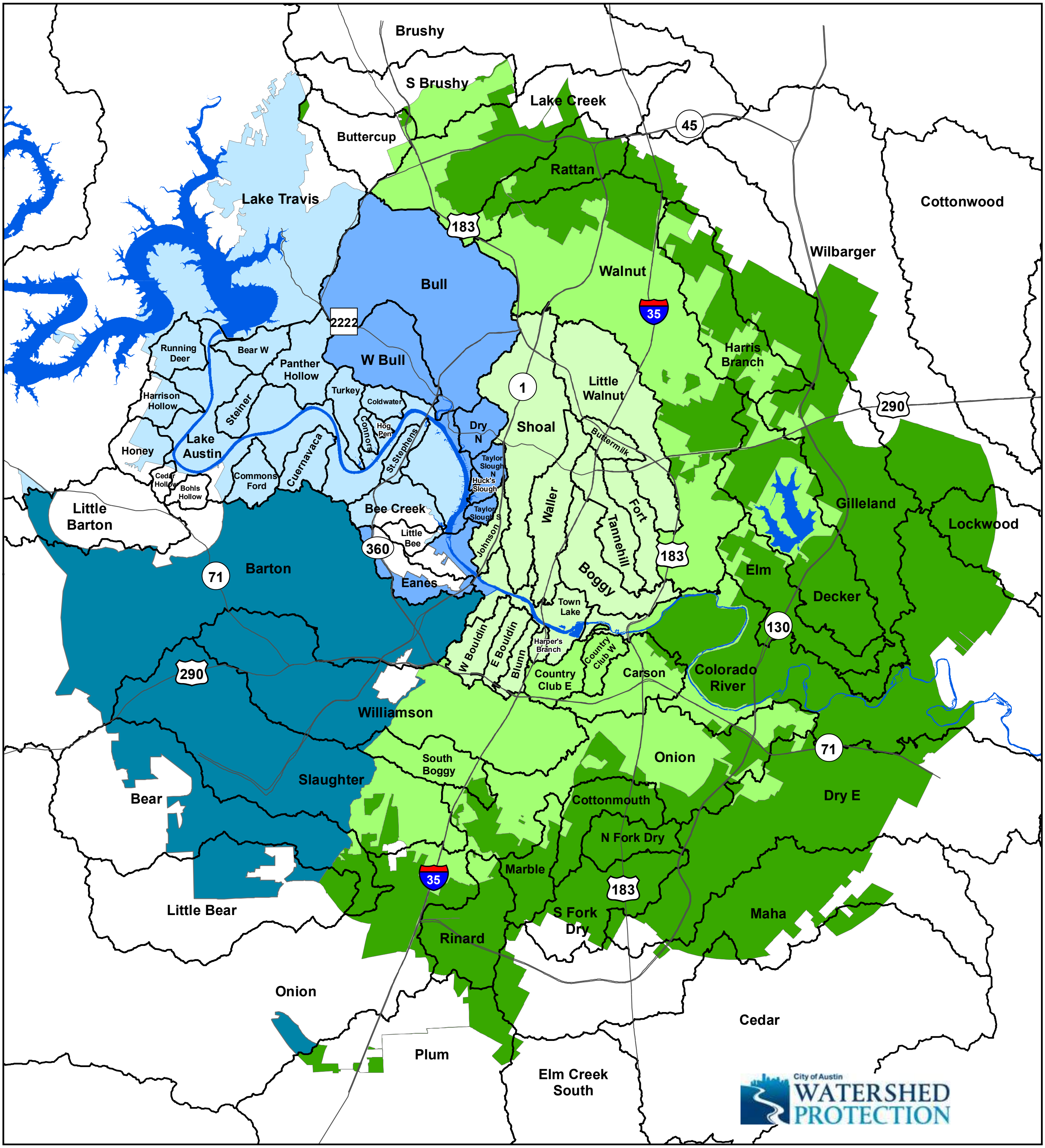
Appendix D –
Environmental Review Records

Exhibit D.1	**Watershed Classifications**
Exhibit D.2	**Erosion Hazard Zone Map and Communication**
Exhibit D.3	**Watershed Protection Department Erosion Inspection Reports**
Exhibit D.4	**Endangered Species Map**
Exhibit D.5	**Texas Commission on Environmental Quality - Water Quality Reports**
Exhibit D.6	**Map of Critical Water Quality Zone**
Exhibit D.7	**Environmental Integrity Index Report**
Exhibit D.8	**Map of Historical Landmarks**

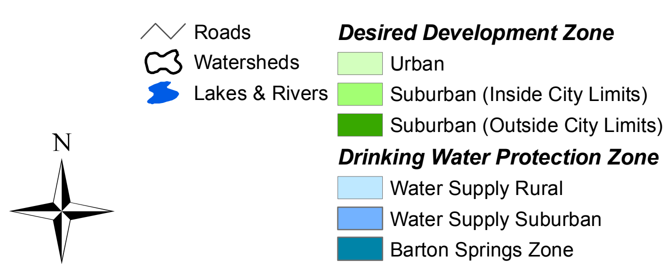
Exhibit D.1

Watershed Classifications



City of Austin Watershed Regulation Areas

0 5 10 Miles



City of Austin Watershed Protection Ordinance Regulations Summary Table

Effective: October 28, 2013

Red Text = Change from Previous Requirements

REGULATORY CATEGORY	ZONE	DESIRED DEVELOPMENT ZONE			DRINKING WATER PROTECTION ZONE		
		Urban	**Suburban City Limits**	**Suburban N. Edwards / ETJ**	**Water Supply Suburban**	**Water Supply Rural**	**Barton Springs Zone**
Impervious Cover (IC)	**Calculation Basis**	Gross Site Area	**Gross Site Area**	**Gross Site Area**	Net Site Area	Net Site Area	Net Site Area
	Transfers Allowed	No	Yes	Yes	Yes	Yes	No
	Uplands: Max Pct IC	Max Pct	Max Pct Std / w Transfer	Max Pct Std / w Transfer	Max Pct Std / w Transfer	Max Pct Std / w Transfer	Max Pct [No Transfers]
	Single-Family Res. (Lot > 5750 ft²)	No Watershed IC Limit: Zoning Limits only	50% / 60%	45% / 50%	30% / 40%	1 unit per 1 ac. / 1 unit per 2 ac.*	R / BC / C ** 15% / 20% / 25% for all uses
	Single-Family Res. (Lot < 5750 ft²)		55% / 60%	55% / 60%			
	Multi-Family Residential Max Pct		60% / 70%	60% / 65%	40% / 55%	20% / 25%	
	Commercial Max Pct		80% / 90%	65% / 70%			
						* Min lot ¾-acre; ½-acre with transfers; Clustering: 1 unit/ac max; 2 units/ac w transfer	** R = Recharge Zone BC = Barton Creek Contributing C = Other Contributing
	WQ Transition Zone: **Max Pct IC** (outside floodplain)	Not Applicable	**Not Applicable**	**Not Applicable**	18%	1 SF unit / 3 acres	1 SF unit / 3 acres None over recharge
	Critical WQ Zone: Max Pct IC	None (except road crossings)	None (except limited road crossings)	None (except limited road crossings)	None (except limited road crossings)	None (except limited road crossings)	None (except limited road crossings)
	Critical Environmental Feature (CEF) Max Pct IC	None within 150 to 300 ft radius	None within 150 to 300 ft radius	None within 150 to 300 ft radius	None within 150 to 300 ft radius	None within 150 to 300 ft radius	None within 150 to 300 ft radius
Waterway Classifications	**Minor**	64 acres	**64 – 320 acres**	**64 – 320 acres**	**64 – 320 acres**	64 – 320 acres	**64 – 320 acres**
	Intermediate		**320 – 640 acres**	**320 – 640 acres**	320 – 640 acres	320 – 640 acres	320 – 640 acres
	Major		**over 640 acres**	**over 640 acres**	over 640 acres	over 640 acres	over 640 acres
	Notes	Urban creeks not classified					
Waterway Setbacks	**Critical Water Quality Zone**						
	Minor	50 – 400 ft. No CWQZ Downtown	**100 ft.**	**100 ft.**	50 – 100 ft.	50 – 100 ft.	50 – 100 ft.
	Intermediate		**200 ft.**	**200 ft.**	100 – 200 ft.	100 – 200 ft.	100 – 200 ft.
	Major		**300 ft.**	**300 ft.**	200 – 400 ft.	200 – 400 ft.	200 – 400 ft. (Barton mainstem 400 ft.)
	Notes	Between min and max width, coincides with the 100-year **fully-developed** floodplain	**"Buffer averaging" allows sites to reduce width of buffers by up to one-half if the overall amount protected remains the same**		Between min and max width, coincides with the 100-year fully-developed floodplain		
	Water Quality Transition Zone						
	Minor	Not Required	**Not Required**	**Not Required**	100 ft.	100 ft.	100 ft.
	Intermediate				200 ft.	200 ft.	200 ft.
	Major				300 ft.	300 ft.	300 ft.
	Variances from Buffers	**Administrative under certain conditions**	Must apply for Land Use Commission variance		Must apply for Land Use Commission variance.		
Water Quality Controls	**Treatment Standard**	Sedimentation/ Filtration	Sedimentation/ Filtration	Sedimentation/ Filtration	Sedimentation/ Filtration	Sedimentation/ Filtration	Non-Degradation
	When Required	**All new/redeveloped if IC > 8,000 sq. ft.**	**All new/redeveloped if IC > 8,000 sq. ft.**	**All new/redeveloped if IC > 8,000 sq. ft.**	All new/redeveloped if IC > 8,000 sq. ft.; all IC in WQTZ	All new/redeveloped if IC > 8,000 sq. ft.; all IC in WQTZ	All development
	Allowed in Creek Buffer	**CWQZ = Yes per ECM** WQTZ = N/A	**CWQZ = Yes per ECM** **WQTZ = N/A**	**CWQZ = Yes per ECM** **WQTZ = N/A**	CWQZ = No **WQTZ = Yes per ECM**	CWQZ = No **WQTZ = Yes per ECM**	CWQZ = No WQTZ = Yes **per ECM**
	Alternative Strategies Allowed	Yes	Yes	Yes	Yes	Yes	No
	Optional Payment-in-Lieu	Yes	No	No	No	No	No

Key: CWQZ = Critical Water Quality Zone; ETJ = Extra-Territorial Jurisdiction; IC = Impervious Cover; SF = Single-Family Residential; WQ = Water Quality; WQTZ = Water Quality Transition Zone

Exhibit D.2

Erosion Hazard Zone Map and Communication

Legend

Erosion Hazard Zone Review Buffer

East Bouldin Creek Centerline

Dube, Kiersten

From: Byars, Morgan
Sent: Thursday, September 04, 2014 12:31 PM
To: Renfro, Janna
Cc: Dube, Kiersten; Kenzle, Susan
Subject: Re: East Bouldin Creek - Annie Street project

I would just add that the existing condition of the outfall(s) will affect the type and extent of armoring and whether a standard detail by itself can be use. On the ground citing with Janna as the MIP rep would be appropriate.
MB

Sent from my iPhone

On Sep 4, 2014, at 12:01 PM, "Renfro, Janna" <Janna.Renfro@austintexas.gov> wrote:

Hi Kiersten –

Since you can't avoid putting outfalls in the Erosion Hazard Zone, the code would require that the outfalls have "protective works" that prevent future erosion from damaging the improvements. In this case, we would want the outfall to be designed to be stable with appropriate energy dissipation/armoring for the channel bed and banks in the immediate area. Using native limestone blocks and riprap with any opportunities for additional vegetation would be preferred. You can refer to Standard Details 508S-16 thru 20 for alternatives to the standard concrete headwall with baffle blocks.

Morgan – anything to add to that? This is a Local Flood project that has been through the MIP integration process. I anticipated that we would provide feedback on the outfall design and locations.

Thanks,
Janna

From: Kenzle, Susan
Sent: Thursday, September 04, 2014 10:03 AM
To: Byars, Morgan; Renfro, Janna
Subject: FW: East Bouldin Creek - Annie Street project
Importance: High

Morgan, Janna:

I think you guys may be better suited to address this question, although I'm happy to help in whatever way I can.

Susan Kenzle, RLA, LI
Watershed Protection Department
City of Austin

(512) 974-6239

From: Dube, Kiersten
Sent: Thursday, September 04, 2014 9:58 AM
To: Kenzle, Susan; Scoggins, Mateo
Cc: Zhang, Xiaoqin; Odufuye, Adewale; Massie-Gore, Jennifer
Subject: East Bouldin Creek - Annie Street project

Hi Susan and Mateo,

I'm working on a Preliminary Engineering Report for a storm drain improvement project on the east side of East Bouldin Creek between Annie and Johanna Streets. I'm looking into any vegetation/erosion/environmental issues that we should include in the report. The area is not in a "grow zone", but is listed as an "erosion hazard review zone". We are in the early stage of examining the problem, but will certainly propose additional outfalls into EBC and/or upsizing existing outfalls. I'd appreciate some perspective on this section of EBC in general and specifically what being in an erosion hazard zone would mean for this project.

Please let me know if you have any comments. If you'd like, I can set up a meeting. A map is attached.

Thanks,

Kiersten Dube
Project Coordinator
City of Austin
Engineering Services Division
512.974.7134
kiersten.dube@austintexas.gov

Exhibit D.3

Watershed Protection Department

Erosion Inspection Reports


1415 South 1st ST (1102 South Congress Ave)
1601 South 1st St
1603 South 1st St
1605 South 1st St
420 W Johanna St
413 W Mary St
419 W Johanna St
500 W Live Oak St
400 W Live Oak St
Legend
<all other values>
SITE_STATU
ACTIVE
CONSTRUCTION
DELETE
DESIGN CMPLT
PLANNING
PROJECT
REPAIRED

Stream Restoration Program - Erosion Site Inspection Form

Date 2/27/08

Inspector LCS

Address 413 Mary

Watershed EBO

Resource Threatened Fence

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

Erosion Type Rating (1, 2, or 3) 3

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure (D_{offset} < 1 ft)

Type 3: Property or structure that may be threatened by future stream channel erosion (D_{Offset} >= 1 ft)

Bank Height (Y) 6 ft

Horizontal Offset from Top of Bank to Threatened Resource (D_{offset}) 2 ft

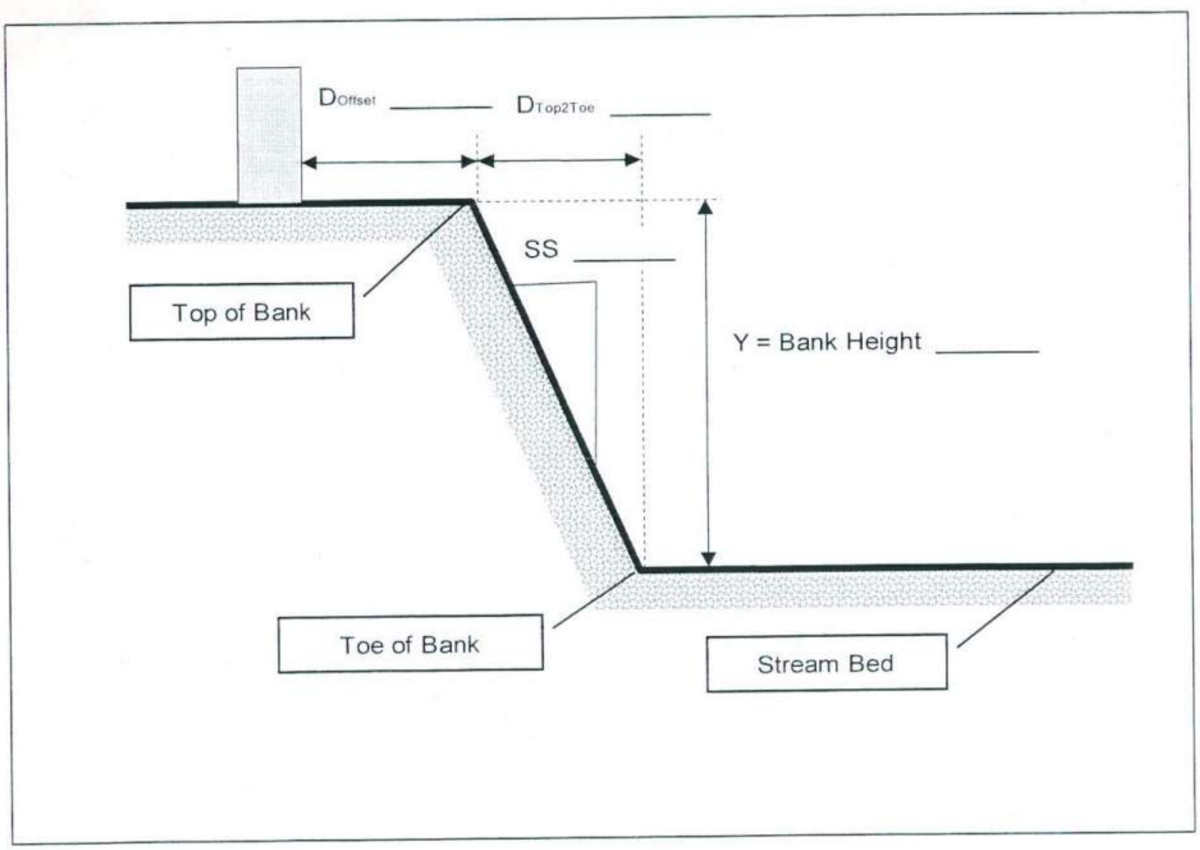
Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$) 6 ft

Existing Bank Slope, Horizontal:Vertical (SS) 1 $D_{Top2Toe}$ / Y:1

Erosion Damage Length along Creek Flowpath (L_e) 40 ft

Bank Composition AL
(alluvial = AL, rock = R, composite = COMP)

Channel Type RB
(alluvial = AL, rock bed = RB, rock controlled = RC)



Stream Restoration Program - Erosion Site Inspection Form

Date 2/27

Inspector LCS

Address 413 Mary St

Watershed EBO

Resource Threatened Yard

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

Erosion Type Rating (1, 2, or 3) 2

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure ($D_{offset} < 1$ ft)

Type 3: Property or structure that may be threatened by future stream channel erosion ($D_{Offset} >= 1$ ft)

Bank Height (Y) 10 ft

Horizontal Offset from Top of Bank to Threatened Resource (D_{offset}) 0 ft

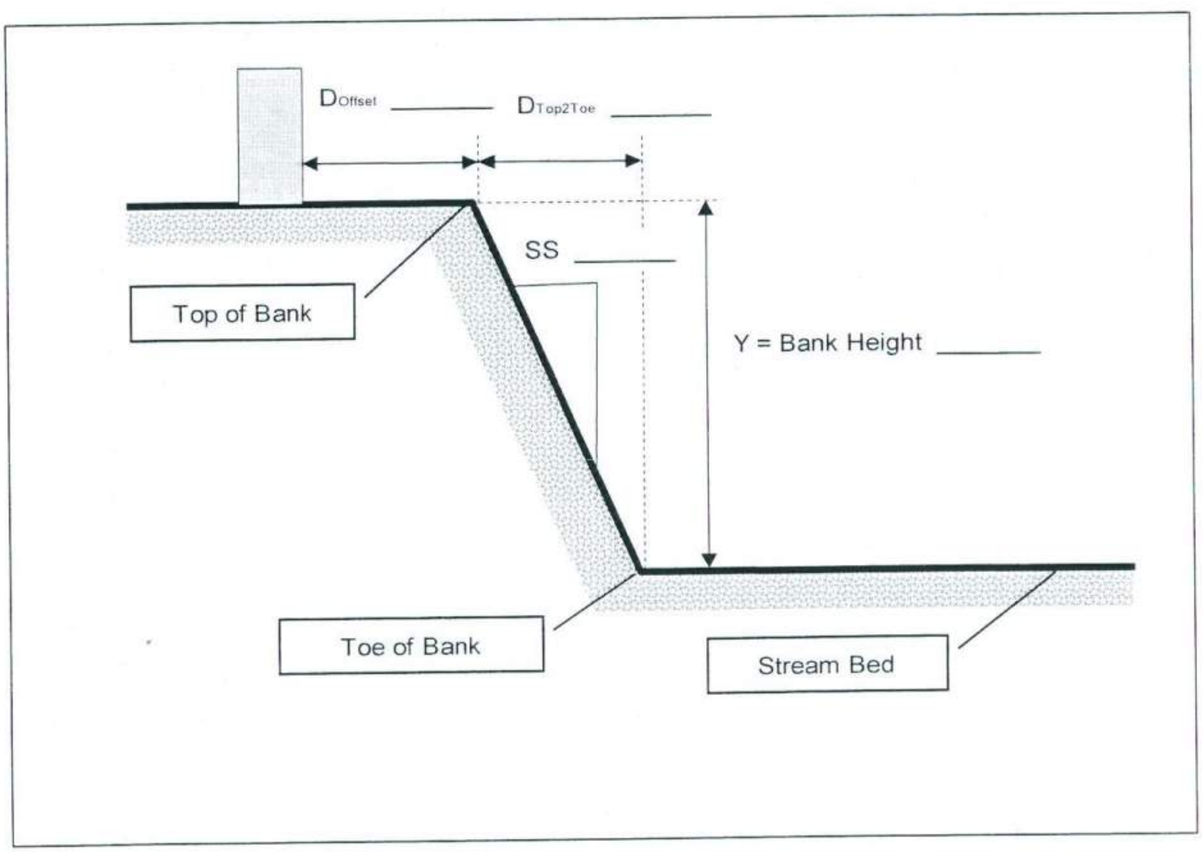
Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$) 3 ft

Existing Bank Slope, Horizontal:Vertical (SS) 0.3 $D_{Top2Toe}$ / Y:1

Erosion Damage Length along Creek Flowpath (L_e) 75 ft

Bank Composition
(alluvial = AL, rock = R, composite = COMP) AL

Channel Type
(alluvial = AL, rock bed = RB, rock controlled = RC) ~~AL~~ RB



Stream Restoration Program - Erosion Site Inspection Form

Date	2/27/08
Inspector	LCS
Address	419 Johanna
Watershed	E60
Resource Threatened	Private Wall

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

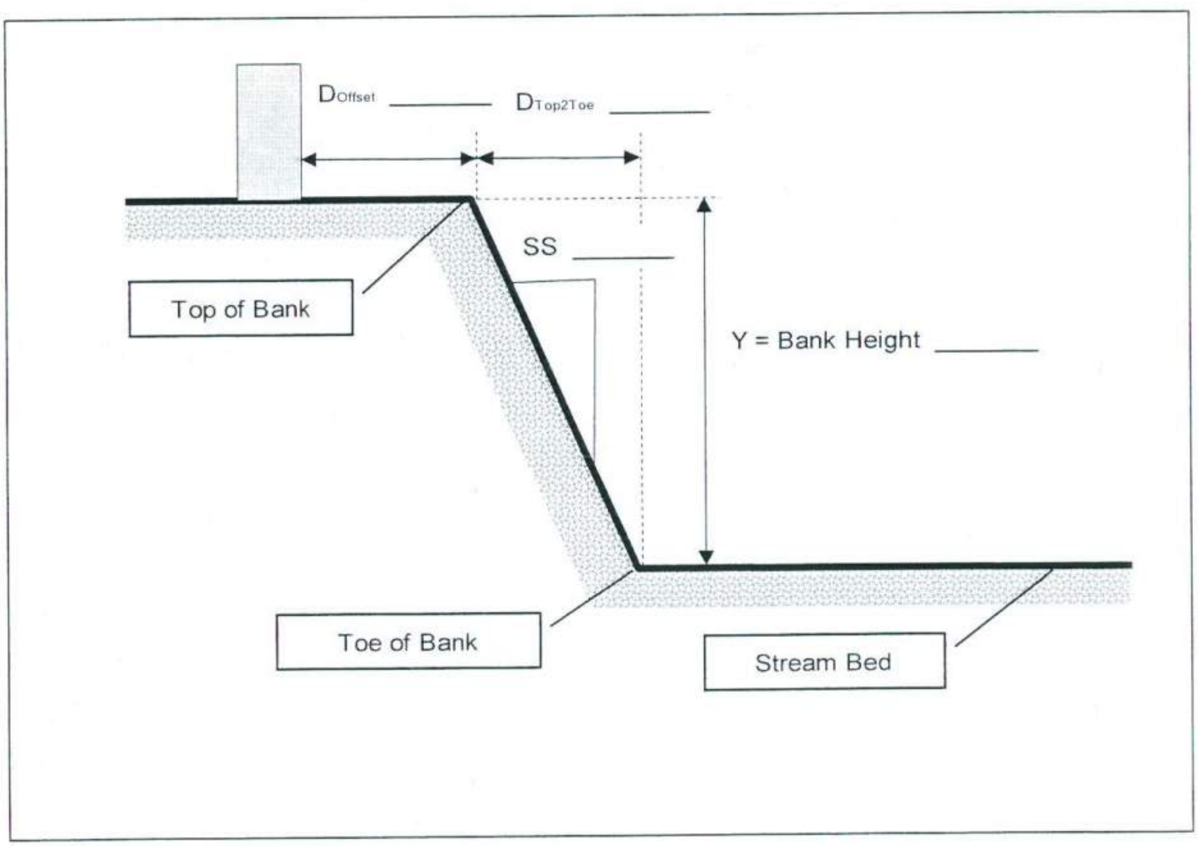
Erosion Type Rating (1, 2, or 3) 4

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure (D_{offset} < 1 ft)

Type 3: Property or structure that may be threatened by future stream channel erosion (D_{Offset} >= 1 ft)

Bank Height (Y)	6	ft
Horizontal Offset from Top of Bank to Threatened Resource (D_{offset})	0	ft
Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$)	6	ft
Existing Bank Slope, Horizontal:Vertical (SS)	1	$D_{Top2Toe}$ / Y:1
Erosion Damage Length along Creek Flowpath (L_e)	50	ft
Bank Composition (alluvial = AL, rock = R, composite = COMP)	AL	
Channel Type (alluvial = AL, rock bed = RB, rock controlled = RC)	AL	



Stream Restoration Program - Erosion Site Inspection Form

Date 2/27/08

Inspector LCS

Address 420 Johanna

Watershed EBD

Resource Threatened Private Wall -> fence threatened N/S

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

Erosion Type Rating (1, 2, or 3) 4 -> Type 3 fence.

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure (D_{offset} < 1 ft)

Type 3: Property or structure that may be threatened by future stream channel erosion (D_{Offset} >= 1 ft)

Bank Height (Y) 4 ft

Horizontal Offset from Top of Bank to Threatened Resource (D_{offset}) 0 ft

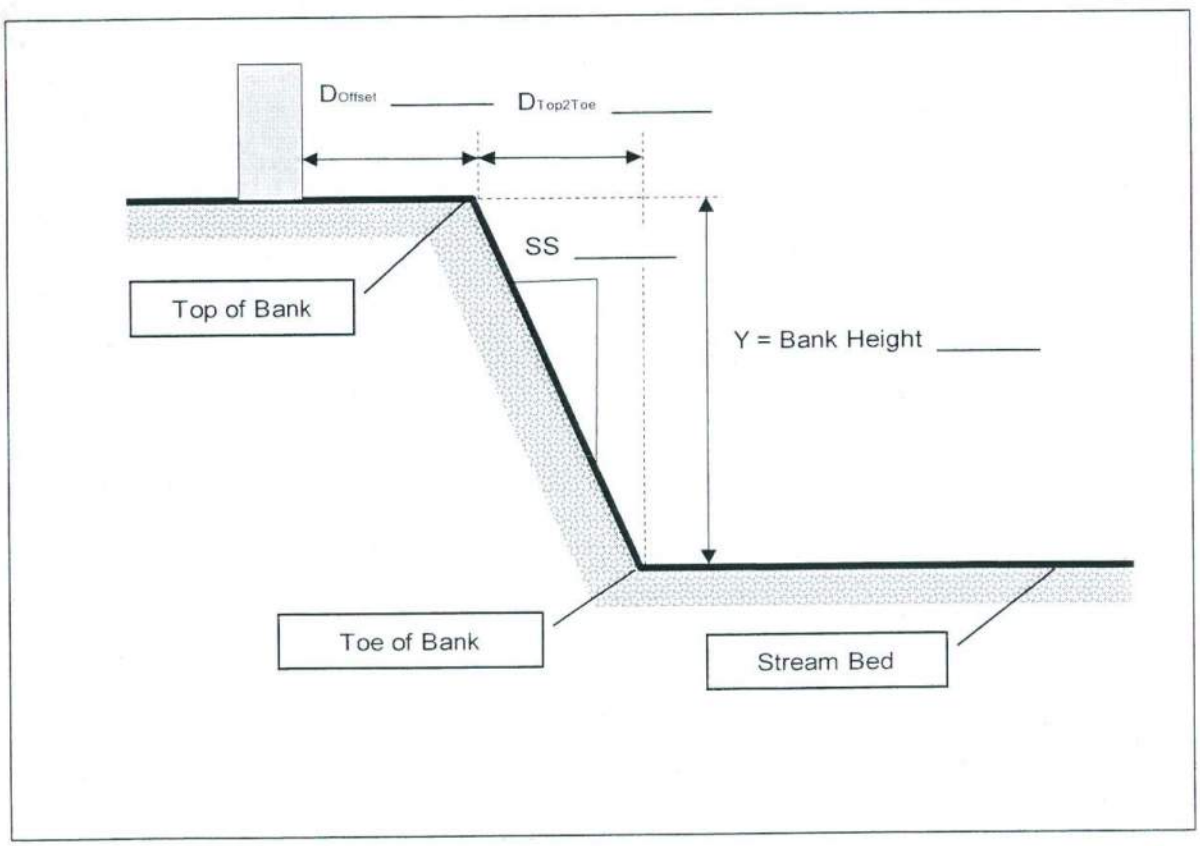
Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$) 0 ft

Existing Bank Slope, Horizontal:Vertical (SS) vert. $D_{Top2Toe}$ / Y:1

Erosion Damage Length along Creek Flowpath (L_e) 100 ft

Bank Composition
(alluvial = AL, rock = R, composite = COMP) AL

Channel Type
(alluvial = AL, rock bed = RB, rock controlled = RC) RB



Erosion Inspection Site – 400 W. Live Oak Street

Stream Restoration Program - Erosion Site Inspection Form

Date: 2/27/08

Inspector: LCS

Address: 500 Live Oak

Watershed: EBO

Resource Threatened: Manhole / Sewer Line

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

Erosion Type Rating (1, 2, or 3): 2

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure (D_{offset} < 1 ft)

Type 3: Property or structure that may be threatened by future stream channel erosion (D_{Offset} >= 1 ft)

Bank Height (Y): 9 ft

Horizontal Offset from Top of Bank to Threatened Resource (D_{offset}): (-) ft

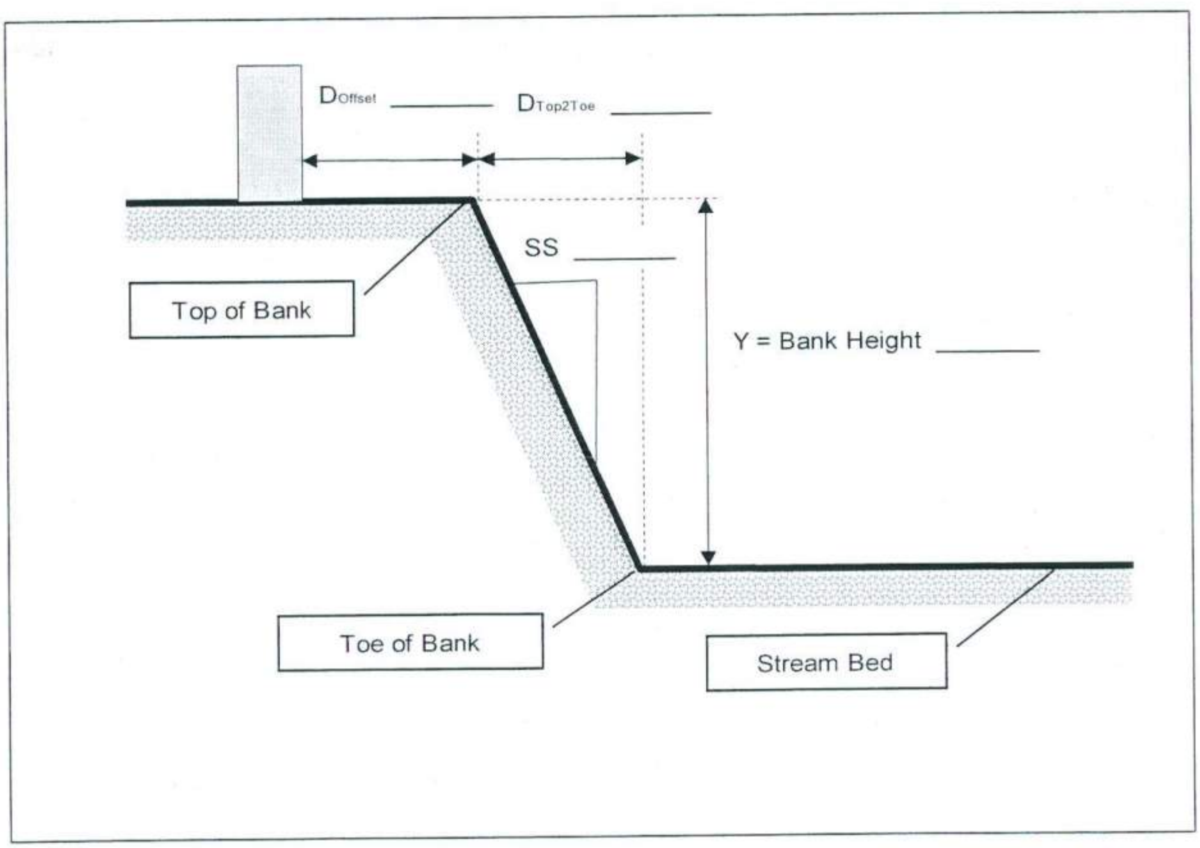
Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$): 0 ft

Existing Bank Slope, Horizontal:Vertical (SS): vertical $D_{Top2Toe}$ / Y:1

Erosion Damage Length along Creek Flowpath (L_e): 100 ft

Bank Composition
(alluvial = AL, rock = R, composite = COMP): AL

Channel Type
(alluvial = AL, rock bed = RB, rock controlled = RC): AL



Stream Restoration Program - Erosion Site Inspection Form

Date 2/27/08

Inspector LLS

Address 1603 S. 1st

Watershed EBD

Resource Threatened Fence

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

Erosion Type Rating (1, 2, or 3) 3

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure (D_{offset} < 1 ft)

Type 3: Property or structure that may be threatened by future stream channel erosion (D_{Offset} >= 1 ft)

Bank Height (Y) 11 ft

Horizontal Offset from Top of Bank to Threatened Resource (D_{offset}) 2 ft

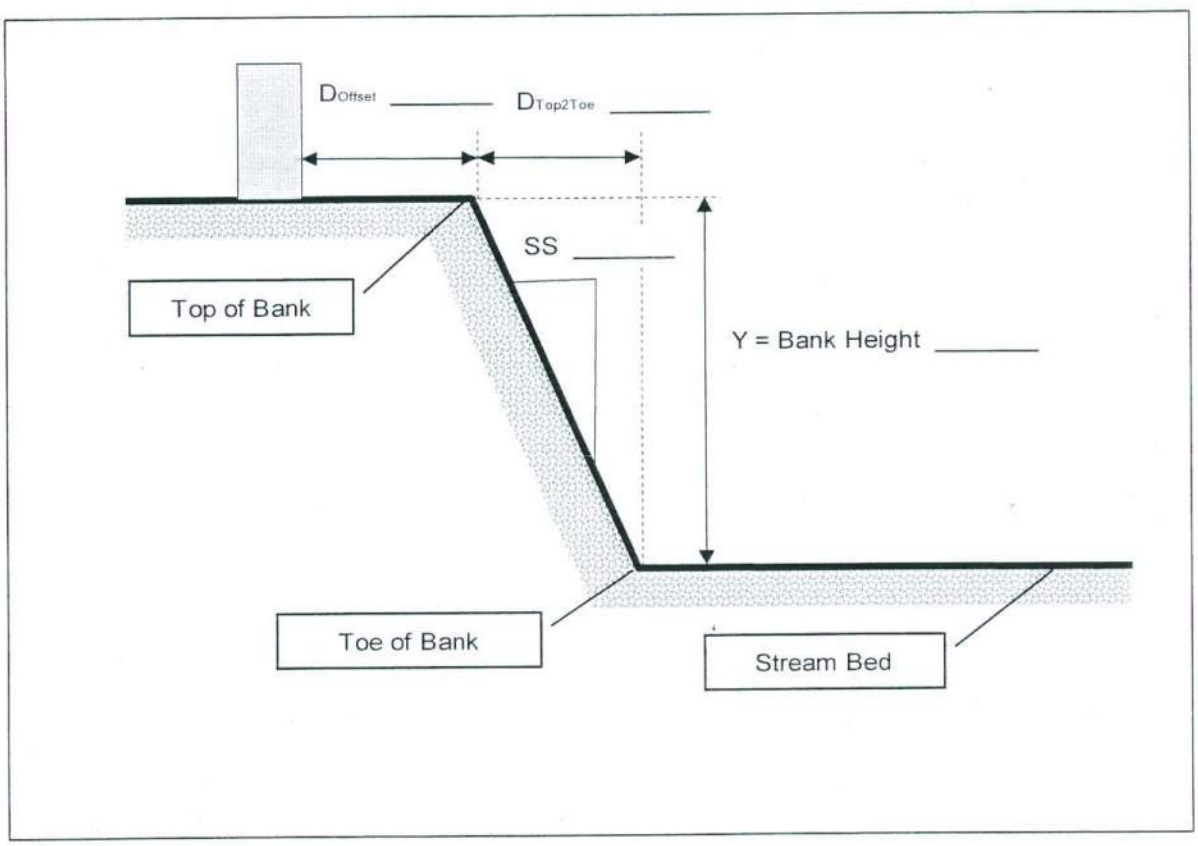
Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$) 4 ft

Existing Bank Slope, Horizontal:Vertical (SS) 4/11 $D_{Top2Toe}$ / Y:1

Erosion Damage Length along Creek Flowpath (L_e) 50 ft

Bank Composition AL
(alluvial = AL, rock = R, composite = COMP)

Channel Type RB ?
(alluvial = AL, rock bed = RB, rock controlled = RC)



Stream Restoration Program - Erosion Site Inspection Form

Date: 2/27/08

Inspector: LCS

Address: 1601 S. 1st

Watershed: EBO

Resource Threatened: Parking Lot

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

Erosion Type Rating (1, 2, or 3): 2

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure (D_{offset} < 1 ft)

Type 3: Property or structure that may be threatened by future stream channel erosion (D_{Offset} >= 1 ft)

Bank Height (Y): 11 ft

Horizontal Offset from Top of Bank to Threatened Resource (D_{offset}): 5 ft

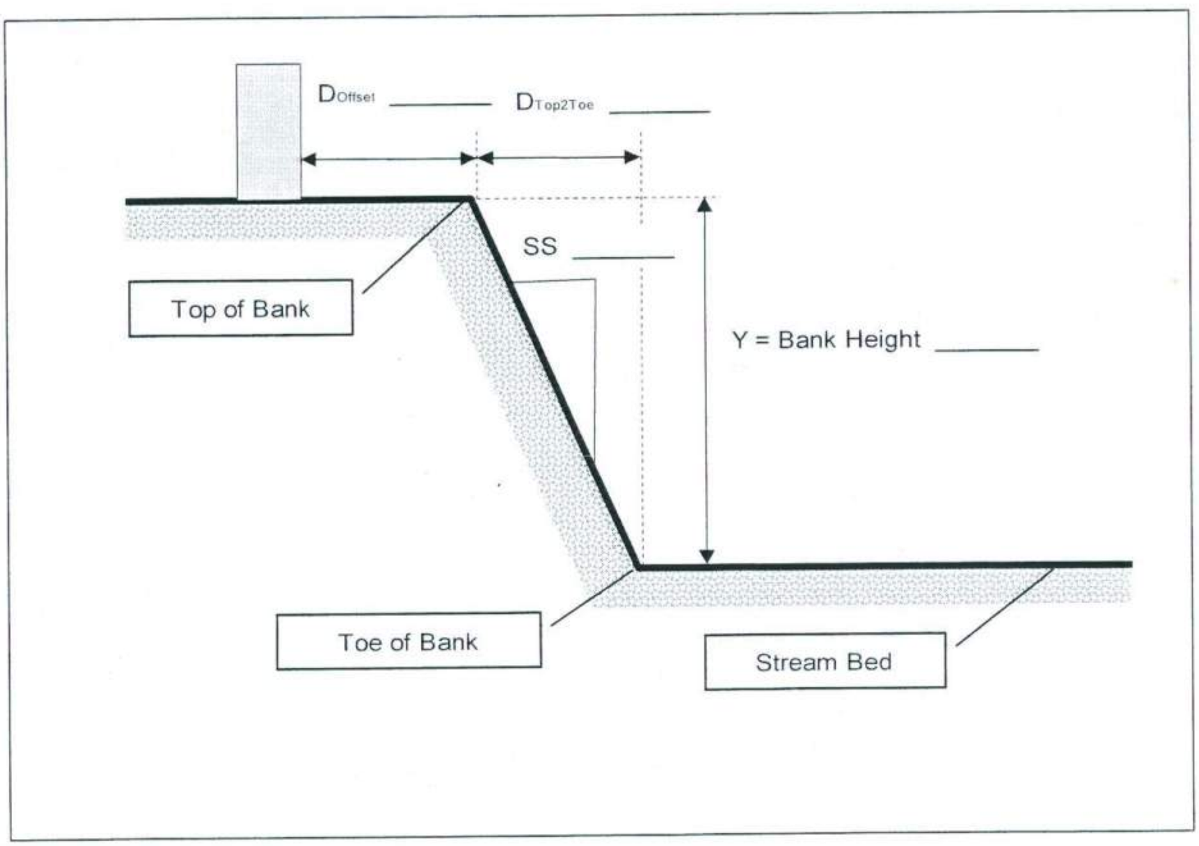
Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$): 6 ft

Existing Bank Slope, Horizontal:Vertical (SS): 6/11 $D_{Top2Toe}$ / Y:1

Erosion Damage Length along Creek Flowpath (L_e): 50 ft

Bank Composition: AL
(alluvial = AL, rock = R, composite = COMP)

Channel Type: RB
(alluvial = AL, rock bed = RB, rock controlled = RC)



Stream Restoration Program - Erosion Site Inspection Form

Date	2/27/08
Inspector	LCS
Address	1605 S. 1st
Watershed	EBO
Resource Threatened	Wall

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

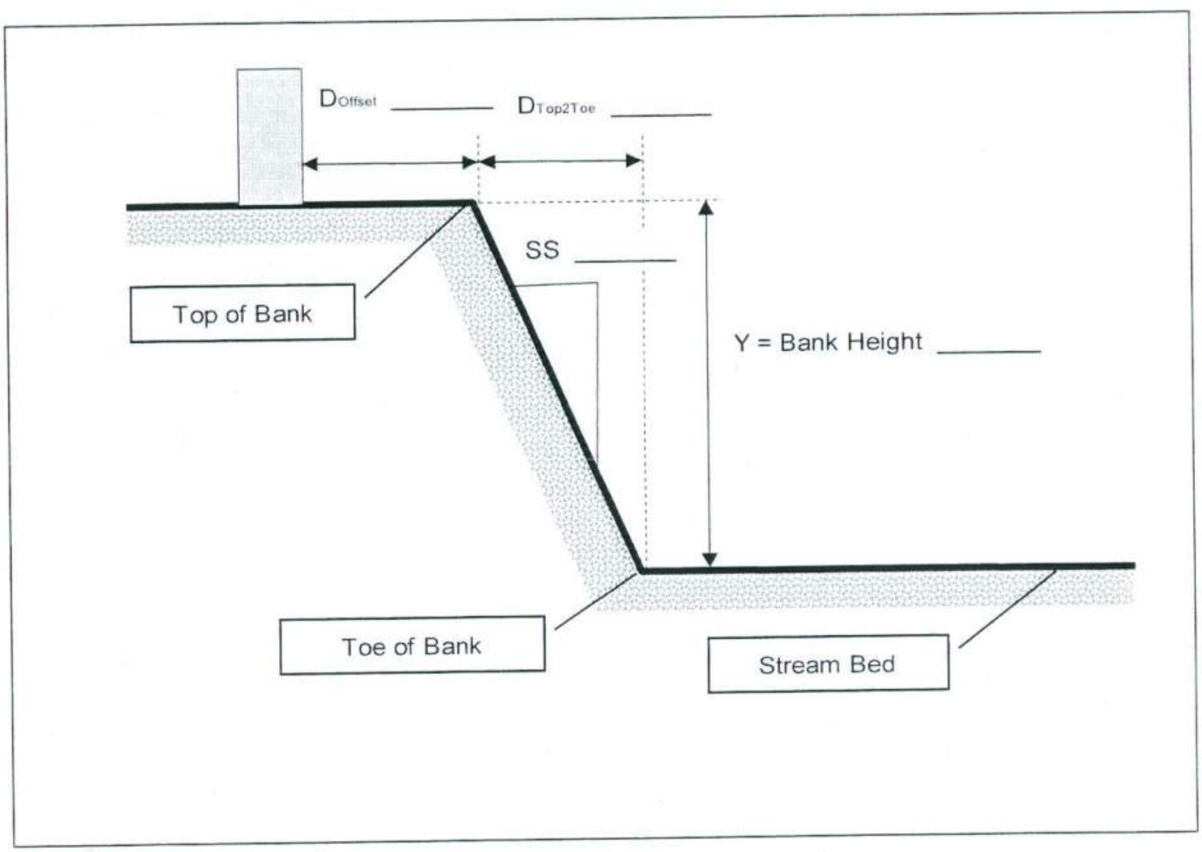
Erosion Type Rating (1, 2, or 3) 4

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure (D_{offset} < 1 ft)

Type 3: Property or structure that may be threatened by future stream channel erosion (D_{Offset} >= 1 ft)

Bank Height (Y)	11	ft
Horizontal Offset from Top of Bank to Threatened Resource (D_{offset})	0	ft
Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$)	0	ft
Existing Bank Slope, Horizontal:Vertical (SS)	vert.	$D_{Top2Toe}$ / Y:1
Erosion Damage Length along Creek Flowpath (L_e)	20	ft
Bank Composition (alluvial = AL, rock = R, composite = COMP)	AL	
Channel Type (alluvial = AL, rock bed = RB, rock controlled = RC)	RB	



Stream Restoration Program - Erosion Site Inspection Form

Date 2/27/08

Inspector LCS

Address 1415 S. 1st (across creek)

Watershed EBO

Resource Threatened Tree / Fence

(i.e. House, Building, Major Road, Minor Road, Low Water Crossing, Mobile Home, Fixed Storage Building, Garage, Dam, Deck, Driveway, Sidewalk, Fence, Yard (major loss), Grade Control, Retaining Wall, Parking Lot, Public Recreational Amenity, Swimming Pool, Tennis Court, Playscape, Hike and Bike Trail, Protected Tree, Manhole, Utility , Line, Pipeline, Power Pole, Concrete Riprap Slope Protection, , Concrete Flume, Bridge, Railroad Bridge, Railroad, Pedestrian Bridge)

Erosion Type Rating (1, 2, or 3) 3

Type 1: Imminent threat to a habitable/primary structure or public roadway.

Type 2: Threat to secondary structure/ private property or public infrastructure (D_{offset} < 1 ft)

Type 3: Property or structure that may be threatened by future stream channel erosion (D_{Offset} >= 1 ft)

Bank Height (Y) 9 ft

Horizontal Offset from Top of Bank to Threatened Resource (D_{offset}) 0 ft

Horizontal Distance from Top of Bank to Toe ($D_{Top2Toe}$) 8 ft

Existing Bank Slope, Horizontal:Vertical (SS) 8/9 ~ 1 $D_{Top2Toe}$ / Y:1

Erosion Damage Length along Creek Flowpath (L_e) 100 ft

Bank Composition
(alluvial = AL, rock = R, composite = COMP) AL

Channel Type
(alluvial = AL, rock bed = RB, rock controlled = RC) AL

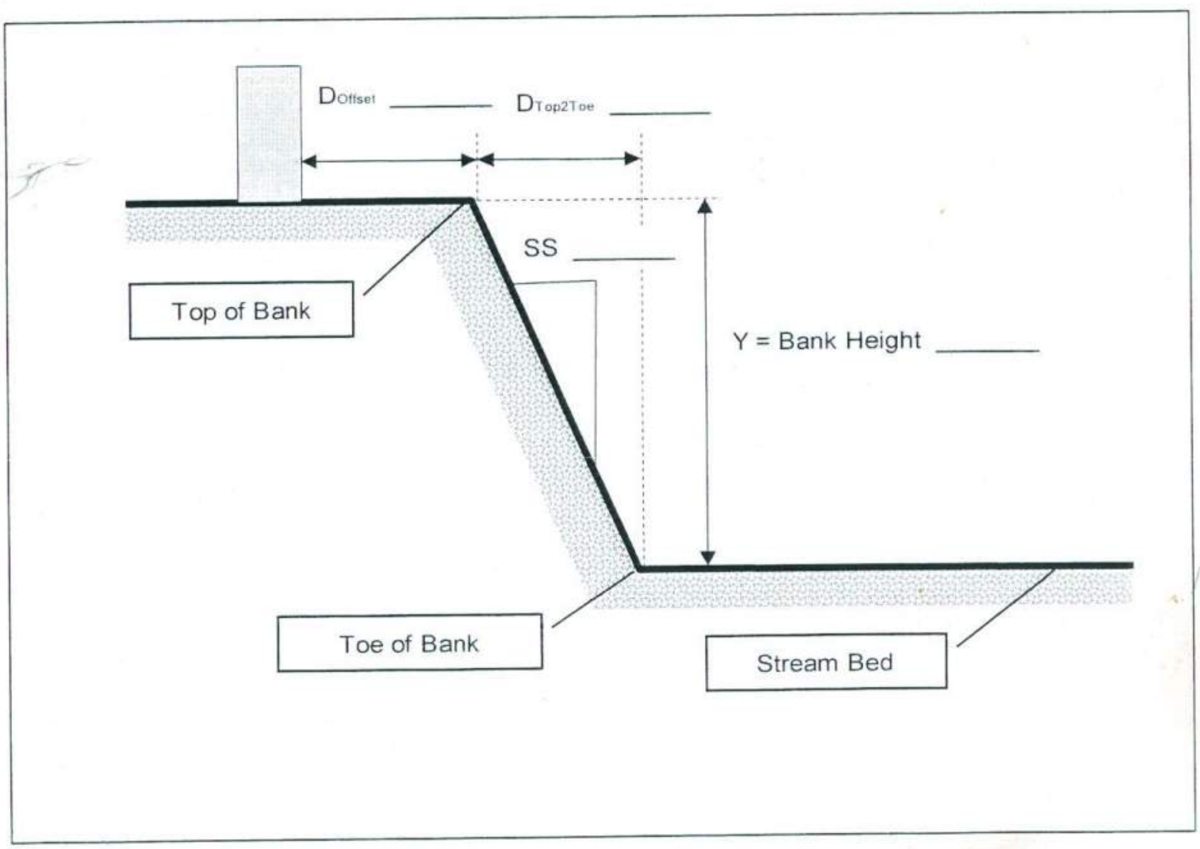
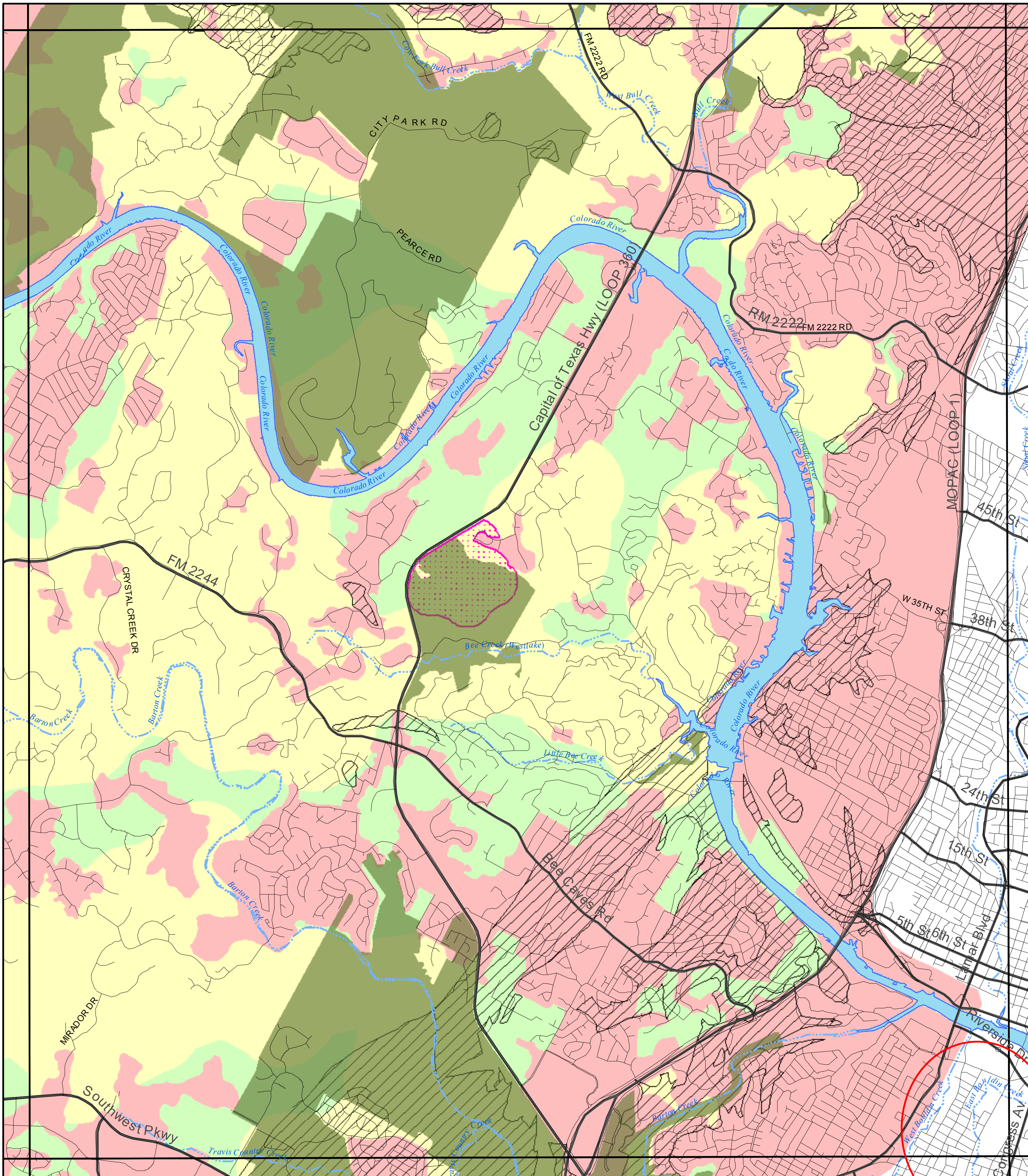


Exhibit D.4

Endangered Species Map



AUSTIN WEST, TEX - USGS 7.5' Quadrangle

Endangered Species Habitat and Potential Preserve System

This map is based on property data from the Travis Central Appraisal District and general biological data available prior to September 1996. The biological data is to be used solely to calculate costs for participation in the Balcones Canyonlands Conservation Plan (BCCP), and not to calculate "take" as determined by the U.S. Fish and Wildlife Service (USFWS). The potential preserve boundary, endangered species habitat, and karst data depicted on this map have been verified by teh USFWS. The delineation for karst does not identify cave locations. Eligibility for participation in the BCCP will be determined by the proximity to caves identified for protection by the BCCP. The map is subject to change based on available information and concurrence of the USFWS and the BCCP coordinating committee. Any such changes will go into effect on March 1st of the years specified by the USFWS. While every effort has been made to ensure the accuracy of the data, neither Travis County, the City of Austin, nor the USFWS are liable for any errors in the data. Errors brought to our attention will be researched and corrected.

Preserve and Refuge are not within the BCCP permit area. Please contact the US Fish and Wildlife Service for development information.

LEGEND

- Golden-cheeked Warbler - Zone 1 (Confirmed habitat)
- Golden-cheeked Warbler - Zone 2 (Unconfirmed habitat)
- Golden-cheeked Warbler - Zone 3 (Not known to be habitat)
- Black-capped Vireo Habitat
- BCP Preserve Area (proposed)
- Endangered Cave Species Habitat Karst Zones 1 & 2
- Balcones Canyonland Wildlife Refuge (proposed)

BALCONES CANYONLANDS PRESERVE
Austin • Texas

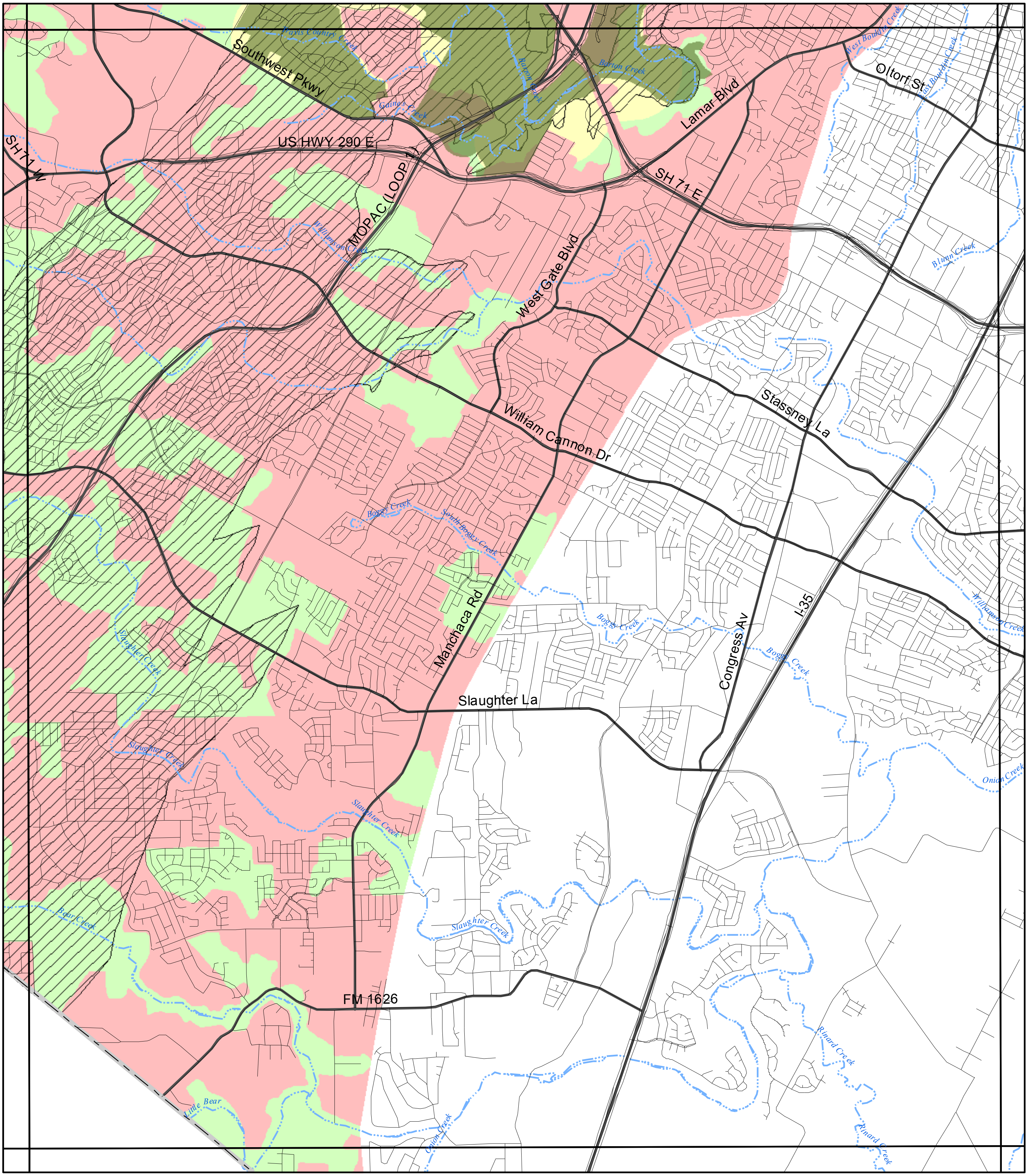
N

0 0.5 1 Miles

DATA SOURCES

Habitat: U.S. Fish and Wildlife Service
Preserve Area: City of Austin/Travis County
Hydrography: U.S. Geological Survey
Highways & Roads: City of Austin, Travis County TNR
Railroads: U.S. Census Bureau
County Boundary: Travis County - TNR

Copies of this map are available through the Travis County Natural Resources Program - (512) 854-9383



OAK HILL, TEX - USGS 7.5' Quadrangle

Endangered Species Habitat and Potential Preserve System

This map is based on property data from the Travis Central Appraisal District and general biological data available prior to September 1996. The biological data is to be used solely to calculate costs for participation in the Balcones Canyonlands Conservation Plan (BCCP), and not to calculate "take" as determined by the U.S. Fish and Wildlife Service (USFWS). The potential preserve boundary, endangered species habitat, and karst data depicted on this map have been verified by teh USFWS. The delineation for karst does not identify cave locations. Eligibility for participation in the BCCP will be determined by the proximity to caves identified for protection by the BCCP. The map is subject to change based on available information and concurrence of the USFWS and the BCCP coordinating committee. Any such changes will go into effect on March 1st of the years specified by the USFWS. While every effort has been made to ensure the accuracy of the data, neither Travis County, the City of Austin, nor the USFWS are liable for any errors in the data. Errors brought to our attention will be researched and corrected.

Preserve and Refuge are not within the BCCP permit area. Please contact the US Fish and Wildlife Service for development information.

LEGEND

- Golden-cheeked Warbler - Zone 1 (Confirmed habitat)
- Golden-cheeked Warbler - Zone 2 (Unconfirmed habitat)
- Golden-cheeked Warbler - Zone 3 (Not known to be habitat)
- Black-capped Vireo Habitat
- BCP Preserve Area (proposed)
- Endangered Cave Species Habitat Karst Zones 1 & 2
- Balcones Canyonland Wildlife Refuge (proposed)

BALCONES CANYONLANDS PRESERVE Austin • Texas

N

Miles
0 0.5 1

DATA SOURCES

Habitat: U.S. Fish and Wildlife Service
Preserve Area: City of Austin/Travis County
Hydrography: U.S. Geological Survey
Highways & Roads: City of Austin, Travis County TNR
Railroads: U.S. Census Bureau
County Boundary: Travis County - TNR

Copies of this map are available through the Travis County Natural Resources Program - (512) 854-9383

Exhibit D.5

Texas Commission on Environmental Quality –

Water Quality Reports

2012 Texas Integrated Report: Assessment Results for Basin 14 - Colorado River

Report Abbreviations	Description:
SEGID:	Unique Segment identification alpha-numeric code; can be stream, reservoir, estuary, oyster waters, beach watch, etc.
AUID:	Unique Assessment Unit code; this is a portion of the segment the AUID begins with and ends with _01, _02, etc. Some AUIDs are special units ending in "SA," or oyster water AUIDs are indicated by "OW" and beach watch AUIDs are indicated by abbreviations for name of beach in AUID.
ASMT Start Date:	The start date of the period of record data for this method was selected; the official 2012 period of record is from 12/1/2003 to 11/30/2010. Assessors have the option of going back 10 years (12/1/2000) to select more data, according to assessment guidance.
ASMT End Date	The end date of the period of record data for this method was selected; the official 2012 period of record dates are 12/1/2003 to 11/30/2010. Assessors have the option of including more recently collected data than 12/01/2010, if available.
# Assd:	Number of samples assessed; some data are averaged, as with profile data, some are eliminated because criteria do not apply during certain conditions such as low flow.
Mean Assd:	Mean of samples assessed; includes averaged methods like chronic criteria as well as geometric mean calculations for bacteria.
# Exceed:	The number of samples that exceed criteria for single sample, or binomial, methods (not averaged data).
Mean Exceed:	This is the mean of the samples that exceeded criteria for the single sample, or binomial, methods (not averaged data).
Criteria:	Value that the data is compared against to determine level of support; Note: for acute metals in water, each value is compared to a calculated criteria and not all criteria could be reported here, only the minimum in the range of criteria calculated are included.
DS Qual:	*Dataset Qualifier - indicates sample sizes:* **AD** = Adequate Data (10 or more samples) **LD** = Limited Data (less than 9, greater than 3) **ID** = Inadequate Data (less than 4) **JQ** = Level of support is based on judgment of the assessor **SM** = This assessment method is superseded by another method **TR** = Temporally Not Representative, used with NA **SR** = Spatially Not Representative, used with NA **OE** = Other information than ambient samples evaluated, generally information is provided by outside entity
LOS:	*Level of support for this use, method, assessment parameter:* **FS** = Fully Supporting **NC** = No Concern **NA** = Not Assessed **NS** = Nonsupport **CS** = Screening Level Concern **CN** = Use Concern
CF:	Carry forward indicator check box: indicates that the Integrated level of support of CS, CN, or NS was carried forward from a previous assessment due to inadequate data for this method in this assessment.
Int LOS:	Integrated level of support. This is the overall level of support for this use, method, parameter group, which could be different from the LOS (described above) due to carry forward information or other types of changes. New Code added in 2010: PI = Pending Issue
TCEQ Cause	This is the impairment description (e.g., bacteria, depressed dissolved oxygen, etc.)
Cat:	*This is the assessment category assigned to this impairment. Subcategories as follows:* **Category 4**: Standard is not supported or is threatened for one or more designated uses but does not require the development of a TMDL. **4a** - TMDL has been completed and approved by EPA.Category. **4b** - Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future. **4c** - Nonsupport of the water quality standard is not caused by a pollutant. **Category 5**: The water body does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants. **5a** - A TMDL is underway, scheduled, or will be scheduled. **5b** - A review of the water quality standards for this water body will be conducted before a TMDL is scheduled. **5c** - Additional data and information will be collected before a TMDL is scheduled.

SEGID 1429D East Bouldin Creek (unclassified water body)

AUID **1429D_01** Entire water body

USE **Aquatic Life Use**

Method	Parameter	ASMT Start Date	ASMT End Date	# Assd	Mean assd	# exceed	Mean exceed	Criteria	DS Qual	LOS	CF	Int LOS	TCEQ Cause	Cat
Toxic Substances in sediment	Fluorene	12/1/2003	11/30/2010	1		0		536.00	ID	NA	☐	NA		
Toxic Substances in sediment	Lead	12/1/2003	11/30/2010	1		0		128.00	ID	NA	☑	CS	lead in sediment	
Toxic Substances in sediment	Mercury	12/1/2003	11/30/2010	1		0		1.06	ID	NA	☐	NA		
Toxic Substances in sediment	Naphthalene	12/1/2003	11/30/2010	1		0		561.00	ID	NA	☐	NA		
Toxic Substances in sediment	Nickel	12/1/2003	11/30/2010	1		0		48.60	ID	NA	☐	NA		
Toxic Substances in sediment	Phenanthrene	12/1/2003	11/30/2010	1		1	1800	1,170.00	ID	NA	☑	CS	phenanthrene in sediment	
Toxic Substances in sediment	Pyrene	12/1/2003	11/30/2010	1		1	5330	1,520.00	ID	NA	☑	CS	pyrene in sediment	
Toxic Substances in sediment	Fluoranthene	12/1/2003	11/30/2010	1		1	5420	2,230.00	ID	NA	☑	CS	fluoranthene in sediment	
Toxic Substances in sediment	Benz(a)anthracene	12/1/2003	11/30/2010						ID	NA	☑	CS	benz(a)antracene in sediment	
Toxic Substances in sediment	Silver	12/1/2003	11/30/2010	1		0		2.20	ID	NA	☐	NA		
Toxic Substances in sediment	alpha-BHC	12/1/2003	11/30/2010	1		0		100.00	ID	NA	☐	NA		
Toxic Substances in sediment	beta-BHC	12/1/2003	11/30/2010	1		0		210.00	ID	NA	☐	NA		
Toxic Substances in sediment	Toxaphene	12/1/2003	11/30/2010	1		0		32.00	ID	NA	☐	NA		
Toxic Substances in sediment	Zinc	12/1/2003	11/30/2010	1		0		459.00	ID	NA	☐	NA		
Toxic Substances in sediment	Acenaphthene	12/1/2003	11/30/2010	1		0		89.00	ID	NA	☐	NA		
Toxic Substances in sediment	Dieldrin	12/1/2003	11/30/2010	1		0		61.80	ID	NA	☐	NA		
Toxic Substances in sediment	Dibenz(a,h)anthracene	12/1/2003	11/30/2010	1		0		140.00	ID	NA	☑	CS	dibenz(a,h)anthracene in sediment	
Toxic Substances in sediment	Copper	12/1/2003	11/30/2010	1		0		149.00	ID	NA	☐	NA		
Toxic Substances in sediment	Chrysene	12/1/2003	11/30/2010	1		1	3770	1,290.00	ID	NA	☑	CS	chrysene in sediment	

AUID **1429D_01** Entire water body

USE **Aquatic Life Use**

Method	Parameter	ASMT Start Date	ASMT End Date	# Assd	Mean assd	# exceed	Mean exceed	Criteria	DS Qual	LOS	CF	Int LOS	TCEQ Cause	Cat
Toxic Substances in sediment	Chromium	12/1/2003	11/30/2010	1		0		111.00	ID	NA	☐	NA		
Toxic Substances in sediment	Chlordane	12/1/2003	11/30/2010	1		1	88	17.60	ID	NA	☐	NA		
Toxic Substances in sediment	Cadmium	12/1/2003	11/30/2010	1		0		4.98	ID	NA	☑	CS	cadmium in sediment	
Toxic Substances in sediment	Benzo(a)pyrene	12/1/2003	11/30/2010	1		1	3240	1,450.00	ID	NA	☐	NA		
Toxic Substances in sediment	Arsenic	12/1/2003	11/30/2010	1		0		33.00	ID	NA	☐	NA		
Toxic Substances in sediment	Anthracene	12/1/2003	11/30/2010	1		0		845.00	ID	NA	☐	NA		
Toxic Substances in sediment	Aldrin	12/1/2003	11/30/2010	1		0		80.00	ID	NA	☐	NA		
Toxic Substances in sediment	Acenaphthylene	12/1/2003	11/30/2010	1		0		130.00	ID	NA	☐	NA		
Toxic Substances in sediment	Benz(a)anthracene	12/1/2003	11/30/2010						ID	NA	☑	NA		
Toxic Substances in sediment	Endrin	12/1/2003	11/30/2010	1		0		207.00	ID	NA	☐	NA		

Exhibit D.6

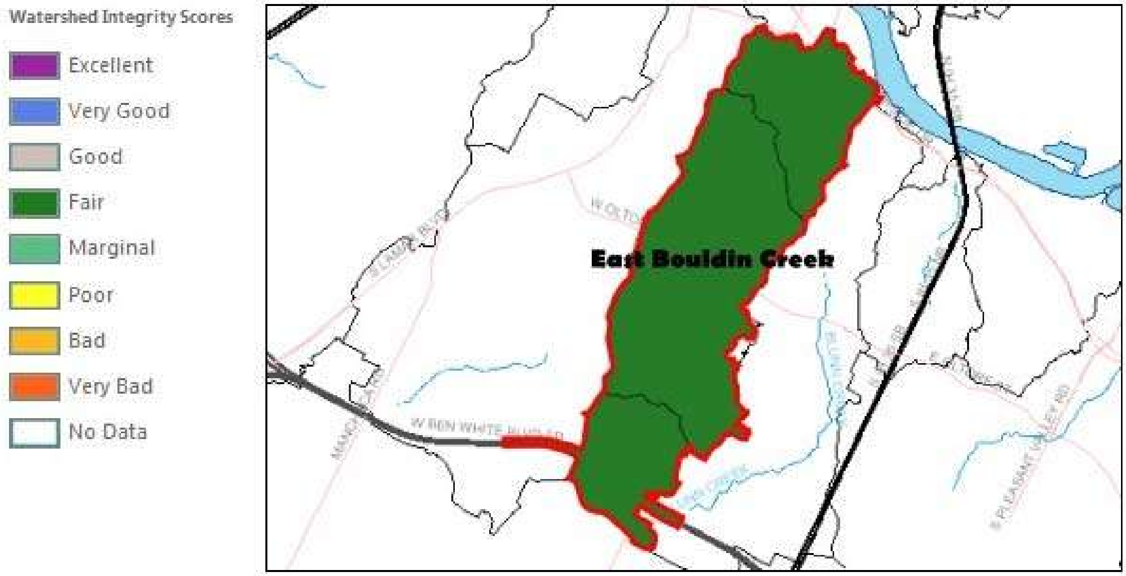
Map of Critical Water Quality Zone


N
Legend
100-year Floodplain
Critical Water Quality Zone
EAST ELIZABETH ST
ROMA ST
MILTON
WEST MILTON ST
WEST ANNIE
WEST ANNIE STREET
E MILTON ST
WEST MARY STREET
NEWTON STREET
EVA STREET
WEST JOHANNA STREET
WILSON STREET
CROCKETT STREET
WEST LIVE OAK ST
FULMORE
JR. HIGH

Exhibit D.7

Environmental Integrity Index Report

East Bouldin Creek



Watershed Scores

Index	Score	Category	Details
Overall Score	58	Fair	East Bouldin Creek ranks better than 8 other watersheds in Austin
Water Chemistry	59	fair	Water quality is average, conductivity is high
Sediment Quality	62	fair	PAHs are high, herbicides/pesticides are low, metals are low
Recreation	41	marginal	Bacteria levels may be a threat
Aesthetics	69	good	Lots of litter present, odor is not a problem, most of the creek bed is dry
Habitat	60	fair	Some sediment deposition, cover is insufficient, some channel alteration, bank stability is marginal, buffer is small
Aquatic Life	55	fair	The benthic macroinvertebrate community is marginal, the diatom community is good

*The above table represents a summary of data collected as part of the Environmental Integrity Index (EII)

Click here for the EII source data

Watershed Facts

- Portions of East Bouldin Creek are listed on the State Water Quality Inventory as being of concern for contaminants in sediment.
- Staff research indicates that a source of high PAH levels may be from coal-based parking lot sealants.
- High nutrient and bacteria concentrations may soon improve due to Austin Clean Water Program's recently finished rehabilitation of some wastewater infrastructure.
- Biological integrity is consistently poor due, in part, to the stream degradation caused by high levels of impervious cover which creates flashy streamflow during rain events which scour the streambed.
- Future development may hold promise for improved conditions as progressive water quality controls are implemented in locations which currently have none.

Exhibit D.8

Map of Historical Landmarks


N
Legend
Historical Landmarks
Wells House
1705 Newton Street
Stanley Homestead Outbuilding
1809 Newton Street
Stanley Homestead Stone House
1811 Newton Street
WEST MILTON ST
WEST ANNIE STREET
WEST MARY STREET
WEST JOHANNA STREET
NEWTON STREET
EVA STREET
WILSON STREET
CROCKETT STREET
E MILTON ST
WEST LIVE OAK ST
FULMORE
JR. HIGH

Appendix E –
Planned Projects

Exhibit E.1	**City of Austin Infrastructure, Management, Mapping, Planning and Coordination Tool (IMMPACT) Database Reports**
Exhibit E.2	**Roadway Maintenance Communication**
Exhibit E.3	**Austin Water Utility Planned Projects**

Exhibit E.1

City of Austin Infrastructure, Management, Mapping, Planning and Coordination Tool (IMMPACT) Database Reports

IMMPACT - *Infrastructure Management, Mapping, Planning & Coordination Tool*

Getting Around | Find and Identify Data | Save, Share & Print Data | Drawing and Measurement | Help

Search Immpact | Time Slider | Find an Address | Point | Query | Filter

Find Activities | Open/Close | Identify & Find Data

PWD-1600 & 1811 Eva St.-UER (C...

Case Number
2020-189920 EX

Name
PWD-1600 & 1811 Eva St.-UER (Contract)

Activity Type
Excavation Permit

Description
PWD/SBO â¿¿ Blanket Utility Cut Repairs â¿¿ 7306 Camp Cove, Make repairs to a Utility Cut UER All work under this application is covered under the signed ***UTILITY CUT REPAIR AGREEMENT BETWEEN ATD AND PWD***

Status
Active

Manager Name
N/A

Manager Phone
N/A

Manager Email
N/A

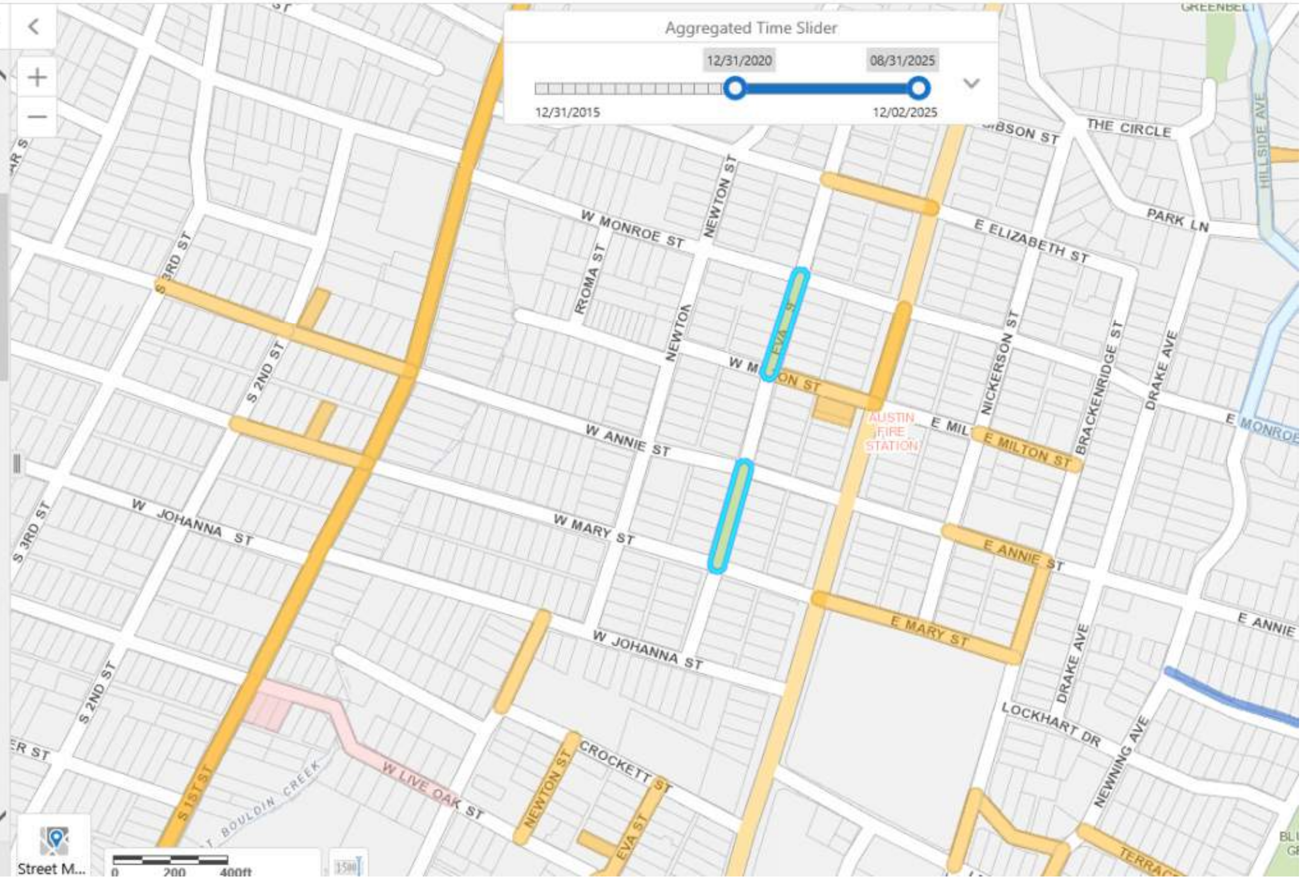
Sponsor Name
N/A

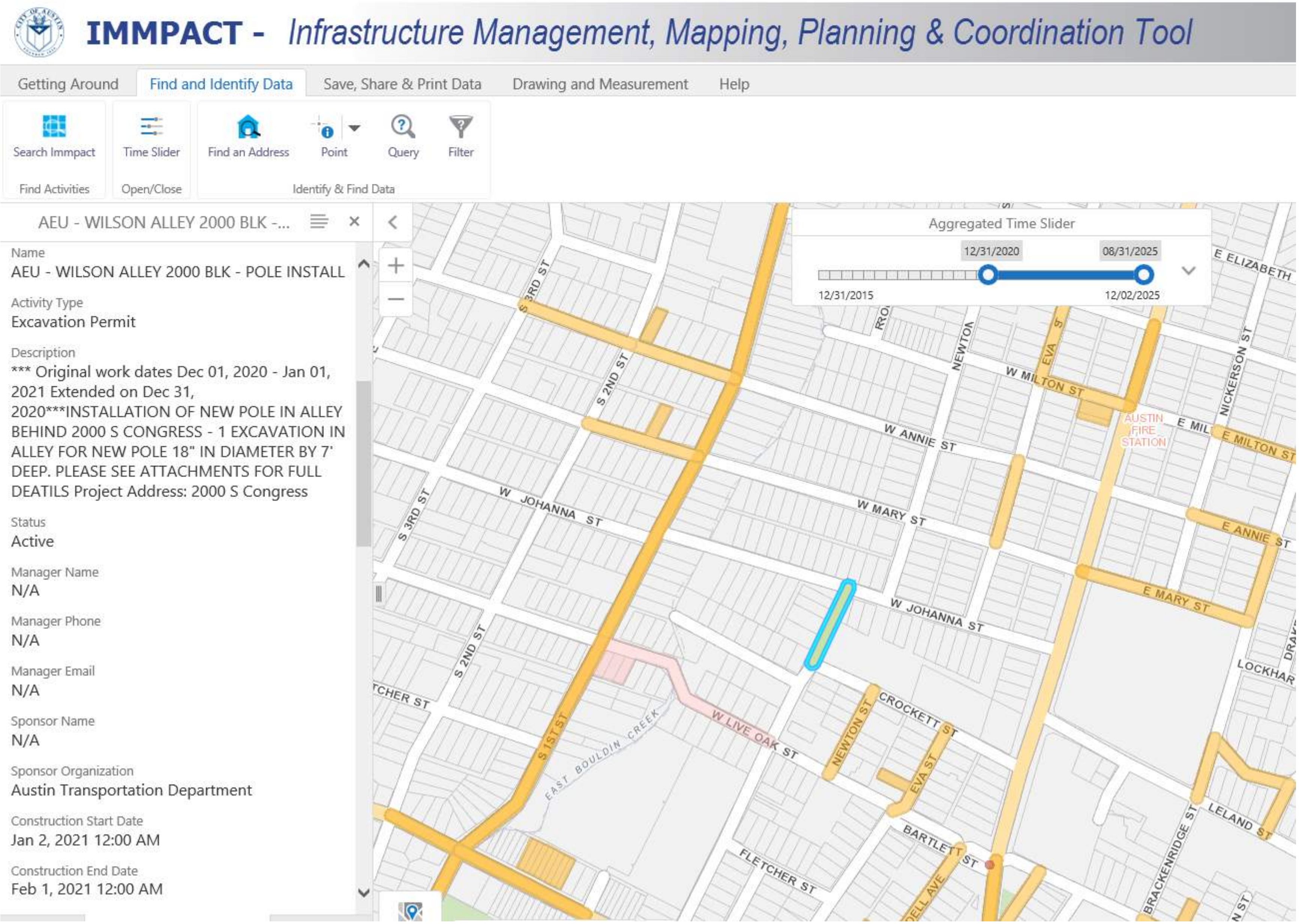
Sponsor Organization
Austin Transportation Department

Construction Start Date
Dec 17, 2020 12:00 AM

Construction End Date
Feb 17, 2021 12:00 AM

Layers | PWD-1600 & 1811 Eva St...




IMMPACT - Infrastructure Management, Mapping, Planning & Coordination Tool
Getting Around
Find and Identify Data
Save, Share & Print Data
Drawing and Measurement
Help
Search Immpact
Find Activities
Time Slider
Open/Close
Find an Address
Point
Query
Filter
Identify & Find Data
AEU - WILSON ALLEY 2000 BLK -...
Name
AEU - WILSON ALLEY 2000 BLK - POLE INSTALL
Activity Type
Excavation Permit
Description
*** Original work dates Dec 01, 2020 - Jan 01, 2021 Extended on Dec 31, 2020***INSTALLATION OF NEW POLE IN ALLEY BEHIND 2000 S CONGRESS - 1 EXCAVATION IN ALLEY FOR NEW POLE 18" IN DIAMETER BY 7' DEEP. PLEASE SEE ATTACHMENTS FOR FULL DEATILS Project Address: 2000 S Congress
Status
Active
Manager Name
N/A
Manager Phone
N/A
Manager Email
N/A
Sponsor Name
N/A
Sponsor Organization
Austin Transportation Department
Construction Start Date
Jan 2, 2021 12:00 AM
Construction End Date
Feb 1, 2021 12:00 AM
Aggregated Time Slider
12/31/2020
08/31/2025
12/31/2015
12/02/2025
W MILTON ST
W ANNIE ST
W MARY ST
W JOHANNA ST
W LIVE OAK ST
CROCKETT ST
BARTLETT ST
FLETCHER ST
E ELIZABETH
E MILTON ST
E ANNIE ST
E MARY ST
AUSTIN FIRE STATION
LOCKHART
LELAND ST
S 1ST ST
S 2ND ST
S 3RD ST
NEWTON ST
EVA ST
NICKERSON ST
BRACKENRIDGE ST
EAST BOULDIN CREEK

IMMPACT - *Infrastructure Management, Mapping, Planning & Coordination Tool*

Getting Around | Find and Identify Data | Save, Share & Print Data | Drawing and Measurement | Help

Search Immpact — Find Activities | Time Slider — Open/Close | Find an Address, Point, Query, Filter — Identify & Find Data

AEU/PIKE - NEWTON ST 2100 ALL...

Case Number
2020-188970 EX

Name
AEU/PIKE - NEWTON ST 2100 ALLEY - POLE RELOCATE

Activity Type
Excavation Permit

Description
Austin Energy is to replace an overhead span of secondary wire running in the alleyway between Eva St. and Newton St. A pole will be removed at 2102 Newton St. Alley and relocated to the property line of 2100/2102 Newton St. Alley in the alleyway. (2) 2x2 ft. cuts will be made for the pole. 12 x 40 ft. of the alley ROW will be needed for the work zone. WR #198011

Status
Active

Manager Name
N/A

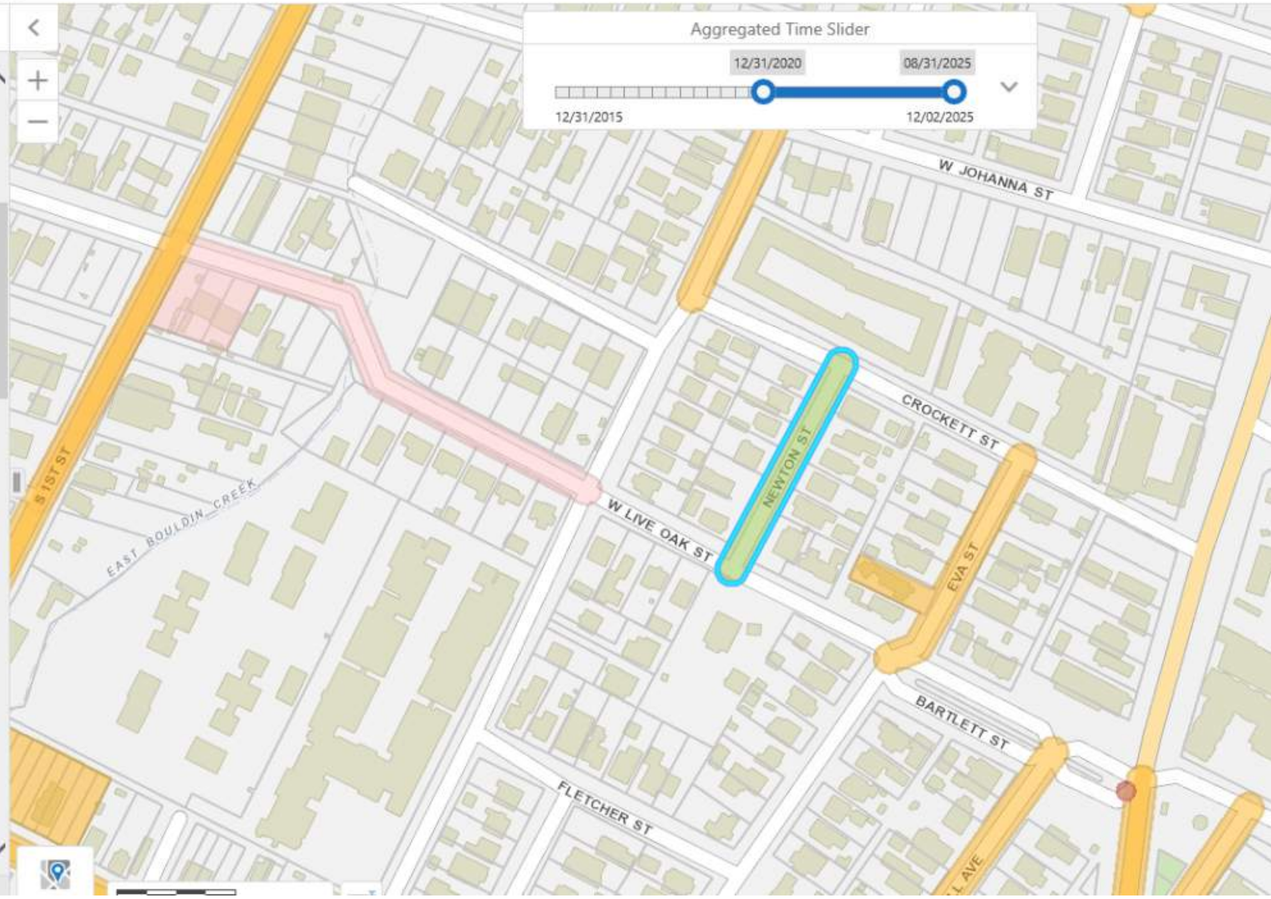
Manager Phone
N/A

Manager Email
N/A

Sponsor Name
N/A

Sponsor Organization
Austin Transportation Department

Construction Start Date



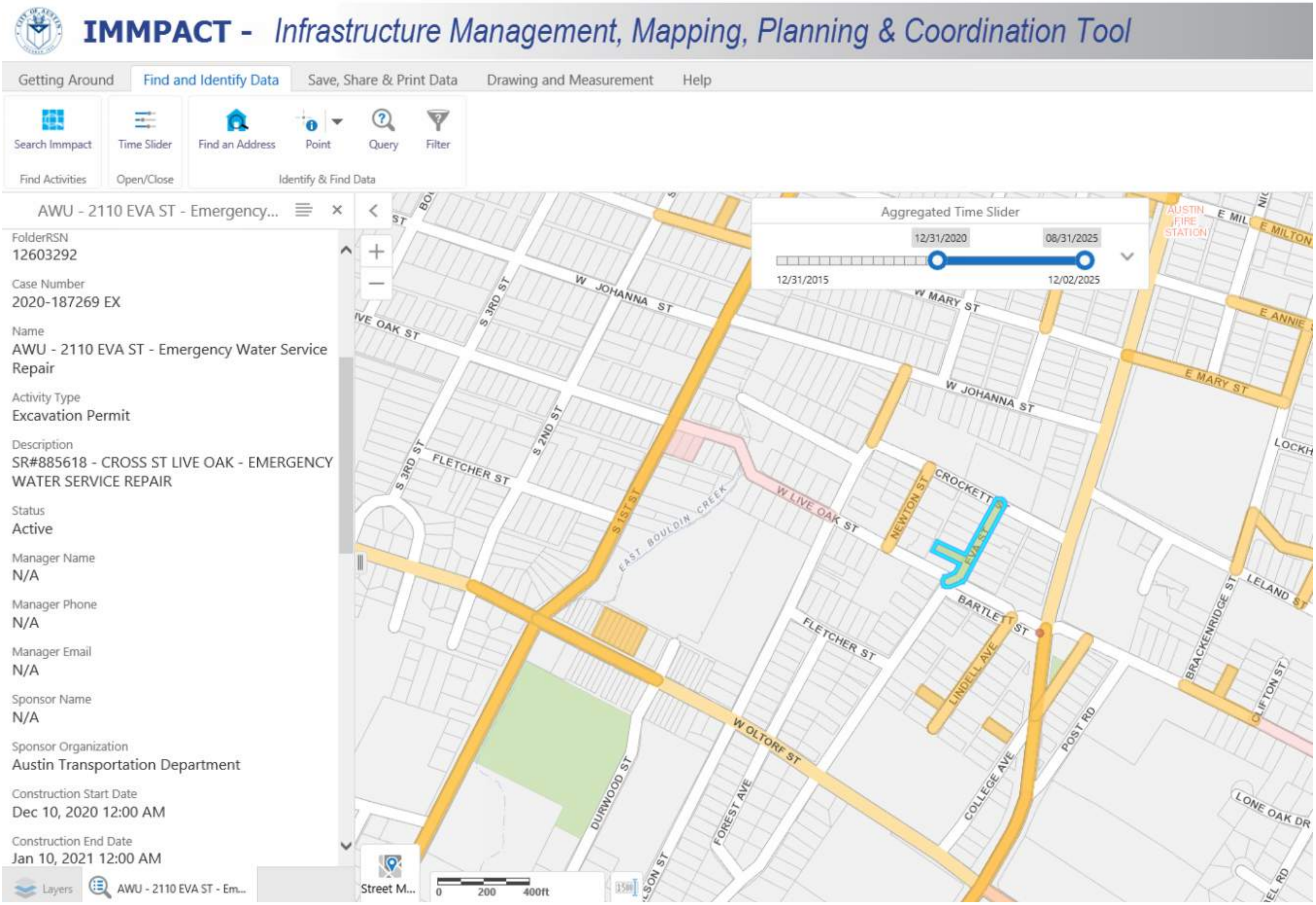

IMMPACT - Infrastructure Management, Mapping, Planning & Coordination Tool
Getting Around
Find and Identify Data
Save, Share & Print Data
Drawing and Measurement
Help
Search Immpact
Find Activities
Time Slider
Open/Close
Find an Address
Point
Query
Filter
Identify & Find Data
AWU - 2110 EVA ST - Emergency...
FolderRSN
12603292
Case Number
2020-187269 EX
Name
AWU - 2110 EVA ST - Emergency Water Service Repair
Activity Type
Excavation Permit
Description
SR#885618 - CROSS ST LIVE OAK - EMERGENCY WATER SERVICE REPAIR
Status
Active
Manager Name
N/A
Manager Phone
N/A
Manager Email
N/A
Sponsor Name
N/A
Sponsor Organization
Austin Transportation Department
Construction Start Date
Dec 10, 2020 12:00 AM
Construction End Date
Jan 10, 2021 12:00 AM
Layers
AWU - 2110 EVA ST - Em...
Aggregated Time Slider
12/31/2020
08/31/2025
12/31/2015
12/02/2025
Street M...
0
200
400ft
W JOHANNA ST
W MARY ST
E MARY ST
E ANNIE
E MILTON
AUSTIN FIRE STATION
FLETCHER ST
CROCKETT
W LIVE OAK ST
NEWTON ST
EVA ST
BARTLETT ST
LINDELL AVE
W OLTORF ST
S 1ST ST
S 2ND ST
S 3RD ST
EAST BOULDIN CREEK
DURWOOD ST
FOREST AVE
COLLEGE AVE
POST RD
BRACKENRIDGE ST
CLIFTON ST
LELAND ST
LONE OAK DR

Exhibit E.2

Roadway Maintenance Communication

Dube, Kiersten

From: Sharma, Binaya
Sent: Monday, June 22, 2015 8:03 AM
To: Boswell, David
Cc: Prabhakar, Veena
Subject: RE: future rehab/overlay work...

David,

For 2016 we have one project planned in the area (listed below); with ten years maintenance cycle, some of streets in the area must have been (or will be) selected for some short of surface treatments as preventive maintenance plan/strategy, but with this information we will stay out of the area; occasionally as the project design move along, they add/drop some streets and we will adjust our yearly service plan accordingly.

Also, any overlay project that are cleared from AWU are routed through AULCC for other reviewers prior to scheduling. For FY 2016 overlay project we will route them through AULCC sometime in September as AWU is reviewing our candidate streets/projects for FY 2016.

FY 2016 Projects in the are:

ID# 40843	Eva ST	Milton ST W to Johanna St W	Mill and Overlay

We will hold this FY 2016 overlay project (most likely AWU will also place a hold on this as they may have joint project with WPD in the area).

With this information we will defer other candidate project in the area that are being considered for future years until WPD finalize their project scope and schedule.

Thanks,
Binaya

From: Boswell, David
Sent: Friday, June 19, 2015 10:27 AM
To: Sharma, Binaya
Subject: future rehab/overlay work...

Hi Binaya,

The below project came through AULCC this week – it is a Preliminary Engineering study of storm drains – see street addresses below (add attached map).

Do you know if any of these streets is proposed for rehab or overlay within the next few years?

Thanks!

David

3 WPD-East Bouldin Creek Storm Drain Improvements

This project is a preliminary study of the existing storm drain system(s) and associated local floo
Crockett Streets between South Congress Avenue and East Bouldin Creek. Improvements to the
as part of this study. These improvements will include upgrades and additions to the existing sto
as the possibility of adding rain gardens and/or storm water detention. We previously received s
clearance distances, etc. from utilities. As part of this current request, please include any propos
to have installed in conjunction with this project. Also, information on any future projects that a

Address Range	Street	Cross Street 1	Cross Street 2
	Annie St	S 1st St	S Congress Ave
	Mary St	S 1st St	S Congress Ave
	Johanna St	S 1st Street	S Congress Ave
	Crockett St	S 1st St	S Congress Ave
	E Bouldin Creek	Annie St	Live Oak St
	Newton St	Annie St	Live Oak St
	Eva St	Annie St	Live Oak St
	S Congress Ave	Annie St	Live Oak St

David L. Boswell, P.E.
Office of the City Engineer | Street & Bridge Operations
Department of Public Works | City of Austin
105 West Riverside Drive, Suite 100 | (512) 974-7071

Exhibit E.3

Austin Water Utility Planned Projects

Water and Wastewater Needs - 5789.106 - Bouldin Neighborhood Annie Street
Internal Review Map

DRAFT

Approved By:	
RAP	
KK	
BB	

REVISION NUMBER	DATE	DESCRIPTION
1	20.12.28	Initial Scope
2	yr.mo.da	Editted Scope
3	yr.mo.da	Edited Scope
4	yr.mo.da	Final Scope

N

0 200 400 800
Feet

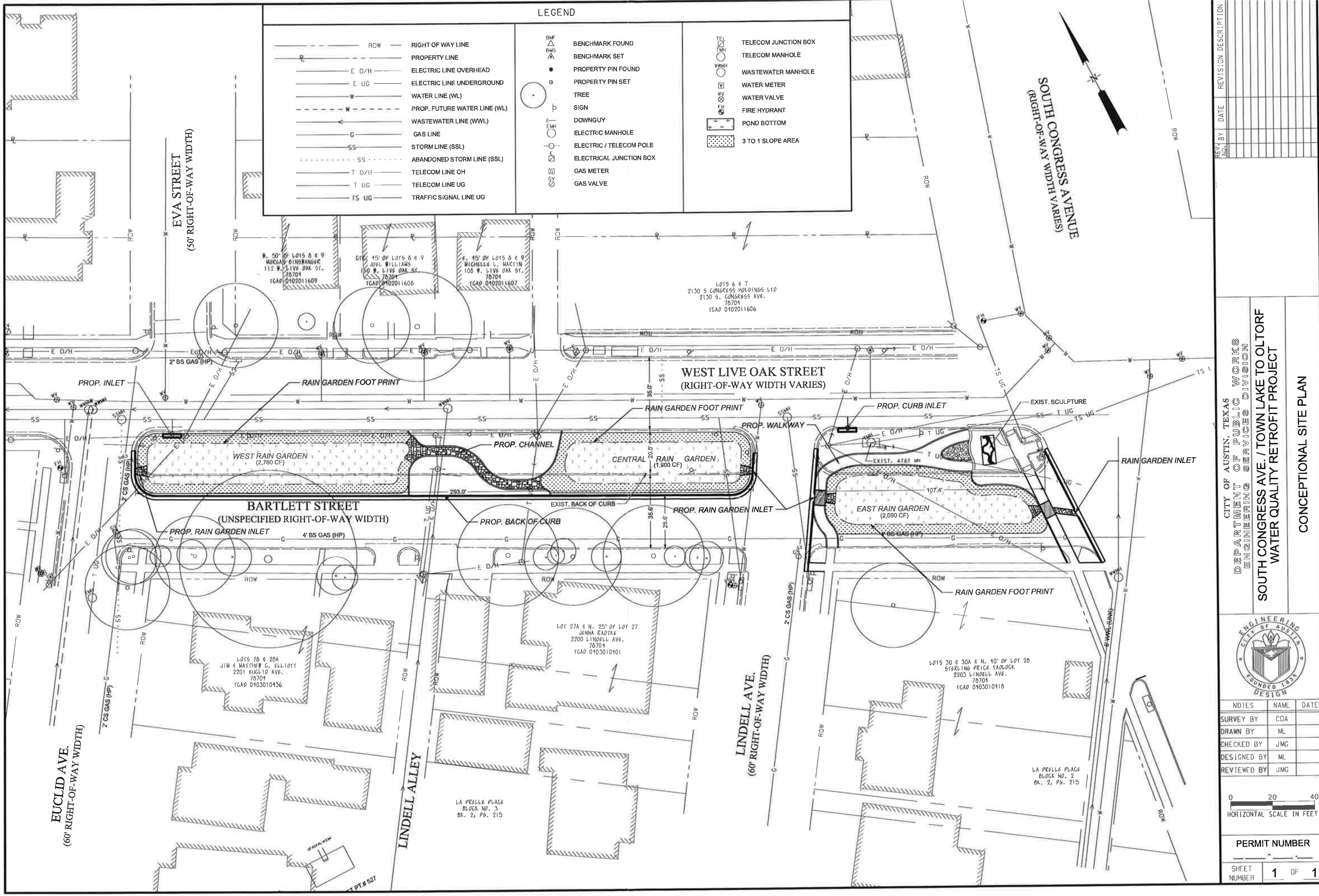
Legend:

- Water Needs (5,893 LF)
- Wastewater Needs (4,315 LF)

Appendix F – Rain Gardens and Detention Opportunities

Exhibit F.1

Live Oak and Bartlett Rain Garden


LEGEND
ROW RIGHT OF WAY LINE
PROPERTY LINE
E O/H ELECTRIC LINE OVERHEAD
E UG ELECTRIC LINE UNDERGROUND
W WATER LINE (WL)
W PROP. FUTURE WATER LINE (WL)
WASTEWATER LINE (WWL)
G GAS LINE
SS STORM LINE (SSL)
SS ABANDONED STORM LINE (SSL)
T O/H TELECOM LINE OH
T UG TELECOM LINE UG
TS UG TRAFFIC SIGNAL LINE UG
BMF BENCHMARK FOUND
BMS BENCHMARK SET
PROPERTY PIN FOUND
PROPERTY PIN SET
TREE
SIGN
DOWNGUY
EMH ELECTRIC MANHOLE
ELECTRIC / TELECOM POLE
ELECTRICAL JUNCTION BOX
GAS METER
GV GAS VALVE
TEL TELECOM JUNCTION BOX
TMH TELECOM MANHOLE
WWMH WASTEWATER MANHOLE
WATER METER
WV WATER VALVE
FH FIRE HYDRANT
POND BOTTOM
3 TO 1 SLOPE AREA
SOUTH CONGRESS AVENUE
(RIGHT-OF-WAY WIDTH VARIES)
EVA STREET
(50' RIGHT-OF-WAY WIDTH)
WEST LIVE OAK STREET
(RIGHT-OF-WAY WIDTH VARIES)
BARTLETT STREET
(UNSPECIFIED RIGHT-OF-WAY WIDTH)
EUCLID AVE.
(60' RIGHT-OF-WAY WIDTH)
LINDELL ALLEY
LINDELL AVE.
(60' RIGHT-OF-WAY WIDTH)
PROP. INLET
RAIN GARDEN FOOT PRINT
WEST RAIN GARDEN
(2,760 CF)
PROP. CHANNEL
CENTRAL RAIN GARDEN
(1,900 CF)
PROP. CURB INLET
PROP. WALKWAY
EXIST. SCULPTURE
RAIN GARDEN INLET
EAST RAIN GARDEN
(2,090 CF)
EXIST. AT&T MH
EXIST. BACK OF CURB
PROP. RAIN GARDEN INLET
PROP. BACK OF CURB
293.0'
107.4'
35.0'
20.5'
35.6'
25.6'
2" BS GAS (HP)
4' BS GAS (HP)
2' CS GAS (HP)
LOTS 6 & 7
2130 S CONGRESS HOLDINGS LTD
2130 S. CONGRESS AVE.
78704
TCAD 0102011606
LOTS 28 & 28A
JIM & MATTHEW G. ELLIOTT
2201 EUCLID AVE.
78704
TCAD 0103010436
LOT 27A & N. 25' OF LOT 27
JENNA RADTKE
2200 LINDELL AVE.
78704
TCAD 0103010401
LOTS 30 & 30A & N. 40' OF LOT 28
STERLING PRICE TADLOCK
2203 LINDELL AVE.
78704
TCAD 0103010418
LA PRELLE PLACE
BLOCK NO. 3
BK. 2, PG. 215
LA PRELLE PLACE
BLOCK NO. 2
BK. 2, PG. 215
CITY OF AUSTIN, TEXAS
DEPARTMENT OF PUBLIC WORKS
ENGINEERING SERVICES DIVISION
SOUTH CONGRESS AVE. / TOWN LAKE TO OLTORF
WATER QUALITY RETROFIT PROJECT
CONCEPTIONAL SITE PLAN
REV. NO. BY DATE REVISION DESCRIPTION
NOTES NAME DATE
SURVEY BY COA
DRAWN BY ML
CHECKED BY JMG
DESIGNED BY ML
REVIEWED BY JMG
0 20 40
HORIZONTAL SCALE IN FEET
PERMIT NUMBER
SHEET NUMBER 1 OF 1
05-AUG-2011

South Congress Ave. / Town lake to Oltorf Water Quality Retrofit Project
East RG
Project CIP ID Number : 6055.007

Engineer's Opinion of Probable Construction Cost Estimate

Bid Item	Quantity	Unit	Item Description	Unit Price	Amount	Estimated Unit Price	Estimated Amount
110S-A1:	140	CY.	Street Excavation, including offsite disposal	$________	$________	$7.50	$1,050.00
111S-A:	350	CY.	Excavation, including offsite disposal.	$________	$________	$50.00	$17,500.00
130S-A:	100	CY.	City of Austin approved Bio-Filtration Media, certified per 2/24/2011 Guidance, complete and in place	$________	$________	$100.00	$10,000.00
206S-B:	22	SY	Flexible Stabilized Base, 8 In.	$________	$________	$50.00	$1,100.00
340AH:	20	SY	Concrete Pavement, 7 In.,(High Early Strength)	$________	$________	$65.00	$1,300.00
340S-B:	10	SY	Hot Mix Asphaltic Concrete Pavement, 3 in., Type D	$________	$________	$54.00	$540.00
430S-A:	150	LF	Concrete Curb and Gutter (Curb and gutter work including excavation and subgrade preparation.) Including Curb & Gutter Rain Garden Inlets	$________	$________	$50.00	$7,500.00
432S-4	740	SF	New P.C. Concrete Sidewalk (5' Width), 4 Inch thickness, Including 6" Ribbon Curb	$________	$________	$15.00	$11,100.00
432SR-4	100	SF	Remove and replace existing sidewalk, w/ 5' Sidewalk, complete-in-place	$________	$________	$10.00	$1,000.00
506M4-SW	1	EA	Standard Pre-Cast Manhole, 48" Dia. w/CIP Base (0"-8" Deep) Stormwater	$________	$________	$2,000.00	$2,000.00
508S-A	40	LF	Trench Drain, including frame and grate, complete and in-place	$________	$________	$50.00	$2,000.00

Bid Item	Quantity	Unit	Item Description	Unit Price	Amount	Estimated Unit Price	Estimated Amount
508S-I10S-F	1	EA	Inlet, Standard (10 Foot), complete and in-place	$________	$________	$3,500.00	$3,500.00
509S-1	50	LF	Trench Excavation Safety Protection	$________	$________	$2.00	$100.00
501-A18-SD	10	LF	Pipe 18" Dia RCP Type (All Depths), Including Excavation and Backfill - Complete	$________	$________	$35.00	$350.00
551-A1:	30	LF	Solid PVC Pipe, 6" Dia.(all depths), including: 5" (Inch) filter material envelope (1 part mulch to 9 parts crushed limestone w/ filter fabric), fittings, length of wyes and cleanouts, connection to proposed inlet - Complete and In Place	$________	$________	$50.00	$1,500.00
551-A2:	180	LF	Perforated PVC Pipe, 6" Dia.(all depths), including: 5" (Inch) filter material envelope (1 part mulch to 9 parts crushed limestone w/ filter fabric), fittings, length of wyes and cleanouts, connection to proposed inlet - Complete and In Place	$________	$________	$50.00	$9,000.00
591S-B1:	6	CY	1-inch Dia. Gravel Mulch 1-inch thickness, rounded gravel	$________	$________	$150.00	$900.00
591S-B2:	5	SY	Dry Riprap, Rounded River Rock (Colorado Rainbow) 2" - 6" diameter	$________	$________	$150.00	$750.00
591S-D:	10	SY	Mortared Rock Riprap, 3" thick flat limestone rock	$________	$________	$50.00	$500.00
608S-1	8	EA	Planting Type "Plugs" native species, per plans, planting tables and details.	$________	$________	$25.00	$200.00
608S-1A	475	EA	Planting Type 4" container native species, per plans, planting tables and details.	$________	$________	$5.00	$2,375.00

Bid Item	Quantity	Unit	Item Description	Unit Price	Amount	Estimated Unit Price	Estimated Amount
608S-1B	775	EA	Planting Type 1-gallon native species, per plans, planting tables and details.	$________	$________	$11.00	$8,525.00
608S-1C	30	EA	Planting Type 5-gallon native species, per plans, planting tables and details.	$________	$________	$20.00	$600.00
608S-1D	5	EA	Planting Type 15 gallon plants, per plans, planting tables and details	$________	$________	$200.00	$1,000.00
608S-2P	1	LS	Permanent Irrigation System, full design submittals for new system by registered landscape architect, and installation of new system, complete and in place.	$________	$________	$4,000.00	$4,000.00
609S-G:	24	EA	Extended Landscape Management, two-year duration, per event	$________	$________	$ 300.00	$ 7,200.00
609S-S:	315	SY	Buffalo Grass (609 Variety) Sodding	$________	$________	$ 5.00	$ 1,575.00
610S-A:	150	LF	Protective Fencing Type A (Tree Protection) Chain Link fence (Typical Application-high damage potential)	$________	$________	$5.00	$750.00
610S-AP:	1	EA	Protective Fencing, Wooden Tree Planking Trunk Protection, per tree.	$________	$________	$100.00	$100.00
620S:	200	SY	Filter Fabric	$________	$________	$25.00	$5,000.00
628S-C:	30	LF	Filter Curb Inlet Protection (Existing Inlet)	$________	$________	$10.00	$300.00
648S:	275	LF	Mulch Sock for Erosion Control	$________	$________	$12.00	$3,300.00
700S-TM:	1	LS	Total Mobilization Payment	$________	$________	$8,969.20	$8,969.20
701-S:	150	LF	Fence (42" tall, 2" x 2" Wire panel Fence with Steel Posts)	$________	$________	$15.00	$2,250.00
802S-B:	1	EA	Project Sign	$________	$________	$500.00	$500.00

Bid Item	Quantity	Unit	Item Description	Unit Price	Amount	Estimated Unit Price	Estimated Amount
803S-MO:	3	MO	Barricades, Signs, and Traffic Handling	$________	$________	$500.00	$1,500.00
824S:	1	EA	Relocate Existing Traffic Signs	$________	$________	$250.00	$250.00
SP432S-PB4	2	EA	P.C. Concrete Bridge for 5 Foot Sidewalk Crossing Inlet Structure	$________	$________	$500.00	$1,000.00

Total	$120,034.20
15% Contingency	$18,005.13
Total w/Contingency	$138,039.33

Exhibit F.2

Lively School Middle School

(formerly Fulmore Middle School)

Rain Garden and Detention Analysis

MEMORANDUM

TO: Jennifer Massie-Gore, P.E.
Supervising Engineer
Public Works Department

FROM: Mike Singleton, E.I.T
Public Works Department

DATE: **June 16, 2015**

SUBJECT: **Annie Street Drainage Improvements- Proposed Fulmore Middle School Rain Gardens and Detention Ponds**

The purpose of this memorandum is to present the results of a preliminary analysis performed in conjunction with the ongoing Annie Street Drainage Analysis.(CIP ID 5789.106).

The site of Fulmore Middle School on South Congress is of interest to the Watershed Protection Department for the possible mitigation of flows and suspended solids entering the Bouldin Creek Watershed. This site is located upstream of the study drainage area which impacts Annie Street drainage. The use of rain gardens and detention ponds at this site was explored for feasibility of geometric positioning, the aesthetics of proposed locations, erosion mitigation, detention volumes, costs of construction, total suspended solids (TSS) removed, and any water quality credits as defined in the COA ECM.

Attachment 1 (RG) provides all possible site improvements studied including detention and rain garden facilities. **Attachment 2 (RG)** provides the Engineering Services Division's recommended site improvements.

Overall, ESD was able to identify six (6) rain garden (RG) sites, two (2) detention ponds (DP), and an improvement to an existing storm sewer pipe to serve as additional detention as potential beneficial improvements to the site.

Percolation testing was conducted on the site at three locations. **Attachment 3 (RG)** provides the locations of the percolation testing. Testing results were provided by Tom Franke with the Watershed Protection Department.

The testing results are as follows:

Test #1: Close to Street – 0.31 inches per hour. A one foot ponding depth in the rain garden can be used.
Test #2: Close to Track – 0.13 inches per hour. A six inch ponding depth in the rain garden can be used.
Test #3: Ground water was encountered at one foot below ground. A rain garden will not work at this site.

Rain Gardens 'B', 'C', and 'G' - 'L' locations were chosen because of positive infiltration tests conducted at or near these locations. Rain Gardens 'A', 'D', 'E', and 'F' should receive percolation testing before their effectiveness and design can be concluded. Rain Gardens 'D' – 'F' will also require review and approval from the City Arborist because of their proximity to desirable trees of significant diameter. The minimum required steps for establishing infiltration rate, found in the City of Austin Environmental Criteria Manual (COA ECM) Table 1.6.7.1, should be conducted to fully establish rain garden specifications.

Attachment 4 (RG) provides geometric and possible water quality credit information for each of the proposed rain gardens. The rain gardens are currently proposed as inline full infiltration rain gardens. A total of twelve (12) rain gardens are possible. There are unknown variables and constraints which may limit any or all of the proposed rain gardens. The rain gardens are proposed to be lined with native grasses including vegetation as defined in the COA ECM Table 1.6.7.C-2 (Recommended Plant Species). Rain Gardens 'A', 'B, 'D', 'E' and 'F' are proposed to overtop rock rip-rap berms after reaching their Water Quality Volume Elevations. Bio-filtration media is proposed in all rain gardens but infiltration testing indicates that existing native soils may be used, in place, without installing designed media which could reduce the cost of each control.

RG 'A' is proposed to be located northeast of the track. Concentrated flow will enter the rain garden through a proposed curb cut at Mary Street and a rock rip rap swale at 4% slope to the control. RG 'A' is proposed to intercept flows from the upstream parking lot and street at the northeast corner of the school site. RG 'A' is currently proposed to have a 12 inch capture depth. A percolation test has not been conducted at this location and may impact its design. RG 'A' will behave as in-line with its current configuration, however, with further analysis it may be possible to design this rain garden in an off-line configuration for flow control by locating the inflow at approximately Elev: 573 msl from Mary Street.

RG 'B' is proposed to be located at the southwest of the track. Concentrated flow will enter the rain garden through a 6 inch HDPE PVC pipe which flows at 2% under the long jump track from RG 'C'. Runoff may also enter RG 'B' as sheet flow from the track.

RG 'C' is proposed to be located on the south side of the long jump track and downstream from the outlet headwall of Ex. Detention Pond 1, located on the east side of the tennis courts. Concentrated flow from Ex. Detention Pond 1 will enter RG 'C' from the outfall of the detention pond and via sheet flow from the site. Water will be released via a 6" PVC pipe which flows to RG 'B' and a 2'x2' overflow inlet is proposed on the west end of the control. Calculations for volume and TSS removal for RG 'B" and 'C' have been combined effectively improving their cost benefit indicating that they are more effective if constructed together.

The configurations of RG 'D', RG 'E', and RG 'F' are proposed to minimize excavation and berm embankment around existing tree root zones in these areas. The water quality volume depth is proposed at 6 inches for each of these rain gardens. Their proposed design excavates a portion of the rain garden on the upstream side and embanks a berm on the downstream side. It may be beneficial to pursue the use of Filtrexx Sock products, or equivalence, for berm construction at these, or any locations.

The City Arborist may not allow excavation in these areas. This condition may require that the overflows be constructed with mortared rock walls to meet elevations. RG 'E' has been designed with a mortared rock wall for illustration and cost analysis. Construction costs may be reduced if mortared rock walls can be eliminated.

RG 'D' is proposed to be located at the northwest corner of the tennis courts. It will receive runoff from the tennis courts as sheet and concentrated flow.

RG 'E' is proposed to be located at the southwest corner of the tennis courts. It will receive concentrated flows from the tennis courts.

RG 'F' is proposed to receive flow from RG 'E' as a tiered rain garden. Calculations for volume and TSS removal for RG 'E' and 'F' have been combined as a single control.

Rain Gardens D-F have been calculated assuming a percolation test of 0.13 inches per hour. Actual test results could change the cost-benefit and other effectiveness measures of the rain gardens.

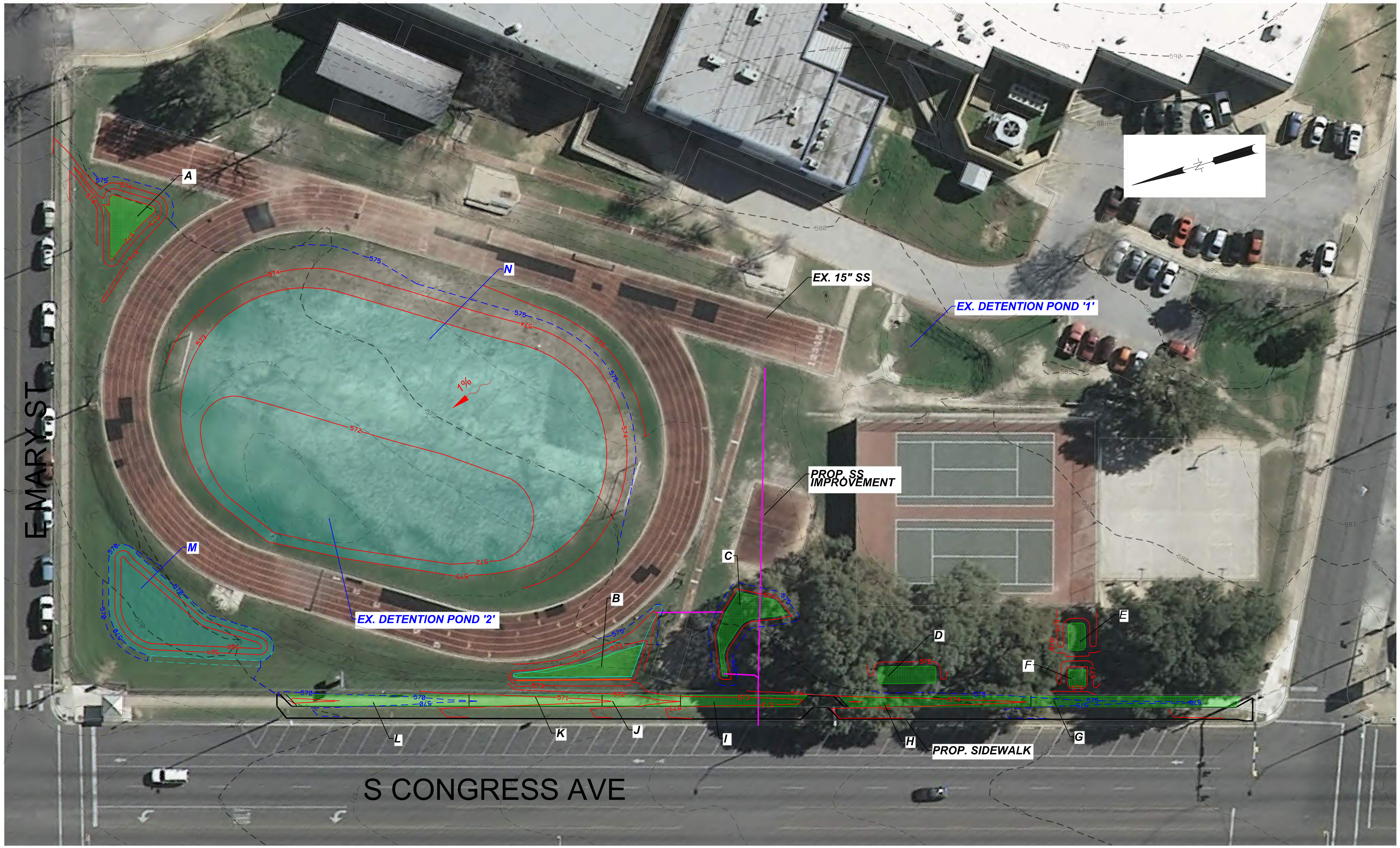
Rain Gardens 'G' – 'L' are proposed to be located between the middle school site and Congress Avenue. Rain Gardens 'G' – 'L' are proposed to be constructed as a set of six (6) tiered rain gardens. Currently there is a 6 foot sidewalk which is located adjacent to the property line and edge of ROW for Congress Avenue. It is proposed that the sidewalk be relocated along the back of curb of the gutter line for Congress Avenue due to the back in parking along Congress Avenue at this location. Relocating the sidewalk will prevent the need for pedestrian bridges to span the proposed rain gardens and potential foot traffic over the controls which would compact and reduce porosity and the efficiency of the controls. The relocation of the sidewalk will also facilitate passengers leaving their vehicles at the back in parking and reduce foot traffic along the front of their vehicles facing Congress Avenue. These rain gardens are proposed within the ROW. A "Complete Streets Review" should be conducted because of the proposed work in the ROW. Subchapter E of the City of Austin Land Development Code (LDC) should also be reviewed for compliance. **Attachment 1A (RG)** provides a plan and profile view of this rain garden site along Congress Avenue. Additional treatment could be achieved if the grades of the controls are constructed horizontal, however, additional pedestrian safety treatments should be considered. The curb cuts in the sidewalk have not been calculated for capacity.

There are two (2) detention ponds proposed. DP 'M' is a proposed new detention facility proposed to capture runoff from Ex. Detention Pond 2 which was constructed with SP-99-2099CX. It is proposed to have a rock rip-rap berm overflow. Water was discovered within 12" from the existing ground surface at this location during a percolation test which disqualifies it for a rain garden location. An impermeable liner may be required to meet design criteria if a detention pond is to be constructed at this location. DP 'N' is a proposed detention pond improvement to Ex. Detention Pond 2. DP 'N' is proposed to utilize additional volume within the soccer field as detention.

There is an existing 15 inch RCP located flowing west through the sports area near the long jump. It outflows to a 24 inch main in Congress Avenue. It is proposed that 155 LF of this 15 inch RCP be replaced with a 48" Class IV RCP and installing an orifice plate at the downstream end of the pipe for outflow control. The orifice will restrict flows in the pipe providing additional storm runoff storage in the pipe. The orifice size has not been calculated. **Attachment 5 (RG)** provides information on the proposed detention pond geometries and the proposed SS pipe improvement.

Total Suspended Solid (TSS) removal was calculated for the Rain Garden Stormwater Control Measures (SCM). The Watershed Departments SLAT tool and the Adams and Papa tool were used to compare TSS removal rates. The TSS removal was compared to the cost of each SCM. The results of these calculations are included in **Attachment 6 (RG).**

Engineering Services recommends that the controls identified on **Attachment 2 (RG)** are implemented with a full design and analysis of these controls.



LEGEND

(green)	= PROP. RAIN GARDEN
(cyan)	= PROP. DETENTION
(grey dashed)	= EX. CONTOUR LINE (MINOR)
(black dashed)	= EX. CONTOUR LINE (MAJOR)
(red)	= PROP. CONTOUR LINE (MINOR)
(blue)	= PROP. CONTOUR LINE (MAJOR)

0 25 50
HORIZONTAL SCALE IN FEET

ATTACHMENT 1 (RG)

REV. NO.	BY	DATE	REVISION DESCRIPTION

CITY OF AUSTIN, TEXAS
DEPARTMENT OF PUBLIC WORKS
ENGINEERING SERVICES DIVISION

ANNIE STREET DRAINAGE IMPROVEMENTS
PROPOSED FULMORE MIDDLE SCHOOL RAIN GARDENS AND DETENTION PONDS

FULMORE MIDDLE SCHOOL
RAIN GARDEN OVERALL MAP

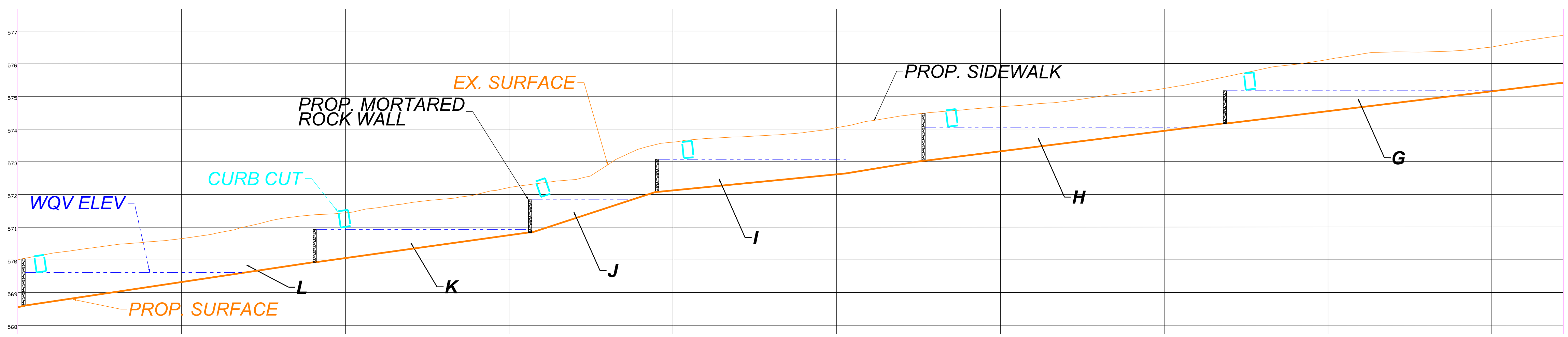
NOTES	NAME	DATE
SURVEY BY		
DRAWN BY		
CHECKED BY		
DESIGNED BY		
REVIEWED BY		

ENGINEERING SERVICES DIVISION

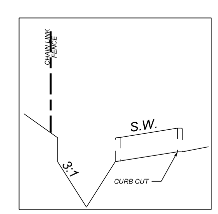
PERMIT NUMBER
__ ___ - ___ . ___

SHEET NUMBER 1 OF 3

N:\Team3\WPD_EBC_Annie\DGN\Annie_RG_OVERALL_PROP.dgn
09-FEB-2016



0 20 40
HORIZONTAL SCALE IN FEET
0 2 4
VERTICAL SCALE IN FEET



RG G-L CROSS SECTION A-A
(TYPICAL)
(NTS)

LEGEND

- = PROP. RAIN GARDEN
- = PROP. CURB CUT
- = EX. CONTOUR LINE (MINOR)
- = EX. CONTOUR LINE (MAJOR)
- = PROP. CONTOUR LINE (MINOR)
- = PROP. CONTOUR LINE (MAJOR)
- = PROP. SIDEWALK (RELOCATION)

ATTACHMENT 1A (RG)

REV. NO.	BY	DATE	REVISION DESCRIPTION

CITY OF AUSTIN, TEXAS
DEPARTMENT OF PUBLIC WORKS
ENGINEERING SERVICES DIVISION

ANNIE STREET DRAINAGE IMPROVEMENTS
PROPOSED FULMORE MIDDLE SCHOOL RAIN GARDENS
AND DETENTION PONDS

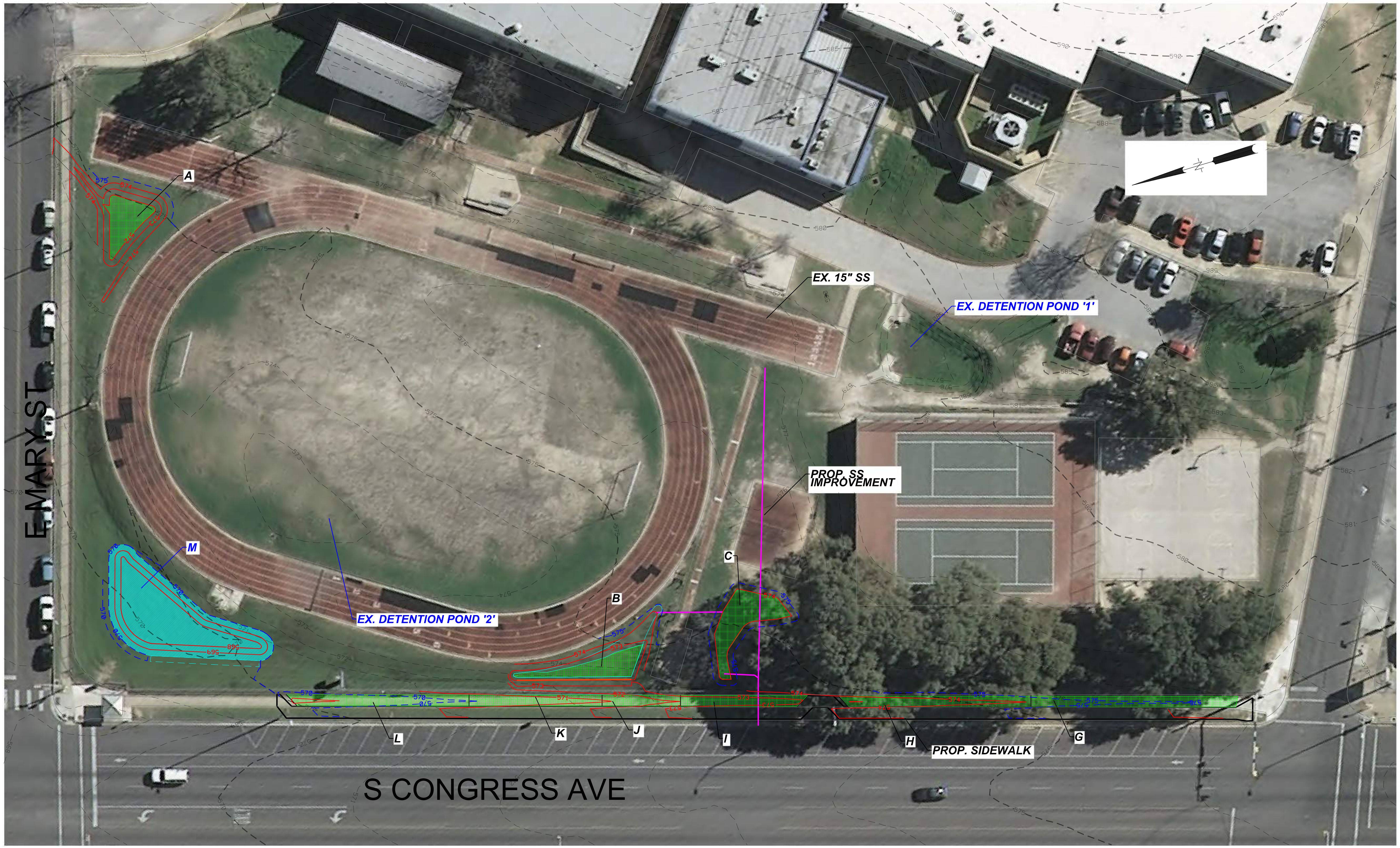
FULMORE MIDDLE SCHOOL
PROPOSED RAIN GARDEN PLAN AND PROFILE

NOTES	NAME	DATE
SURVEY BY		
DRAWN BY		
CHECKED BY		
DESIGNED BY		
REVIEWED BY		

ENGINEERING SERVICES DIVISION

PERMIT NUMBER
__ ___-___-__

SHEET NUMBER 2 OF 3



LEGEND

- = PROP. RAIN GARDEN
- = PROP. DETENTION
- = EX. CONTOUR LINE (MINOR)
- = EX. CONTOUR LINE (MAJOR)
- = PROP. CONTOUR LINE (MINOR)
- = PROP. CONTOUR LINE (MAJOR)

0 25 50
HORIZONTAL SCALE IN FEET

ATTACHMENT 2 (RG)

REV. NO.	BY	DATE	REVISION DESCRIPTION

CITY OF AUSTIN, TEXAS
DEPARTMENT OF PUBLIC WORKS
ENGINEERING SERVICES DIVISION

ANNIE STREET DRAINAGE IMPROVEMENTS
PROPOSED FULMORE MIDDLE SCHOOL RAIN GARDENS AND DETENTION PONDS

FULMORE MIDDLE SCHOOL RECOMMENDED RAIN GARDENS OVERALL MAP

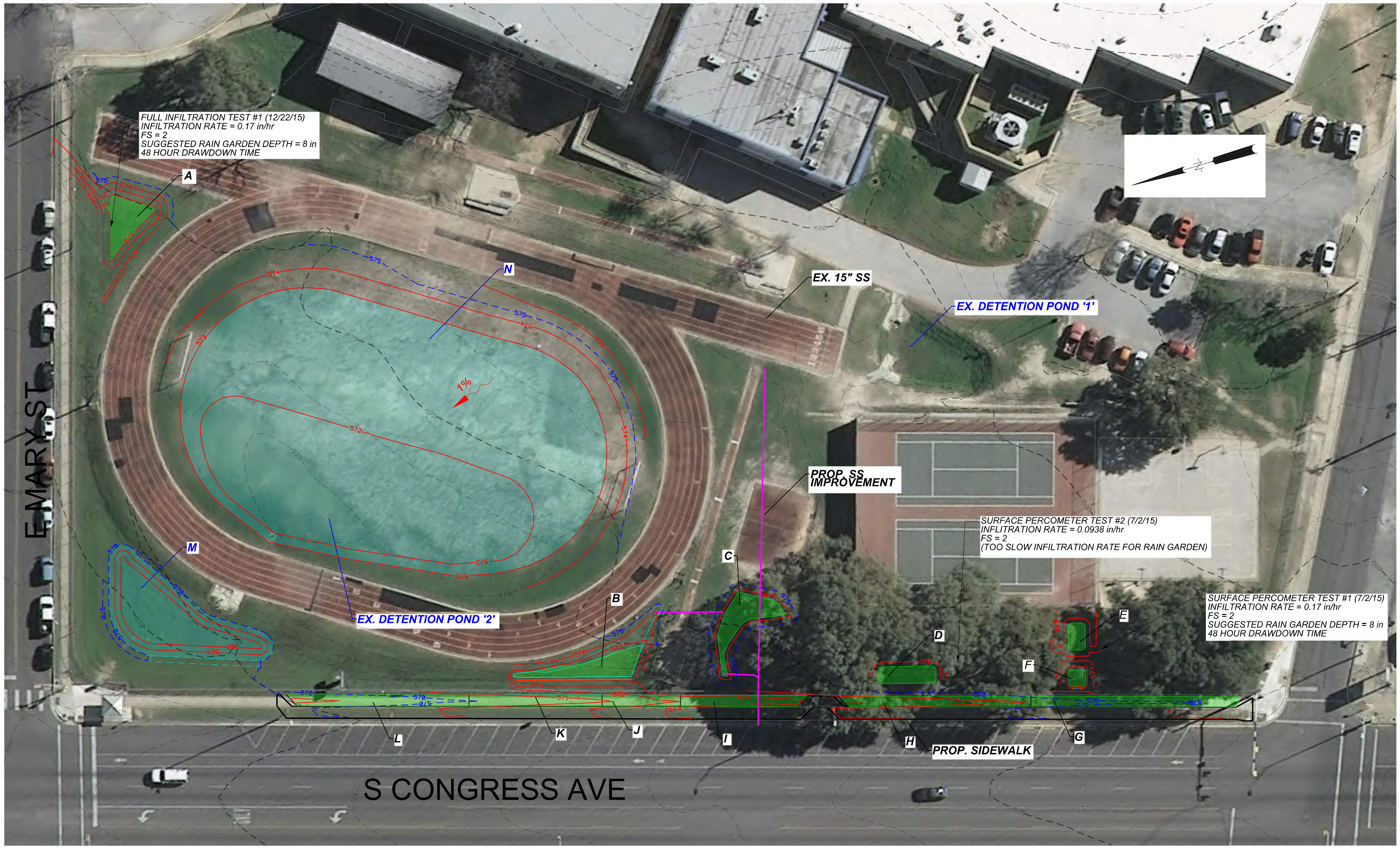
NOTES	NAME	DATE
SURVEY BY		
DRAWN BY		
CHECKED BY		
DESIGNED BY		
REVIEWED BY		

ESD
ENGINEERING SERVICES DIVISION

PERMIT NUMBER
__ ___ - ___ . __

SHEET NUMBER 3 OF 3

N:\Team3\WPD_EBC_Annie\DGN\Annie_RG_ESD_PROP.dgn
03-FEB-2016



LEGEND

- = PROP. RAIN GARDEN
- = PROP. DETENTION
- = EX. CONTOUR LINE (MINOR)
- = EX. CONTOUR LINE (MAJOR)
- = PROP. CONTOUR LINE (MINOR)
- = PROP. CONTOUR LINE (MAJOR)

0 25 50
HORIZONTAL SCALE IN FEET

ATTACHMENT 1 (RG)

REV. NO.	BY	DATE	REVISION DESCRIPTION

CITY OF AUSTIN, TEXAS
DEPARTMENT OF PUBLIC WORKS
ENGINEERING SERVICES DIVISION

ANNIE STREET DRAINAGE IMPROVEMENTS
PROPOSED FULMORE MIDDLE SCHOOL RAIN GARDENS
AND DETENTION PONDS

FULMORE MIDDLE SCHOOL
RAIN GARDEN OVERALL MAP

CITY OF AUSTIN FOUNDED 1839

NOTES	NAME	DATE
SURVEY BY		
DRAWN BY		
CHECKED BY		
DESIGNED BY		
REVIEWED BY		

ESD
ENGINEERING SERVICES
DIVISION

PERMIT NUMBER
__ ___ - ___ - ___

SHEET NUMBER 1 OF 1

N:\Team3\WPD_EBC_Annie\DGN\Annie_INFILTRATION_TESTS.dgn
03-MAR-2016

Annie Street Drainage Improvements- Proposed Fulmore Middle School Rain Gardens and Detention Ponds
CIP ID: 5789.106

Attachment 4 (RG)

			RG B&C COMBO			RG E&F COMBO		RG G-L						
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**G-L COMBO**
BASE FOOTPRINT	SF	400	405	420	294	143	103	453	443	284	168	356	370	2074
TOP AREA	SF	683	577	618	414	224	168	453	443	284	168	356	370	2074
AVG POND AREA **(A_i)**	SF	541.5	491	519	354	183.5	135.5	453	443	284	168	356	370	2074.05
DEPTH **(H)**	VF	1	0.5	0.5	0.5	0.5	0.5	0.95	0.95	0.95	0.95	0.95	0.95	0.95
VOLUME	CF	541.5	245.5	259.5	177	91.75	67.75	72.00	70.44	45.55	27.53	56.85	58.93	331
FILTRATION MEDIA DEPTH **(L)**	FT	1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
PERC TEST RESULTS	DEPTH	NEEDED	6" MAX	6" MAX	NEEDED	NEEDED	NEEDED	12" MAX	12" MAX	12" MAX	12" MAX	12" MAX	12" MAX	12" MAX
BASE ELEV	MSL	572	572.5	573.5	575.25	578.25	575.75	SLOPING	SLOPING	SLOPING	SLOPING	SLOPING	SLOPING	VARIES
WQV ELEV	MSL	573	573	574	575.75	578.75	576.75	575.17	574.04	573.07	571.84	570.93	569.62	VARIES
TOTAL CONTRIBUTING AREA **(A)**	SF	87068	5996	37239	4216	3316	3316	19388	10164	6005	2399	3636	7973	49565
TOTAL IC **(IC)**	SF	53672	2645	25397	2926	2478	2478	12001	7083	3684	1954	2801	7973	53672
PARTIAL WATER QUALITY CREDIT														
WQC = WATER QUALITY CREDIT														
WQC = IAF * BMPDF		**0.2**	**1**	**0.245**	**0.92**	**0.71**	**0.565**	**0.325**	**0.52**	**0.6**	**0.68**	**0.86**	**0.45**	**0.2**
IAF = IMPERVIOUS AREA FACTOR		1	1	1	1	1	1	1	1	1	1	1	1	1
BMPDF = BEST MGMT PRACTICES DESIGN FACTOR (FIG. 1.6.7.D)		0.2	0.21	0.245	0.92	0.71	0.565	0.325	0.52	0.6	0.68	0.86	0.45	0.2
WQV_{BMP}/WQV_{ECM}		0.116	1.128	0.145	0.722	0.452	0.334	0.375	0.645	0.765	0.929	1.352	0.526	0.447
$WQV_{BMP} = 12*A_i*(H+0.24*L)/(0.87*A)$	IN	0.106	0.836	0.142	0.718	0.473	0.349	0.345	0.643	0.699	1.035	1.447	0.684	0.618
$WQV_{ECM} = 0.5 + (IC/A - 0.2)$	IN	0.916	0.741	0.982	0.994	1.047	1.047	0.919	0.997	0.913	1.115	1.070	1.300	1.383

Annie Street Drainage Improvements- Proposed Fulmore Middle School Rain Gardens and Detention Ponds
CIP ID: 5789.106

Attachment 5 (RG)

		DP1	DP2	SS RCP-5x2	Option: 48" RCP	Option: 42" RCP
BASE FOOTPRINT	SF	1171	21693			
TOP AREA	SF	2421	24643			
AVG POND AREA	SF	1796	23168			
DEPTH	VF	2	0.5			
VOLUME	CF	3592	11584			
BASE ELEV		573	568			
PROP SS IMPROVEMENT	LF			155	155	155
TOTAL VOLUME	CF			1550	1948	1491
15" RCP	LF			155	155	155
15" PIPE VOLUME	CF			190	190	190
ADDED VOLUME of SS IMPROVEMENT	CF			1360	1758	1301

Annie Street Drainage Improvements- Proposed Fulmore Middle School Rain Gardens and Detention Ponds
CIP ID: 5789.106

Attachment 6 (RG)

	SCM (Rain Garden Name)															
									Prop. Long Tiered Rain Garden along Congress Ave						
	A	B	C	B/C COMBO	D	E	F	E/F COMBO	G	H	I	J	K	L	G-L COMBO
A&P Model Cost Analysis $ / TSS lb removed	$11.82	$46.56	$18.31	$13.39	$38.76	$61.71	$64.19	$36.41	$53.11	$56.52	$92.31	$149.17	$80.19	$65.64	$27.49
SLAT Model Cost Analysis $ / TSS lb removed	$3.75			$10.11	$181.29			$63.35							$10.45

Fullmore Middle School- Detention Ponds and SS Detention

Project CIP ID Number : 5789.106

Engineer's Opinion of Probable Construction Cost Estimate - Rain Garden A

Bid Item	Quantity	Unit	Item Description	Estimated Unit Price	Estimated Amount
111S-A:	40	CY.	Excavation, including offsite disposal.	$50.00	$2,005.56
430S-A:	4.00	LF	Concrete Curb and Gutter (Curb and gutter work including excavation and subgrade preparation.) Including Curb & Gutter Rain Garden Inlets	$50.00	$200.00
432SR-4	0.00	SF	Remove and replace existing sidewalk, w/ 6' Sidewalk, complete-in-place	$10.00	$0.00
	20.00	SF	Remove Sidewalk	$10.00	$200.00
	20.00	SF	Diamond Plate Grate for Sidwalk channel	$100.00	$2,000.00
	0.00	LF	6" Solid PVC C900	$45.00	$0.00
591S-B2:	47.11	SY	Dry Riprap, Rounded River Rock (Colorado Rainbow) 2" - 6" diameter	$150.00	$7,066.67
609S-G:	2	EA	Extended Landscape Management, two-year duration, per event	$300.00	$600.00
609S-S:	232	SY	Buffalo Grass (609 Variety) Sodding	$5.00	$1,162.22
620S:	0	SY	Filter Fabric	$25.00	$0.00
628S-C:	0	LF	Filter Curb Inlet Protection (Existing Inlet)	$10.00	$0.00
648S:	188.00	LF	Mulch Sock for Erosion Control	$12.00	$2,256.00
700S-TM:	1	LS	Total Mobilization Payment	$1,349.24	$1,349.24
802S-B:	1	EA	Project Sign	$125.00	$125.00
803S-MO:	3	MO	Barricades, Signs, and Traffic Handling	$125.00	$375.00
	1	MO	Traffic Control-	$375.00	$375.00
SP432S-PB4	1.00	EA	P.C. Concrete Bridge for 5 Foot Sidewalk Crossing Inlet Structure	$500.00	$500.00
	0.00	CF	Mortared Rock Wall	$350.00	$0.00
	0.00		Grading- Earthwork	$50.00	$0.00
130S-A:	20	CY	City of Austin approved Bio-Filtration Media, certified per 2/24/2011 Guidance, complete and in place	$100.00	$2,005.56

Total	$20,220.24
15% Contingency	$3,033.04
Total Detention Improvements w/Contingency	**$23,253.27**

Fullmore Middle School- Detention Ponds and SS Detention

Project CIP ID Number : 5789.106

Engineer's Opinion of Probable Construction Cost Estimate - Rain Garden B

Bid Item	Quantity	Unit	Item Description	Estimated Unit Price	Estimated Amount
111S-A:	27	CY.	Excavation, including offsite disposal.	$50.00	$1,363.89
430S-A:	0.00	LF	Concrete Curb and Gutter (Curb and gutter work including excavation and subgrade preparation.) Including Curb & Gutter Rain Garden Inlets	$50.00	$0.00
432SR-4	0.00	SF	Remove and replace existing sidewalk, w/ 6' Sidewalk, complete-in-place	$10.00	$0.00
	0.00	SF	Diamond Plate Grate for Sidwalk channel	$100.00	$0.00
	0.00	LF	6" Solid PVC C900	$45.00	$0.00
591S-B2:	42.89	SY	Dry Riprap, Rounded River Rock (Colorado Rainbow) 2" - 6" diameter	$150.00	$6,433.33
609S-G:	2	EA	Extended Landscape Management, two-year duration, per event	$300.00	$600.00
609S-S:	139	SY	Buffalo Grass (609 Variety) Sodding	$5.00	$696.67
	0	SY	Seeding	$5.00	$0.00
610S-A:	0	LF	Protective Fencing Type A (Tree Protection) Chain Link fence (Typical Application-high damage potential)	$5.00	$0.00
610S-AP:	0.00	EA	Protective Fencing, Wooden Tree Planking Trunk Protection, per tree.	$100.00	$0.00
620S:	0	SY	Filter Fabric	$25.00	$0.00
628S-C:	0	LF	Filter Curb Inlet Protection (Existing Inlet)	$10.00	$0.00
648S:	78.00	LF	Mulch Sock for Erosion Control	$12.00	$936.00
700S-TM:	1	LS	Total Mobilization Payment	$884.84	$884.84
802S-B:	1	EA	Project Sign	$125.00	$125.00
803S-MO:	3	MO	Barricades, Signs, and Traffic Handling	$125.00	$375.00
	1	MO	Traffic Control-	$375.00	$375.00
SP432S-PB4	0.00	EA	P.C. Concrete Bridge for 5 Foot Sidewalk Crossing Inlet Structure	$500.00	$0.00
	0.00	CF	Mortared Rock Wall	$350.00	$0.00
	3.11		Grading- Earthwork	$50.00	$155.56
130S-A:	18	CY.	City of Austin approved Bio-Filtration Media, certified per 2/24/2011 Guidance, complete and in place	$100.00	$1,818.52

Total	$13,763.80
15% Contingency	$2,064.57
Total Detention Improvements w/Contingency	**$15,828.37**

Fullmore Middle School- Detention Ponds and SS Detention

Project CIP ID Number : 5789.106

Engineer's Opinion of Probable Construction Cost Estimate - Rain Garden C

Bid Item	Quantity	Unit	Item Description	Estimated Unit Price	Estimated Amount
111S-A:	29	CY.	Excavation, including offsite disposal.	$50.00	$1,441.67
501-A12-SD	18.00	LF	Pipe 12" Dia RCP Type (All Depths), Including Excavation and Backfill - Complete and in Place	$50.00	$900.00
501-A24-SD	0.00	LF	Pipe 24" Dia RCP Type (All Depths), Including Excavation and Backfill - Complete and in Place	$80.00	$0.00
508S	1.00	EA	2' X 2' Inlet	$2,000.00	$2,000.00
510-ASD-6	34.00	LF	6" Solid PVC C900	$45.00	$1,530.00
591S-B2:	5.33	SY	Dry Riprap, Rounded River Rock (Colorado Rainbow) 2" - 6" diameter	$150.00	$800.00
609S-G:	2	EA	Extended Landscape Management, two-year duration, per event	$300.00	$600.00
609S-S:	117	SY	Buffalo Grass (609 Variety) Sodding	$5.00	$583.33
610S-AP:	2.00	EA	Protective Fencing, Wooden Tree Planking Trunk Protection, per tree.	$100.00	$200.00
648S:	92.00	LF	Mulch Sock for Erosion Control	$12.00	$1,104.00
700S-TM:	1	LS	Total Mobilization Payment	$802.72	$802.72
802S-B:	1	EA	Project Sign	$125.00	$125.00
803S-MO:	3	MO	Barricades, Signs, and Traffic Handling	$125.00	$375.00
	1	MO	Traffic Control-	$375.00	$375.00
130S-A:	19	CY.	City of Austin approved Bio-Filtration Media, certified per 2/24/2011 Guidance, complete and in place	$100.00	$1,922.22

Total	$12,758.94
15% Contingency	$1,913.84
Total Detention Improvements w/Contingency	**$14,672.78**

Fullmore Middle School- Detention Ponds and SS Detention

Project CIP ID Number : 5789.106

Engineer's Opinion of Probable Construction Cost Estimate - Rain Garden D

Bid Item	Quantity	Unit	Item Description	Estimated Unit Price	Estimated Amount
111S-A:	20	CY.	Excavation, including offsite disposal.	$50.00	$983.33
591S-B2:	15.11	SY	Dry Riprap, Rounded River Rock (Colorado Rainbow) 2" - 6" diameter	$150.00	$2,266.67
609S-G:	2	EA	Extended Landscape Management, two-year duration, per event	$300.00	$600.00
609S-S:	46	SY	Buffalo Grass (609 Variety) Sodding	$5.00	$230.00
	0	SY	Seeding	$5.00	$0.00
610S-A:	0	LF	Protective Fencing Type A (Tree Protection) Chain Link fence (Typical Application-high damage potential)	$5.00	$0.00
610S-AP:	3.00	EA	Protective Fencing, Wooden Tree Planking Trunk Protection, per tree.	$100.00	$300.00
648S:	56.00	LF	Mulch Sock for Erosion Control	$12.00	$672.00
700S-TM:	1	LS	Total Mobilization Payment	$479.12	$479.12
802S-B:	1	EA	Project Sign	$125.00	$125.00
803S-MO:	3	MO	Barricades, Signs, and Traffic Handling	$125.00	$375.00
	1	MO	Traffic Control-	$375.00	$375.00
	0.00	CF	Mortared Rock Wall	$350.00	$0.00
	1.24		Grading- Earthwork	$50.00	$62.04
130S-A:	13	CY.	City of Austin approved Bio-Filtration Media, certified per 2/24/2011 Guidance, complete and in place	$100.00	$1,311.11

Total	$7,779.27
15% Contingency	$1,166.89
Total Detention Improvements w/Contingency	**$8,946.16**

Fullmore Middle School- Detention Ponds and SS Detention

Project CIP ID Number : 5789.106

Engineer's Opinion of Probable Construction Cost Estimate - Rain Garden E

Bid Item	Quantity	Unit	Item Description	Estimated Unit Price	Estimated Amount
111S-A:	10	CY.	Excavation, including offsite disposal.	$50.00	$509.72
591S-B2:	11.56	SY	Dry Riprap, Rounded River Rock (Colorado Rainbow) 2" - 6" diameter	$150.00	$1,733.33
609S-G:	2	EA	Extended Landscape Management, two-year duration, per event	$300.00	$600.00
609S-S:	25	SY	Buffalo Grass (609 Variety) Sodding	$5.00	$124.44
610S-AP:	3.00	EA	Protective Fencing, Wooden Tree Planking Trunk Protection, per tree.	$100.00	$300.00
648S:	68.00	LF	Mulch Sock for Erosion Control	$12.00	$816.00
700S-TM:	1	LS	Total Mobilization Payment	$678.75	$678.75
802S-B:	1	EA	Project Sign	$125.00	$125.00
803S-MO:	3	MO	Barricades, Signs, and Traffic Handling	$125.00	$375.00
	1	MO	Traffic Control-	$375.00	$375.00
	10.00	CF	Mortared Rock Wall	$350.00	$3,500.00
	0.52		Grading- Earthwork	$50.00	$25.93
130S-A:	7	CY.	City of Austin approved Bio-Filtration Media, certified per 2/24/2011 Guidance, complete and in place	$100.00	$679.63

Total	$9,842.81
15% Contingency	$1,476.42
Total Detention Improvements w/Contingency	**$11,319.23**

Fullmore Middle School- Detention Ponds and SS Detention

Project CIP ID Number : 5789.106

Engineer's Opinion of Probable Construction Cost Estimate - Rain Garden F

Bid Item	Quantity	Unit	Item Description	Estimated Unit Price	Estimated Amount
111S-A:	8	CY.	Excavation, including offsite disposal.	$50.00	$376.39
591S-B2:	6.67	SY	Dry Riprap, Rounded River Rock (Colorado Rainbow) 2" - 6" diameter	$150.00	$1,000.00
609S-G:	2	EA	Extended Landscape Management, two-year duration, per event	$300.00	$600.00
609S-S:	19	SY	Buffalo Grass (609 Variety) Sodding	$5.00	$93.33
700S-TM:	1	LS	Total Mobilization Payment	$237.65	$237.65
802S-B:	1	EA	Project Sign	$125.00	$125.00
803S-MO:	3	MO	Barricades, Signs, and Traffic Handling	$125.00	$375.00
	1	MO	Traffic Control-	$375.00	$375.00
	0.52		Grading- Earthwork	$50.00	$25.93
130S-A:	5	CY.	City of Austin approved Bio-Filtration Media, certified per 2/24/2011 Guidance, complete and in place	$100.00	$501.85

Total	$3,710.15
15% Contingency	$556.52
Total Detention Improvements w/Contingency	**$4,266.67**

Fullmore Middle School- Detention Ponds and SS Detention

Project CIP ID Number : 5789.106

Engineer's Opinion of Probable Construction Cost Estimate - Rain Garden G-L

Bid Item	Quantity	Unit	Item Description	Estimated Unit Price	Estimated Amount
111S-A:	100	CY.	Excavation, including offsite disposal.	$50.00	$5,000.00
430S-A:	12.00	LF	Concrete Curb and Gutter (Curb and gutter work including excavation and subgrade preparation.) Including Curb & Gutter Rain Garden Inlets	$50.00	$600.00
432SR-4	2882.00	SF	Remove and replace existing sidewalk, w/ 6' Sidewalk, complete-in-place	$10.00	$28,820.00
	72.00	SF	Diamond Plate Grate for Sidwalk channel	$100.00	$7,200.00
591S-B2:	5.33	SY	Dry Riprap, Rounded River Rock (Colorado Rainbow) 2" - 6" diameter	$150.00	$800.00
609S-G:	12	EA	Extended Landscape Management, two-year duration, per event	$300.00	$3,600.00
609S-S:	298	SY	Buffalo Grass (609 Variety) Sodding	$5.00	$1,490.56
628S-C:	10	LF	Filter Curb Inlet Protection (Existing Inlet)	$10.00	$100.00
700S-TM:	1	LS	Total Mobilization Payment	$4,758.84	$4,758.84
802S-B:	1	EA	Project Sign	$125.00	$125.00
803S-MO:	3	MO	Barricades, Signs, and Traffic Handling	$125.00	$375.00
	1	MO	Traffic Control-	$375.00	$375.00
SP432S-PB4	6.00	EA	P.C. Concrete Bridge for 5 Foot Sidewalk Crossing Inlet Structure	$500.00	$3,000.00
	20.00	CF	Mortared Rock Wall	$350.00	$7,000.00
	100.00	LF	Triangular Filter Dike	$10.00	$1,000.00
	0	LF	5' x 2' Box Culvert	$1,000.00	$0.00
130S-A:	50	CY.	City of Austin approved Bio-Filtration Media, certified per 2/24/2011 Guidance, complete and in place	$100.00	$4,968.52

Total	$69,212.92
15% Contingency	$10,381.94
Total Detention Improvements w/Contingency	**$79,594.86**

Life Cycle Cost Estimate – Rain Gardens

Rain gardens require regular maintenance in order to function properly. Routine quarterly maintenance requirements are listed in ECM 1.6.3.C.6 and include removing accumulated debris and sediment, trimming grasses and adding new mulch. Design decisions can reduce maintenance costs. Maintenance reducing design suggestions can be found in ECM 1.6.7.5.H.3. Rain gardens at One Texas Center are similar to rain gardens proposed in this report, although they include a high percentage of ornamental plants that require more maintenance. The One Texas Center property manager, Carol Sapstead, estimates that maintenance costs range from $500 to $700 per month. This is used as the approximate quarterly maintenance cost for rain gardens proposed in this report.

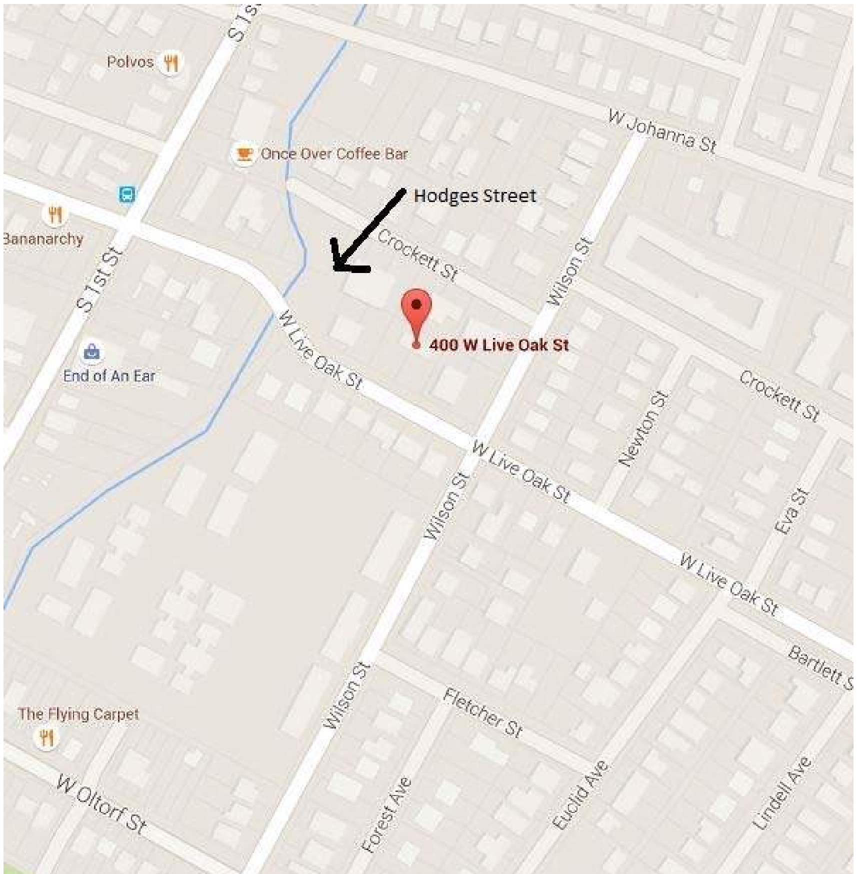
Rain Garden Location	Approximate Quarterly Maintenance Cost (low estimate)	Approximate Quarterly Maintenance Cost (high estimate)
Fulmore Middle School and Live Oak/Bartlett Streets	**$500**	**$700**
	Design Life Estimate	75 years
	Total Life Cycle Cost Estimate (low estimate)*	$150,000
	Total Life Cycle Cost Estimate (high estimate)*	$210,000

*Total Life Cycle Cost = Quarterly Cost x 4 x 75

Exhibit F.3

Hodges Street Detention

Area Map of Hodges Street



Travis CAD Map of Hodges Street

Aerial Map of Hodges Street

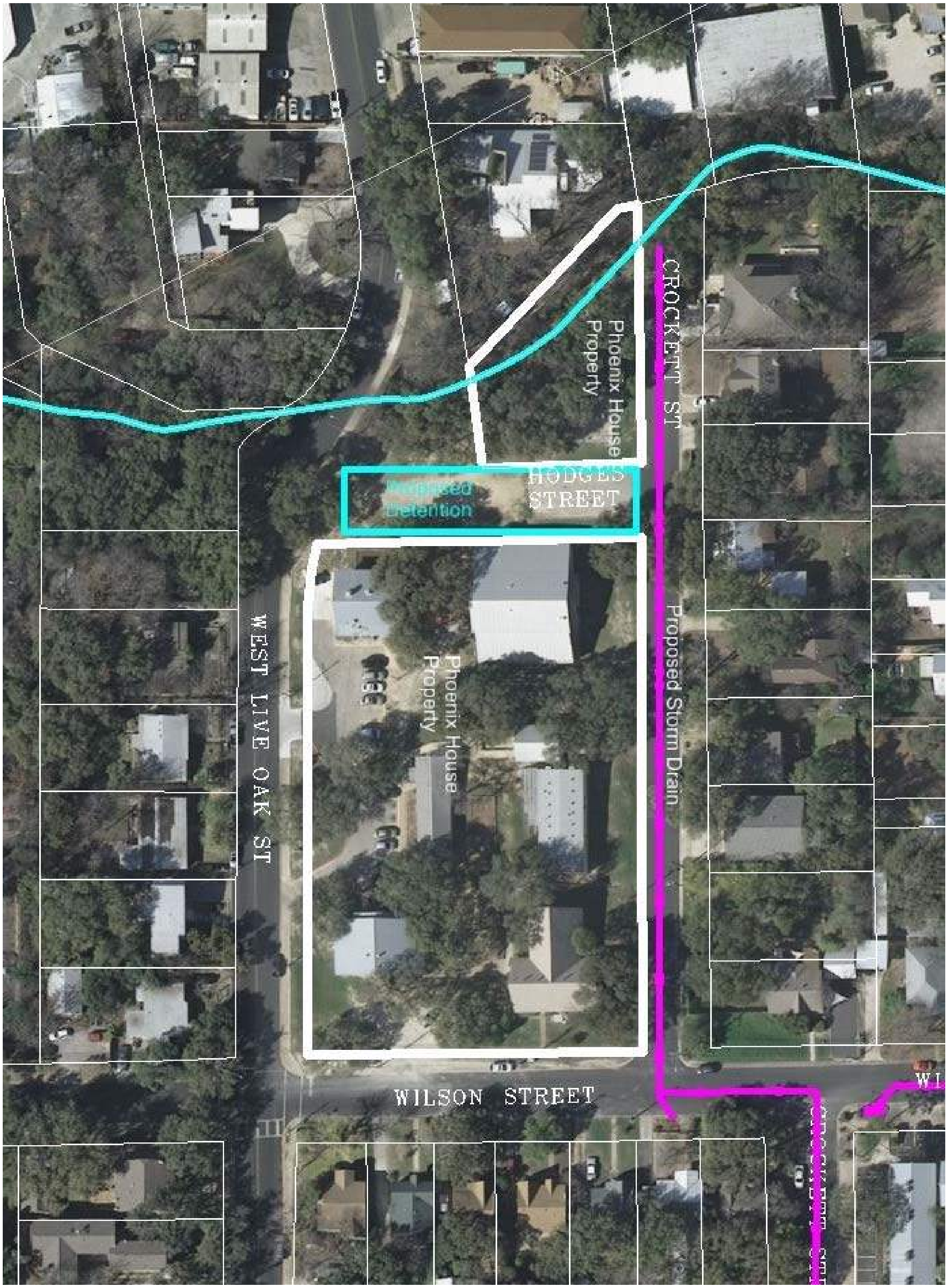


Photo of Hodges Street Fenced in ROW taken from Crockett Street

Dube, Kiersten

From: Sweat, Kevin
Sent: Wednesday, July 29, 2015 9:55 AM
To: Dube, Kiersten
Cc: Massie-Gore, Jennifer; Odufuye, Adewale
Subject: FW: using fenced-in ROW for detention

Kiersten,

Please see below and pass this along to WPD. If they decide to move forward in earnest we can start the conversation at the Department Director level.

Thanks again for gathering all of the back-up.

Kevin

Kevin Sweat
512-974-7017
512-699-6657 mobile

From: Magana, David
Sent: Wednesday, July 29, 2015 9:34 AM
To: Sweat, Kevin
Subject: RE: using fenced-in ROW for detention

I do not foresee any problems with its use by WPD. However, I recommend an IDA or MOA be developed for Department heads to sign and agree to the terms of the Agreement.

Thanks,

David V. Magaña, PE, PWLF
Office of the City Engineer
Public Works Department
City of Austin, Texas
Office: (512) 974-7042
Mobile: (512) 851-7252
Fax: (512) 974-8737

From: Sweat, Kevin
Sent: Tuesday, July 28, 2015 5:29 PM
To: Magana, David
Subject: FW: using fenced-in ROW for detention

David,

Our sponsor department representative in WPD asked us to help coordinate with PWD about the potential for locating a drainage/WQ feature in some unused ROW.

Can our team schedule a time to present the details to you for consideration?

Thank you,
Kevin

Kevin Sweat
512-974-7017
512-699-6657 mobile

From: Dube, Kiersten
Sent: Tuesday, July 28, 2015 7:39 AM
To: Sweat, Kevin
Cc: Massie-Gore, Jennifer; Odufuye, Adewale
Subject: RE: using fenced-in ROW for detention

Hi Kevin,

Land Development Ch 25 and DCM both state that the drainage system/detention facilities must be in the right-of-way OR drainage easement. See below. I do not know if WPD prefers to have a drainage easement for facilities that are in the ROW.

If PWD agrees to using Hodges Street for detention, perhaps a first step would be to offer them something that takes minimal effort (Memo Of Understanding?), but would assure them that the land could be used for detention and they wouldn't be wasting money by looking into detention feasibility.

Thanks!
Kiersten

DCM Section 1.2.2.C – General
In addition to B. above, the public drainage system shall be designed to convey those flows from greater than 25-year frequency storm up to and including the 100-year frequency storm within defined public rights of way or drainage easements.

DCM Section1.2.3.B – Street Drainage
For non-curbed streets all flows for the 100-year frequency storm shall be contained within paralleling roadside ditches, medians, drainage channels or other drainage facilities located within public rights-of-way or drainage easements.

Land Development Chapter 5-7 Article 5:
§ 25-7-151 - STORMWATER CONVEYANCE AND DRAINAGE FACILITIES.
(D) The responsibility of the owner proposing to develop the property includes the responsibility to dedicate or obtain the dedication of any right-of-way or easement necessary to accommodate the required construction or improvement of the storm drainage facility.

From: Sweat, Kevin
Sent: Monday, July 27, 2015 12:34 PM
To: Dube, Kiersten
Cc: Massie-Gore, Jennifer; Odufuye, Adewale
Subject: RE: using fenced-in ROW for detention

Thanks, Kiersten

Hopefully this is my last question:

Appendix G –
Revised Pre-Project HEC-HMS Model

Exhibit G.1

Map of Effective HEC-HMS Model Basins

Exhibit G.2

Map of Effective and Revised Pre-Project Basins

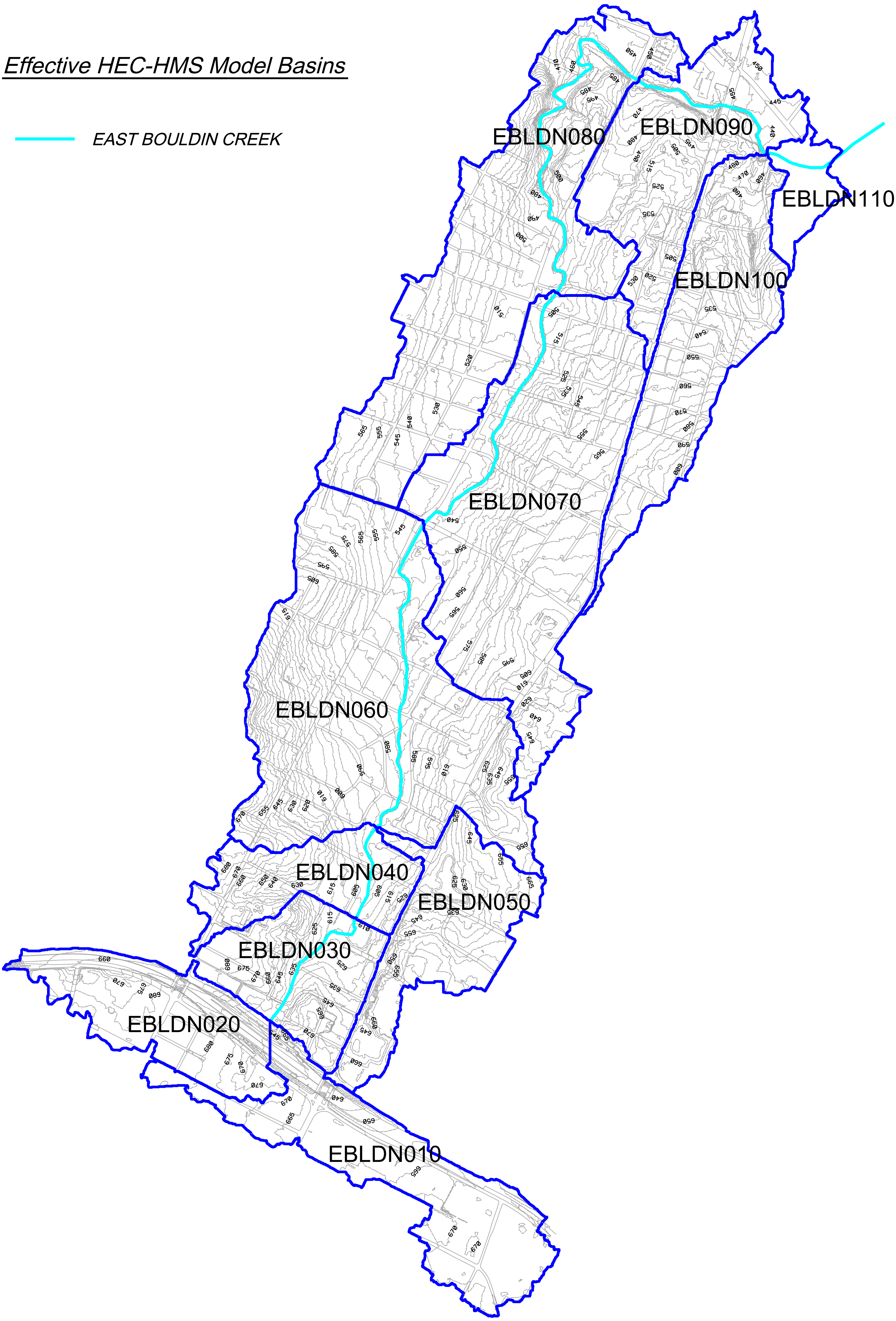
Exhibit G.3

Map of Revised Pre-Project Basins, Storm Drains and Contours

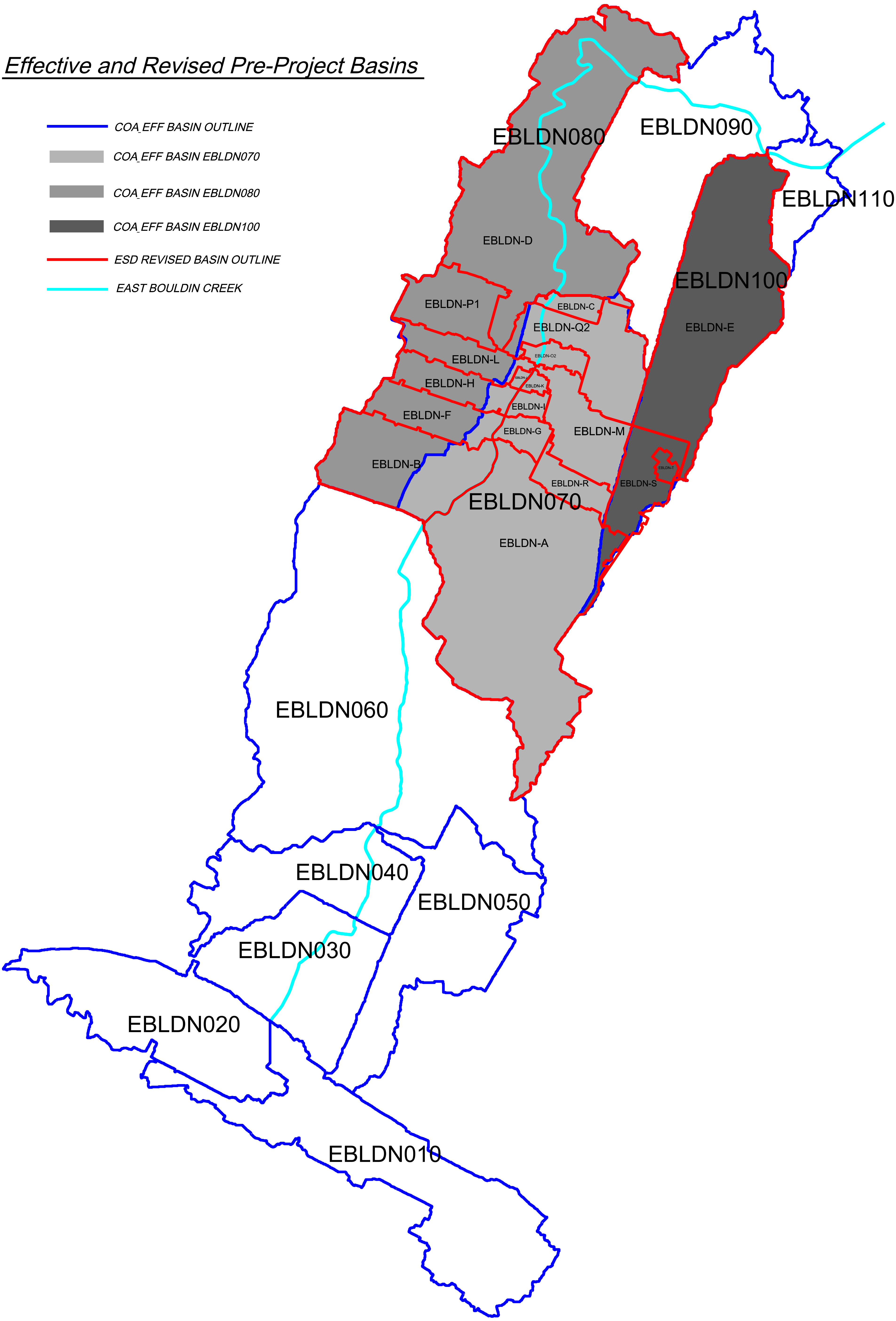
Exhibit G.4

Map of Revised Pre-Project HEC-HMS Elements

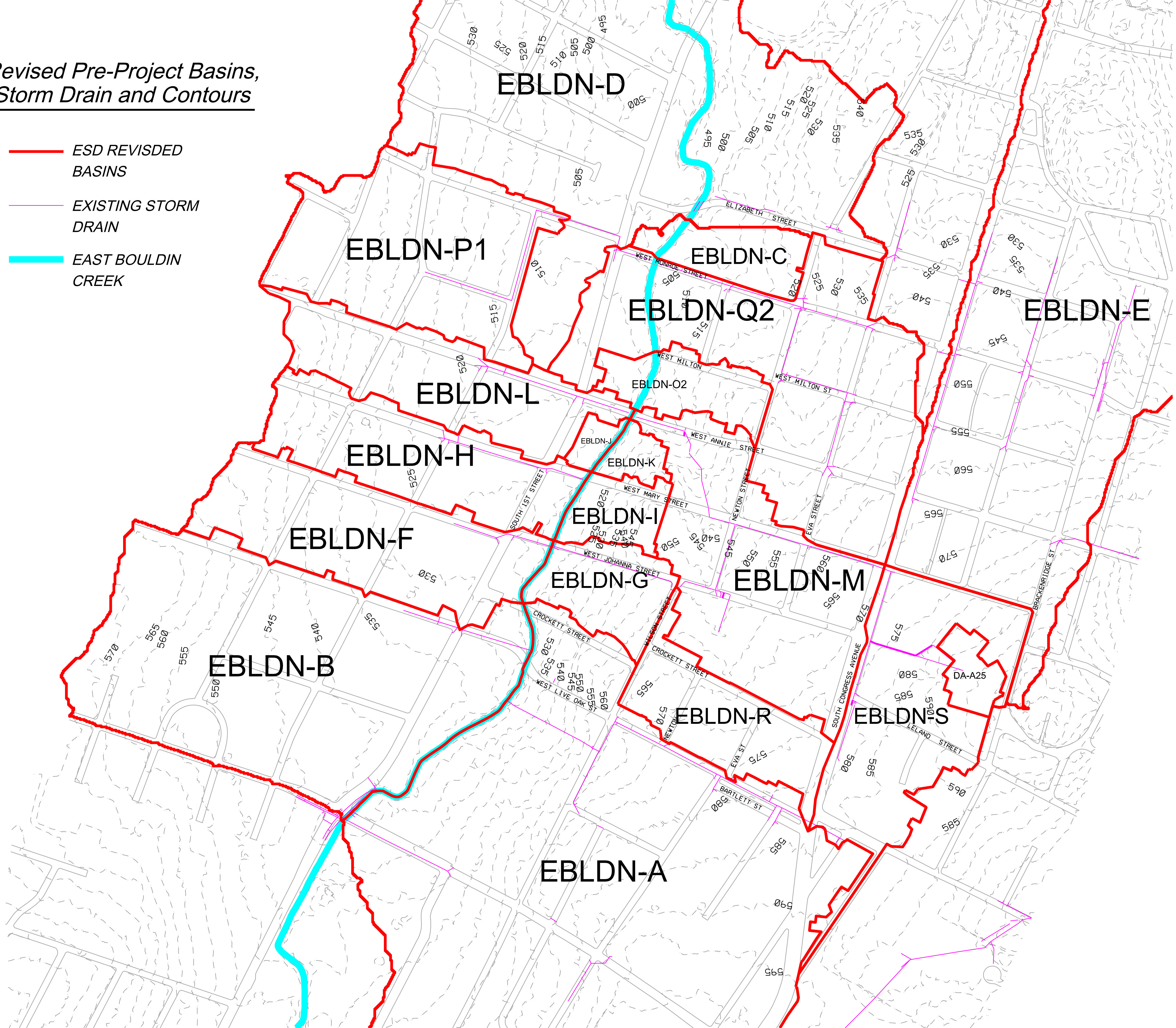
Effective HEC-HMS Model Basins

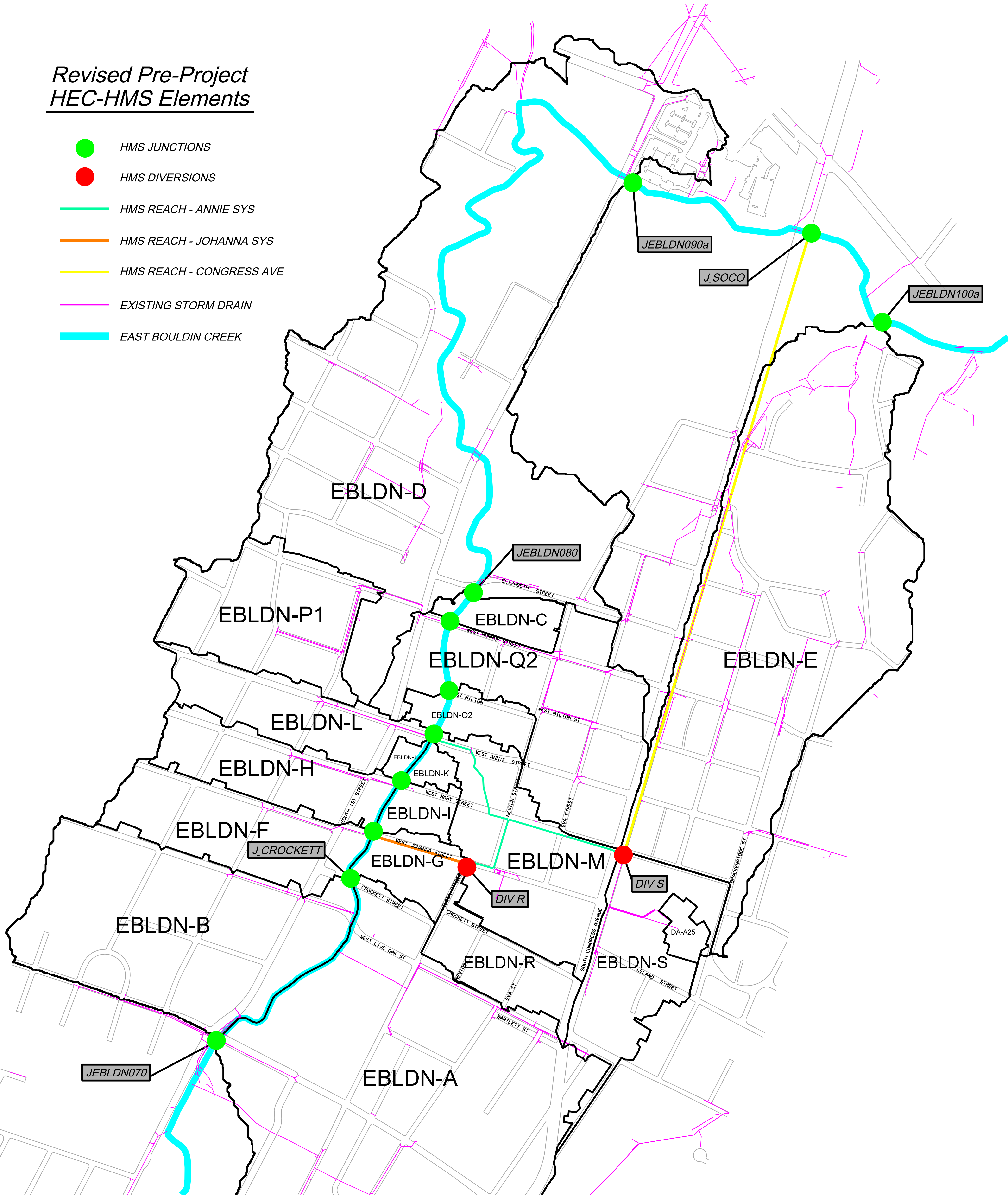


Effective and Revised Pre-Project Basins



Revised Pre-Project Basins, Storm Drain and Contours





Revised Pre-Project
HEC-HMS Elements
HMS JUNCTIONS
HMS DIVERSIONS
HMS REACH - ANNIE SYS
HMS REACH - JOHANNA SYS
HMS REACH - CONGRESS AVE
EXISTING STORM DRAIN
EAST BOULDIN CREEK
JEBLDN090a
J SOCO
JEBLDN100a
EBLDN-D
JEBLDN080
EBLDN-P1
EBLDN-C
EBLDN-Q2
EBLDN-E
EBLDN-O2
EBLDN-L
EBLDN-J
EBLDN-K
EBLDN-H
EBLDN-I
EBLDN-F
J CROCKETT
EBLDN-G
DIV R
EBLDN-M
DIV S
EBLDN-B
DA-A25
EBLDN-R
EBLDN-S
JEBLDN070
EBLDN-A
ELIZABETH STREET
WEST MONROE STREET
WEST MILTON ST
WEST ANNIE STREET
WEST MARY STREET
WEST JOHANNA STREET
CROCKETT STREET
WEST LIVE OAK ST
SOUTH 1ST STREET
NEWTON STREET
EVA STREET
SOUTH CONGRESS AVENUE
LELAND STREET
BARTLETT ST
BRACKENRIDGE ST

Exhibit G.5

Model Schematic

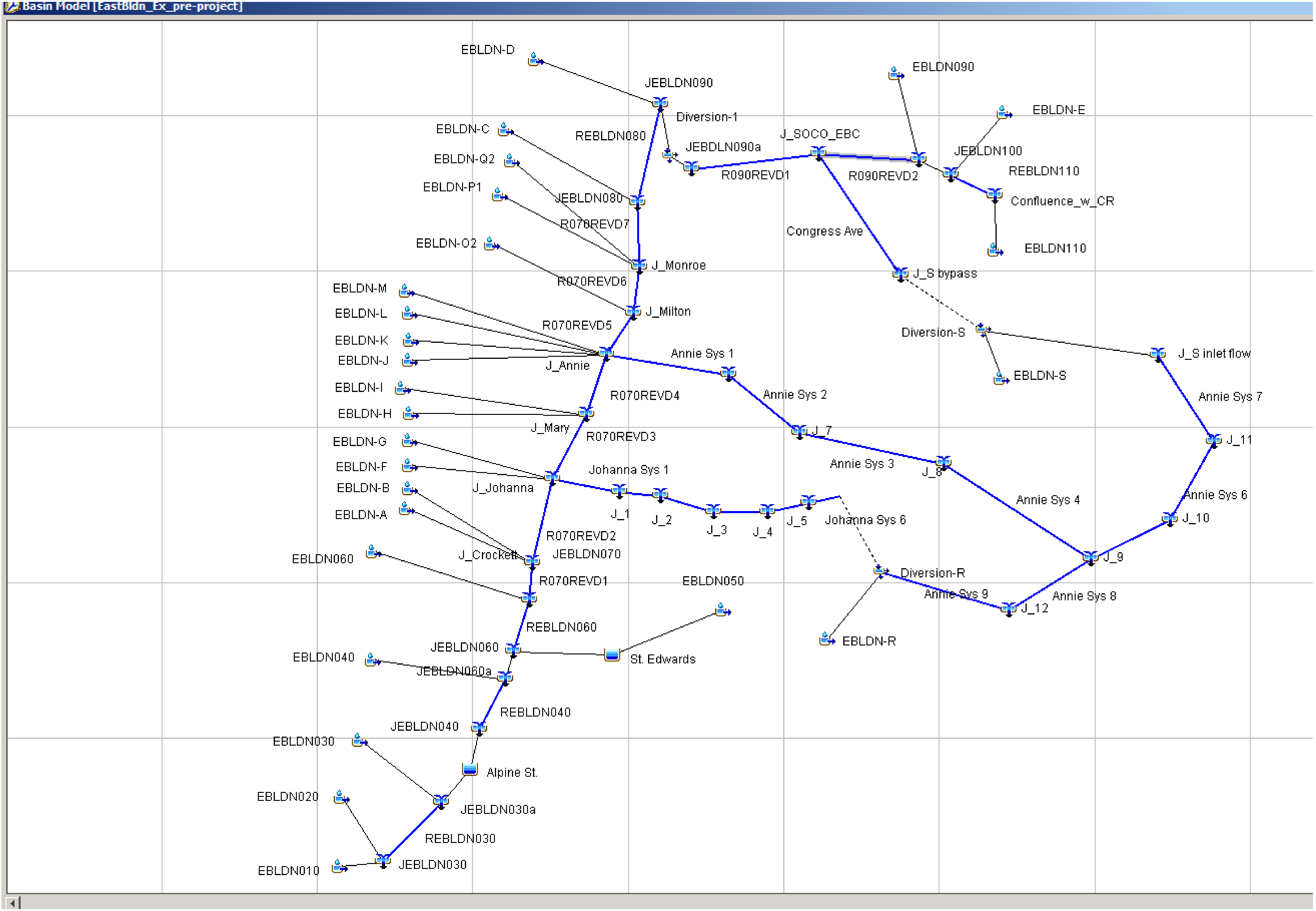

Basin Model [EastBldn_Ex_pre-project]
EBLDN-D
JEBLDN090
Diversion-1
EBLDN090
EBLDN-E
EBLDN-C
REBLDN080
JEBDLN090a
J_SOCO_EBC
JEBLDN100
EBLDN-Q2
R090REVD1
R090REVD2
REBLDN110
EBLDN-P1
JEBLDN080
Confluence_w_CR
R070REVD7
Congress Ave
EBLDN-O2
J_Monroe
EBLDN110
R070REVD6
J_S bypass
EBLDN-M
J_Milton
EBLDN-L
R070REVD5
Diversion-S
EBLDN-K
Annie Sys 1
J_S inlet flow
EBLDN-J
J_Annie
EBLDN-S
EBLDN-I
R070REVD4
Annie Sys 2
Annie Sys 7
EBLDN-H
J_Mary
J_7
R070REVD3
J_11
EBLDN-G
Annie Sys 3
EBLDN-F
Johanna Sys 1
J_8
EBLDN-B
J_Johanna
Annie Sys 4
Annie Sys 6
EBLDN-A
J_1
J_2
J_3
J_4
J_5
Johanna Sys 6
J_10
R070REVD2
J_Crockett
JEBLDN070
EBLDN060
J_9
R070REVD1
EBLDN050
Diversion-R
Annie Sys 9
Annie Sys 8
J_12
REBLDN060
EBLDN-R
JEBLDN060
EBLDN040
St. Edwards
JEBLDN060a
REBLDN040
JEBLDN040
EBLDN030
Alpine St.
EBLDN020
JEBLDN030a
REBLDN030
JEBLDN030
EBLDN010

Exhibit G.6

Area, Impervious Cover and Curve Number

Name	Area	Area	Area	Ex_%IC	Area 700	Area 800	Area not 700 or 800	Area Pervious 700	Area Pervious 800	%IC 700	%IC 800	Ult_%IC not 700 or 800	Ult_%IC	CN for Pervious Soil Type D
	SF	AC	sq mi		SF	SF	SF	SF	SF					
Calc Notes -->	(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
EBLDN-A	5539727	127.17	0.1987	61.0%	84482	1151318	4303927	57521	272478	32%	76%	80%	78.2%	80
EBLDN-B	1833447	42.09	0.0658	48.8%	0	397444	1436003	0	89020	0%	78%	77%	77.5%	80
EBLDN-C	193475	4.44	0.0069	31.0%	0	7279	186196	0	5659	0%	22%	69%	67.1%	80
EBLDN-D	5497139	126.20	0.1972	50.0%	173294	1041875	4281970	143659	311218	17%	70%	76%	73.2%	80
EBLDN-E	3811129	87.49	0.1367	57.0%	85483	1028071	2697575	81659	292774	4%	72%	79%	75.2%	80
EBLDN-F	734427	16.86	0.0263	53.3%	0	203634	530793	0	65059	0%	68%	71%	70.1%	80
EBLDN-G	248097	5.70	0.0089	42.0%	0	47777	200320	0	14797	0%	69%	66%	66.3%	80
EBLDN-H	579249	13.30	0.0208	53.6%	0	169827	409422	0	41860	0%	75%	73%	73.4%	80
EBLDN-I	141785	3.25	0.0051	43.4%	0	31799	109986	0	8258	0%	74%	66%	67.7%	80
EBLDN-J	42247	0.97	0.0015	46.6%	0	1120	41127	0	497	0%	56%	95%	94.0%	80
EBLDN-K	65108	1.49	0.0023	26.8%	0	1536	63572	0	1375	0%	10%	67%	65.6%	80
EBLDN-L	567898	13.04	0.0204	55.5%	0	186177	381721	0	43011	0%	77%	71%	72.8%	80
EBLDN-M	947265	21.75	0.0340	60.9%	0	296902	650363	0	57456	0%	81%	75%	76.8%	80
EBLDN-O2	214122	4.92	0.0077	46.3%	0	28668	185454	0	8203	0%	71%	73%	72.7%	80
EBLDN-P1	865081	19.86	0.0310	48.5%	0	241343	623738	0	80859	0%	66%	66%	65.8%	80
EBLDN-Q2	1292455	29.67	0.0464	58.6%	0	417645	874810	0	97176	0%	77%	76%	76.0%	80
EBLDN-R	393040	9.02	0.0141	58.5%	0	121890	271150	0	19452	0%	84%	71%	75.4%	80
EBLDN-S	753334	17.29	0.0270	67.2%	0	179946	573388	0	28718	0%	84%	83%	83.4%	80

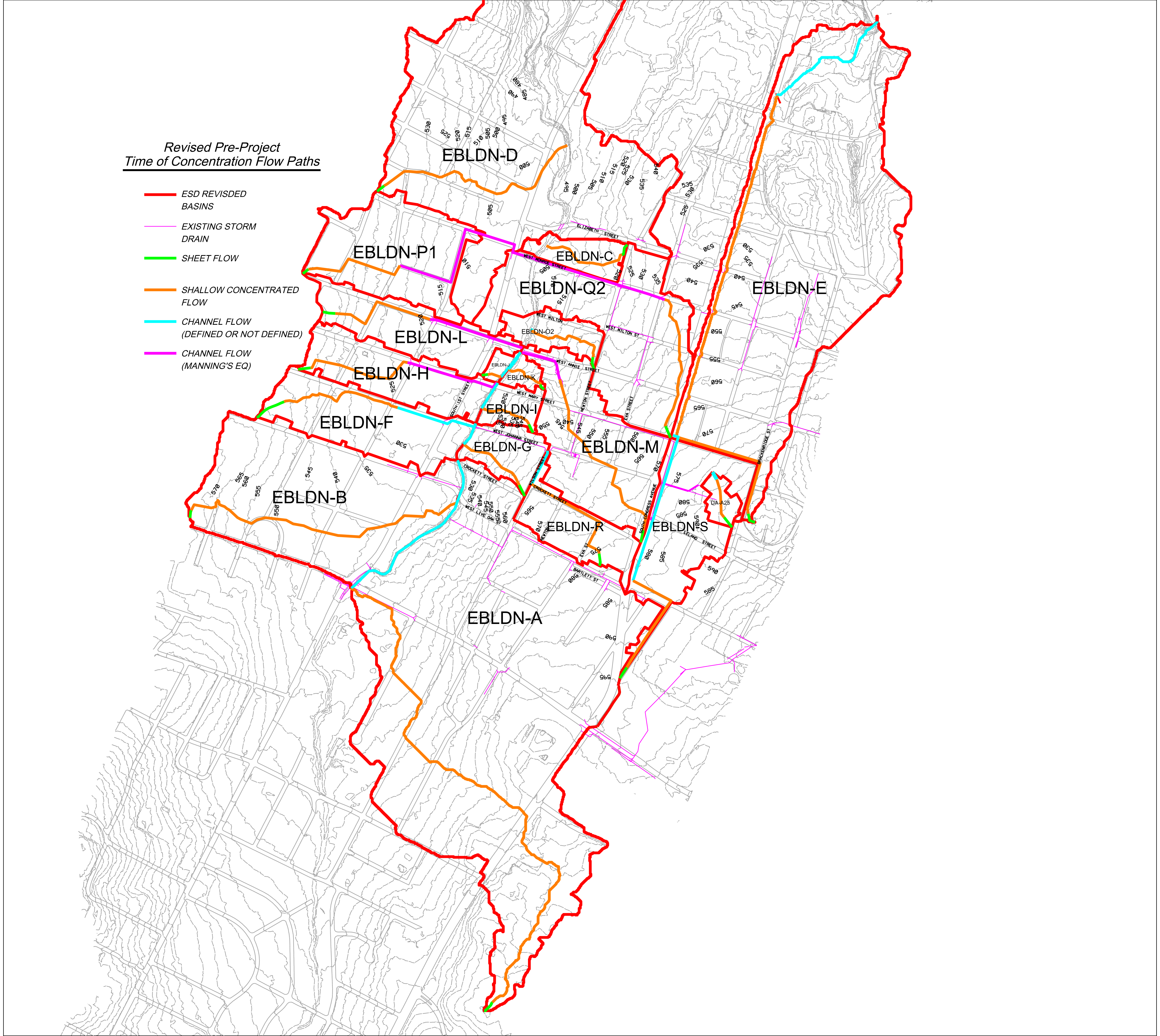
(1) Drainage Area
(2) Area (sq mi) = Area / 27,878,400
(3) Ex_%IC = 1 - (sum(remaining pervious area)) / Area
(4) Area 700 = area that is LU category 700
(5) Area 800 = area that is LU category 800
(6) Area not 700 or 800 = (Area) - (Area 700) - (Area 800)
(7) Area Pervious 700 = remaining pervious area within LU category 700
(8) Area Pervious 800 = remaining pervious area within LU category 800
(9) %IC 700 = 1 - (Area Pervious 700)/(Area 700)
(10) %IC 800 = 1 - (Area Pervious 800)/(Area 800)
(11) Ult_%IC not 700 or 800 = weighted average for area not within LU categories 700 or 800; see GIS Join Table for Impervious Cover percentages by Land Use Category
(12) Ult_%IC = weighted average of (9) , (10) and (11)
(13) Reference TR-55 Table 2-2a, Open Space Good Condition

GIS Join Table

LU	Ult_IC
100	0.65
111	0.65
200	0.80
201	0.88
300	0.95
330	0.95
430	0.95
600	0.80
601	0.80
602	0.88
700	N/A
800	N/A
870	0.86

Exhibit G.7

Lag Time


Revised Pre-Project
Time of Concentration Flow Paths
ESD REVISDED BASINS
EXISTING STORM DRAIN
SHEET FLOW
SHALLOW CONCENTRATED FLOW
CHANNEL FLOW (DEFINED OR NOT DEFINED)
CHANNEL FLOW (MANNING'S EQ)
EBLDN-D
EBLDN-P1
EBLDN-C
EBLDN-Q2
EBLDN-E
EBLDN-L
EBLDN-H
EBLDN-F
EBLDN-I
EBLDN-G
EBLDN-M
EBLDN-B
EBLDN-R
EBLDN-S
EBLDN-A

Lag Time Calculations for the East Bouldin Creek Watershed (Existing Conditions)

Sheet Flow

HMS Program Basin Name	Longest Flowpath (ft) (1)	Length (ft) (2)	IC% (3)	Land Use (4)	Surface Description (5)	Manning's roughness n (6)	Slope (ft/ft) (7)	Tt1 (min.) (8)
EBLDN-A	6,592	100	62	Single Family	Short Grass	0.15	0.015	10.60
EBLDN-B	2,866	63	49	SF, MF, Paved Surface	Dense grass	0.24	0.023	9.01
EBLDN-C	921	100	31	SF, Commercial, Paved Surface	Short Grass	0.15	0.023	8.94
EBLDN-D	6,305	72	50	SF, Mixed Use Paved Surface	Short Grass	0.15	0.018	7.55
EBLDN-E	5,536	100	57	SF, MF, Commercial, Mixed Use, Paved Surface	Asphalt	0.016	0.015	1.77
EBLDN-F	1,927	92	53	SF, Mixed Use	Short Grass	0.15	0.022	8.51
EBLDN-G	878	100	42	SF, Mixed Use, Paved Surface	Short Grass	0.15	0.038	7.31
EBLDN-H	1,772	100	54	SF, Mixed Use	Dense grass	0.24	0.005	23.96
EBLDN-I	739	75	43	SF, Mixed Use	Short Grass	0.15	0.009	10.24
EBLDN-J	416	52	47	Paved Surface	Concrete & Asphalt	0.0155	0.029	0.79
EBLDN-K	540	52	27	SF	Asphalt	0.016	0.081	0.54
EBLDN-L	1,797	100	55	SF, Mixed Use, Paved Surface	Dense grass	0.24	0.040	10.43
EBLDN-M	2,014	100	61	SF, MF, Mixed Use, Paved Surface	Asphalt	0.016	0.030	1.34
EBLDN-O2	923	100	46	SF, Mixed Use, Paved Surface	Asphalt	0.016	0.013	1.87
EBLDN-P1	2,464	58	48	SF, Mixed Use, Paved Surface	Short Grass	0.15	0.009	8.62
EBLDN-Q2	2,236	100	59	SF, Mixed Use, Paved Surface	Asphalt	0.016	0.027	1.40
EBLDN-R	1,357	100	58	SF, MF, Mixed Use, Paved Surface	Short Grass	0.15	0.026	8.51
EBLDN-S	2,354	100	67	SF, MF, Mixed Use, Fulmore MS,Paved Surface	Asphalt	0.016	0.015	1.77

Shallow Concentrated Flow

HMS Program Basin Name	Length 2 (ft) (9)	L2 paved (ft) (10)	L2 unpaved (ft) (11)	Slope 2 (ft/ft) (12)	Assumption for Tt2 (13)	Tt2 (paved) (min.) (13)	Tt2 (unpaved) (min.) (14)	Tt2 (min.) (15)
EBLDN-A	4,941	3,063	1,878	0.025	Paved & Unpaved	16.02	12.37	28.38
EBLDN-B	2,444	1,197	1,246	0.023	Paved & Unpaved	6.54	8.57	15.11
EBLDN-C	710	220	490	0.039	Paved & Unpaved	0.92	2.57	3.49
EBLDN-D	1,838	919	919	0.030	Paved & Unpaved	4.38	5.51	9.89
EBLDN-E	4,072	2,321	1,751	0.027	Paved & Unpaved	11.61	11.03	22.64
EBLDN-F	1,184	628	557	0.030	Paved & Unpaved	2.97	3.32	6.29
EBLDN-G	583	245	338	0.070	Paved & Unpaved	0.76	1.32	2.07
EBLDN-H	976	527	449	0.029	Paved & Unpaved	2.53	2.71	5.24
EBLDN-I	425	183	242	0.094	Paved & Unpaved	0.49	0.82	1.31
EBLDN-J	99	47	52	0.040	Paved & Unpaved	0.19	0.27	0.46
EBLDN-K	319	86	233	0.005	Paved & Unpaved	1.03	3.51	4.54
EBLDN-L	928	510	418	0.036	Paved & Unpaved	2.20	2.27	4.47
EBLDN-M	1,407	858	549	0.042	Paved & Unpaved	3.45	2.78	6.23
EBLDN-O2	666	307	360	0.060	Paved & Unpaved	1.02	1.51	2.54
EBLDN-P1	892	428	464	0.024	Paved & Unpaved	2.27	3.10	5.37
EBLDN-Q2	1,112	656	456	0.023	Paved & Unpaved	3.58	3.13	6.71
EBLDN-R	955	554	401	0.020	Paved & Unpaved	3.25	2.96	6.21
EBLDN-S	995	667	328	0.011	Paved & Unpaved	5.32	3.30	8.63

Channel Flow

HMS Program Basin Name	Length 3 (ft) (16)	Slope 3 (ft/ft) (17)	V (ft/s) (18)	Assumption for V (19)	Tt3 (sec) (20)	Tt3 (min.) (21)	**Tc (min) (22)**	**Final Tc (min) (23)**	**Tlag (min) (24)**	**Final Tlag (min) (25)**	**Total Flowpath Lenth (ft)**	Sub-basin
EBLDN-A	1,551	0.015	3.53	Defined Channel	439	7.32	46.31	46.31	27.78	27.8	6592	EBLDN-A
EBLDN-B	359	0.010	3.52	Defined Channel	102	1.70	25.82	25.82	15.49	15.5	2866	EBLDN-B
EBLDN-C	110	0.027	3.55	Defined Channel	31	0.52	12.94	12.94	7.77	7.8	921	EBLDN-C
EBLDN-D	4,395	0.010	3.52	Defined Channel	1248	20.79	38.23	38.23	22.94	22.9	6305	EBLDN-D
EBLDN-E	1,364	0.045	4.00	No Defined Channel	341	5.68	30.09	30.09	18.05	18.1	5536	EBLDN-E
EBLDN-F	651	0.022	3.00	No Defined Channel	217	3.62	18.42	18.42	11.05	11.1	1927	EBLDN-F
EBLDN-G	195	0.020	3.54	Defined Channel	55	0.92	10.30	10.30	6.18	6.2	878	EBLDN-G
EBLDN-H	696	0.027	8.58	Manning's Equation	81	1.35	30.56	30.56	18.34	18.3	1772	EBLDN-H
EBLDN-I	238	0.013	3.53	Defined Channel	68	1.13	12.68	12.68	7.61	7.6	739	EBLDN-I
EBLDN-J	265	0.038	3.57	Defined Channel	74	1.24	2.48	5.00	3.00	3.5	416	EBLDN-J
EBLDN-K	168	0.170	3.81	Defined Channel	44	0.74	5.81	5.81	3.49	3.5	540	EBLDN-K
EBLDN-L	769	0.010	7.70	Manning's Equation	100	1.66	16.57	16.57	9.94	9.9	1797	EBLDN-L
EBLDN-M	507	0.024	18.36	Manning's Equation	28	0.46	8.03	8.03	4.82	4.8	2014	EBLDN-M
EBLDN-O2	156	0.013	3.53	Defined Channel	44	0.74	5.15	5.15	3.09	3.5	923	EBLDN-O2
EBLDN-P1	1,514	0.014	10.68	Manning's Equation	142	2.36	16.35	16.35	9.81	9.8	2464	EBLDN-P1
EBLDN-Q2	1,024	0.039	12.57	Manning's Equation	81	1.36	9.47	9.47	5.68	5.7	2236	EBLDN-Q2
EBLDN-R	302	0.012	2.50	No Defined Channel	121	2.01	16.73	16.73	10.04	10.0	1357	EBLDN-R
EBLDN-S	1,259	0.012	2.50	No Defined Channel	504	8.39	18.79	18.79	11.27	11.3	2354	EBLDN-S

Notes:

Please refer to N:\Team3\WPD_EBC_Annie\DGN\Annie_EXIST_TC_021115.dgn for drainage sub-basins and times of concentration flow paths.

(1) Longest flow path equals sum of sheet, shallow concentrated and channel flow lengths.
(2) Sheet flow was considered to occur at short distances with a maximum of 100 feet for both natural (undeveloped) and developed conditions;
(3) Percent impervious cover calculations presented as part of HEC-HMS input data.
(4) Land use determined from 2012 aerial photography.
(5) Surface description (DCM Table 2-2)
(6) Manning's roughness n (DCM Table 2-2)
(7) Sheet flow slope = (US elevation - DS elevation) / overland flow length
(8) Sheet Flow Time of concentration (Tt1) = 0.42(nL)^08/((P2)^0.5 S^0.4) (DCM Eq. 2-3)
(9) Shallow concentrated flow length
(10) paved length = shallow concentrated paved length x IC% / 100
(11) unpaved length = shallow concentrated flow length - paved length
(12) slope = (US elevation - DS elevation) / shallow concentrated flow length
(13) Tt2 (Paved) = L/60(20.3282)(S)^0.5 DCM Eq. 2-5
(14) Tt2 (Unpaved) = L/60(16.1345)(S)^0.5 DCM Eq. 2-4
(15) = (13) + (14)
(16) Total Channel flow length
(18) Channel velocity equations were determined by statistical analysis on the existing HEC-RAS models for East Bouldin Creek
East Bouldin Main Channel Velocity Equation (Halff Associates, July 2005) = 178.89 *(slope 2/100)+3.5055 (For "no defined channel" flow paths, velocity is assumed 2.5 - 4.0 fps based on channel slope)
Manning's equation is used for storm drain system velocity calculations assuming pipe flowing full (V=Vfull/Area). See Manning's Equation calculation sheet.
(19) Channel flow assumptions
(20) T = L / V in seconds
(21) Channel Time of Concentration = time in seconds / 60
(22) Tc = Sheet Flow Time of Concentration (Tt1) + Shallow Concentrated Flow (Tt2)+Channel Flow Time of Concentration (Tt3)
(23) If Tc > 5 minutes, Tc = Final Tc, else Final Tc = 5 minutes
(24) Lag Time (T lag) = 0.6* Final Tc (Soil Conservation Service)
(25) A minimum lag time of 3.5 minutes is required by HMS so that lag*0.29 is greater than the minimum time step of 1 min

The following Data were collected from City of Austin Watershed Protection Department GIS information (Drainage Pipe)

Manning's Calculation (Existing Land Use Conditions) n = 0.013

EBLDN-P1&P2

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	24	308	520.13	511.00	0.0296	2.96	38.92	3.14	12.39	0.20	2.52
2	24	91	511.00	507.65	0.0368	3.68	43.39	3.14	13.82	0.06	0.83
3	24	39	507.43	506.00	0.0367	3.67	43.34	3.14	13.80	0.03	0.36
4	42	242	504.50	502.72	0.0074	0.74	86.54	9.62	9.00	0.16	1.44
5	42	150	502.72	501.61	0.0074	0.74	86.54	9.62	9.00	0.10	0.89
6	42	48	501.61	501.26	0.0073	0.73	85.96	9.62	8.94	0.03	0.28
7	42	148	501.26	499.79	0.0099	0.99	100.10	9.62	10.41	0.10	1.02
8	42	256	499.75	497.20	0.00996	0.996	100.40	9.62	10.44	0.17	1.76
9	42	40	497.20	496.90	0.0075	0.75	87.13	9.62	9.06	0.03	0.24
10	42	6	496.90	496.86	0.0067	0.67	82.35	9.62	8.56	0.00	0.03
11	42	15	496.86	496.75	0.0073	0.73	85.96	9.62	8.94	0.01	0.09
12	42	40	496.75	496.44	0.0078	0.78	88.85	9.62	9.24	0.03	0.24
13	42	131	496.44	494.92	0.0116	1.16	108.35	9.62	11.26	0.09	0.97
	Total	**1,514**								**1.00**	**10.68**

EBLDN-Q2

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	30	358.79	-	-	0.0290	2.90	69.85	4.91	14.23	0.35	4.98
2	30	344.47	-	-	0.0290	2.90	69.85	4.91	14.23	0.34	4.79
3	15	320.8	-	-	0.0290	2.90	11.00	1.23	8.94	0.31	2.80
Note: Average channel slope is assumed for unknown U.S./D.S. Flow Elevations											
	Total	**1,024**								**1.00**	**12.57**

EBLDN-L

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope* (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	18	33	-	-	0.0100	1.00	17.89	1.77	10.11	0.04	0.43
2	18	27	-	-	0.0100	1.00	17.89	1.77	10.11	0.04	0.35
3	36	87	511.56	511.01	0.0063	0.63	52.94	7.07	7.49	0.11	0.85
4	36	359	511.01	508.92	0.0058	0.58	50.79	7.07	7.18	0.47	3.35
5	36	34	508.86	508.65	0.0062	0.62	52.52	7.07	7.43	0.04	0.33
6	36	229	508.65	507.00	0.0072	0.72	56.59	7.07	8.00	0.30	2.38
Note: Average channel slope is assumed for unknown U.S./D.S. Flow Elevations											
	Total	**769**								**1.00**	**7.70**

EBLDN-M

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	36	172	507.48	501.75	0.0333	3.33	121.71	7.07	17.21	0.34	5.85
2	36	88	511.00	507.48	0.0400	4.00	133.39	7.07	18.87	0.17	3.28
3	36	31	-	-	**0.0500**	**5.00**	149.13	7.07	21.09	0.06	1.29
4	30	215.5	-	-	**0.0500**	**5.00**	91.71	4.91	18.68	0.43	7.95
Note: Average channel slope was changed from 0.051 to 0.050 based on StormCAD											
Total		**507**								**1.00**	**18.36**

EBLDN-H

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	18	10	-	-	**0.0230**	**2.30**	**15.93**	**1.77**	9.00	0.01	0.13
2	30	8	-	-	**0.0230**	**2.30**	**62.20**	**4.91**	12.67	0.01	0.15
3	30	5	-	-	**0.0230**	2.30	**62.20**	**4.91**	12.67	0.01	0.09
4	30	17	-	-	**0.0230**	2.30	**62.20**	**4.91**	12.67	0.02	0.31
5	36	44	516.72	516.51	**0.0048**	**0.48**	**46.21**	**7.07**	6.54	0.06	0.41
6	36	58	516.51	516.22	**0.0050**	**0.50**	**47.16**	**7.07**	6.67	0.08	0.56
7	36	341	516.22	514.51	**0.0050**	**0.50**	**47.16**	**7.07**	6.67	0.49	3.27
8	36	18	514.51	514.42	**0.0050**	**0.50**	**47.16**	**7.07**	6.67	0.03	0.17
9	36	19	514.42	514.10	**0.0168**	**1.68**	**86.45**	**7.07**	12.23	0.03	0.33
10	36	176	514.10	511.00	**0.0176**	**1.76**	**88.48**	**7.07**	12.51	0.25	3.16
Note: Average channel slope is assumed for unknown U.S./D.S. Flow Elevations											
Total		**696**								**1.00**	**8.58**

Lag Time Calculations for the East Bouldin Creek Watershed (Ultimate Conditions)

HMS Program Basin Name	Longest Flowpath (ft) (1)	Sheet Flow: Length (ft) (2)	IC% (3)	Land Use (4)	Surface Description (5)	Manning's roughness n (6)	Slope (ft/ft) (7)	Tt1 (min.) (8)
EBLDN-A	6,592	100	79	Single Family	Short Grass	0.15	0.015	10.60
EBLDN-B	2,866	63	78	SF, MF, Paved Surface	Dense grass	0.24	0.023	9.01
EBLDN-C	921	100	67	SF, Commercial, Paved Surface	Short Grass	0.15	0.023	8.94
EBLDN-D	6,305	72	73	SF, Mixed Use Paved Surface	Short Grass	0.15	0.018	7.55
EBLDN-E	5,536	100	75	SF, MF, Commercial, Mixed Use, Paved Surface	Asphalt	0.016	0.015	1.77
EBLDN-F	1,927	92	70	SF, Mixed Use	Short Grass	0.15	0.022	8.51
EBLDN-G	878	100	66	SF, Mixed Use, Paved Surface	Short Grass	0.15	0.038	7.31
EBLDN-H	1,772	100	73	SF, Mixed Use	Dense grass	0.24	0.005	23.96
EBLDN-I	739	75	68	SF, Mixed Use	Short Grass	0.15	0.009	10.24
EBLDN-J	416	52	94	Paved Surface	Concrete & Asphalt	0.0155	0.029	0.79
EBLDN-K	540	52	66	SF	Asphalt	0.016	0.081	0.54
EBLDN-L	1,797	100	73	SF, Mixed Use, Paved Surface	Dense grass	0.24	0.040	10.43
EBLDN-M	2,014	100	77	SF, MF, Mixed Use, Paved Surface	Asphalt	0.016	0.030	1.34
EBLDN-O2	923	100	73	SF, Mixed Use, Paved Surface	Asphalt	0.016	0.013	1.87
EBLDN-P1	2,464	58	66	SF, Mixed Use, Paved Surface	Short Grass	0.15	0.009	8.62
EBLDN-Q2	2,236	100	76	SF, Mixed Use, Paved Surface	Asphalt	0.016	0.027	1.40
EBLDN-R	1,357	100	75	SF, MF, Mixed Use, Paved Surface	Short Grass	0.15	0.026	8.51
EBLDN-S	2,354	100	83	SF, MF, Mixed Use, Fulmore MS,Paved Surface	Asphalt	0.016	0.015	1.77

HMS Program Basin Name	Shallow Concentrated Flow: Length 2 (ft) (9)	L2 paved (ft) (10)	L2 unpaved (ft) (11)	Slope 2 (ft/ft) (12)	Assumption for Tt2 (13)	Tt2 (paved) (min.) (13)	Tt2 (unpaved) (min.) (14)	Tt2 (min.) (15)
EBLDN-A	4,941	3,903	1,038	0.025	Paved & Unpaved	20.41	6.83	27.24
EBLDN-B	2,444	1,906	538	0.023	Paved & Unpaved	10.41	3.70	14.11
EBLDN-C	710	476	234	0.039	Paved & Unpaved	1.98	1.23	3.21
EBLDN-D	1,838	1,342	496	0.030	Paved & Unpaved	6.39	2.98	9.37
EBLDN-E	4,072	3,054	1,018	0.027	Paved & Unpaved	15.27	6.41	21.69
EBLDN-F	1,184	829	355	0.030	Paved & Unpaved	3.93	2.12	6.05
EBLDN-G	583	385	198	0.070	Paved & Unpaved	1.19	0.77	1.96
EBLDN-H	976	712	264	0.029	Paved & Unpaved	3.42	1.59	5.01
EBLDN-I	425	289	136	0.094	Paved & Unpaved	0.78	0.46	1.23
EBLDN-J	99	93	6	0.040	Paved & Unpaved	0.38	0.03	0.41
EBLDN-K	319	211	108	0.005	Paved & Unpaved	2.52	1.63	4.15
EBLDN-L	928	677	251	0.036	Paved & Unpaved	2.92	1.36	4.28
EBLDN-M	1,407	1,083	324	0.042	Paved & Unpaved	4.36	1.64	5.99
EBLDN-O2	666	486	180	0.060	Paved & Unpaved	1.62	0.76	2.38
EBLDN-P1	892	589	303	0.024	Paved & Unpaved	3.12	2.03	5.15
EBLDN-Q2	1,112	845	267	0.023	Paved & Unpaved	4.61	1.83	6.45
EBLDN-R	955	716	239	0.020	Paved & Unpaved	4.20	1.76	5.96
EBLDN-S	995	826	169	0.011	Paved & Unpaved	6.59	1.70	8.29

HMS Program Basin Name	Channel Flow: Length 3 (ft) (16)	Slope 3 (ft/ft) (17)	V (ft/s) (18)	Assumption for V (19)	Tt3 (sec) (20)	Tt3 (min.) (21)	**Tc (min) (22)**	**Final Tc (min) (23)**	**Tlag (min) (24)**	**Final Tlag (min) (25)**	**Total Flowpath Length (ft)**	Sub-basin
EBLDN-A	1,551	0.015	3.53	Defined Channel	439	7.32	45.17	45.17	27.10	27.1	6592	EBLDN-A
EBLDN-B	359	0.010	3.52	Defined Channel	102	1.70	24.81	24.81	14.89	14.9	2866	EBLDN-B
EBLDN-C	110	0.027	3.55	Defined Channel	31	0.52	12.67	12.67	7.60	7.6	921	EBLDN-C
EBLDN-D	4,395	0.010	3.52	Defined Channel	1248	20.79	37.70	37.70	22.62	22.6	6305	EBLDN-D
EBLDN-E	1,364	0.045	4.00	No Defined Channel	341	5.68	29.14	29.14	17.48	17.5	5536	EBLDN-E
EBLDN-F	651	0.022	3.00	No Defined Channel	217	3.62	18.18	18.18	10.91	10.9	1927	EBLDN-F
EBLDN-G	195	0.020	3.54	Defined Channel	55	0.92	10.19	10.19	6.11	6.1	878	EBLDN-G
EBLDN-H	696	0.027	8.58	Manning's Equation	81	1.35	30.33	30.33	18.20	18.2	1772	EBLDN-H
EBLDN-I	238	0.013	3.53	Defined Channel	68	1.13	12.60	12.60	7.56	7.6	739	EBLDN-I
EBLDN-J	265	0.038	3.57	Defined Channel	74	1.24	2.43	5.00	3.00	3.5	416	EBLDN-J
EBLDN-K	168	0.170	3.81	Defined Channel	44	0.74	5.42	5.42	3.25	3.5	540	EBLDN-K
EBLDN-L	769	0.010	7.70	Manning's Equation	100	1.66	16.38	16.38	9.83	9.8	1797	EBLDN-L
EBLDN-M	507	0.024	18.36	Manning's Equation	28	0.46	7.80	7.80	4.68	4.7	2014	EBLDN-M
EBLDN-O2	156	0.013	3.53	Defined Channel	44	0.74	4.99	5.00	3.00	3.5	923	EBLDN-O2
EBLDN-P1	1,514	0.014	10.68	Manning's Equation	142	2.36	16.13	16.13	9.68	9.7	2464	EBLDN-P1
EBLDN-Q2	1,024	0.039	12.57	Manning's Equation	81	1.36	9.20	9.20	5.52	5.5	2236	EBLDN-Q2
EBLDN-R	302	0.012	2.50	No Defined Channel	121	2.01	16.48	16.48	9.89	9.9	1357	EBLDN-R
EBLDN-S	1,259	0.012	2.50	No Defined Channel	504	8.39	18.46	18.46	11.07	11.1	2354	EBLDN-S

Notes:

Please refer to N:\Team3\WPD_EBC_Annie\DGN\Annie_EXIST_TC_021115.dgn for drainage sub-basins and times of concentration flow paths.
(1) Longest flow path equals sum of sheet, shallow concentrated and channel flow lengths.
(2) Sheet flow was considered to occur at short distances with a maximum of 100 feet for both natural (undeveloped) and developed conditions;
(3) Percent impervious cover calculations presented as part of HEC-HMS input data.
(4) Land use determined from 2012 aerial photography.
(5) Surface description (DCM Table 2-2)
(6) Manning's roughness n (DCM Table 2-2)
(7) Sheet flow slope = (US elevation - DS elevation) / overland flow length
(8) Sheet Flow Time of concentration (Tt1) = 0.42(nL)^08/((P2)^0.5 S^0.4) (DCM Eq. 2-3)
(9) Shallow concentrated flow length
(10) paved length = shallow concentrated paved length x IC% / 100
(11) unpaved length = shallow concentrated flow length - paved length
(12) slope = (US elevation - DS elevation) / shallow concentrated flow length
(13) Tt2 (Paved) = L/60(20.3282)(S)^0.5) DCM Eq. 2-5
(14) Tt2 (Unpaved) = L/60(16.1345)(S)^0.5) DCM Eq. 2-4
(15) = (13) + (14)
(16) Total Channel flow length
(18) Channel velocity equations were determined by statistical analysis on the existing HEC-RAS models for East Bouldin Creek
East Bouldin Main Channel Velocity Equation (Halff Associates, July 2005) = 178.89 *(slope 2/100)+3.5055 (For "no defined channel" flow paths, velocity is assumed 2.5 - 4.0 fps based on channel slope)
Manning's equation is used for storm drain system velocity calculations assuming pipe flowing full (V=Vfull/Area). See Manning's Equation calculation sheet.
(19) Channel flow assumptions
(20) T = L / V in seconds
(21) Channel Time of Concentration = time in seconds / 60
(22) Tc = Sheet Flow Time of Concentration (Tt1) + Shallow Concentrated Flow (Tt2)+Channel Flow Time of Concentration (Tt3)

The following Data were collected from City of Austin Watershed Protection Department GIS information (Drainage Pipe)

Manning's Calculation (Ultimate Development Land Use Conditions) n = 0.013

EBLDN-P1&P2

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	24	308	520.13	511.00	0.0296	2.96	38.92	3.14	12.39	0.20	2.52
2	24	91	511.00	507.65	0.0368	3.68	43.39	3.14	13.82	0.06	0.83
3	24	39	507.43	506.00	0.0367	3.67	43.34	3.14	13.80	0.03	0.36
4	42	242	504.50	502.72	0.0074	0.74	86.54	9.62	9.00	0.16	1.44
5	42	150	502.72	501.61	0.0074	0.74	86.54	9.62	9.00	0.10	0.89
6	42	48	501.61	501.26	0.0073	0.73	85.96	9.62	8.94	0.03	0.28
7	42	148	501.26	499.79	0.0099	0.99	100.10	9.62	10.41	0.10	1.02
8	42	256	499.75	497.20	0.00996	0.996	100.40	9.62	10.44	0.17	1.76
9	42	40	497.20	496.90	0.0075	0.75	87.13	9.62	9.06	0.03	0.24
10	42	6	496.90	496.86	0.0067	0.67	82.35	9.62	8.56	0.00	0.03
11	42	15	496.86	496.75	0.0073	0.73	85.96	9.62	8.94	0.01	0.09
12	42	40	496.75	496.44	0.0078	0.78	88.85	9.62	9.24	0.03	0.24
13	42	131	496.44	494.92	0.0116	1.16	108.35	9.62	11.26	0.09	0.97
	Total	**1,514**								**1.00**	**10.68**

EBLDN-Q2

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	30	358.79	-	-	0.0290	2.90	69.85	4.91	14.23	0.35	4.98
2	30	344.47	-	-	0.0290	2.90	69.85	4.91	14.23	0.34	4.79
3	15	320.8	-	-	0.0290	2.90	11.00	1.23	8.94	0.31	2.80
Note: Average channel slope is assumed for unknown U.S./D.S. Flow Elevations											
	Total	**1,024**								**1.00**	**12.57**

EBLDN-L

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope* (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	18	33	-	-	0.0100	1.00	17.89	1.77	10.11	0.04	0.43
2	18	27	-	-	0.0100	1.00	17.89	1.77	10.11	0.04	0.35
3	36	87	511.56	511.01	0.0063	0.63	52.94	7.07	7.49	0.11	0.85
4	36	359	511.01	508.92	0.0058	0.58	50.79	7.07	7.18	0.47	3.35
5	36	34	508.86	508.65	0.0062	0.62	52.52	7.07	7.43	0.04	0.33
6	36	229	508.65	507.00	0.0072	0.72	56.59	7.07	8.00	0.30	2.38
Note: Average channel slope is assumed for unknown U.S./D.S. Flow Elevations											
	Total	**769**								**1.00**	**7.70**

EBLDN-M

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	36	172	507.48	501.75	0.0333	3.33	121.71	7.07	17.21	0.34	5.85
2	36	88	511.00	507.48	0.0400	4.00	133.39	7.07	18.87	0.17	3.28
3	36	31	-	-	**0.0500**	**5.00**	149.13	7.07	21.09	0.06	1.29
4	30	215.5	-	-	**0.0500**	**5.00**	91.71	4.91	18.68	0.43	7.95
Note: Average channel slope was changed from 0.051 to 0.050 based on StormCAD											
	Total	**507**								**1.00**	**18.36**

EBLDN-H

Segment	Pipe Size (in)	Length (ft)	Upstream Flow El. (ft)	Downstream Flow El. (ft)	Slope (ft/ft)	Slope (%)	Flow Capacity (cfs)	Flow Area (s.f.)	Vfull (fps)	Li/Ltotal	Average V (ft/s)
1	18	10	-	-	**0.0230**	**2.30**	**15.93**	**1.77**	9.00	0.01	0.13
2	30	8	-	-	**0.0230**	**2.30**	**62.20**	**4.91**	12.67	0.01	0.15
3	30	5	-	-	**0.0230**	2.30	**62.20**	**4.91**	12.67	0.01	0.09
4	30	17	-	-	**0.0230**	2.30	**62.20**	**4.91**	12.67	0.02	0.31
5	36	44	516.72	516.51	**0.0048**	**0.48**	**46.21**	**7.07**	6.54	0.06	0.41
6	36	58	516.51	516.22	**0.0050**	**0.50**	**47.16**	**7.07**	6.67	0.08	0.56
7	36	341	516.22	514.51	**0.0050**	**0.50**	**47.16**	**7.07**	6.67	0.49	3.27
8	36	18	514.51	514.42	**0.0050**	**0.50**	**47.16**	**7.07**	6.67	0.03	0.17
9	36	19	514.42	514.10	**0.0168**	**1.68**	**86.45**	**7.07**	12.23	0.03	0.33
10	36	176	514.10	511.00	**0.0176**	**1.76**	**88.48**	**7.07**	12.51	0.25	3.16
Note: Average channel slope is assumed for unknown U.S./D.S. Flow Elevations											
	Total	**696**								**1.00**	**8.58**

Exhibit G.8

Routing Steps

Routing Step Calculations

COA_Eff_REV2 Time Step = 1 mins
Eff_COA time step = 2 mins

Reach Name	Length (1)	Slope (2)	Average Velocity (3)	Steps (4)	Rounded Steps (Subreaches) (5)	Steps in Effective model
REBLDN030	1950		7.07	4.60	5.0	3
REBLDN040	1331		6.44	3.44	4.0	2
REBLDN060	4490		7.29	10.27	11.0	6
R070REVD1	1608	0.015	6.14	4.37	5.0	
R070REVD2	366	0.018	6.77	0.90	1.0	
R070REVD3	398	0.013	5.81	1.14	2.0	
R070REVD4	382	0.010	5.24	1.21	2.0	
R070REVD5	314	0.009	5.19	1.01	2.0	
R070REVD6	467	0.003	4.02	1.94	2.0	
R070REVD7	250	0.022	7.40	0.56	1.0	
REBLDN080	5214		6.18	14.06	15.0	8
R090REVD1	1315	0.005	4.41	4.97	5.0	
R090REVD2	882	0.006	4.58	3.21	4.0	
REBLDN110	1098		4.44	4.12	5.0	3

(1) Length of main channel measured on DGN file or providedin 2005 study
(2) Average slope computed from RAS channel invert slopes
(3) Equation developed in 2005 study: average channel velocity = 179.98 * (channel slope) + 3.5055
(4) Steps = (length) / (Velocity * time step)
(5) steps rounded up
Note: The Revised Pre-project model uses a 1-minute time step due to shorter lag times as compared to the Effective model. HEC-HMS warning message 47184 states that the simulation time interval should not be greater than 0.29 x lag time. See Section 9.1 of the report for further discussion.

Exhibit G.9

Storage-Discharge Functions

Ref file Floodpro\Floodpro_models_20140919\East_Bouldin_ESD Revised\RAS routing run

RAS Stations used for Storage-Discharge Functions

	RAS Reach	Upstream RAS Cross Section	Upstream HMS Junction	RAS Reach	Downstream RAS Cross Section	Downstream HMS Junction	HEC_DSS file name
R070REVD1 - Culvert Split	Culvert Split	12685	JEBLDN070	Reach 3	12071	N/A	12071
R070REVD1 - Reach 2/3	Reach 2	12685	JEBLDN070	Reach 3	10809	J_Crockett	10809
R070REVD2	Reach 3	10809	J_Crockett	Reach 3	10559	J_Johanna	10559
R070REVD3	Reach 3	10559	J_Johanna	Reach 3	10203	J_Mary	10203
R070REVD4	Reach 3	10203	J_Mary	Reach 3	9840	J_Annie	9840
R070REVD5	Reach 3	9840	J_Annie	Reach 3	9537	J_Milton	9537
R070REVD6	Reach 3	9537	J_Milton	Reach 3	9081	J_Monroe	9081
R070REVD7	Reach 3	9081	J_Monroe	Reach 3	8857	JEBLDN080	8857
R090REVD1	Reach 3	4022	JEBLDN090	Reach 3	2447	J_SOCO	2447
R090REVD2	Reach 3	2447	J_SOCO	Reach 3	1823	JEBLDN100a	1823

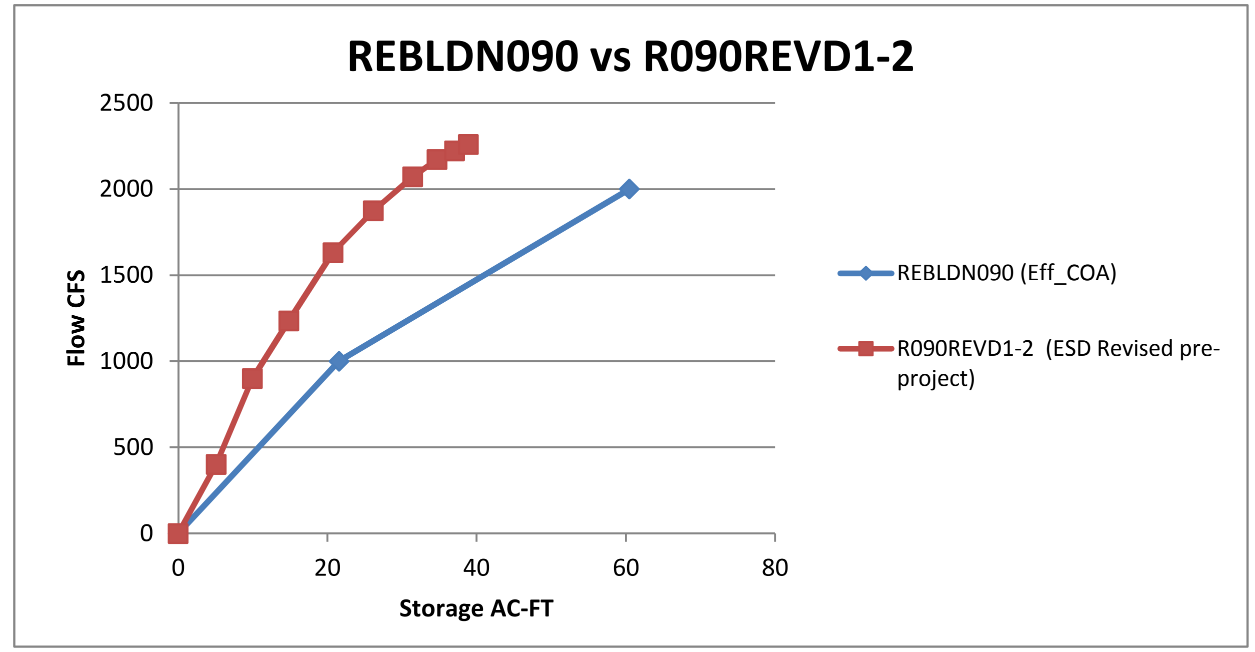
Culvert Split 12071 AC-FT	Reach 2/3 10809 AC-FT	Total Storage R070REVD1 AC-FT	Flow CFS
0.00	0.00	0.00	0
0.71	3.70	4.41	400
1.08	4.98	6.06	900
1.22	7.78	9.00	1300
1.23	13.39	14.62	1900
1.23	17.33	18.57	2400
1.23	20.90	22.14	2900
1.23	24.23	25.47	3400
1.23	27.72	28.95	3900
1.23	31.82	33.05	4400

R070REVD2 10559 AC-FT	R070REVD3 10203 AC-FT	R070REVD4 9840 AC-FT	R070REVD5 9537 AC-FT	R070REVD6 9081 AC-FT	R070REVD7 8857 AC-FT	Flow CFS
0.00	0.00	0.00	0.00	0.00	0.00	0
0.43	0.54	0.58	0.54	1.31	0.39	400
0.86	1.00	1.10	1.05	2.63	0.74	900
1.30	1.44	1.56	1.32	3.20	1.04	1300
1.96	2.21	2.39	1.85	4.05	1.47	1900
2.43	2.86	2.99	2.27	4.70	1.85	2400
2.84	3.44	3.52	2.67	5.33	2.34	2900
3.26	3.98	4.04	3.15	6.09	2.88	3400
3.66	4.48	4.48	3.73	7.03	3.39	3900
4.05	5.01	4.92	4.35	8.17	3.91	4400

R090REVD1 2447 AC-FT	R090REVD2 1823 AC-FT	Flow CFS
0	0.00	0.00
3.90	1.18	400.00
7.90	2.05	900.00
12.28	2.53	1233.60
17.46	3.27	1631.20
22.27	3.90	1874.50
26.98	4.45	2071.50
29.99	4.71	2172.00
32.20	4.83	2222.30
33.97	4.93	2258.30

Effective Model Storage-Discharge Functions vs Revised Pre-Project Storage-Discharge Functions

Total Storage 4022 t0 1823 REBLDN090 AC-FT	Routing Table in HMS Eff_COA for storage AC-FT	flow CFS
0	0	0
5.0798	21.56	1000
9.949	60.46	2000
14.8126	275.42	5000
20.7281	391.86	7000
26.1701		
31.4334		
34.6988		
37.0387		
38.8933		



Total Storage 12685 to 8857 REBLDN070 AC-FT	Routing Table in HMS Eff_COA for REBLDN070 storage AC-FT	flow CFS
0		
8.20	0	0
13.44	15.62	1000
18.87	28.89	2000
28.55	59.79	5000
35.66	84.08	7000
42.29		
48.85		
55.73		
63.47		

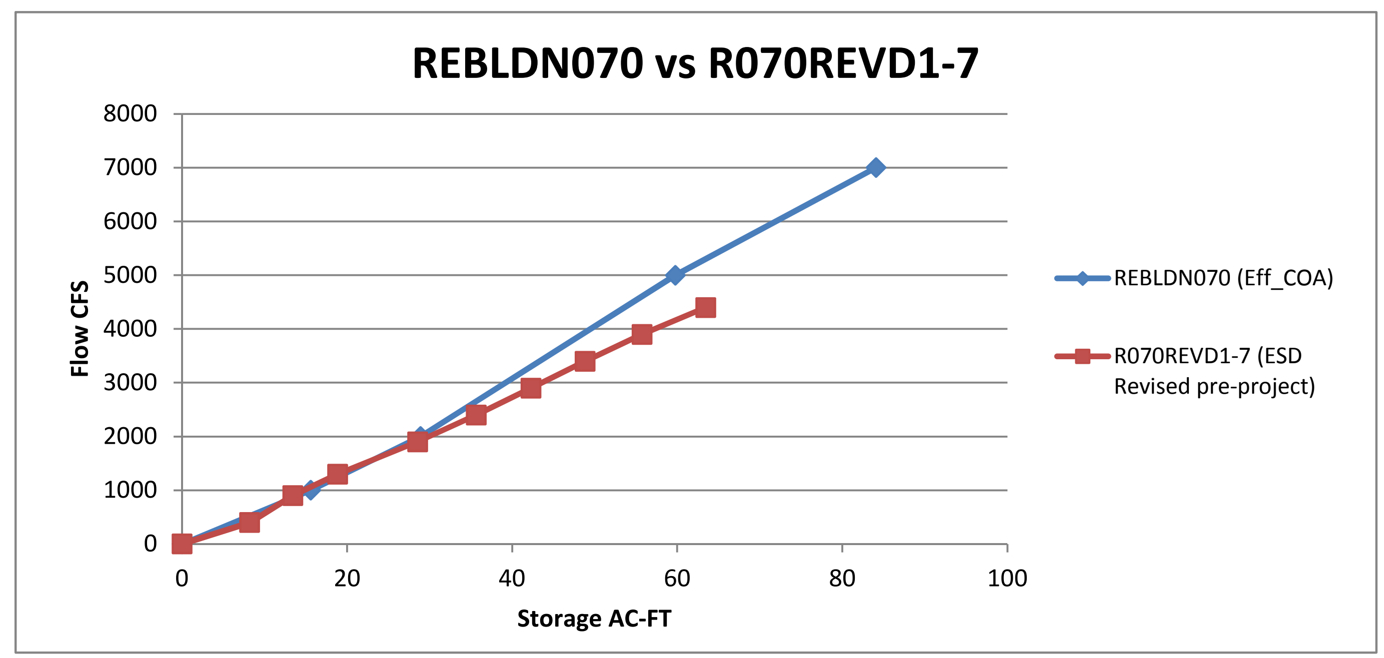


Exhibit G.10

Congress Avenue Lag Time

Reach: Congress Ave

Lag = travel time from South Congress and Mary (Diversion-R) to Congress and East Bouldin Creek (J_SOCO_EBC)

US Elev	DS Elev	Distance	Slope	Velocity	Travel Time	
			S	V		
		ft	ft/ft	ft/sec	sec	
				(1)	(2)	
566.9	543	1158	0.021	6.65	174	
543	500	1028.5	0.042	9.47	109	
500	490.5	1121.4	0.008	4.26	263	
490.5	459.75	814.5	0.038	9.00	91	
			Total Travel Time =		**636**	seconds
			Total Travel Time =		**10.6**	**minutes**

(1) V = k*S$^{0.5}$; k for paved gutter is 46.3 as found in Table 3-14 of: Richard McCuen, Hydrologic Analysis and Design (New Jersey: Prentice Hall, 1998), p.143.

(2) time = length / velocity

Exhibit G.11

Johanna Street Storm System Data

Johanna Street Storm Drain System - from Wilson to EBC

Data from As-builts: Street and Drainage Improvements Community Development District No. 18, Phase II (PPC-1-A-7673)

Diameter	DS Station	US Station	Length	Slope	HMS Reach Names	As-built Sheet Name	Notes
27	220	320	100	2.30%	Johanna Sys 1	1A-7673 (W)	slope noted on plans
24	320	575	255	8.08%	Johanna Sys 2	1A-7673 (W)	slope noted on plans
24	575	660	85	3.96%	Johanna Sys 3	1A-7673 (X)	slope from as-built note on plans
24	660	740	80	8.96%	Johanna Sys 4	1A-7673 (X)	slope from as-built note on plans
24	740	798	58	3.45%	Johanna Sys 5	1A-7673 (Y)	slope and length noted on plans
24	7+98 = 33+20.99		39.5	3.40%	Johanna Sys 5	1A-7673 (AA)	slope and length noted on plans
21			27.5	2.10%	Johanna Sys 6	1A-7673 (AA)	slope and length noted on plans

Data used in HMS

Reach name	Length	Slope	Manning n	Diameter	Location Notes
Johanna Sys 1	100	0.023	0.013	27	starts at Johanna/EBC
Johanna Sys 2	255	0.081	0.013	24	
Johanna Sys 3	85	0.040	0.013	24	
Johanna Sys 4	80	0.090	0.013	24	
Johanna Sys 5	97.5	0.034	0.013	24	
Johanna Sys 6	27.5	0.021	0.013	21	ends at Wilson St grate inlet (EBLDN-R)

Exhibit G.12

Annie Street Storm System Data

Annie Street Storm Drain System

Data used in HMS					
Reach name	**Length**	**Slope**	**Manning n**	**Diameter**	**Notes**
Annie Sys 1	100.00	0.021	0.013	36	starts at EBC
Annie Sys 2	50.00	0.006	0.013	36	
Annie Sys 3	86.50	0.069	0.013	36	
Annie Sys 4	562.13	0.041	0.013	30	ends at Mary Newton; length measured on DGN file to account for distance through manholes and inlets
Annie Sys 5	103.10	0.061	0.013	24	Mary St
Annie Sys 6	566.76	0.032	0.013	24	Mary St
Annie Sys 7	99.17	0.054	0.013	24	ends at Mary/Congress
Annie Sys 8	322.71	0.024	0.013	30	begins at Mary/Newton
Annie Sys 9	183.50	0.037	0.013	18	ends at Wilson St grate inlet (EBLDN-R)

Exhibit G.13

Diversion-R Inflow-Diversion Table

Diversion R Inflow-Diversion Function - Existing and Ultimate Conditions

Ref for Q and inlet calcs: Inlet Calcs_Ultimate Conditions_Div R.xls
Diversion R is located at the intersection of Johanna Street and Wilson Street

% of Total Inflow to east side of Wilson (DA-A22) =	50%
% of Total Inflow to inlets on west side of Wilson =	50%

Based on video provided by Courtyard Condominiums at 300 Crockett, showing street flow overtopping curb, assume flow from Crockett overtops crown of Wilson and half the flow travels along west side of Wilson and half along th eeast side.

Grate Inlet on east side of Wilson (DA-A22):
Water Intercepted by this inlet goes to Johanna Street Storm Drain System
Water that bypasses this inlet goes to Annie Street Storm Drain System

Inlet Calcs column name -->	Total Runoff	Intercepted Flow
HMS column name -->	Inflow	Diversion to Johanna Sys
	CFS	CFS
	0	0
	12.50	4.43
	25.00	8.44
	37.50	12.65
	50.00	16.87

Inlets on west side of Wilson:
Question: Is a diversion needed on the west side of Wilson? Or, can 50% of total runoff be diverted to Johanna System?

Notes:
Water that overtops the crown and is intercepted by inlets on west side of Wilson goes to Johanns Street Storm Drain System

Water that bypasses inlets on west side of Wilson flows through gutter to Johanna/EBC.
Travel time through gutter = L/(k*S^.5) = (627 ft) / (43.6 * (.057)^.5) = 56.5 sec = 0.94 min
Revised Pre-projec HMSmodel peak flow at diversion = 12:11 hrs ; Revised Pre-project HMS model peak flow from Johanna Sys into EBC = 12:12 hrs (10-year existing conditions)

Gutter flow enters EBC through inlet that outfalls directly into creek; storm drain flow enters EBC through pipe through culvert wall; both flows in RAS should be routed through the culvert

Conclusion: Since travel time through gutter and difference between HMS peaks are both approx 1 min and both flows go through culvert in RAS, a diversion is not needed on the east side of Wilson. 50% of runoff can be routed to Johanna Sys through Inflow-Diversion Table below

	Total Runoff	Intercepted Flow
HMS column name -->	Inflow	Diversion to Johanna Sys
	CFS	CFS
	0	0
	12.50	12.50
	25.00	25.00
	37.50	37.50

Total Runoff to Diversion-R	Total Intercepted Flow
Inflow	Diversion
CFS	CFS
0	0
25.00	16.93
50.00	33.44
75.00	50.15
100.00	66.87

GRATE INLETS ON GRADE, Type G-2 V-shaped gutter

12.5 CFS INFLOW

Equation in cell ==>		(2)	(3)					(4)	(5)	(5)	(6)	(7)	(8)	(9)	(10)				(11)	(12)	(13)			(14)	(15)	(16)	(17)	(18)	(19)	
DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft)	Curb Height (in)	Parking lane cross slope Sx1	Street Cross Slope Sx2	Sx	(ft) AB	(ft) BC	Manning's n	Ku	HYPOTHETICAL PONDED WIDTH (ft) T'	MAXIMUM PONDED WIDTH (ft) Tmax	PONDED WIDTH (ft) T	Gutter Depression Width (ft) W_{gutter}	Grate Width (in)	Grate Width (ft) W_{grate}	Eo	R_f	Ku	Grate Length (in)	Grate Length (ft) L	Gutter Velocity (ft/s) V	R_s	E	GRATE INLET REDUCTION FACTOR (%)	INTERCEPTED FLOW (cfs) Qi	BYPASS FLOW (cfs) Qb	INLET TYPE
DA-A22	Wilson St	12.50	0.0175	29.8	8.0	0.028	0.054	0.018	9.0	14.0	0.016	0.56	17.7	23.0	17.7	0.00	18.00	1.50	0.21	1.0	0.15	108.00	9.00	6.13	0.424	0.55	35%	4.43	8.07	Type G-2

25 CFS INFLOW

Equation in cell ==>		(2)	(3)					(4)	(5)	(5)	(6)	(7)	(8)	(9)	(10)				(11)	(12)	(13)			(14)	(15)	(16)	(17)	(18)	(19)	
DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft)	Curb Height (in)	Parking lane cross slope Sx1	Street Cross Slope Sx2	Sx	(ft) AB	(ft) BC	Manning's n	Ku	HYPOTHETICAL PONDED WIDTH (ft) T'	MAXIMUM PONDED WIDTH (ft) Tmax	PONDED WIDTH (ft) T	Gutter Depression Width (ft) W_{gutter}	Grate Width (in)	Grate Width (ft) W_{grate}	Eo	R_f	Ku	Grate Length (in)	Grate Length (ft) L	Gutter Velocity (ft/s) V	R_s	E	GRATE INLET REDUCTION FACTOR (%)	INTERCEPTED FLOW (cfs) Qi	BYPASS FLOW (cfs) Qb	INLET TYPE
DA-A22	Wilson St	25.00	0.0175	29.8	8.0	0.028	0.054	0.018	9.0	14.0	0.016	0.56	22.9	23.0	22.9	0.00	18.00	1.50	0.17	1.0	0.15	108.00	9.00	6.13	0.424	0.52	35%	8.44	16.56	Type G-2

37.5 CFS INFLOW

Equation in cell ==>		(2)	(3)					(4)	(5)	(5)	(6)	(7)	(8)	(9)	(10)				(11)	(12)	(13)			(14)	(15)	(16)	(17)	(18)	(19)	
DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft)	Curb Height (in)	Parking lane cross slope Sx1	Street Cross Slope Sx2	Sx	(ft) AB	(ft) BC	Manning's n	Ku	HYPOTHETICAL PONDED WIDTH (ft) T'	MAXIMUM PONDED WIDTH (ft) Tmax	PONDED WIDTH (ft) T	Gutter Depression Width (ft) W_{gutter}	Grate Width (in)	Grate Width (ft) W_{grate}	Eo	R_f	Ku	Grate Length (in)	Grate Length (ft) L	Gutter Velocity (ft/s) V	R_s	E	GRATE INLET REDUCTION FACTOR (%)	INTERCEPTED FLOW (cfs) Qi	BYPASS FLOW (cfs) Qb	INLET TYPE
DA-A22	Wilson St	37.50	0.0175	29.8	8.0	0.028	0.054	0.018	9.0	14.0	0.016	0.56	26.7	23.0	23.0	0.00	18.00	1.50	0.16	1.0	0.15	108.00	9.00	6.13	0.424	0.52	35%	12.65	24.85	Type G-2

50 CFS INFLOW

Equation in cell ==>		(2)	(3)					(4)	(5)	(5)	(6)	(7)	(8)	(9)	(10)				(11)	(12)	(13)			(14)	(15)	(16)	(17)	(18)	(19)	
DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft)	Curb Height (in)	Parking lane cross slope Sx1	Street Cross Slope Sx2	Sx	(ft) AB	(ft) BC	Manning's n	Ku	HYPOTHETICAL PONDED WIDTH (ft) T'	MAXIMUM PONDED WIDTH (ft) Tmax	PONDED WIDTH (ft) T	Gutter Depression Width (ft) W_{gutter}	Grate Width (in)	Grate Width (ft) W_{grate}	Eo	R_f	Ku	Grate Length (in)	Grate Length (ft) L	Gutter Velocity (ft/s) V	R_s	E	GRATE INLET REDUCTION FACTOR (%)	INTERCEPTED FLOW (cfs) Qi	BYPASS FLOW (cfs) Qb	INLET TYPE
DA-A22	Wilson St	50.00	0.0175	29.8	8.0	0.028	0.054	0.018	9.0	14.0	0.016	0.56	29.7	23.0	23.0	0.00	18.00	1.50	0.16	1.0	0.15	108.00	9.00	6.13	0.424	0.52	35%	16.87	33.13	Type G-2

75 CFS INFLOW

Equation in cell ==>		(2)	(3)					(4)	(5)	(5)	(6)	(7)	(8)	(9)	(10)				(11)	(12)	(13)			(14)	(15)	(16)	(17)	(18)	(19)	
DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft)	Curb Height (in)	Parking lane cross slope Sx1	Street Cross Slope Sx2	Sx	(ft) AB	(ft) BC	Manning's n	Ku	HYPOTHETICAL PONDED WIDTH (ft) T'	MAXIMUM PONDED WIDTH (ft) Tmax	PONDED WIDTH (ft) T	Gutter Depression Width (ft) W_{gutter}	Grate Width (in)	Grate Width (ft) W_{grate}	Eo	R_f	Ku	Grate Length (in)	Grate Length (ft) L	Gutter Velocity (ft/s) V	R_s	E	GRATE INLET REDUCTION FACTOR (%)	INTERCEPTED FLOW (cfs) Qi	BYPASS FLOW (cfs) Qb	INLET TYPE
DA-A22	Wilson St	75.00	0.0175	29.8	8.0	0.028	0.054	0.018	9.0	14.0	0.016	0.56	34.6	23.0	23.0	0.00	18.00	1.50	0.16	1.0	0.15	108.00	9.00	6.13	0.424	0.52	35%	25.30	49.70	Type G-2

100 CFS INFLOW

Equation in cell ==>		(2)	(3)					(4)	(5)	(5)	(6)	(7)	(8)	(9)	(10)				(11)	(12)	(13)			(14)	(15)	(16)	(17)	(18)	(19)	
DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft)	Curb Height (in)	Parking lane cross slope Sx1	Street Cross Slope Sx2	Sx	(ft) AB	(ft) BC	Manning's n	Ku	HYPOTHETICAL PONDED WIDTH (ft) T'	MAXIMUM PONDED WIDTH (ft) Tmax	PONDED WIDTH (ft) T	Gutter Depression Width (ft) W_{gutter}	Grate Width (in)	Grate Width (ft) W_{grate}	Eo	R_f	Ku	Grate Length (in)	Grate Length (ft) L	Gutter Velocity (ft/s) V	R_s	E	GRATE INLET REDUCTION FACTOR (%)	INTERCEPTED FLOW (cfs) Qi	BYPASS FLOW (cfs) Qb	INLET TYPE
DA-A22	Wilson St	100.00	0.0175	29.8	8.0	0.028	0.054	0.018	9.0	14.0	0.016	0.56	38.6	23.0	23.0	0.00	18.00	1.50	0.16	1.0	0.15	108.00	9.00	6.13	0.424	0.52	35%	33.73	66.27	Type G-2

Exhibit G.14

Diversion-S Inflow-Diversion Table

Diversion S Inflow-Diversion Function - Existing and Ultimate Conditions

Ref: Inlet Calcs_Equivalent Long Inlet_Div S.xls
Lag Time Calculations for Annie_Existing Conditions_REV_021215.xls

Notes: Intercepted Flow and Max Capacity Flow is calclated on referenced spreadsheet assuming no bypass flow from upstream inlets.

Diverted flow into inlets:

						Inflow	Diversion
GIS Drainage ID -->	**21880**	**21879**	**none**				
Drainage Area -->	**DA-A11**	**DA-A12**	**13, 14, 15, 16, 26**	**EBLDN T = DA-A25**			
Location -->	**Mary St sump**	**Congress at Mary sump**	**Equivalent Long Inlet on grade**	**Fulmore Middle School**			
HMS column name -->							
Inlet Calcs column name -->	**Maximum Capacity Flow CFS**	**Maximum Capacity Flow CFS**	**Intercepted Flow CFS**	**Design Flow CFS**	**Flow to Annie Storm Drain CFS**	**Q for EBLDN-S CFS**	**Flow to Congress Ave CFS**
	(1)		**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
					0	**0**	**0**
2 year_Ex	3.68	3.56	23.79	7.8	38.83	**36.44**	**0.00**
10 year_Ex	4.76	3.63	30.47	12.87	51.73	**61.08**	**9.35**
25 year_Ex	5.37	4.02	33.77	16.15	59.31	**78.15**	**18.84**
100 year_Ex	6.35	4.62	38.40	22.16	71.53	**112.97**	**41.44**
500 year_Ex	8.29	5.28	43.00	29.26	85.83	**161.75**	**75.92**

(1) Maximum Capacity Flow calculated for sump inlets assuming no bypass from upstream inlets
(2) Intercepted flow for Equivalent Long Inlet
(3) Rational Method peak flow for EBLDN-T (DA-A25)
(4) Sum of columns (1), (2) and (3) flows to Annie Street Storm Drain system
(5) Rational Method peak flow calculated below
(6) Flow to Congress Ave = (5) - (4)

Q for EBLDN-S, Existing Conditions

		Rational Method C, Existing Conditions									
Sub-basins	**Area (AC)**	**2-year**	**10-year**	**25-year**	**100-year**	**500-year**	**C2*Area**	**C10*Area**	**C25*Area**	**C100*Area**	**C500*Area**
DA-A11	3.42	0.53	0.59	0.63	0.71	0.78	1.80	2.02	2.17	2.45	2.68
DA-A12	3.19	0.55	0.61	0.66	0.74	0.80	1.75	1.96	2.10	2.36	2.56
Equivalent Long Inlet (Areas DA-A13, DA-A14, DA-A15, DA-A16, DA-A26)	10.68	0.65	0.72	0.77	0.85	0.91	6.92	7.70	8.21	9.12	9.67
Total Area	17.29										

Tc for EBLDN-S = 18.77 mins Calculated on Existing Lag Time spreadsheet

	Composite C	**i**	**A**	**Q = Inflow**
2-year	0.61	3.48	17.29	36.44
10-year	0.68	5.23	17.29	61.08
25-year	0.72	6.26	17.29	78.15
100-year	0.81	8.11	17.29	112.97
500-year	0.86	10.85	17.29	161.75

	2-year	10-year	25-year	100-year	500-year
a=	54.767	70.820	82.9360	118.3000	188.0
b=	11.051	10.396	10.7460	13.1850	17.233
c=	0.8116	0.7725	0.7634	0.7736	0.7959

RUNOFF COMPUTATIONS (Existing Conditions)

			2 Year Storm Event			10 Year Storm Event			25 Year Storm Event			100 Year Storm Event			500 Year Storm Event		
Drainage Area Number	Drainage Area (acres)	Time of Concentration Tc (min)	Runoff Coefficient C2	Intensity I2	Design Flow Q2 (cfs)	Runoff Coefficient C10	Intensity I10	Design Flow Q10 (cfs)	Runoff Coefficient C25	Intensity I25	Design Flow Q25 (cfs)	Runoff Coefficient C100	Intensity I100	Design Flow Q100 (cfs)	Runoff Coefficient C500	Intensity I500	Design Flow Q500 (cfs)
DA-A11	3.42	5.26	0.53	5.68	10.22	0.59	8.46	17.08	0.63	9.99	21.70	0.71	12.41	30.35	0.78	15.78	42.29
DA-A12	3.19	5.00	0.55	5.76	10.05	0.61	8.57	16.76	0.66	10.11	21.24	0.74	12.54	29.58	0.80	15.93	40.78
DA-A13	1.13	5.86	0.60	5.52	3.72	0.66	8.22	6.19	0.71	9.71	7.82	0.79	12.10	10.89		15.45	0.00
DA-A14	1.83	5.00	0.66	5.76	6.93	0.73	8.57	11.48	0.78	10.11	14.43	0.87	12.54	19.87		15.93	0.00
DA-A15	2.25	9.51	0.60	4.71	6.33	0.67	7.02	10.55	0.72	8.34	13.40	0.80	10.57	18.95		13.75	0.00
DA-A16	4.62	7.46	0.65	5.13	15.50	0.73	7.64	25.75	0.78	9.05	32.52	0.86	11.37	45.41		14.65	0.00
DA-A25	1.93	5.00	0.70	5.76	7.80	0.78	8.57	12.87	0.83	10.11	16.15	0.91	12.54	22.16	0.95	15.93	29.26
DA-A26	0.85	5.00	0.71	5.76	3.50	0.79	8.57	5.77	0.84	10.11	7.24	0.93	12.54	9.92		15.93	0.00
Equivalent long inlet (13, 14, 15, 16, 26)	10.68	0.00	0.65	7.79	53.93	0.72	11.60	89.38	0.77	13.54	111.16	0.85	16.09	146.80	0.91	19.50	188.53

From DCM Section 2.4.3, Table 2-5:

	2-year	10-year	25-year	100-year	500-year
a=	54.767	70.820	82.9360	118.3000	188.0000
b=	11.051	10.396	10.7460	13.1850	17.2330
c=	0.8116	0.7725	0.7634	0.7736	0.7959

CURB INLETS IN SUMPS, Type S-1, parabolic crown and SUBMERGED CURB INLETS ON GRADE, parabolic crown

2 YEAR STORM

Equation in cell ==>			(1)	(2)	(3)					(4)				(5)	(6)	(7)	(8)	(9)		(10)	(11)					(12)	(13)	(14)	(15)		(16)	(17)
DRAINAGE AREA	**STREET**	**DRAINAGE AREA**	**DISCHARGE FROM DRAINAGE AREA**	**TOTAL RUNOFF**	**SLOPE**	**Street Width (FOC-FOC)**	**Curb Height**	**Split**	**High or low gutter**	K_o	K_1	K_2	K_3	**WATER FLOW DEPTH**	**ESD Field Measured Street Cross Slope**	**Dist. Curb to Crown**	**Crown Height**	**PONDED WIDTH**	**Over Crown?**	**GUTTER DEPRESSION**		**CURB OPENING HEIGHT**	**Gutter Depression Width**	**CURB INLET LENGTH**		**If d > 1.4*h, use orifice EQ**	**WEIR COEFFICIENT**	**EFFECTIVE HEAD ON ORIFICE**	**ORIFICE COEFFICIENT**	**GRAVITY**	**MAXIMUM CAPACITY FLOW WEIR EQ**	**MAXIMUM CAPACITY FLOW ORIFICE EQ**
		(ac.)	*(cfs)*	*(cfs)*	*(ft/ft)*	*(ft)*	*(ft)*	*(ft)*						*(ft)*		*(ft)*	*(ft)*	*(ft)*		*(in)*	*(in)*	*(ft)*	*(ft)*	*(ft)*	*(ft)*	Else, use weir EQ		*(ft)*		*(ft/s^2)*	*(cfs)*	*(cfs)*
				Q	$S_o = S_L$			CS						Yo = d	Sx	B	H	T		a_{DIG}	a_{HEC22}	h	W	L	1.4*h		Cw	d_o	Co	g	Qi	Qi
DA-A11	Mary	3.42	10.22	10.22	0.022	37.0	0.5	0.0		2.89	0.50	2.99	0.000	0.445	0.022	18.5	0.30	18.5	over crown	4.00	3.63	0.50	1.42	2.83	1.90	weir EQ	2.30	0.50	0.67	32.2	3.68	----
DA-A12	Congress	3.19	10.05	10.05	0.021	91.5	0.5	1.0	high	2.85	0.50	2.74	-0.043	0.443	0.018	43.5	1.41	7.5	no	1.50	1.23	0.38	1.25	3.00	1.78	weir EQ	2.30	0.36	0.67	32.2	3.56	----

10 YEAR STORM

HEC-22 variable or EQ ==>				Q										d	Sx	B EQ B-11	H EQ B-11	T EQ 4-3			a Fig 4-13	h EQ 4-29, Fig 4-18.a		L		EQ 4-29	EQ 4-28, 4-30 Cw	d_o EQ 4-31a	Co EQ 4-31		EQ 4-28	EQ 4-29
DCM Variable or EQ==>				Q						K_o	K_1	K_2	K_3	Y_o EQ 3-5	Sx	assumes crown to curb = street width/2; not true for streets with curb split	H EQ 3-1			DIG instructions		EQ 4-2 h		L		EQ 4-2	EQ 4-1, 4-3 Cw	d_o EQ 4-4a	Co EQ 4-4		EQ 4-1	EQ 4-4a
GIS StormwaterInfrastructureFIELD ==>																				Depression_a												
Equation in cell ==>			(1)	(2)	(3)					(4)				(5)	(6)	(7)	(8)	(9)		(10)	(11)					(12)	(13)	(14)	(15)		(16)	(17)
DRAINAGE AREA	**STREET**	**DRAINAGE AREA**	**DISCHARGE FROM DRAINAGE AREA**	**TOTAL RUNOFF**	**SLOPE**	**Street Width (FOC-FOC)**	**Curb Height**	**Split**	**High or low gutter**	K_o	K_1	K_2	K_3	**WATER FLOW DEPTH**	**ESD Field Measured Street Cross Slope**	**Dist. Curb to Crown**	**Crown Height**	**PONDED WIDTH**	**Over Crown?**	**GUTTER DEPRESSION**		**CURB OPENING HEIGHT**	**Gutter Depression Width**	**CURB INLET LENGTH**		**If d > 1.4*h, use orifice EQ**	**WEIR COEFFICIENT**	**EFFECTIVE HEAD ON ORIFICE**	**ORIFICE COEFFICIENT**	**GRAVITY**	**MAXIMUM CAPACITY FLOW WEIR EQ**	**MAXIMUM CAPACITY FLOW ORIFICE EQ**
		(ac.)	*(cfs)*	*(cfs)*	*(ft/ft)*	*(ft)*	*(ft)*	*(ft)*						*(ft)*		*(ft)*	*(ft)*	*(ft)*		*(in)*	*(in)*	*(ft)*	*(ft)*	*(ft)*	*(ft)*	Else, use weir EQ		*(ft)*		*(ft/s^2)*	*(cfs)*	*(cfs)*
				Q	$S_o = S_L$			CS						Yo = d	Sx	B	H	T		a_{DIG}	a_{HEC22}	h	W	L	1.4*h		Cw	d_o	Co	g	Qi	Qi
DA-A11	Mary	3.42	17.08	17.08	0.022	37.0	0.5	0.0		2.89	0.50	2.99	0.000	0.529	0.022	18.5	0.30	18.5	over crown	4.00	3.63	0.50	1.42	2.83	0.70	weir EQ	2.30	0.58	0.67	32.2	4.76	----
DA-A12	Congress	3.19	16.76	16.76	0.021	91.5	0.5	1.0	high	2.85	0.50	2.74	-0.043	0.534	0.018	43.5	1.41	9.2	no	1.50	1.23	0.38	1.25	3.00	0.53	orifice EQ	2.30	0.45	0.67	32.2	----	3.63

25 YEAR STORM

HEC-22 variable or EQ ==>				Q										d	Sx	B EQ B-11	H EQ B-11	T EQ 4-3			a Fig 4-13	h EQ 4-29, Fig 4-18.a		L		EQ 4-29	EQ 4-28, 4-30 Cw	d_o EQ 4-31a	Co EQ 4-31		EQ 4-28	EQ 4-29
DCM Variable or EQ==>				Q						K_o	K_1	K_2	K_3	Y_o EQ 3-5	Sx	assumes crown to curb = street width/2; not true for streets with curb split	H EQ 3-1			DIG instructions		EQ 4-2 h		L		EQ 4-2	EQ 4-1, 4-3 Cw	d_o EQ 4-4a	Co EQ 4-4		EQ 4-1	EQ 4-4a
GIS StormwaterInfrastructureFIELD ==>																				Depression_a												
Equation in cell ==>			(1)	(2)	(3)					(4)				(5)	(6)	(7)	(8)	(9)		(10)	(11)					(12)	(13)	(14)	(15)		(16)	(17)
DRAINAGE AREA	**STREET**	**DRAINAGE AREA**	**DISCHARGE FROM DRAINAGE AREA**	**TOTAL RUNOFF**	**SLOPE**	**Street Width (FOC-FOC)**	**Curb Height**	**Split**	**High or low gutter**	K_o	K_1	K_2	K_3	**WATER FLOW DEPTH**	**ESD Field Measured Street Cross Slope**	**Dist. Curb to Crown**	**Crown Height**	**PONDED WIDTH**	**Over Crown?**	**GUTTER DEPRESSION**		**CURB OPENING HEIGHT**	**Gutter Depression Width**	**CURB INLET LENGTH**		**If d > 1.4*h, use orifice EQ**	**WEIR COEFFICIENT**	**EFFECTIVE HEAD ON ORIFICE**	**ORIFICE COEFFICIENT**	**GRAVITY**	**MAXIMUM CAPACITY FLOW WEIR EQ**	**MAXIMUM CAPACITY FLOW ORIFICE EQ**
		(ac.)	*(cfs)*	*(cfs)*	*(ft/ft)*	*(ft)*	*(ft)*	*(ft)*						*(ft)*		*(ft)*	*(ft)*	*(ft)*		*(in)*	*(in)*	*(ft)*	*(ft)*	*(ft)*	*(ft)*	Else, use weir EQ		*(ft)*		*(ft/s^2)*	*(cfs)*	*(cfs)*
				Q	$S_o = S_L$			CS						Yo = d	Sx	B	H	T		a_{DIG}	a_{HEC22}	h	W	L	1.4*h		Cw	d_o	Co	g	Qi	Qi
DA-A11	Mary	3.42	21.70	21.70	0.022	37.0	0.5	0.0		2.89	0.50	2.99	0.000	0.573	0.022	18.5	0.30	18.5	over crown	4.00	3.63	0.50	1.42	2.83	0.70	weir EQ	2.30	0.63	0.67	32.2	5.37	----
DA-A12	Congress	3.19	21.24	21.24	0.021	91.5	0.5	1.0	high	2.85	0.50	2.74	-0.043	0.582	0.018	43.5	1.41	10.2	no	1.50	1.23	0.38	1.25	3.00	0.53	orifice EQ	2.30	0.50	0.67	32.2	----	4.02

100 YEAR STORM

HEC-22 variable or EQ ==>				Q										d	Sx	B EQ B-11	H EQ B-11	T EQ 4-3			a Fig 4-13	h EQ 4-29, Fig 4-18.a		L		EQ 4-29	EQ 4-28, 4-30 Cw	d_o EQ 4-31a	Co EQ 4-31		EQ 4-28	EQ 4-29
DCM Variable or EQ==>				Q						K_o	K_1	K_2	K_3	Y_o EQ 3-5	Sx	assumes crown to curb = street width/2; not true for streets with curb split	H EQ 3-1			DIG instructions		EQ 4-2 h		L		EQ 4-2	EQ 4-1, 4-3 Cw	d_o EQ 4-4a	Co EQ 4-4		EQ 4-1	EQ 4-4a
GIS StormwaterInfrastructureFIELD ==>																				Depression_a												
Equation in cell ==>			(1)	(2)	(3)					(4)				(5)	(6)	(7)	(8)	(9)		(10)	(11)					(12)	(13)	(14)	(15)		(16)	(17)
DRAINAGE AREA	STREET	DRAINAGE AREA	DISCHARGE FROM DRAINAGE AREA	TOTAL RUNOFF	SLOPE	Street Width (FOC-FOC)	Curb Height	Split	High or low gutter	K_o	K_1	K_2	K_3	WATER FLOW DEPTH	ESD Field Measured Street Cross Slope	Dist. Curb to Crown	Crown Height	PONDED WIDTH	Over Crown?	GUTTER DEPRESSION		CURB OPENING HEIGHT	Gutter Depression Width	CURB INLET LENGTH		If d > 1.4*h, use orifice EQ	WEIR COEFFICIENT	EFFECTIVE HEAD ON ORIFICE	ORIFICE COEFFICIENT	GRAVITY	MAXIMUM CAPACITY FLOW WEIR EQ	MAXIMUM CAPACITY FLOW ORIFICE EQ
		(ac.)	*(cfs)*	*(cfs)*	*(ft/ft)*	*(ft)*	*(ft)*	*(ft)*						*(ft)*		*(ft)*	*(ft)*	*(ft)*		*(in)*	*(in)*	*(ft)*	*(ft)*	*(ft)*	*(ft)*	Else, use weir EQ		*(ft)*		*(ft/s²)*	*(cfs)*	*(cfs)*
				Q	$S_o = S_L$			CS						Yo = d	Sx	B	H	T		a_{DIG}	a_{HEC22}	h	W	L	1.4*h		Cw	d_o	Co	g	Qi	Qi
DA-A11	Mary	3.42	30.35	30.35	0.022	37.0	0.5	0.0		2.89	0.50	2.99	0.000	0.641	0.022	18.5	0.30	18.5	over crown	4.00	3.63	0.50	1.42	2.83	0.70	weir EQ	2.30	0.69	0.67	32.2	6.35	----
DA-A12	Congress	3.19	29.58	29.58	0.021	91.5	0.5	1.0	high	2.85	0.50	2.74	-0.043	0.657	0.018	43.5	1.41	11.7	no	1.50	1.23	0.38	1.25	3.00	0.53	orifice EQ	2.30	0.57	0.67	32.2	----	4.62

500 YEAR STORM

HEC-22 variable or EQ ==>				Q										d	Sx	B EQ B-11	H EQ B-11	T EQ 4-3			a Fig 4-13	h EQ 4-29, Fig 4-18.a		L		EQ 4-29	EQ 4-28, 4-30 Cw	d_o EQ 4-31a	Co EQ 4-31		EQ 4-28	EQ 4-29
DCM Variable or EQ==>				Q						K_o	K_1	K_2	K_3	Y_o EQ 3-5	Sx	assumes crown to curb = street width/2; not true for streets with curb split	H EQ 3-1			DIG instructions		EQ 4-2 h		L		EQ 4-2	EQ 4-1, 4-3 Cw	d_o EQ 4-4a	Co EQ 4-4		EQ 4-1	EQ 4-4a
GIS StormwaterInfrastructureFIELD ==>																				Depression_a												
Equation in cell ==>			(1)	(2)	(3)					(4)				(5)	(6)	(7)	(8)	(9)		(10)	(11)					(12)	(13)	(14)	(15)		(16)	(17)
DRAINAGE AREA	STREET	DRAINAGE AREA	DISCHARGE FROM DRAINAGE AREA	TOTAL RUNOFF	SLOPE	Street Width (FOC-FOC)	Curb Height	Split	High or low gutter	K_o	K_1	K_2	K_3	WATER FLOW DEPTH	ESD Field Measured Street Cross Slope	Dist. Curb to Crown	Crown Height	PONDED WIDTH	Over Crown?	GUTTER DEPRESSION		CURB OPENING HEIGHT	Gutter Depression Width	CURB INLET LENGTH		If d > 1.4*h, use orifice EQ	WEIR COEFFICIENT	EFFECTIVE HEAD ON ORIFICE	ORIFICE COEFFICIENT	GRAVITY	MAXIMUM CAPACITY FLOW WEIR EQ	MAXIMUM CAPACITY FLOW ORIFICE EQ
		(ac.)	*(cfs)*	*(cfs)*	*(ft/ft)*	*(ft)*	*(ft)*	*(ft)*						*(ft)*		*(ft)*	*(ft)*	*(ft)*		*(in)*	*(in)*	*(ft)*	*(ft)*	*(ft)*	*(ft)*	Else, use weir EQ		*(ft)*		*(ft/s²)*	*(cfs)*	*(cfs)*
				Q	$S_o = S_L$			CS						Yo = d	Sx	B	H	T		a_{DIG}	a_{HEC22}	h	W	L	1.4*h		Cw	d_o	Co	g	Qi	Qi
DA-A11	Mary	3.42	42.29	42.29	0.022	37.0	0.5	0.0		2.89	0.50	2.99	0.000	0.716	0.022	18.5	0.30	18.5	over crown	4.00	3.63	0.50	1.42	2.83	0.70	orifice EQ	2.30	0.77	0.67	32.2	----	8.29
DA-A12	Congress	3.19	40.78	40.78	0.021	91.5	0.5	1.0	high	2.85	0.50	2.74	-0.043	0.738	0.018	43.5	1.41	13.5	no	1.50	1.23	0.38	1.25	3.00	0.53	orifice EQ	2.30	0.65	0.67	32.2	----	5.28

CURB INLETS ON GRADE, Type G-1 OR Type G-3, parabolic crown

EQUATION

(A)	Intercepted flow for curb inlets on grade that are part of Diversion-S; there is no bypass to these inlets
(B)	Sum of intercepted flow for the upstream inlets
(C)	Use Goal Seek to find inlet length for Intercepted Flow from (B)
(D)	(Sum of inlet lengths for 2, 10, 25 and 100 year storms) / 4 ; this is the Equivalent Long Inlet Length

2 YEAR STORM

DRAINAGE AREA	STREET NAME	DRAINAGE AREA	DRAINAGE AREA	DISCHARGE FROM DRAINAGE AREA	TOTAL RUNOFF	ESD Field Measured Street Cross Slope	Dist. Curb to Crown	Crown Height	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a					PONDED WIDTH		GUTTER DEPRESSION		Gutter Depression Width	Gutter Depression Width					Manning's n	INLET LENGTH FOR TOTAL CAPTURE	CURB INLET REDUCTION FACTOR	CURB OPENING LENGTH	CURB OPENING LENGTH	INLET EFFICIENCY	INTERCEPTED FLOW	
			(ac.)	(cfs)	(cfs) Q	Sx	(ft) B	(ft) H	a H / B^2	b -(2H/B)	c Yo	x1	x2	(ft) T	K_T	(in) a_{DIG}	(in) a_{HEC22}	(in)	(ft) W	S'w	Sw	Eo	Se	n	L_T	(%)	(in)	(ft) L	E	(cfs) Qi	EQUATION
DA-A26	driveway	DA-A26	0.85	3.50	3.50	0.020	24.0	0.47	0.0008	-0.0392	0.2350	40.9713	7.0287	12.00	0.6	5.0	4.6	18.0	1.50	0.26	0.28	0.56	0.16	0.016	7.30	0%	120	10.00	1.00	3.50	(A)
DA-A15	Leland St.	DA-A15	2.25	6.33	6.33	0.043	15.0	0.85	0.0038	-0.1133	0.3526	26.4745	3.5255	3.53	0.6	7.0	6.2	18.0	1.50	0.35	0.39	0.96	0.38	0.016	11.00	0%	59	4.92	0.66	4.15	(A)
DA-A16	S. Congress Ave.	DA-A16	4.62	15.50	15.50	0.060	23.3	1.14	0.0021	-0.0979	0.6044	39.2376	7.3224	7.32	0.6	6.0	5.0	17.0	1.42	0.29	0.35	0.62	0.24	0.016	13.87	0%	36	3.00	0.36	5.51	(A)
DA-A14	Leland St.	DA-A14	1.83	6.93	6.93	0.044	15.0	0.85	0.0038	-0.1133	0.3561	26.4344	3.5656	3.57	0.6	7.0	6.2	18.0	1.50	0.34	0.39	0.96	0.37	0.016	11.87	0%	61	5.08	0.63	4.40	(A)
DA-A13	S. Congress Ave.	DA-A13	1.13	3.72	3.72	0.101	30.8	1.28	0.0013	-0.0829	0.3780	56.5598	4.9602	4.96	0.6	5.0	3.2	18.0	1.50	0.18	0.28	0.72	0.23	0.016	7.44	0%	36	3.00	0.61	2.25	(A)
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	13,14,15,16,26	10.68	53.93	53.93	0.054	30.8	1.28	0.0014	-0.0832	0.9818	45.6078	15.9122	15.91	0.6	5.0	4.0	18.0	1.50	0.22	0.28	0.29	0.12	0.016	34.92	0%		6.52	0.31	16.76	(C)
																									Sum of Intercpted Flow for 13, 14, 15, 16, 26 =					19.81	(B)

10 YEAR STORM

DRAINAGE AREA	STREET NAME	DRAINAGE AREA	DRAINAGE AREA	DISCHARGE FROM DRAINAGE AREA	TOTAL RUNOFF	ESD Field Measured Street Cross Slope	Dist. Curb to Crown	Crown Height	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a					PONDED WIDTH		GUTTER DEPRESSION		Gutter Depression Width	Gutter Depression Width					Manning's n	INLET LENGTH FOR TOTAL CAPTURE	CURB INLET REDUCTION FACTOR	CURB OPENING LENGTH	CURB OPENING LENGTH	INLET EFFICIENCY	INTERCEPTED FLOW	
			(ac.)	(cfs)	(cfs) Q	Sx	(ft) B	(ft) H	a H / B^2	b -(2H/B)	c Yo	x1	x2	(ft) T	K_T	(in) a_{DIG}	(in) a_{HEC22}	(in)	(ft) W	S'w	Sw	Eo	Se	n	L_T	(%)	(in)	(ft) L	E	(cfs) Qi	
DA-A26	driveway	DA-A26	0.85	5.77	5.77	0.020	24.0	0.47	0.0008	-0.0392	0.2836	39.1156	8.8844	14.48	0.6	5.0	4.6	18.0	1.50	0.26	0.28	0.47	0.14	0.016	9.95	0%	120	10.00	1.00	5.77	(A)
DA-A15	Leland St.	DA-A15	2.25	10.55	10.55	0.043	15.0	0.85	0.0038	-0.1133	0.4173	25.7027	4.2973	4.30	0.6	7.0	6.2	18.0	1.50	0.35	0.39	0.92	0.36	0.016	13.92	0%	59	4.92	0.54	5.73	(A)
DA-A16	S. Congress Ave.	DA-A16	4.62	25.75	25.75	0.060	23.3	1.14	0.0021	-0.0979	0.7273	37.2876	9.2724	9.27	0.6	6.0	5.0	17.0	1.42	0.29	0.35	0.50	0.21	0.016	18.82	0%	36	3.00	0.27	See Calcs on Sump/S	(A)
DA-A14	Leland St.	DA-A14	1.83	11.48	11.48	0.044	15.0	0.85	0.0038	-0.1133	0.4205	25.6624	4.3376	4.34	0.6	7.0	6.2	18.0	1.50	0.34	0.39	0.92	0.36	0.016	14.99	0%	61	5.08	0.53	6.03	(A)
DA-A13	S. Congress Ave.	DA-A13	1.13	6.19	6.19	0.101	30.8	1.28	0.0013	-0.0829	0.4551	55.4268	6.0932	6.09	0.6	5.0	3.2	18.0	1.50	0.18	0.28	0.62	0.21	0.016	9.66	0%	36	3.00	0.49	3.02	(A)
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	13,14,15,16,26	10.68	89.38	89.38	0.054	30.8	1.28	0.0014	-0.0832	1.1806	39.3335	22.1865	22.19	0.6	5.0	4.0	18.0	1.50	0.22	0.28	0.21	0.10	0.016	48.16	0%		7.80	0.27	24.35	(C)
																									Sum of Intercpted Flow for 13, 14, 15, 16, 26 =					30.18	(B)

25 YEAR STORM

DRAINAGE AREA	STREET NAME	DRAINAGE AREA	DRAINAGE AREA	DISCHARGE FROM DRAINAGE AREA	TOTAL RUNOFF	ESD Field Measured Street Cross Slope	Dist. Curb to Crown	Crown Height	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a					PONDED WIDTH		GUTTER DEPRESSION		Gutter Depression Width	Gutter Depression Width					Manning's n	INLET LENGTH FOR TOTAL CAPTURE	CURB INLET REDUCTION FACTOR	CURB OPENING LENGTH	CURB OPENING LENGTH	INLET EFFICIENCY	INTERCEPTED FLOW	
			(ac.)	(cfs)	(cfs) Q	Sx	(ft) B	(ft) H	a H / B^2	b -(2H/B)	c Yo	x1	x2	(ft) T	K_T	(in) a_{DIG}	(in) a_{HEC22}	(in)	(ft) W	S'w	Sw	Eo	Se	n	L_T	(%)	(in)	(ft) L	E	(cfs) Qi	
DA-A26	driveway	DA-A26	0.85	7.24	7.24	0.020	24.0	0.47	0.0008	-0.0392	0.3087	38.0619	9.9381	15.76	0.6	5.0	4.6	18.0	1.50	0.26	0.28	0.42	0.13	0.016	11.48	0%	120	10.00	0.98	7.06	(A)
DA-A15	Leland St.	DA-A15	2.25	13.40	13.40	0.043	15.0	0.85	0.0038	-0.1133	0.4515	25.2702	4.7298	4.73	0.6	7.0	6.2	18.0	1.50	0.35	0.39	0.90	0.35	0.016	15.62	0%	59	4.92	0.49	6.61	(A)
DA-A16	S. Congress Ave.	DA-A16	4.62	32.52	32.52	0.060	23.3	1.14	0.0021	-0.0979	0.7920	36.1433	10.4167	10.42	0.6	6.0	5.0	17.0	1.42	0.29	0.35	0.45	0.19	0.016	21.76	0%	36	3.00	0.23	See Calcs on Sump/S	(A)
DA-A14	Leland St.	DA-A14	1.83	14.43	14.43	0.044	15.0	0.85	0.0038	-0.1133	0.4535	25.2444	4.7556	4.76	0.6	7.0	6.2	18.0	1.50	0.34	0.39	0.90	0.35	0.016	16.75	0%	61	5.08	0.48	6.90	(A)
DA-A13	S. Congress Ave.	DA-A13	1.13	7.82	7.82	0.101	30.8	1.28	0.0013	-0.0829	0.4958	54.8072	6.7128	6.71	0.6	5.0	3.2	18.0	1.50	0.18	0.28	0.58	0.20	0.016	10.92	0%	36	3.00	0.44	3.44	(A)
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	13,14,15,16,26	10.68	111.16	111.16	0.054	30.8	1.28	0.0014	-0.0832	1.2784	31.8630	29.6570	29.66	0.6	5.0	4.0	18.0	1.50	0.22	0.28	0.15	0.09	0.016	57.18	0%		8.06	0.24	26.59	(C)
																									Sum of Intercpted Flow for 13, 14, 15, 16, 26 =					34.33	(B)

100 YEAR STORM

DRAINAGE AREA	STREET NAME	DRAINAGE AREA	DRAINAGE AREA	DISCHARGE FROM DRAINAGE AREA	TOTAL RUNOFF	ESD Field Measured Street Cross Slope	Dist. Curb to Crown	Crown Height	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a					PONDED WIDTH		GUTTER DEPRESSION		Gutter Depression Width	Gutter Depression Width					Manning's n	INLET LENGTH FOR TOTAL CAPTURE	CURB INLET REDUCTION FACTOR	CURB OPENING LENGTH	CURB OPENING LENGTH	INLET EFFICIENCY	INTERCEPTED FLOW	
			(ac.)	(cfs)	(cfs) Q	Sx	(ft) B	(ft) H	a H / B^2	b -(2H/B)	c Yo	x1	x2	(ft) T	K_T	(in) a_{DIG}	(in) a_{HEC22}	(in)	(ft) W	S'w	Sw	Eo	Se	n	L_T	(%)	(in)	(ft) L	E	(cfs) Qi	
DA-A26	driveway	DA-A26	0.85	9.92	9.92	0.020	24.0	0.47	0.0008	-0.0392	0.3475	36.2550	11.7450	17.74	0.6	5.0	4.6	18.0	1.50	0.26	0.28	0.37	0.12	0.016	14.03	0%	120	10.00	0.89	8.87	(A)
DA-A15	Leland St.	DA-A15	2.25	18.95	18.95	0.043	15.0	0.85	0.0038	-0.1133	0.5062	24.5393	5.4607	5.46	0.6	7.0	6.2	18.0	1.50	0.35	0.39	0.85	0.34	0.016	18.59	0%	59	4.92	0.42	8.05	(A)
DA-A16	S. Congress Ave.	DA-A16	4.62	45.41	45.41	0.060	23.3	1.14	0.0021	-0.0979	0.8946	34.0817	12.4783	12.48	0.6	6.0	5.0	17.0	1.42	0.29	0.35	0.37	0.17	0.016	26.95	0%	36	3.00	0.19	See Calcs on Sump/S	(A)
DA-A14	Leland St.	DA-A14	1.83	19.87	19.87	0.044	15.0	0.85	0.0038	-0.1133	0.5040	24.5696	5.4304	5.43	0.6	7.0	6.2	18.0	1.50	0.34	0.39	0.85	0.34	0.016	19.68	0%	61	5.08	0.42	8.27	(A)
DA-A13	S. Congress Ave.	DA-A13	1.13	10.89	10.89	0.101	30.8	1.28	0.0013	-0.0829	0.5594	53.8050	7.7150	7.72	0.6	5.0	3.2	18.0	1.50	0.18	0.28	0.51	0.19	0.016	12.98	0%	36	3.00	0.38	4.10	(A)
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	13,14,15,16,26	10.68	146.80	146.80	0.054	30.8	1.28	0.0014	-0.0832	1.4149	--	--	30.76	0.6	5.0	4.0	18.0	1.50	0.22	0.28	0.14	0.09	0.016	64.85	0%		8.48	0.22	32.74	(C)
																									Sum of Intercpted Flow for 13, 14, 15, 16, 26 =					40.73	(B)

Average Inlet Length = Equivalent Long Inlet Length (ft) = 7.71 (D)

CURB INLETS ON GRADE, Type G-1 OR Type G-3, parabolic crown

EQUATION
(A) Intercepted flow for Equivalent Long Inlet Length

2 YEAR STORM

DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft) W	Curb Height (in)	Curb Height (ft)	CURB OPENING HEIGHT (in)	CURB OPENING HEIGHT (ft) h	Split (ft) CS	High or low gutter	K_o	K_1	K_2	K_3	WATER FLOW DEPTH (ft) Yo = d	ESD Field Measured Street Cross Slope Sx	Dist. Curb to Crown (ft) B	Crown Height (ft) H	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a — a H / B^2	b -(2H/B)	c Yo	x1	x2	PONDED WIDTH (ft) T	K_T	GUTTER DEPRESSION (in) a_{DIG}	(in) a_{HEC22}	Gutter Depression Width (in)	Gutter Depression Width (ft) W	S'w	Sw	Eo	Se	Manning's n n	INLET LENGTH FOR TOTAL CAPTURE L_T	CURB OPENING LENGTH (ft) L	INLET EFFICIENCY E	INTERCEPTED FLOW (cfs) Qi	EQ
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	53.93	0.0105	91.5	6.0	0.5	7.0	0.6	2.5	high	2.85	0.50	2.74	-0.043	0.9818	0.066	30.8	2.02	0.0021	-0.1310	0.9818	52.7882	8.7318	8.73	0.6	5.0	3.8	18.0	1.50	0.21	0.28	0.51	0.17	0.016	27.94	7.71	0.44	**23.79**	(A)

10 YEAR STORM

DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft) W	Curb Height (in)	Curb Height (ft)	CURB OPENING HEIGHT (in)	CURB OPENING HEIGHT (ft) h	Split (ft) CS	High or low gutter	K_o	K_1	K_2	K_3	WATER FLOW DEPTH (ft) Yo = d	ESD Field Measured Street Cross Slope Sx	Dist. Curb to Crown (ft) B	Crown Height (ft) H	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a — a H / B^2	b -(2H/B)	c Yo	x1	x2	PONDED WIDTH (ft) T	K_T	GUTTER DEPRESSION (in) a_{DIG}	(in) a_{HEC22}	Gutter Depression Width (in)	Gutter Depression Width (ft) W	S'w	Sw	Eo	Se	Manning's n n	INLET LENGTH FOR TOTAL CAPTURE L_T	CURB OPENING LENGTH (ft) L	INLET EFFICIENCY E	INTERCEPTED FLOW (cfs) Qi	
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	89.38	0.0105	91.5	6.0	0.5	7.0	0.6	2.5	high	2.85	0.50	2.74	-0.043	1.1806	0.066	30.8	2.02	0.0021	-0.1310	1.1806	50.5566	10.9634	10.96	0.6	5.0	3.8	18.0	1.50	0.21	0.28	0.41	0.15	0.016	37.32	7.71	0.34	**30.47**	(A)

25 YEAR STORM

DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft) W	Curb Height (in)	Curb Height (ft)	CURB OPENING HEIGHT (in)	CURB OPENING HEIGHT (ft) h	Split (ft) CS	High or low gutter	K_o	K_1	K_2	K_3	WATER FLOW DEPTH (ft) Yo = d	ESD Field Measured Street Cross Slope Sx	Dist. Curb to Crown (ft) B	Crown Height (ft) H	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a — a H / B^2	b -(2H/B)	c Yo	x1	x2	PONDED WIDTH (ft) T	K_T	GUTTER DEPRESSION (in) a_{DIG}	(in) a_{HEC22}	Gutter Depression Width (in)	Gutter Depression Width (ft) W	S'w	Sw	Eo	Se	Manning's n n	INLET LENGTH FOR TOTAL CAPTURE L_T	CURB OPENING LENGTH (ft) L	INLET EFFICIENCY E	INTERCEPTED FLOW (cfs) Qi	
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	111.16	0.0105	91.5	6.0	0.5	7.0	0.6	2.5	high	2.85	0.50	2.74	-0.043	1.2784	0.066	30.8	2.02	0.0021	-0.1310	1.2784	49.3609	12.1591	12.16	0.6	5.0	3.8	18.0	1.50	0.21	0.28	0.37	0.14	0.016	42.33	7.71	0.30	**33.77**	(A)

100 YEAR STORM

DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft) W	Curb Height (in)	Curb Height (ft)	CURB OPENING HEIGHT (in)	CURB OPENING HEIGHT (ft) h	Split (ft) CS	High or low gutter	K_o	K_1	K_2	K_3	WATER FLOW DEPTH (ft) Yo = d	ESD Field Measured Street Cross Slope Sx	Dist. Curb to Crown (ft) B	Crown Height (ft) H	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a — a H / B^2	b -(2H/B)	c Yo	x1	x2	PONDED WIDTH (ft) T	K_T	GUTTER DEPRESSION (in) a_{DIG}	(in) a_{HEC22}	Gutter Depression Width (in)	Gutter Depression Width (ft) W	S'w	Sw	Eo	Se	Manning's n n	INLET LENGTH FOR TOTAL CAPTURE L_T	CURB OPENING LENGTH (ft) L	INLET EFFICIENCY E	INTERCEPTED FLOW (cfs) Qi	
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	146.80	0.0105	91.5	6.0	0.5	7.0	0.6	2.5	high	2.85	0.50	2.74	-0.043	1.4149	0.066	30.8	2.02	0.0021	-0.1310	1.4149	47.5491	13.9709	13.97	0.6	5.0	3.8	18.0	1.50	0.21	0.28	0.32	0.13	0.016	49.75	7.71	0.26	**38.40**	(A)

500 YEAR STORM

DRAINAGE AREA	STREET NAME	TOTAL RUNOFF (cfs) Q	SLOPE (ft/ft) $S_o = S_L$	Street Width (FOC-FOC) (ft) W	Curb Height (in)	Curb Height (ft)	CURB OPENING HEIGHT (in)	CURB OPENING HEIGHT (ft) h	Split (ft) CS	High or low gutter	K_o	K_1	K_2	K_3	WATER FLOW DEPTH (ft) Yo = d	ESD Field Measured Street Cross Slope Sx	Dist. Curb to Crown (ft) B	Crown Height (ft) H	Quadratic Formula T = min(x1, x2); x = [-b +/- (b^2 - 4ac)^0.5] / 2a — a H / B^2	b -(2H/B)	c Yo	x1	x2	PONDED WIDTH (ft) T	K_T	GUTTER DEPRESSION (in) a_{DIG}	(in) a_{HEC22}	Gutter Depression Width (in)	Gutter Depression Width (ft) W	S'w	Sw	Eo	Se	Manning's n n	INLET LENGTH FOR TOTAL CAPTURE L_T	CURB OPENING LENGTH (ft) L	INLET EFFICIENCY E	INTERCEPTED FLOW (cfs) Qi	
Equivalent long inlet (13, 14, 15, 16, 26)	Congress	188.53	0.0105	91.5	6.0	0.5	7.0	0.6	2.5	high	2.85	0.50	2.74	-0.043	1.5502	0.066	30.8	2.02	0.0021	-0.1310	1.5502	45.5369	15.9831	15.98	0.6	5.0	3.8	18.0	1.50	0.21	0.28	0.28	0.12	0.016	57.59	7.71	0.23	**43.00**	(A)

Exhibit G.15

Revised Pre-Project Model Results

and

Comparison to Effective Model

Comparison of ESD Revised Pre-Project Model and COA_Eff Model

Model Descriptions:
COA_Eff is the effective COA HEC-HMS model developed by Halff and Associates in July 2005.
COA_Eff time interval: 2 mins

ESD Revisded Pre-Project - Existing Conditions is the effective COA HEC-HMS model that has been revised by ESD and is based on existing land use conditions.
ESD Revisded Pre-Project - Ultimate Development Conditions is the effective COA HEC-HMS model that has been revised by ESD and is based on future land use conditions.
ESD Revised Pre-Project time interval: 1 min

Simulation start time: 01Jan2001, 00:00

Junction Name	Contributing Drainage Area (sq. mi.)				COA_Eff Peak Flow (cfs) and Time to Peak (hour)						ESD Revised Pre-Project - Existing Conditions Peak Flow (cfs) and Time to Peak (hour)							
	COA_Eff		ESD Revised		10-year		25-year		100-year		2-year		10-year		25-year		100-year	
	Incremental	Cumulative	Incremental	Cumulative	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time
JEBLDN070		0.97		0.97	1176	01Jan2001, 12:22	1645	01Jan2001, 12:22	2440	01Jan2001, 12:22	571	01Jan2001, 12:18	1185	01Jan2001, 12:23	1670	01Jan2001, 12:22	2515	01Jan2001, 12:20
JEBLDN080	0.35	1.33	0.52	1.49	1762	01Jan2001, 12:30	2389	01Jan2001, 12:30	3478	01Jan2001, 12:28	985	01Jan2001, 12:23	1914	01Jan2001, 12:28	2562	01Jan2001, 12:30	3723	01Jan2001, 12:30
JEBLDN090	0.33	1.65	0.20	1.69	2158	01Jan2001, 12:44	2695	01Jan2001, 12:50	3715	01Jan2001, 12:52	1071	01Jan2001, 12:41	2147	01Jan2001, 12:40	2649	01Jan2001, 12:54	3759	01Jan2001, 12:55
JEBLDN090a	0	1.65	0	1.69	1207	01Jan2001, 12:44	1506	01Jan2001, 12:50	2057	01Jan2001, 12:52	590	01Jan2001, 12:41	1201	01Jan2001, 12:40	1481	01Jan2001, 12:54	2081	01Jan2001, 12:55
JEBLDN100a	0.17	1.83	0.17	1.86	1150	01Jan2001, 13:06	1460	01Jan2001, 13:12	1954	01Jan2001, 13:18	644	01Jan2001, 12:47	1294	01Jan2001, 12:47	1552	01Jan2001, 13:03	2096	01Jan2001, 13:11
JEBLDN100	0.17	2.00	0.14	1.99	1257	01Jan2001, 12:52	1565	01Jan2001, 13:10	2077	01Jan2001, 13:16	708	01Jan2001, 12:45	1427	01Jan2001, 12:41	1765	01Jan2001, 12:34	2261	01Jan2001, 12:28
Confluence w/ CR	0.03	2.03	0.03	2.03	1264	01Jan2001, 13:00	1569	01Jan2001, 13:16	2085	01Jan2001, 13:20	712	01Jan2001, 12:50	1438	01Jan2001, 12:47	1781	01Jan2001, 12:41	2305	01Jan2001, 12:32

Junction Name	Contributing Drainage Area (sq. mi.)				COA_Eff Peak Flow (cfs) and Time to Peak (hour)						ESD Revised Pre-Project - Ultimate Development Conditions Peak Flow (cfs) and Time to Peak (hour)							
	COA_Eff		ESD Revised		10-year		25-year		100-year		2-year		10-year		25-year		100-year	
	Incremental	Cumulative	Incremental	Cumulative	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time
JEBLDN070		0.97		0.97	1176	01Jan2001, 12:22	1645	01Jan2001, 12:22	2440	01Jan2001, 12:22	571	01Jan2001, 12:18	1185	01Jan2001, 12:23	1670	01Jan2001, 12:22	2515	01Jan2001, 12:20
JEBLDN080	0.35	1.33	0.52	1.49	1762	01Jan2001, 12:30	2389	01Jan2001, 12:30	3478	01Jan2001, 12:28	1036	01Jan2001, 12:23	1958	01Jan2001, 12:28	2600	01Jan2001, 12:30	3760	01Jan2001, 12:30
JEBLDN090	0.33	1.65	0.20	1.69	2158	01Jan2001, 12:44	2695	01Jan2001, 12:50	3715	01Jan2001, 12:52	1137	01Jan2001, 12:40	2208	01Jan2001, 12:39	2695	01Jan2001, 12:54	3802	01Jan2001, 12:54
JEBLDN090a	0	1.65	0.00	1.69	1207	01Jan2001, 12:44	1506	01Jan2001, 12:50	2057	01Jan2001, 12:52	628	01Jan2001, 12:40	1235	01Jan2001, 12:39	1506	01Jan2001, 12:54	2104	01Jan2001, 12:54
JEBLDN100a	0.17	1.83	0.17	1.86	1150	01Jan2001, 13:06	1460	01Jan2001, 13:12	1954	01Jan2001, 13:18	683	01Jan2001, 12:46	1332	01Jan2001, 12:46	1578	01Jan2001, 13:03	2119	01Jan2001, 13:11
JEBLDN100	0.17	2.00	0.14	1.99	1257	01Jan2001, 12:52	1565	01Jan2001, 13:10	2077	01Jan2001, 13:16	754	01Jan2001, 12:44	1472	01Jan2001, 12:40	1801	01Jan2001, 12:35	2297	01Jan2001, 12:27
Confluence w/ CR	0.03	2.03	0.03	2.03	1264	01Jan2001, 13:00	1569	01Jan2001, 13:16	2085	01Jan2001, 13:20	757	01Jan2001, 12:49	1483	01Jan2001, 12:46	1819	01Jan2001, 12:40	2343	01Jan2001, 12:31

Exhibit G.16

Effective Model – 1 Minute Time Interval Results

Simulation start time: 01Jan2001, 00:00
Time interval: 1 min

Junction Name	COA_Eff (1 minute time interval)					
	Peak Flow (cfs) and Time to Peak (hour)					
	10-year		25-year		100-year	
	Peak Flow	Time	Peak Flow	Time	Peak Flow	Time
JEBLDN070	1185	01Jan2001, 12:23	1670	01Jan2001, 12:22	2515	01Jan2001, 12:20
JEBLDN080	1789	01Jan2001, 12:29	2439	01Jan2001, 12:30	3574	01Jan2001, 12:28
JEBLDN090	2218	01Jan2001, 12:43	2759	01Jan2001, 12:53	3899	01Jan2001, 12:53
JEBLDN090a	1241	01Jan2001, 12:43	1541	01Jan2001, 12:53	2157	01Jan2001, 12:53
JEBLDN100a	1195	01Jan2001, 13:09	1528	01Jan2001, 13:15	2059	01Jan2001, 13:21
JEBLDN100	1284	01Jan2001, 13:06	1622	01Jan2001, 13:14	2169	01Jan2001, 13:20
Confluence w/ CR	1290	01Jan2001, 13:12	1628	01Jan2001, 13:19	2178	01Jan2001, 13:25

Reach Name	Subreaches (Routing Steps)
REBLDN030	5
REBLDN040	4
REBLDN060	11
REBLDN070	10
REBLDN080	15
REBLDN090	7
REBLDN110	5

Exhibit G.17

Correspondence with WPD

Dube, Kiersten

From:	Recker, Jason
Sent:	Tuesday, December 1, 2020 1:12 PM
To:	Simmons, Jennifer; Massie-Gore, Jennifer; Dube, Kiersten
Subject:	FW: Annie St. CIP - Flow Increase Analysis

Hey Team,

Karl with flood plain confirmed that the current modeling scenario will be acceptable.

Let me know if you have any questions.

Thanks,

Jason Recker, P.E.
Engineer B
City of Austin
Watershed Protection Department
Jason.Recker@austintexas.gov
512-974-2382

From: McArthur, Karl <Karl.McArthur@austintexas.gov>
Sent: Tuesday, December 1, 2020 12:57 PM
To: Recker, Jason <Jason.Recker@austintexas.gov>; Middleton, John <John.Middleton@austintexas.gov>
Cc: Sabnis, Rupali <Rupali.Sabnis@austintexas.gov>
Subject: RE: Annie St. CIP - Flow Increase Analysis

Jason,

I agree with John. Consider Annie and Mary as one project and compare to the pre-project modeling without either set of improvements.

Regards,

Karl McArthur, P.E., CFM
City of Austin Watershed Protection Department, Watershed Engineering Division

Floodplain Management, Flood Early Warning System, RSMP
Karl.McArthur@austintexas.gov
512.974.9126

From: Recker, Jason <Jason.Recker@austintexas.gov>
Sent: Tuesday, December 1, 2020 11:27 AM
To: Middleton, John <John.Middleton@austintexas.gov>; McArthur, Karl <Karl.McArthur@austintexas.gov>
Cc: Sabnis, Rupali <Rupali.Sabnis@austintexas.gov>
Subject: RE: Annie St. CIP - Flow Increase Analysis

Karl and John,

Just revisiting this question below. I feel like it was answered but I have no paper trail to confirm that.

Please let me know if you need more information.

Thanks,

Jason Recker, P.E.
Engineer B
City of Austin
Watershed Protection Department
Jason.Recker@austintexas.gov
512-974-2382

City of Austin
WATERSHED PROTECTION

From: Middleton, John <John.Middleton@austintexas.gov>
Sent: Monday, March 30, 2020 10:28 AM
To: Recker, Jason <Jason.Recker@austintexas.gov>; McArthur, Karl <Karl.McArthur@austintexas.gov>
Cc: Sabnis, Rupali <Rupali.Sabnis@austintexas.gov>
Subject: RE: Annie St. CIP - Flow Increase Analysis

Karl,

My 2 cents is to go with Option 1 (below). Option 1 (pre-project before Mary and Annie improvements) has leass than a 1% flow increase and would require less work for ESD.

Thanks,

John Middleton, PE, CFM

Local Flood Risk Reduction
Watershed Engineering Division, Watershed Protection Department
City of Austin
505 Barton Springs Rd, 12th floor
Austin, TX 78704
(512) 974-3515

From: Recker, Jason <Jason.Recker@austintexas.gov>
Sent: Wednesday, March 18, 2020 1:03 PM
To: McArthur, Karl <Karl.McArthur@austintexas.gov>
Cc: Middleton, John <John.Middleton@austintexas.gov>; Sabnis, Rupali <Rupali.Sabnis@austintexas.gov>
Subject: Annie St. CIP - Flow Increase Analysis

Good Afternoon Karl,

I am starting to get the Annie St. Project moving again and had a question for you. ESD is going to put together an addendum to their PER for a design alternative that has less than a 1% flow increase. So my questions is what would be the appropriate pre-project scenario to use:

- Option 1 - Pre-project model before Mary St. and Annie St. improvements
- Option 2 - Pre-project model includes Mary St. improvements (w/restrictor plate)

Both options would be compared to the same post project model that includes Mary St. improvements (no restrictor plate) and Annie St. improvements. ESD is basically asking if they can analyze both Mary St. and Annie St. as one project when comparing flow increases. Which option should I have them analyze for the flow increase comparison?

Let me know if you have any questions.

Thanks,

Jason Recker, P.E.
Engineer B
City of Austin
Watershed Protection Department
Jason.Recker@austintexas.gov
512-974-2382

City of Austin
WATERSHED PROTECTION

Search

Bohrer, Katina, Massie-Gore, Je..., Recker, Jason

Chat Files

Massie-Gore, Jennifer added Bohrer, Katina to the chat.

Bohrer, Katina 11/12/20 11:24 AM
sorry guys - I'm in a training right now.

whats the question

Recker, Jason 11/12/20 11:25 AM
I'm also in a training.

11/12/20 11:26 AM
We have been asked to update an HMS model to Atlas 14 rainfall. The model we're using is based on the effective East Bouldin Creek model, which uses the SCS Storm with 24-hour rainfall depth. Can we just update the depth to the Atlas 14 depth, or do we need to change the storm to the frequency storm as well? (as opposed to SCS storm).

Bohrer, Katina 11/12/20 11:27 AM
You technically need to update to Frequency storm event.

11/12/20 11:27 AM
Can we use the SCS storm 500-year as an approximation of Atlas 14 100-year?

Bohrer, Katina 11/12/20 11:27 AM
(it should hopefully return the same result as SCS type 3 as the frequency storm used is supposed to mimic the SCS type 3)

yes, you can always use the 500-yr as a stand in.

11/12/20 11:29 AM
Ok, thanks! We're getting different results fro SCS Storm with Atlas 14 depth vs Atlas 14 frequency storm. Atlas 14 frequency storm is higher peak flow for the few basins we looked at.

Bohrer, Katina 11/12/20 11:30 AM
interesting - maybe if I ever have time again, I'll look into it to do a sensitivity analysis.

Call ended 54m 10s 11/12/20 12:16 PM

Type a new message