Texas Department of Transportation®

EL PASO DISTRICT

BORDER HIGHWAY WEST EXTENSION
LOOP 375

Contract No. 24-648P5003
CSJ: 2552-04-027

PRELIMINARY ENGINEERING
DRAINAGE REPORT

(Draft 100% Submittal for Review Purposes Only)

February 1, 2013

PLANNING • ENGINEERING • PROJECT MANAGEMENT
MCi Moreno Cardenas Inc.
Leaders in Project Delivery & Performance
Texas Registration Number: F-000554

Table of Contents

List of Tables

List of Figures

Appendices

Acronyms

American Smelting and Refining Company……ASARCO
American Telephone & Telegraph……... AT&T
Border Highway West…….. BHW
Camino Real Regional Mobility Authority…….. CRRMA
Cementos de México…… CEMEX
Design Drainage Manual…….. DDM
El Paso Electric Company…… EPEC
El Paso Natural Gas…….. EPNG
El Paso Water Utilities……..EPWU
Federal Emergency Management Agency……FEMA
Flood Insurance Rate Maps…….. FIRMs
International Boundary and Water Commission……... IBWC
Interstate 10…….. I-10
Metropolitan Planning Organization…… MPO
Metropolitan Transportation Plan…….MTP
National Flood Insurance Program……...NFIP
Office of Facilities Planning and Construction…….OFPC
Plans, Specifications, and Estimates……PS&E
Ponding Area…… PA
State Highway 20…….…… SH 20
Stormwater Master Plan……... SMP
Texas Commission of Environmental Quality……. TCEQ
Texas Department of Transportation…… TxDOT
Texas Gas Service…… TGS
Time Warner Cable……...TW
United States Army Corps of Engineers……...USACE
United States Highway 54…… US 54
United States Highway 85…… US 85
University of Texas at El Paso……. UTEP

1.0 INTRODUCTION

Project Overview

The Texas Department of Transportation (TxDOT) is proposing to extend Loop 375 to address the needed improvements required for the system capacity, reliability, and regional system linkage for the El Paso, Texas metropolitan area (the Project). The Project is known as the Border Highway West Extension. The Project proposes a four-lane controlled access facility that would begin at Racetrack Drive, near its intersection with Doniphan Drive, and extend to the United States Highway (US) 54 near downtown El Paso, a distance of approximately nine miles. Refer to **Figure 1**. The Project would provide a continuation of Loop 375 to the west, thus establishing an additional safe and efficient east-west travel corridor through the El Paso metropolitan area. The Project construction cost is anticipated to be approximately $500 million. Construction is anticipated to begin in the year 2015. Portions of the Project (from Park Street to Schuster Avenue) are included in the current El Paso Metropolitan Planning Organization (MPO) Mission 2035 Metropolitan Transportation Plan (MTP) that was amended in September 2012, as a 4-lane toll Project. The entire Project from Racetrack Drive to US 54 is included in the Comprehensive Mobility Plan, adopted by the region in 2008, and will be included in the Horizon Model 2040 MTP update by the El Paso MPO. The Project is a cooperative effort between TxDOT, the Camino Real Regional Mobility Authority (CRRMA), the City of El Paso, and other participating agencies. TxDOT is carrying the Project through the planning/environmental document phase. The implementation phase may be carried forward by either TxDOT or the CRRMA, pending further discussions and agreements.

This Preliminary Engineering Drainage Report was prepared along with the Schematic Layout prepared for the Project. It defines the existing drainage conditions of the Project corridor, and begins to establish the drainage requirements for the Project.

2.0 EXISTING CONDITIONS

2.1 Land Use

The Project corridor is located in the northwest and central areas of the City of El Paso, Texas, above the flood plain of the Rio Grande River, at the foothills of the Franklin Mountains, and below the escarpment of the Hueco Bolson. The Project corridor is mostly urbanized, consisting of a mixture of residential and commercial land uses. Some of the major landmarks located within the Project corridor include the University of Texas at El Paso (UTEP) Campus, Sunset Heights Historic District, Downtown El Paso, former American Smelting and Refining Company (ASARCO) property, US 85, I-10, several Flowpaths, the American Canal, and the Rio Grande River.

2.2 Drainage

A watershed plan of the Project corridor was prepared using the 2009 aerial photography with topographic information provided by the TxDOT El Paso District, as-built drawings obtained from TxDOT for their facilities, as-built drawings obtained from the City of El Paso Engineering Department for subdivisions in the vicinity of the Project corridor, as-built drawings obtained from UTEP Office of Facilities Planning and Construction (OFPC) for their facilities, and field observations from several site visits to the Project corridor. Refer to **Figure 2**.

The existing off-site drainage areas affecting the Project extend over three distinct geographic areas each with unique drainage characteristics. These drainage areas were identified as regional study areas or "regions" in the 2009 City of El Paso Stormwater Master Plan (SMP), commissioned by the City of El

Paso, El Paso Water Utilities (EPWU) Municipal Drainage Utility System. The regions with impacts on the Project corridor include:

- Northwest;
- West Central; and
- Central.

Generally, runoff from the Franklin Mountains and its foothills is conveyed by natural ephemeral arroyos, or manmade systems in urbanized areas, across I-10 and Paisano Drive (US 85)/Cesar Chavez Border Highway (Loop 375), and ultimately discharged in the River. The same regional approach as defined in the SMP will be used for the purpose of describing the drainage conditions in the Project corridor.

Northwest Region: The Northwest Region is the area located west of the Franklin Mountains on the escarpment between the Rio Grande River Valley (Upper Valley) and the foothills of the Franklin Mountains. The portion of the Project corridor in this region is the uppermost area extending from Mesa Street (SH 20) to approximately 0.5 miles south of Sunland Park Drive. The Project corridor encompasses the undeveloped corridor along I-10 bounded to the east and west by low to medium density residential developments with intermixed commercial nodes along the main roads.

In this Region, the Project corridor is characterized by a series of ephemeral arroyos crossing I-10 and conveying runoff from the foothills of the Franklin Mountains to the Upper Valley. The major drainage features in the region include the Keystone Dam located west of I-10, the Oxidation Dam east of I-10, numerous natural arroyos, and the drainage appurtenances associated with I-10. The storm runoff from the upper watershed is associated with large amounts of sediment and debris, impacting the carrying capacity of natural arroyos, manmade channels, and drainage appurtenances.

West Central Region: The West Central Region is the area located at the southwest tip of the Franklin Mountains, north of the Downtown District. The portion of the Project corridor in this region extends from approximately 0.5 miles south of Sunland Park Drive to the northern limit of the Downtown District. The study area is largely undeveloped but for a small residential development at its northern end, the CEMEX plant, former ASARCO Property, and portions of the UTEP Campus and the Hospital District.

In this Region, the terrain is hilly with a substantial drop in elevation between I-10 and Paisano Drive. The major drainage features consist of the numerous natural ephemeral arroyos originating at the foothills of the mountains and terminating at the base of the escarpment along Paisano Drive. Other drainage appurtenances include the structures associated with I-10 and Paisano Drive. Along this region, there are several outfall structures on the River eastern bank. The storm runoff from the upper watershed is associated with large amounts of sediment and debris, impacting the carrying capacity of natural arroyos, manmade channels, and drainage appurtenances.

Central Region: The Central Region is the area encompassing most of the Downtown District and some of the oldest and most historic neighborhoods in the City of El Paso. The portion of the Project corridor in this Region extends from the northern limit of the Downtown District to Fonseca Drive; and is bounded by I-10 to the north and the Rio Grande River to the south. The land uses in this area primarily consist of commercial, office, and high-density residential.

The Project corridor is located in the valley area of the Region with gradual slopes in a southeasterly direction. The drainage impacts from the watershed above the Project corridor are mitigated by a series of 12 dams dispersed in the foothills of the Franklin Mountains. To a large extent, runoff is conveyed on the streets to underground stormwater systems. The collected runoff is then pumped into the River or discharged by gravity. There are several gravity outfalls along the River banks and four pumping

stations: Chihuahuita Pump Station North and South, Cebada Pump Station (Cordova Bridge), and Dallas Pump Station.

The SMP states the following for this Region, "Historically, the Central Region suffers from frequent flooding of the downtown area and segments of Interstate Highway 10 (IH-10). There is insufficient detention upstream of the developed areas and inadequate conveyance through the downtown area to prevent flooding. Due to the flat terrain of the valley floor, gravity drainage to the Rio Grande is not always an option. The downtown area is fully developed and space is not readily available for pump station basin enlargements or new pump station basin placements."

2.3 Floodplains

There are several 100-year floodplains within the Project corridor. Refer to **Figures 3 and 4** for the effective flood hazard areas based on the Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA). **Table 1** summarizes the FIRMs used to locate the flood hazard areas in the Project corridor.

Table 1 – Existing Flood Hazard Areas

Name	Panel	Community – Panel #	Date
Flow Path Nos. 20A, 20 and 21 and 21A; the Rio Grande River	32 of 52	480214 0032 C	February 6, 1986
Flow Path Nos. 20, 21A, and 23	33 of 52	480214 0033 B	October 15, 1982
Flow Path No. 23 and Rio Grande River	39 of 52	480214 0039 B	October 15, 1982
Rio Grande River	38 of 52	480214 0038 B	October 15, 1982

Flooding Potential

The following are specific problem areas identified in the SMP along the Project corridor:

Northwest Region: The SMP identified several undersized crossings along Arroyo 4 and Arroyo 5. Two of the undersized crossings identified in the SMP are located at Mesa Street. The crossings for Arroyo 4 and Arroyo 5 located at I-10 were not analyzed by the SMP. Other undersized structures identified were the Doniphan Ditch and eight crossings located downstream of I-10. These undersized structures and the large sediment deposits carried under I-10 to Doniphan Drive (SH 20) may have some impacts to the US 85/I-10 interchange.

West Central Region: There is potential for flooding at Paisano Drive near Executive Center Boulevard due to the undersized crossings for Flow Path Nos. 20 and 21. The private crossings inside the former ASARCO property were not analyzed but the SMP suspected that all crossings are undersized for the 100-year storm. The SMP identified flooding at the three crossings for Flow Path No. 23 at US 85 near the Rio Grande River. These Flow Paths (Nos. 20, 21 and 23) carry large sedimentation transport from I-10 to Paisano Drive, which reduce structure capacities. The SMP also identified localized flooding south of the Paisano Drive/I-10 interchange at Hillside Drive from Doniphan Drive to Magdalena Street and at the 200 block of Porfirio Diaz alley from Missouri Avenue to Mundy Drive.

Central Region: The SMP identified the Government Hills Ditch Outlet Conduit which includes a 90-inch pressurized conduit outfalling to the Rio Grande River. This 90-inch conduit is performing over capacity due to recent storm sewer tie-ins. Flooding between Paisano Drive and Loop 375 along the Government Hills Ditch Outlet Conduit is due to undersized street inlets and inadequate culvert capacities. Another conduit structure with low capacity and outfalling to the Rio Grande River is the Cebada Drainage Outfall which connects to the Cebada Pump Station. The SMP identified flooding of

surrounding properties. Floodwaters pool behind I-10 from Wyoming Avenue to east of Raynor Street due to the low capacity of the Cebada Drainage Outfall. Lastly, the SMP identified several locations of localized flooding with potential impact to the Study Area. Some of the most critical locations identified were Hills Street near Loop 375, Delta Drive/San Marcial Street, Delta Drive/Cebada Pump, and Val Verde near Loop 375.

2.4 Existing Drainage Structures

The existing drainage facilities in the Project corridor were located based on record drawings obtained from TxDOT, the City of El Paso, Texas and the SMP. **Table 2** summarizes the record drawings used for preparing **Figures 5 and 6** of the existing drainage appurtenances. These figures present the existing drainage appurtenances along with the approximate locations of existing underground storm sewer systems, culvert crossings, and outfalls to the Rio Grande River, location of pump stations, arroyos, and flow paths with effective flood zone delineations, major dams and major retention/detention ponding areas.

Table 2 – Available Record Drawings for the Study Area

Name of Project	Source	Record Drawing #	Date
Shadow Mountain (from Mesa to Doniphan)	City of El Paso	236597	February 1970
Central Business District	City of El Paso	237298	July 1989
San Marcos Street (connecting to Executive Center)	City of El Paso	237261	August 1990
US Highway 80 – Paisano (from Santa Fe to Cotton)	TxDOT	1-4-7	September 28, 1946
US Highway 80 – Paisano (from Eucalyptus to Alameda)	TxDOT	1-4-8	May 31, 1948
US Highway 80 – Paisano (from Globe Street to Yandell Bridge)	TxDOT	1-4-15	July 20, 1949
US Highway 80 – Paisano (from Yandell Bridge (Viaduct) to Santa Fe)	TxDOT	1-4-16	August 19, 1949
US Highway 80 – Paisano (in front of Union Station)	TxDOT	1-4-21	October 29, 1951
US Highway 80 – Paisano (from 0.3 mi. east of Courchesne School to Railroad Bridge, Executive Center)	TxDOT	1-4-29	February 17, 1955
US Highway 80A (from Cement Plant to Viaduct-Yandell Bridge)	TxDOT	1-4-36	May 26 1961
US 85 – Paisano (from 1.65 KM north of Executive Center to Executive Center)	TxDOT	1-4-72	May 2, 1997
US 85 – Paisano (from Santa Fe to Campbell)	TxDOT	1-4-73	December 3, 2002
US 85 – Paisano (from Executive Center to San Francisco Street)	TxDOT	1-4-79	January 2, 2002
I-10 (from New Mexico State Line to Texas 20-Mesa Road)	TxDOT	2121-1-16	April 10, 1973
I-10 (from Loop 16-Old Spur 1 to Schuster Interchange)	TxDOT	2121-2-26	February 15, 1967
I-10 (Sun Bowl Rd. and Schuster Ave. Off Ramp)	TxDOT	2121-2-4	February 24, 1975
Loop 375 – Border Highway (Santa Fe to Coles and a portion under US 54)	TxDOT	2552-4-4	November 30, 1970
Loop 375 Chamizal Border Highway (Right of Way Project) (from Santa Fe to FM 659-Zaragoza)	TxDOT	2552-4-2	August 20, 1980
Border Highway – Loop 375 (Fonseca Interchange)	TxDOT	2552-4-12	March 5, 1985

2.5 Existing Outfalls to Rio Grande River

The Project corridor parallels the Rio Grande River, along several segments of the proposed alignment. Based on the topography of the Project corridor, the Rio Grande River has the lowest elevations. The existing surface runoff from US 85, Downtown El Paso, and Loop 375 eventually makes it to the River via several existing storm sewer systems outfalling to the River.

Where the proposed alignment is adjacent to the Rio Grande River, the proposed storm sewer trunklines would connect to existing drainage structures that outfall to the Rio Grande River. To offset the runoff increases from the proposed alignment, existing runoff captured by the existing storm sewer trunklines upstream of the proposed alignment would be captured by a series of Ponding Areas north of the proposed roadway in exchange for the runoff from the proposed roadway. This is described further in the latter Ponding Area Concepts section of this report. Refer to **Figures 7-11**, for a summary of existing Rio Grande River outfalls, which would be utilized by the Project.

If the Project is designated as a hazardous materials cargo route, measures may need to be considered to address accidental hazardous-materials spills on the bridge structures, which outfall to the Rio Grande River.

Where the alignment utilizes the existing US 85 roadway footprint and is adjacent to the Rio Grande River (between Racetrack Drive and Executive Center Boulevard), the proposed trunklines would be connected to existing drainage structures that outfall to the Rio Grande River. Based on meetings with representatives of the International Boundary and Water Commission (IBWC), it is understood that the IBWC is developing improvement plans for the River levee along that reach. Included in those plans, is the reconfiguration of the system of outfalls to reduce its number from 15 locations to only five locations. Therefore, the Project's proposed drainage improvements conform to the proposed configuration and locations of River outfalls. If the IBWC improvements are built before the Project, US 85 along this reach would require drainage improvements consisting of a combination of pump stations, rectangular channels, and/or large culvert structures. A combination of these options would allow existing US 85 to drain its surface runoff during the Rio Grande River's high surface water elevation(s). **Figure 7** depicts the proposed IBWC outfall structures.

3.0 DRAINAGE DESIGN CRITERIA

3.1 Hydrologic Criteria

The criteria used to determine and obtain the design frequency, peak runoff values, maximum water surface elevations, and storage capacities for the Project corridor are shown in **Table 3** and **Table 4** below. Since the Project corridor is under the jurisdiction of TxDOT and the City of El Paso, the two respective tables show the hydrologic criteria requirements for each entity. The two tables are based on the latest TxDOT Hydraulic Design Manual dated October 2011 and the City of El Paso Drainage Design Manual dated June 2008. TxDOT's drainage design criteria for hydrologic calculations, applies for the Border Highway West Extension mainlanes and ramps, US 85, and Doniphan Drive Extension. City of El Paso criteria controls for local streets such as Santa Fe Street, Oregon Street, Mesa Street, Stanton Street, Kansas Street, Campbell Street, Florence Street, St. Vrain Street, Cotton Street, and Coles Street.

Table 3 – TxDOT Hydrologic Criteria

Functional classification and structure type	Design Annual Exceedance Probability (AEP) (Design Annual Recurrence Interval (ARI))				
	50% (2-yr)	**20% (5-yr)**	**10% (10-yr)**	**4% (25-yr)**	**2% (50-yr)**
Freeways (main lanes):					
Culverts					X
Bridges					X
Principal arterials:					
Culverts			X	[X]	X
Small bridges			X	[X]	X
Major river crossings					[X]
Minor arterials and collectors (including frontage roads):					
Culverts		X	[X]	X	
Small bridges			X	[X]	X
Major river crossings				X	[X]
Local roads and streets:					
Culverts	X	X	X		
Small bridges	X	X	X		
Off-system Projects:					
Culverts	FHWA policy is "same or slightly better" than existing.				X
Small bridges					X
Storm drain systems on interstates and controlled access highways (main lanes):					
Inlets and drain pipe			X		
Inlets for depressed roadways*					X
Storm drain systems on other highways and frontage roads:					
Inlets and drain pipe	X	[X]	X		
Inlets for depressed roadways*				[X]	X

Table 3 notes: * A depressed roadway provides nowhere for water to drain even when the curb height is exceeded.
[ ] Brackets indicate recommended AEP. Federal directives require interstate highways, bridges, and culverts be designed for the 2% AEP flood event. Storm drains on facilities such as underpasses, depressed roadways, etc., where no overflow relief is available should be designed for the 2% AEP event.
All facilities must be evaluated to the 1% AEP flood event.

Source: TxDOT Hydraulic Design Manual, October 2011

Table 4 – City of El Paso Hydrologic Criteria

Conveyance Structures	Design Storm and Duration	Maximum Water Surface Allowed
Streets (Arterials and Major Collectors)	25-year	One lane high and dry (on roadway of four lanes or more)
	100-year	Within curb height
Streets (Local Streets)	25-year	Within curb height
	100-year	Within Right-of-Way
Storm Drain	100-year	HGL below finished grade
Channels	100-year	Contains Water Surface Elevation (WSEL) plus freeboard requirements
Culverts	50-year	Headwater (HW) to soffit
	100-year	HW to edge of road
Bridges	100-year	WSEL plus 1-foot freeboard below the low chord
	500-year	Withstand the structural forces
Retention Basins (no outlet)	100-year	Contain 100% of the runoff volume
Detention Basins	100-year	Basins to be designed utilizing good engineering practices and accepted methods (HEC-HMS) whereby 100% of the runoff volume to be properly managed through the use of channels and basins.

Source: City of El Paso Drainage Design Manual, June 2008

3.2 Hydraulic Criteria

The combined hydraulic criteria, based on TxDOT and City of El Paso guidelines and requirements, is summarized in **Table 5**. The hydraulic criteria shown on this table was used to analyze the hydraulic capacity of the existing drainage structures/appurtenances, and the proposed drainage improvements in the Project corridor. Similar to the hydrologic criteria, the TxDOT hydraulic design criteria applies for the Border Highway West Extension mainlanes and ramps, US 85, and Doniphan Drive Extension. City of El Paso criteria controls for local/side streets.

Table 5 – Hydraulic Design Criteria

Roadway and Structure Type	Allowable Ponding Width	Design Frequency (Year)	Check Flood
Freeways (main lanes):			
• Culverts	---	50-year	100-year
• Bridges	---	50-year	100-year
Frontage Roads, Frontage Road Connectors, and Cloverleaf:			
• Culverts (**)	---	25-year	100-year
• Bridges	---	25-year	100-year
Storm drain systems on I-10, Loop 375, US 85 (main lanes, ramps and direct connectors):			
• Inlets and drain pipe	Shoulder (Check is one lane free)	10-year	100-year
• Inlets for depressed sections	Shoulder (Check is one lane free)	50-year	100-year
Storm drain systems on Spur 1966, Frontage Roads, Frontage Road Connectors, and Access Roads:			
• Inlets and drain pipe	Width of Outer Lane (Pond Entire Roadway for 100-Year Storm)	5-year	100-year
• Inlets for depressed sections	Width of Outer Lane (Pond Entire Roadway for 100-Year Storm)	50-year	100-year
OTHER DRAINAGE CONSIDERATIONS:			
Retention/detention basin (ponding areas): Storage for 100-Year frequency (based on City of El Paso Drainage Design Manual June, 2008)			
Open Channels and Ditches: 0.5% min. grade, V-ditch or trapezoidal (6 ft. bottom constant), lining based on shear stress (FHWA HEC-15), slopes between 4:1 & 6:1 required 4" rock riprap, steeper than 4:1 required 4" concrete riprap, WSE 1 ft. below subgrade crown (6" below subgrade crown for median ditch)			
All drainage structures with a calculated exit velocity of greater than 8 feet/sec shall have energy dissipaters and proper channel protection.			
The product of depth times velocity shall not exceed 6.5 at any location on any street (with velocity calculated as the average velocity measure in feet per second and depth measured at the gutter flowline in feet).			
Inverted crown streets are prohibited.			
Pipe shall be rubber-gasketed reinforced concrete pipe.			
Minimum slope shall be 0.10%.			
Minimum velocity is 3 feet per second; maximum on main trunk line is 20 feet per second.			
Pipe carrying significant amounts of sediments shall consist of 24-inch diameter minimum; all other pipes shall be 18-inch diameter minimum.			
If pipes are less than 30-inch diameter, manholes shall be spaced 300-feet apart; pipes larger than 30-inch diameter, manholes shall be spaced at 450-feet.			

4.0 PROPOSED DRAINAGE ANALYSIS

For the purposes of the Schematic Layout, the drainage analysis of the Project consisted of estimating the additional runoff generated by the alignment, preliminary grading of the Ponding Areas for storing the additional runoff, approximate location of inlets, manholes & deck drains, and approximate sizes of the proposed storm sewer trunk lines with outfall structures. The Schematic Layout for the Project consists of the following:

Segment A – From Station 376+73.02 (approx. Spur 1966) to Station 560+44 (Santa Fe Street)

- The Segment A alignment limits are from the pinch point at the proposed Spur 1966 intersection with US 85 and tie-in to the existing terminus of Loop 375 (Border Highway) at Santa Fe Street. Existing Loop 375 is proposed to be reconstructed from Santa Fe Street to Park Street to implement access management for downtown. Additionally, a new interchange is proposed on the east side of downtown near Coles Street. Generally, the alignment begins adjacent to I-10; crosses US 85, then is located between the Burlington Northern/Santa Fe Rail Yard and the Rio Grande River. The proposed right-of-way is 122 feet wide.
- Segment A consists mostly of an 82-foot wide elevated structure between Spur 1966 and Santa Fe Street with interchanges at Spur 1966 and the Downtown Area (Coles Street interchange). Through downtown, it is primarily an at grade facility.

Segment B – From Station 183+25 (approx. Racetrack Drive) to Station 381+75 (approx. Spur 1966)

- The limits of Segment B are from the US 85/Racetrack Drive interchange to the pinch point located at the proposed Spur 1966 intersection with US 85, where segment A begins. The proposed right-of-way varies from 122 to 1000 feet wide.
- The Segment B alignment runs north-south and follows the existing US 85 footprint to Station 220+00. From Station 220+00, Segment B continues in a northeast direction, then curves south to parallel the west side of I-10 to the pinch point.
- Similar to Segment A, Segment B consists mostly of an 82-foot wide elevated structure with interchanges at Racetrack/Doniphan (McNutt Road and NM 273), Executive Center Boulevard and Spur 1966.

4.1 Offsite Drainage Area Analysis

The existing offsite drainage areas for the majority of the alignment are conveyed underneath the Project's bridge structures except for the location, from Station 195+00 to Station 228+00, where the runoff is conveyed by three culvert structures. The limits where the existing offsite runoff is conveyed are along the Doniphan Drive Extension between NM 273 and Executive Center Boulevard. Three drainage areas are conveyed by structures, which have been sized with the following dimensions 2-7'X5' (Culvert #1, Sta. 201+11.43), 2-6'X4' (Culvert #2, Sta. 213+44.97), and 2-4'X4' (Culvert #3, Sta. 228+00). The following table summarizes the hydraulic analysis of these culverts. Refer to **Figure 12**. The original roadway concept for Doniphan Drive Extension consisted of embankment and retaining walls along the proposed culverts. However, Culvert #1 will not be required for the Doniphan Drive Extension, since the roadway is on a structure along the length of the culvert structure.

Table 6 – Proposed Culvert Structures (Segment B)

Culvert #	Structure Size & Type	Station At Alignment	Length	WSE (100-Yr.) Upstream (ft.)	WSE (100-Yr.) Downstream (ft.)
1	2 – 7'x5' MBC	DON STA 201+11.43	112'	3749.23	3749.23
2	2 – 6' x 4' MBC	DON STA 213+44.97	118'	3748.17	3748.59
3	2 – 4' x 4' MBC	DON STA 228+00.00	132'	3747.00	3747.00

4.2 Hydrologic Analysis

The drainage area plan for the proposed conditions was developed by delineating drainage areas based on the proposed roadway improvements. The drainage areas for the Project were delineated using the proposed schematic vertical profile mainlane alignments of the two segments. The following table summarizes the high and low points for the two segments. Refer to **Figures B-1 – B-15**.

Table 7 – Schematic Layout – Vertical Profile High and Low Points

Alignment Station	Elevation (ft.)	H/L Point	Approach Grade	Departure Grade	Length (ft.)
Segment B					
186+97.30	3,757.78	Low	-1.85%	+2.62%	900
220+55.00	3,798.20	High	+0.50%	-2.00%	650
234+01.58	3,780.46	Low	-2.00%	+3.00%	1,000
266+83.87	3,858.36	High	+3.00%	-0.50%	900
306+00.00	3,823.60	Low	-2.00%	+0.50%	500
314+87.41	3,827.46	High	+0.50%	-1.00%	400
376+73.02	3,756.12	Low	-1.00%	+0.50%	300
Segment A					
399+57.70	3,785.21	High	+2.00%	-1.50%	900
424+73.25	3,752.62	Low	-1.50%	+0.50%	400
431+61.00	3,755.50	High	+0.50%	-0.50%	250
441+71.55	3,751.01	Low	-0.50%	+1.50%	400
451+69.16	3,762.34	High	+1.50%	-5.00%	800
467+75.70	3,709.46	Low	-5.00%	+0.70%	550
472+32.11	3,712.06	High	+0.70%	-0.70%	200
477+29.09	3,709.40	Low	-0.70%	+0.35%	200
481+76.94	3,710.68	High	+0.35%	-0.35%	200
*					

*****The alignment for the Project continues to Station 561+21 along the existing footprint of the Border Highway West (Loop 375).

The drainage areas delineated from the alignment's high and low points were computed in acres and converted to peak discharges for the design storm using the Rational Method and Geopak Drainage computer software. Utilizing Geopak Drainage, the drainage areas were further subdivided into smaller subareas to compute the peak discharges that would only pond the width of the shoulder along the Project's mainlanes and ramps as required by the Drainage Design Criteria. Refer to **Appendix A**, for the proposed drainage area calculations, which summarize the area identification names and numbers, drainage area, runoff coefficient, time of concentration, intensity, and peak discharges for the 50-year and 100-year. Refer to **Appendix B**, for the Proposed Drainage Area Maps for the entire Project's mainlanes alignment. The computed peak discharges were used for sizing the storm sewer systems consisting of inlets, manholes, deck drains, pipes, and outfalls described in the Hydraulic Analysis Section below.

4.3 Hydraulic Analysis

The additional runoff generated by the Project was separated from the offsite drainage areas by a roadway/bridge drainage system, consisting of inlets, manholes, deck drains, pipes, and outfalls. The drainage system within the Project right-of-way was determined with the use of Geopak Drainage computer software hydraulic package. Geopak Drainage is a powerful tool for analyzing storm sewers systems, computing tail water elevations, backwater effects, and for plotting storm sewer profiles. The computed peak discharges were entered in the computer models and the hydraulic computations were performed. The hydraulic analysis consisted of assigning a drainage area, along with the peak discharge, to a series of storm sewer systems consisting of inlets, for the areas where the alignment is on-grade, and

deck drains where the alignment is elevated on bridge structures and pipes (Reinforced Concrete Pipe or Steel Pipe). The pipes running along the bridge structures were located at the centerline of the mainlanes and deck drains were connected transversely. The size and location of the 6" to 12" PVC, and 12" to 18" steel pipes inside the super structure, was closely coordinated with the structure's discipline. Refer to the Bridge Memorandum for the details regarding the location of the main trunkline inside the bridge superstructure. Refer to **Appendix C** and **Appendix D** for the summary of hydraulic calculations for inlets and pipes required for the Project.

4.4 Proposed Drainage Improvements

The proposed stormwater management system for the Project would consist of a combination of storm sewer systems, drainage ditches, Ponding Areas (PAs), and river outfall structures described in the following sections. The various proposed storm sewer systems were structured and named, based on the outfall designation.

Existing storm sewer systems and outfalls impacted by the proposed project will require coordination with the City of El Paso Engineering & Construction Management and the EPWU Stormwater Utility since some of these structures are owned and maintained by these two agencies.

Proposed Storm Sewer Systems

The runoff from the Project would be collected by a series of storm sewer systems discharging to either the proposed ponding areas or existing Rio Grande River outfalls as follows:

Segment A

- Generally described as trunklines located beneath the bridge deck and running parallel to the roadway alignment, consisting of deck drains, PVC pipes and/or steel pipes. These pipes would be hung from the bridge structures, drop at certain columns, and be connected to underground storm sewer RCPs discharging to the ponding areas. Refer to **Appendix E, Figures E7 – E13**.
- A portion of Segment A at Spur 1966 is proposed (PA-B7 to PA-B8) on grade and therefore, the proposed storm sewer systems would consist of underground RCPs discharging to the proposed ponding area PA-B8, refer to **Appendix E, Figures E6 – E7**.
- In order to drain the proposed low point at Santa Fe Street, the Project would require an approximately 25' deep gravity force main, sump and pump station located adjacent to ponding area PA-A3, refer to **Figure E10**.
- The proposed Coles Interchange storm sewer systems would use a combination of a new ponding area (PA-A4) and existing outfalls to the Rio Grande River, refer to **Figure E13**.

Segment B

- Generally described as trunklines located beneath the bridge deck and running parallel to the roadway alignment consisting of deck drains, PVC pipes and/or steel pipes. These pipes would be hung from the bridge structures, drop at certain columns, and connect to underground storm sewer RCPs discharging to the ponding areas (PA-B1 to PA-B8). Refer to **Appendix E, Figures E1 – E7**.
- Where the alignment utilizes the existing US 85 roadway footprint and is adjacent to the Rio Grande River (between Racetrack Drive and Executive Center Boulevard), the proposed trunklines would be connected to existing drainage structures that outfall to the Rio Grande River. This was discussed in detail under Section 2.5.
- A series of ponding areas (PA-B1 to PA-B6), have been proposed to mitigate the additional surface runoff, generated by the proposed ramps and Doniphan Drive extension located north of the proposed roadway alignment, between Racetrack Drive/McNutt Road (NM 273) and Executive Center Boulevard. The storm sewer trunklines would consist of bridge deck drains,

PVC pipes, and underground RCPs draining into the proposed ponds. Refer to **Figures E1 and E2**.

- The proposed storm sewer systems from Executive Center Boulevard to the Spur 1966 would require similar bridge drainage appurtenances as described above, and the additional runoff would be collected by the proposed ponding areas PA-B6 to PA-B8. In the area where the alignment is, between I-10 and the former ASARCO property, the equivalent of the existing runoff from the Project's alignment footprint would be continued to be conveyed similar to the existing conveyance system by the I-10 drainage crossings. Refer to **Figures E3 – E5**.

Proposed Ponding Area Concepts

The ponding area concepts for the Project were sized based on the following guidelines (refer to **Appendix E** for the plan view area of the ponds and **Appendix F** for the ponding area cross sections):

- Based on City of El Paso Design Drainage Manual (DDM).
- Proposed contributing drainage areas.
- Using the available aerial photography and topographic information.
- Ponding areas were located on parcels appearing undeveloped, and/or parcels with minimum impacts to existing structures, and/or if a parcel was already impacted by the Project's horizontal alignment and/or as determined from the available aerial photography.
- In highly urbanized areas, there are instances where the proposed ponding areas would be located on developed parcels.
- Development of storm sewer configurations and ponding area locations were closely coordinated with roadway design and preparation of environmental document.
- Where groundwater information was available, the depth of groundwater was considered in determining the depth of ponding areas. However, the proposed depths are subject to change based on groundwater conditions determined during the design phase of the project.
- Based on field observations.

The following sections describe the proposed ponding area concepts. The ponding areas have been conceptually delineated to be either retention (PA-B7 and PA-B8) or detention (PA-B1 to PA-B6 and PA-A1 to PA-A4) ponds. The detention ponds have been configured with an outfall to the River. The ponding areas were named in sequential order and based on the segment where the ponds are located i.e. PA-A1 refers to proposed ponding area 1 in Segment A similarly; PA-B1 refers to proposed ponding area 1 in Segment B.

The following is a description of the proposed ponding area concepts:

Segment A

- Consists of PA-A1 through PA-A4. Refer to **Figures F10 – F13**.
- PA-A1 and PA-A3 may be capped and configured to be underground detention basins to maintain the existing parking lot for these properties.
- PA-A1 would be located at the existing Sun Metro yard north of the proposed roadway alignment. PA-A1 does not capture surface runoff directly from the Project but mitigates the additional runoff generated by the portion of the proposed roadway alignment from Station 400+35 to 432+38. This pond is located in an environmentally sensitive area where a diesel spill has been reported, which was mitigated. This proposed ponding area would allow the surface runoff from the proposed roadway to utilize an existing storm sewer outfall to the Rio Grande River located at Station 414+00 (O-26). Also, the surface runoff generated by the proposed Project would require a new outfall structure to the Rio Grande River at Station 425+50 (O-27).

The storm sewer system upstream of outfall O-26 would be re-routed to the proposed ponding area.

- PA-A2 would be located south of US 85 at the intersection of Durango Street and Paisano Drive. Similar to PA-A1, PA-A2 does not capture surface runoff directly from the Project, but mitigates the additional runoff generated by the portion of the proposed roadway alignment from Station 432+38 to 452+54. PA-A2 captures a portion of the existing surface runoff discharging to the Rio Grande River at outfall structure O-29 located at Station 445+00.
- PA-A3 would be located on a property currently serving as a parking lot at the intersection Santa Fe Street and Loop 375. PA-A3 would capture surface runoff from the proposed Project from Station 452+54 to Station 473+75. The PA-A3 footprint would include a pump station and sump on the southern end of the pond. The proposed pump station would drain the low point located at Santa Fe Street and Loop 375 at Station 468+79. Groundwater depth at this location is unknown; therefore, these improvements may change based on the actual groundwater depth.
- PA-A4 would be located on the northeast quadrant of Paisano Drive and Cotton Street. Refer to **Figure F13**. This ponding area would mitigate the additional runoff generated by the Coles Interchange. PA-A4 would capture surface runoff from the proposed improvements to the surface streets (Paisano Drive and Coles Street), two of the interchange direct connectors, and portions of the existing surface runoff discharging to the Rio Grande outfall structures (O-35 and O-36). The remaining two interchange direct connectors would utilize as discharge points the existing Rio Grande outfall structures (O-34, O-35, O-36, O-37, and O-38).

Segment B

- Consists of PA-B1 through PA-B8. Refer to **Figures F1-F9**.
- PA-B1 would be located near the Buena Vista community and would consist of the expansion of an existing ponding area owned by the City of El Paso. The design of this ponding area will require coordination with the improvements proposed for I-10 by the Collector-Distributor project, which is being developed by TxDOT and other cooperating entities.
- PA-B2 through PA-B5, PA-B7 and PA-B8 would be located adjacent to the proposed roadway alignment. The surface runoff generated by the proposed roadway alignment would be discharged directly to these ponding areas. PA-B2 and PA-B3 would not capture runoff from the mainlanes but would capture the additional runoff generated by the Doniphan Drive Extension.
- PA-B6 would be located underneath the Project's proposed bridge structure. PA-B6 would only have capacity to capture the 82' width of the proposed roadway footprint, between the high point located at Executive Center Boulevard, and the high point located near the existing "Rubber Pond." Refer to **Figure F7**. The Rubber Pond is an existing ponding area, and low point that captures the runoff from the former ASARCO property. Preliminary investigations identify that it was not feasible to utilize the Rubber Pond for the Project and therefore, the Project does not drain to the Rubber Pond.
- Similar to PA-B6, a portion of PA-B7 and PA-B8 would be located underneath the Project's proposed bridge structure, which would require that the foundations be submerged under standing water for prolonged periods of time.

The following tables summarize the proposed ponding area storage requirements for both Segment A and Segment B. Refer to **Appendix E, Figures E1-E13** for the conceptual plan of the proposed ponding areas and **Appendix F, Figures F1-F13** for the ponding area cross sections.

Table 8 – Summary of Proposed Ponding Areas (Segment A)

Pond ID	Station	Area (Acres)	Intensity "R" (inches)	Run off "C"	Storage Required (Ac-ft.)	Pond Capacity [(1)] (Ac-ft.)	Pond Depth ft.	Typical Side Slopes	Top Elevation	Bottom Elevation	High Water Elevation
PA-A1	418+00	6.10	4.0	0.95	1.93	2.99	2	6:1	3725	3723	3724.34
PA-A2	439+00	3.78	4.0	0.95	1.20	1.61	2	3:1	3710	3708	3709.53
PA-A3 [(1)]	465+00	12.80	4.0	0.95	4.04	5.90	6	6:1	3709	3703	3707.11
PA-A4	**	6.44	4.0	0.95	2.04	3.83	3	4:1	3701	3704	3702.68

(1) The proposed pump station footprint located in this Ponding Area was sized based on fitting the necessary equipment (sump, pumps, pump house, discharge conduits, etc.) to operate the pump station.

** This proposed ponding area addresses the drainage requirements for the Coles Interchange beyond the improvements of the Border Highway West Extension. Refer to the Coles Interchange **Figure E13** for the plan view.

Table 9 – Summary of Ponding Areas (Segment B)

Pond ID	Station	Area (Acre)	Intensity "R" (inches)	Run off "C"	Storage Required (Ac-ft.)	Pond Capacity (Ac-ft.)	Pond Depth ft.	Typical Side Slopes	Top Elevation	Bottom Elevation	High Water Elevation
PA-B1	184+02	1.738	4.0	0.95	0.83	1.30	3	4:1	3732	3729	3730.96
PA-B2	206+54	1.568	4.0	0.95	1.76	3.98	3	4:1	3736	3733	3734.33
PA-B3	215+00	2.039	4.0	0.95	2.05	4.28	3	4:1	3736	3733	3734.43
PA-B4A	226+00	2.038	4.0	0.95	1.85	2.04	3	4:1	3737	3734	3736.72
PA-B4B	232+50	2.003	4.0	0.95	1.36	1.95	3	4:1	3735	3732	3734.09
PA-B5	241+00	51.248	4.0	0.75	12.09	25.87	3	4:1	3733	3730	3731.49
PA-B6	302+00	3.683	4.0	0.95	3.43	3.91	10	1:1	3781	3771	3779.78
PA-B7	362+50	3.328	4.0	0.95	2.93	2.98	3	4:1	3740	3737	3739.95
PA-B8	377+50	10.728	4.0	0.95	4.25	5.96	3	4:1	3744	3741	3743.13

5.0 REGULATORY COORDINATION

5.1 Federal Emergency Management Agency (FEMA) Coordination

The National Flood Insurance Program (NFIP) is a FEMA management program. The NFIP's goals are to minimize loss of life and property due to flooding. The City of El Paso is a participant of the NFIP and is responsible for administering local floodplain management measures. The proposed improvements along the Project and US 85 are located within 100-year flood zone areas. It is not anticipated that the Project would have an impact to existing flood zone areas, which consist of flowpaths #20, 21, and 23, since the Project proposes to bridge over those flood zones.

5.2 United States Department of the Army Section 404 Permit Requirements

The placement of fill in ephemeral streams is regulated under the provision of the Clean Water Act and enforced by the United States Army Corps of Engineers (USACE). The USACE, Albuquerque District office in El Paso, has jurisdiction on determining required permit(s). At this time, no changes or placement of fill material in ephemeral streams is anticipated for this Project; therefore coordination with the USACE is recommended for determination that a Section 404 Permit is not anticipated.

5.3 Texas Commission of Environmental Quality (TCEQ)

If the USACE determines a Section 404 Permit is required, a separate water quality certification (401 Certification) would be required. This certification is obtained through an application provided to TCEQ. The USACE is responsible in submitting the application to TCEQ for review and approval. The Section 404 Permit cannot be issued without the 401 Certification approval from TCEQ.

5.4 United States International Boundary and Water Commission (US IBWC)

The outfalls to the Rio Grande River are regulated by IBWC. The Project will require design modifications to the existing outfalls and the Project will require new outfalls to the River as discussed earlier in this report. As the project is developed during the PS&E phase, design drawings will be required to be submitted to IBWC for obtaining a license that covers the Project requirements to discharge runoff to the River. This process has been initially coordinated with IBWC during the Schematic and environmental development phase of the Project but the coordination process has to be continued as the Project is further developed. Securing the approved license from IBWC is a critical component for development of the Project.

6.0 EXISTING UTILITIES

There are numerous utility facilities either paralleling or crossing the Project. An initial letter was sent in June 2010, to several utility agency representatives requesting the agency's as-built information for the Project corridor. Refer to **Appendix I** for a copy of the letter and the tracking report. Several agencies responded to the letter stating whether they had assets or they did not have assets in the Project corridor. Those agencies that had facilities in the Project corridor provided copies of their as-built information. The utility facilities found in the Project corridor include natural gas pipelines, potable water pipelines, sanitary sewer pipelines, overhead and underground electric lines, and communication lines. Refer to **Appendix G, Figures G1 – G13**. In late 2012, a meeting was held with a representative from the EPWU, TGS, and EPEC. Mr. Frank Gonzalez, AT&T, was contacted. However, AT&T declined to meet, due to the schematic level of the project. EPEC is in the process of adjusting their major transmission line paralleling I-10 and crossing at Executive Center Boulevard. Coordination needs to continue with EPEC to ensure that the facility avoids impacts to the Project alignment. The utility facilities and agencies that may be impacted by the Project alignment include: EPWU, TGS, EPEC, AT&T, EPNG, and Time Warner Cable Company. Refer to **Appendix H** for the detail report of the utilities crossing or paralleling the alignment, along with the station locations. The schematic layout has not made provisions for providing a utility corridor for these facilities. Areas where the utility facility crosses the alignment may require encasing the facility. Further utility coordination is required, once the locations of the bridge columns are set during the PS&E phase of the Project.

7.0 CONCLUSIONS AND RECOMMENDATIONS

This Preliminary Engineering Drainage Report defines the existing drainage conditions within the limits of the proposed Project improvements, and identifies the schematic drainage system requirements needed for the preliminary engineering detailed in the Schematic Design for the Project. The drainage analysis has determined that increases in runoff from the Project will be mitigated by the proposed ponding areas. This report summarizes the drainage infrastructure required to develop the Project for the PS&E phase. The Project would require coordination with the City of El Paso, EPWU Stormwater Utility, and IBWC, since some of the proposed improvements are located within their rights-of-way.

The following are the recommendations to develop the drainage concepts for the Project:

- Coordinate the Collector Distributor project drainage improvements at Racetrack Drive.

- Submit the License Application to IBWC for the two new outfall structures and the revised existing outfall structures to the Rio Grande River.
- Right-of-Way acquisition for the new ponding areas.
- Environmental mitigation for the new ponding area located in Sun Metro property.
- Avoid impacts to Flowpath #23 (Hart-Mill Arroyo).
- Coordinate the new outfall to Flowpath #20 with EPWU Stormwater Utility
- PS&E phase needs to account for three ponding areas to be located under the alignment's bridge structure.
- The majority of the drainage concept for the bridge structures for the Project was based on pipes running inside the superstructure; only three areas were identified for slotted rail (Stations 225+00 to 255+00; 268+00 to 310+00; and 387+00 to 391+00).

REFERENCES

1. Hydraulic Design Manual, Texas Department of Transportation, Design Division, October 2011

2. Soil Survey, El Paso County, Texas, United States Department of Agriculture, Soil Conservation Service, 1971

3. Preliminary Engineering Report (PER) I-10/Schuster Avenue Proposed Improvements, Texas Department of Transportation, HALFF/MCi, November 2007

4. National Flood Insurance Act, National Flood Insurance Program Requirements, http://www.fema.gov/plan/prevent/fhm/dl_cgs.shtm

5. City of El Paso, Texas, Drainage Design Manual, June 2008

6. Flowpath No. 23 Flood Boundary Delineation Study, University of Texas at El Paso, MCi, June 2010

7. El Paso Water Utilities and the City of El Paso, El Paso Stormwater Master Plan, March 2009