455	
Number of Cycles	13	
Magnification (L/W)	4.95	
100-yr Max WSEL	770.1	Saddle on SE side of flood pool
75% PMF Max WSEL Elevation (ft-msl)	773.8	Quarry to the northeast (775)
Volume Detained in 100-yr Event (ac-ft)	347.6	
Volume Detained in 75% PMF-yr event (ac-ft)	618.9	
100-yr Maximum Inflow (cfs)	3,005	
100-yr Maximum Outflow (cfs)	1,466	
75% PMF Maximum Inflow (cfs)	35,226	
75% PMF Maximum Outflow (cfs)	35,093	

Karst Mitigation

Embankment dams with karst conditions in the foundation can be at risk of piping or internal erosion as well as foundation erosion-related modes of failure. Karst conditions are variable with openings ranging from tight to cavern sized. Also important is the degree of interconnectivity of the openings. Risk to the embankment can include erosion of the foundation rock, leading to collapse of the foundation and overlying embankment, or piping of the embankment materials if the openings are in contact with the karst features and water flows through the karst features. Based on a review of the desktop geologic report for the A-17 site, relatively large, open karst features exist within the Edwards Limestone that will form the foundation for the embankment.

During design, a number of foundation treatment features could be used to reduce risk of embankment piping and foundation erosion. Investigations to identify the location, orientation, and extent of the karst features might be conducted to select mitigation alternatives. The mitigation alternatives might include foundation blanket grouting, curtain grouting, excavation of portions of the karstic rock, cleaning and backfilling of large karst features, filters and drains for protection from seepage, a concrete grout cap, and cutoff walls. The final design would likely include a combination of these mitigation features. Based on the current understanding of site conditions, design will require piping control features, and although less likely needed, foundation erosion control features. The choice of treatment feature and its cost will follow detailed foundation investigation associated with the next phase of design. Costs associated with foundation treatment are not included in the table in Appendix B.





N

UPPER BRUSHY CREEK W.C.I.D.

Texas Water Development Board

URS

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A17-1
Site Concept Design
A-17

SITE A-17 EXPANDED – NEW DAM ON LAKE CREEK DOWNSTREAM OF DAVIS BRANCH AND UPSTREAM OF RATTAN CREEK

Proposed new Dam A-17 Expanded is located on Lake Creek downstream of its confluence with Davis Springs and upstream of its confluence with Rattan Creek. It is intended to control the upstream watershed of approximately 8,912 acres, containing Dam 8 and the proposed Dam A-16. Dam A-17 Expanded has been conceptually designed assuming Dam A-16 is not built. Dam A-17 Expanded is intended to reduce the flood risk primarily at PA6 on Lake Creek, but will have additional benefits at PAs 9, 10, 11, and 13. Multiple dam alignments were considered, but it has been decided to position the dam on the Robinson-owned property to the west within the Robinson open space area.

The 1% AEP (100-year) event design scenario used assumed full development of the Robinson property upstream of the dam. This assumption was made to facilitate potential agreements with the landowner.

The principal spillway configuration is designed to contain the 100-year event. The maximum water surface elevation during the 100-year event is constrained by the low chord of the O'Conner Dr. Bridge over Lake Creek, at an elevation of 781.7 ft-msl. It has been estimated that three (3) 60-inch conduits set at an upstream invert of 756 ft-msl would be sufficient to contain the 100-year event with a maximum water surface elevation of 775.1 ft-msl. The 100-year maximum flow at the dam location is reduced from 5,588 cfs to 1,235 cfs.

Dam A-17 Expanded is a high-hazard dam of intermediate size. The auxiliary spillway configuration will be sized to pass the 76% PMF. This is in accordance with *TCEQ Chapter 299 – Dams and Reservoirs, Subchapter B, January 1, 2009*. The maximum water surface elevation during the 76% PMF is constrained by the auxiliary spillway of Dam 9 at an elevation of 786 ft-msl. It has been estimated that an ogee concrete spillway would be necessary to pass the 76% PMF over the auxiliary spillway. The concrete spillway will be 525 feet in length, located in the saddle on the southeast side of the flood pool, discharging into Rattan Creek downstream of Dam 9. The maximum water surface elevation of the 76% PMF is 784.96 ft-msl, leaving 1 foot of freeboard. This design can be optimized in the future to reduce concrete volume and overall cost by consideration of alternative labyrinth weir configurations, and use of a converging spillway chute.

Basic design dimensions are provided in Table A17-2. A preliminary geotechnical evaluation of the site is provided in Appendix C.

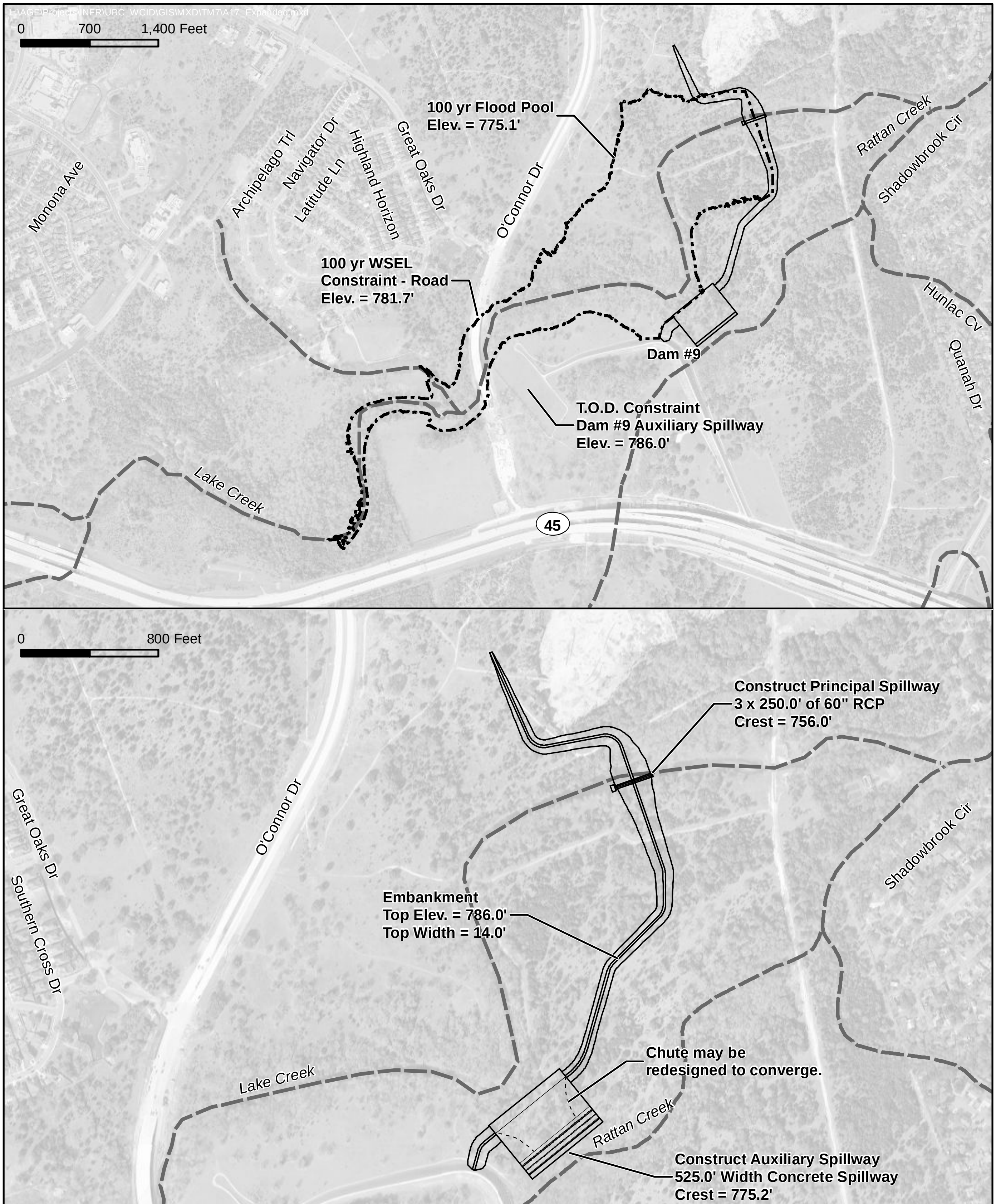
Table A17-2. Expanded Design Dimensions

Site A-17 Concept Design Parameters	Design	Constraint
Thalweg Dam (ft-msl)	751.19	
Top of Embankment (ft-msl)	786	Dam 9 Auxiliary Spillway Crest Elevation
Embankment Width (ft)	14	
Dam Height (ft)	34.81	
Principal Spillway Upstream Invert (ft-msl)	756	
Principal Spillway Conduit Diameter (in)	60	
Number of Principal Spillway Conduits	3	
Auxiliary Spillway Crest Elevation (ft-msl)	775.2	
Spillway Width (ft)	525	
100 yr Max WSEL	775.14	O'Connor Dr. (781.7)
76% PMF Max WSEL Elevation (ft-msl)	784.96	1 ft Freeboard
Volume Detained in 100-yr event (ac-ft)	734.7	
Volume Detained in 76% PMF-yr event (ac-ft)	1618.2	
100 yr Maximum Inflow (cfs)	5,588	
100 yr Maximum Outflow (cfs)	1,235	
75% PMF Maximum Inflow (cfs)	53,444	
75% PMF Maximum Outflow (cfs)	52,808	

Karst Mitigation

Embankment dams with karst conditions in the foundation can be at risk of piping or internal erosion as well as foundation erosion-related modes of failure. Karst conditions are variable with openings ranging from tight to cavern sized. Also important is the degree of interconnectivity of the openings. Risk to the embankment can include erosion of the foundation rock, leading to collapse of the foundation and overlying embankment, or piping of the embankment materials if the openings are in contact with the karst features and water flows through the karst features. Based on a review of the desktop geologic report for the A-17 site, relatively large, open karst features exist within the Edwards Limestone that will form the foundation for the embankment.

During design, a number of foundation treatment features could be used to reduce risk of embankment piping and foundation erosion. Investigations to identify the location, orientation, and extent of the karst features might be conducted to select mitigation alternatives. The mitigation alternatives might include foundation blanket grouting, curtain grouting, excavation of portions of the karstic rock, cleaning and backfilling of large karst features, filters and drains for protection from seepage, a concrete grout cap, and cutoff walls. The final design would likely include a combination of these mitigation features. Based on the current understanding of site conditions, design will require piping control features, and although less likely needed, foundation erosion control features. The choice of treatment feature and its cost will follow detailed foundation investigation associated with the next phase of design. Costs associated with foundation treatment are not included in the table in Appendix B.



N

Upper Brushy Creek W.C.I.D.

Texas Water Development Board

URS

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A17-2
Site Concept Design
A-17 Expanded

SITE A-19 – EXISTING FM 620 QUARRY AND PROPOSED OVERFLOW CHANNEL

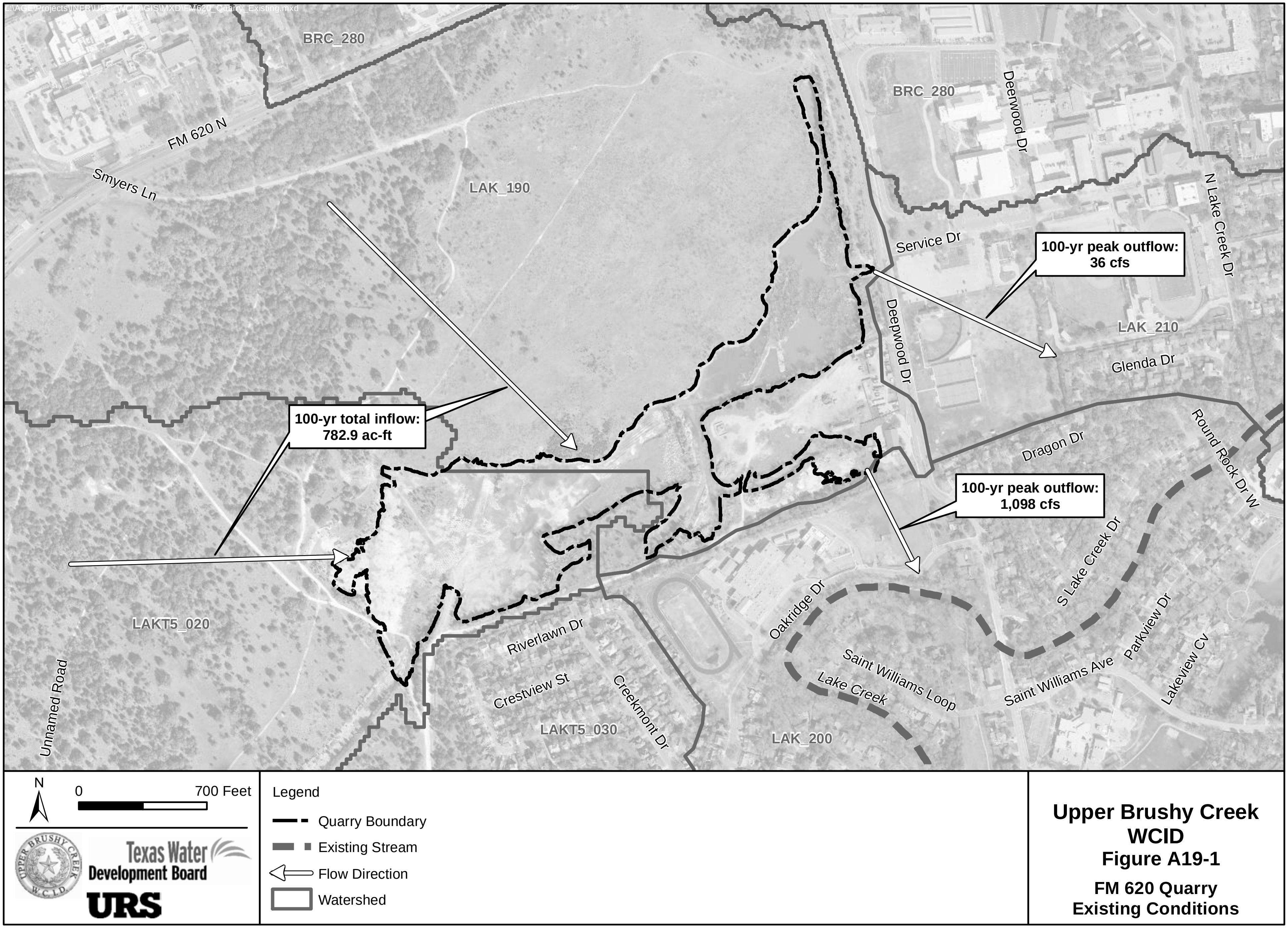
Concept Design Parameters	Design
Existing Quarry 100-year Storage	451.79 ac-ft
100-year Total Inflow	782.9 ac-ft
100-year Peak Outflow	1,134 cfs
Upstream Channel Invert	749.3 ft-msl
Quarry Invert Elevation	730.8 ft-msl
Downstream Channel Invert	745.0 ft-msl
Channel Length	580 ft-msl
Channel Slope	0.0074
Channel Bottom Width	40 ft
Side Slopes	3:1
Channel Depth	4 ft

An existing quarry is located south of FM 620 and west of Deep Woods Dr. The quarry currently receives flows from the drainage areas north, west, and southwest of the quarry. The total drainage area into the quarry is approximately 1,089 acres, and the total inflow during the 100-year event is 782.9 ac-ft.

The quarry currently begins overflowing at a water surface elevation of 749.3 ft-msl to the southeast across an athletic field east of Chisolm Trail Middle School. The total quarry storage at elevation 749.3 ft-msl is 375.4 ac-ft. The quarry also overflows east across Deep Woods Dr. beginning at a water surface elevation of 750.3 ft-msl. During the 100-year event, the water surface reaches an elevation of 751.1 ft-msl. The estimated existing peak outflow in the 100-year event is 1,098 cfs to the southeast and 36 cfs to the east.

There are two issues of concern with the FM 620 quarry. First, in the event that the quarry is backfilled, the existing flood pool storage that the quarry provides will need to be provided elsewhere or adverse flooding impacts will occur. The quarry has been observed to fill during storm events, and if this storage volume is lost and no additional storage is provided, downstream flows will increase substantially.

Secondly, the flows out of the quarry once it overtops are currently uncontrolled. A channel could be constructed from the southeast corner of the quarry to carry the overflow south along Deep Woods Dr., under Oak Ridge Dr. through a proposed culvert, and into Lake Creek. A concept design for this channel has been completed, and the dimensions can be found in the above table. In addition, the embankment to the east of the quarry could be raised to prevent overflows from the quarry. The cost estimate for design and construction of the embankment improvement, channel, culvert, and energy dissipator is $554,000. A detailed cost estimate is provided in Table B-9.



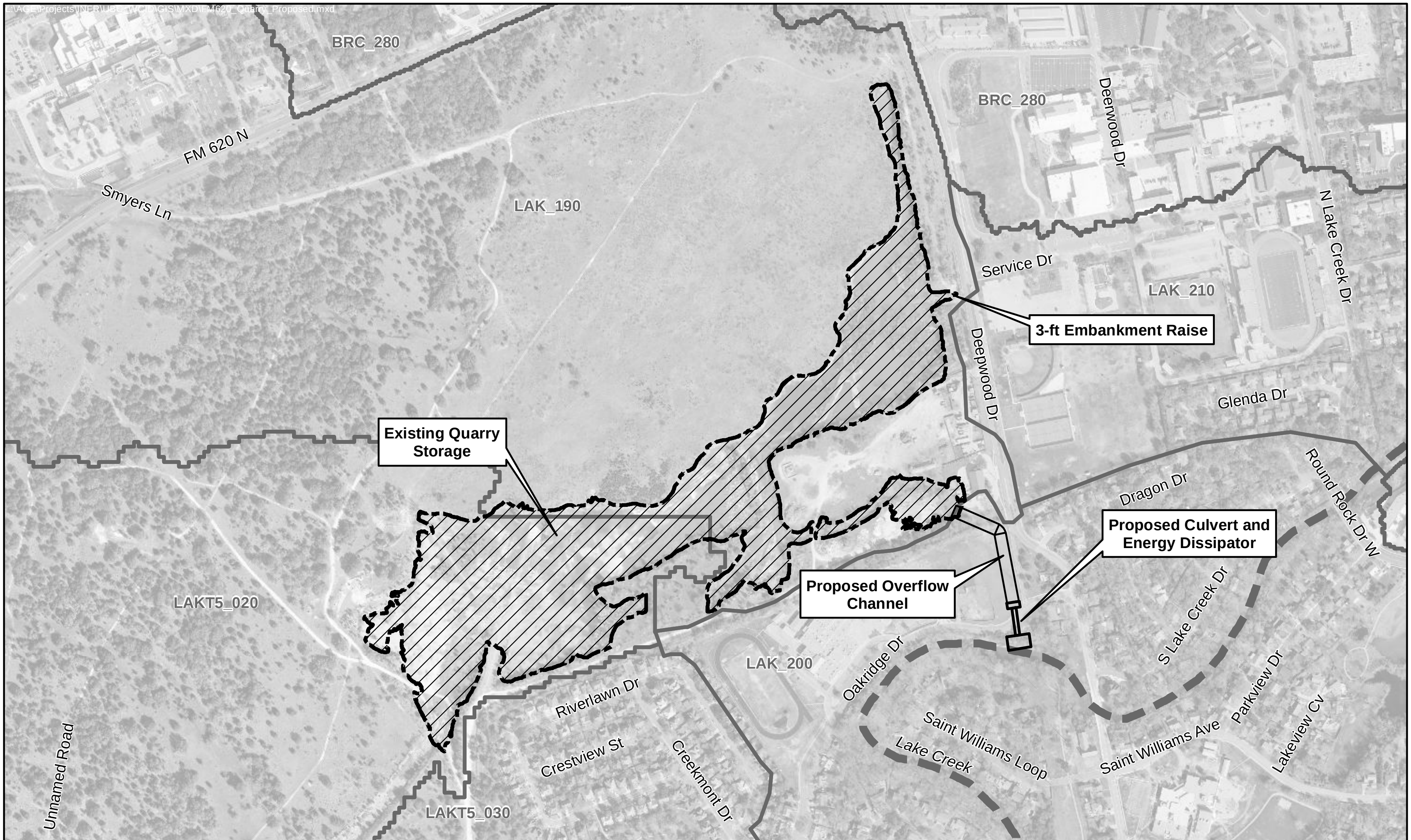
Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A19-1

FM 620 Quarry Existing Conditions



N

0 700 Feet

Legend

Quarry Boundary

Existing Stream

Watershed

Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A19-2

FM 620 Quarry Proposed Channel

SITE A-20 – IMPROVEMENT OF BRUSHY CREEK CROSSING OF RED BUD LANE

Existing Conditions

The crossing of Red Bud Lane over Brushy Creek is an area of concern as the 500-year event encompasses many of the surrounding habitable structures as well as several of the structures of the upstream wastewater treatment plant, as shown on Figure A20-1. Although the Brushy Creek channel is relatively deep at this location, the additional flow from the upstream confluence with Chandler Branch spills out of the channel during the 500-year storm event. Several factors combine to obstruct flows in this area, including a narrow channel at Red Bud Lane, a low-water crossing immediately downstream of the structure, and the artificial constriction of the floodplain approximately 1,600 feet downstream of the crossing.

Table A20-1. Red Bud Lane Existing Depth of Flooding

HS_ID	Depth of Flooding (ft)					
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr
445	0.00	0.00	0.00	0.00	0.00	1.93
639	0.00	0.00	0.00	2.37	3.84	7.93
446	0.00	0.00	0.00	0.00	0.00	3.07
239	0.00	0.00	0.00	0.00	0.00	3.09
638	0.00	0.00	0.00	0.00	0.00	1.49
323	0.00	0.00	0.00	0.00	0.00	2.25
637	0.00	0.00	0.00	0.00	0.00	0.30
240	0.00	0.00	0.00	0.00	0.00	0.00
237	0.00	0.00	0.00	0.00	0.00	0.28
287	0.00	0.00	0.00	0.00	0.00	0.00
241	0.00	0.00	0.00	0.00	0.00	0.77
447	0.00	0.00	0.00	0.00	0.00	0.00
322	0.00	0.00	0.00	0.00	0.00	0.00
232	0.00	0.00	0.00	0.00	0.00	1.58
233	0.00	0.00	0.00	0.00	0.00	0.27
320	0.00	0.00	0.00	0.00	0.00	2.19
229	0.00	0.00	0.00	0.00	0.00	0.00
250	0.00	0.00	0.00	0.00	0.00	0.70
321	0.00	0.00	0.00	0.00	0.00	2.19
276	0.00	0.00	0.00	0.00	0.00	1.06
310	0.00	0.00	0.00	0.00	0.00	0.86
425	0.00	0.00	0.00	0.00	0.00	0.00
451	0.00	0.00	0.00	0.00	0.00	2.24
238	0.00	0.00	0.00	0.00	0.00	2.08
277	0.00	0.00	0.00	0.00	0.00	0.00
458	0.00	0.00	0.00	0.00	0.00	0.00
220	0.00	0.00	0.00	0.00	0.00	0.00
230	0.00	0.00	0.00	0.00	0.00	0.91
324	0.00	0.00	0.00	0.00	0.00	2.13
426	0.00	0.00	0.00	0.00	0.00	0.00

N

0 700 Feet

Texas Water Development Board

URS

Stream

XS Cut Line

Modeled 100-Year Floodplain

Modeled 500-Year Floodplain

Upper Brushy Creek WCID

Brushy Creek

9/29/2014

Figure A20-1

HS_ID	Depth of Flooding (ft)					
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr
308	0.00	0.00	0.00	0.00	0.00	0.06
326	0.00	0.00	0.00	0.00	0.00	1.60
307	0.00	0.00	0.00	0.00	0.00	0.89
427	0.00	0.00	0.00	0.00	0.00	0.00
284	0.00	0.00	0.00	0.00	0.00	0.53
309	0.00	0.00	0.00	0.00	0.00	0.00
325	0.00	0.00	0.00	0.00	0.00	1.93
424	0.00	0.00	0.00	0.00	0.00	0.00
302	0.00	0.00	0.00	0.00	0.00	0.00
252	0.00	0.00	0.00	0.00	0.00	1.90
262	0.00	0.00	0.00	0.00	0.00	0.25
428	0.00	0.00	0.00	0.00	0.00	0.00
299	0.00	0.00	0.00	0.00	0.00	1.81
219	0.00	0.00	0.00	0.00	0.00	0.95
261	0.00	0.00	0.00	0.00	0.00	0.00
285	0.00	0.00	0.00	0.00	0.00	0.67
243	0.00	0.00	0.00	0.00	0.00	0.00
288	0.00	0.00	0.00	0.00	0.00	1.19
290	0.00	0.00	0.00	0.00	0.00	0.00
264	0.00	0.00	0.00	0.00	0.00	0.38
263	0.00	0.00	0.00	0.00	0.00	0.00
429	0.00	0.00	0.00	0.00	0.00	0.25
265	0.00	0.00	0.00	0.00	0.00	0.08
242	0.00	0.00	0.00	0.00	0.00	2.64
286	0.00	0.00	0.00	0.00	0.00	0.00
1459	0.00	0.00	0.00	0.00	0.00	0.00
266	0.00	0.00	0.00	0.00	0.00	0.00
244	0.00	0.00	0.00	0.00	0.00	2.52
245	0.00	0.00	0.00	0.00	0.00	0.00
289	0.00	0.00	0.00	0.00	0.00	0.75
453	0.00	0.00	0.00	0.00	0.00	0.00
454	0.00	0.00	0.00	0.00	0.00	0.87
457	0.00	0.00	0.00	0.00	0.00	0.12
1462	0.00	0.00	0.00	0.00	0.00	0.00
327	0.00	0.00	0.00	0.00	0.00	2.42
455	0.00	0.00	0.00	0.00	0.00	3.05
650	0.00	0.00	0.00	0.00	0.00	0.00
291	0.00	0.00	0.00	0.00	0.00	3.19
292	0.00	0.00	0.00	0.00	0.00	1.09
294	0.00	0.00	0.00	0.00	0.00	1.09
452	0.00	0.00	0.00	0.00	0.00	1.30
295	0.00	0.00	0.00	0.00	0.00	0.00
328	0.00	0.00	0.00	0.00	0.00	0.00
456	0.00	0.00	0.00	0.00	0.00	0.00
1335	0.00	0.00	0.00	0.00	0.00	0.00

HS_ID	Depth of Flooding (ft)					
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr
247	0.00	0.00	0.00	0.00	0.00	1.89
211	0.00	0.00	0.00	0.00	0.00	0.15
246	0.00	0.00	0.00	0.00	0.00	0.00
248	0.00	0.00	0.00	0.00	0.00	1.67
249	0.00	0.00	0.00	0.00	0.00	0.00
251	0.00	0.00	0.00	0.00	0.00	0.10
293	0.00	0.00	0.00	0.00	0.00	0.38
296	0.00	0.00	0.00	0.00	0.00	1.00
297	0.00	0.00	0.00	0.00	0.00	2.01

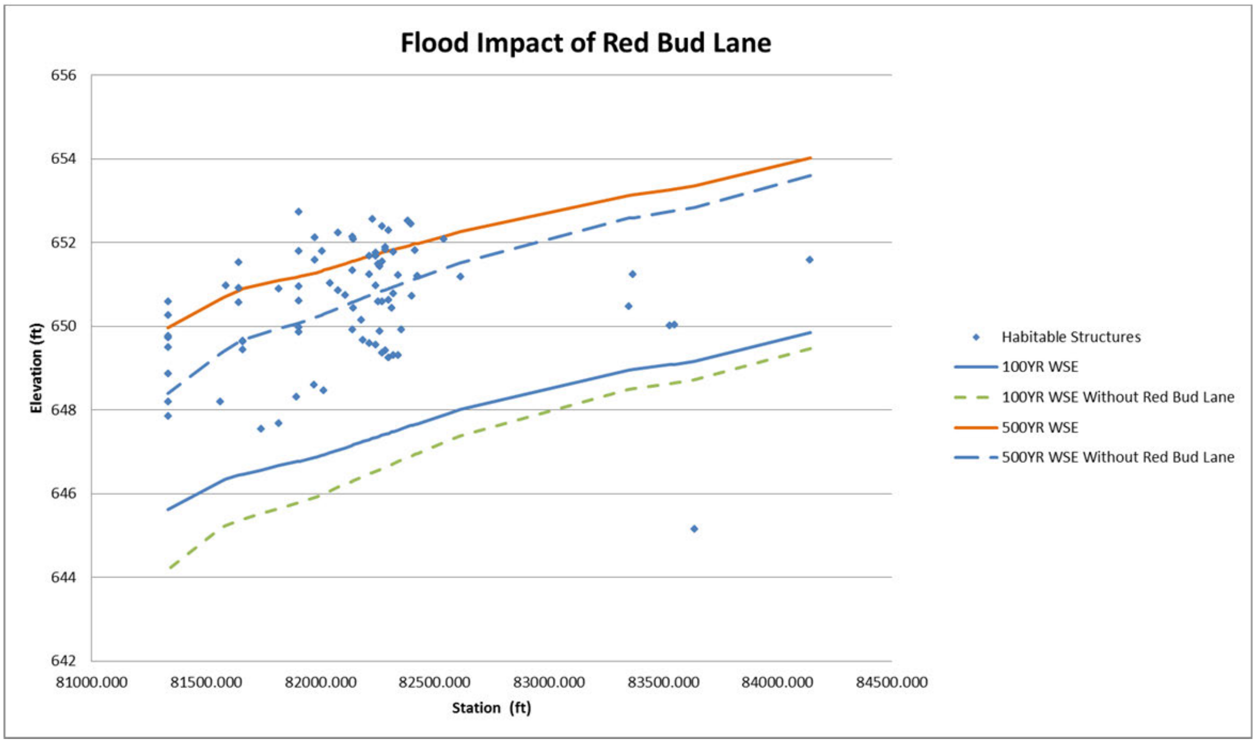


Figure A20-2. Red Bud Lane Existing Flood Profiles

Alternatives Analysis

Considering the structural geometry of the bridge and channel, few options were available for expanding the capacity of Red Bud Lane as pier placement prevents the channel from being further widened. However, three options were analyzed separately as well as in tandem to reduce water surface elevations upstream:

- Use an existing channel south of Brushy Creek as a secondary crossing under Red Bud Lane in flood conditions. Five 6-ft x 8-ft rectangular concrete culverts would be added at this location to increase capacity during large flow events.

- Remove the low-water crossing immediately downstream of Red Bud Lane to prevent obstruction to flow at this location and lower the channel elevation.
- Restore the floodplain accessibility of the channel where constricted 1,600 feet downstream of the crossing. A significant volume of fill that appears to have been artificially added at the floodplain at this location prevents higher frequency flows from spreading out. This modification involves trimming the bank elevation down to match those upstream and downstream of the constriction.

Table A20-2. Reduced Flood Depths for All Proposed Modifications

HS_ID	Change in Water Surface Elevation (ft)						Change in FS
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr	
445	0	0	0	0	0	0.07	0.01
639	0	0	0	0.30	0.18	0.09	0.47
446	0	0	0	0	0	0.09	0.01
239	0	0	0	0	0	0.09	0.01
638	0	0	0	0	0	0.09	0.01
323	0	0	0	0	0	0.09	0.01
637	0	0	0	0	0	0.14	0.02
240	0	0	0	0	0	0	0.00
237	0	0	0	0	0	0.14	0.02
287	0	0	0	0	0	0	0.00
241	0	0	0	0	0	0.14	0.02
447	0	0	0	0	0	0	0.00
322	0	0	0	0	0	0	0.00
232	0	0	0	0	0	0.14	0.02
233	0	0	0	0	0	0.14	0.02
320	0	0	0	0	0	0.14	0.02
229	0	0	0	0	0	0	0.00
250	0	0	0	0	0	0.14	0.02
321	0	0	0	0	0	0.14	0.02
276	0	0	0	0	0	0.14	0.02
310	0	0	0	0	0	0.14	0.02
425	0	0	0	0	0	0	0.00
451	0	0	0	0	0	0.14	0.02
238	0	0	0	0	0	0.14	0.02
277	0	0	0	0	0	0	0.00
458	0	0	0	0	0	0	0.00
220	0	0	0	0	0	0	0.00
230	0	0	0	0	0	0.14	0.02
324	0	0	0	0	0	0.14	0.02
426	0	0	0	0	0	0.08	0.01
308	0	0	0	0	0	0.14	0.02
326	0	0	0	0	0	0.14	0.02
307	0	0	0	0	0	0.14	0.02
427	0	0	0	0	0	0.13	0.02
284	0	0	0	0	0	0.14	0.02

HS_ID	Change in Water Surface Elevation (ft)						Change in FS
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr	
309	0	0	0	0	0	0	0.00
325	0	0	0	0	0	0.14	0.02
424	0	0	0	0	0	0	0.00
302	0	0	0	0	0	0	0.00
252	0	0	0	0	0	0.14	0.02
262	0	0	0	0	0	0.14	0.02
428	0	0	0	0	0	0	0.00
299	0	0	0	0	0	0.14	0.02
219	0	0	0	0	0	0.16	0.02
261	0	0	0	0	0	0	0.00
285	0	0	0	0	0	0.16	0.02
243	0	0	0	0	0	0	0.00
288	0	0	0	0	0	0.16	0.02
290	0	0	0	0	0	0	0.00
264	0	0	0	0	0	0.16	0.02
263	0	0	0	0	0	0	0.00
429	0	0	0	0	0	0.16	0.02
265	0	0	0	0	0	0.16	0.02
242	0	0	0	0	0	0.16	0.02
286	0	0	0	0	0	0	0.00
1459	0	0	0	0	0	0	0.00
266	0	0	0	0	0	0	0.00
244	0	0	0	0	0	0.16	0.02
245	0	0	0	0	0	0	0.00
289	0	0	0	0	0	0.17	0.02
453	0	0	0	0	0	0	0.00
454	0	0	0	0	0	0.17	0.02
457	0	0	0	0	0	0.17	0.02
1462	0	0	0	0	0	0	0.00
327	0	0	0	0	0	0.17	0.02
455	0	0	0	0	0	0.17	0.02
650	0	0	0	0	0	0	0.00
291	0	0	0	0	0	0.17	0.02
292	0	0	0	0	0	0.17	0.02
294	0	0	0	0	0	0.17	0.02
452	0	0	0	0	0	0.17	0.02
295	0	0	0	0	0	0	0.00
328	0	0	0	0	0	0	0.00
456	0	0	0	0	0	0	0.00
1335	0	0	0	0	0	0	0.00
247	0	0	0	0	0	0.20	0.02
211	0	0	0	0	0	0.10	0.01
246	0	0	0	0	0	0	0.00
248	0	0	0	0	0	0.10	0.01
249	0	0	0	0	0	0	0.00

HS_ID	Change in Water Surface Elevation (ft)						Change in FS
	2-yr	10-yr	25-yr	50-yr	100-yr	500-yr	
251	0	0	0	0	0	0.10	0.01
293	0	0	0	0	0	0.10	0.01
296	0	0	0	0	0	0.10	0.01
297	0	0	0	0	0	0.10	0.01

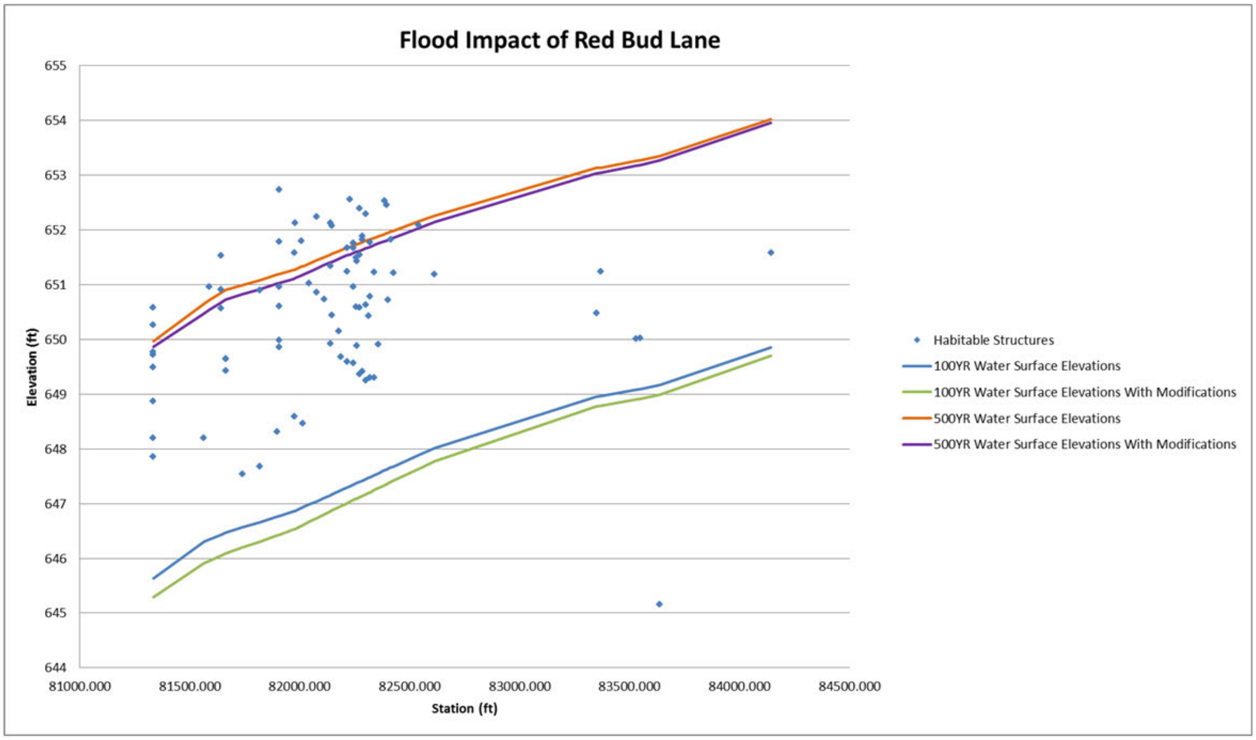


Figure A20-3. Flood Profiles for All Proposed Solutions

Benefits Analysis

This analysis showed that even with a combination of possible modifications to Red Bud Lane, few of the habitable structures upstream of the structure were effectively removed from the 500-year floodplain. The cost benefit ratio therefore precludes any of these alternatives from being considered and further developed.

SITE A-21 – COTTONWOOD CREEK DAM (NEW DAM)

Project Purpose

The project is conceived to detain flood flows from Cottonwood Creek (see Figure A21-1) for the purpose of lowering peak flows and associated flooding in PA12 and downstream PA13 along the Brushy Creek main stem (see Figure S-1).

Project Description

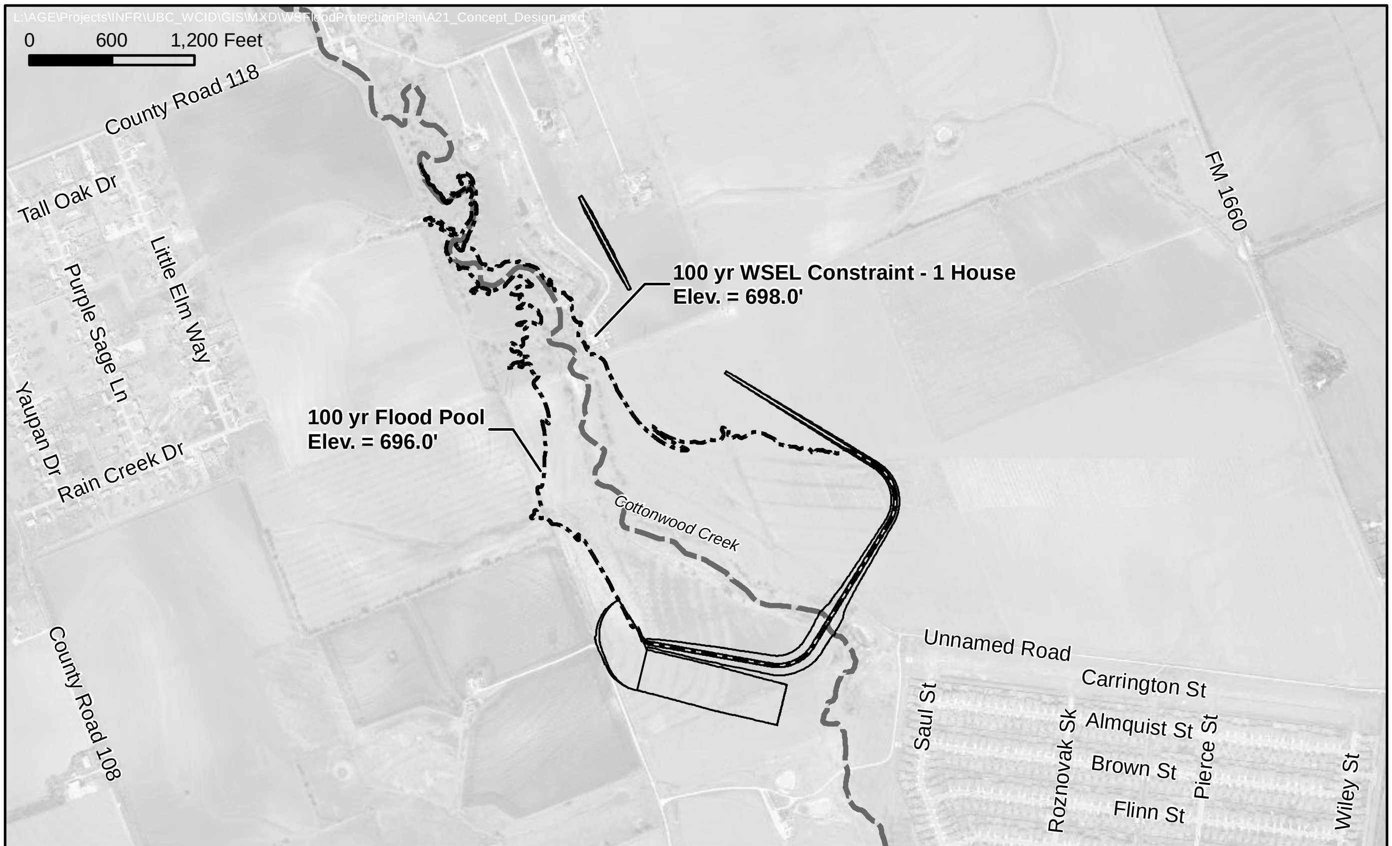
A new dam is proposed on Cottonwood Creek, Reach 1, near County Road 119 and the intersection of Saul Street and Carrington Street. A 24-inch-diameter concrete principal spillway is proposed with an intake structure and a 300-foot auxiliary spillway on the west side. See Figure A21-1.

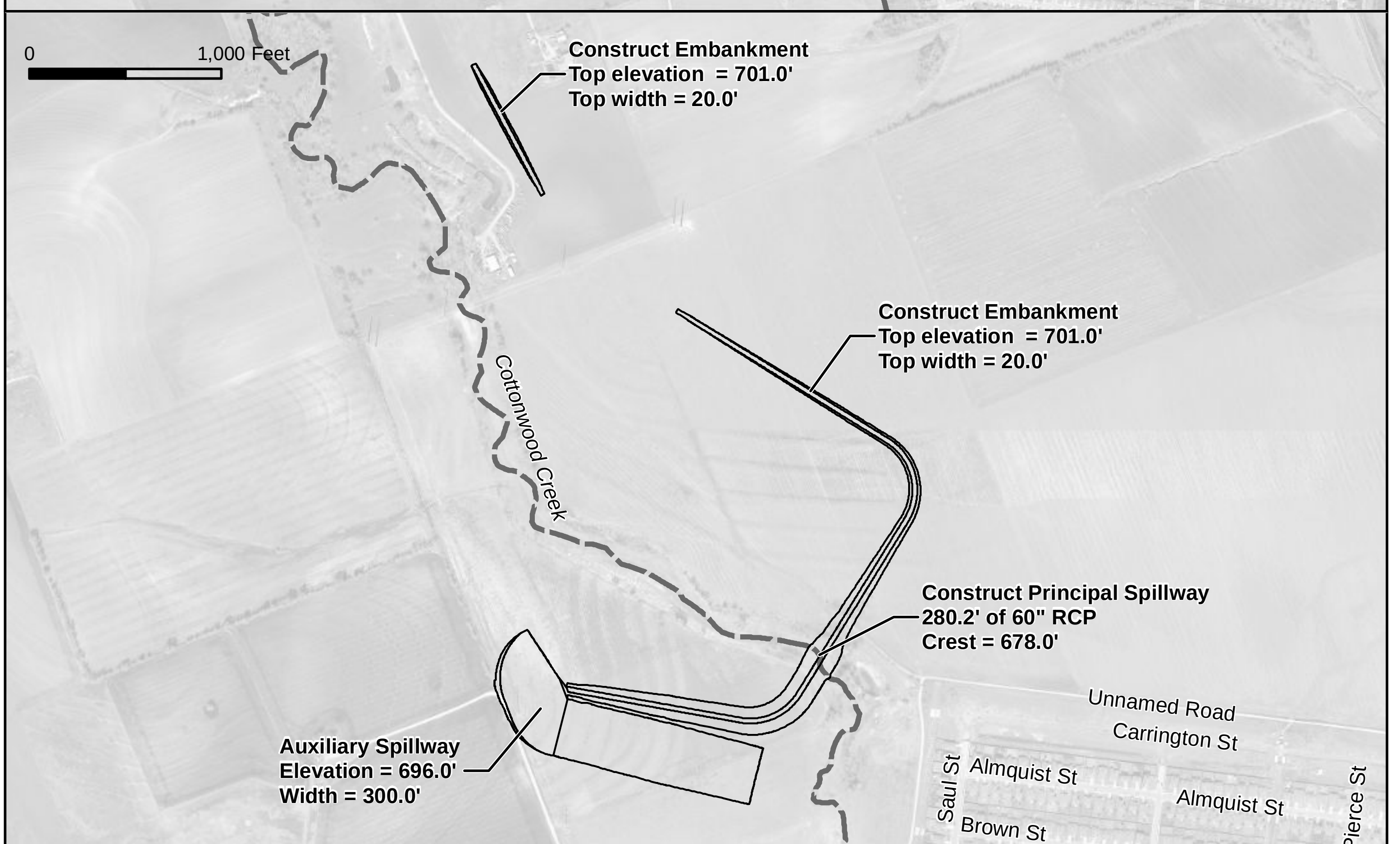
The modifications will include construction of a new 20-foot-wide embankment approximately 4,100 feet in length with a maximum height of approximately 29 feet and an additional 20-foot-wide containment embankment approximately 750 feet in length to the north; installation of a 280-foot-long, 24-inch-diameter concrete pipe, an intake structure and stilling basin; and construction of a 300-foot auxiliary spillway. Estimated costs are $9,260,000; see Table B-10.

Table A21-1. Project Summary Table

Site A-21 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	701.0	
Embankment Width (ft)	20	
Toe of Embankment (ft-msl)	672	
Principal Spillway Crest (ft-msl)	678.0	
Principal Spillway Diameter (in)	24	
Principal Spillway Length (ft)	280.2	
Auxiliary Spillway Crest (ft-msl)	696.0	696 (Maximum)
Auxiliary Spillway Width (ft)	300	200 (Maximum)*
Volume Detained in 1% AEP Event (ac-ft)	642	

*Spillway was aligned to not intrude on the constraint.





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Texas Water Development Board

URS

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A21-1
Site Concept Design
A-21

SITE A-22 – POND NEAR FM 685 (IN-LINE DETENTION)

Improvements were originally proposed for expansion of an existing pond near the confluence of Brushy Creek and Brushy Creek Tributary 7, on the east side of County Road 685 (see Figure S-1). However, upon further investigation of the site, the site did not potentially contain enough detention volume to materially reduce flood peaks from this tributary into Brushy Creek.

SITE A-23 – COTTONWOOD CHANNEL IMPROVEMENT (CHANNEL IMPROVEMENT)

Project Purpose

The project is conceived to divert flood flows from Cottonwood Creek (see Figure A23-1) for the purpose of lowering peak flows and associated flooding in PA12 (see Figure S-1).

Project Description

A new diversion channel within the floodplain is proposed for Cottonwood Creek near North Creek Bend Drive to alleviate flooding during the 1% AEP storm in the adjacent neighborhood. A low is apparent in the existing topography along the proposed track of the new engineered channel, and there is a strong potential that this area has been graded in the past to intercept flood flows from Cottonwood Creek. See Figure A23-1.

The entire channel area is currently within the 1% AEP flood extent, so the 1% AEP flood surface reduction is by expansion of existing flow area, rather than capture and diversion of the creek peak flow. Because of this, the channel needs to be over 200 feet wide to have any substantive effect on FS. A channel 600 feet wide, with an entrance elevation at the 2-year flood level in Cottonwood Creek, would have a minimal reduction of 1.4 in FS within PA12.

The modifications will involve excavating a new 600-foot-wide channel. Estimated costs are provided in Table B-11.

Table A23-1. Project Summary Table

Site A-23 Concept Design Parameters	Design
Upstream Tie-in Elevation (ft-msl)	628.76
Downstream Tie-in Elevation (ft-msl)	626

Upper Brushy Creek W.C.I.D.

Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A23-1
Site Concept Design
A-23

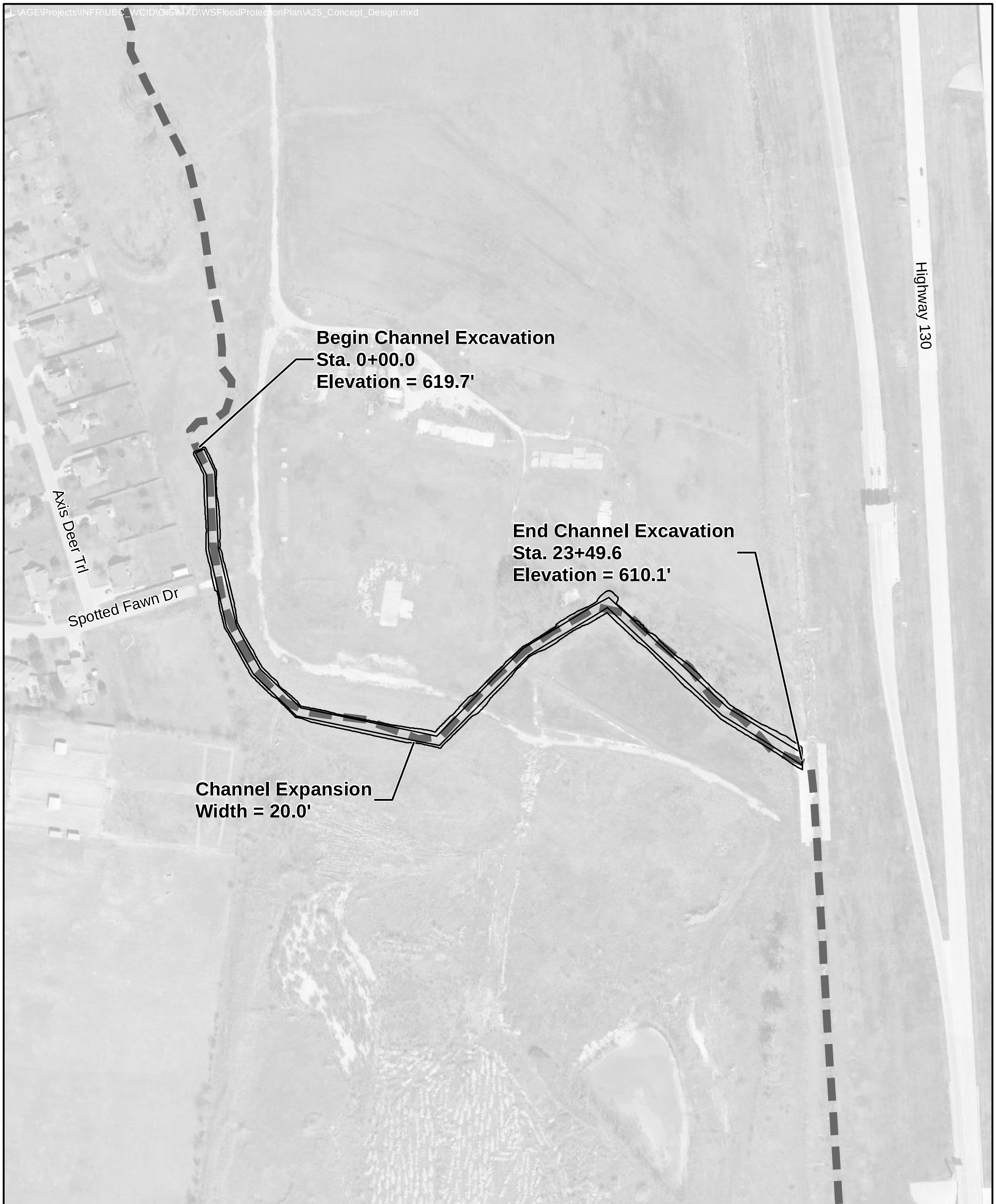
SITE A-24 – OFF-CHANNEL STORAGE NEAR DAM 18 (OFF-CHANNEL RESERVOIR)

An off-channel reservoir was suggested to URS located near the confluence of Dam 18 Tributary 1 and Brushy Creek. However, upon further investigation, it was discovered that approximately half of this site was already inundated during the 1% AEP event, and it was estimated that any detention achieved beyond that would be negligible with respect to the flows on Brushy Creek. Accordingly, analysis of this site was suspended.

SITE A-25 – DAM 18 CHANNEL MODIFICATION (CHANNEL IMPROVEMENT)

A modification is proposed to the stream known as Dam 18 Tributary, between Spotted Fawn Drive and Highway 130, south of Highway 79, to alleviate flooding in the neighborhood to the west from this tributary. This neighborhood is within PA10. This includes modifying the channel to a bottom width of 20 feet and grading the bed to a uniform slope. See Figure A25-1.

The modifications will involve excavating a 20-foot-wide channel approximately 2,000 feet in length and establishing a higher, uniform slope to increase conveyance (see Figure A25-2). The project reduces FS by 0.5. The improvement addresses the three houses within the floodplain in the subject reach, removing all three from the 50-year floodplain and one from the 100-year floodplain. Estimated costs are $446,000; see Table B-12.



Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A25-1
Site Concept Design
A-25

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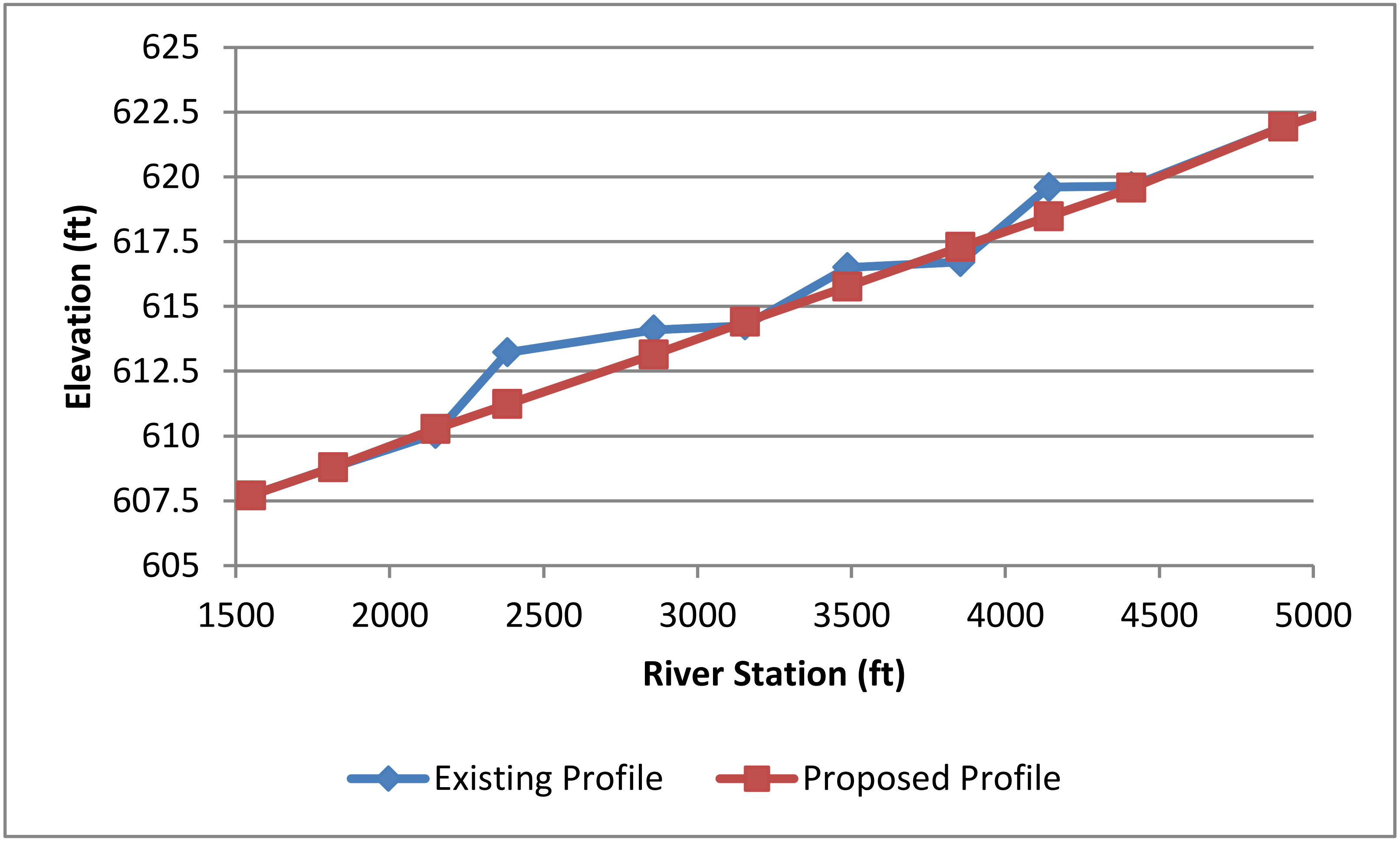


Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A25-2
Channel Profile

SITE A-26 – UPGRADE TO ZIMMERMAN DAM (DAM IMPROVEMENT)

Improvements were recommended to a dam located on Zimmerman Creek on the east side of County Road 139, south of the intersection with Brushy Creek Trail, to alleviate flooding in PA11, specifically, flooding caused by Zimmerman Creek. However, it was estimated that during the 1% AEP event the flooding in PA11 over Zimmerman Creek is caused by Brushy Creek and that any flood improvements to Zimmerman Creek will have negligible effect on area flood risk. Accordingly, analysis of this site was suspended.

SITE A-27 – DAM ON CHANDLER BRANCH TRIBUTARY 4 (NEW DAM)

Project Purpose

The project is conceived to detain flood flows from Chandler Branch Tributary 3 (see Figure A27-1) for the purpose of lowering peak flows and associated flooding in PA9 and other PAs downstream along the Brushy Creek main stem (see Figure S-1).

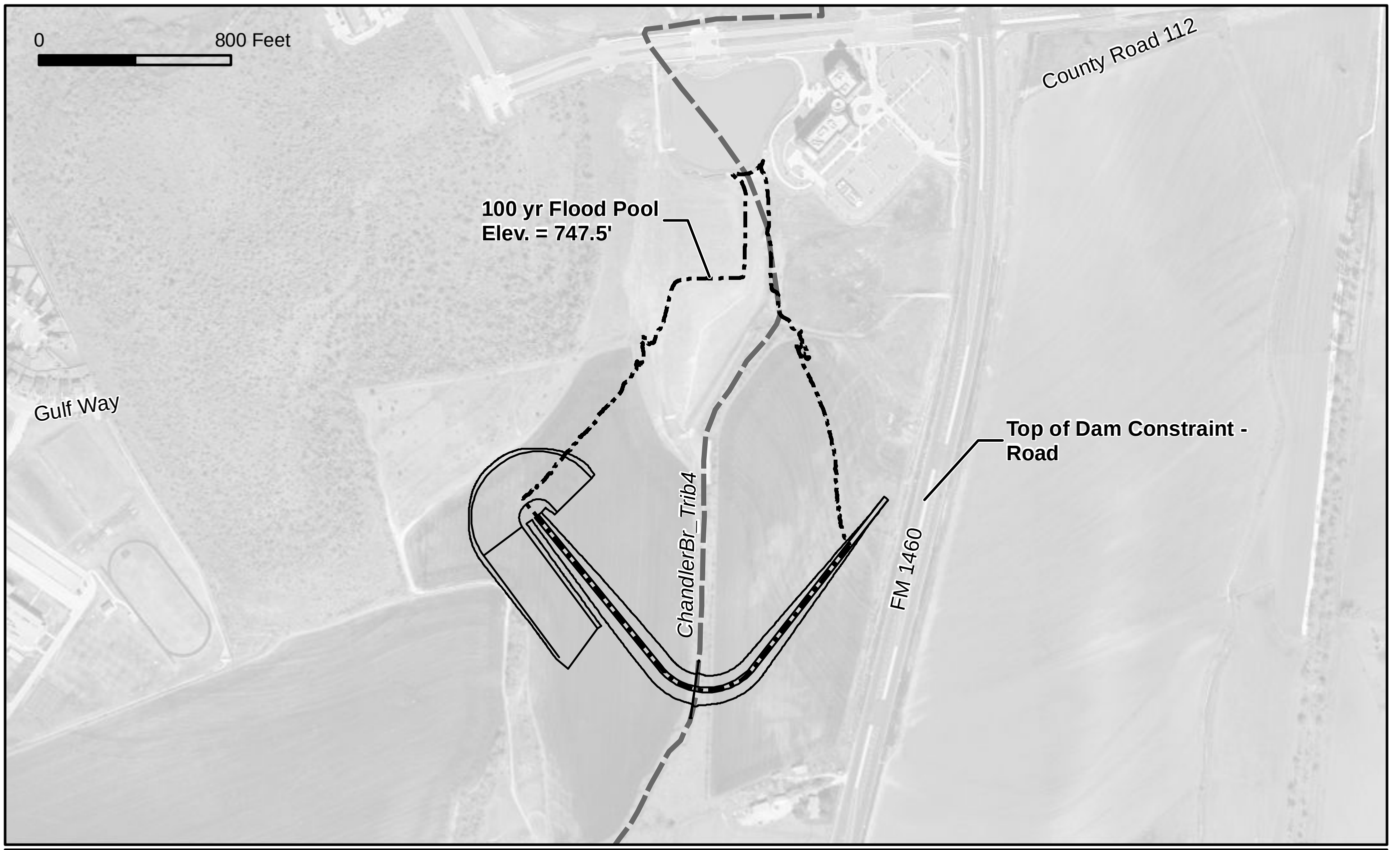
Project Description

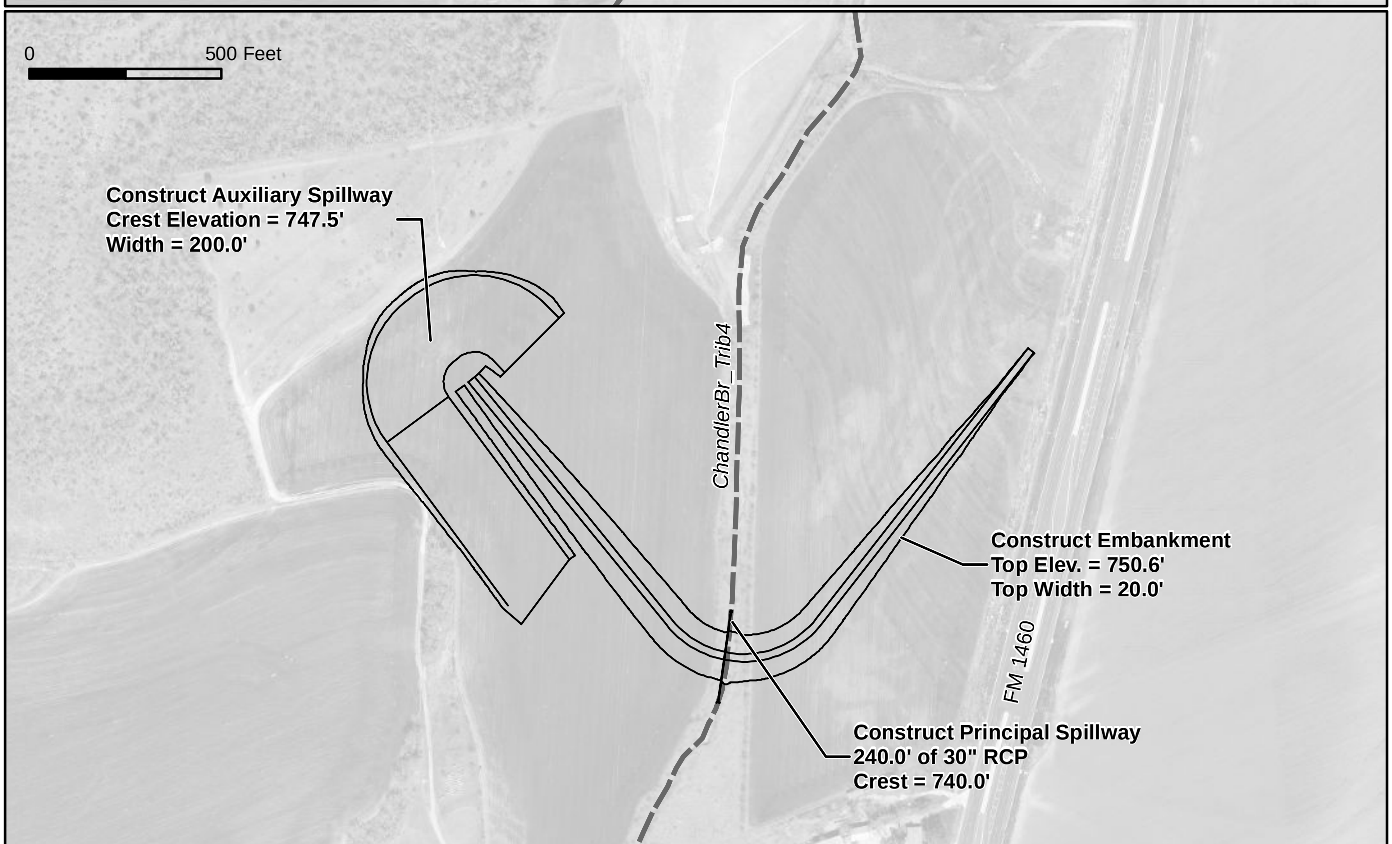
A new dam is proposed on Chandler Branch Tributary 4 on the west side of Highway 1460, just east of District Dam Number 14. A 30-inch-diameter concrete principal spillway is proposed with an intake structure and a 200-foot auxiliary spillway on the west side. See Figure A27-1.

The modifications will include construction of a new 20-foot-wide embankment approximately 2,200 feet in length with a maximum height of approximately 20 feet; installation of a 240-foot-long, 30-inch-diameter concrete pipe, an intake structure and stilling basin; and construction of a 200-foot auxiliary spillway. Estimated costs are $4,462,000; see Table B-13.

Table A27-1. Project Summary Table

Site A-27 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	750.6	756 (maximum)
Embankment Width (ft)	20	
Toe of Embankment (ft-msl)	731	
Principal Spillway Crest (ft-msl)	740	
Principal Spillway Diameter (in)	30	
Principal Spillway Length (ft)	240	
Auxiliary Spillway Crest (ft-msl)	747.5	748 (maximum)
Auxiliary Spillway Width (ft)	200	200 (maximum)
Volume Detained in 1% AEP Event (ac-ft)	214.2	204 (est.)





N

Texas Water Development Board

URS

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A27-1
Site Concept Design
A-27

SITE A-28 – DAM ON MCNUTT CREEK TRIBUTARY 3 (NEW DAM)

Project Purpose

The project is conceived to detain flood flows from McNutt Creek, Tributary 3 (see Figure A28-1) for the purpose of lowering peak flows and associated flooding in PA10 and other PAs downstream along the Brushy Creek main stem (see Figure S-1). This dam is sited downstream of Dam A-28. Two dams were proposed as neither site alone could fully contain the 100-year flow volume.

Project Description

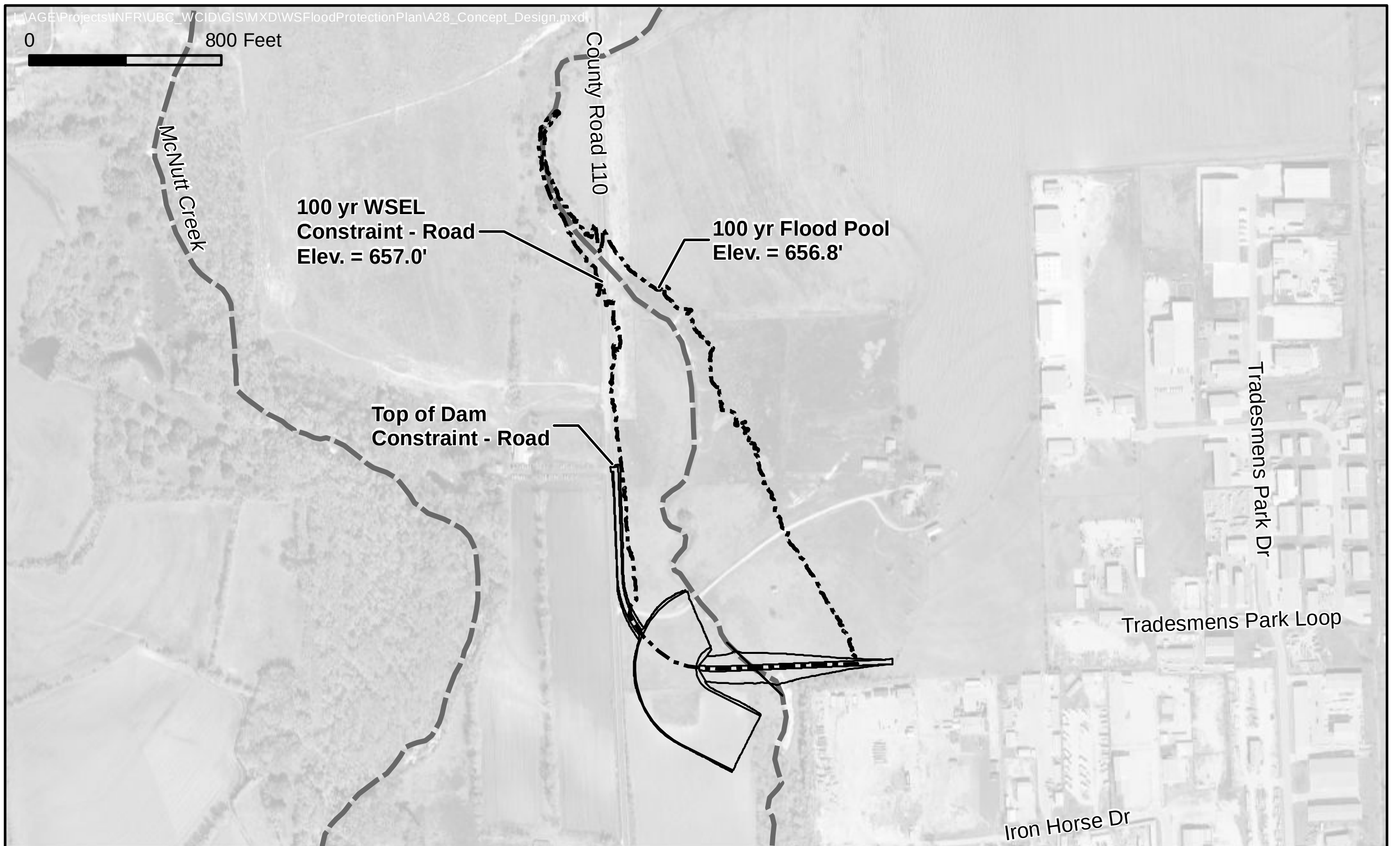
A new dam is proposed on McNutt Creek, Tributary 3, on the east side of County Road 110, north of Highway 79. A 60-inch-diameter concrete principal spillway is proposed with an intake structure and a 250-foot auxiliary spillway on the west side. See Figure A28-1.

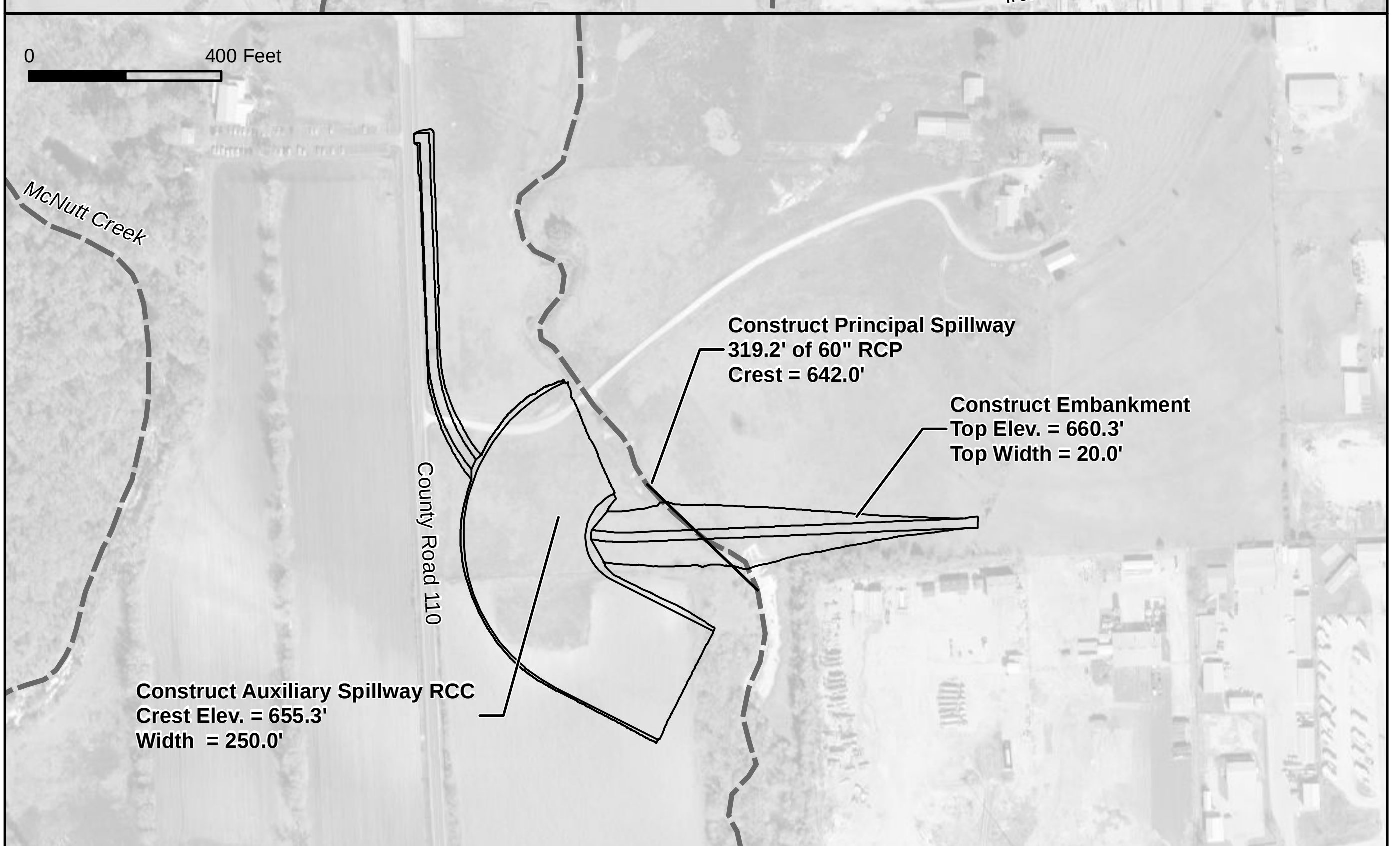
The modifications will include construction of a new 20-foot-wide embankment approximately 850 feet in length with a maximum height of approximately 21 feet; installation of a 160-foot-long, 60-inch-diameter concrete pipe, an intake structure and stilling basin; and construction of a 250-foot auxiliary spillway. Estimated costs are $7,533,000; see Table B-14.

Table A28-1. Project Summary Table

Site A-28 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	660	660 (maximum)
Embankment Width (ft)	20	
Toe of Embankment (ft-msl)	639	
Principal Spillway Crest (ft-msl)	642	
Principal Spillway Diameter (in)	60	
Principal Spillway Length (ft)	160	
Auxiliary Spillway Crest (ft-msl)	655.3	656 (maximum)
Auxiliary Spillway Width (ft)	250	200 (maximum)*
Volume Detained in 1% AEP Event (ac-ft)	101.2	393 (est.)

*Embankment/spillway was aligned to not intrude on the constraint.





N

Upper Brushy Creek W.C.I.D.
Texas Water Development Board
URS

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A28-1
Site Concept Design
A-28

SITE A-29 – DAM ON MCNUTT CREEK TRIBUTARY 3 (NEW DAM)

Project Purpose

The project is conceived to detain flood flows from McNutt Creek, Tributary 3 (see Figure A29-1) for the purpose of lowering peak flows and associated flooding in PA10 and other PAs downstream along the Brushy Creek main stem (see Figure S-1). This dam is sited upstream of Dam A-28. Two dams were proposed as neither site alone could fully contain the 100-year flow volume.

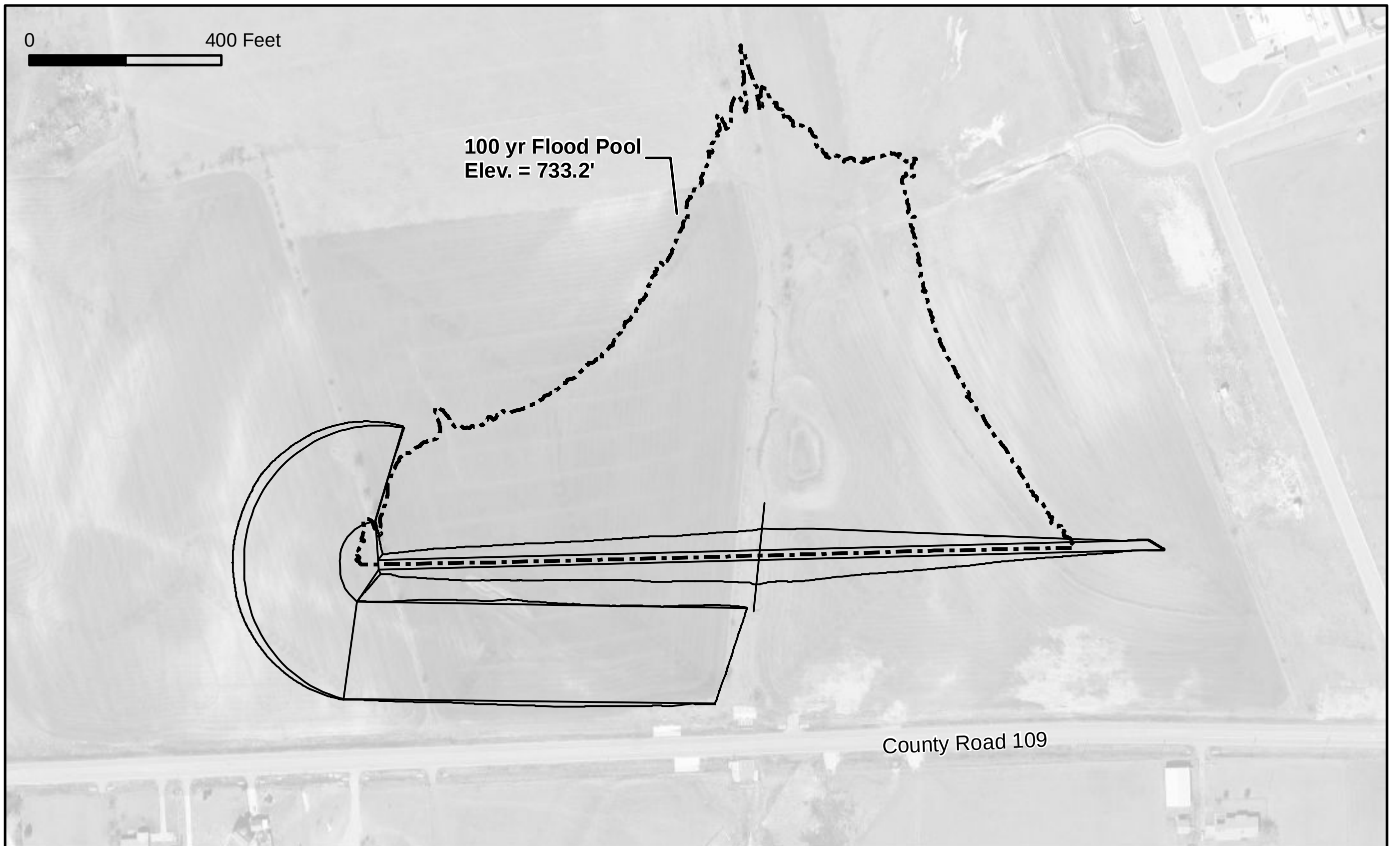
Project Description

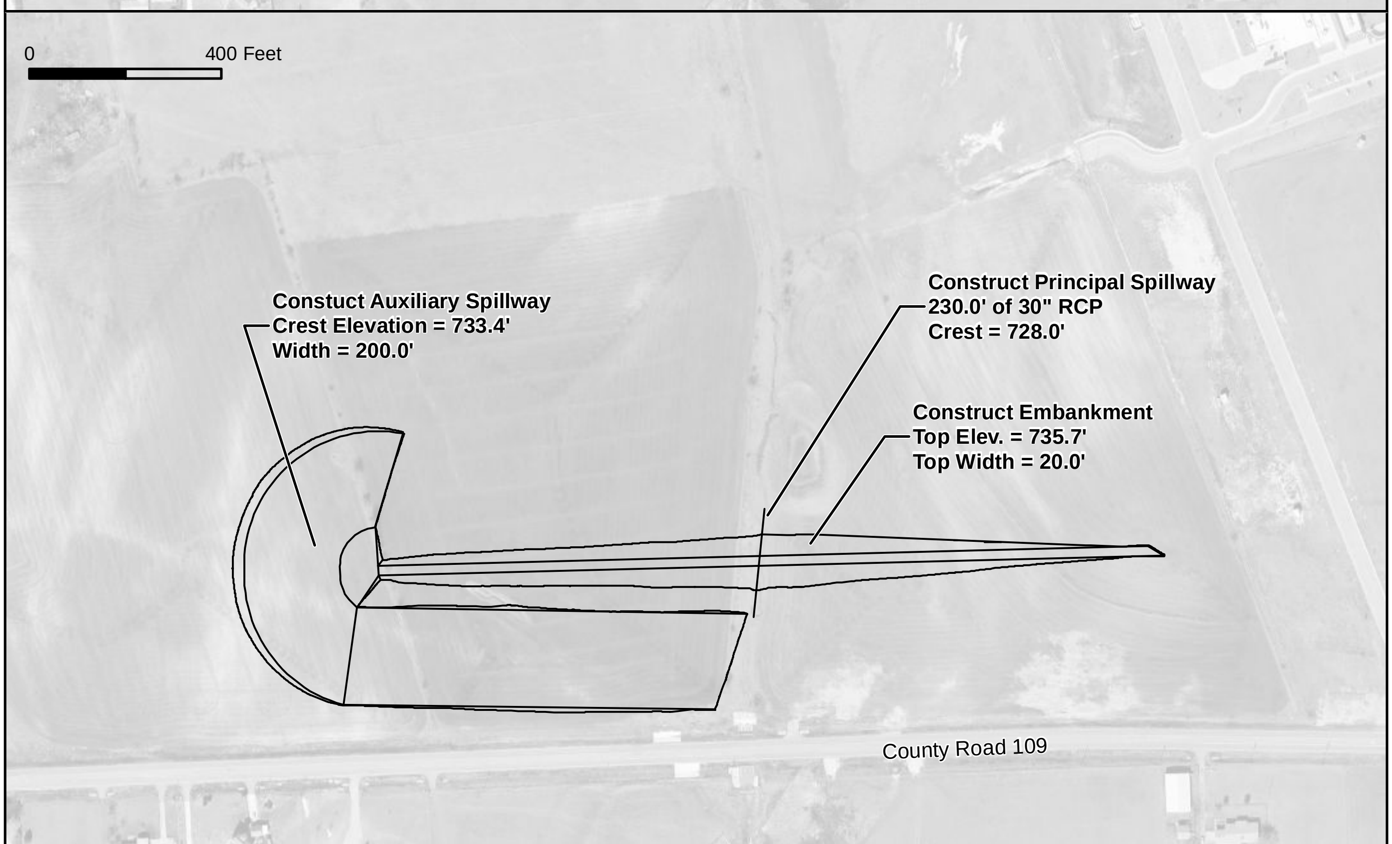
A new dam is proposed on McNutt Creek, Tributary 3, Reach 1, on the north side of Limmer Loop, east of County Road 110. A 30-inch-diameter concrete principal spillway is proposed with an intake structure and a 200-foot auxiliary spillway on the west side. See Figure A29-1.

The modifications will include construction of a new 20-foot-wide embankment approximately 1,650 feet in length with a maximum height of approximately 16 feet; installation of a 230-foot-long, 30-inch-diameter concrete pipe, an intake structure and stilling basin; and construction of a 200-foot auxiliary spillway. Estimated costs are $3,577,000; see Table B-15.

Table A29-1. Project Summary Table

Site A-29 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	735.7	746 (maximum)
Embankment Width (ft)	20	
Toe of Embankment (ft-msl)	720	
Principal Spillway Crest (ft-msl)	728	
Principal Spillway Diameter (in)	30	
Principal Spillway Length (ft)	230	
Auxiliary Spillway Crest (ft-msl)	733.4	
Auxiliary Spillway Width (ft)	200	200 (maximum)
Volume Detained in 1% AEP Event (ac-ft)	78.8	102 (est.)





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Texas Water Development Board

URS

Legend

Recommended Improvement

——— Construction

Upper Brushy Creek WCID

Figure A29-1
Site Concept Design
A-29

SITE A-30 – LAKELINE DAM (NEW DAM)

Project Purpose

The project is conceived to detain flood flows from a watershed immediately adjacent to the Dam 6 flood pool (see Figure A30-1) for the purpose of lowering flood volume into Dam 6 and reducing the associated Dam 6 backwater elevation (see Figure S-1).

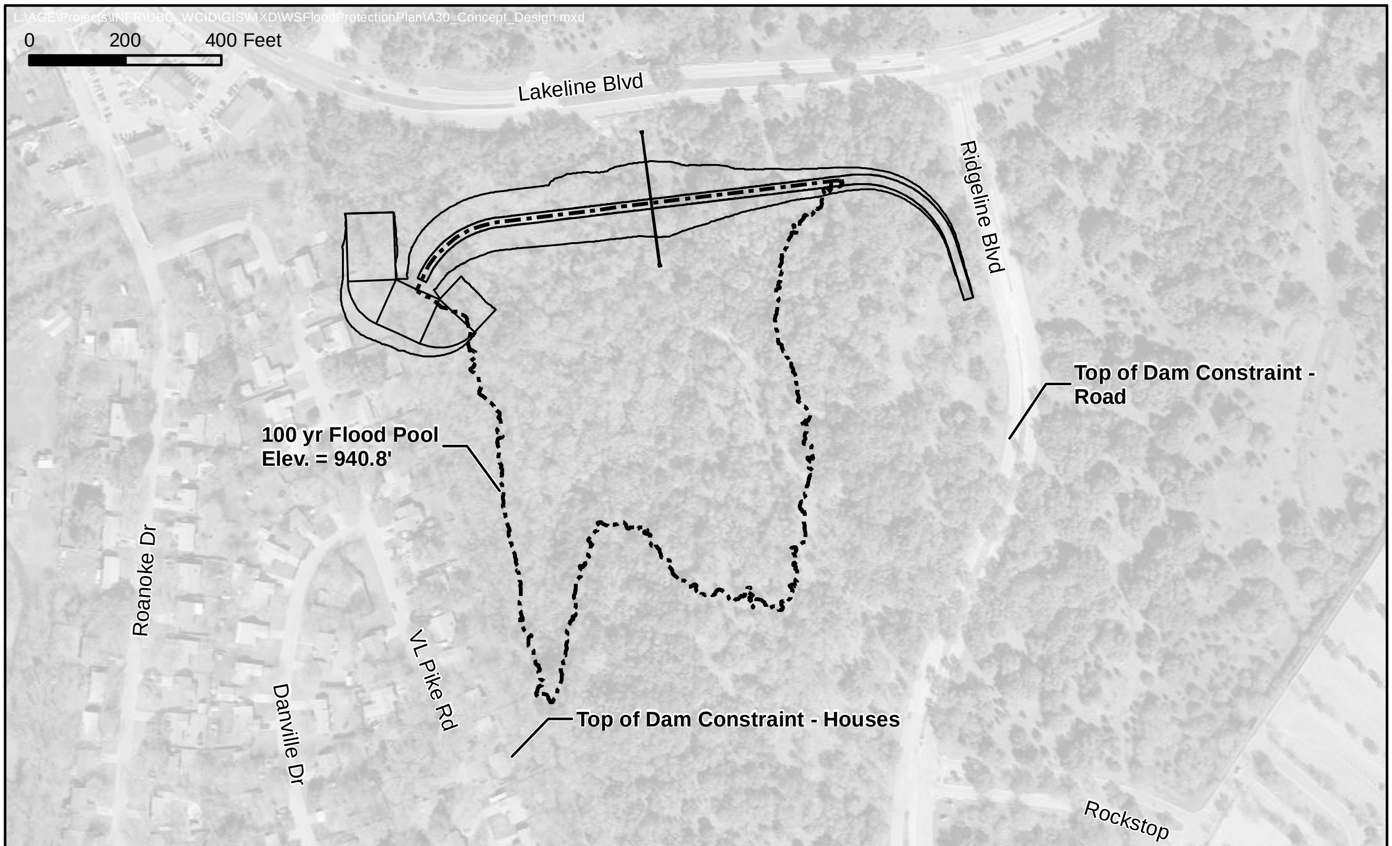
Project Description

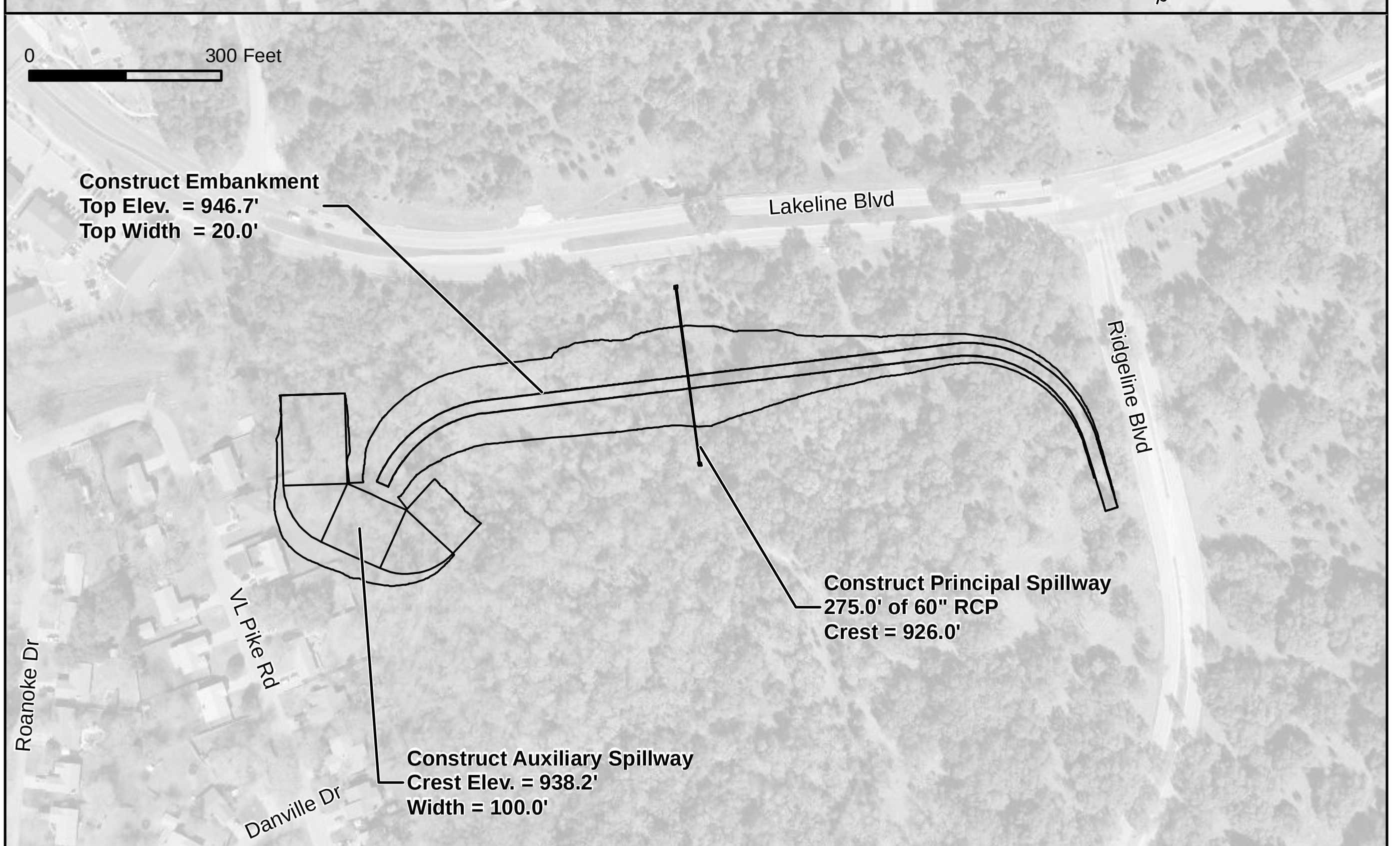
A new dam is proposed on an unnamed stream, on the south side of Lakeline Blvd, just west of Ridgeline Blvd. A 60-inch-diameter concrete principal spillway is proposed with an intake structure and a 100-foot auxiliary spillway on the west side. See Figure A30-1.

The modifications will include construction of a new 20-foot-wide embankment approximately 1,350 feet in length with a maximum height of approximately 26 feet; installation of a 275-foot-long, 60-inch-diameter concrete pipe, an intake structure and stilling basin; and construction of a 100-foot auxiliary spillway. Estimated costs are $2,630,000; see Table B-16.

Table A30-1. Project Summary Table

Site A-30 Concept Design Parameters	Design	Constraint
Top of Embankment (ft-msl)	946	946 (maximum)
Embankment Width (ft)	20	
Toe of Embankment (ft-msl)	920	
Principal Spillway Crest (ft-msl)	926	
Principal Spillway Diameter (in)	60	
Principal Spillway Length (ft)	275	
Auxiliary Spillway Crest (ft-msl)	938.8	944 (maximum)
Auxiliary Spillway Width (ft)	100	100 (maximum)
Volume Detained in 1% AEP Event (ac-ft)	47.7	337 (est.)





N

Upper Brushy Creek W.C.I.D.
Texas Water Development Board
URS

Legend

Recommended Improvement

——— Construction

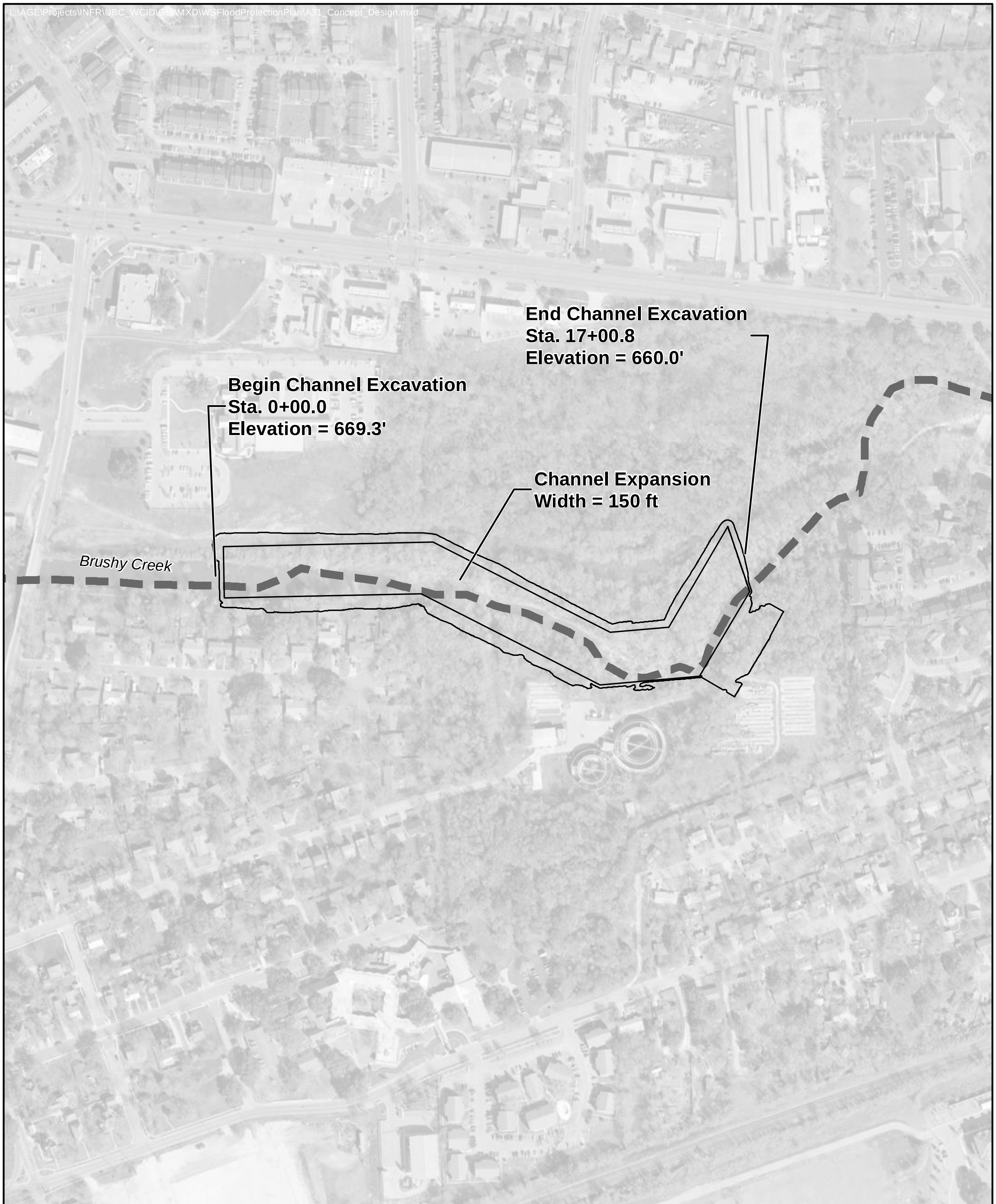
Upper Brushy Creek WCID

Figure A30-1
Site Concept Design
A-30

SITE A-31 – BRUSHY SLOPES CHANNEL IMPROVEMENT (CHANNEL IMPROVEMENT)

An improvement to Brushy Creek is proposed between North Georgetown Street and Lance Lane to alleviate flooding during the 1% AEP storm in the Brushy Slopes subdivision. See Figure A31-1.

The modifications will involve excavating the channel to a uniform width of 150 feet (the maximum width available at the site) and increasing bed slope (see Figure A31-2). Estimated costs are $2,891,000; see Table B-17.



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0 400 Feet

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Figure A31-1
Site Concept Design
A-31

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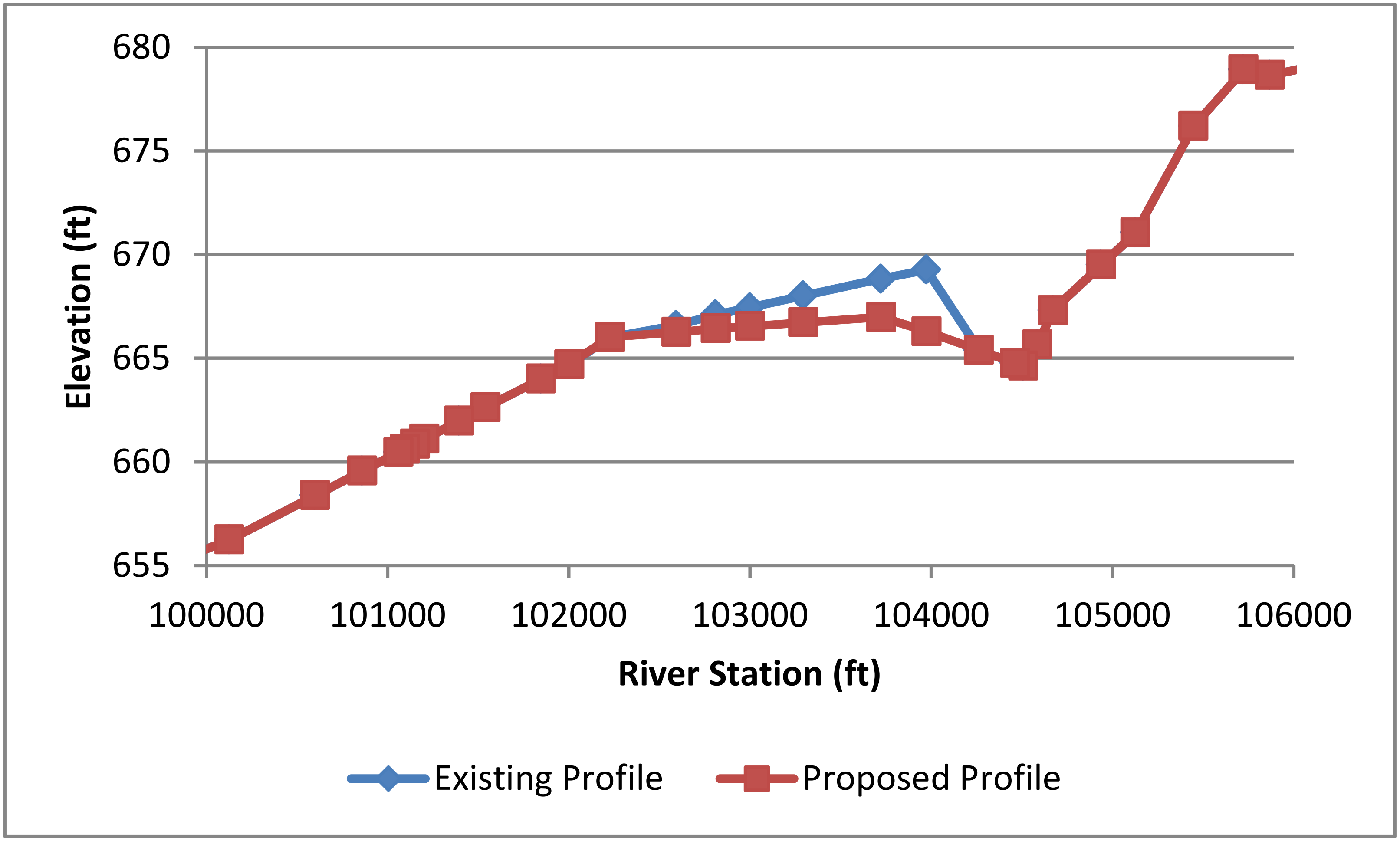


Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A31-2
Channel Profile

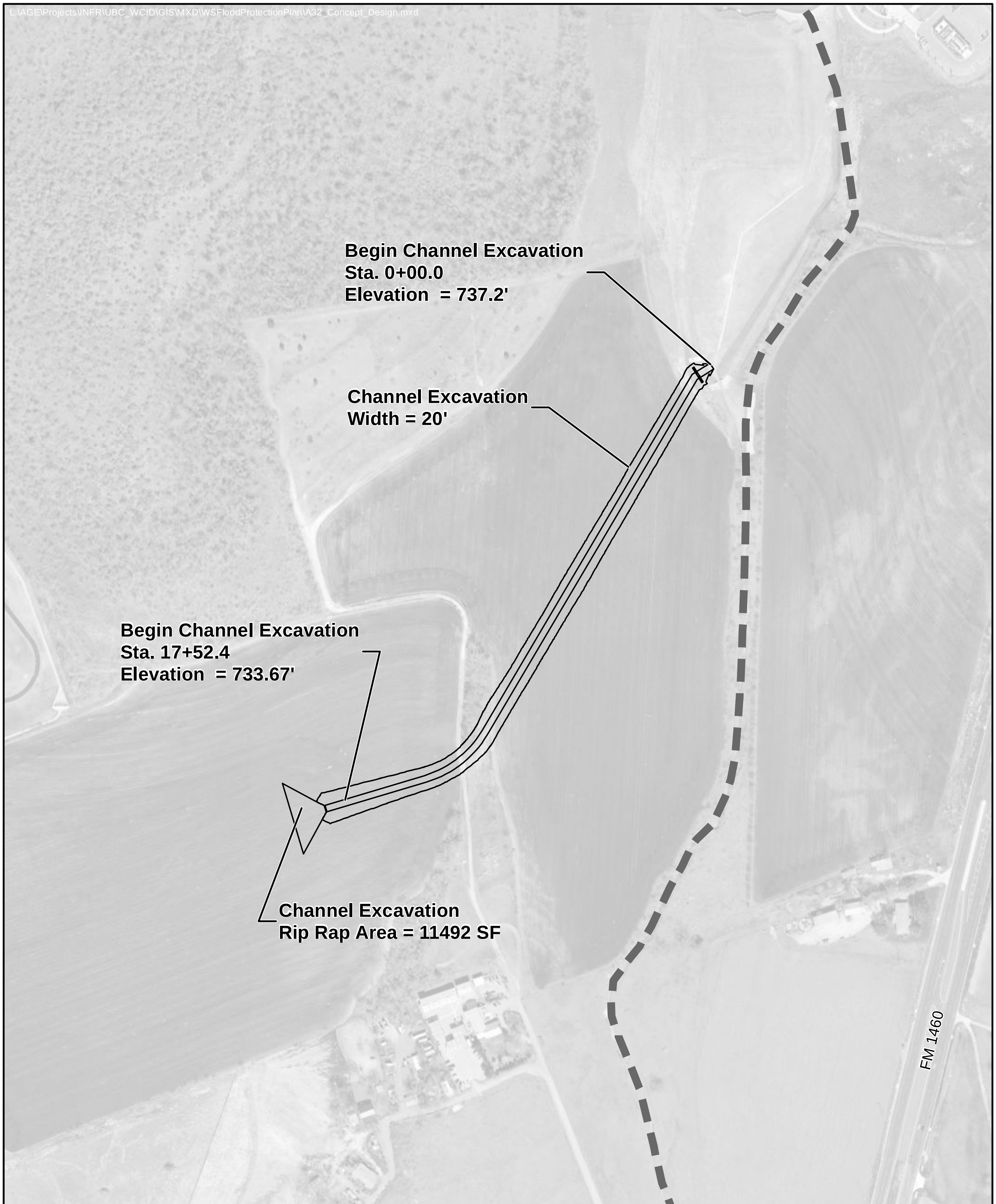
SITE A-32 – CHANDLER BRANCH, TRIB 4 DIVERSION (RIVER DIVERSION)

A new diversion channel is proposed as an alternative to Site A-27, on Chandler Branch, Trib 4, Reach 1, on the west side of Highway 1460, east of District Dam Number 14. To the southwest of the Texas A&M Health Science Center on the corner of CR 112 and Highway 1460 is an existing detention pond with a single outlet weir 6.25 feet wide. The diversion channel will begin at a proposed second weir in this pond with the same bottom elevation as the existing weir. The outlet of the diversion channel will be upstream of District Dam Number 14, which has an available 148 ac-ft of surplus storage during the 1% AEP event. The weir at the entrance of the diversion channel will have a width of 11 feet, which will release a total of 146.5 ac-ft through the channel into District Dam Number 14 during the 1% AEP event. See Figure A32-1.

The modifications will include construction of a new 20-foot-wide channel approximately 1,750 feet in length with a bed slope of 0.2%; and installation of a new concrete weir opening 11 feet wide, 5 feet tall, and 1 foot thick, a riprap apron, and two new channel dikes approximately 300 feet each in length. Estimated costs are $855,000; see Table B-18.

Table A32-1. Project Summary Table

Site A-32 Concept Design Parameters	Design	Constraint
Upstream Invert (ft-msl)	737.15	
Upstream Opening Width (ft)	11	
Upstream Opening Height (ft)	5	
Channel Width (ft)	20	
Channel Length (ft)	1,750	
Downstream Invert (ft-msl)	733.67	



N
0 400 Feet

Legend

Existing Stream

Recommended Improvement

Construction

Upper Brushy Creek WCID

Texas Water Development Board

URS

Upper Brushy Creek WCID

Figure A32-1
Site Concept Design
A-32

Exhibit T
Cost Estimates for
Flood Mitigation Measures

Table B-1. Site A1 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	7.9	AC	$1,000.00	$7,900
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	7.9	AC	$2,100.00	$16,590
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	54,300	CY	$10.96	$595,128
7	Embankment, Select	3,700	CY	$27.00	$99,900
8	US Concrete Weir Structure	2	EA	$5,000.00	$10,000
9	DS Intake Structure	1	EA	$5,000.00	$5,000
10	DS 12" RCP Conduit	86.0	LF	$200.00	$17,200
11	DS 12" Flap Gate	1	EA	$5,000.00	$5,000
				Subtotal:	$816,718
12	Contingency on Construction	1	LS	30%	$245,015
				Subtotal:	$1,061,733
13	Design	1	LS	10%	$106,173
14	Permitting	1	LS	5%	$53,087
15	Construction Oversight	1	LS	8%	$84,939
16	Geo-Tech	1	LS	5%	$53,087
17	Land Cost	7.9	AC	Land Costs not Included	
				Total Estimated Cost:	**$1,360,000**

Table B-2. Site A2 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Excavation (Channel)	840	CY	$30.00	$25,200
				Subtotal:	$25,200
2	Contingency on Construction	1	LS	30%	$7,560
				Subtotal:	$32,760
3	Design	1	LS	20%	$6,552
4	Permitting	1	LS		$10,000
5	Construction Oversight	1	LS	8%	$2,621
6	Geo-Tech	1	LS	15%	$4,914
				Total Estimated Cost:	**$57,000**

Table B-3. Site A3 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	3.8	AC	$1,000.00	$3,800
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	3.8	AC	$2,100.00	$7,980
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	13,200	CY	$10.96	$144,672
7	Embankment, Select	9,600	CY	$27.00	$259,200
8	Detention Weir Structure	1	EA	$10,000.00	$10,000
9	Detention DS Intake Structure	1	EA	$5,000.00	$5,000
10	Detention Conduit 12"	88.1	LF	$200.00	$17,620
				Subtotal:	$508,272
11	Contingency on Construction	1	LS	30%	$152,482
				Subtotal:	$660,754
12	Design	1	LS	10%	$66,075
13	Permitting	1	LS	5%	$33,038
14	Construction Oversight	1	LS	8%	$52,860
15	Geo-Tech	1	LS	5%	$33,038
16	Land Cost	3.8	AC	Land Costs not Included	
				Total Estimated Cost:	**$846,000**

Table B-4. Site A5 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	5.4	AC	$1,000.00	$5,400
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	5.4	AC	$2,100.00	$11,340
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	16,300	CY	$10.96	$178,648
7	Embankment, Select	200	CY	$27.00	$5,400
				Subtotal:	$260,788
8	Contingency on Construction	1	LS	30%	$78,236
				Subtotal:	$339,024
9	Design	1	LS	10%	$33,902
10	Permitting	1	LS	5%	$16,951
11	Construction Oversight	1	LS	8%	$27,122
12	Geo-Tech	1	LS	5%	$16,951
13	Land Cost	5.4	AC	Land Costs not Included	
				Total Estimated Cost:	**$434,000**

Table B-5. Site A11 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	8.0	AC	$1,000.00	$8,000
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	8.0	AC	$2,100.00	$16,800
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	99,700	CY	$10.96	$1,092,712
7	Embankment, Select	900	CY	$27.00	$24,300
8	Oulet Weir Structure	1	EA	$10,000.00	$10,000
				Subtotal:	$1,211,812
9	Contingency on Construction	1	LS	30%	$363,544
				Subtotal:	$1,575,356
10	Design	1	LS	10%	$157,536
11	Permitting	1	LS	5%	$78,768
12	Construction Oversight	1	LS	8%	$126,028
13	Geo-Tech	1	LS	5%	$78,768
14	Land Cost	8.0	AC	Land Costs not Included	
				Total Estimated Cost:	**$2,017,000**

Table B-6. Site A12 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	1.9	AC	$1,000.00	$1,900
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	1.9	AC	$2,100.00	$3,990
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	266,800	CY	$10.96	$2,924,128
7	Embankment, Select	22,700	CY	$27.00	$612,900
8	Inlet Weir Concrete Structure	1	LS	$10,000.00	$10,000
9	PS Inlet Conc. Structure	1	LS	$5,000.00	$5,000
10	PS 24" RCP Conduit	191.8	LF	$200.00	$38,360
11	PS Oulet Structure	1	LS	$5,000.00	$5,000
				Subtotal:	$3,661,278
9	Contingency on Construction	1	LS	30%	$1,098,383
				Subtotal:	$4,759,661
10	Design	1	LS	10%	$475,966
11	Permitting	1	LS	5%	$237,983
12	Construction Oversight	1	LS	8%	$380,773
13	Geo-Tech	1	LS	5%	$237,983
14	Land Cost	1.9	AC	Land Costs not Included	
				Total Estimated Cost:	**$6,093,000**

Table B-7. Site A13 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	17.9	AC	$1,000.00	$17,900
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	17.9	AC	$2,100.00	$37,590
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	38,100	CY	$10.96	$417,576
7	Embankment, Select	72,000	CY	$27.00	$1,944,000
8	PS Inlet Structure	1	LS	$10,000.00	$10,000
9	PS 18" RCP Conduit	240.0	LF	$100.00	$24,000
10	PS Outlet Structure	1	LS	$10,000.00	$10,000
				Subtotal:	$2,521,066
11	Contingency on Construction	1	LS	30%	$756,320
				Subtotal:	$3,277,386
12	Design	1	LS	10%	$327,739
13	Permitting	1	LS	5%	$163,869
14	Construction Oversight	1	LS	8%	$262,191
15	Geo-Tech	1	LS	5%	$163,869
16	Land Cost	17.9	AC	Land Costs not Included	
				Total Estimated Cost:	**$4,196,000**

Exhibit T

Table B-8. Site A14 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	6.6	AC	$1,000.00	$6,600
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	6.6	AC	$2,100.00	$13,860
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	14,300	CY	$10.96	$156,728
7	Embankment, Select	24,100	CY	$27.00	$650,700
8	PS Inlet Structure	1	LS	$10,000.00	$10,000
9	PS 24" RCP Conduit	190.0	LF	$150.00	$28,500
10	PS Outlet Structure	1	LS	$10,000.00	$10,000
				Subtotal:	$936,388
11	Contingency on Construction	1	LS	30%	$280,916
				Subtotal:	$1,217,304
12	Design	1	LS	10%	$121,730
13	Permitting	1	LS	5%	$60,865
14	Construction Oversight	1	LS	8%	$97,384
15	Geo-Tech	1	LS	5%	$60,865
16	Land Cost	6.6	AC	Land Costs not Included	
				Total Estimated Cost:	**$1,559,000**

Table B-9. Site A16 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Mobilize Equipment and Personnel	1.0	LS	$761,255.08	$761,255
2	Pollution Control	1.0	LS	$25,000.00	$25,000
3	Construction Surveys	1.0	LS	$50,000.00	$50,000
4	Contractor Quality Control	1.0	LS	$100,000.00	$100,000
5	Clearing and Grubbing	5.8	AC	$1,000.00	$5,781
6	Water Management	1.0	LS	$50,000.00	$50,000
7	Stripping	3,000.0	CY	$3.00	$9,000
8	Foundation Excavation	5,185.2	CY	$10.00	$51,852
9	Earth Fill (Including Clay Core)	31,965.5	CY	$7.00	$223,759
10	Concrete CIP, Inlet Structure	36.0	CY	$850.00	$30,600
11	Concrete CIP, Impact Basin	145.0	CY	$850.00	$123,250
12	Reinforced Concrete Pressure Pipe, 60" I.D.	800.0	LF	$800.00	$640,000
13	Concrete CIP, Concrete Cradle	300.0	CY	$600.00	$180,000
14	Steel Trash Rack	1.0	LS	$20,000.00	$20,000
15	Discharge Channel Rock Riprap	300.0	TN	$80.00	$24,000
16	Concrete CIP, Foundation	5,185.2	CY	$450.00	$2,333,333
17	Concrete CIP, Labyrinth Weir	577.5	CY	$850.00	$490,875
18	Concrete CIP, Approach Channel Slab	1851.1	CY	$450.00	$833,000
19	Concrete CIP, Discharge Chute Slab	11814.4	CY	$450.00	$5,316,500
20	Concrete CIP, Walls	400.0	CY	$550.00	$220,000
21	Concrete CIP, Wall Footings	173.3	CY	$450.00	$78,000
22	Riprap Bedding	500.0	CY	$70.00	$35,000
23	Rock Riprap	1,500.0	CY	$80.00	$120,000
24	Barbed Wire	3,000.0	LF	$8.00	$24,000
25	Chainlink	200.0	LF	$35.00	$7,000
26	Salvaging and Placing Topsoil	27978.9	SY	$2.60	$72,745
27	Seeding and Hay Mulch	5.8	AC	$2,100.00	$12,140
				Subtotal:	$11,837,089
28	Contingency on Construction	1	LS	30%	$3,551,127
				Subtotal:	$15,388,216
29	Design	1	LS	10%	$1,538,822
30	Permitting	1	LS	5%	$769,411
31	Construction Oversight	1	LS	8%	$1,231,057
32	Geo-Tech	1	LS	5%	$769,411
		Total Estimated Cost:			**$19,697,000**

Table B-10. Site A17 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Mobilize Equipment and Personnel	1.0	LS	$761,255.08	$761,255
2	Pollution Control	1.0	LS	$25,000.00	$25,000
3	Construction Surveys	1.0	LS	$50,000.00	$50,000
4	Contractor Quality Control	1.0	LS	$100,000.00	$100,000
5	Clearing and Grubbing	7.0	AC	$1,000.00	$7,026
6	Water Management	1.0	LS	$50,000.00	$50,000
7	Stripping	4,392.1	CY	$3.00	$13,176
8	Foundation Excavation	3,703.7	CY	$10.00	$37,037
9	Earth Fill (Including Clay Core)	23,824.2	CY	$7.00	$166,770
10	Concrete CIP, Inlet Structure	36.0	CY	$850.00	$30,600
11	Concrete CIP, Impact Basin	145.0	CY	$850.00	$123,250
12	Reinforced Concrete Pressure Pipe, 60" I.D.	800.0	LF	$800.00	$640,000
13	Concrete CIP, Concrete Cradle	300.0	CY	$600.00	$180,000
14	Steel Trash Rack	1.0	LS	$20,000.00	$20,000
15	Discharge Channel Rock Riprap	300.0	TN	$80.00	$24,000
16	Concrete CIP, Foundation	3,703.7	CY	$450.00	$1,666,667
17	Concrete CIP, Labyrinth Weir	488.0	CY	$850.00	$414,789
18	Concrete CIP, Approach Channel Slab	2005.4	CY	$450.00	$902,417
19	Concrete CIP, Discharge Chute Slab	12799.0	CY	$450.00	$5,759,542
20	Concrete CIP, Walls	433.3	CY	$550.00	$238,333
21	Concrete CIP, Wall Footings	187.8	CY	$450.00	$84,500
22	Riprap Bedding	500.0	CY	$70.00	$35,000
23	Rock Riprap	1,500.0	CY	$80.00	$120,000
24	Barbed Wire	3,000.0	LF	$8.00	$24,000
25	Chainlink	200.0	LF	$35.00	$7,000
26	Salvaging and Placing Topsoil	34004.3	SY	$2.60	$88,411
27	Seeding and Hay Mulch	7.0	AC	$2,100.00	$14,754
				Subtotal:	$11,583,527
28	Contingency on Construction	1	LS	30%	$3,475,058
				Subtotal:	$15,058,585
29	Design	1	LS	10%	$1,505,858
30	Permitting	1	LS	5%	$752,929
31	Construction Oversight	1	LS	8%	$1,204,687
32	Geo-Tech	1	LS	5%	$752,929
		Total Estimated Cost:			**$19,275,000**

Table B-11. Site A17 Expanded Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount (Low)	Amount (High)
1	Mobilize Equipment and Personnel	1.0	LS	$761,255.08	$761,255	$761,255
2	Pollution Control	1.0	LS	$25,000.00	$25,000	$25,000
3	Construction Surveys	1.0	LS	$50,000.00	$50,000	$50,000
4	Contractor Quality Control	1.0	LS	$100,000.00	$100,000	$100,000
5	Clearing and Grubbing	20.0	AC	$1,000.00	$20,000	$20,000
6	Water Management	1.0	LS	$50,000.00	$50,000	$50,000
7	Stripping	12555.6	CY	$3.00	$37,667	$37,667
8	Foundation Excavation	25111.1	CY	$10.00	$251,111	$251,111
9	Foundation Preparation	37666.7	SY	$2.00	$75,333	$75,333
10	Earth Fill (Including Clay Core)	154666.7	CY	$7.00	$1,082,667	$1,082,667
11	Concrete CIP, Inlet Structure	36.0	CY	$850.00	$30,600	$30,600
12	Concrete CIP, Impact Basin	145.0	CY	$850.00	$123,250	$123,250
13	Reinforced Concrete Pressure Pipe, 60" I.D.	690.0	LF	$800.00	$552,000	$552,000
14	Concrete CIP, Concrete Cradle	316.9	CY	$600.00	$190,133	$190,133
15	Steel Trash Rack	1.0	LS	$20,000.00	$20,000	$20,000
16	Discharge Channel Rock Riprap	300.0	TN	$80.00	$24,000	$24,000
17	Concrete CIP, Approach Channel Slab	2313.9	CY	$450.00	$1,041,250	$1,041,250
18	Concrete CIP, Discharge Chute Slab	14768.1	CY	$450.00	$2,658,250	$6,645,625
19	Concrete CIP, Ogee Crest Weir	1963.9	CY	$850.00	$1,669,306	$1,669,306
20	Concrete CIP, Walls	500.0	CY	$550.00	$275,000	$275,000
21	Concrete CIP, Wall Footings	216.7	CY	$450.00	$97,500	$97,500
22	Riprap Bedding	586.7	CY	$70.00	$41,067	$41,067
23	Rock Riprap	1760.0	CY	$80.00	$140,800	$140,800
24	Barbed Wire	3000.0	LF	$8.00	$24,000	$24,000
25	Chainlink	200.0	LF	$35.00	$7,000	$7,000
26	Salvaging and Placing Topsoil	37666.7	SY	$2.60	$97,933	$97,933
27	Seeding and Hay Mulch	8	AC	$2,100.00	$16,342.98	$16,343
				Subtotal:	$9,461,465	$13,448,840
28	Contingency on Construction	1	LS	30%	$2,838,439	$4,034,652
				Subtotal:	$12,299,904	$17,483,492
29	Design	1	LS	7%	$860,993	$1,223,844
30	Permitting	1	LS	1.5%	$184,499	$262,252
31	Construction Oversight	1	LS	6%	$737,994	$1,049,009
32	Geo-Tech	1	LS	1%	$122,999	$174,835
		Total Estimated Cost:			**$14,207,000**	**$20,194,000**

Table B-12. Site A19 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Mobilize, Polution Control, Survey	1	LS	$50,000.00	$50,000
2	Clearing and Grubbing	1.5	AC	$2,500.00	$3,750
3	Channel Excavation	4600	CY	$10.00	$46,000
4	Embankment Fill	111	CY	$7.00	$778
5	Seeding and Hay Mulch, Channel	2	AC	$5,000.00	$7,500
6	Struct Excav (Box)	2000	CY	$14.57	$29,132
7	Cut & Restoring Pav	200	SY	$58.62	$11,725
8	Reinforced Concrete Pressure Pipe, 60" I.D.	100	LF	$800.00	$80,000
9	Rock Riprap, Outlet	50	TN	$150.00	$7,500
10	Concrete CIP, Outlet	175	CY	$450.00	$78,750
11	Chainlink	500	LF	$35.00	$17,500
				Subtotal:	$332,634
12	Contingency on Construction	1	LS	30%	$99,790
				Subtotal:	$432,425
13	Design	1	LS	10%	$43,242
14	Permitting	1	LS	5%	$21,621
15	Construction Oversight	1	LS	8%	$34,594
16	Geo-Tech	1	LS	5%	$21,621
		Total Estimated Cost:			**$554,000**

Table B-13. Site A21 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	19.7	AC	$1,000.00	$19,700
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	19.7	AC	$2,100.00	$41,370
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	22,000	CY	$10.96	$241,120
7	Embankment, Select	126,900	CY	$27.00	$3,426,300
				Subtotal:	$3,788,490
8	Contingency on Construction	1	LS	30%	$1,136,547
				Subtotal:	$4,925,037
9	Design	1	LS	10%	$492,504
10	Permitting	1	LS	5%	$246,252
11	Construction Oversight	1	LS	8%	$394,003
12	Geo-Tech	1	LS	5%	$246,252
13	Land Cost	19.7	AC	Land Costs not Included	
				Total Estimated Cost:	**$6,305,000**

Table B-14. Site A23 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	1.3	AC	$1,000.00	$1,300
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	1.3	AC	$2,100.00	$2,730
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	1,600	CY	$10.96	$17,536
7	Embankment, Select	100	CY	$27.00	$2,700
				Subtotal:	$84,266
8	Contingency on Construction	1	LS	30%	$25,280
				Subtotal:	$109,546
9	Design	1	LS	10%	$10,955
10	Permitting	1	LS	5%	$5,477
11	Construction Oversight	1	LS	8%	$8,764
12	Geo-Tech	1	LS	5%	$5,477
13	Land Cost	1.3	AC	Land Costs not Included	
				Total Estimated Cost:	**$141,000**

Table B-15. Site A25 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Work or Material	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	1.7	AC	$1,000.00	$1,700
2	Pollution Control	1	LS	$5,000.00	$5,000
3	Establish Vegetation	1.7	AC	$2,100.00	$3,570
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	5,600	CY	$10.96	$61,376
7	Embankment, Select	100	CY	$27.00	$2,700
				Subtotal:	$114,346
8	Contingency on Construction	1	LS	30%	$34,304
				Subtotal:	$148,650
9	Design	1	LS	10%	$14,865
10	Permitting	1	LS	5%	$7,432
11	Construction Oversight	1	LS	8%	$11,892
12	Geo-Tech	1	LS	5%	$7,432
13	Land Cost	1.7	AC	Land Costs not Included	
				Total Estimated Cost:	**$191,000**

Exhibit T

Table B-16. Site A27 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	10.3	AC	$1,000.00	$10,300
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	10.3	AC	$2,100.00	$21,630
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	8,800	CY	$10.96	$96,448
7	Embankment, Select	55,800	CY	$27.00	$1,506,600
8	PS Inlet Structure	1	LS	$5,000.00	$5,000
9	PS 24" RCP Conduit	239.1	LF	$200.00	$47,820
10	PS Outlet Structure	1	LS	$5,000.00	$5,000
				Subtotal:	$1,752,798
11	Contingency on Construction	1	LS	30%	$525,839
				Subtotal:	$2,278,637
12	Design	1	LS	10%	$227,864
13	Permitting	1	LS	5%	$113,932
14	Construction Oversight	1	LS	8%	$182,291
15	Geo-Tech	1	LS	5%	$113,932
16	Land Cost	10.3	AC	Land Costs not Included	
				Total Estimated Cost:	**$2,917,000**

Table B-17. Site A28 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	6.9	AC	$1,000.00	$6,900
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	6.9	AC	$2,100.00	$14,490
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	1,100	CY	$10.96	$12,056
7	Embankment, Select	23,100	CY	$27.00	$623,700
8	PS Inlet Structure	1	LS	$10,000.00	$10,000
9	PS 24" RCP Conduit	319.3	LF	$150.00	$47,895
10	PS Outlet Structure	1	LS	$10,000.00	$10,000
11	Roller Compacted Concrete	10,400	CY	$300.00	$3,120,000
				Subtotal:	$3,905,041
12	Contingency on Construction	1	LS	30%	$1,171,512
				Subtotal:	$5,076,553
13	Design	1	LS	10%	$507,655
14	Permitting	1	LS	5%	$253,828
15	Construction Oversight	1	LS	8%	$406,124
16	Geo-Tech	1	LS	5%	$253,828
17	Land Cost	6.9	AC	Land Costs not Included	
				Total Estimated Cost:	**$6,498,000**

Table B-18. Site A29 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	9.6	AC	$1,000.00	$9,600
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	9.6	AC	$2,100.00	$20,160
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	14,600	CY	$10.96	$160,016
7	Embankment, Select	36,300	CY	$27.00	$980,100
8	PS Inlet Structure	1	LS	$10,000.00	$10,000
9	PS 24" RCP Conduit	227.2	LF	$150.00	$34,080
10	PS Outlet Structure	1	LS	$10,000.00	$10,000
				Subtotal:	$1,283,956
11	Contingency on Construction	1	LS	30%	$385,187
				Subtotal:	$1,669,143
12	Design	1	LS	10%	$166,914
13	Permitting	1	LS	5%	$83,457
14	Construction Oversight	1	LS	8%	$133,531
15	Geo-Tech	1	LS	5%	$83,457
16	Land Cost	9.6	AC	Land Costs not Included	
				Total Estimated Cost:	**$2,137,000**

Table B-19. Site A30 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	4.0	AC	$1,000.00	$4,000
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	4.0	AC	$2,100.00	$8,400
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	5,900	CY	$10.96	$64,664
7	Embankment, Select	37,700	CY	$27.00	$1,017,900
8	PS Inlet Structure	1	LS	$5,000.00	$5,000
9	PS 24" RCP Conduit	273.9	LF	$200.00	$54,780
10	PS Outlet Stucture	1	EA	$5,000.00	$5,000
				Subtotal:	$1,219,744
11	Contingency on Construction	1	LS	30%	$365,923
				Subtotal:	$1,585,667
12	Design	1	LS	10%	$158,567
13	Permitting	1	LS	5%	$79,283
14	Construction Oversight	1	LS	8%	$126,853
15	Geo-Tech	1	LS	5%	$79,283
16	Land Cost	4.0	AC	Land Costs not Included	
				Total Estimated Cost:	**$2,030,000**

Table B-20. Site A31 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Work or Material	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	8.9	AC	$1,000.00	$8,900
2	Pollution Control	1	LS	$12,000.00	$12,000
3	Vegetation Establishment	8.9	AC	$2,100.00	$18,690
4	Construction Surveys	1	LS	$25,000.00	$25,000
5	Removal of Water	1	LS	$30,000.00	$30,000
6	Excavation, export to waste	76,400	CY	$10.96	$837,344
7	Embankment, select import	100	CY	$27.00	$2,700
				Subtotal:	$934,634
8	Contingency on Construction	1	LS	30%	$280,390
				Subtotal:	$1,215,024
9	Design	1	LS	10%	$121,502
10	Permitting	1	LS	5%	$60,751
11	Construction Oversight	1	LS	8%	$97,202
12	Geo-Tech	1	LS	5%	$60,751
13	Land Cost	8.9	AC	Land Costs not Included	
				Total Estimated Cost:	**$1,556,000**

Table B-21. Site A32 Cost Estimate
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	3.0	AC	$1,000.00	$3,000
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	3.0	AC	$2,100.00	$6,300
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	9,300	CY	$10.96	$101,928
7	Embankment, Select	1,700	CY	$27.00	$45,900
8	US Weir Stucuture	6.5	CY	$500.00	$3,250
9	DS Rock Riprap	11,500	SF	$2.00	$23,000
				Subtotal:	$243,378
10	Contingency on Construction	1	LS	30%	$73,013
				Subtotal:	$316,391
11	Design	1	LS	10%	$31,639
12	Permitting	1	LS	5%	$15,820
13	Construction Oversight	1	LS	8%	$25,311
14	Geo-Tech	1	LS	5%	$15,820
15	Land Cost	3.0	AC	Land Costs not Included	
				Total Estimated Cost:	**$405,000**

Table B-22. Regulatory Dam Cost Estimate - Option 1
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Construction Cost w/ Construction Contingency	Total
1	Regulatory Dam B1 - TOD = 819'	$2,436,942	$3,071,000
2	Diversion Channel C5	$3,165,849	$4,053,000
3	Diversion Channel C2	$375,799	$482,000
4	Dam 9 Auxiliary Spillway Widening	$328,718	$421,000
	Total Estimated Cost:		**$8,028,000**

Table B-23. Regulatory Dam Cost Estimate, Option 1
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	5.5	AC	$1,000.00	$5,500
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	5.5	AC	$2,100.00	$11,550
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	2,637	CY	$10.96	$28,906
7	Embankment, Select	39,225	CY	$27.00	$1,059,083
8	Articulated Concrete Block	33,000	SF	$12.00	$396,000
9	Detention US Intake Structure	1	EA	$5,000.00	$5,000
10	Detention DS Outflow Structure	1	EA	$5,000.00	$5,000
11	Detention Conduit 42"	203	LF	$200.00	$40,600
12	Excavation (Channel)	10,111	CY	$10.96	$110,812
13	Conc Box Culvert (7 FT X 5 FT X 160 FT)	2	LF	$410.24	$131,275
14	Cut & Restoring Pav	356	SY	$58.62	$20,844
				Subtotal:	$1,874,571
15	Contingency on Construction	1	LS	30%	$562,371
				Subtotal:	$2,436,942
16	Design	1	LS	9%	$219,325
17	Permitting	1	LS	5%	$121,847
18	Construction Oversight	1	LS	8%	$194,955
19	Geo-Tech	1	LS	4%	$97,478
20	Land Cost	5.5	AC	Land Costs not Included	
				Total Estimated Cost:	**$3,071,000**

Table B-24. C5 Channel Diversion Cost Estimate, Option 1
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	3.1	AC	$1,000.00	$3,100
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	3.1	AC	$2,100.00	$6,510
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Structural Concrete	2557	CY	$767.73	$1,963,027
6	Non-structural Concrete	271	CY	$319.27	$86,522
7	Excavation, Export	11,968	CY	$10.96	$131,164
8	Embankment, Select	5053	CY	$27.00	$136,433
9	DS Rock Riprap	747	SF	$91.72	$68,511
				Subtotal:	$2,435,268
10	Contingency on Construction	1	LS	30%	$730,580
				Subtotal:	$3,165,849
11	Design	1	LS	10%	$316,585
12	Permitting	1	LS	5%	$158,292
13	Construction Oversight	1	LS	8%	$253,268
14	Geo-Tech	1	LS	5%	$158,292
15	Land Cost	3.1	AC	Land Costs not Included	
				Total Estimated Cost:	**$4,053,000**

Exhibit T

Table B-25. C2 Channel Diversion Cost Estimate, Option 1
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	2.7	AC	$1,000.00	$2,700
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	2.7	AC	$2,100.00	$5,670
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	20,134	CY	$10.96	$220,669
7	Embankment, Select	1	CY	$27.00	$38
				Subtotal:	$289,076
8	Contingency on Construction	1	LS	30%	$86,723
				Subtotal:	$375,799
9	Design	1	LS	10%	$37,580
10	Permitting	1	LS	5%	$18,790
11	Construction Oversight	1	LS	8%	$30,064
12	Geo-Tech	1	LS	5%	$18,790
13	Land Cost	2.7	AC	Land Costs not Included	
				Total Estimated Cost:	**$482,000**

Table B-26. Dam 9 Auxiliary Spillway Widening Cost Estimate, Option 1
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	2.8	AC	$1,000.00	$2,800
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	2.8	AC	$2,100.00	$5,880
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	2,139	CY	$10.96	$23,439
7	Embankment, Select	5953	CY	$27.00	$160,742
				Subtotal:	$252,860
8	Contingency on Construction	1	LS	30%	$75,858
				Subtotal:	$328,718
9	Design	1	LS	10%	$32,872
10	Permitting	1	LS	5%	$16,436
11	Construction Oversight	1	LS	8%	$26,297
12	Geo-Tech	1	LS	5%	$16,436
13	Land Cost	2.8	AC	Land Costs not Included	
				Total Estimated Cost:	**$421,000**

Table B-27. Regulatory Dam Cost Estimate - Option 2
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Construction Cost w/ Construction Contingency	Total
1	Regulatory Dam B1	$3,443,649	$4,339,000
2	Diversion Channel C2	$375,799	$482,000
3	Dam 9 Auxiliary Spillway Widening	$207,612	$346,000
	Total Estimated Cost:		**$5,168,000**

Table B-28. Regulatory Dam Cost Estimate, Option 2
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	8.3	AC	$1,000.00	$8,250
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	8.3	AC	$2,100.00	$17,325
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	2,521	CY	$10.96	$27,633
7	Embankment, Select	67,638	CY	$27.00	$1,826,222
8	Articulated Concrete Block	33,000	SF	$12.00	$396,000
9	Detention US Intake Structure	1	EA	$5,000.00	$5,000
10	Detention DS Outflow Structure	1	EA	$5,000.00	$5,000
11	Detention Conduit 42"	203	LF	$200.00	$40,600
12	Excavation (Channel)	10,111	CY	$10.96	$110,812
13	Cut & Restoring Pav	356	SY	$58.62	$20,844
14	Conc Box Culvert (7 ft X 5 ft X 160 ft)	2	LF	$410.24	$131,275
				Subtotal:	$2,648,961
15	Contingency on Construction	1	LS	30%	$794,688.27
				Subtotal:	$3,443,649
16	Design	1	LS	9%	$309,928.43
17	Permitting	1	LS	5%	$172,182
18	Construction Oversight	1	LS	8%	$275,492
19	Geo-Tech	1	LS	4%	$137,746
20	Land Cost	8.3	AC	Land Costs not Included	
				Total Estimated Cost:	**$4,339,000**

Table B-29. C2 Channel Diversion Cost Estimate, Option 2
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	2.7	AC	$1,000.00	$2,700
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	2.7	AC	$2,100.00	$5,670
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	20,134	CY	$10.96	$220,669
7	Embankment, Select	1	CY	$27.00	$38
				Subtotal:	$289,076
8	Contingency on Construction	1	LS	30%	$86,723
				Subtotal:	$375,799
9	Design	1	LS	10%	$37,580
10	Permitting	1	LS	5%	$18,790
11	Construction Oversight	1	LS	8%	$30,064
12	Geo-Tech	1	LS	5%	$18,790
13	Land Cost	2.7	AC	Land Costs not Included	
				Total Estimated Cost:	**$482,000**

Table B-30. Dam 9 Auxiliary Spillway Widening Cost Estimate, Option 2
Texas Water Development Board - Upper Brushy Creek

Item No.	Construction Task	Quantity	Unit	Unit Price	Amount
1	Clearing and Grubbing	2.1	AC	$1,000.00	$2,065
2	Pollution Control	1	LS	$20,000.00	$20,000
3	Establish Vegetation	2.1	AC	$2,100.00	$4,337
4	Construction Survey	1	LS	$20,000.00	$20,000
5	Removal of Water	1	LS	$20,000.00	$20,000
6	Excavation, Export	1,891	CY	$10.96	$20,724
7	Embankment, Select	4462	CY	$27.00	$120,486
				Subtotal:	$207,612
8	Contingency on Construction	1	LS	30%	$62,284
				Subtotal:	$269,896
9	Design	1	LS	10%	$26,990
10	Permitting	1	LS	5%	$13,495
11	Construction Oversight	1	LS	8%	$21,592
12	Geo-Tech	1	LS	5%	$13,495
13	Land Cost	2.1	AC	Land Costs not Included	
				Total Estimated Cost:	**$346,000**

Exhibit U
Desktop Geologic Assessment
for Sites A-16 and A-17

URS

TO: Ruth Haberman, General Manager, Upper Brushy Creek Water Control and Improvement District

FROM: Jeff Irvin, PE, (URS)

CC: Rebecca Russo, PE, (URS); Kevin Pasternak, PG (URS)

DATE: May 12, 2014

RE: Technical Memorandum – Desktop Geologic Assessment
Flood Protection Planning for Upper Brushy Creek Watershed
Complex Detention Storage Sites A-16 and A-17

Purpose and Scope

URS Corporation (URS) has performed a Desktop Geologic Assessment for the above referenced project. Our work was performed as authorized in Contract 1, Work Authorization No. 3, dated October 12, 2012, and Scope Change dated November 2013.

The purpose of this desktop study was to assemble and summarize readily available aerial, topographic, geologic, and soil survey information to evaluate the feasibility of proposed detention pond structures construction. Specifically, the scope of work included a brief site reconnaissance; review of geologic and soil survey publications; geotechnical assessment of earthen construction feasibility; and preparation of this assessment report.

The following sections present a brief description of the project site conditions, geologic and near-surface soils synopsis, observations from the brief site reconnaissance performed on March 24, 2014, and feasibility remarks regarding dam and impoundment construction for each of the sites. It is noted that the site reconnaissance was performed in areas accessible to a vehicle, and for the purpose of confirming geologic formations and features identified in the desktop study. The site reconnaissance was intended to be brief, and was not meant to be exhaustive or to serve as a formal geologic assessment. Findings presented herein may warrant further geologic investigation.

Project Site Conditions

Upper Brushy Creek (UBC) Watershed Management is considering adding Complex Detention Storage sites, as shown on the attached Figure U-1. The project vicinity is located in the northwest and southwest quadrants of the intersection of SH 45 and McNeil Road. This assessment report pertains to Complex Detention Storage Sites A-16, A-17 and A-19. The proposed detention sites are mostly undeveloped, wooded, or quarried land with gravel roads across the proposed dam centerline at site A-17. Support data collected and assembled for the proposed Complex Detention Storage Site A-16 is included in Appendix A. Support data for the proposed Complex Detention Storage Site A-17 is included in Appendix B. The following sections present a brief discussion of the site conditions, geology, and feasibility remarks for each of the sites.

Site A-16. The proposed dam at Site A-16 will be located on Lake Creek, just north of SH 45. The proposed dam and impoundment area are superimposed over the aerial image shown on Figure A-1 in Appendix A. Also shown on Figure A-1 are 10-ft topographic contour intervals and the approximate dam centerline (shown in green). The proposed impoundment area will extend along Davis Spring Branch on the north side of SH 45, and along Lake Creek south of SH 45. The impoundment will also extend along an existing railroad, south of SH 45.

The proposed impoundment area superimposed on a geologic map is presented on Figure A-2 in Appendix A. The geologic map shows the dam and impoundment underlain by limestone of the Edwards Formation. The Edwards Formation is known to contain karst voids and other solution features, which is further discussed in the subsequent geologic section of this report.

The near-surface soil survey mapping is shown on Figure A-3 in Appendix A, with the proposed impoundment area superimposed. Mapped soil series within and near the dam footprint are Eckrant and Georgetown soils consisting of "very shallow to moderately deep, calcareous and noncalcareous, stony, cobbly, and loamy soils formed in indurated fractured limestone; on uplands[1]." The soils are defined as hydrologic soil group D with high runoff potential[2].

During the brief site reconnaissance, URS was unable to access the property from public right-of-ways and easements. Photographs of the proposed dam area and Lake Creek at SH 45 are included in Appendix A, following the figures.

Site A-17. The proposed dam at Site A-17 is located along an existing gravel road that is used by the property owner to access quarry areas and cross Lake Creek. Currently, the proposed dam and impoundment footprint are mostly undeveloped property, as shown in Figure B-1 in Appendix B. A buried utility vent was noted just downstream of the proposed centerline alignment and appears to trend along the (proposed) downstream toe. Residential property is located further downstream of the proposed dam. Due to the downstream residential development, the dam will likely classify as high hazard.

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1 Soil Survey of Williamson County, Texas (1983), U.S. Department of Agriculture, Soil Conservation Service.
2 *Ibid.*

The proposed impoundment area is superimposed on the geologic map, presented on Figure B-2 in Appendix B. The geologic map shows the dam and impoundment underlain by limestone of the Edwards Formation. One fault (denoted as a black line) is mapped across the proposed impoundment area, and two faults are mapped to the east and downstream of the proposed dam centerline. A geologic contact between the Edwards and Georgetown Formations is mapped about 2,000 feet east (downstream) of the dam footprint.

The near-surface soil survey map is shown on Figure B-3 in Appendix B with the proposed impoundment area superimposed. Again, mapped soil series within and near the dam footprint are Eckrant and Georgetown soils. The soils are defined as hydrologic group D with high runoff potential[3]. Quarry (QU) is also denoted on the soil series map north of the dam and impoundment area.

As part of the brief site reconnaissance, the proposed dam centerline was accessed with a vehicle that entered the project area from the south at SH 45. Stockpiled limestone boulders and some construction debris were noted just downstream (east) of the proposed dam centerline, likely within the dam footprint. Also noted during the site reconnaissance was a critical environmental feature (CEF) located along the north side of the proposed impoundment area. The general location of the CEF is shown on Figure B-2 in Appendix B and should be considered approximate. Photographs of the CEF are included in Appendix B, following the figures. Detailed identification of the CEF is beyond the scope of this desktop report.

Geologic and Near-Surface Soil Synopsis

Geology. Based on published geologic maps[4], the site is underlain by Edwards (Ked) limestone with outcropping of the Georgetown (Kgt) formation about ½ mile east of Site A-17. A normal fault is shown to extend through the A-17 impoundment area where Lake Creek bends, offsets approximately 1,000 feet, and terminates at the confluence of the unnamed tributaries (sinkhole). Normal faulting is mapped just downgradient (offsite) of A-17, south and southeast of the confluence of Rattan Creek and Lake Creek. Fault gouge and unmapped splay (secondary) faulting may be present as well. Faults are generally considered seismically inactive in central Texas, but may provide preferential groundwater flow paths or surface seeps.

The Edwards Formation is Cretaceous age and consists of relatively soft to extremely hard limestone, dolomitic limestone, and dolomite. The limestone is vuggy, honeycombed, and

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3 Soil Survey of Williamson County, Texas (1983), U.S. Department of Agriculture, Soil Conservation Service.

4 Garner, L.E. and Young, K.P. (1976), "Environmental Geology of the Austin Area: An Aid to Urban Planning," Report of Investigation No. 86, Bureau of Economic Geology, The University of Texas at Austin, Plate VII (reprinted 1986).

porous, oftentimes having solution cavities and voids (karst) and chert. The dolomite and dolomitic limestone of the Edwards is typically softer, and when exposed to weathering, may take on a soil-like consistency. Weathered remnants of the parent limestone consist of surficial fat and lean clay with various sand and limestone fragment content. The Edwards limestone is comprised of four members, with the basal member known for karst conditions.

Although not mapped within the complex detention storage sites considered herein, the Georgetown Formation is composed of fine-grained, light gray to yellowish gray, fossiliferous, nodular limestones, marly limestone, and marl. The Georgetown is geologically situated above the Edwards limestone.

Soil Survey. Referring to Figures A-3 and B-3 for each detention site, near-surface soils mapped within the proposed dam and inundation area include mostly Georgetown and Eckrant series. Crawford clay is mapped outside the planned inundation areas.

The Georgetown series consists of moderately deep, loamy, and stony soils on uplands. Slopes range from 0 to 3 percent. The soil mangle ranges from 20 to 40 inches in thickness with limestone fragments (stone-size) that make up less than 3 percent of the surface. Coarse fragments increase in depth and make up 2 to 35 percent of the volume. The limy earth transitions to fractured limestone at about 35 to 47 inches deep.

The Eckrant consists of shallow to very shallow stony clayey soils with slopes ranging from 1 to 30 percent, but typically 0 to 3 percent. The soil mantle ranges from 5 to 20 inches in thickness, and the limestone fragments cover about 10 to 60 percent of the surface. Pebbles, cobbles and stones make up about 35 to 80 percent of the matrix.

The Crawford series consists of moderately deep clayey soils on uplands. Slopes range from 0 to 4 percent. The soil mantle is 20 to 40 inches thick and has (desiccation) cracks of ½ to 2 inches wide that extend below 20 inches. The soil texture is clay or silty clay.

Feasibility

Based on a review of the readily available aerial, geologic, topographic, and soil surveys and a brief site reconnaissance, the following technical issues may adversely affect siting of the dam and impoundment and should be considered in selecting a site. Noted issues are summarized below for each detention storage structure:

URS

A-16

- Impoundment of water against an existing railroad and along SH 45 may adversely impact embankments supporting the roadway/railroad tracks. Analyses should include inundation period and possible rapid drawdown effects of the water surface elevation at reservoir slopes. This may include coordination with and technical review by SH 45 and railroad officials, whereby demonstrating impounded water on structural embankments will not adversely affect stability. In summary, geotechnical analyses associated with dam construction will also need to include analyses of existing roadway and railroad embankments as part of design.

A-17

- Due to the existing downstream development, this dam will likely be classified as a high hazard dam in accordance with TCEQ.
- Presence of an existing utility near or within the dam footprint will need to be further investigated and possibly relocated outside the dam footprint. The presence of a utility (and utility backfill) may adversely affect long-term stability of the embankment dam.
- Debris stockpiled in the downstream toe area will require removal for embankment dam construction.
- A CEF was located near the impoundment. Although this feature appears to be outside the impoundment area, further study including a formal Geologic Assessment by a professional geologist is recommended.

Geologic Overview

- Geologic mapping and site observations indicate the presence of Edwards limestone beneath surficial soils and at some surficial outcroppings. The Edwards is known to contain voids and solution features, which may be problematic for impounding water and maintaining dam stability (high seepage gradients) without proactive seepage control measures. The Edwards limestone should be further investigated by a site-specific drilling and geophysical program.

- The mapped faults and observed suspected solution features (CEF, sinkhole) are present in the planned development area. The environmental impacts of development around these features will need to be further addressed in a formal Geologic Assessment. Detailed documentation, classification, and reference of applicable environmental regulations were beyond the scope of this desktop assessment.

* * *

The following attachments complete this report:

Figure U-1	Overall Site Plan
Appendix A – **Site A-16**	Figure A-1 – Aerial and Topography Figure A-2 – Geologic Map Figure A-3 – Soil Survey Photographic Record
Appendix B – **Site A-17**	Figure B-1 – Aerial and Topography Figure B-2 – Geologic Map Figure B-3 – Soil Survey Map Photographic Record

Upper Brushy Creek WCID

Figure U-1
Location of
A-16 and A-17

URS

Appendix A

Site A-16

L:\AGE\Projects\INFR\UBC_WCID\5.0-Engineering\5.8-Alternatives_Analysis\5.8.2c-Complex_Site_Concept_Designs\GIS\MXD\Fig1_A-16_Topo.mxd

0 500 1,000 Feet

N

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Austin, TX 78729
Phone: (512) 454-4797
www.urscorp.com

Legend

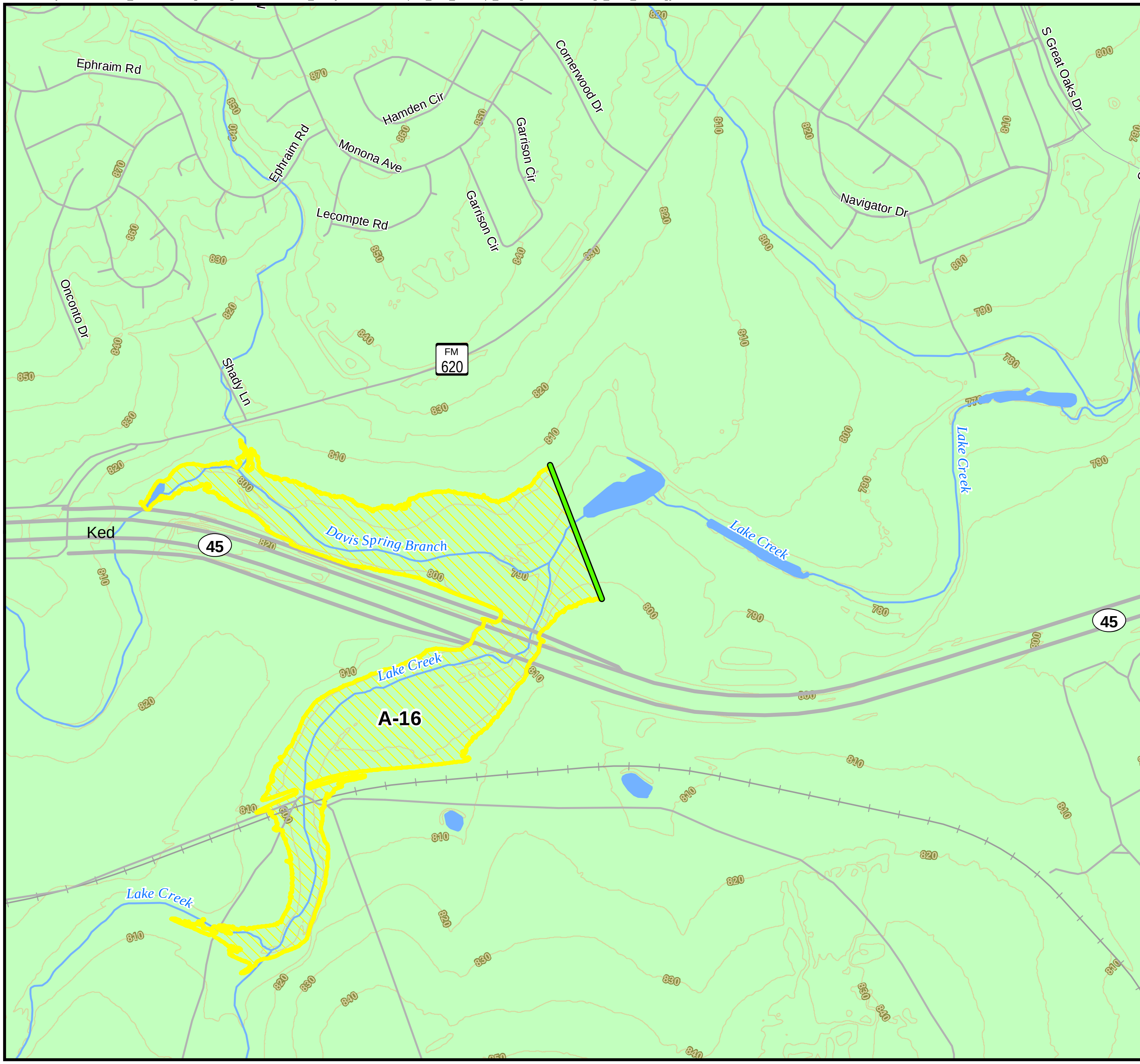
- Dam Centerline
- Approximate Impoundment Area
- Topography

Aerial Photography and Topography

Complex Detention Storage Site
A-16
Williamson County, Texas

Date: 9/29/2014	Figure A-1

L:\AGE\Projects\INFR\UBC_WCID\5.0-Engineering\5.8-Alternatives_Analysis\5.8.2c-Complex_Site_Concept_Designs\GIS\MXD\Fig2_A-16_Geology.mxd



0 500 1,000 Feet

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w w w . u r s c o r p . c o m

Legend

- Dam Centerline
- Approximate Impoundment Area
- Major Road
- Secondary Road
- Railroad
- Topography
- Stream/River
- Lake/Pond

Geologic Unit

- Ked - Edwards Formation

Source: Bureau of Economic Geology

Edwards Aquifer Recharge Zone

Entire map view is within recharge zone.

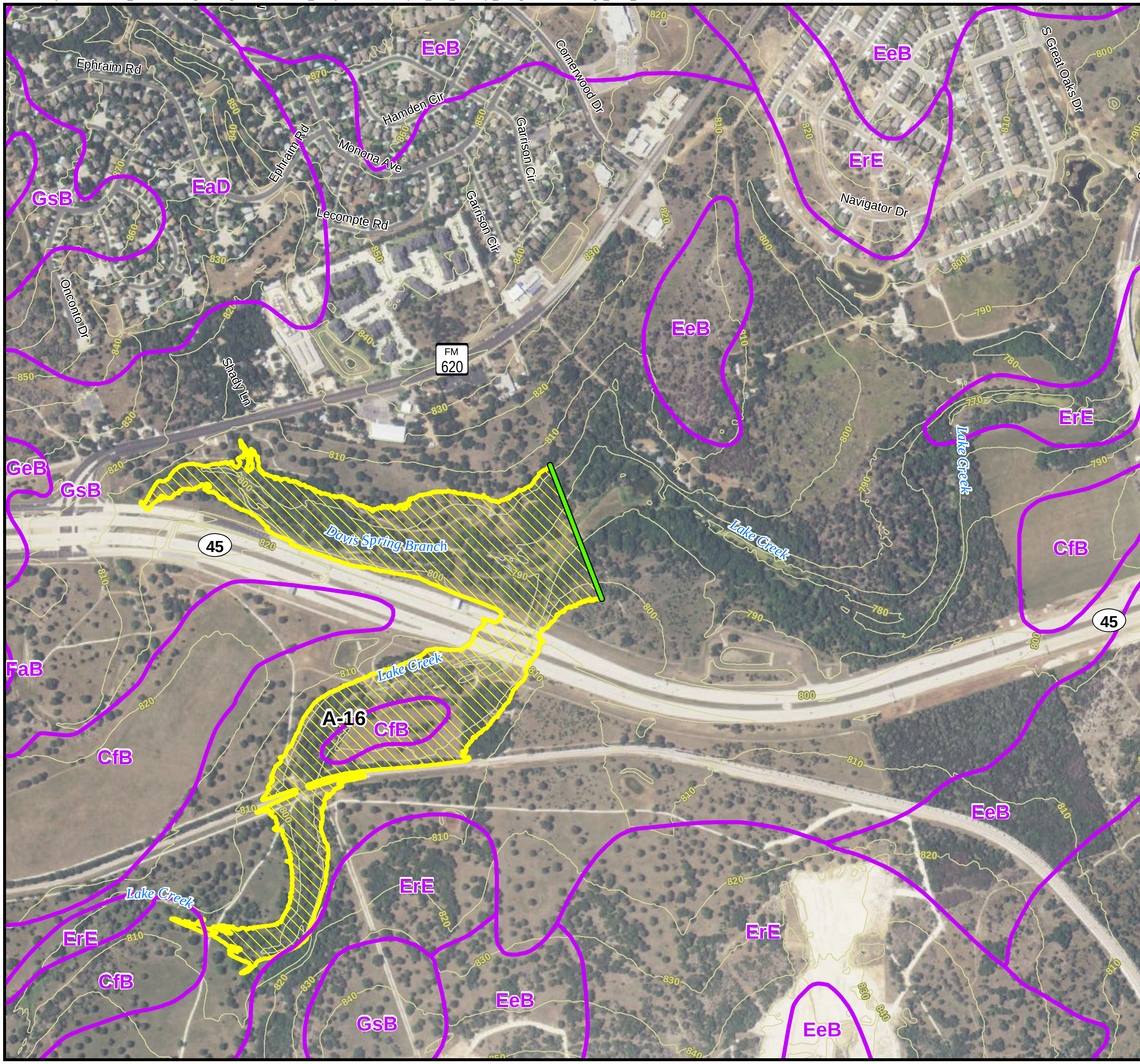
Geologic Map

Complex Detention Storage Site
A-16
Williamson County, Texas

Date: 9/29/2014

Figure A-2

L:\AGE\Projects\INFR\UBC_WCID\5.0-Engineering\5.8-Alternatives_Analysis\5.8.2c-Complex_Site_Concept_Designs\GIS\MXD\Fig3_A-16_Soil.mxd



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www.urscorp.com

Legend

- Dam Centerline
- Approximate Impoundment Area
- Topography
- Soil Survey

CfB: Crawford clay, 1 to 3 percent slopes

EaD: Eckrant cobbly clay, 1 to 8 percent slopes

EeB: Eckrant extremely stony clay, 0 to 3 percent slopes

ErE: Eckrant-Rock outcrop complex, rolling

FaB: Fairlie clay, 1 to 2 percent slopes

GeB: Georgetown clay loam, 0 to 2 percent slopes

GsB: Georgetown stony clay loam, 1 to 3 percent slopes

Hydrologic Soil Group: D
(for all soils shown)

Soil Survey

Complex Detention Storage Site
A-16
Williamson County, Texas

Date: 9/29/2014

Figure A-3

	PHOTOGRAPHIC RECORD TEST PITS	
Project: Upper Brushy Creek A-16 – Dam Assessment	**Client:** Upper Brushy Creek Water Control and Improvement District (WCID)	**Project Number:** 41010842

PHOTO #1	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-16	
View Direction: North	
Description: View from offsite easement area along SH 45.	

PHOTO #2	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-16	
View Direction: Northeast	
Description: View from offsite easement area along SH 45.	

URS	PHOTOGRAPHIC RECORD TEST PITS	
Project: Upper Brushy Creek A-16 – Dam Assessment	**Client:** Upper Brushy Creek Water Control and Improvement District (WCID)	**Project Number:** 41010842

PHOTO #3

Photo Filename:

Date of Photo:
3/24/2014

Location:
A-16

View Direction:
Southwest

Description:
SH 45 bridge at Lake Creek.

PHOTO #4

Photo Filename:

Date of Photo:
3/24/2014

Location:
A-16

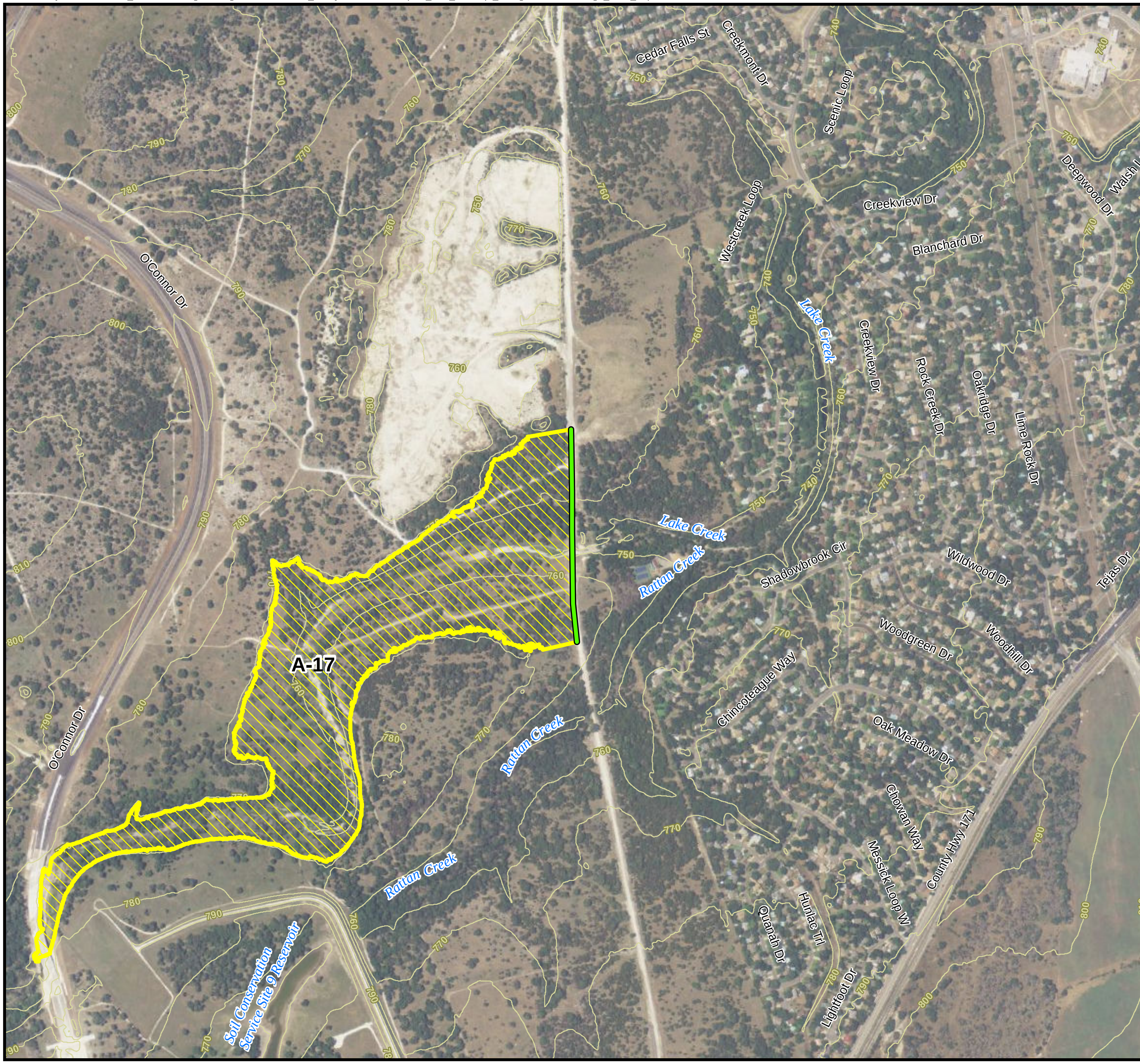
View Direction:
North

Description:
Lake Creek entering property / impoundment area.

Appendix B

Site A-17

L:\AGE\Projects\INFR\UBC_WCID\5.0-Engineering\5.8-Alternatives_Analysis\5.8.2c-Complex_Site_Concept_Designs\GIS\MXD\Fig1_A-17_Topo.mxd



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Legend

- Dam Centerline
- Approximate Impoundment Area
- Topography

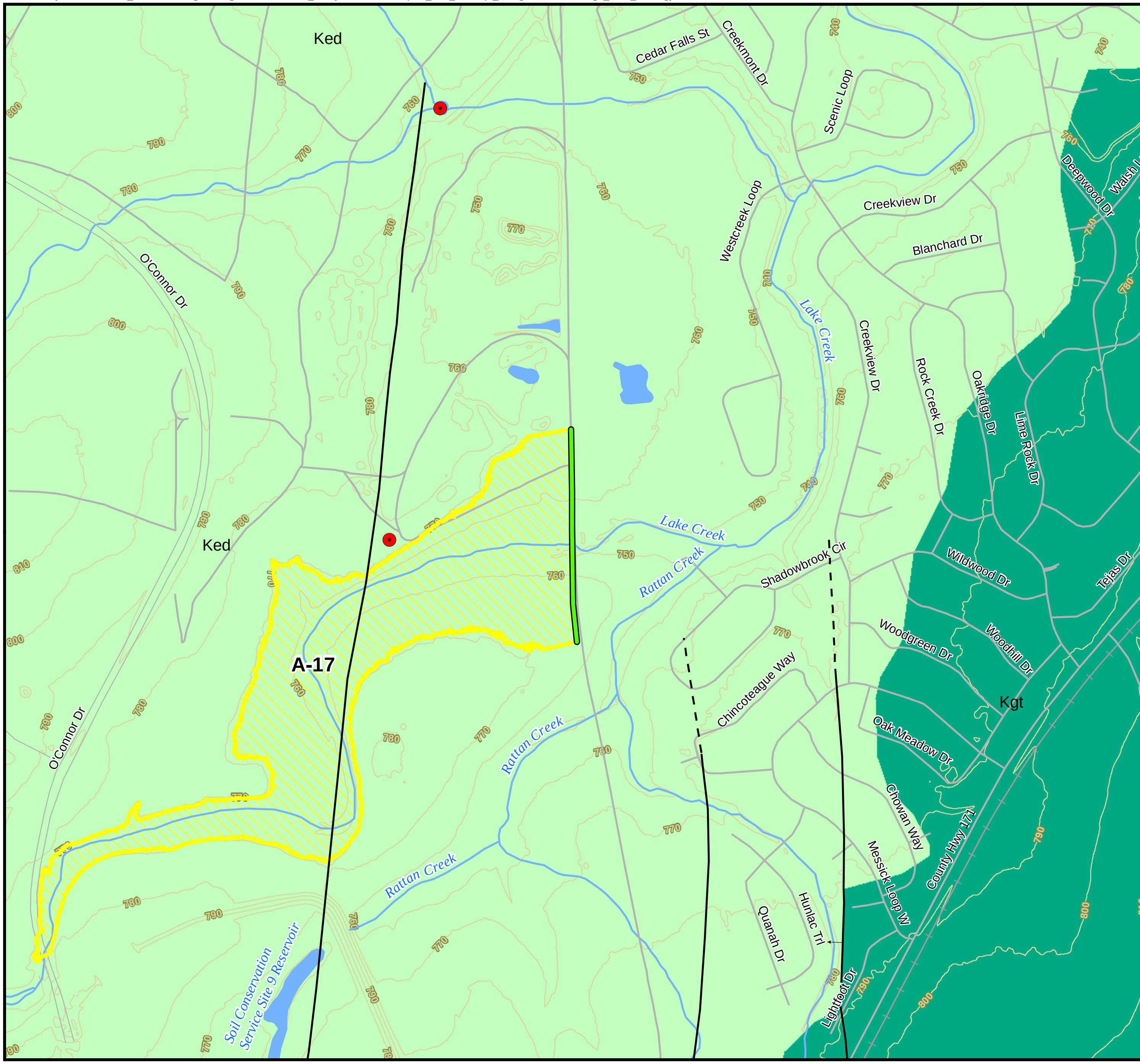
Aerial Photography and Topography

Complex Detention Storage Site A-17
Williamson County, Texas

Date: 9/29/2014

Figure B-1

L:\AGE\Projects\INFR\UBC_WCID\5.0-Engineering\5.8-Alternatives_Analysis\5.8.2c-Complex_Site_Concept_Designs\GIS\MXD\Fig2_A-17_Geology.mxd



0 500 1,000 Feet

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Legend

- Dam Centerline
- Approximate Impoundment Area
- Major Road
- Secondary Road
- Railroad
- Topography
- Stream/River
- Lake/Pond
- Critical Environmental Feature (approx.)

Geologic Unit

- Ked - Edwards Formation
- Kgt - Georgetown Formation

Faults:

- Inferred Normal
- Normal

Source: Bureau of Economic Geology

Edwards Aquifer Recharge Zone

Entire map view is within recharge zone.

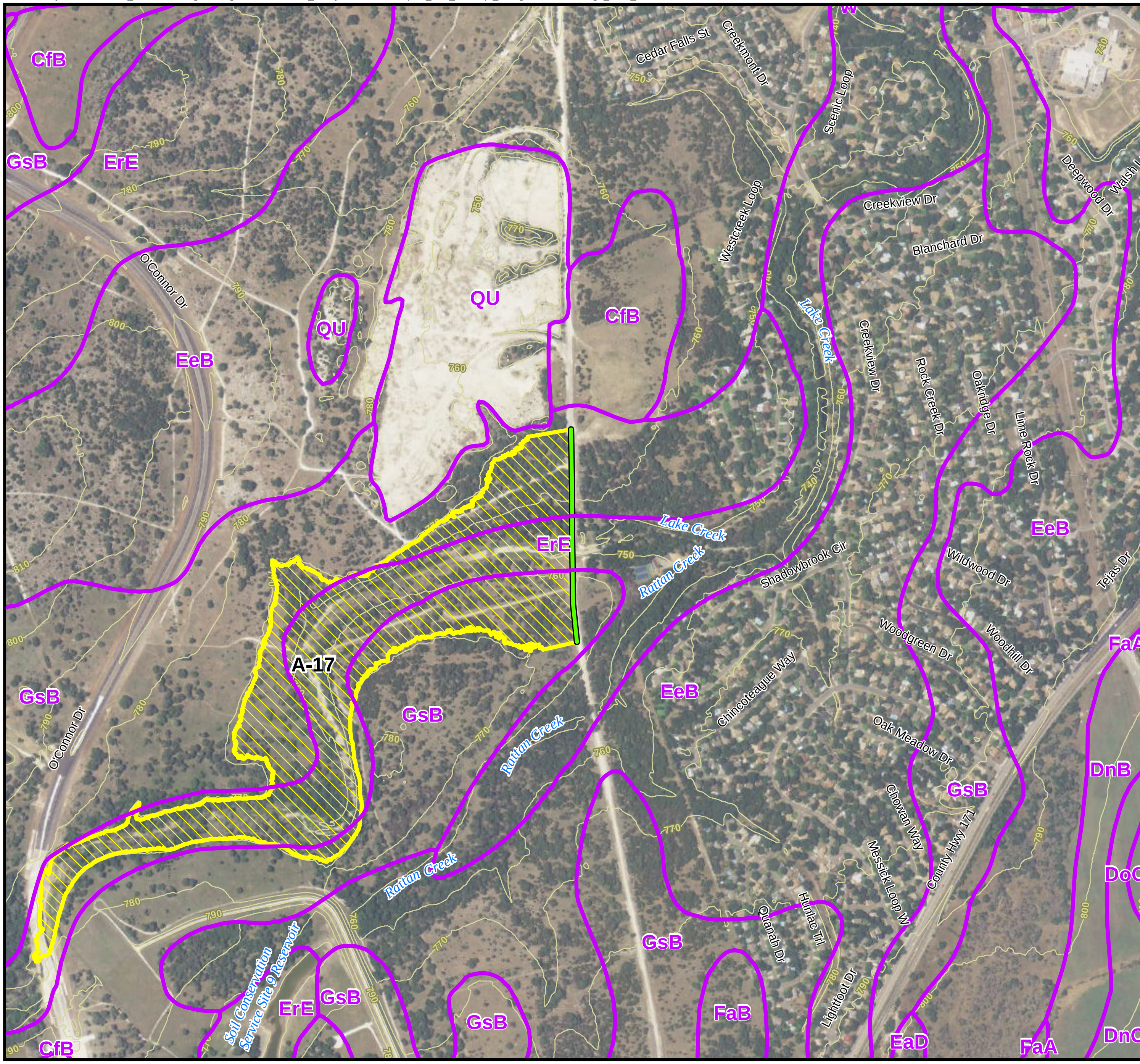
Geologic Map

Complex Detention Storage Site
A-17
Williamson County, Texas

Date: 9/29/2014

Figure B-2

L:\AGE\Projects\INFR\UBC_WCID\5.0-Engineering\5.8-Alternatives_Analysis\5.8.2c-Complex_Site_Concept_Designs\GIS\MXD\Fig3_A-17_Soil.mxd



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Phone: (512) 454-4797

w w w . u r s c o r p . c o m

Legend

- Dam Centerline
- Approximate Impoundment Area
- Topography
- Soil Survey

CfB: Crawford clay, 1 to 3 percent slopes

DnB: Denton silty clay, 1 to 3 percent slopes

DnC: Denton silty clay, 3 to 5 percent slopes

DoC: Doss silty clay, 1 to 5 percent slopes

EaD: Eckrant cobbly clay, 1 to 8 percent slopes

EeB: Eckrant extremely stony clay, 0 to 3 percent slopes

ErE: Eckrant-Rock outcrop complex, rolling

FaA: Fairlie clay, 0 to 1 percent slopes

FaB: Fairlie clay, 1 to 2 percent slopes

GsB: Georgetown stony clay loam, 1 to 3 percent slopes

QU: Quarry

W: Water

Hydrologic Soil Group: D (for all soils shown, except QU and W)

Soil Survey

Complex Detention Storage Site A-17
Williamson County, Texas

Date: 9/29/2014 | Figure B-3

URS	**PHOTOGRAPHIC RECORD** **TEST PITS**

Project:	**Client:**	**Project Number:**
Upper Brushy Creek A-17 – Dam Assessment	Upper Brushy Creek Water Control and Improvement District (WCID)	41010842

PHOTO #1	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-17	
View Direction: North, from right abutment	
Description: Hard stand roadway across proposed dam crest.	

PHOTO #2	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-17	
View Direction: Northwest, right abutment	
Description: View from proposed crest, facing slightly upstream (reservoir area)	

URS	PHOTOGRAPHIC RECORD TEST PITS	
Project: Upper Brushy Creek A-17 – Dam Assessment	**Client:** Upper Brushy Creek Water Control and Improvement District (WCID)	**Project Number:** 41010842

PHOTO #3	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-17	
View Direction: Northeast, right abutment	
Description: View from proposed crest, facing slightly downstream. Note debris/cut limestone stockpiles.	

PHOTO #4	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-17	
View Direction: Northwest, creek	
Description: View from creek, facing downstream. Note debris/cut limestone stockpiles.	

URS	**PHOTOGRAPHIC RECORD** **TEST PITS**	
Project: Upper Brushy Creek A-17 – Dam Assessment	**Client:** Upper Brushy Creek Water Control and Improvement District (WCID)	**Project Number:** 41010842

PHOTO #5	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-17	
View Direction: Southwest, from left abutment	
Description: View from proposed crest, left abutment, facing proposed reservoir area.	

PHOTO #6	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-17	
View Direction: North	
Description: Exposed limestone outcropping, at dam centerline.	

URS	PHOTOGRAPHIC RECORD TEST PITS	
Project: Upper Brushy Creek A-17 – Dam Assessment	**Client:** Upper Brushy Creek Water Control and Improvement District (WCID)	**Project Number:** 41010842

PHOTO #7	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-17	
View Direction: West	
Description: Critical environmental feature noted near mapped fault (see Figure 2)	

PHOTO #8	
Photo Filename:	
Date of Photo: 3/24/2014	
Location: A-17	
View Direction:	
Description: Critical environmental feature (same as above).	

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

May 6, 2016

Ms. Ruth Haberman, P.E., CFM
Upper Brushy Creek WCID
1850 Round Rock Ave. Suite 100
Round Rock, TX 78681-4024

Re: Flood Protection Planning Grant between the Texas Water Development Board (TWDB) and the Upper Brushy Creek Water Control and Improvement District (District); TWDB Contract No. 1148321283, Draft Report Comments

Dear Ms. Haberman:

Staff members of the TWDB have completed a review of the draft report prepared under the above-referenced contract. ATTACHMENT I provides the comments resulting from this review. As stated in the TWDB contract, the DISTRICT will consider revising the final report in response to comments from the Executive Administrator and other reviewers. In addition, the DISTRICT will include a copy of the Executive Administrator's draft report comments in the Final Report.

The TWDB looks forward to receiving one (1) electronic copy of the entire Final Report in Portable Document Format (PDF) and six (6) bound double-sided copies. **Please further note, that in compliance with Texas Administrative Code Chapters 206 and 213 (related to Accessibility and Usability of State Web Sites), the digital copy of the final report must comply with the requirements and standards specified in statute. For more information, visit http://www.sos.state.tx.us/tac/index.shtml.** If you have any questions on accessibility, please contact David Carter with the Contract Administration Division at (512) 936-6079 or david.carter@twdb.texas.gov.

The DISTRICT shall also submit one (1) electronic copy of any computer programs or models, and, if applicable, an operations manual developed under the terms of this Contract.

If you have any questions concerning this amendment, please contact Kathy Hopkins, the TWDB's designated Contract Manager for this project at (512) 463-6198 or kathy.hopkins@twdb.texas.gov.

Sincerely,

Robert E. Mace, Ph.D., P.G.
Deputy Executive Administrator
Water Science and Conservation

Enclosures

c: Kathy Hopkins, TWDB

ATTACHMENT

Review of Draft Report of Contract No. 1148321283
Upper Brushy Creek Water Control and Improvement District
Upper Brushy Creek Watershed Flood Protection Plan

The study follows standard methodologies and practices utilizing acceptable HEC modeling in the engineering aspects of hydrologic and hydraulic techniques. The hydrologic modeling parameters were determined based on the calculation and engineering judgments for the existing and ultimate conditions. Mitigation alternatives identified by the study are eligible for funding under the Board's financial assistance programs. Application requirements and eligibility criteria are identified by Board rules specified in Section 363 of the Texas Administrative Code (TAC). The report would be appropriate for use in support of an application to the Board for financing the proposed improvements. All additional information required by Board rules, 31 TAC 363.401-404, as well as necessary information to make legal findings as required by Texas Water Code Chapter 17.771-776, would be required at the time of the loan application.

Recommendations for Consideration

1. Please perform a final edit for typos, grammar, and inconsistent usage of acronyms and abbreviations. In addition, please verify references used in the text and correctly cite all references.

2. It was noted that references to Exhibits, Tables, and Figures throughout the draft study were incorrectly referenced or were not provided. Please perform a final review of all references pertaining to Exhibits, Tables, and Figures and correct as required.